Nonresidential Mechanical Systems

Figure 1. *Types of Mechanical Requirements Covered In This Fact Sheet*

What's Included in this Fact Sheet?

This fact sheet explains the 2022 California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) mechanical system requirements for nonresidential, hotel, and motel building projects that are classified as New Construction, Additions, or Alterations. The mechanical features covered include heating, ventilation, and air-conditioning (HVAC) systems; nonresidential water-heating systems; and covered process systems that typically serve a nonresidential building, such as a laboratory, computer room, elevator, and parking garage.

For a full listing of the building and occupancy types covered in this fact sheet, refer to Table 2.

Energy Code Ace™ offers fact sheets on mechanical systems for other building and occupancy types. For multifamily projects, see the Multifamily HVAC Systems Fact Sheet. For Single-family building Additions and Alterations, consult the *2022 Single-family Buildings HVAC Additions and Alterations Fact Sheet*. Residential water-heating requirements are covered in the *2022 Domestic Water Heating Fact Sheet*. Energy Code Ace™ fact sheets are available at www.energycodeace.com/resources.

This fact sheet organizes the Energy Code's mechanical requirements for nonresidential buildings into three main sections:

- **Wet Systems at the Plant Level:** Chillers, cooling towers, boilers, thermal energy storage and applicable distribution and control requirements
- **Dry and Wet Systems at the Zonal Systems:** Air handling units, terminal units, exhaust and supply fans, and applicable distribution and control requirements
- **Acceptance Tests:** Testing requirements for certain small commercial HVAC projects depending on scope

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This fact sheet does not include mechanical systems serving covered process refrigerated warehouse, commercial refrigeration, controlled environment horticulture, commercial kitchens, and factory exhaust systems.

For other covered processes, refer to the *Nonresidential What's Changed in 2022 Fact Sheet*.

Healthcare Facilities:
This fact sheet supports the many exceptions associated with mechanical systems serving Licensed Healthcare Facilities (Occupancy I-2).

How Does this Fact Sheet Apply to Your Project?

Use this fact sheet to determine the Energy Code nonresidential HVAC systems requirements (both air and hydronic systems) for New Construction, Additions, and Alterations. There are three basic steps to comply with the Energy Code:

1. Meet all Mandatory Measures by installing required systems, equipment, and devices and ensuring that they perform all functions required by the Energy Code.
2. Select your method of compliance by choosing either the Performance Approach or the Prescriptive Approach.
3. Research any locally adopted energy ordinances that may dictate equipment utility type, such as heat pump versus gas equipment.

Mandatory Requirements

All mechanical systems serving nonresidential and hotel or motel buildings must meet a set of Mandatory requirements for minimum equipment efficiencies, ventilation, controls, distribution, and verification or acceptance testing.

Prescriptive Approach

The Prescriptive Approach is considered the most direct path to compliance. It is a set of prescribed performance levels for various building components, where each component must meet the required minimum efficiency. There are different Prescriptive requirements for different Climate Zones and for New Construction or Additions versus Alterations. The Performance Approach can be used to gain flexibility with the Prescriptive requirements.

Performance Approach

The Performance Approach builds on the Prescriptive Approach by letting energy allotments be traded between different building systems associated with conditioned spaces for nonresidential, hotel, or motel buildings. The Performance Approach allows trade-offs between the energy use of different features of the proposed design, such as the building envelope, domestic water heating, and space-heating and cooling equipment. This compliance approach requires using energy analysis software that has been approved by the California Energy Commission (CEC). Note that Mandatory Measures cannot be traded away using the Performance Approach.

Local Adopted Energy Ordinances: In addition to Title 24, Part 6, local jurisdictions may enforce local ordinances, also known as reach codes. These local ordinances may affect aspects of the project such as requiring equipment to be "all-electric," which mandates use of heat pump space-heating equipment versus gas-fueled space-heating equipment. Being aware of local ordinances in the design phase of the project reduces the project's cost, time, and effort as well as helping to avoid extensive and costly change orders. Go to www.localenergycodes.com for a list of local ordinances that have been adopted statewide.

Compliance and Refrigeration

Refrigerants are used in many pieces of equipment and systems, such as air conditioning, commercial and industrial refrigeration, and water heating heat pumps, which are regulated by the U.S. Department of Energy and Title 24, Part 6 (the Energy Code) as applicable. However, these codes do not have any specific refrigerant requirements. The California Air Resources Board (CARB) Refrigerant Management Program, which supports California's Global Warming Solutions Act of 2006, requires leak inspections, repairs, and record keeping indicating how greenhouse gas (GHG) emissions have been reduced from equipment. Additionally, in 2023, CARB began prohibiting the use of certain hydrofluorocarbons (HFC) in new air conditioning equipment, refrigeration equipment, and chillers. Affected systems, listed in Table 1 below, are now required to be charged with low global warming potential (GWP) refrigerant from the factory. Other programs within California may have additional requirements for stationary refrigeration systems, such as the South Coast Air Quality Management District (AQMD) Rule 1415.1.

Systems Which Are Required to be Charged with Low Global Warming Potential (GWP) Refrigerant

End-Use (New Equipment)	Prohibited Refrigerants	Effective Date
Room/wall/window air-conditioning equipment, PTACs, PTHPs, portable air-conditioning equipment, and residential dehumidifiers	≥ 750 GWP	1/1/2023
Other air-conditioning equipment (residential and nonresidential)	≥ 750 GWP	1/1/2025
Variable Refrigerant Flow (VRF) system	≥ 750 GWP	1/1/2026
Chillers: Air-conditioning, process refrigeration designed for chilled fluid leaving the chiller at temperatures > +35°F (2°C)	≥ 750 GWP	1/1/2024
Chillers: Process refrigeration designed for chilled fluid leaving the chiller at temperatures ≤ +35°F (2°C) and > -10°F (-23°C)	≥ 1,500 GWP	1/1/2024
Chillers: Process refrigeration designed for chilled fluid leaving the chiller at temperatures ≤ -10°F (-23°C) and > -58°F (-50°C)	≥ 2,200 GWP	1/1/2024
Refrigeration equipment containing > 50 pounds refrigerant	≥ 150 GWP	1/1/2022

Table 1. *Systems Which Are Required to be Charged with Low Global Warming Potential (GWP) Refrigerant*

For a listing of occupancies and buildings covered in this fact sheet, see Table 2 below.

