2022 Energy Code

Multifamily Mechanical Overview

California Energy Commission
Gagandeep Randhawa
Mechanical Engineer

Agenda

- Title 24, Part 6 Multifamily HVAC Sections
- 2022 Energy Code basics and overview
- All occupancies - mandatory
- Multifamily mechanical – mandatory
- Multifamily mechanical – prescriptive
- Multifamily mechanical – additions and alterations
- Demonstrating Compliance Documentation - Forms
- Resources

Title 24, Part 6 Multifamily HVAC Sections

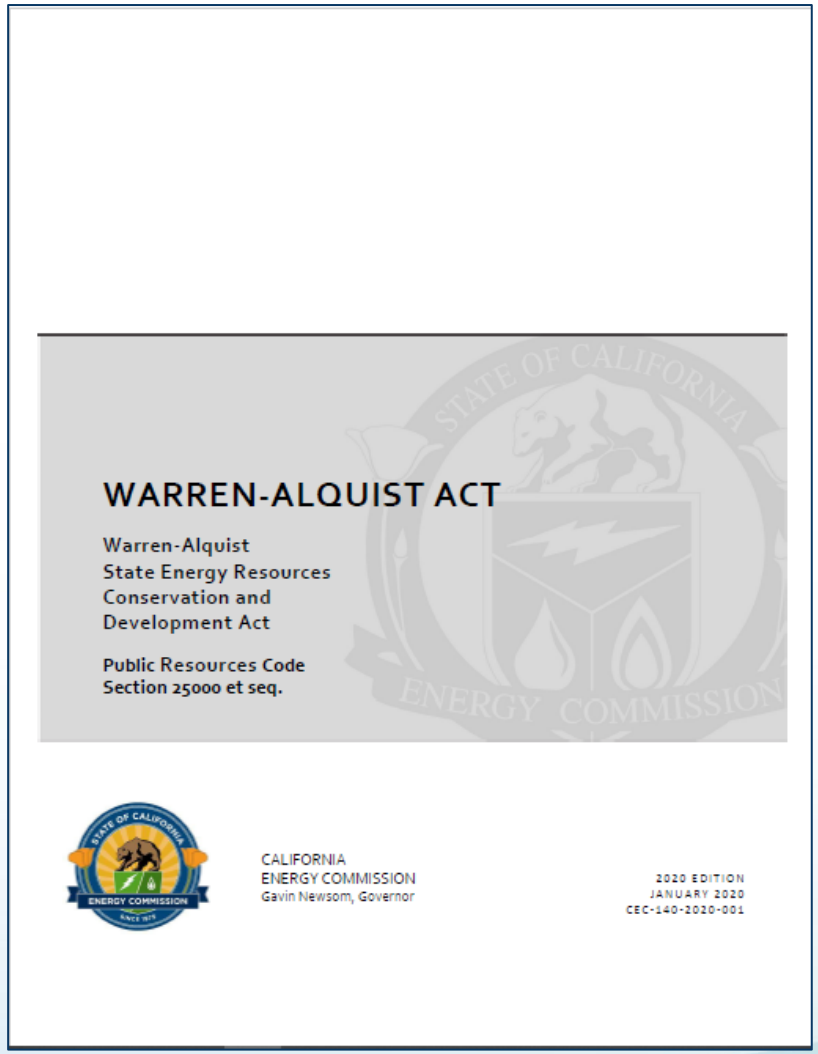
Subchapter	Subchapter Title	Section	Section Title
2	**All Occupancies** - **Mandatory** Requirements for the Manufacture, Construction and Installation of Systems, Equipment, and Building Components	§110.1 §110.2 §110.5 §110.12	Mandatory requirements for Appliances Mandatory requirements for Space-Conditioning Equipment Pilot Lights Prohibited Mandatory requirements for Demand Management
10	Multifamily Buildings -**Mandatory** Requirements	§160.2 §160.3	Requirements for ventilation and indoor air quality Requirements for space conditioning systems in multifamily buildings
11	Multifamily Buildings - **Performance and Prescriptive Compliance** Approaches	§170.0 §170.1 §170.2	Performance and Prescriptive Compliance Approaches Performance Approach: Prescriptive Approach
12	Multifamily Buildings - **Additions, Alterations, and Repairs to existing multifamily buildings**	§180.1 §180.2 §180.3 §180.4	Additions Alterations Repairs Whole building

Restructuring of Multifamily Mandatory Requirements

2019 Sections with Multifamily	2022 Newly Created Sections
§120.0: High-rise residential • Mandatory requirements §150.0: Low-rise residential • Mandatory features and devices	§§160.0-160.9: Multifamily buildings • Mandatory requirements

2022 Energy Code Basics

Energy Code History



Warren-Alquist Act established CEC in 1974

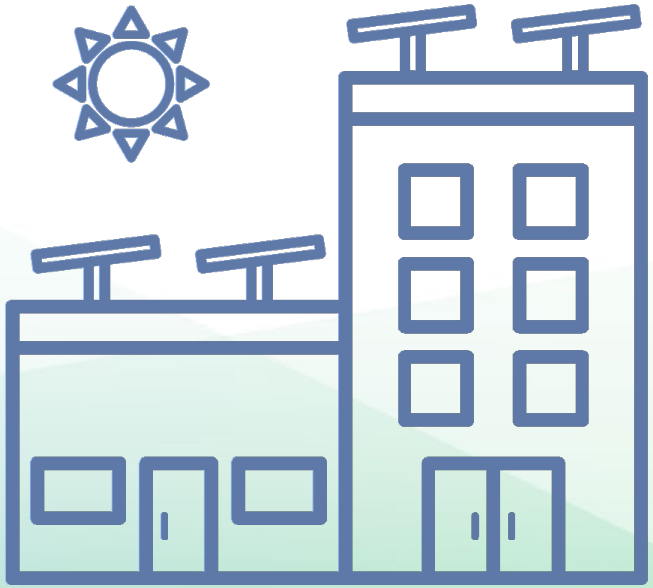
Authority to develop and maintain Building Energy Efficiency Standards (Energy Code)

Requires CEC to update periodically, usually every 3 years

Requires Energy Code to be cost-effective over economic life of building

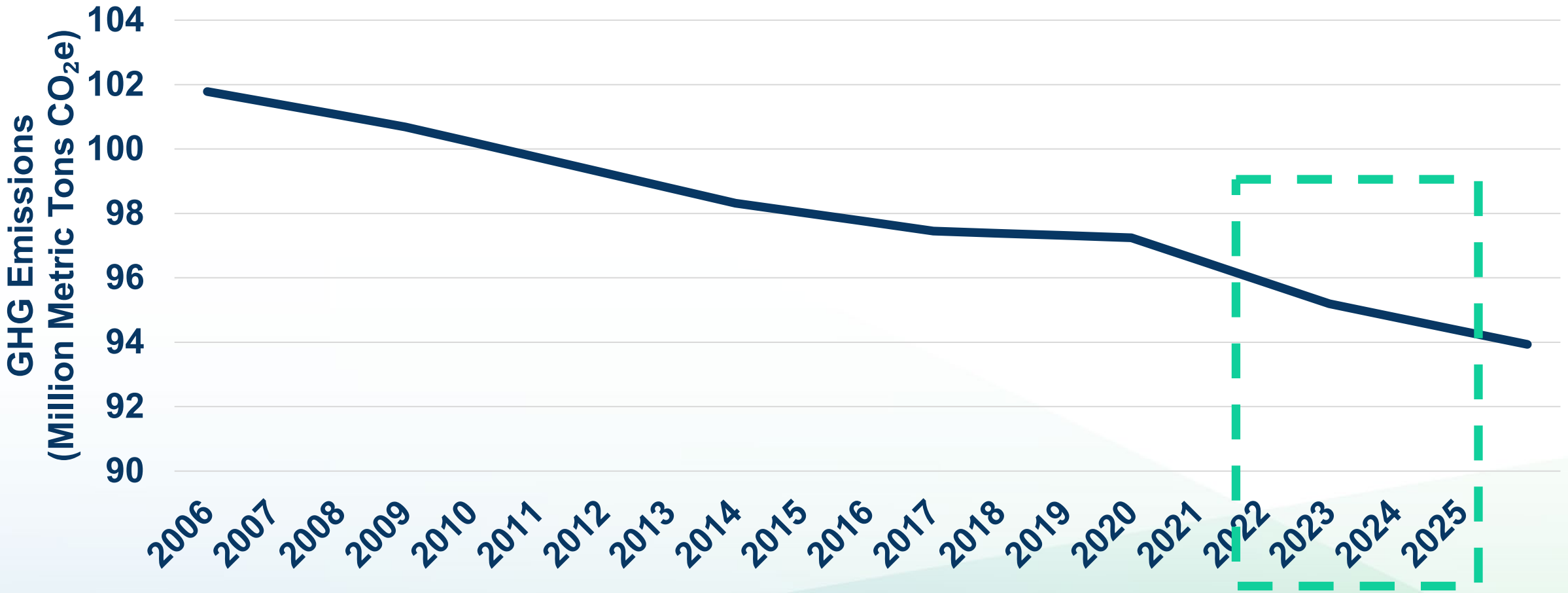
2022 Energy Code Goals

- Increase building energy efficiency cost-effectively
- Contribute to California's greenhouse gas (GHG) reduction goals
- Enable pathways for all-electric buildings
- Reduce residential building impacts on the electricity grid
- Promote demand flexibility and self-utilization of photovoltaic (PV)
- Provide tools for local government reach codes



Energy Code Environmental Benefit

Reduced Statewide Emissions

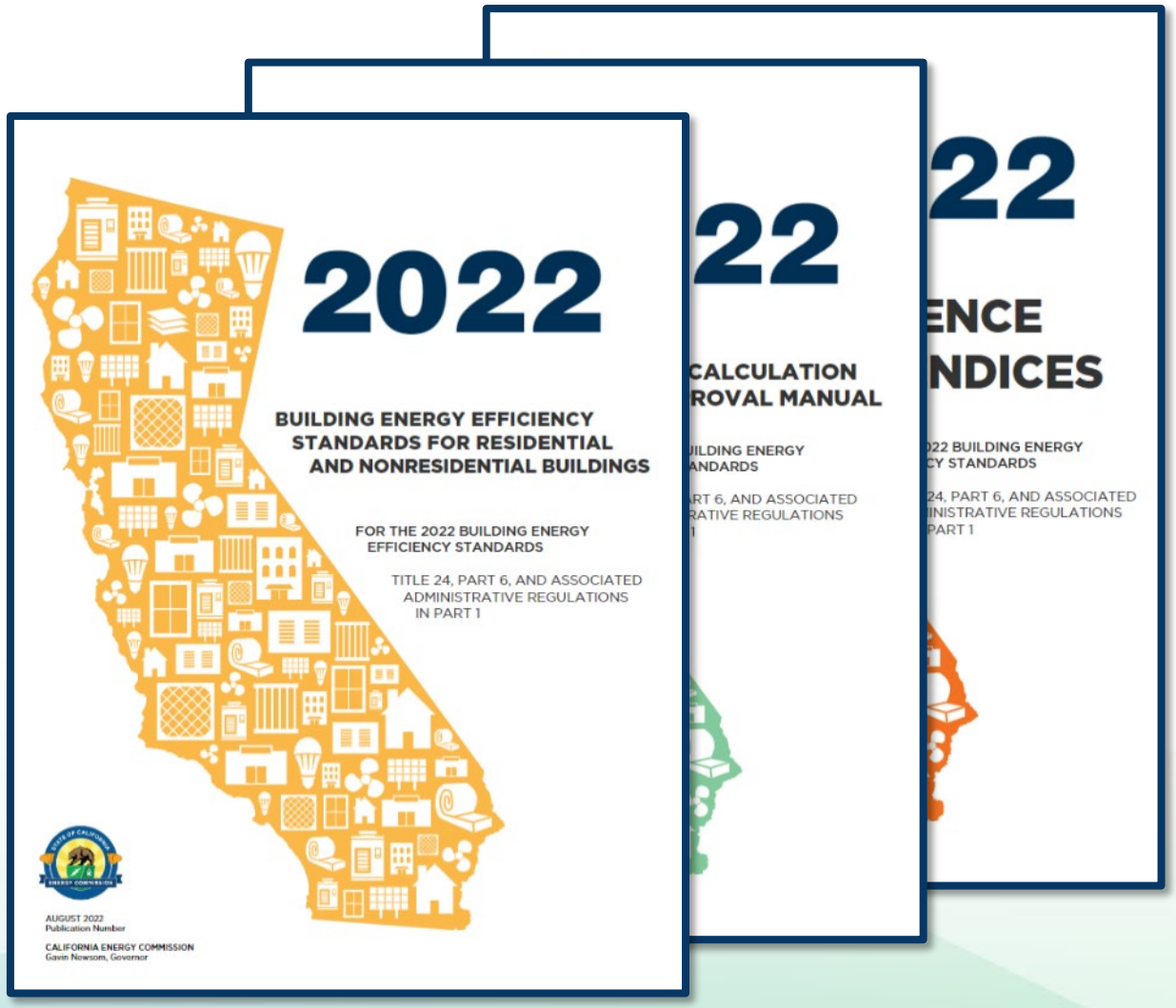


Source: CEC Impact Analysis 2005, 2008, 2013, 2016, 2019, 2022

2022 Energy Code

Effective January 1, 2023

- Building permit applications submitted on or after Jan 1, 2023
- Must use 2022 tools
  - Software
  - Forms



2022 Documents Online

2022 Building Energy Efficiency Standards

The Building Energy Efficiency Standards (Energy Code) apply to newly constructed buildings, additions, and alterations. They are a vital pillar of California's climate action plan. The 2022 Energy Code will produce benefits to support the state's public health, climate, and clean energy goals.

The California Energy Commission (CEC) updates the Energy Code every three years. On August 11, 2021, the CEC adopted the 2022 Energy Code. In December, it was approved by the California Building Standards Commission for inclusion into the California Building Standards Code. The 2022 Energy Code encourages efficient electric heat pumps, establishes electric-ready requirements for new homes, expands solar photovoltaic and battery storage standards, strengthens ventilation standards, and more. Buildings whose permit applications are applied for on or after January 1, 2023, must comply with the 2022 Energy Code.

2022 Energy Code for Residential and Nonresidential Buildings

2022 ENERGY CODE

Expand All

Supporting Documents – Appendices, Compliance Manuals, and Forms

Software – Compliance Software, Manuals, and Tools

BUILDING ENERGY EFFICIENCY STANDARDS - TITLE 24

2025 Building Energy Efficiency Standards

2022 Building Energy Efficiency Standards

— Workshops, Notices, and Documents

2019 Building Energy Efficiency Standards

2016 Building Energy Efficiency Standards

Past Building Energy Efficiency Standards

Climate Zone tool, maps, and information supporting the California Energy Code

Online Resource Center

Solar Assessment Tools

RELATED LINKS

Workshops, Notices, and Documents

CONTACT

Building Energy Efficiency Standards - Title 24

Toll-free in California: 800-772-3300
Outside California: 916-654-5106

SUBSCRIBE

Building Energy Efficiency Standards

Email *

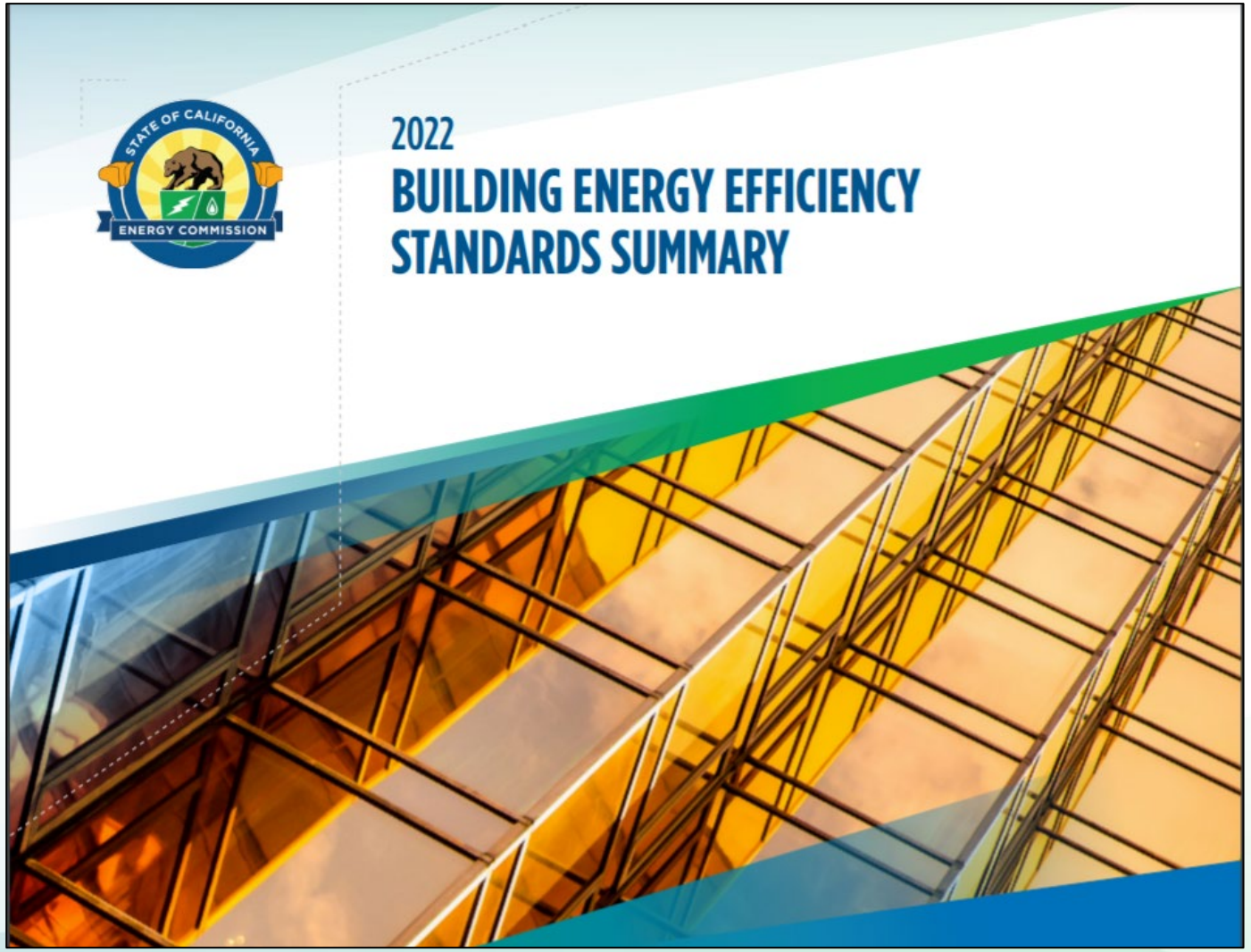
Email

SUBSCRIBE

- Energy Code
- Reference Appendices
- Compliance Manuals
- Software
- Forms

2022 Energy Code Highlights

- Heat pump baselines
- Solar and battery storage
- Ventilation requirements
- Lighting
- Multifamily restructuring



