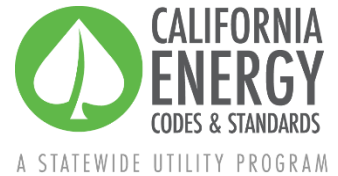


# Proposal Summary



## 2022 California Energy Code (Title 24, Part 6)

### Nonresidential HVAC Controls: HVAC Controls

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### Introduction

The document summarizes a proposed revision to the California Energy Code (Title 24, Part 6) that was first discussed during two utility-sponsored stakeholder meetings – one on October 15, 2019 and the second on November 5, 2019. The Statewide Utility Codes and Standards Enhancement (CASE) Team has updated this language based on initial feedback from stakeholders and is interested in additional feedback on our current version.

### Measure Description

Below is a quick description of the four measure and their submeasures:

#### (1) **Dedicated Outside Air Systems**

- Allow DOAS units have ventilation heat recovery with bypass (free cooling) to not require an economizer for space conditioning cooling systems.
- Require DOAS units to have modulating fan speed control capabilities.
- Set DOAS unit fan power limits for fans under 5hp.
- Require space heating and cooling systems to cycle off when thermostats are meet.
- Limit DX-DOAS reheat temperatures when in cooling mode.

#### (2) **Exhaust Air Heat Recovery**

- Adds new prescriptive requirements for Exhaust Air Heat Recovery based on air handler flow rates, occupancy, and climate zone.

#### (3) **VAV Deadband Airflow** (previously “VAV Minimum Airflow Rates”)

- Prescriptive adjustment: removes prescriptive minimum airflow requirements to rely only on the mandatory requirements when in deadband operation

#### (4) **Expand Economizer Requirements** (previously “Air Efficiency”)

- Economizing on Smaller units (Prescriptive) which will lower the threshold for requiring an economizer to smaller-sized units
- Expand Integrated Economizing (Prescriptive) which specifies lower minimum compressor displacement requirements in order to enable additional economizing hours at lower loads

## Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions). Expected sections or tables of the proposed code (but not specific changes at this time) are highlighted in yellow.

### SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

**Dedicated Outdoor Air Systems (DOAS)** – An HVAC system which uses separate equipment to condition, temper, or filter all the outdoor air brought into a building for ventilation and delivers it to each space, either directly or in conjunction with local or central HVAC units serving those same spaces used to maintain space temperature.

**DX-Dedicated Outdoor Air System units (DX-DOAS units)**- a type of air-cooled, water-cooled, or water-source factory assembled product that dehumidifies 100 percent outdoor air to a low dew point and includes reheat that is capable of controlling the supply dry-bulb temperature of the dehumidified air to the designed supply air temperature. This conditioned outdoor air is then delivered directly or indirectly to the conditioned spaces. It may precondition outdoor air by containing an enthalpy wheel, sensible wheel, desiccant wheel, plate heat exchanger, heat pipes, or other heat or mass transfer apparatus.

### Section 120.2 – Require Controls for Space-Conditioning Systems

- (i) **Economizer Fault Detection and Diagnostics (FDD)**. All newly installed air handlers with a mechanical cooling capacity ~~greater than over 54,000 Btu/hr~~ 33,000 Btu/hr and an installed air economizer shall include a stand-alone or integrated Fault Detection and Diagnostics (FDD) system in accordance with Subsections 120.2(i)1 through 120.2(i)8.

### SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

**(d) Space-conditioning Zone Controls.** Each space-conditioning zone shall have controls designed in accordance with 1 or 2:

1. Each space-conditioning zone shall have controls that prevent:
  - A. Reheating; and
  - B. Recooling; and
  - C. Simultaneous provisions of heating and cooling to the same zone, such as mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled either by cooling equipment or by economizer systems; or
2. Zones served by VAV systems that are designed and controlled to reduce, to a minimum, the volume of reheated, re-cooled, or mixed air are allowed only if the controls meet all the following requirements:
  - A. For each zone with direct digital controls (DDC):
    - i. The volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:
      - a. 50 percent of the peak primary airflow; or
      - b. The design zone outdoor airflow rate as specified by Section 120.1(c)3.