Occupancies and Buildings Covered in this Fact Sheet			
Building Type	**Group**	**Occupancy Group and Building Type California Building Code §§303-309, 311-312**	**Building and Space Types Subject to Nonresidential and Multifamily Common Use Area Lighting Requirements**
Nonresidential Buildings	**A**	**Assembly:** Buildings or spaces where groups of people gather for civic, social or religious functions, recreation, food or drink consumption, entertainment, awaiting transportation, or television and movie production, among other uses	**Occupancy Group A:** Assembly Examples: Auditoriums, convention centers (assembly buildings), libraries, tenant lease spaces[1], theaters
	B	**Business**: Buildings or spaces for office, professional or service-type transactions, including storage of records and accounts	**Occupancy Group B:** Business Examples: Financial institutions, offices, restaurants, tenant lease spaces[1], medical office buildings or clinics
	E	**Education:** Buildings or spaces used for more than six persons at any one time for educational purposes through the 12th grade.	**Occupancy Group E:** Education Examples: Schools for any number of students at any grade level, classrooms, training, vocational areas
	F	**Factory:** Buildings or spaces used for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations that are not classified as a Group H hazardous or Group S storage occupancy	**Occupancy Group F:** Factory Examples: Warehouses, tenant lease spaces[1]
	H	**High Hazard:** Buildings or spaces that involve the manufacturing, processing, generation or storage of materials that constitute a substantial physical or health hazard	**Occupancy Group H:** High hazard Examples: Factories or storage facilities for hazardous materials
	I-2	**Institutional Group I-2:** Hospitals and 24-hour medical care facilities	**Occupancy Group I-2:** Hospitals and 24-hour medical care facilities Examples: Exam and treatment rooms, medical supply rooms, nurse's stations, patient rooms, physical therapy rooms
	M	**Mercantile:** Buildings or spaces used to display and sell merchandise to the public, plus supporting areas for stocks of goods, wares, or merchandise	**Occupancy Group M:** Mercantile Examples: Grocery stores, retail stores, tenant lease spaces[1]
	S	**Storage:** Buildings or spaces used to store materials that are not classified as hazardous	**Occupancy Group S:** Storage Examples: Self storage facilities, public parking garages, open or enclosed
	U	**Miscellaneous:** Accessory buildings and structures and miscellaneous structures not classified in any specific occupancy	**Occupancy Group U:** Utility and Miscellaneous Examples: Nonresidential accessory buildings, private parking garages

1 Tenant lease space is a room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application.

Table 2. *Occupancies and Buildings Covered in this Fact Sheet*

(Continued)

Key Terms

Certified to the Energy Commission:

- Appliances subject to the certification requirements of §1606 of Title 20 of the California Code of Regulations; or,
- Certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable provisions of Title 24, Part 6; and, if applicable, that the equipment, product, or device was tested under the applicable test method specified in Title 24, Part 6.

Mechanical Cooling is lowering the temperature within a space using refrigerant compressors or absorbers, desiccant dehumidifiers, or other systems that require energy to directly condition the space. Systems that are solely energy recovery ventilation (ERV) or heat recovery ventilation (HRV) are not considered mechanical cooling. In nonresidential, multifamily, hotel, and motel buildings, cooling of a space by direct or indirect evaporation of water alone is not considered mechanical cooling.

Mechanical Heating is raising the temperature within a space using electric resistance heaters, fossil fuel burners, heat pumps, or other systems that require energy to directly condition the space. Systems that only use solar energy or heat recovery as the heat source are not mechanical heating systems.

Natural Gas Availability: For Newly Constructed buildings, natural gas is available if a gas service line can be connected to the site without a gas main extension. For Additions and Alterations, natural gas is available if a gas service line is connected to the existing building.

Occupiable Space is any enclosed space that is intended for human occupancy, including all habitable spaces as well as bathrooms, toilets, closets, halls, storage and utility areas, laundry areas, and similar areas.

Space-conditioning System is a system that provides mechanical heating, or mechanical cooling within or associated with conditioned spaces in a building, and may incorporate use of components such as chillers/compressors, fluid distribution systems (e.g., air ducts, water piping, refrigerant piping), pumps, air handlers, cooling and heating coils, air or water cooled condensers, economizers, terminal units, and associated controls.

Importance of Compliance

Cost Savings

Energy-efficient commercial buildings create real savings for owners every month in the form of reduced utility bills. For many businesses, reducing monthly expenses results in a more profitable business and, with low maintenance costs, energy-efficient design and construction, may provide ongoing savings to the owner.

Increased Comfort

In addition to lowering operating costs for owners, the HVAC requirements of California's Energy Code have the very tangible benefit of improving occupant comfort and indoor air quality. Meeting the Energy Code requires careful design considerations including load calculations to properly size equipment and ventilation to provide acceptable levels of indoor air quality.

Progress Toward Energy Efficiency Goals

The Energy Code's requirements for efficient equipment selection, proper installation, acceptance testing and use of heat pump equipment are getting California closer to its decarbonization goals.

Verification and Acceptance Testing

See the Energy Code Ace *Nonresidential and Multifamily Buildings Acceptance Testing 2022* and *Multifamily Buildings Just the Basics: HERS Verification 2022* Fact Sheets to learn more about the testing and verification requirements for mechanical systems.

What Is Your Project Type: New Construction, Addition, Alteration, or Repair?

Is Your Nonresidential Project New Construction, Addition, Alteration, or Repair?

Project Scope	Project Type	Is the Energy Code Triggered?
Newly constructed building with HVAC systems	New Construction	**YES**
Tenant improvement that is the first conditioned build out of the space	New Construction	**YES**
Adding newly conditioned floor area and volume to a building	Addition	**YES**
Conditioning an existing building for the first time	Addition	**YES**
Replacing existing HVAC equipment and/or distribution system	Alteration	**YES**
Adding HVAC equipment to an existing conditioned space	Alteration	**YES**
Repairing HVAC system components such as motors or compressors	Repair	No

Conditioned Space *is an enclosed space within a building that is directly conditioned or indirectly conditioned.*

Conditioned Space, Directly *is an enclosed space that is provided with wood heating, mechanical heating that has a capacity exceeding 10 Btu/hr-ft², or mechanical cooling that has a capacity exceeding 5 Btu/hr-ft². Directly conditioned space does not include process space. (See definition of "process space" below.)*

Conditioned Space, Indirectly *is enclosed space that (1) is not directly conditioned space; and (2) either (a) has a thermal transmittance area product (UA) to directly conditioned space exceeding that to the outdoors or to unconditioned space and does not have fixed vents or openings to the outdoors or to unconditioned space, or (b) is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.*

Newly Conditioned Space *is any space being converted from unconditioned to directly conditioned or indirectly conditioned space. Newly conditioned space must comply with the requirements for an addition. See §141.0 for nonresidential occupancies and §150.2 for residential occupancies.*

Newly Constructed Building *is a building that has never been used or occupied for any purpose.*

Process Space *is a nonresidential space that is designed to be thermostatically controlled to maintain a process environment temperature less than 55° F or to maintain a process environment temperature greater than 90° F for the whole space that the system serves, or that is a space with a space-conditioning system designed and controlled to be incapable of operating at temperatures above 55° F or incapable of operating at temperatures below 90° F at design conditions.*

Repairs *must not increase the preexisting energy consumption of the repaired component, system or equipment.*

Table 3. *Is Your Nonresidential Project New Construction, Addition, Alteration, or Repair?*

Wet System Components (Plant Level)

Chillers, cooling towers, boilers, thermal energy storage, and applicable distribution and controls requirements

Key Terms

Boiler System is one or more boilers and their piping and controls that work together to supply steam or hot water to heat output devices remote from the boiler.