Energy Code Requirements

Mandatory requirements

- Minimum efficiency requirements must always be met
- Can never trade off

Prescriptive requirements

- Predefined efficiency requirements
- May supersede mandatory requirements
- Different requirements for newly constructed buildings, additions, and alterations

Compliance Approaches

Prescriptive approach

- Simple approach, no trade-offs
- Defines the standard building design
- 2022 heat pump baselines

Performance approach

- Most flexible approach, allows for trade-offs
- Must meet all mandatory requirements
- Requires the use of CEC-approved software
- Proposed building design meets or exceed standard building design

2022 Performance Metrics

Source energy performance calculations

- Nonresidential and multifamily
  - Hourly source energy
  - TDV Efficiency
  - TDV Total
    - Efficiency, PV + battery

Demonstrating Compliance

Compliance forms confirm Energy Code is met

- Completed by responsible party
  - Designers, consultants, builders, contractors, technicians, ATTs, HERS raters, etc.
- Submitted to enforcement agencies for verification

Type of form	Single-family	Multifamily 3 or less habitable stories	Nonresidential, Multifamily 4 or more habitable stories
Certificate of compliance	CF1R	LMCC	NRCC
Certificate of installation	CF2R	LMCI	NRCI
Certificate of verification	CF3R	LMCV	NRCV
Certificate of acceptance	-	-	NRCA

2022 Compliance Software

Performance approach must use approved compliance software versions

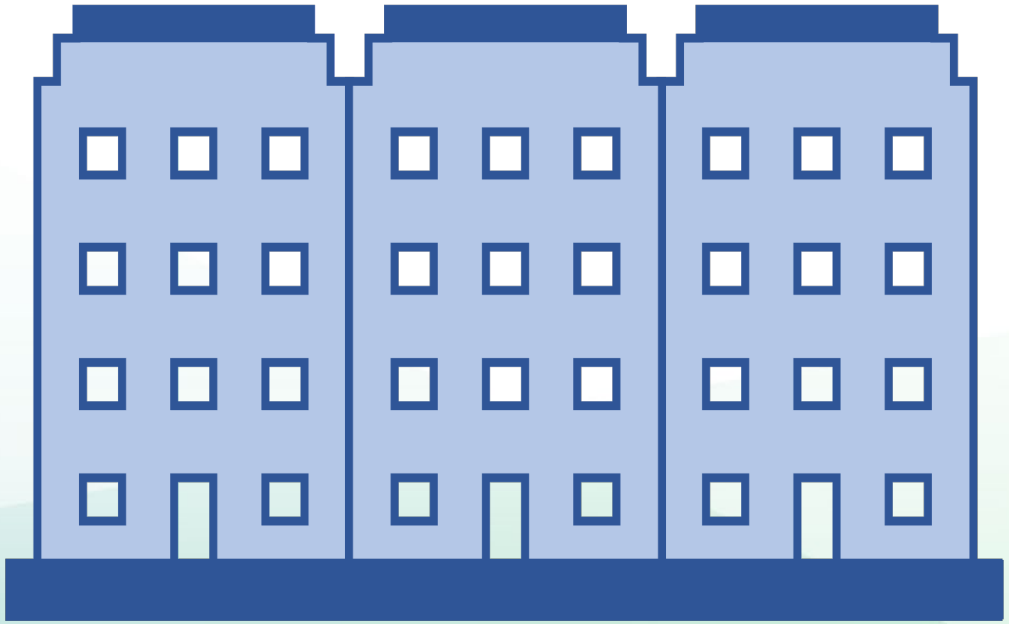
- Nonresidential and multifamily
  - CBECC 2022.3.0
  - EnergyPro 9.2
  - IES 1.0

Multifamily Defined

All Buildings § 100.1

Multifamily building

- Occupancy group R-2
  - Not hotel/motel building or timeshare property
- Occupancy group R-3 non-transient congregate residence
  - Not boarding houses of more than 6 guests
  - Not alcohol or drug abuse recovery homes of more than 6 guests
- Occupancy group R-4



Subchapter 2 - All Occupancies

Mandatory §§ 110.0, 110.2, 110.5, 110.12

All Occupancies - Mandatory HVAC Requirements

§110.1 - §110.12

- §110.1 - Mandatory Requirements for Appliances
- §110.2 - Mandatory Requirements for Space Conditioning Equipment
- §110.5 - Natural Gas Central Furnaces, Cooking Equipment, Pool and Spa Heaters, and Fireplaces: Pilot Lights Prohibited
- §110.12 - Mandatory Requirements for Demand Management

Mandatory Requirements for Appliances

§110.1

- **Systems, equipment and appliances may be installed only if they are certified and listed as follows:**
  - If the item is covered by Title 20, it must meet the Title 20 efficiency requirements and be listed in the Title 20 database (MAEDBS)
  - Items having efficiency requirements in Title 24, Part 6 must be listed in one of the following:
    - Title 20 database
    - Federal database
    - Approved trade association database such as AHRI or CTI
  - If the equipment cannot be listed, you must demonstrate efficiency conformance per the procedures outlined in Section 10-109 of Part 1

Mandatory Requirements for Space Conditioning Equipment

§110.2(a)

- All equipment covered in this section must be certified by the manufacturer
- All equipment listed in TABLE 110.2-A through TABLE 110.2-N must meet the applicable efficiencies when tested per the listed test procedure

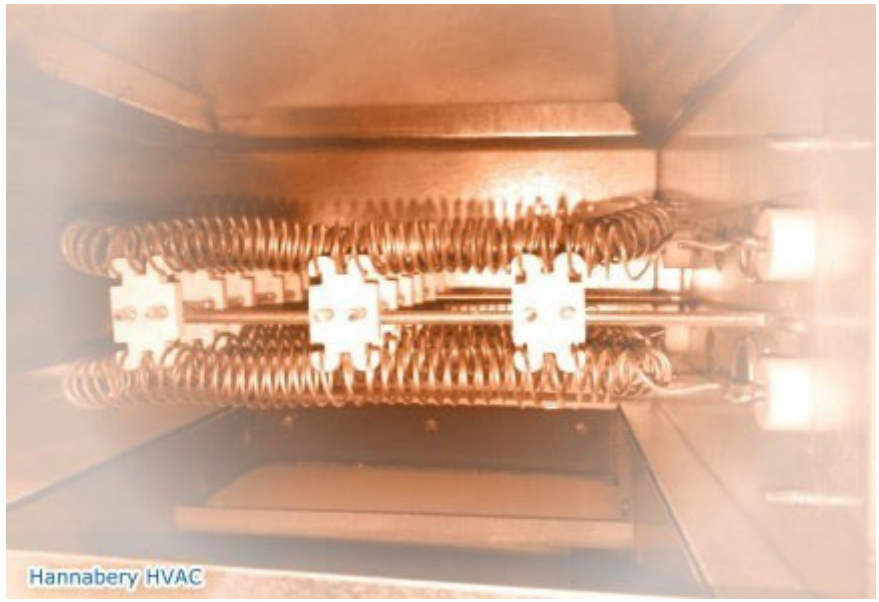
EXCEPTIONS:

- There are exceptions for some water chilling packages, some positive displacement chillers and equipment serving refrigerated warehouses or commercial refrigeration. See §110.2(a) for details.

Mandatory Requirements for Space Conditioning Equipment

§110.2(b)

- **Heat pumps with supplementary electric resistance heaters must have controls that do the following:**
  - Prevent supplementary heater operation when the heating load can be met by the heat pump alone
  - The cut-on and cut-off temperatures for the electric resistance heating must be lower than the heat pump cut-on and cut-off temperatures
- EXCEPTION:
  - There are exceptions for defrost, transient periods, and room air conditioners.



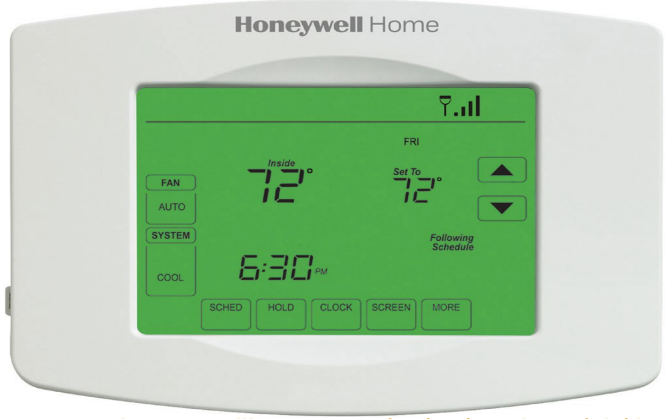
Source: https://www.hannabery.com/faq4.shtml

Mandatory Requirements for Space Conditioning Equipment

§110.2(c)

- **Thermostat Requirements**
  - All unitary systems without an EMCS must have a setback thermostat that can be programmed with at least four temperature setpoints within 24 hours.
  - Thermostats for heat pumps must also control supplementary electric resistance heaters as discussed on the previous slide

- EXCEPTION:
  - Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps are not required have to have setback thermostats.



Source: www.honeywellhome.com/us/en/products/air/thermostats/

Mandatory Requirements for Space Conditioning Equipment

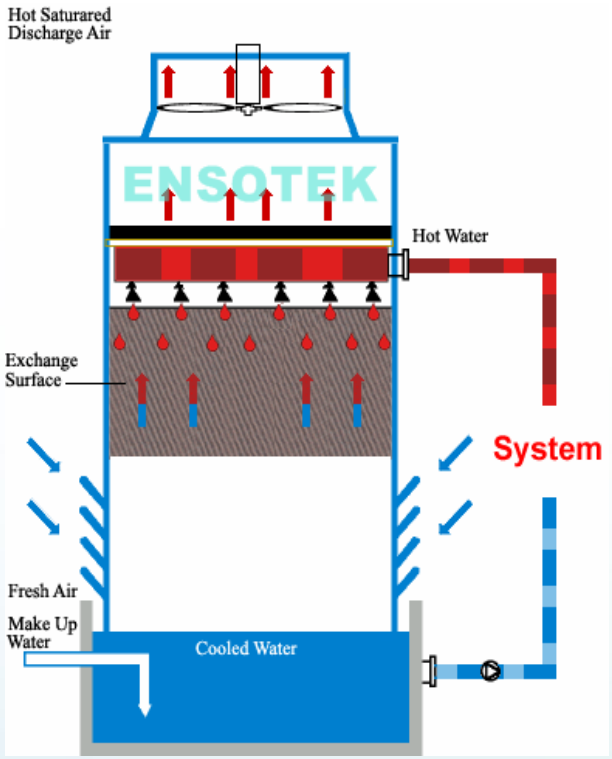
§110.2(d)

- **Gas- and Oil-Fired Furnaces ≥ 225,000 Btu/h must have controls to limit Standby Loss:**
  - They must have an **intermittent ignition or interrupt device** (IID)
  - They must have either **power venting** or a **flue damper**
  - A **vent damper** is permissible with furnaces using combustion air from the conditioned space
  - All furnaces not located within the conditioned space must have **jacket heat losses** not exceeding 0.75 percent of the input rating

Mandatory Requirements for Space Conditioning Equipment

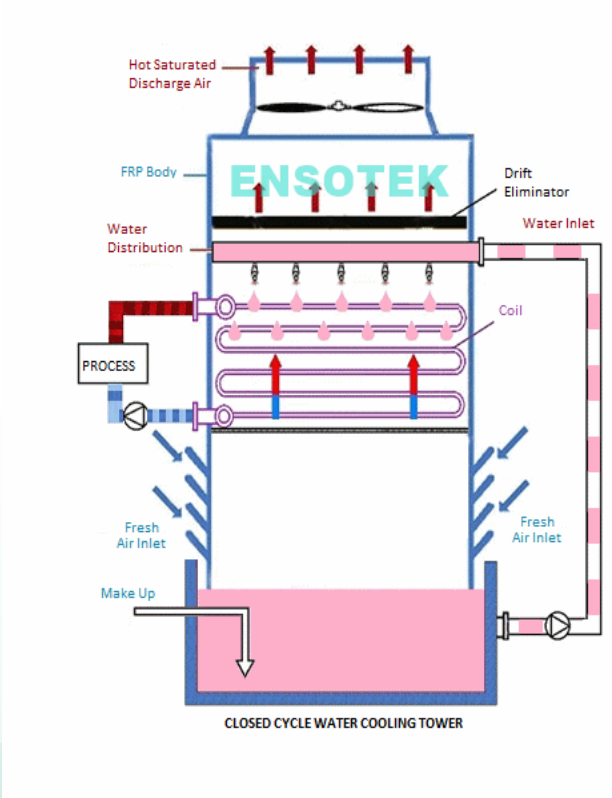
Two types of cooling towers

Open Cycle



Source: www.Ensotek.com

Closed Cycle

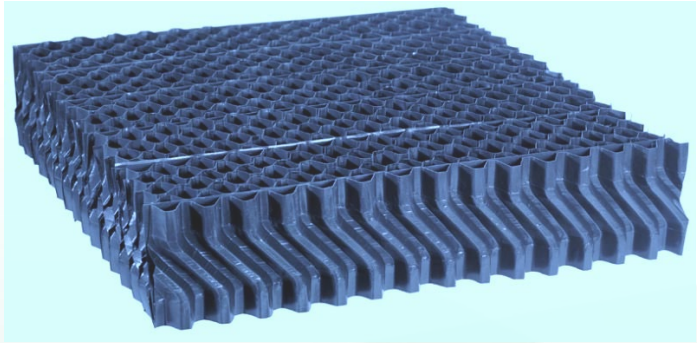


Source: www.Ensotek.com

Mandatory Requirements for Space Conditioning Equipment

§110.2(e)

- Cooling towers > 150 tons must have the following:
  - Conductivity or Flow-based controls that **maximize cycles of concentration** based on local water quality and an approved calculator using a **Langelier Saturation Index** (LSI) of 2.5 or less
    - The NRCC-MCH-E, Table M is used to document this and must be signed by a Professional Engineer (PE)
  - A **flow meter** with an analog output for flow either hardwired or available through a gateway on the makeup water line and have an **overflow alarm**
  - Equipped with **Drift Eliminators** with drift reduction to 0.002% of the circulated water volume for counter-flow towers and 0.005% for cross-flow towers
  - Nonresidential Manual chapter 4.2.7 is a good resource for cooling tower water conservation information



Source: https://www.innovek.co.th

Natural Gas Central Furnaces, Cooking Equipment, Pool and Spa Heaters, and Fireplaces: Pilot Lights Prohibited

§110.5

- **Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:**
  - Fan-type central furnaces
  - Household cooking appliances
    - EXCEPTION: Household cooking appliances without an electrical supply voltage connection and each pilot consumes less than 150 Btu/hr
  - Pool heaters
  - Spa heaters
  - Indoor and outdoor fireplaces

Mandatory Requirements for Demand Management

§110.12(a)

- **Demand Responsive Controls**
  - When meeting demand management requirements, thermostats must meet JA5 requirements, if no EMCS
  - Must be capable of communicating using one or more of the following: Wi-Fi, ZigBee, BACnet, Ethernet, or hard-wiring
  - Spelled out communication protocols
    - Must be certified as Open ADR 2.0a or b Virtual End Node (VEN), certified and listed at https://products.openadr.org/, or
    - Must be capable of responding to open ADR 2.0b VEN, certified to CEC and listed at www.energy.ca.gov/title24/equipment_cert/

Mandatory Requirements for Demand Management

§110.12(b)

- **Demand Responsive Zonal HVAC Controls**

  Systems with DDC to the Zone shall be programmed to allow centralized demand shed for noncritical zones as follows:

  - A centralized contact or software point within an Energy Management Control System (EMCS) must have the following remote capabilities:
    - Increase the operating cooling temperature set points by 4° or more
    - Decrease the operating heating temperature set points by 4° or more
    - Must reset the temperatures in all to the original operating levels
  - The controls must provide an adjustable rate of change for the temperature increase, decrease, and reset.
  - The controls shall have the following features:
    - Can be disabled by authorized facility operators; and
    - Allow manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS

Subchapter – 10
Multifamily buildings

Mandatory §§ 160.2, 160.3

Ventilation and Indoor Air Quality

§160.2(b)1A – Attached Dwelling Unit

- **Air Filtration**

Required for the following:

- Mechanical space-conditioning systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length.
- Mechanical supply-only ventilation systems and makeup air systems that provide outside air to an occupiable space.
- The supply side of mechanical balanced ventilation systems, including
  - Heat recovery ventilation (HRV) systems
  - Energy recovery ventilation (ERV) systems

Ventilation and Indoor Air Quality

§160.2(b)1B – Attached Dwelling Unit

Air Filtration – cont.

- Filters required for both **space conditioning and ventilation systems**:
  - Filter depth:
    - 2-inch depth filter: allowable pressure drop determined by the system designer

    OR

    - 1-inch depth filter allowed if: Sized per equation 160.2-A at ≤ 150 ft/min face velocity:

$$A_{face} = Q_{filter} / V_{face}$$ Equation 160.2-A

Where:

A_{face} = filter face area (ft^2)

Q_{filter} = design airflow rate for filter (ft^3/min)

V_{face}= face velocity (150 ft/min or less)

  - Use of gaskets, sealing or other means to close gaps around filters

Ventilation and Indoor Air Quality

§160.2(b)1B – Attached Dwelling Unit

Air Filtration

- Air filter racks or grilles be gasketed or sealed

Ventilation and Indoor Air Quality

§160.2(b)1C - E – Attached Dwelling Unit

Air Filtration – cont.