- ii. The volume of primary air in the dead band shall not exceed ~~the larger of:~~
    - a. ~~20 percent of the peak primary airflow; or~~
    - b. ~~T~~ the design zone outdoor airflow rate as specified by Section 120.1(c)3.
  - iii. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95°F while the airflow is maintained at the dead band flow rate.
  - iv. The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.
- B. For each zone without DDC, the volume of primary air that is reheated, re-cooled, or mixed air supply shall not exceed the larger of the following:
- i. 30 percent of the peak primary airflow; or
  - ii. The design zone outdoor airflow rate as specified by Section 120.1(c)3.

**(e) Economizers**

1. Each cooling air handler that has a design total mechanical cooling capacity over ~~54,000 Btu/hr~~33,000 Btu/hr, or chilled-water cooling systems without a fan or that use induced airflow that has a cooling capacity greater than the systems listed in Table 140.4-C, shall include either:
  - A. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air; or
  - B. A water economizer capable of providing 100 percent of the expected system cooling load, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

**EXCEPTION 1 to Section 140.4(e)1:** Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

**EXCEPTION 2 to Section 140.4(e)1:** Where the use of outdoor air for cooling will affect other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building TDV energy use.

**EXCEPTION 3 to Section 140.4(e)1:** Systems serving high-rise residential living quarters and hotel/motel guest rooms.

**EXCEPTION 4 to Section 140.4(e)1:** Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE 140.4-D.

**EXCEPTION 5 to Section 140.4(e)1:** Fan systems primarily serving computer rooms. See Section 140.9(a) for computer room economizer requirements.

**EXCEPTION 6 to Section 140.4(e)1:** Systems designed to operate at 100 percent ~~outside~~ outdoor air at all times.

**EXCEPTION 7 to Section 140.4(e)1:** In buildings no greater than 150,000 sf or 5 stories in all Climate Zones where comfort cooling systems are decoupled from ventilation conditioning and a dedicated outdoor air system unit, serving the same spaces and meets or exceeds the requirements of 140.4 (p).

*TABLE 140.4-C CHILLED WATER SYSTEM COOLING CAPACITY*

Climate Zones	Total Building Chilled Water System Capacity, Minus Capacity of the Cooling units with Air Economizers	
	Building Water-Cooled Chilled Water System	Air-Cooled Chilled Water Systems or District Chilled Water Systems
15	≥ 960,000 Btu/h (280 kW)	≥ 1,250,000 Btu/h (365 kW)
1-14	≥720,000 Btu/h (210 kW)	≥940,000 Btu/h (275 kW)
16	≥1,320,000 Btu/h (385 kW)	≥1,720,000 Bu/h (505 kW)

TABLE 140.4-D ECONOMIZER TRADE-OFF TABLE FOR COOLING SYSTEMS

Climate Zone	Efficiency Improvement <sup>a</sup>	
1	70%	<sup>a</sup> If a unit is rated with an <u>annualized or part-load metric (PLV, IEER or SEER)</u> , then to eliminate the required <u>air or water</u> economizer, <u>only the applicable annualized or part-load</u> minimum cooling efficiency of the <u>HVAC</u> unit must be increased by the percentage shown. If the <u>HVAC</u> unit is only rated with a full load metric, <u>such as like</u> EER or COP cooling, then that metric must be increased by the percentage shown. <u>To determine the efficiency required to eliminate economizer, when the unit equipment efficiency is rated with an energy-input divided by work-output metric, the metric shall first be converted to COP prior to multiplying by the efficiency improvement percentage and then converted back to the rated metric.</u>
2	65%	
3	65%	
4	65%	
5	70%	
6	30%	
7	30%	
8	30%	
9	30%	
10	30%	
11	30%	
12	30%	
13	30%	
14	30%	
15	30%	
16	70%	

2. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then it shall be:
  - A. [no change]
  - B. [no change]
  - C. [no change]
  - D. [no change]
  - E. The space conditioning system shall include the following:
    - A. Unit controls shall have mechanical capacity controls interlocked with economizer controls such that the economizer is at 100 percent open position when mechanical cooling is on and does not begin to close until the leaving air temperature is less than 45°F.