Closed-circuit Cooling Tower is a cooling tower that utilizes indirect contact between a heated fluid, typically water or glycol, and the cooling atmosphere to transfer the source heat load through sensible heat, latent heat, and mass transfer indirectly to the air, essentially combining a heat exchanger and cooling tower into an integrated and relatively compact device.

Commercial Boiler is a type of boiler with a capacity (rated maximum input) of 300,000 British thermal units per hour (Btuh) or more and serving a space heating or water heating load in a commercial building.

Cycles of Concentration are the number of times the concentration of total dissolved solids (TDS) in cooling tower water is multiplied relative to the TDS in the makeup water. Because evaporation of pure water leaves dissolved solids behind in the system water, TDS increases over time as the tower operates. The number of times the dissolved minerals are concentrated is relative to the TDS in the makeup water. For example, five cycles of concentration represents five times the concentration of solids in the cooling tower system water relative to the TDS in the makeup water entering the tower.

Mandatory Certification and Minimum Efficiencies

§§110.1, 110.2, 110.3(a), 110.3(b)

Installers should confirm and document that only certified products are installed. Use the Product Finder and Modernized Appliance Efficiency Database System (MAEDbS) tools to find certified products.

(MAEDbS)

Equipment Types and Efficiency Tables

For plant-level wet systems, refer to Table 4 on this page for a list of the equipment types and the efficiency table for each system. Per §110.0, equipment listed in Table 4 can only be installed if certified to the Commission.

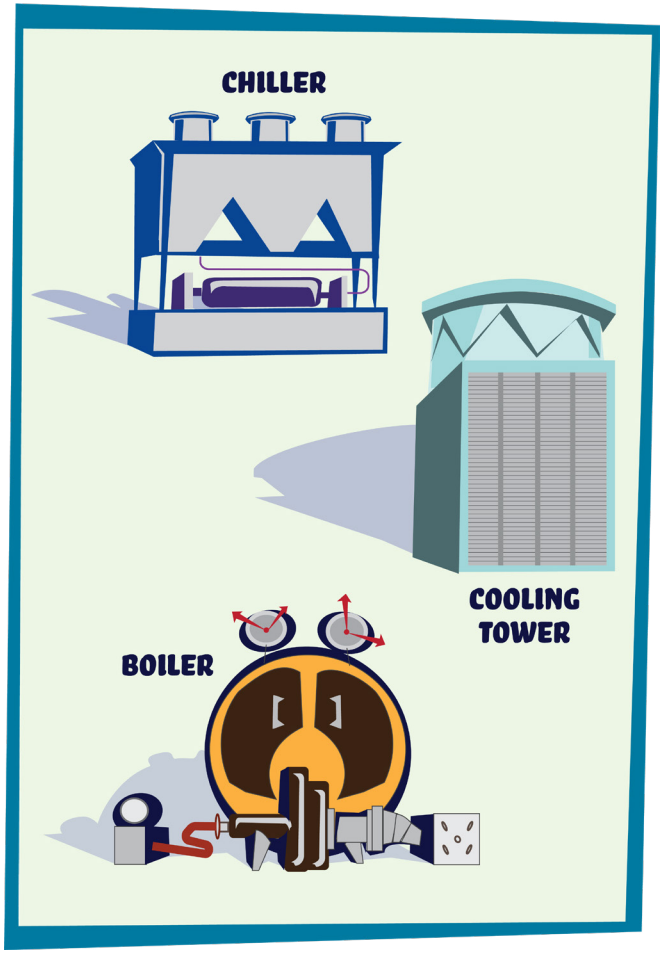

Figure 2. *Images of a Boiler, Chiller, and Cooling Tower*

HVAC Wet Systems at the Plant Level: Equipment Types and Efficiency Tables

Systems Listed in the NRCC-MCH-E	Equipment Types in Each System	Efficiency Tables
Boilers	✦ Hot Water: Gas-fired ✦ Hot Water: Oil-fired ✦ Steam: Gas-fired, natural draft ✦ Steam: Gas-fired, not natural draft ✦ Steam: Oil-fired	Table 110.2-J
Chillers	✦ Absorption: Double effect, direct-fired ✦ Absorption: Double effect, indirect-fired ✦ Air-cooled: Absorption, single effect ✦ Air-cooled: Condenser, electrically operated ✦ Air-cooled: Without condenser, electronically operated ✦ Water-cooled: Electrically operated, centrifugal ✦ Water-cooled: Electrically operated, reciprocating ✦ Water-cooled: Absorption, single effect ✦ Water-cooled: Gas engine ✦ Water-cooled: Positive displacement	Table 110.2-D
	✦ Air source Heat Pump ✦ Heat Recovery Chiller: Positive displacement ✦ Heat Recovery Chiller: Centrifugal	Table 110.2-N
Cooling Towers	Heat Rejection Equipment: ✦ Air-cooled Condensers ✦ Axial Fan: Open-circuit cooling tower, CW loop in CHW plant ≥ 900 gpm of §§140.4(h)5 and 170.2(c)4Fv ✦ Centrifugal Fan: Closed-circuit cooling tower ✦ Centrifugal Fan: Evaporative condensers ✦ Centrifugal Fan: Open-circuit cooling tower ✦ Propeller/Axial Fan: Closed-circuit cooling tower ✦ Propeller/Axial Fan: Evaporative condensers ✦ Propeller/Axial Fan: Open-circuit cooling tower ✦ Propeller/Axial Fan: Dry cooler ✦ Replacement Axial Fan: Open-circuit cooling tower, CW loop in CHW plant ≥ 900 gpm per Table 110.2-F	Table 110.2-F
	Waterside Economizer	§140.4(e)1

***CHW** = chilled water; **CW** = condenser water; **HVAC** = heating, ventilation and air conditioning; **NRCC-MCH-E** = Nonresidential Certificate of Compliance for Mechanical Systems.*

Table 4. *HVAC Wet Systems at the Plant Level: Equipment Types and Efficiency Tables*

Mandatory, Prescriptive, and Performance Requirements

For the Mandatory, Prescriptive, and Performance requirements for plant-level wet systems, see Table 5 below.