- Filter efficiency must be equal to or greater than MERV 13
- Filters must conform to applicable maximum allowable clean-filter pressure drop.
- All the systems must be labeled by the manufacturer with the efficiency and pressure drop ratings

Exception to 160.2(b)1

- Evaporative coolers

Ventilation and Indoor Air Quality

§160.2(b)2Ai – Attached Dwelling Unit

Amendments to ASHRAE 62.2

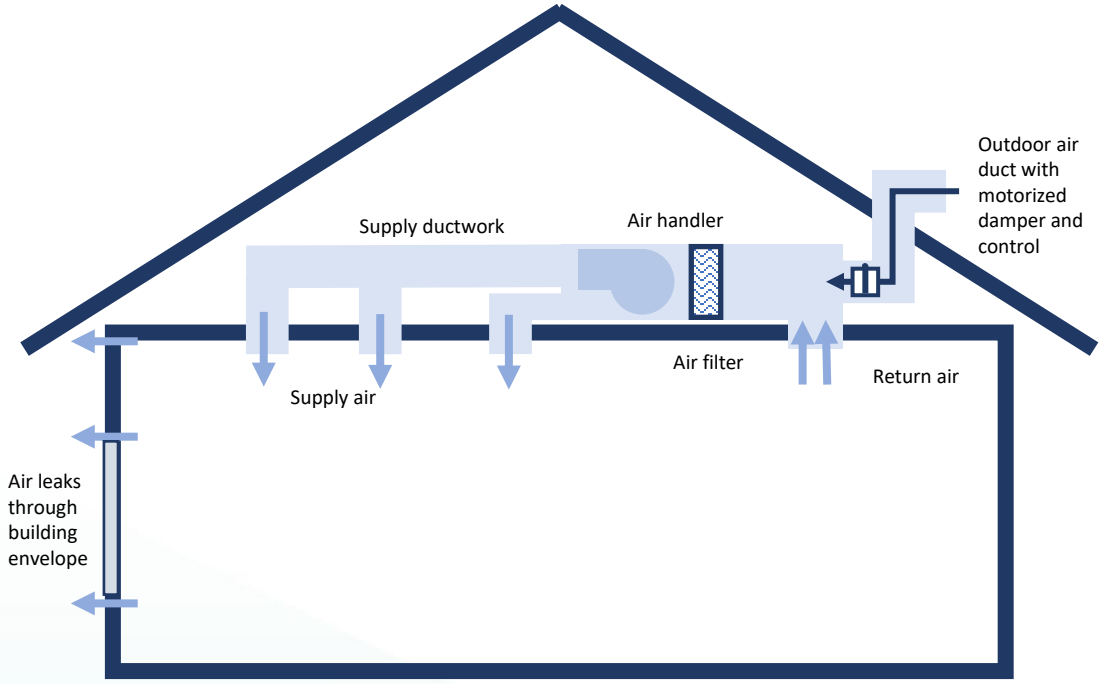
- The requirements of ASHRAE 62.2-2019 apply except as amended by this section.
- Window Operation
  - Window operation is not a permissible method of providing the dwelling unit ventilation.

Ventilation and Indoor Air Quality

§160.2(b)2Aii – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Central Fan Integrated (CFI) Ventilation Systems
  - Continuous operation of central system air handlers is not allowed for providing the dwelling unit ventilation airflow.
  - Motorized outdoor air damper must be installed and controlled.
  - Variable ventilation controls
    - Systems must have controls to track outdoor air ventilation run time.
    - Systems must operate space-conditioning system central fan and outdoor air damper when necessary.



Ventilation and Indoor Air Quality

§160.2(b)2Aiv – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Whole-dwelling unit mechanical ventilation for multifamily attached dwelling units
  - Total required dwelling unit ventilation rate [ASHRAE 62.2:4.1.1]

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

Where:

Q_{tot} = total required ventilation rate, cfm

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

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

Ventilation and Indoor Air Quality

§160.2(b)2Aiv – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Whole-dwelling unit mechanical ventilation for multifamily attached dwelling units
  - All dwelling units must use same whole-dwelling ventilation system type. System type must be:
    - Supply or Exhaust with compartmentalization testing, or
    - Balanced

Ventilation and Indoor Air Quality

§160.2(b)2Av – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Multifamily building central ventilation system airflow rate tolerance
  - Must have airflow rates meets or exceeds design ventilation airflow rate specification when serve multiple dwelling units.
  - Airflow in each dwelling unit must not be more than 20 percent greater than specified design ventilation airflow rate.

Ventilation and Indoor Air Quality

§160.2(b)2Avi – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Local mechanical exhaust
  - Nonenclosed kitchens must have demand-controlled mechanical exhaust system.
  - Enclosed kitchens and all bathrooms must have either demand-controlled or continuous mechanical exhaust system.
    - Enclosed kitchen per ASHRAE 62.2: a kitchen whose permanent openings to interior adjacent spaces do not exceed a total of 60 ft² (6 m²).

Ventilation and Indoor Air Quality

§160.2(b)2Avi – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Local mechanical exhaust
  - Demand-controlled mechanical exhaust
    - Control and operation: Occupant controlled ON-OFF control and automatic control that not impede occupant ON control.
    - Ventilation rate and capture efficiency: must meet or exceed either minimum airflow in Table 160.2-E or the minimum capture efficiency in Table 160.2-E and Table 160.2-G.

Ventilation and Indoor Air Quality

§160.2(b)2Avi – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Local mechanical exhaust
  - Continuous mechanical exhaust
    - Control and operation: Manual ON-OFF control
    - Ventilation rate: must meet minimum delivered ventilation in Table 160.2-F

Ventilation and Indoor Air Quality

Table 160.2-E,F – Attached Dwelling Unit

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

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

Table 160.2-F Continuous Local Ventilation Exhaust Airflow Rates

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

Ventilation and Indoor Air Quality

Table 160.2-G – Attached Dwelling Unit

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

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

Ventilation and Indoor Air Quality

§160.2(b)2Avi – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Local mechanical exhaust
  - Airflow measurement by the system installer
    - Measure the airflow per Reference Residential Appendix RA3.7 or NA2.2, or
    - Installed exhaust fan and duct system per Table 160.2-H and visually inspected.
  - Sound ratings
    - Sound rated per section 7.2 of ASHRAE 62.2 with minimum airflow rate 100 cfm.

Ventilation and Indoor Air Quality

Table 160.2-H – Attached Dwelling Unit

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

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

Ventilation and Indoor Air Quality

§160.2(b)2Aix – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Local mechanical exhaust
  - Label for whole-dwelling unit ventilation system on-off control
    - Manual switches operating whole house ventilation systems must be labeled with the following or equivalent:

    “This switch controls the indoor air quality ventilation for the home. Leave it on unless the outdoor air quality is very poor.”

Ventilation and Indoor Air Quality

§160.2(b)2Ax – Attached Dwelling Unit

Amendments to ASHRAE 62.2 – cont.

- Local mechanical exhaust
  - Combustion air and compensating outdoor air or makeup air
    - All dwelling units must meet the applicable requirements of
      - California Mechanical Code Chapter 7, combustion air
      - ASHRAE 62.2 Section 6.4, combustion and solid fuel burning appliances

Ventilation and Indoor Air Quality

§160.2(b)2B – Attached Dwelling Unit

Dwelling unit HERS field verification and diagnostic testing

- Whole-dwelling unit ventilation airflow must be confirmed through HERS field verification and diagnostic testing.
  - RA3.7.4.1.1 or NA2.2.4.1.1 for Supply and exhaust
  - RA3.7.4.1.2 or NA2.2.4.1.2 for balanced systems
- Vented range hoods installed in kitchens for local mechanical exhaust must be confirmed through HERS field verification and confirm the model is rated by HVI or AHAM and meet requirements of section 160.2(b)2Biia,b.
  - RA3.7.4.3 or NA2.2.4.1.4
- HRV and ERV system fan efficacy must be $\leq$ 1.0 W/cfm and confirmed through HERS field verification.
  - RA3.7.4.4 or NA2.2.4.1.5

Ventilation and Indoor Air Quality

§160.2(b)2C – Attached Dwelling Unit

Multifamily building central ventilation system field verification

- Ventilation ducts which serves multiple dwelling units and provides continuous airflows or airflow to provide balanced ventilation must meet
  - Duct sealing requirements of California Mechanical Code section 603.10
  - Leakage ≤ 6 percent of rooftop fan or central fan design airflow rate confirmed by field verification per NA7.18.3
    - Test pressure 25 Pa (0.1 inch) for six or fewer dwelling units
    - Test pressure 50 Pa (0.2 inch) for more than six dwelling units

Ventilation and Indoor Air Quality

§160.2(c)1A – Common Use Areas

- **Air Filtration**

Required for the following:

- Mechanical space-conditioning systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length.
- Mechanical supply-only ventilation systems and makeup air systems that provide outside air to an occupiable space.
- The supply side of mechanical balanced ventilation systems, including
  - Heat recovery ventilation (HRV) systems
  - Energy recovery ventilation (ERV) systems

Ventilation and Indoor Air Quality

§160.2(c)1B-D – Common Use Areas

Air Filtration – cont.

- Filters with required for both **space conditioning and ventilation systems**:
  - Filter efficiency MERV 13 or greater
  - Filter depth:
    - 2-inch depth filter: allowable pressure drop determined by the system designer

    OR
    - 1-inch depth filter allowed if: Sized per equation 160.2-A at ≤ 150 ft/min face velocity:

$$A_{face} = Q_{filter} / V_{face}$$ Equation 160.2-A

A_{face} = filter face area (ft^2)

Q_{filter} = design airflow rate for filter (ft^3/min)

V_{face}= face velocity (150 ft/min or less)

  - Use of gaskets, sealing or other means to close gaps around filters

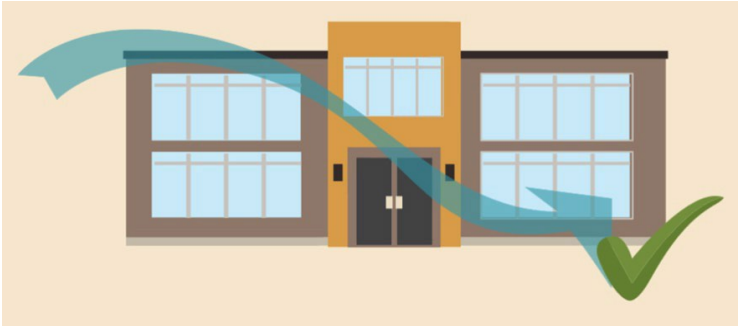
Ventilation and Indoor Air Quality

§160.2(c)2 – Common Use Areas

- **Natural Ventilation**
  - If a natural ventilation system used, there must also be a mechanical system per 160.2(c)3.
    - Exceptions where mechanical ventilation is not required:
      - If natural ventilation openings are permanently open; or
      - If there are controls preventing ventilation openings from closing during times of expected occupancy; or
      - In zones not served by a space conditioning system

Ventilation and Indoor Air Quality

§§160.2(c)2A-C – Common Use Areas



- **Natural Ventilation**
  - Requirements aligned with ASHRAE 62.1.
  - Maximum distance from operable openings is based on location, number of openings, and ceiling height.
  - Size of openings must be **≥ 4%** of ventilated floor area.
  - Adjoining rooms without outside air openings must have a permanently opened area **≥ 8%** of the unventilated area but not less than 25 sf.

Ventilation and Indoor Air Quality

§160.2(c)3A – Common Use Areas

- **Mechanical Ventilation**
  - Outdoor ventilation rate is determined by Equation 160.2-G:

$$V_z = R_a \times A_z$$

Where:

V_z = Required outdoor airflow rate (cfm)

R_a = Outdoor airflow rate per unit area from Table 160.2-B (cfm/sf)

A_z = The net floor area of the ventilation zone (sf)

Ventilation and Indoor Air Quality

§160.2(c)3B – Common Use Areas

- **Mechanical Ventilation – cont.**
  - Spaces with an expected number of occupants or fixed seating use **Equation 160.2-H**:

$$V_z = R_p \times P_z$$

Where:

V_z = Required outdoor airflow rate (cfm)

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

P_z = The expected number of occupants as specified by the building designer, or for spaces with fixed seating, as determined by the California Building Code

Ventilation and Indoor Air Quality

§160.2(c)4 – Common Use Areas

- **Exhaust Ventilation**
  - New exhaust ventilation rate requirements are listed in Table 160.2-C (Aligns with ASHRAE 62.1)

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

Occupancy Category[3]	Exhaust Rete, cfm/unit	Exhaust Rate, cfm/ft²	Air Class	Notes
Copy, printing rooms	-	0.50	2	
Janitor closets, trash rooms, recycling	-	1.00	3	
Kitchenettes	-	0.30	2	
Kitchens – commercial	-	0.70	2	
Locker rooms for athletic or industrial facilities	-	0.50	2	
All other locker rooms	-	0.25	2	
Shower rooms	20/50	-	2	G, H
Parking garages	-	0.75	2	C
Pet shops (animal areas)	-	0.90	2	
Soiled laundry storage rooms	-	1.00	3	F
Storage rooms, chemical	-	1.50	4	F
Toilets – private	25/50	-	2	E
Toilets – public	50/70	-	2	D

Ventilation and Indoor Air Quality

§§160.2(c)5A-B – Common Use Areas

Operation and control requirements for minimum quantities of outdoor air

- **Times of Occupancy**
  - The minimum outdoor air must be supplied at all times **unless**:
    - The space, without processes or operations which generate dusts, fumes, mists, vapors or gases, is intermittently occupied and controlled with an **Occupancy Sensor** (OS) or **Demand Control Ventilation** (DCV)
    - A temporary reduction is allowed for up to 30 minutes at a time if the average rate for each hour is ≥ the required rate
- **Pre-Occupancy**
  - A preoccupancy purge is required in the hour prior to occupancy. The **lesser** of the following must be provided to the entire building:
    - The minimum required rate of outdoor air, or
    - Three complete air changes

Ventilation and Indoor Air Quality

§160.2(c)5C – Common Use Areas

Operation and control requirements for minimum quantities of outdoor air

- **Required demand control ventilation**
  - DCV is required if the system serving the space has one of the following:
    - An air economizer; or
    - Modulating outside air control; or
    - A design outdoor airflow rate is > 3,000 cfm
  - EXCEPTIONS:
    - There are several exceptions to demand control ventilation §160.2(c)5C. related to airborne contaminates, space type, occupant density, exhaust rate, and space size.

Ventilation and Indoor Air Quality

§160.2(c)5D – Common Use Areas

Operation and control requirements for minimum quantities of outdoor air

- **Demand control ventilation devices**
  - Requirements for DCV systems with **CO_2 Sensors**
    - CO_2 sensors required in each room with no less than one per 10,000 ft².
    - When a zone or space served by more than one sensor, a high CO_2 signal from any sensor must increase ventilation
    - CO_2 sensors must be located between 3 ft and 6 ft above the floor or at the anticipated height of the occupants heads
    - CO_2 must be maintained to 600 ppm or less plus the outdoor air CO_2 concentration - space ventilation rate does not have to be exceeded
    - Outdoor air CO_2 can be assumed to be 400 ppm or measured with a CO_2 sensor located within 4 feet of the outdoor air intake.
    - Sensors must be factory calibrated and display readings continuously.

Ventilation and Indoor Air Quality

§160.2(c)5E – Common Use Areas

Operation and control requirements for minimum quantities of outdoor air

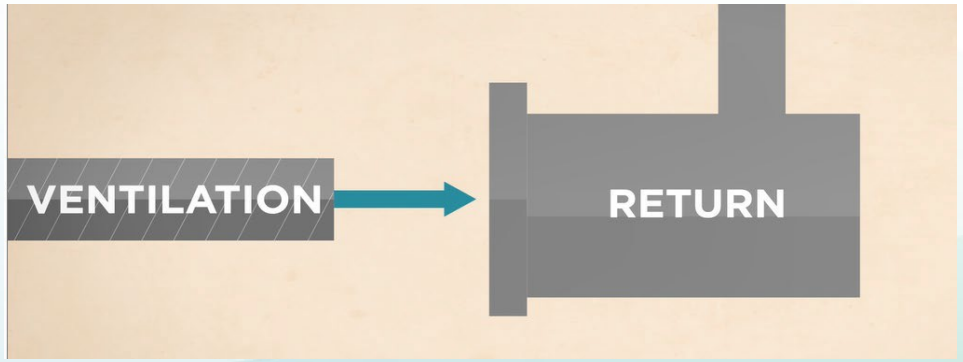
- **Occupant sensor ventilation control devices**
  - Occupant sensor ventilation controls required when
    - HVAC zones where ventilation air reduced to zero while in occupied-standby mode per Table 160.2-B and
    - Installed occupant sensors to meet §160.5(b)4Cv-vii
  - Occupant sensors comply with following requirements:
    - Indicate room vacant after 20 minutes max
    - Independent sensor in each room
    - Allow pre-occupancy purge per §160.2(c)5B
    - Sensor overridden when zone scheduled for Occupied mode
    - Ventilation shut off after 5 minutes
    - Occupied standby mode in 5 min or less and zone setpoints reset per §120.2(e)3

Ventilation and Indoor Air Quality

§160.2(c)6 – Common Use Areas

Ducting for zonal heating and cooling units

- Where a return plenum is used to supply outdoor air, the outdoor air should be ducted to discharge either:
  - Within 5 feet of the intake; or
  - If the velocity is ≥ 500 feet per minute, it can be up to 15 feet away if it is directed substantially toward the intake



Ventilation and Indoor Air Quality

§160.2(c)7 – Common Use Areas

Design and control requirements for quantities of outdoor air

- Systems must have ductwork, dampers, and controls to supply the larger of:
  - the required outside air rates; **or**
  - the rate required for make-up of all exhaust systems that are required for processes, control of odors, or the removal of contaminants
- VAV systems must have dynamic controls to maintain measured outside air ventilation rates within 10% of the required rate
- All mechanical ventilation and space- conditioning systems must be within 10 percent of the required outside air rate

Ventilation and Indoor Air Quality

§160.2(c)8, §160.2(d)

Air classification and recirculation limitations – Common use areas

- There are limits on the recirculation or transfer of air based on the occupancy air classification
  - Table 160.2 -B or D designates the air class for each occupancy as: 1, 2, 3, or 4
  - The lower the number, the higher the air quality. For example:
    - Class 1 air can be recirculated or transferred to any space
    - Class 4 air cannot be recirculated or transferred to any other space
  - This aligns with ASHRAE 62.1

Parking garages

- Mechanical ventilation systems for enclosed parking garages must meet the requirements of Section 120.6(c).