- B. ~~Direct Expansion (DX) units greater than 65,000 Btu/hr that control the capacity of the mechanical cooling directly based on occupied space temperature shall have a minimum of 2 stages of mechanical cooling capacity.~~
- C. DX units ~~not within the scope of Section 140.4(e)2E,B~~ that include an air side economizer to meet 140.4(e) shall (i) comply with the requirements in TABLE 140.4-F, and (ii) shall have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means except at the lowest stage of mechanical cooling capacity.

*TABLE 140.4-F DIRECT EXPANSION (DX) UNIT REQUIREMENTS  
FOR COOLING STAGES AND COMPRESSOR DISPLACEMENT*

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement
<u>≥33,000 Btu/h and &lt;65,000 Btu/h</u>	<u>2 stages</u>	<u>≤ 50% full load</u>
<del>≥ 65,000 Btu/h and &lt; 240,000 Btu/h</del> <u>≥65,000 Btu/h and &lt;110,000 Btu/h</u>	3 stages	≤ 35% full load
<del>≥ 65,000 Btu/h and &lt; 240,000 Btu/h</del> <u>≥110,000 and &lt;240,000 Btu/h</u>	<del>3 stages</del> 4 stages	<del>≤ 35% full load</del> <u>≤ 25% full load</u>
≥ 240,000 Btu/h	4 stages	<del>≤ 25% full load</del> <u>≤ 15 % full load</u>

**(p) Dedicated Outdoor Air Systems (DOAS).**

For all buildings with occupancies as shown in Table 140.4 X which utilize a DOAS unit or ventilation duct work configuration to condition, temper, or filter 100 percent outdoor air brought into a building separate from local or central HVAC units maintaining space temperature shall meet the following criteria:

1. Ventilation energy recovery and airflow capacity capable of meeting or exceeding the following criteria:
  - a. Ventilation sensible energy recovery ratio with a minimum of 60 percent for cooling and heating at design conditions.
  - b. Energy recovery bypass or free cooling control capabilities to directly economize with ventilation air based on outdoor air limits specified in TABLE 140.4-E.
  - c. DOAS unit shall have a design airflow rate no less than 150 percent of outdoor airflow rate (Vz) to each zone.
  - d. DOAS unit controls capable to meet demand ventilation control requirements for all space types included in 120.1(d) 3, 4, 5.

**EXCEPTION 1 to Section 140.4(p)1:** Systems installed for sole purpose of providing makeup air for exhausting toxic, flammable, paint, or corrosive fumes or dust, dryer exhaust, or commercial kitchen hoods used for collecting and removing grease vapors and smoke.

**EXCEPTION 2 to Section 140.4(p)1:** Where all comfort cooling systems serving the same spaces as the DOAS unit meet or exceed the requirements of 140.4 (e)1 not utilizing Exception 7 to 140.4 (e)1.

2. Fan systems shall be capable of modulating fan speed control.
3. For DOAS fans with a motor nameplate hp less than 5 hp shall not exceed a total combined fan power of 1.0 W/cfm of outdoor air. Fans greater than 5 hp shall meet requirements of Section 140.4 (c).
4. Fans not required for ventilation shall cycle off and terminal unit primary cooling air shall be shut off when there is no call for heating or cooling in a zone.

**EXCEPTION 1 to Section 140.4(p)4:** Fans used for heating and/or cooling which operate at no more than 50 percent airflow when space temperatures are within the thermostat deadband and have proportional fan control such that at 50 percent air flow the power draw is no more than 30 percent of fan power at full flow.

5. DOAS systems with active cooling shall not use heating or heat recovery to warm the supply air above 60°F when representative building loads or outdoor air temperatures indicate the majority of zones require cooling.