Mandatory Requirement Prescriptive Requirement Performance Approach

HVAC Wet Systems at the Plant Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Equipment: Mandatory	§110.2(a) Efficiency: Minimum efficiency requirements (in Table 4 above) must be met and all equipment listed in §110.2 must be certified by the manuacturer to MAEDbS.	✦ When serving covered process features such as a refrigerated warehouse or commercial refrigeration, covered process requirements for those systems are required instead.
Controls: Mandatory	§120.2(e) Shut-Off and Reset Control for each space-conditioning system supporting automatic shut-off, restart, and occupant sensing zone controls.	✦ Enforcing agency is satisfied that the area must operate continuously ✦ Systems with full load demand ≤ 2 kW with readily accessible manual shut-off switch ✦ Hotel and motel guest rooms with readily accessible manual shut-off switch ✦ Licensed Healthcare Facilities
	§120.2(g) Isolation Area Devices for space-conditioning systems serving multiple zones with floor area > 25,000 ft^2.	✦ Zones designed to be conditioned continuously
	§120.2(h) Automatic Demand Shed Control (DSC) required when noncritical HVAC systems subject to §120.2(j) DDC requirements at the Zone level.	✦ Zones without Direct Digital Control (DDC) ✦ Licensed Healthcare Facilities
	§120.2(j) Direct Digital Control (DDC) meeting the control logic requirements of §§110.12(a), 110.12(b), 120.1(d) and 120.2(j).	✦ Individual plants that serve ≤ 3 zones ✦ Design heating or cooling capacity of < 300 kBtuh
	§120.2(k) Optimum Start/Stop Control required for space conditioning systems with DDC to the zone level.	✦ Systems that must operate continuously
Distribution: Mandatory	§120.3 Pipe Insulation and Protection	✦ Factory-installed piping within equipment certified per §110.1 *Mandatory Requirements for Appliances* or §110.2 *Mandatory Requirements for Space-Conditioning Equipment* ✦ Pipes that convey fluid with design operating temperature between 60°F and 105°F ✦ Where heat transfer without insulation will not increase building source energy use ✦ Where pipes penetrate framing. Metal piping that penetrates metal framing must use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing.

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HVAC Wet Systems at the Plant Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Equipment: Prescriptive	§140.4(a) Sizing, Equipment Selection, and Type: Mechanical heating and mechanical 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, as calculated according to §140.4(b) *Calculations*.	✦ Oversizing will not increase TDV energy use ✦ Standby equipment controlled to operate when primary equipment not operating ✦ Multiple units of the same type controlled to meet load
Controls: Prescriptive	§140.4(f) Supply Air Temperature Reset Control: Space-conditioning systems supplying heated or cooled air to multiple zones must include controls that automatically reset supply air temperatures.	✦ System that meets §140.4(d)1 *Space-Conditioning Reheating/Recooling Zone Controls* and is not using Exception 1 of that section ✦ Where supply-air temperature reset would increase overall building energy use ✦ Specific process humidity loads, not including IT equipment rooms ✦ Systems serving Licensed Healthcare Facilities
Hydronic System Controls: Prescriptive ***§140.4(k)***	Hydronic Variable Flow Pump Control	✦ ≤ 3 control valves ✦ Total pump power ≤ 1.5 hp
	Chiller Isolation	None
	Boiler Isolation	None
	Chilled Water Temperature Reset Control	✦ Hydronic systems that use variable flow to reduce pumping energy in accordance with this section ✦ Systems serving Licensed Healthcare Facilities
	Water-cooled Air Conditioner and Hydronic Heat Pump Systems	None
	Variable Flow Pump Control	✦ Water-heating systems ✦ Condenser water systems that serve only water-cooled chillers
	Hydronic Heat Pump Control	✦ Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, deadbands < 20°F allowed

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Mandatory Requirement | Prescriptive Requirement | Performance Approach

HVAC Wet Systems at the Plant Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Boiler: Mandatory ***§120.9 Combustion Air***	Positive Shut-Off	None
	Boiler Combustion Air Fans with Motors ≥ 10 hp	None
	Maintenance of excess oxygen concentrations	✦ Boilers with steady-state full-load combustion efficiency ≥ 90%
Boiler: Prescriptive	§140.4(k)8 High Capacity Space-heating Gas Boiler Systems: CZs 1-6 and 9-14 and 16 when total system input ≥ 1 MMBtuh but no more than 10 MMBtuh, system(s) to meet 90% thermal efficiency and distribution design requirements.	✦ Where on-site renewable energy, site-recovered energy, or heat recovery chillers provide 25% of the annual space heating ✦ Space heating boilers that are installed in individual dwelling units ✦ Where ≥ 50% of heating load uses perimeter convective heating, radiant ceiling panels or both ✦ Individual gas boilers with input capacity < 300,000 Btuh
	§140.4(g) Electric Resistance Heating is not to be used for space heating.	✦ When supplemental to a heating system that has ≥ 60% site-solar or recovered energy ✦ When supplemental to a heating system in which a heat pump satisfies > 75% of the heating load ✦ Total capacity < 10% of total design output serving the entire building ✦ Capacity ≤ 3 kW serving the entire building, not including the supplemental heat pump exception above ✦ When no natural gas available, CFA ≤ 5,000 ft² (excluding hotel and motel buildings) and no mechanical cooling and serves the entire building ✦ When operating as emergency backup to gas heating equipment
Chiller: Prescriptive	§140.4(i) Minimum Chiller Efficiency: Chillers must meet or exceed Path B from Table 110.2-D. Path A only allowed when using the Performance Approach and successfully offsetting energy penalty associated with Path A.	✦ Chillers with electrical service > 600V ✦ Chillers attached to heat recovery systems with recovery capacity > 40% of design chiller capacity ✦ Chillers used to charge a thermal energy storage (TES) system with design temperature < 40°F ✦ Fourth chiller and beyond in a system
	§140.4(j): Limitations of Air-cooled Chillers: Air-cooled chillers are limited to ≤ 300 tons.	✦ Failure of water quality at building site to meet manufacturer specifications for water-cooled chillers ✦ Charging TES with design temperature < 40°F ✦ Systems serving Licensed Healthcare Facilities

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Mandatory Requirement | Prescriptive Requirement | Performance Approach