Required Controls for Space-Conditioning Systems

§160.3(a)1

Controls – Dwelling Unit

- Systems not controlled by EMCS must have setback thermostat per Section 110.2(c)
  - All heating systems
  - All cooling systems
  - Heat pumps

Required Controls for Space-Conditioning Systems

§160.3(a)2A - Common Use Areas

Thermostatic controls for each zone

- Each zone must have an individual thermostatic control or be controlled by an Energy Management Control System (EMCS)

- EXCEPTION:
  - There is an exception that allows for an independent perimeter heating or cooling system to serve more than one zone without individual thermostatic controls. See Exception to 160.3(a)2A for details.

Required Controls for Space-Conditioning Systems

§§160.3(a)2Bi-iii - Common Use Areas

Criteria for zonal thermostatic controls

- Thermostats must be able to set temperatures to the following:
  - Down to 55°F or lower for heating
  - Up to 85°F or higher for cooling
- If used for both heating and cooling it must also have a **dead band** of at least 5°F where space conditioning is shut off or reduced to a minimum
- EXCEPTIONS:
  - Systems with thermostats that require manual changeover between heating and cooling modes do not need a dead band.

Required Controls for Space-Conditioning Systems

§160.3(a)2Biv - cont.

Criteria for zonal thermostatic controls - Common Use Areas

- **Single zone** systems must have one of the following controls:
  - An **Occupant Controlled Smart Thermostat** (OCST) that meets setback requirements of §110.2(c) and demand response signal requirements in §110.12(a) and certified to the Commission per requirements in JA5
  - And if system has DDC to the zone, the OCST must also meet the demand response control requirements in §110.12(b)
- EXCEPTIONS:
  - Package terminal air conditioners, package terminal heat pumps, room air conditioners, and room air-conditioner heat pumps.

Required Controls for Space-Conditioning Systems

§160.3(a)2C - Common Use Areas

Heat Pump Controls

- All heat pumps with supplementary electric resistance heaters must have controls that comply with Section 110.2(b)

Required Controls for Space-Conditioning Systems

§160.3(a)2Di - Common Use Areas

Shut-off and reset controls for space-conditioning systems

- The controls must be able to automatically shut off the system during periods of nonuse and must have **one** of the following:
  - An **occupancy sensor**; or
  - A **4-hour timer** that can be manually operated; or
  - An **automatic time switch control** listed in the Title 20 database (MAEDBS), with an accessible manual override for up to 4 hours

Required Controls for Space-Conditioning Systems

§160.3(a)2Dii - Common Use Areas

Shut-off and reset controls for space-conditioning systems

- When turning the system on after a shutdown, controls must automatically restart the system to maintain:
  - A setback heating thermostat setpoint; and
  - A setup cooling thermostat setpoint
- EXCEPTIONS:
  - Not required for cooling where the Summer Design Dry Bulb 0.5 percent temperature is less than 100°F.
  - Not required for heating where the Winter Median of Extremes outdoor air temperature is greater than 32°F.

Required Controls for Space-Conditioning Systems

§160.3(a)2Diii - Common Use Areas

Shut-off and reset controls for space-conditioning systems

- For HVAC system which also provides ventilation, occupancy sensors are mandatory per section 160.2(c)5E
  - In 5 minutes or less in occupied standby mode
    - The temperature must automatically set up the operating cooling or heating temperature set point by 2°F or more
    - For multiple zone systems with (DDC) to the zone, setup and setback temperatures by 0.5°F or more
  - During occupied-standby mode, all air must be turned off if zone temperature is between setpoints

Required Controls for Space-Conditioning Systems

§160.3(a)2E - Common Use Areas

Dampers for air supply and exhaust equipment

- Outdoor air supply and exhaust equipment must have **dampers that automatically close** upon fan shutdown

- EXCEPTIONS:
  - When the equipment serves an area that must operate continuously.
  - When it is a gravity type or other nonelectrical equipment with readily accessible manual damper controls.
  - At combustion air intake and shaft vents.
  - When it is prohibited by other provisions of law.

Required Controls for Space-Conditioning Systems

§160.3(a)2F - Common Use Areas

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.

- Each zone, or any combination of zones not exceeding 25,000 ft^2, is considered a separate isolation area
- Each isolation area must have isolation devices, such as valves or dampers that control heating or cooling independently of other isolation areas
- Each isolation area must have shut-off and reset controls such as an automatic time switch, occupancy sensor, or a 4-hour manual timer

- EXCEPTION:
  - Zones designed to be conditioned continuously.

Required Controls for Space-Conditioning Systems

§160.3(a)2G - Common Use Areas

Automatic demand shed controls

- Buildings, other than healthcare facilities, that install or are required to install demand responsive controls must comply with the applicable demand responsive control requirements of Section 110.12
  - Certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN); or
  - Certified as capable of responding to a demand response signal from a certified OpenADR 2.0b Virtual End Node
- Does not have to be implemented but the controls must have these capabilities

Required Controls for Space-Conditioning Systems

§160.3(a)2H - Common Use Areas

Economizer fault detection and diagnostics (FDD)

- Economizer FDD is required for all newly installed air handlers with the following:
  - Cooling capacity greater than 33,000 Btu/hr; and
  - An air economizer
- Temperature sensors must be permanently installed to monitor:
  - Outside air
  - Supply air
  - Return air
- Temperature sensors must have an accuracy of ±2°F in the range of 40°F to 80°F.
- The controller must be capable of displaying the value of **each** sensor

Required Controls for Space-Conditioning Systems

§160.3(a)2H – cont.

Economizer fault detection and diagnostics (FDD) – Common Use Areas

- The controller must provide system status by indicating the following conditions:
  - Free cooling available;
  - Economizer enabled;
  - Compressor enabled;
  - Heating enabled, if the system is capable of heating; **and**
  - Mixed air low limit cycle active
- The **unit** controller must allow **manual initiation** of each operating mode so that the **operation** of cooling system, economizers, fans, and heating systems can be **independently** tested and verified

Required Controls for Space-Conditioning Systems

§160.3(a)2H – cont.

Economizer fault detection and diagnostics (FDD) – Common Use Areas

- Faults must be reported in **one** of the following ways:
  - Reported to an EMCS that is monitored by facility personnel
  - Reported to a fault management application which automatically provides notification of the fault to a remote HVAC service provider
  - Display the fault on one or more zone thermostats, or a device within five (5) feet of zone thermostat(s), clearly visible, and meeting the following requirements:
    - Display instructions to contact appropriate building personnel or an HVAC technician; and
    - In buildings with multiple tenants, the display must either be within the property management offices or in a common space accessible to the facilities manager

Required Controls for Space-Conditioning Systems

§160.3(a)2H – cont.

Economizer fault detection and diagnostics (FDD) – Common Use Areas

- The FDD system must detect the following faults:
  - Air temperature sensor failure/fault;
  - Not economizing when it should be;
  - Economizing when it should not be;
  - Damper not modulating; and
  - Excess outdoor air
- The FDD systems must be **certified** to the Energy Commission as meeting all of these requirements
- EXCEPTION to FDD:
  - FDD algorithms based in Direct Digital Control systems are not required to be certified to the Energy Commission.

Required Controls for Space-Conditioning Systems

§160.3(a)2I - Common Use Areas

Direct Digital Controls (DDC)

- DDC must be provided as specified in Table 160.3-C
  - The DDC system must meet control logic requirements for ventilation in 160.3(a)2E and 160.3(a)2G, and the following:
  - **Monitoring zone and system demand** for fan pressure, pump pressure, heating and cooling;
  - **Transferring demand information** from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers;
  - 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;
  - Allow for **operator removal** of zones(s) from the reset algorithm;
  - For new buildings, **trending and graphical displaying** of input and output points
  - Resetting heating and cooling setpoints in all noncritical zones

Required Controls for Space-Conditioning Systems

Table 160.3-C

TABLE 160.3-C DDC Applications and Qualifications

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

Required Controls for Space-Conditioning Systems

§160.3(a)2J - Common Use Areas

Optimum start/stop controls

- Space conditioning systems with **DDC to the zone** level must have optimum start/stop controls
- The control algorithm must, as a minimum, be a function of the difference between occupied space temperature setpoint, the outdoor air temperature, and the amount of time prior to scheduled occupancy
- Mass radiant floor slab systems must also incorporate floor temperature into the optimum start algorithm
- EXCEPTIONS:
  - Systems that must operate continuously.

Space-conditioning equipment

§§160.3(b)1,2 – Dwelling Unit

Building cooling and heating load

- Heating and cooling loads are determined by using either ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers), SMACNA (Sheet Metal and Air Conditioning Contractors' National Association), or ACCA (Air Conditioning Contractors of America)
    - Heating systems must meet CBC minimum requirements

Design conditions

- Sizing HVAC
    - Indoor Temperatures (Heating: 68°F and Cooling: 75°F)
    - Outdoor Temperatures (References Joint Appendix JA2)

Space-conditioning equipment

§160.3(b)3 – Dwelling Unit

Outdoor condensing units

- Clearances
  - 5 feet from outlet of dryer vents

- Liquid line filter drier
  - when required by manufacturer

Space-conditioning equipment

§160.3(b)4 – Dwelling Unit

Central forced-air heating furnaces

- Temperature rise
  - Installations configured to operate with manufacturer inlet to outlet temperature rise specifications

Requirements for Ducts and Plenums

§160.3(b)5A – Dwelling Unit

CMC compliance

- All air distribution systems must be installed, sealed and insulated to meet the requirements of the California Mechanical Code (CMC) and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition
- This includes the following:
  - Ducts
  - Plenums
  - Building cavities
  - Mechanical closets
  - Air-handler boxes
  - Support platforms used as ducts or plenums

Requirements for Ducts and Plenums

§160.3(b)5A – cont.

CMC compliance – Dwelling Unit

- Portions of supply-air and return-air ducts and plenums
  - Insulation R-6 or higher, or
  - Insulation not required if located entirely in conditioned space
    - Confirmed through field verification and diagnostic testing per RA3.1.4.3.8

Requirements for Ducts and Plenums

§160.3(b)5A – cont.

CMC compliance – Dwelling Unit

- Connections of metal ducts and the inner core of flexible ducts must be mechanically fastened.
- Openings must be sealed with mastic, tape, aerosol sealant that meets the requirements of UL 723, or other duct-closure system that meets the requirements of UL 181, 181A, or 181B.
- 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.

Requirements for Ducts and Plenums

§§160.3(b)5B - D – Dwelling Unit

Ducts and plenum materials

- The energy code requires UL and/or ASTM material performance testing for the following:
  - Factory fabricated ducts
  - Field fabricated ducts
  - Tapes
  - Mastics and Mesh
  - Aerosol sealants
  - Draw bands
  - Insulation R-values

Requirements for Ducts and Plenums

§160.3(b)5E – Dwelling Unit

Duct Insulation Thickness

- Nominal thickness must be used for duct board, duct liner and factory-made rigid ducts not subject to compression.
- 75 percent of nominal thickness must be used for duct wrap.
- Thickness must be determined by dividing the difference between the actual outside diameter and nominal inside diameter by 2 for factory made flexible ducts.

Requirements for Ducts and Plenums

§§160.3(b)5F - H – Dwelling Unit

Duct Labeling

- Insulated duct products must include labels showing R-value for insulation in maximum intervals of 3 feet.

Backdraft Dampers

- All fan systems must be provided with backdraft or automatic dampers to prevent unintended air leakage.

Gravity Ventilation Dampers

- All gravity ventilating systems must have 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

Requirements for Ducts and Plenums

§160.3(b)5I – Dwelling Unit

Protection of insulation

- Insulation must be protected from damages due to:
  - Sunlight
  - Wind
  - Moisture
  - Maintenance equipment
- Exposed insulation protection
  - Aluminum, sheet metal, painted canvas, plastic cover
  - Cellular foam can be protected by coating that is water retardant and provides shielding from solar radiation

Requirements for Ducts and Plenums

§§160.3(b)5J - K – Dwelling Unit

Porous inner core flex duct

- Flexible ducts with porous inner cores must have nonporous layer or air barrier between inner core and outer vapor barrier.

Duct system sealing and leakage testing

Multifamily dwellings with air-handling unit (AHU) and the ducts connected directly to the air handler must have

- Total leakage ≤ 12% of air handler airflow determined per procedures mentioned in Reference Residential Appendix RA3.1.4.3.1, or
- Duct system leakage to outside ≤ 6% of air handler airflow determined per procedures mentioned in Reference Residential Appendix RA3.1.4.3.4

Requirements for Ducts and Plenums

§160.3(b)5K – Dwelling Unit

Exceptions

- Buildings with 4 or more habitable stories exempted from HERS verification; installing contractor conducts the testing
- Buildings with 4 or more habitable stories in climate zone 1,3,5 and 7

Requirements for Ducts and Plenums

§160.3(b)5L – Dwelling Unit

Airflow rate and fan efficacy

- Systems must have a hole for the placement of a static pressure probe (HSPP) or permanently installed static pressure probe (PSPP)
- Fan efficacy for systems supplying cooling with ducts
  - All single and multi-zone systems:
    - Airflow rate ≥ 350 cfm per ton of nominal cooling system
    - Systems with gas furnaces fan efficacy ≤ 0.45 W/cfm
    - All other air handlers must be ≤ 0.58 W/cfm
  - Small Duct High Velocity Systems requirements:
    - Airflow rate ≥ 250 cfm per ton of cooling
    - Fan efficacy ≤ 0.62 W/cfm
  - HERS verification required

Requirements for Ducts and Plenums

§160.3(b)5L – Dwelling Unit

Exceptions

- Buildings with 4 or more habitable stories exempted from HERS verification; installing contractor conducts the testing.
- Buildings with 4 or more habitable stories in climate zone 1.

Requirements for Ducts and Plenums

§160.3(b)6 – Dwelling Unit

Piping for space-conditioning systems

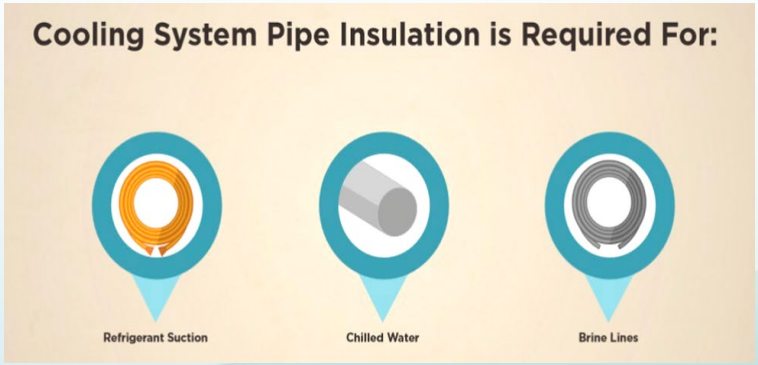
- Piping for space-conditioning systems, distribution piping for steam and hydronic heating system must meet the requirements of Section 160.3(c)1.

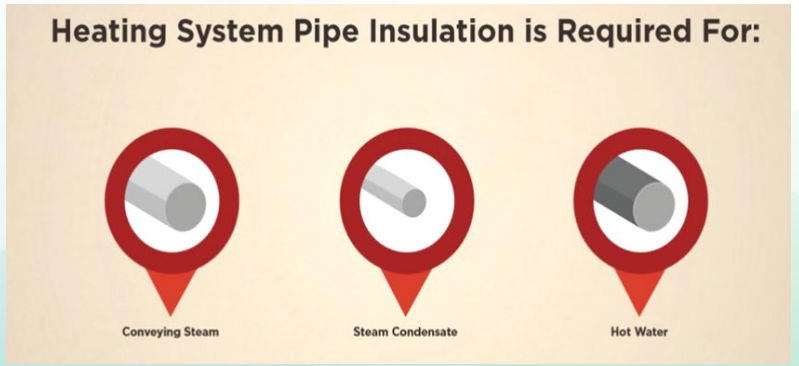
Requirements for Pipe Insulation

§§ 160.3(c)1A-B – Common Use Areas

General requirements

- Insulation is required on the following:
  - Space cooling refrigerant suction, chilled water and brine lines.
  - Space heating systems steam, steam condensate and hot water lines
    - Non insulation required on the refrigerant liquid line.
- Insulation conductivity determined per ASTM C335 at mean temperature listed in Table 160.3-D





Requirements for Pipe Insulation

§160.3(c)1C – Common Use Areas

Insulation Protection

- Insulation must be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind
- Insulation exposed to weather must be water retardant and provide shielding from solar radiation that can cause degradation of the material
- Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space must have a Class I or Class II vapor retarder
- All penetrations and joints must be sealed
- Pipe insulation buried below grade must be installed in a waterproof and non-crushable casing or sleeve

Requirements for Pipe Insulation

§160.3(c)1D – Common Use Areas

Insulation Thickness

- Insulation thickness levels are specified in Table 160.3-D
- If the conductivity is outside the range listed in Table 160.3-D, the calculation method shown below must be used

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

T = minimum insulation thickness

PR = actual outside radius

t = insulation thickness from Table 160.3-D

K = conductivity of alternate material from Table 160.3-D

k = lower value of the conductivity range from Table 160.3-D

Requirements for Pipe Insulation

§160.3(c) – Common Use Areas

Insulation Thickness – cont.

Table 160.3-D Pipe insulation thickness

TABLE 160.3-D PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity			Nominal Pipe Diameter (in inches)				
	Conductivity (in Btu·in/h·ft²·°F)	Mean Rating Temperature (°F)		< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating (Steam, Steam Condensate, Refrigerant, Space Heating)				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8

Requirements for Ducts and Plenums

§160.3(c)2A – Common Use Areas

CMC compliance

- All air distribution systems must be installed, sealed and insulated to meet the requirements of the California Mechanical Code (CMC) and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition
- This includes the following:
  - Ducts
  - Plenums
  - Building cavities
  - Mechanical closets
  - Air-handler boxes
  - Support platforms used as ducts or plenums

Requirements for Ducts and Plenums

§160.3(c)2A - cont.