6. TABLE 140.4 X – Occupancy Classifications for DOAS Criteria		
Occupancy Classifications	Inclusions	Exempted
A-1	All occupancies not specifically exempted	Television and radio studios
A-2	Casinos (gaming area)	All other A-2 occupancies
A-3	Lecture halls, community halls, exhibit halls, gymnasiums, courtrooms, libraries, places of religious worship	All other A-3 occupancies
A-4		All occupancies excluded
B	All occupancies not specifically exempted	Food processing establishments including commercial kitchens, restaurants, cafeterias; laboratories for testing and research; data processing facilities and telephone exchanges; air traffic control towers; animal hospitals, kennels, pounds; ambulatory care facilities.
F, H, I, R, S, U		All occupancies excluded
E, M	All occupancies included	

- a. Occupancy classification from the International Building Code Chapter 3.

**(o) Exhaust Air Heat Recovery**

Systems matching the criteria listed in either Table 140.4-[X]1 or Table 140.4[X]2 shall include an exhaust air heat recovery system. The system shall be configured to provide a minimum of 60 percent sensible energy recovery ratio and ability to bypass or control to directly provide ventilation economizing. The bypass or control shall include the ability to modulate the bypass to achieve a supply air setpoint or outdoor air temperature setpoint including an upper limit as specified in TABLE 140.4-E.

TABLE 140.4-[X]1: Energy Recovery Requirements (ventilating systems operating less than 8,000 hours per year)

California Climate Zone	% Outdoor Air at Full Design Airflow							
	≥10% and <20%	≥20% and <30%	≥30% and <40%	≥40% and <50%	≥50% and <60%	≥60% and <70%	≥70% and <80%	≥80%
	Design Supply Fan Airflow Rate, cfm							
CZ01 - CZ14	NR	NR	NR	NR	NR	NR	NR	NR
CZ15	NR	NR	NR	NR	≥26,000	≥12,000	≥5,000	≥4,000
CZ16	≥28,000	≥26,500	≥11,000	≥5,500	≥4,500	≥3,500	≥2,500	≥1,500

TABLE 140.4-[X]2: Energy Recovery Requirements (ventilating systems operating 8,000 hours or more per year)

California Climate Zone	% Outdoor Air at Full Design Airflow							
	≥10% and <20%	≥20% and <30%	≥30% and <40%	≥40% and <50%	≥50% and <60%	≥60% and <70%	≥70% and <80%	≥80%
	Design Supply Fan Airflow Rate, cfm							
CZ02 - CZ06	NR	NR	NR	NR	NR	NR	NR	NR
CZ01, CZ07 - CZ12, CZ15	NR	≥19,500	≥9,000	≥5,000	≥4,000	≥3,000	≥1,500	≥120
CZ13, CZ14	≥2,500	≥2,000	≥1,000	≥500	≥140	≥120	≥100	≥80
CZ16	≥200	≥130	≥100	≥80	≥70	≥60	≥50	≥40

**EXCEPTION 1** to Section 140.4(o): Systems meeting Section 140.9(c) Prescriptive Requirements for Laboratory and Factory Exhaust Systems

**EXCEPTION 2** to Section 140.4(o): Systems serving spaces that are not cooled and that are heated to less than 60°F.

**EXCEPTION 3** to Section 140.4(o): Where more than 60 percent of the outdoor air heating energy is provided from site-recovered energy in Climate Zone 16.

**EXCEPTION 4** to Section 140.4(o): Where the sum of the airflow rates exhausted and relieved within 20 feet of each other is less than 75 percent of the design outdoor airflow rate, excluding exhaust air that is either:

1. used for another energy recovery system.
2. not allowed by California Mechanical Code (Title 24, Part 4) for use in energy recovery systems with leakage potential, or
3. of Class 4 as defined in ASHRAE Standard 62.1.

**EXCEPTION 5** to Section 140.4(o): Systems expected to operate less than 20 hours per week.