HVAC Wet Systems at the Plant Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Cooling Tower (Heat Rejection): Mandatory	§110.2(e): Cooling Towers ≥ 150 Tons: These must be equipped with conductivity or flow-based controls; document maximum achievable cycles of concentration; have a flow meter with an analog output for flow either hardwired or available through a gateway on the makeup water line; have an overflow alarm to prevent overflow of the sump in case of makeup water valve failure; and have efficient drift eliminators that achieve drift reduction.	✦ Cooling towers with rated capacity < 150 tons
Cooling Tower (Heat Rejection): Prescriptive §140.4(h)	Fan Speed Control	✦ When heat rejection devices integral to equipment listed in Tables 110.2-A through 110.2-N ✦ Condenser fans for multiple circuits ✦ Condenser fans for flooded condensers ✦ ≤ 1/3 fans for condenser or tower when lead fans meet speed control requirements
	Tower Flow Turndown	None
	Limitation on Centrifugal Fan Cooling Towers	✦ Ducted systems ✦ Systems that use a sound trap ✦ Cooling tower efficiency that meets propeller fan tower efficiency per Table 110.2-F
	Multiple Cell Heat Rejection Equipment	None
	Cooling Tower Efficiency	✦ When replacing existing cooling towers that are inside or on the roof ✦ Cooling towers in Climate Zones 1 or 16
Economizer for Chilled-Water Cooling Systems: Prescriptive	§140.4(e): Water Economizers: Economizers are required for each chilled-water cooling system without a fan or that uses induced airflow that has a cooling capacity greater than the system's per Table 140.4-E Chilled Water System Cooling Capacity.	✦ When special outside air filtration and treatment associated with unusual outdoor contaminants makes compliance infeasible ✦ When an economizer will increase time dependent valuation (TDV) energy use ✦ System serving hotel or motel guest rooms ✦ Comfort cooling system that meets Table 140.4-F ✦ Computer room that meets §140.9(a) Prescriptive Requirements for Computer Rooms ✦ When air handler design total cooling capacity < 54,000 Btuh AND DOAS heat recovery ventilation system meets requirements of §140.4(e)1 exception 6
Thermal Energy Storage (TES): Performance	Thermal energy storage systems can be used within the Performance Approach to support increased energy savings NRACM5.8.8.	None

Table 5. *HVAC Wet Systems at the Plant Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements*

Alterations

Energy Code Triggers for Plant-level Wet System Alterations

Alterations to plant-level wet systems require different Energy Code compliance measures depending on the scope of work. Project scopes range from replacing whole systems to replacing or repairing individual components.

Tables 6 through 9 below cover Energy Code triggers for some, but not all, common Alterations to cooling towers (Table 6), chillers (Table 7), boilers (Table 8), and water-side distribution systems (Table 9). The trigger tables cross-reference proposed project scopes (shown in the left column) to the applicable Mandatory and Prescriptive Energy Code requirements.

Note that the Energy Code sections listed for Alterations also apply to New Construction and Additions because §141.0(b)2 for altered systems incorporates many of those other Energy Code requirements.

Mandatory Requirement *Prescriptive Requirement* *Performance Approach*

Cooling Tower Heat Rejection Alterations Trigger Table

Project Scope	Controls		Equipment	
	Open and Closed -Circuit Cooling Tower Cycle of Concentration, Flow Meter, Overflow Alarm and Drift Eliminators *(When ≥ 150 tons)* §110.2(e)	Fan Speed §140.4(h)1 Tower Flow Turndown §140.4(h)2 Multiple Cell Heat Rejection Equipment with Variable Speed Fan(s) §140.4(h)4	Minimum Efficiency Table 110.2-F Cooling Tower Efficiency *(When axial fan open-circuit* [1]*)* §140.4(h)5	Limitation on Centrifugal Fan Cooling Towers §140.4(h)3
Replace (1) Tower	**YES**	**YES**	**YES**	**YES**
Replace All Towers	**YES**	**YES**	**YES**	**YES**
Add (1) Tower	**YES**	**YES**	**YES**	**YES**
Replace Tower Piping [2]	No	No	No	No
Replace or Repair Tower Fan or Motor [2]	No	No	No	No

1 *Replacement of existing cooling towers that are inside an existing building (or on an existing roof) and cooling towers serving buildings in Climate Zones 1 or 16 are exempt.*

2 *Existing energy use and performance must be maintained with any changes to these systems. If a repair or replacement increases energy use or degrades performance, then it is considered an Energy Code trigger and must meet all applicable Energy Code requirements.*

Table 6. *Cooling Tower Heat Rejection Alterations Trigger Table*

Chiller Alterations Trigger Table

Project Scope	Controls				Equipment		
	Demand Shed *(When existing Direct Digital Control is at the zonal level)* §120.2(h)	Direct Digital Control (DDC) §120.2(j)	Optimum Start/Stop *(When existing Direct Digital Control is at the zonal level)* §120.2(k)	Hydronic Variable Flow Systems *(When > 3 control valves)* §140.4(k)1 Chilled Water Temperature Reset *(When design capacity > 500 kBtuh* [1] §140.4(k)4	Minimum Efficiency Table 110.2-D Table 110.2-N Minimum Chiller Efficiency §140.4(i)	Air-Cooled Chiller Limitations §140.4(j)	Chiller Isolation Valves §140.4(k)2
Replace (1) Water Cooled Chiller	**YES**	No	**YES**	**YES**	**YES**	No	**YES**
Replace (1) Air Cooled Chiller	**YES**	No	**YES**	**YES**	**YES**	**YES** Limited to ≤ 300 tons per site	**YES**
Replace All Chillers	**YES**	**YES** when capacity ≥ 300 kBtuh	**YES**	**YES**	**YES**	**YES** Limited to ≤ 300 tons per site	**YES**
Add (1) Water Cooled Chiller	**YES**	No	**YES**	**YES**	**YES**	N/A	**YES**
Add (1) Air Cooled Chiller	**YES**	No	**YES**	**YES**	**YES**	**YES** Limited to ≤ 300 tons per site	**YES**
Add (1) Heat Pump or Heat Recovery Chiller	**YES**	No	**YES**	**YES**	**YES**	**YES** Limited to ≤ 300 tons per site	**YES**
Repair or Replace Motor(s), Drive(s), Chiller or Pump Component(s) [2]	No	No	No	No	No	No	No

1 *Hydronic systems that use variable flow to reduce pumping energy in accordance with §140.4(k)1 and systems serving healthcare facilities are exempt to these requirements.*

2 *Existing energy use and performance must be maintained with any changes to these systems. If a repair or replacement increases energy use or degrades performance, then it is considered an Energy Code trigger and must meet all applicable Energy Code requirements.*

Table 7. *Chiller Alterations Trigger Table*

Boiler Alterations Trigger Table

Project Scope	Controls			Equipment	
	Direct Digital Control (DDC) *(When all space heating boilers are new and plant design heating capacity is ≥ 300 kBtuh)* §120.2(j) Optimum Start/Stop *(When existing Direct Digital Control at the zonal level)* §120.2(k)	Combustion Fan(s) ≥ 10 hp Speed Control §120.9(b) Oxygen Trim Control > 5 MMBtuh *(Except when using ≥ 90% Efficiency System)* §120.9(c)	Hydronic Variable Flow Systems *(When > 3 control valves)* §140.4(k)1 Boiler Isolation §140.4(k)3 Hot Water Temperature Reset *(When design capacity > 500 kBtuh)* §140.4(k)4	Minimum Efficiency Table 110.2-J	Combustion air shut off ≥ 2.5 MMBtuh §120.9(a) Water heater/boiler Isolation Valves §140.4(k)3
Replace one water heater/boiler	**YES**	**YES**	**YES** [1]	**YES**	**YES**
Replace all water heaters/boilers	**YES**	**YES**	**YES** [1]	**YES**	**YES**