CMC Compliance – Common Use Areas

- Connections of metal ducts and the inner core of flexible ducts must be mechanically fastened
- Openings must be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the requirements of UL 181, 181A, or 181B
- 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

Requirements for Ducts and Plenums

§160.3(c)2B – Common Use Areas

CMC Compliance

- Supply and return ducts located in the following spaces must be insulated to a minimum of R-8:
  - Outdoors
  - In a space between the roof and an insulated ceiling
  - Directly under a roof with fixed vents or openings to the outside or unconditioned spaces
  - In an unconditioned crawlspace
  - In other unconditioned spaces
- Parts of the supply ducts not located in one of these spaces, including buried in concrete slab, must be insulated to a minimum of R-4.2
- Parts of the supply ducts enclosed inside directly conditioned spaces do not need to be insulated

Requirements for Ducts and Plenums

§§160.3(c)2C-D – Common Use Areas

Ducts and plenum materials

- The energy code requires UL and/or ASTM material performance testing for the following:
  - Factory fabricated ducts
  - Field fabricated ducts
  - Tapes
  - Mastics and Mesh
  - Aerosol sealants
  - Draw bands
  - Insulation R-values
- Duct and plenum materials with pressure class rating: all ductwork and plenums construction to Seal A

Requirements for Ducts and Plenums

§160.3(c)2G – Common Use Areas

Protection of Insulation

- Insulation must be protected from sunlight, moisture, equipment maintenance, and wind
- Insulation exposed to weather must be protected by aluminum, sheet metal, painted canvas, or plastic cover
- Cellular foam insulation must be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation

Requirements for Ducts and Plenums

§160.3(c)2H – Common Use Areas

Duct Sealing

Duct systems must comply with the following:

- Leakage rate ≤ 6% of nominal air handler airflow rate for new ducts systems tested by HERS Rater and
  - Provides conditioned air to an occupiable space for constant volume, single zone and space conditioning system
  - Serves single zone < 5,000 square ft of conditioned floor area
  - Ducts outdoors or unconditioned space combined surface area > 25% of entire duct system
- OR, meet testing requirements CMC §603.9.2

Required Mechanical System Acceptance

§160.3(d)1

Mechanical System Acceptance Test – Common Areas

Equipment/System	Nonresidential Appendix Reference
Outdoor air ventilation	NA7.5.1
Constant volume, single zone air conditioning and heat pump unit controls	NA7.5.2
Duct systems	NA7.5.3
Air economizers	NA7.5.4
Demand control ventilation	NA7.5.5
Supply fan variable flow control	NA7.5.6
Hydronic system variable flow controls	NA7.5.7 & NA7.5.9
Boiler or Chiller with isolation controls	NA7.5.7

Required Mechanical System Acceptance

§160.3(d)1

Mechanical System Acceptance Test – Common Areas

Equipment/System	Nonresidential Appendix Reference
Hydronic systems with supply water temperature reset controls	NA7.5.8
Automatic demand shed controls	NA7.5.10
FDD for packaged DX units	NA7.5.11
Automatic FDD for air handling units	NA7.5.12
Distributed energy storage DX ac systems	NA7.5.13
Thermal Energy storage (TES)	NA7.5.14
Supply air temperature reset controls	NA7.5.15
Water-cooled chillers served by cooling towers with condenser water reset controls	NA7.5.16
Occupant sensing zone controls	NA7.5.17

Required Mechanical System Acceptance

§§160.3(d)2 – 3

Mechanical System Acceptance

- Multifamily building with 4 or more habitable stories
  - Dwelling units' ventilation systems must be tested per NA7.18.1
  - Dwelling units' enclosure leakage must be tested per NA7.18.2
  - Central ventilation ducts must be tested per NA7.18.3
  - Central ventilation system heat recovery or energy recovery systems must be tested per NA7.18.4
- Certified mechanical acceptance test technician (CMATT) must report results of acceptance testing on respective NRCA-MCH form at final inspection

Subchapter – 11
Multifamily Buildings

Performance and Prescriptive §§ 170.1, 170.2

Restructuring of Multifamily Prescriptive Requirements

2019 Sections with Multifamily	2022 Newly Created Sections
§§140.0-140.8: High-rise residential • Performance and prescriptive compliance approaches §150.1: Low-rise residential • Performance and prescriptive compliance approaches	§§170.0-170.2: Multifamily buildings • Performance and prescriptive compliance approaches

Performance Approach: Energy Budgets

§§170.1(a),(b),(c)

Energy Budget

Energy budget = sum of TDV for HVAC, indoor lighting, water heating, and covered process

- Standard Design = Mandatory and prescriptive requirements
- Proposed Design = Calculated TDV for proposed design by CEC-certified compliance software
    - Required solar PV/battery can be offset by CEC-approved (§10-115) community shared solar and/or battery system providing dedicated benefits to permitted building
- Source energy, efficiency TDV, and total TDV must be met separately

Prescriptive Approach for Space Conditioning Systems

§170.2(c)1 – Common Use Areas

Sizing, Equipment Selection, and Type

- **Sizing and equipment selection:** Heating and cooling equipment must 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

  EXCEPTIONS:

  - Where it can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building TDV energy use
  - Standby equipment with controls that allow the standby equipment to operate only when the primary equipment is not operating
  - 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

Prescriptive Approach for Space Conditioning Systems

§170.2(c)2 – Common Use Areas

Calculations

- Heating and cooling **design loads** must be determined in accordance with the ASHRAE Handbook, Fundamentals Volume, or as specified in a method approved by the Commission
- Other calculation methods such as ACCA, SMACNA, etc., are acceptable because they are based on ASHRAE
- **Indoor** design conditions must be determined in accordance with ASHRAE Standard 55 or ASHRAE Handbook, Fundamentals Volume
- **Outdoor** design conditions must be selected from Reference Joint Appendix JA2, which is based on climate data from ASHRAE

Prescriptive Approach for Space Conditioning Systems

§170.2(c)2 – cont.

Calculations – Common Use Areas

- Load calculations should include the following:
  - Outdoor air ventilation
  - Envelope thermal conductance and air leakage
  - Solar heat gain
  - Shading such as overhangs
  - People loads based on occupant density
  - Process loads
  - Lighting loads
  - Any anticipated miscellaneous loads
- Internal heat gains can be ignored for heating calcs

Prescriptive Approach for Space Conditioning Systems

§170.2(c)2– cont.

Calculations – Common Use Areas

- **Safety factor:** Design loads may be increased by up to 10 percent to account for unexpected loads or changes in space usage.
- **Other loads:**
  - Loads such as warm-up or cool-down should be based on the heat capacity of the building and contents, the degree of setback, and desired recovery time
  - They may be assumed to be up to 30 percent for heating and 10 percent for cooling on top of the 10 percent safety actor.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3A – Dwelling Units

Space conditioning systems

- Heating system
  - 3 habitable stories or less
    - CZ 1-15 must be a heat pump for space conditioning system.
    - CZ 16 must be an air conditioner with furnace
  - 4 habitable stories or more
    - CZ 2-15 must be a heat pump for space conditioning system.
    - CZ 1 and 16 must be duel-fuel heat pump

- Exception:
  - Supplemental heating unit installed with unit thermal capacity ≤ 2kW or 7,000 Btu/hr and controlled by time-limiting device not exceeding 30 min.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3Bi – Dwelling Units

Space conditioning systems

- Refrigerant charge
  - Required in Climate Zones 2, and 8 – 15
  - Applies to ducted ACs and heat pumps (split or packaged), mini-splits, and small duct high velocity systems
  - Measurement access holes (MAH) per RA3.2.2.3
  - Refrigerant charge verified per RA 3.2
  - System airflow verification per RA 3.3
    - ≥ 350 cfm/ton for A/C and heat pump
    - ≥ 250 cfm/ton for small duct high velocity systems
  - HERS verified
  - Exceptions may apply

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3Bi – Dwelling Units

Measurement Access Hole (MAH)

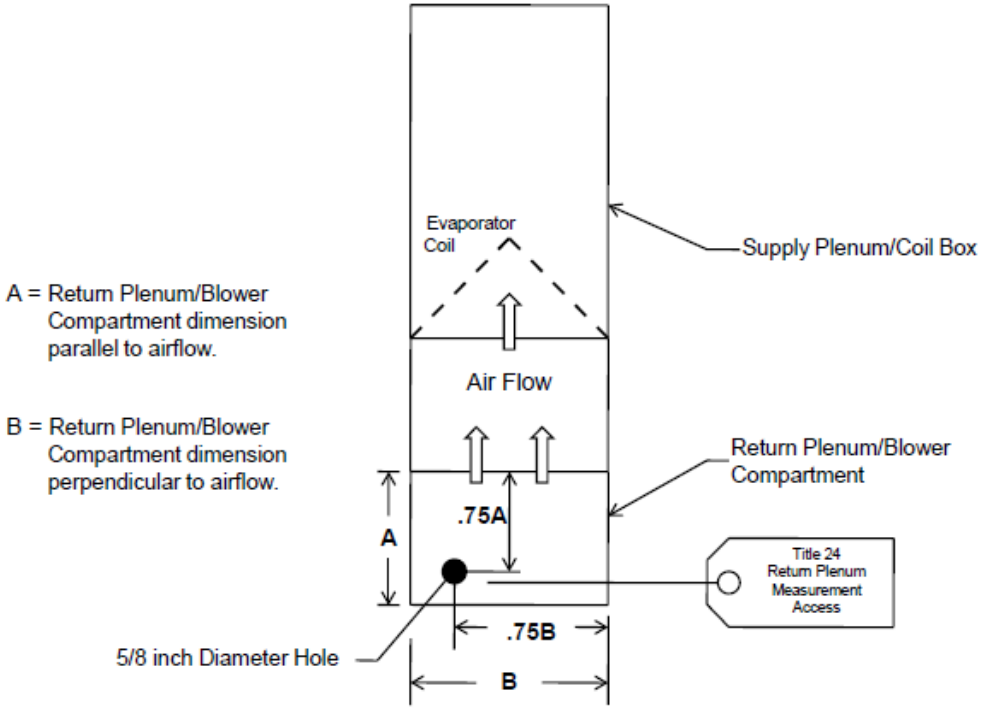


Figure RA3.2-1 Measurement Access Hole

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3Bii – Dwelling Units

- Space conditioning distribution systems
  - Two options for duct insulation and location:
    - With a High Performance Attic (HPA)
      - – Air handlers or ducts can be located in the HPA
      - – Insulation levels per Option B in Table 170.2-A

    Or;

    - With only ceiling insulation
      - – Ducts and plenums must be inside conditioned space
      - – Confirmed by field verification and diagnostic testing per RA3.1.4.3.8

Prescriptive Approach for Space Conditioning Systems

Table 170.2-A

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

Multifamily				Climate Zone														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Roof/Ceiling	Option B (meets § 170.2(a)1Bii)	Below Roof Deck Insulation [1,2] (With Air Space)		NR	NR	NR	R19	NR	NR	NR	R19	R19	R13	R19	R19	R19	R19	R19	R13
		Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
		Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
		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
			Solar Reflectance Index (SRI)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	75	NR	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
			Solar Reflectance Index (SRI)	NR	NR	NR	NR	NR	NR	NR	NR	NR	16	16	16	16	16	16	NR
	Option C (meets § 170.2(a)1Biii)	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
		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
			Solar Reflectance Index (SRI)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	75	NR	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
			Solar Reflectance Index (SRI)	NR	NR	NR	NR	NR	NR	NR	NR	NR	16	16	16	16	16	16	NR
	Option D (Non Attic Roof)	Metal Building U-factor		0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
		Wood Framed and Other U-factor		0.028	0.028	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
		Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	0.63	0.63	0.63	NR	0.63	0.63	0.63	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
			Solar Reflectance Index (SRI)	NR	NR	NR	NR	NR	NR	NR	NR	75	75	75	NR	75	75	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
			Solar Reflectance Index (SRI)	NR	16	16	16	16	16	16	16	16	16	16	16	16	16	16	NR

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3Biii – Dwelling Units

- Central Fan Integrated Ventilation Systems
  - Air-handling unit fan efficacy
    - Without Furnace: ≤ 0.58 W/cfm
    - With Furnace: ≤ 0.45 W/cfm
  - Field Verification
    - Diagnostic Testing per RA3.3
    - Intermittent Ventilation Systems as specified in Reference Residential Appendix RA3.7.4.2

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3Biv – Dwelling Units

Space conditioning systems

- Balanced ventilation system – serving individual unit
  - CZ 1,2 and 11-16 must be a ERV or HRV
  - Minimum sensible recovery efficiency 67 percent
  - Fan efficacy < 0.6W/cfm
  - Verified per RA3.7.4.4 (3 habitable stories or less)
  - Verified per NA2.2.4.1.5 (4 habitable stories or more)
- Balanced ventilation system – serving multiple units with 4 or more habitable stories
  - CZ 1,2 and 11-16 must be a ERV or HRV
  - Minimum sensible recovery efficiency 67 percent
  - Fan power requirements per 170.2(c)4A
  - Recovery bypass or control to directly economize with ventilation airbased on outside temperature limits from table 170.2-G
  - Verified per NA7.18.4
- Balanced ventilation system – 3 or less habitable stories
  - CZ 4 -10 with heat pump and without ERV and HRV
    - Fan efficacy must be ≤ 0.4W/cfm

Prescriptive Approach for Space Conditioning Systems

Table 170.2-G

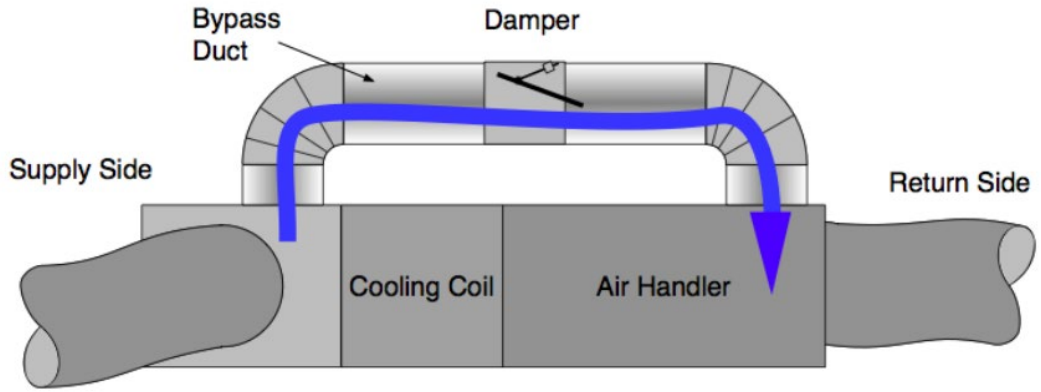
TABLE 170.2-G AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type[a]	Climate Zones	Required High Limit (Economizer Off When):	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
Fixed Dry Bulb	2, 4, 10	T_{OA} > 73°F	Outdoor air temperature exceeds 73°F
Fixed Dry Bulb	6, 8, 9	T_{OA} > 71°F	Outdoor air temperature exceeds 71°F
Fixed Dry Bulb	7	T_{OA} > 69°F	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	T_{OA} > T_{RA}°F	Outdoor air temperature exceeds return air temperature
Differential Dry Bulb	2, 4, 10	T_{OA} > T_{RA}-2°F	Outdoor air temperature exceeds return air temperature minus 2°F
Differential Dry Bulb	6, 8, 9	T_{OA} > T_{RA}-4°F	Outdoor air temperature exceeds return air temperature minus 4°F
Differential Dry Bulb	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

Prescriptive Approach for Space Conditioning Systems

§170.2(c)3C – Dwelling Units

- HVAC system bypass ducts
  - Not allowed prescriptively.
  - More information
    - Blueprint Issue 110 (July – August 2015)



Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ai – Common Use Areas

Fan Systems

- Fan Power budget
  - For each fan system that includes at least one fan or fan array with fan electrical input power $\geq$ 1 kW; fan system electrical input power (Fan $kW_{design,system}$) must not exceed Fan kW_{budget}

Prescriptive Approach for Space Conditioning Systems

§ 170.2(c)4Ai – Common Use Areas

Fan Systems

- Calculation of fan power budget (Fan kW_{budget})
  - Fan power allowance dependent on system type

Fan System Type	Fan System Power Allowance Tables
Single Cabinet	170.2-B and 170.2-C
Supply Only	170.2-B
Relief	170.2-C
Exhaust, Return, Transfer	170.2-C
Complex Supply, Return/Exhaust	Airflow- - Supply – 170.2-B - Return/Exhaust – 170.C

  - To determine fan power allowance for the components of fan system, use equation.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ai – Common Use Areas

- Fan Power Allowance

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

Where:

FPA_{adj} = The corrected fan power allowance for the component in w/cfm

Q_{comp} = The airflow through component in cfm

Q_{sys} = The fan system airflow in cfm

FPA_{comp} = The fan power allowance of the component from Table 170.2-B or Table 170.2-C

Prescriptive Approach for Space Conditioning Systems

§ 170.2(c)4Ai – Common Use Areas

Fan Systems

- To determine fan power allowance for the components of fan system, use equation
- Multiply the fan system airflow by the sum of the fan power allowances for the fan system.
- Divide by 1000 to convert to Fan kW_{budget}
- Building at elevations > 3,000 ft, use correction factor in Table 170.2-D

TABLE 170.2-D AIR DENSITY CORRECTION FACTORS

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

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ai – Common Use Areas

Fan Systems

- Determination of fan system electrical input power (Fan $kW_{design,system}$) and depends on:
  - Designed fan power for each fan or fan array in the system
  - Efficiency losses of variable speed drives
  - Clean filter and final filter pressure drop
- Designed fan power must be determined by using of the following:
  - Using Table 170.2-E-1
    - Not for complex fan systems
  - Provided by manufacturer
  - Using maximum electrical input power on motor nameplate

Prescriptive Approach for Space Conditioning Systems

Table 170.2-E-1

Default Values for Fan kW_{design} based on motor nameplate HP

Motor Nameplate HP	Default Fan kW_{design} with variable speed drive (Fan kW_{design})	Default Fan kW_{design} without variable speed drive(Fan kW_{design})
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15
≥7.5 and <10	8.46	8.13
≥10 and <15	12.47	12.03
≥15 and <20	16.55	16.04
≥20 and <25	20.58	19.92
≥25 and <30	24.59	23.77
≥30 and <40	32.74	31.70
≥40 and <50	40.71	39.46
≥50 and <60	48.50	47.10
≥60 and <75	60.45	58.87
≥75 and ≤100	80.40	78.17

Prescriptive Approach for Space Conditioning Systems

§§170.2(c)4Aii-iii – Common Use Areas

Fan Systems

Variable air volume (VAV) systems

- Static pressure sensors location requirements for optimal operation
- Static pressure setpoint reset based on the zone requiring the most pressure for DDC systems

Fractional HVAC motos for fans

- HVAC motors for fans that are < 1 hp and ≥ 1/12 hp must be electronically commutated motors (ECM) or have a minimum motor efficiency of 70 percent
- These motors must also be capable of speed adjustment
- EXCEPTIONS:
  - Motors in fan-coils and terminal units that operate only when providing heating to the space served
  - Motors in space conditioning equipment certified under Section 110.1 or 110.2

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4B – Common Use Areas

Space-conditioning zone controls

Each space-conditioning zone must have controls to prevent

- Reheating, recooling and mixed air supply, or
- For variable air volume (VAV) systems with and without DDC, there are some allowances for how much volume of primary air that can be reheated, re-cooled, or mixed air supply.

EXCEPTIONS:

- Zones with special pressurization relationships or cross-contamination control needs
- Zones with systems in which at least 75 percent of the energy for reheating, or warm air in mixing systems, is from a site-recovered or site solar energy source
- Zones where specific humidity levels are required
- Zones with a peak supply-air quantity of 300 cfm or less

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4C – Common Use Areas

Economizers

Cooling air handlers over 33,000 Btu/hr or chilled water systems without a fan and with capacities listed in Table 170.2-E-2 must have either:

- A modulating air economizer capable of supplying 100 percent of the design supply cooling air as outside-air; or
- A water economizer providing 100 percent of the cooling load at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below

Exemptions:

- Systems serving dwelling units
- Fans systems primarily serving computer rooms

Prescriptive Approach for Space Conditioning Systems

Table 170.2-E-2

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)

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Cii – Common Use Areas

Economizers

If an air economizer is installed to meet the prescriptive requirement, it must have controls that:

- Prevent an increase in the building heating energy use during normal operation
  - EXCEPTION: Systems that provide 75 percent of the annual energy used for mechanical heating from site-recovered energy or a site-solar energy source may increase building energy use.
- Must provide partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load
- Air economizers must be a type listed in TABLE 170.2-G with high limit shut off shown

Prescriptive Approach for Space Conditioning Systems

Table 170.2-G

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

Device Type[a]	Climate Zones	Required High Limit (Economizer Off When):	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
Fixed Dry Bulb	2, 4, 10	T_{OA} > 73°F	Outdoor air temperature exceeds 73°F
Fixed Dry Bulb	6, 8, 9	T_{OA} > 71°F	Outdoor air temperature exceeds 71°F
Fixed Dry Bulb	7	T_{OA} > 69°F	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	T_{OA} > T_{RA}°F	Outdoor air temperature exceeds return air temperature
Differential Dry Bulb	2, 4, 10	T_{OA} > T_{RA}-2°F	Outdoor air temperature exceeds return air temperature minus 2°F
Differential Dry Bulb	6, 8, 9	T_{OA} > T_{RA}-4°F	Outdoor air temperature exceeds return air temperature minus 4°F
Differential Dry Bulb	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

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ciii – Common Use Areas

Economizers

Air economizer and all air dampers requirements:

- **Warranty**: 5-year Manufacturer warranty of economizer assembly
- **Damper reliability testing:** Suppliers must certify that dampers and actuators operate at rated system airflow and pressure for 60,000 cycles
- **Damper leakage:** Outdoor and return dampers must be tested to leak ≤ 10 cfm/sf at 250 Pascals (1.0 in. of water) when tested per AMCA Standard 500-D, and leakage rates **certified to the Commission** per Section 110.0
- **Adjustable setpoint:** If the high-limit control is fixed dry-bulb or fixed enthalpy + fixed dry-bulb then the control must have an adjustable setpoint
- **Relief air system**. Relief air systems must allow 100 percent outside air without over-pressurizing the building
- **Sensors must be calibrated**

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Civ – Common Use Areas

Economizers

Space-conditioning systems requirements:

- **Capacity controls** interlocked with economizer allowing 100 percent open and does not start closing until the leaving air is less than 45°F
- Direct Expansion **(DX) units** > 65,000 Btu/hr controlling cooling **based on the occupied space temperature** must have a **minimum of 2 stages** of mechanical cooling
- All other DX units must comply with the following:
  - 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
  - Comply with the requirements in TABLE 170.2-H

Prescriptive Approach for Space Conditioning Systems

Table 170.2-H

TABLE 170.2-H 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

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Cv – Common Use Areas

Economizers

Water Economizers requirements:

- Precooling coils and water-to-water heat exchangers must have a waterside pressure drop of < 15 feet of water; or secondary loop that prevents the coil or heat exchanger from contributing to pressure drop when the system is in non-economizer cooling mode.
- Must be integrated to allow partial cooling

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4D – Common Use Areas

Supply air temperature (SAT) reset controls

- Space-conditioning systems supplying multiple zones must include controls that automatically reset supply-air temperatures
- SAT must be reset by the following:
  - In response to representative building loads or to outdoor air temperature.
  - At least 25 percent of the difference between the design supply-air temperature and the design room air temperature
- EXCEPTIONS:
  - There are some exceptions for certain zonal controls and process humidification requirements

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4E – Common Use Areas

Electric resistance heating

- Electric resistance heating systems cannot be used for space heating

- EXCEPTIONS:
  - There are exceptions related to solar power, heat pumps, percentage of total building design output, maximum wattage, and building features.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Fi – Common Use Areas

Heat rejection systems

Fan speed Control:

- Fan motor 7.5 hp (5.6 kW) or larger must be able to operate at 2/3 of full speed or less
- Fans must be able to change speed in order to control condenser temperature or pressure

- EXCEPTIONS:
  - Heat rejection devices included as an integral part of the equipment listed in Table 110.2-A through 110.2-N
  - Condenser fans serving multiple refrigerant circuits
  - Condenser fans serving flooded condensers.
  - 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.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Fii – Common Use Areas

Tower flow turndown

- Open cooling towers with multiple condenser water pumps must be designed so that all cells can be run in parallel with the larger of:
  - The flow that is produced by the smallest pump; or
  - 50 percent of the design flow for the cell

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Fiii – Common Use Areas

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 wetbulb temperature, must use propeller fans and cannot use centrifugal fans
- EXCEPTIONS:
    - Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability
    - Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, Table 110.2-F

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Fiv – Common Use Areas

Multiple cell heat rejection equipment

- Multiple cell heat rejection equipment with variable speed fan drives must:
  - Operate the maximum number of fans allowed by the manufacturer
  - Control all operating fans to the same speed
  - Minimum fan speed is based on the manufacture's specifications
  - Staging of fans is allowed once the fans are at their minimum operating speed

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Fv – Common Use Areas

Cooling tower efficiency

- Axial fan, open-circuit cooling towers with capacity of 900 gpm or greater, must have an efficiency ≥ 60 gpm/hp

- EXCEPTIONS:
  - Replacement of existing cooling towers inside an existing building or on an existing roof
  - Cooling towers serving buildings in Climate Zone 1 or 16

Prescriptive Approach for Space Conditioning Systems

§§170.2(c)4G,H – Common Use Areas

Minimum chiller efficiency

- Chillers must meet or exceed Path B from Table 110.2-D
- EXCEPTIONS:
  - There are exceptions related to electrical service size, chillers with heat recovery systems, thermal energy storage and the number of chillers.

Limitation of air-cooled chillers

- Chilled water plants cannot have more than 300 tons of capacity provided by air-cooled chillers.
- EXCEPTIONS:
  - There are exceptions related to poor water quality and thermal energy storage.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ii – Common Use Areas

Hydronic system measures

Hydronic variable flow systems

- HVAC chilled and hot water must have variable fluid flow and be capable of reducing pump flow rates to no more than the larger of:
  - 50 percent or less of the design flow rate; or
  - The minimum flow required by the equipment manufacturer.

- EXCEPTIONS:
  - Systems that include no more than three control valves or have total pump power less than 1.5 hp.

Prescriptive Approach for Space Conditioning Systems

§§170.2(c)4Iii-iii – Common Use Areas

Hydronic system measures

Chiller isolation

- System with parallel chillers must have provisions to automatically shut off flow to chillers not in use while still maintaining flow through operating chiller(s).
- Chillers that are piped in series for the purpose of increased temperature differential shall be considered as one chiller.

Boiler isolation

- Hot water plants with more than one boiler must automatically shut off flow through boilers not in use while maintaining flow through other operating boiler(s).

Prescriptive Approach for Space Conditioning Systems

§§170.2(c)4liv-v – Common Use Areas

Hydronic system measures

Chilled and hot water temperature reset controls

- Systems with a design capacity exceeding 500,000 Btu/hr supplying chilled or heated water must have controls that automatically reset supply water temperatures as a function of building loads or outside air temperature

Water-cooled air conditioner and hydronic heat pump systems

- Systems with total pump system power exceeding 5 hp must have variable flow controls
- Air conditioners and heat pumps must automatically shut off water flow when the compressor is off

Exceptions may apply

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ivi – Common Use Areas

Hydronic system measures

Variable flow controls

- Individual pumps serving variable flow systems and having a motor horsepower exceeding 5 hp must have motors with 30% power at 50% flow.
- Pressure Sensor Location and Setpoint depends on DDC to the coil or not.

- EXCEPTIONS:
  - Heating hot water systems
  - Condenser water systems serving only water-chilled chillers

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4Ivii – Common Use Areas

Hydronic system measures

Hydronic heat pump (WLHP) controls

- WLHPs with central heat rejection and heat addition must allow for a water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition

- EXCEPTIONS:
  - Systems with a temperature optimization controller.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4K – Common Use Areas

Space conditioning systems

Fan control

- Each cooling system listed in TABLE 140.4-I must vary the indoor fan airflow as a function of load
- These systems must have least 2 speed fan control

TABLE 140.4-I 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

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4L – Common Use Areas

Mechanical system shut-off

- Any space with operable openings to outdoors must have interlock controls
- When open for more than 5 minutes:
  - Disable or reset the setpoint to 55°F for mechanical heating, and
  - Disable or reset the setpoint to 90°F for mechanical cooling

EXCEPTIONS:

- They are not required on openings with automatic closing devices or in spaces without thermostatic control.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4M – Common Use Areas

Exhaust system transfer air

- Conditioned supply air delivered to a space with mechanical exhaust cannot exceed the greater of:
  - The supply flow required to meet the space heating or cooling load; or
  - The required ventilation rate; or
  - The mechanical exhaust flow minus the available transfer air

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4N – Common Use Areas

Dedicate outdoor air systems (DOAS)

- DOAS unit fan system power less than 1kW not exceed total combined fan power 1.0 W/cfm.
- DOAS fan power greater than 1kW meets follow requirements in section 170.2(c)4A.
- DOAS supply air delivered directly to occupied space or at outlet of any terminal heating or cooling coils and equipment fans shut off when no call for heat or cooling.
  - Active chilled beam systems exempted.
- Ventilation fans must have modulating fan speed control
- System must not use heat recovery or heating to warm the supply air above 60°F when majority of zones require cooling.

Prescriptive Approach for Space Conditioning Systems

§170.2(c)4O – Common Use Areas

Exhaust air heat recovery

Fan systems designed to criteria in either Table 170.2-I or Table 170.2-J must include exhaust air heat recovery system and must have the following requirements.

- Sensible energy ratio no less than 60% or enthalpy recovery ratio no less than 50%.
- Energy recovery bypass or control

EXCEPTIONS:

- Please refer to section 170.2(c)4O for exceptions

Prescriptive Approach for Space Conditioning Systems

Table 170.2-I

Energy Recovery Requirements By Climate Zone And Percent Outdoor Air at Full Design Airflow (<8,000 Hours / Year)

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

Prescriptive Approach for Space Conditioning Systems

Table 170.2-J

Energy Recovery Requirements By Climate Zone And Percent Outdoor Air at Full Design Airflow (≥8,000 Hours / Year)

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

Subchapter – 12
Multifamily Buildings

Additions, Alterations, and Repairs §§ 180.1, 180.2

Restructuring of Multifamily Addition Alteration Requirements

2019 Sections with Multifamily	2022 Newly Created Sections
§141.0: High-rise residential • Additions, alterations, and repairs §150.2: Low-rise residential • Additions and alterations to existing low-rise residential buildings	§§180.0-180.4: Multifamily buildings • Additions, alterations, and repairs to existing multifamily buildings

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.1

Additions

- **Definition:** Addition is any change to a building that increases conditioned floor area and conditioned volume. 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.
- **Prescriptive Approach**: Newly installed space-conditioning systems installed in an addition must meet the applicable prescriptive requirements of §170.2 and all applicable mandatory requirements as discussed in previous sections.
- **Performance Approach**: All applicable mandatory measures must be achieved or exceeded; Either the addition alone can comply or the existing plus addition or the existing plus addition plus alteration approach can be taken.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.1

Exceptions

- When expanding existing systems, existing systems and equipment need not comply with current requirements except for duct sealing.
- Existing duct system and ducts must meet §180.2(b)2Ai,ii when any length of ducts extended from existing duct system as addition.
- New or replacement space heating system serving additions may be a heat pump or gas for dwelling unit.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.1(a)2

Additions - Prescriptive and Performance Approach

Mechanical Ventilation for indoor Air quality

- Whole-Dwelling Unit Mechanical Ventilation
  - No requirements for additions 1,000 ft² or less
  - No requirements for Junior ADUs that are additions to an existing building

Local Mechanical Exhaust

- Additions to existing buildings shall comply with all applicable requirements specified in 160.2(b)2Avi and 160.2(b)2B.

HERS requirements

- 3 habitable stories or less per Residential Appendices
- 4 or more habitable stories per Nonresidential Appendices NA1 and NA2

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Ai – Dwelling Units

Alterations – Prescriptive approach

Space conditioning systems

- Entirely new or complete replacement space-conditioning systems
    - Altered components and new installed equipment that serves the alteration must meet applicable requirements within:
        - §110.0 – 110.9
        - §160.2(a)1, §160.3(a)1, §160.3(b)1-3,5-6, §160.3(c)1
        - §170.2(c)3B
        - §180.2(b)2Av and Table 180.2-C
- Systems include but not limited to condensing unit cooling or heating coil, and air handler for split systems; or complete replacement of a packaged unit; plus entirely new or replacement duct system.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Aii – Dwelling Units

Alterations – Prescriptive approach

Space conditioning systems

- Altered duct systems- duct sealing
  - New or Replaced ducts > 25ft
    - Duct insulation
      - R-6 in Climate Zones 3,5 through 7
      - R-8 for Climate Zones 1,2,4,8 through 16
  - Must meet Section 180.2(b)2AiiaI or 180.2(b)2AiiaII

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Aiial – Dwelling Units

Alterations - Prescriptive Approach

Space conditioning systems

- Entirely new or complete replacement duct system
  - 75% or more of the ducts are replaced
    - Duct Leakage testing is required in All CZs
    - Total Leakage ≤ 12% of total air handler airflow; or
    - Duct system leakage to the outside ≤ 6% of total air handler airflow

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Aiiall – Dwelling Units

Alterations - Prescriptive Approach

Space conditioning systems

- Extension of an existing duct system (> 25 feet)
  - Duct leakage allowance
    - Leakage ≤ 15% of total air handler airflow; or
    - Leakage to outside ≤ 10% of total air handler airflow
    - If leakage requirements not met, visual inspection and smoke test by certified HERS Rater required to verify all accessible leaks are sealed.
  - Exception
    - Existing duct systems constructed, insulated or sealed with asbestos.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Aiii – Dwelling Unit

Alterations - Prescriptive Approach

Space conditioning systems

- Altered space conditioning system – duct sealing
    - Duct leakage testing applies when replacing the air handler, condensing unit of a split system air conditioner or heat pump, or cooling or heating coil.
        - Duct leakage testing is required in all climate zones
            - Leakage ≤ 15% of total air handler airflow per RA3.1.4.3.1; or
            - Leakage ≤ 10% to outside per RA3.1.4.3.4; or
            - All accessible leaks are sealed and verified by visual inspection and a smoke test by certified HERS Rater.
            - Buildings with 4 or more habitable stories are exempt from HERS verification; installing contractor conducts the testing

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Aiv – Dwelling Unit

Alterations - Prescriptive Approach

Space conditioning systems

- Altered space conditioning system – mechanical cooling
  - Requirements when installing or replacing a refrigerant-containing component:
    - Setback thermostat must be installed
    - Airflow and Refrigerant charge is required in CZs 2, and 8 – 15
      - Small duct high velocity systems with nominal cooling capacity ≥ 250 cfm per ton, HERS tested; or
      - All other systems with nominal cooling capacity ≥ 300 cfm per ton, HERS tested
      - Buildings with 4 or more habitable stories are exempt from HERS verification; installing contractor conducts the testing

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Av – Dwelling Units

Alterations - Prescriptive Approach

Space conditioning systems

- Altered space heating system
  - No electric resistance as the primary heat source.
- Exceptions
  - If existing equipment is electric resistance either
    - Non-ducted systems
    - Ducted systems only replacing heating
    - Climate zones 6,7,8 or 15

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Bi – Common Use Areas

Alterations - Prescriptive Requirements

New or replacement space-conditioning systems or components

- New Systems or Components except ducts must meet the requirements of section §170.2(c)1,2,4 applicable to the systems or components being altered
- Additional fan power allowances available per Table 180.2-D

EXCEPTIONS:

- New or replacement space conditioning systems or components
- Replacements of electric resistance heaters with equivalent or smaller heaters for high rise residential units or when natural gas is not available.
- Single package air-cooled unitary AC and heat pumps with cooling capacity < 54,000 Btu/h

Additions, Alterations, and Repairs for Space Conditioning Systems

Table 180.2-D

TABLE 180.2-D Fan Power Limitation Pressure Drop Adjustment

Airflow	Multi-Zone VAV Systems[1] ≤5,000 cfm	Multi-Zone VAV Systems[1] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[1] >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Supply Fan System Additional Allowance	0.135	0.114	0.105	0.139	0.12	0.107
Supply Fan System Additional Allowance In Unit with Adapter Curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/ Relief/ Return/ Transfer Fan System Additional Allowance	0.07	0.061	0.054	0.07	0.062	0.055
Exhaust/ Relief/ Return/ Transfer Fan System Additional Allowance In Unit with Adapter Curb	0.016	0.017	0.022	0.000	0.000	0.000

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Bii – Common Use Areas

Alterations - Prescriptive Requirements

Altered Duct Systems

- Entirely new or complete replacement duct system with at least 75% new duct material
    - Up to 25% may be reused parts from existing system
    - Leak tested per section 160.2(c)2H

OR

- Extended ducts to existing duct system must be sealed and seal rate not more than 15% of nominal air handler airflow tested per NA1 and NA2. The combined new system also meets all the following criteria:
    - Provides conditioned air to occupiable space for constant volume, single zone, space-conditioning system
    - Serves less than 5,000 sq ft of conditioned floor area
    - Combined surface area of ducts in specific areas is not less than 25% of the total surface area of entire duct system.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(b)2Bii – Common Use Areas

Alterations - Prescriptive Requirements

Altered Space-Conditioning Systems

- When replacing the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil:
  - An Occupant Controlled Smart Thermostat (OCST) that complies with Reference Joint Appendix JA5 must be installed; and
  - The connected duct system to new or replaced space-conditioning system shall be sealed.