1 *Existing energy use and performance must be maintained with any changes to these systems. If a replacement increases energy use or degrades performance, then it is considered an Energy Code trigger and must meet all applicable Energy Code requirements.*

Table 8. *Boiler Alterations Trigger Table*

Water-side Distribution Alterations Trigger Table

Project Scope	Hydronic Heat Pump System Flow Pump Controls *(When > 5 hp)* §140.4(k)5	Variable Water Flow *(When > 5 hp)* §140.4(k)6 [1]	Pipe Insulation §120.3
Chiller			
Replace All Chilled Water Piping [2]	**YES**	**YES**	**YES**
Replace Some Chilled Water Piping [2]	No	No	**YES**
Replace Water Pump(s) [2]	No	No	No
Replace or Upgrade Chiller Controls [2]	No	No	No
Repair or Replace Pump Component(s) [2]	No	No	No
Cooling Tower			
Replace All Tower Piping [2]	**YES**	**YES**	No
Replace Some Tower Piping [2]	No	No	No
Replace Condenser Water Pump [2]	No	**YES**	No
Replace Condenser Water System [2]	**YES**	**YES**	No
Boiler			
Replace All Hot Water Piping [2]	**YES**	**YES**	**YES**
Replace Some Hot Water Piping [2]	No	No	**YES**
Replace Hot Water Pump [2]	No	No	**YES**
Replace Hot Water System (including pumps and piping) [2]	**YES**	**YES**	**YES**
Repair or Replace Pump Component(s) [2]	No	No	No

1 *Condenser water systems serving only water-cooled chillers are exempt.*

2 *Existing energy use and performance must be maintained with any changes to these systems. If a repair, replacement, or upgrade increases energy use or degrades performance, then it is considered an Energy Code trigger and must meet all applicable Energy Code requirements.*

Table 9. *Water-side Distribution Alterations Trigger Table*

Wet and Dry Zonal Systems

Wet and dry zonal systems include air handling units (AHUs), unitary equipment, terminal units, and distribution and controls. They also include computer rooms, parking garage ventilation, elevators, and laboratory and factory exhaust systems serving B occupancies.

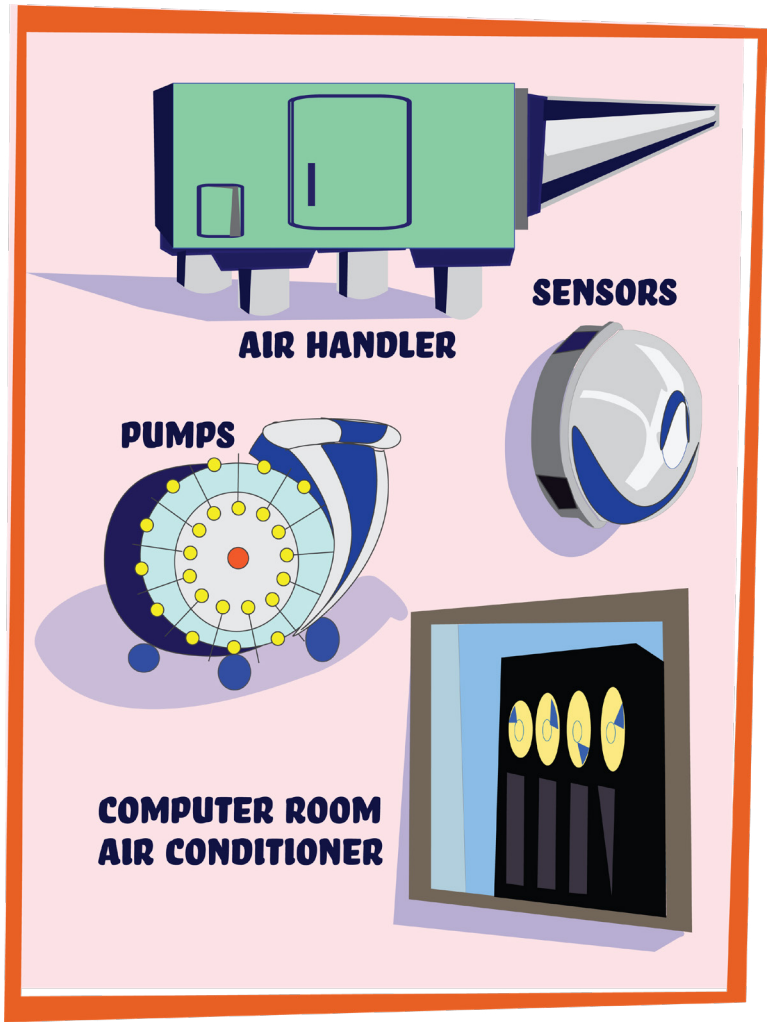

Figure 3. *Examples of Wet and Dry Zonal Systems*

Key Terms

Air-handling Unit or **Air Handler** is a blower or fan that distributes supply air to a room, space, or area

Air-to-air heat Exchanger is a device which will reduce the heat losses or gains that occur when a building is mechanically ventilated, by transferring heat between the conditioned air being exhausted and outside air being supplied.

Appliance Efficiency Regulations are the regulations in Title 20, §§1601 et seq. of the California Code of Regulations.

Dedicated Outdoor Air System (DOAS) is a ventilation system that delivers 100 percent outdoor air and delivers ventilation supply air to each space, either directly or in conjunction with local or central space-conditioning systems serving those same spaces such as a DX-DOAS, HRV, ERV, or custom ventilation only unit.

Direct Digital Control (DDC) is a type of control where controlled and monitored analog or binary data, such as temperature and contact closures, are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control mechanical devices.

Dual-fuel Heat Pump is an electric heat pump with gas furnace supplemental heat that alternates between the two fuel sources.

DX-Dedicated Outdoor Air System Unit (DX-DOAS) is a type of air-cooled, water-cooled, or water-source DOAS unit that dehumidifies 100 percent outdoor air 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.

Fan, Embedded is a fan that is part of a manufactured assembly where the assembly includes functions other than air movement.

Fan Arrays are multiple fans in parallel and in a single enclosure between two plenum sections in an air distribution system, where plenum means a compartment or chamber that forms a part of the air distribution system, and that is not used for occupancy or storage.

Fan Energy Index (FEI) is the ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated per ANSI/AMCA 208-18 at fan system design conditions.

Fan System Design Conditions are operating conditions that can be expected to occur during normal system operation that result in the highest supply airflow rate to or from the conditioned spaces served by the fan system.

Zone, Space-conditioning is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in §140.4(b), as applicable, can be maintained throughout the zone by a single controlling device.

Equipment Types and Efficiency Tables

For zonal wet and dry systems, refer to Table 10 below for a list of the equipment types and the efficiency table for each system.

Mandatory Certification and Minimum Efficiencies

§§110.1, 110.2, 110.3(a), 110.3(b)

Installers should confirm and document that only certified products are installed. Use the Product Finder and Modernized Appliance Efficiency Database System (MAEDbS) tools to find certified products.

(MAEDbS)

HVAC Unitary Dry Systems Equipment Types and Efficiency Tables

As Supported in NRCC-MCH-EE	Equipment Types for Each System	Common Equipment Names	Efficiency Tables
Computer Room AC ✦ Ceiling Mounted ✦ Floor Mounted	Downflow, upflow, horizontal (ducted and nonducted) ✦ Air-cooled ✦ Water-cooled ✦ Glycol-cooled	✦ Computer room air conditioner ✦ Computer room unit ✦ Computer Room Air Conditioner (CRAC)	✦ Table 110.2-L (Floor-mounted) ✦ Table 110.2-M (Ceiling-mounted) ✦ Title 20: Table C-7
Dedicated Outside Air System (DOAS)	✦ Air-cooled DOAS or direct expansion (DX) DOAS ✦ Water source DOAS or DX DOAS	✦ Dedicated ventilation system ✦ Air handler unit	Table 110.2-K §140.4(p)
Dual Fuel Heat Pump	An electric heat pump with gas furnace supplemental heat that alternates between the two fuel sources	✦ Dual fuel system ✦ Heat pump with furnace back up ✦ Air handler unit	✦ Table 110.2-B ✦ Table 110.2-C ✦ Table 110.2-E ✦ Table 110.2-H ✦ Table 110.2-I ✦ Table 110.2-J ✦ When < 65 KBtuh and 1-phase electrical supply, see the Residential Quick Reference Sheet [1]
Electric Resistance Heating	✦ Baseboard ✦ Under-Mat ✦ Other	Be aware of the Prescriptive limitations of using electric resistance per §140.4(g).	Be aware of the Prescriptive limitations of using electric resistance per §140.4(g).

1 See the Residential Minimum Heating and Cooling Efficiencies 2022 Quick Reference Sheet for this equipment type, even if not serving a residential occupancy.

(continued)

(continued)

HVAC Unitary Dry Systems Equipment Types and Efficiency Tables

As Supported in NRCC-MCH-EE	Equipment Types for Each System	Common Equipment Names	Efficiency Tables
Furnace and AC *(Heating and Cooling)*	Air-cooled Air Conditioner and Gas Furnace: ✦ 1- or 3-phase split or packaged AC with furnace (weatherized or nonweatherized)	✦ Split DX using AC and gas-fired furnace ✦ Packaged DX using AC and gas-fired furnace ✦ Air handler unit	✦ Table 110.2-A ✦ Table 110.2-I ✦ Title 20: Table C-3 ✦ Title 20: Table C-4 ✦ Title 20: Table E-6 ✦ When < 65 KBtuh and 1-phase electrical supply, see the Residential Quick Reference Sheet [1]
Furnace and Unit Heater *(Heating Only)*	Warm-air Central, Duct or Unit Gas-fired Heaters: ✦ Central 1-phase furnace (weatherized or nonweatherized) ✦ Wall furnace, fan or gravity heater ✦ Floor furnace or room heater	✦ Space heater	✦ Table 110.2-I ✦ Title 20: Table E-2 ✦ Title 20: Table E-5 ✦ Title 20: Table E-6
PTAC/PTHP	Packaged Terminal Air Conditioner or Heat Pump: ✦ Newly constructed ✦ Newly conditioned ✦ Replacements	✦ Through the wall air conditioner	✦ Table 110.2-E
Room AC/HP	Room Air Conditioner or Heat Pump: ✦ Louvered or nonlouvered sides ✦ Casement or casement and slider	✦ Window unit ✦ Single room air conditioner	✦ Title 20: Table B-2
Small Commercial AC	3-phase Air-cooled Unitary: ✦ AC or heat pump split ✦ AC or heat pump packaged *See Unitary AC for all others.*	✦ Small commercial split or packaged ✦ Packaged AC with heating ✦ Gas heat with AC ✦ Heat pump heating and AC	✦ Title 20: Table C-4
SPVAC/SPVHP	Single Package Vertical AC or Heat Pump: ✦ Weatherized ✦ Nonweatherized, space constrained	✦ Vertical air conditioner (VTAC)	✦ Table 110.2-E ✦ Title 20: Table C-6
Unitary AC/Condensers *(Cooling Only)* **Unitary AC/Condensers *(no electric resistance heating)***	Air-cooled Split or Package, 1- or 3-phase electrical supply: ✦ Small duct high velocity ✦ Space constrained ✦ Air, water or evaporatively cooled condensing units	✦ Split and packaged DX ✦ Variable air volume (VAV) (air side) ✦ Single-zone air conditioner ✦ Dual or double duct ✦ DX VAV (air side) ✦ Air handler unit	✦ Table 110.2-A ✦ Title 20: Table C-3 ✦ When < 65 KBtuh and 1-phase electrical supply, see the Residential Quick Reference Sheet [1]

1 *See the Residential Minimum Heating and Cooling Efficiencies 2022 Quick Reference Sheet for this equipment type, even if not serving a residential occupancy.*

(continued)

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HVAC Unitary Dry Systems Equipment Types and Efficiency Tables			
As Supported in NRCC-MCH-EE	**Equipment Types for Each System**	**Common Equipment Names**	**Efficiency Tables**
Unitary Heat Pumps	Heating and Cooling: Air-cooled Split or Package, 1- or 3-phase electrical supply: ✦ Water, groundwater, ground, water-to-water or brine-to-water ✦ Air-cooled gas engine heat pump ✦ Small duct high velocity ✦ Space constrained	✦ Split and packaged DX ✦ VAV (air side) ✦ Dual or double duct ✦ DX VAV (air side) ✦ Single-zone heat pump ✦ Hydronic heat pump ✦ Air handler unit ✦ Mini splits (ducted or ductless)	✦ Table 110.2-B ✦ Table 110.2-C ✦ Title 20: Table C-3 ✦ Title 20: Table C-4 ✦ When < 65 KBtuh and 1-phase electrical supply, see the Residential Quick Reference Sheet [1]
Unitary Heat Pumps ***(no electric resistance heating)***			
Variable Refrigerant Flow	Variable Refrigerant Flow (VRF) or Variable Refrigerant Volume (VRV): ✦ Air-cooled AC or heat pump ✦ Water source ✦ Ground or groundwater source	✦ Variable refrigerant flow (VRF) ✦ Variable refrigerant volume (VRV)	✦ Table 110.2-G ✦ Table 110.2-H

1 *See the Residential Minimum Heating and Cooling Efficiencies 2022 Quick Reference Sheet for this equipment type, even if not serving a residential occupancy.*

***AC** = air conditioning; **DOAS** = dedicated outside air system; **DX** = direct expansion; **PTAC** = packaged terminal air conditioner; **PTHP** = packaged terminal heat pump; **SPVAC** = single package vertical air conditioning; **SPVHP** = single package vertical heat pump; **VAV** = variable air volume; **VRF** = variable refrigerant flow; **VRV** = variable refrigerant volume; and **VTAC** = vertical air conditioner.*

Table 10. *HVAC Unitary Dry Systems Equipment Types and Efficiency Tables*

New Construction and Additions

Mandatory, Prescriptive, and Performance

For the Mandatory, Prescriptive and Performance requirements for zonal-level wet and dry HVAC system components, see Table 11 below.