EXCEPTIONS:

- Buildings altered so that the duct system no longer meets the criteria of Section 170.2(c)4Ji.
- Ducts documented to have been previously tested by a HERS Rater.
- Existing duct systems constructed, insulated or sealed with asbestos.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.2(c)

Alterations - Performance Approach

- All applicable mandatory measures for the new equipment must be met.
- For altered components, the standard design is based on either the existing conditions or the prescriptive requirements, which ever has higher efficiency.
- For components not being altered, the standard design is based on the existing conditions.
- The proposed design must be based on the actual values of the altered components.

Additions, Alterations, and Repairs for Space Conditioning Systems

§180.3

Repairs

- A repair is the reconstruction or renewal for the purpose of maintenance of a component, system, or equipment of an existing building.
- Replacement of any component, system, or equipment for which there are requirements in the Standards is considered an alteration and not a repair.
- Repairs do not have requirements under Part 6 except they shall not increase the preexisting energy consumption of the repaired component, system, or equipment.

Multifamily buildings

Enforcement: Compliance Forms

Enforcement – Prescriptive Compliance

Permit and Plans Review

- LMCC, LMCI, LMCV Certificates:
  - Used for Low-rise Multifamily
- NRCC, NRCI, NRCA, NRCV Certificates:
  - Used for High-rise Multifamily

Enforcement – Prescriptive Compliance

Permit and Plans Review

- LMCC-MCH-01-E Certificate of Compliance:
  - Verify Table **A. GENERAL INFORMATION** is correct

CALIFORNIA ENERGY COMMISSION MECHANICAL SYSTEMS 2022-CEC-LMCC-MCH-01-E

NOT REGISTERED - CAN BE USED FOR SUBMISSION TO BUILDING DEPARTMENTS PRIOR TO DECEMBER 31, 2023

Project Details

Field Name	Data Entry	Field Name	Data Entry
Project Name:		Enforcement Agency:	
Dwelling Address:		Permit Number:	
City and Zip Code:		Date Permit Issued:	

Table A. Project Information

Complete one Certificate of Compliance LMCC-MCH-01-E for each building on the project site.

Field	Field Name	Data Entry
01	Project Location (city)	
02	Climate Zone (1-16)	
03	Occupancy Type within Project (See Note 1)	☐ Office ☐ Warehouse ☐ School ☐ Low-Rise Residential ☐ Healthcare Facility ☐ Theater ☐ Auditorium ☐ Relocatable School Building ☐ Data Center ☐ Classroom ☐ Grocery Store ☐ Restaurant/Commercial Kitchen ☐ All Others ☐ Retail ☐ Hotel/Motel ☐ Support Areas ☐ Commercial ☐ Parking Garage ☐ Sports Arena ☐ Library ☐ Medical Clinic ☐ Convention Center ☐ Gymnasium ☐ Religious Facility ☐ Financial Institution
04	Total Conditioned Floor Area (square feet)	
05	Total Unconditioned Floor Area (square feet)	
06	Number of Stories (Habitable above grade)	

Enforcement – Prescriptive Compliance

Permit and Plans Review

- LMCC-MCH-01-E Certificate of Compliance:
  - Verify Table **B. PROJECT SCOPE** on form matches scope of work on plans

Table B: Project Scope
Check all that apply.

Field	Field Name	Data Entry
01	Air System(s)	☐ Heating Air System ☐ Cooling Air System
	Mechanical Controls	☐ Mechanical Controls (existing to remain, altered or new)
02	Water System Components	☐ Water Economizer ☐ Pumps ☐ System Piping ☐ Cooling Towers ☐ Chillers ☐ Boilers
03	Dry System Components	☐ Air Economizer ☐ Electric Resistance Heat ☐ Fan Systems ☐ Ductwork (existing to remain, altered or new) ☐ Ventilation ☐ Zonal Systems/ Terminal Boxes

Enforcement – Prescriptive Compliance

Permit and Plans Review

- LMCC-MCH-01-E Certificate of Compliance:
  - Verify Table **C. COMPLIANCE RESULTS** shows **COMPLIES** when forms filled using VCA.

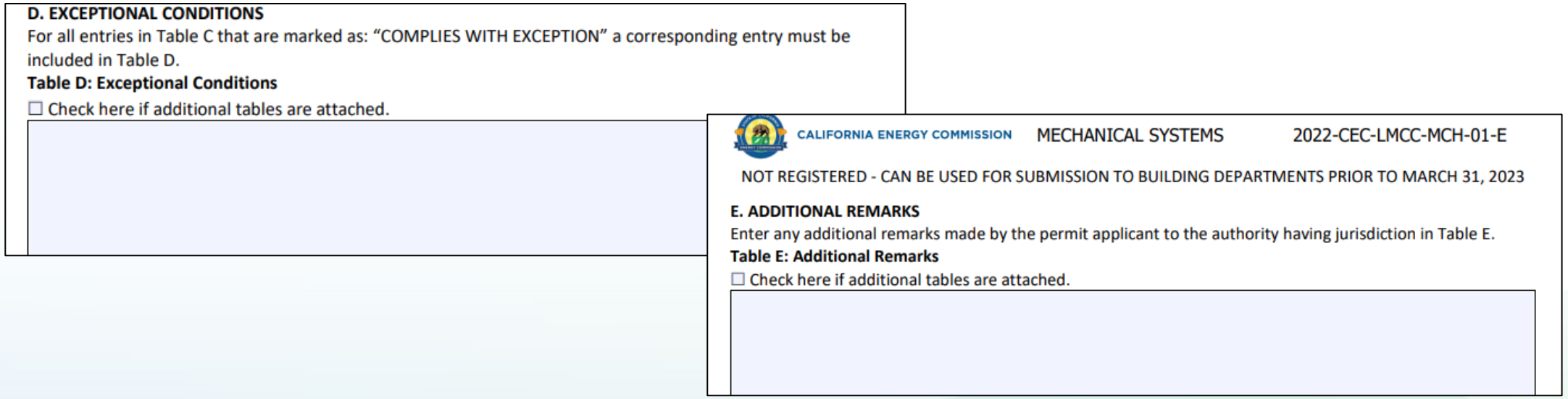
Table C: Compliance Results

Field	Field Name	Energy Code Sections	Section Table	Compliance Status
01	System Summary	110.1, 110.2, 140.4, 170.2(c)	F	
02	Pumps	140.4(k), 170.2(c)4I	G	
03	Fans Economizers	140.4(c), 140.4(e), 170.2(c)	H	
04	System Controls	110.2, 120.2, 140.4(f), 170.2(c)	I	
05	Ventilation	120.1, 160.2	J	
06	Terminal Box Controls	140.4(d), 170.2(c)4B	K	
07	Distribution	120.3, 120.4, 160.2, 160.3	L	
08	Cooling Towers	110.2(e)2	M	

Enforcement – Prescriptive Compliance

Permit and Plans Review

- LMCC-MCH-01-E Certificate of Compliance:
  - Table **D. EXCPTIONAL CONDITIONS** and Table **E. ADDITIONAL REMARKS** are information tables to assist the AHJ at permit and plan check



D. EXCEPTIONAL CONDITIONS

For all entries in Table C that are marked as: "COMPLIES WITH EXCEPTION" a corresponding entry must be included in Table D.

Table D: Exceptional Conditions

☐ Check here if additional tables are attached.

CALIFORNIA ENERGY COMMISSION MECHANICAL SYSTEMS 2022-CEC-LMCC-MCH-01-E

NOT REGISTERED - CAN BE USED FOR SUBMISSION TO BUILDING DEPARTMENTS PRIOR TO MARCH 31, 2023

E. ADDITIONAL REMARKS

Enter any additional remarks made by the permit applicant to the authority having jurisdiction in Table E.

Table E: Additional Remarks

☐ Check here if additional tables are attached.

Enforcement – Prescriptive Compliance

Permit and Plans Review

- LMCC-MCH-01-E Certificate of Compliance:
  - Verify mechanical plans match the equipment Tables F- M

F. HVAC SYSTEMS SUMMARY (DRY AND WET SYSTEMS)

This section is used to document the mechanical equipment compliance with the Energy Code sections 110.1, 110.2, 140.4(a), 140.4(b), 140.4(k) (or 141.0(b)2), 170.2(c)1, 170.2(c)3, and 180.2(b)2 as they are applicable to the project (Table B).

Table F-1: HVAC System Summary

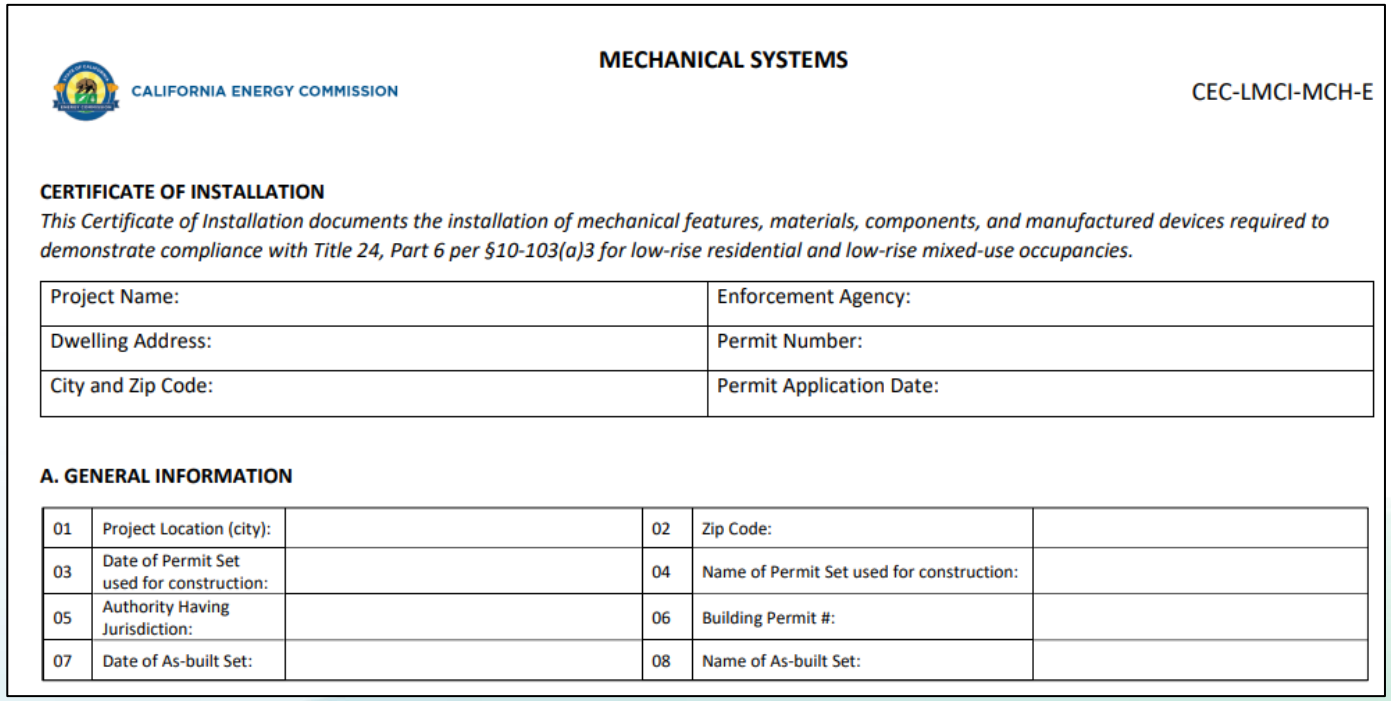
☐ Check here if additional tables are attached.

Field	Field Name	HVAC-1	HVAC-2	HVAC-3
01	Names/Tag			
02	Quantity			
03	System Serving (See Note 1)			
04	System Status (See Note 2)			
05	Space Type (See Note 3)			

Enforcement – Prescriptive Compliance

Field Inspection

- LMCI-MCH-E Certificate of Installation:
  - Verify LMCI table **A. GENERAL INFORMATION** matches plans and LMCC-MCH-E information



CALIFORNIA ENERGY COMMISSION

MECHANICAL SYSTEMS

CEC-LMCI-MCH-E

CERTIFICATE OF INSTALLATION

This Certificate of Installation documents the installation of mechanical features, materials, components, and manufactured devices required to demonstrate compliance with Title 24, Part 6 per §10-103(a)3 for low-rise residential and low-rise mixed-use occupancies.

Project Name:	Enforcement Agency:
Dwelling Address:	Permit Number:
City and Zip Code:	Permit Application Date:

A. GENERAL INFORMATION

01	Project Location (city):		02	Zip Code:	
03	Date of Permit Set used for construction:		04	Name of Permit Set used for construction:	
05	Authority Having Jurisdiction:		06	Building Permit #:	
07	Date of As-built Set:		08	Name of As-built Set:	

Enforcement – Prescriptive Compliance

Field Inspection

- LMCI-MCH-E Certificate of Installation:
  - Verify information provided in **Table B. INSTALLER SCOPE** and if the installed features match exactly with LMCC-MCH

B. INSTALLER SCOPE

This table indicates construction systems and materials documented on this Certificate of Installation.

		01					
□	Dry System (Airside) Equipment	□	Ventilation	□	System Controls	□	Ductwork
□	Boiler	□	Pumps	□	Terminal Box Controls	□	Piping
□	Chiller	□	Fans and Air Economizers	□	Heat Rejection Equipment (cooling towers, condensers, waterside economizers)	□	Electric Resistance Heating

C. COMPLIANCE RESULTS

This table indicates whether the as-built conditions documented in this form are equal or better than what was documented on the permitted Certificate of Compliance. If the installation is not equal or better, Section 10-103(a)2B requires the Certificate of Compliance form to be revised accordingly to demonstrate compliance.

01	INSTALLED FEATURES EXACTLY MATCH DESIGN ON PERMITTED CERTIFICATE OF COMPLIANCE
	Documented as-built conditions should be verified by inspector from Authority Having Jurisdiction to comply.

Documented as-built conditions should be verified by inspector from Authority Having Jurisdiction to comply.

The Certificate of Compliance should be revised to confirm as-built conditions comply and this Certificate of Installation updated accordingly.

Enforcement – Prescriptive Compliance

Field Inspection

- LMCI-MCH-E Certificate of Installation:
  - Verify installation details match with Table B and the as-built conditions documented by the installer/document author.

F. INSTALLATION DETAILS

The following tables indicate performance requirements as documented on the permitted Certificate of Compliance for all systems and components included in Table B. Installer Scope. Also indicated are the as-built conditions documented by the installer/ documentation author.

Dry System Equipment Schedule

01		02	03	04	05	06	07	08	09	10	11	12	13
Name or Item Tag		Model #	Equipment Type	Heating Mode				Cooling Mode					Equipment Compliance
				Rated Output (kBtu/h)	Supplemental Heating Output (kBtu/h)	Efficiency	Efficiency Unit	Rated Output (kBtu/h)	Efficiency	Efficiency Unit	Efficiency	Efficiency Unit	
Per C of C													
As-built Conditions													

Enforcement – Prescriptive Compliance

Field Inspection

- LMCC-MCH-E Certificate of Compliance:
  - Check pass or fail in **Table N Declaration of Required Certificates of Installation** to verify NRCI-MCH-01 completion.

MECHANICAL SYSTEMS

CALIFORNIA ENERGY COMMISSION

CEC-NRCC-MCH-E

N. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Selections have been made based on information provided in previous tables of this document. If any selection needs to be changed, please explain why in Table E. Additional Remarks. These documents must be provided to the building inspector during construction and can be found online at https://www.energy.ca.gov/title24/2022standards/2022_compliance_documents/Nonresidential_Documents/NRCI/

YES	NO	Form/Title	Field Inspector	
			Pass	Fail
●	❍	NRCI-MCH-01-E - Must be submitted for all buildings.	☐	☐
●	❍	2022 NRCI-MCH-20-F Duct Leakage Diagnostic Test	☐	☐
●	❍	2022 NRCI-MCH-22-F Fan Efficacy	☐	☐
●	❍	2022-NRCI-MCH-23-F Airflow Rate	☐	☐
●	❍	2022-NRCI-MCH-25-F Refrigerant Charge Verification	☐	☐

Enforcement – Prescriptive Compliance

Field Inspection

- LMCC-MCH-01-E Certificate of Compliance:
  - Review Table O and Table P to verify all acceptance and verification testing is complete. There should be an NRCA and LMCV form for each required test.

O. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Table O shows the Certificates of Acceptance that must be completed by an Acceptance Test Technician (ATT) with a valid and current certification from an Energy Commission approve Acceptance Test Technician Certification Provider (ATTCP). The determination of requiring each certificate is included in Table O. The number of required tests must be set to zero (for none) or any whole number. The Name/Tag of the installation to be tested must also be identified, matching the number of tests required. For example, if three NRCA-MCH-04-A duct tests are required, then the table must list three installation name/tags.

Table O: Required Certificates of Acceptance

Field	Certificate of Installation	Trigger	No. Req.	List each Name/Tag Triggering the Certificate
01	NRCA-MCH-02-A Outdoor Air	Required if Table B, Field 16 is selected		
02	NRCA-MCH-03-A Constant Volume	Required if Constant Volume Single Zone HVAC Systems are included in the scope		
03	NRCA-MCH-04-A Air Distribution Duct Leakage	Required if Table B, Field 16 is selected and Table L-2, Fields 3, 4, and 5 are set to "Yes"		

Table P: Required Certificates of Verification

Field	Certificate of Verification	Trigger	No. Req.	List each Name/Tag Triggering the Certificate	AHJ Field Inspector
01	LMCV-MCH-04-H Duct Leakage Test	(See Note 1)			☐ Pass ☐ Fail
02	LMCV-MCH-24-H Enclosure Air Leakage Worksheet	(See Note 2)			☐ Pass ☐ Fail
03	LMCV-MCH-27-H Indoor Air Quality and Mechanical Ventilation	Required if Table J-3, Field 8 is set to "Bathroom IAQ & Vent."			☐ Pass ☐ Fail
04	LMCV-MCH-32-H Local Mechanical Exhaust	Required if Table J-3, Field 8 is not set to "N/A"			☐ Pass ☐ Fail

Notes:

Enforcement – Prescriptive Compliance

LMCI-MCH-E Certificates of Installation:

- LMCI-MCH-01 Space Conditioning Systems
- LMCI-MCH-20 Duct Leakage Diagnostic Test
- LMCI-MCH-21 Duct Location
- LMCI-MCH-22 Space Conditioning System Fan Efficacy
- LMCI-MCH-25 Refrigerant Charge Verification
- LMCI-MCH-26 Rated space conditioning system equipment verification
- LMCI-MCH-27 IAQ and Mechanical Ventilation
- LMCI-MCH-28 Return Duct design and filter device sizing
- LMCI-MCH-29 Duct surface area reduction
- LMCI-MCH-32 Local Mechanical Exhaust
- LMCI-MCH-33 Variable capacity Heat pump compliance credit

Enforcement – Prescriptive Compliance

NRCI-MCH-E Certificates of Installation:

- NRCI-MCH-20 Duct Leakage Diagnostic Test
- NRCI-MCH-22 Space Conditioning System Fan Efficacy
- NRCI-MCH-23 Space Conditioning System Airflow Rate
- NRCI-MCH-25 Refrigerant Charge Verification

Enforcement – Prescriptive Compliance

NRCA-MCH-E Certificates of Acceptance:

- NRCA-MCH-02-A Outdoor Air
- NRCA-MCH-03-A HVAC and Heat Pumps – Cont Volume Single Zone HVAC
- NRCA-MCH-04-A Duct Leakage
- NRCA-MCH-05-A Economizer DOAS HRV ERV
- NRCA-MCH-06-A Demand Control Ventilation
- NRCA-MCH-07-A Supply Fan Variable Flow Controls
- NRCA-MCH-08-A Valve Leakage Test
- NRCA-MCH-09-A Water Temp Reset
- NRCA-MCH-10-A Hydronic System Variable Flow Control Acceptance
- NRCA-MCH-11 Automatic Demand Shed Controls

Enforcement – Prescriptive Compliance

NRCA-MCH-E Certificates of Acceptance: Continued

- NRCA-MCH-12 FDD - Packaged Units
- NRCA-MCH-13-A AHU and Zone Terminal FDD
- NRCA-MCH-14-A Energy Storage for A/C – Distributed Energy Storage DX AX Systems
- NRCA-MCH-15-A Thermal Energy Storage
- NRCA-MCH-16-A Supply Air Temperature Reset Controls
- NRCA-MCH-17-A Condenser Water Temperature Reset Controls
- NRCA-MCH-18 EMS System Acceptance
- NRCA-MCH-19-A Occupied Standby
- NRCA-MCH-20 MF Dwelling Ventilation
- NRCA-MCH-21 MF Envelope Leakage
- NRCA-MCH-22 System Duct Leakage
- NRCA-MCH-22 HRV-ERV Verification
- NRCA-PRC-01-F Compressed Air System Controls

Enforcement – Prescriptive Compliance

LMCV-MCH-E Certificates of Verification:

- LMCV-MCH-20 Duct Leakage Diagnostic Test
- LMCV-MCH-21 Duct Location
- LMCV-MCH-22 Fan Efficacy
- LMCV-MCH-24 Building Air Leakage Diagnostic Test
- LMCV-MCH-25 Refrigerant Charge
- LMCV-MCH-27 Indoor Air Quality and Mechanical Ventilation
- LMCV-MCH-28 Return duct design and filter device sizing
- LMCV-MCH-32 Local Mechanical Exhaust
- LMCV-MCH-33 Variable capacity heat pump compliance credit

Enforcement – Prescriptive Compliance

NRCV-MCH-E Certificates of Verification:

- NRCV-MCH-04-H Duct Leakage Diagnostic Test
- NRCV-MCH-24 Building Air Leakage Diagnostic Test
- NRCV-MCH-27 Indoor Air Quality and Mechanical Ventilation
- NRCV-MCH-32 Local Mechanical Exhaust

Resources

Online Resource Center

www.energy.ca.gov/orc

Handouts

- Fact sheets
- Guides

Tools

- Checklists
- Blueprint newsletter

Training

- Presentations
- Videos

Links

- Internal resources
- External resources

2022 Energy Code Handouts

- Solar PV and battery fact sheets coming soon
- Covered processes fact sheets
- Envelope fact sheets
- Summary of significant changes
- Summary of mandatory requirements
- Download from the Online Resource Center

HERS Program

HERS Program information

CalCERTS, Inc. HERS PROVIDER	CHEERS
Newly constructed buildings	Newly constructed buildings
Additions	Additions
Alterations of residential and nonresidential buildings	Alterations of residential and nonresidential buildings
California whole-house home energy ratings	
HERS building performance contractors	

ATTCP Program

ATTCP Program information

Mechanical Systems

- California State Pipe Trades Council (CSPTC)
- National Energy Management Institute Committee (NEMIC)
- National Environmental Balancing Bureau (NEBB)
- Refrigeration Service Engineers Society (RSES)

a. NEMIC Logo (Background Watermark on NEMIC Acceptance Forms)

NEMIC
NATIONAL ENERGY MANAGEMENT INSTITUTE COMMITTEE

b. ICB/TABB Logo (Lower Right-Hand Corner on NEMIC Acceptance Forms)

ICB/TABB
INTERNATIONAL CERTIFICATION BOARD
TESTING, ADJUSTING AND BALANCING BUREAU
THE PROFESSIONAL'S CHOICE

NEBB

RSES
The HVACR Training Authority

Title 24 Acceptance Test Technician Certification Provider (ATTCP) Program

Blueprint Newsletter

Energy Code quarterly newsletter

- Updates
- Clarifications
- Frequently asked questions

Issue 138 | April - June 2022

BLUEPRINT

CALIFORNIA ENERGY COMMISSION

EFFICIENCY DIVISION

IN THIS ISSUE

- 2022 Energy Code: Multifamily Summary
- 2022 Energy Code: Compliance Software
- 2019 Energy Code: HERS Verifications
- Q&A
  - Solar PV for Multifamily Buildings
  - Multifamily Water Heating
  - Multifamily Common Use Areas

For additional help with the Energy Code see Energy Code Ace's **online offerings** of trainings, tools, and resources.

2022 Energy Code: Multifamily Summary

The 2022 Building Energy Efficiency Standards (Energy Code) reorganizes low-rise (three or fewer habitable stories) and high-rise (four or more habitable stories) multifamily buildings into one building type, updates the multifamily buildings definition in § 100.1, and moves all requirements for multifamily buildings to §§ 160.0-180.4. This and other significant changes include:

Mandatory Requirements

- Updates minimum efficiencies for HVAC equipment; adds minimum efficiency requirements for dedicated outdoor air systems (DOAS), heat pump, and heat recovery chiller packages. § 110.2
- Changes demand responsive lighting controls trigger to 4,000 watts or more; adds requirements for controlled receptacles. §§ 110.12, 160.5(b)4E
- Unifies envelope insulation, vapor retarder, and fenestration requirements. § 160.1
- For dwelling units
  - Adds requirements for central fan integrated ventilation systems requiring a motorized controlled damper, damper controls, and variable ventilation. § 160.2(b)2Aii
  - Requires vented kitchen range hoods ventilation rates or capture efficiencies based on conditioned floor area and fuel type per Tables 160.2-E, F, G. § 160.2(b)2Avic2
  - Requires a HERS-verified maximum fan efficacy of 1.0 Watts per cfm for heat recovery ventilation (HRV) and energy recovery ventilation (ERV) systems. § 160.2(b)2Biii
  - Adds mechanical acceptance testing requirements. § 160.3(d)2
  - Adds electric-ready requirements when gas equipment is installed for space heating, cooking, and clothes dryers. § 160.9(a-c)

1

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  - Appliances
  - Blueprint
  - Building Standards
- Respond to confirmation email

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Monday through Friday

- 8:00 a.m. to 12:00 p.m.
- 1:00 p.m. to 4:30 p.m.

Call

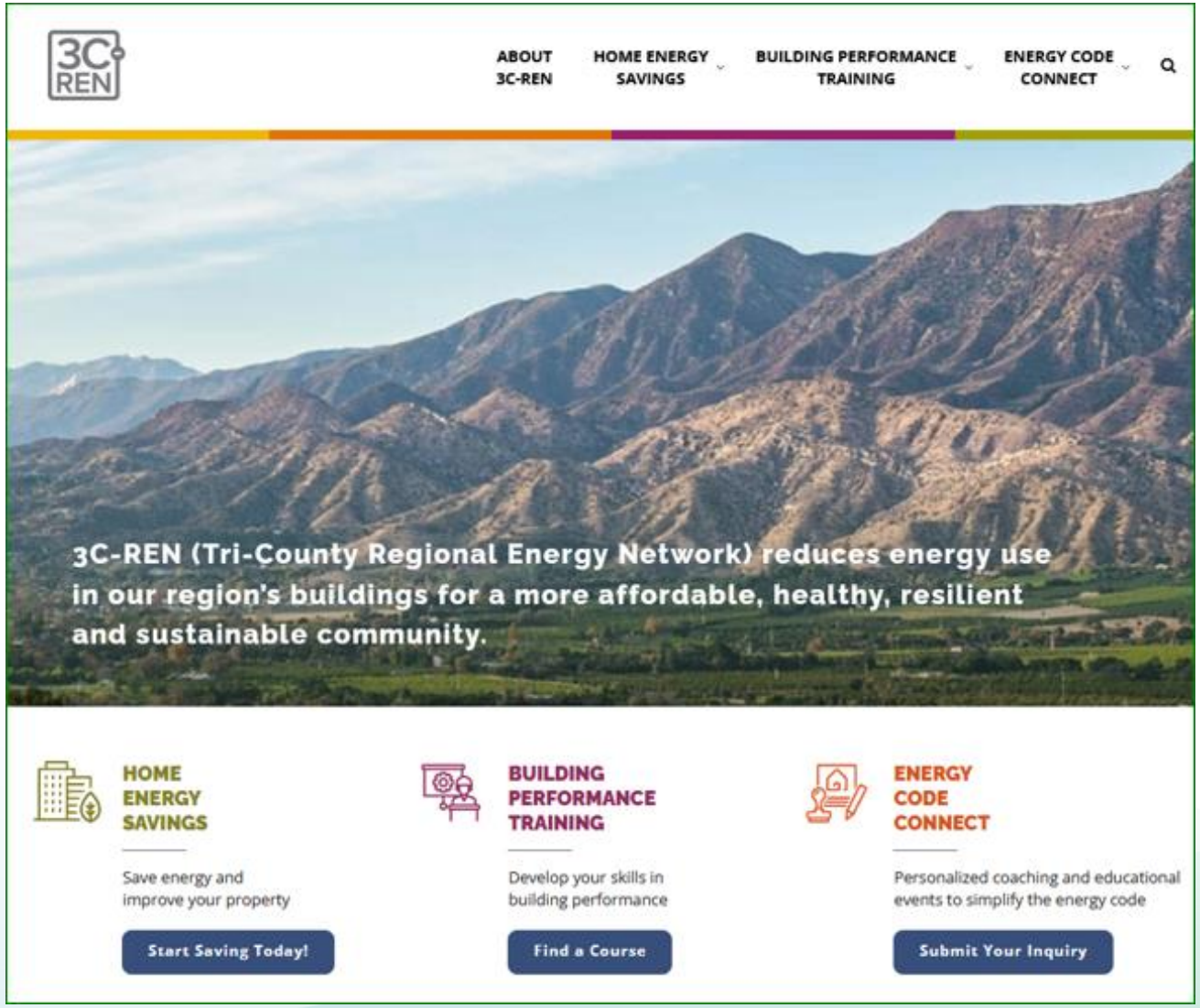
- 800-772-3300 in CA
- 916-654-5106 outside CA

Email

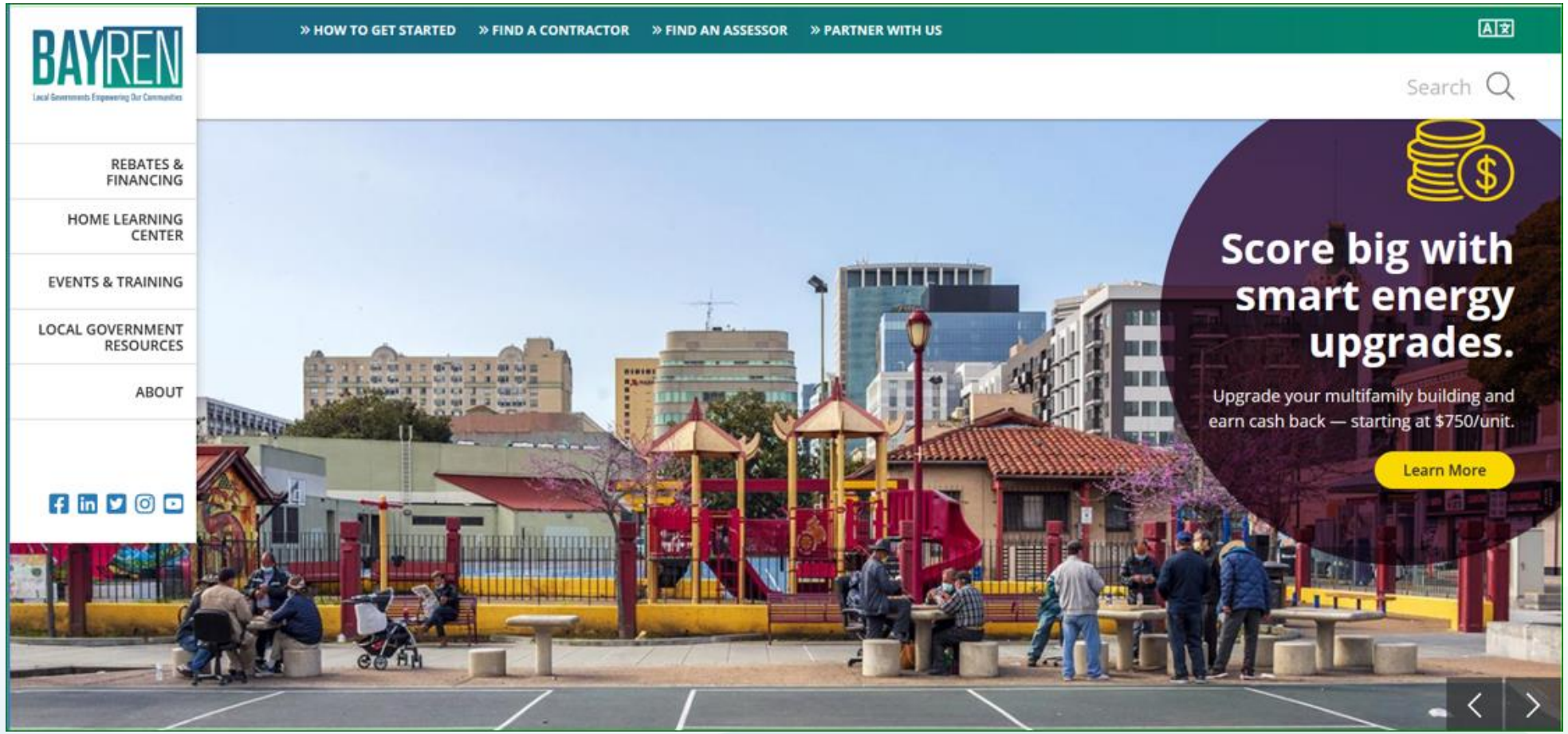
- Title24@energy.ca.gov

Other Available Resources – Energy Code Ace

Other Available Resources – 3C-REN



Other Available Resources – BayREN



Other Available Resources –
Inland Regional Energy Network (I-REN)

iren.gov
info@iren.gov

Codes and Standards

Training and Education Program

- Free ICC-approved training sessions for 2022 Energy Code (Title 24, Part 6) requirements → www.iren.gov/161/CS-Trainings
- Requested training courses can also be scheduled

C&S Technical Support Program

Request Free Technical Assistance from Local Code Experts—Reach Code Development, Permit Guides, Etc. → www.iren.gov/162/CS-Technical-Support

Ask a Code Mentor an Energy Code Question

Submit queries online and receive a personalized response addressed by energy code experts within two business days! → www.iren.gov/162/CS-Technical-Support

I·REN = CVAG

INLAND REGIONAL ENERGY NETWORK

Coachella Valley Association of Governments (CVAG)
San Bernardino Council of Governments (SBCOG)
Western Riverside Council of Governments (WRCOG)

* Not affiliated with, or endorsed by, the CEC

Thank you