Mandatory Requirement Prescriptive Requirement Performance Approach

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Equipment: Mandatory	§110.2(a) Efficiency: Minimum efficiency requirements (in Table 6 above) must be met and all equipment listed in §110.2 must be certified by the manufacturer to MAEDbS	✦ When serving Covered Process features such as a Refrigerated Warehouse or Commercial Refrigeration: Covered Process requirements for those systems are required instead.
Equipment: Prescriptive	§140.4(a)1 Sizing and Equipment Selection: Mechanical heating and mechanical 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, as calculated according to §140.4(b) Calculations	✦ No increase in time dependent valuation (TDV) energy use from oversizing ✦ Controls that limit standby equipment to operate when primary equipment is not operating ✦ Controls that ensure that multiple units of the same type meet load
	§140.4(a)2 Single-zone Space Conditioning System Type: Single-zone DX AC with rated cooling capacity ≤ 240,000 Btuh must meet the following minimum requirements: ✦ Retail and Grocery: ◊ CZ 2 to 15 must be a heat pump. ◊ CZ 1 and 16 when cooling capacity < 65,000 Btuh must be an AC with furnace. ◊ CZ 1 and 16 when cooling capacity ≥ 65,000 Btuh must be a dual-fuel heat pump. ✦ School: ◊ CZ 2 to 15 must be a heat pump. ◊ CZ 1 and 16 must be a dual-fuel heat pump. ✦ Office, Financial Institution, Library: ◊ CZ 1 to 15 must be a heat pump. ◊ CZ 16 when cooling capacity < 65,000 Btuh must be an AC with furnace. ◊ CZ 16 when cooling capacity ≥ 65,000 Btuh must be a dual-fuel heat pump. ✦ Office space in a warehouse: Must be a heat pump in all climate zones.	✦ Systems that use recovered heat for space heating

(Continued)

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Controls: Mandatory	§110.2(c) Thermostats: Setback thermostats are required that operate via a clock mechanism that allows the building occupant to program the temperature setpoints for at least four periods within 24 hours	✦ Gravity gas wall heaters, gravity floor heaters, gravity room heaters, noncentral electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps.
	§120.2(a) Thermostatic Controls for Each Zone: Setback thermostats are required that meet §110.2(c) Thermostats and §120.2(b) Criteria for Zonal Thermostatic Controls for each zone Hotel and motel guest rooms: Thermostats must meet §120.2(c) Hotel and Motel Guest Room Thermostats	✦ Independent perimeter heating or cooling system: System may serve more than one zone if additional requirements are met. ✦ Additional exceptions may apply to Criteria for Zonal Thermostatic Controls.
	§120.2(e) Shut-Off and Reset Control for each space-conditioning system supporting automatic shut-off, restart, and occupant sensing zone controls.	✦ Enforcement-satisfied area that must operate continuously ✦ Systems with full load demand ≤ 2 kW and readily accessible manual shut-off switch ✦ Hotel and motel guest rooms with readily accessible manual shut-off switch (not applicable to occupant sensing zone controls) ✦ Licensed Healthcare Facilities
	§120.2(g) Isolation Area Devices for space-conditioning systems serving multiple zones with floor area > 25,000 ft^2	✦ Zones that are designed to be conditioned continuously
	§120.2(h) Demand Shed Control required when noncritical HVAC systems subject to §120.2(j) DDC requirements at the Zone level	✦ Zones that are designed to be conditioned continuously and have direct digital control at the zonal level ✦ Licensed Healthcare Facilities
	§120.2(j) Direct Digital Control (DDC) meeting the control logic requirements of §§110.12(a), 110.12(b), 120.1(d) and 120.2(j)	✦ An air handling unit that serves ≤ 3 zones and has a design heating or cooling capacity of < 300 kBtuh
	§120.2(k) Optimum Start/Stop Control required for space conditioning systems with DDC to the zone level	✦ Systems that must operate continuously

(Continued)

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Controls: Prescriptive	§140.4(d) Space Conditioning Zone Controls: 1. Each zone must have controls that prevent reheating, recooling, and simultaneous heating and cooling to the same zone. OR 2. Zones are served by a variable air volume system: ✦ With DDC at the zonal level: ◊ The volume of primary air that is reheated, recooled or mixed air supply must not exceed the larger of (1) 50% of the peak primary airflow or (2) the design zone outdoor airflow rate per §120.1(c)3. ◊ The volume of primary air in the deadband must not exceed the design zone outdoor airflow rate per §120.1(c)3. Additional staging requirements apply. ✦ Without DDC at the zonal level: ◊ Volume of primary air reheated, recooled or mixed air supply must not exceed the larger of (1) 30% of the peak primary airflow or (2) the design zone outdoor airflow rate per §120.1(c)3.	✦ Special pressurization relationships or cross-contamination control needs ✦ When a site-recovered or site solar energy source provides ≥ 75% of energy for reheating, or for warm air in mixing systems ✦ Humidity levels required for exempt process loads (not including computer rooms or IT equipment) ✦ When peak supply-air quantity is ≤ 300 CFM ✦ Licensed Healthcare Facilities
	§140.4(f) Supply Air Temperature Reset Controls: Space-conditioning systems supplying heated or cooled air to multiple zones must include controls that automatically reset supply-air temperatures.	✦ System that meets §140.4(d)1 Reheating/Recooling Controls and does not use §140.4(d)1 Exception 1 ✦ When an overall energy use increase would result from meeting §140.4(f) ✦ Specific process humidity loads, not including IT equipment rooms ✦ Licensed Healthcare Facilities
	§140.4(n) Mechanical System Shut-Off (Interlocks): Any directly conditioned space with operable wall or roof openings to the outdoors must be provided with interlock controls that disable or reset the temperature setpoints to the temperatures, when any such opening is open > 5 minutes: 55°F for mechanical heating and 90°F for mechanical cooling	✦ Auto closing doors ✦ No thermostatic control in the space ✦ Licensed Healthcare Facilities

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(Continued)

Mandatory Requirement | Prescriptive Requirement | Performance Approach

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Distribution: Mandatory	§120.3 Pipe Insulation and Protection	✦ Factory-installed piping within equipment certified per §110.1 Mandatory Requirements for Appliances or §110.2 Mandatory Requirements for Space-Conditioning Equipment ✦ Pipes that move fluid with design operating temperature between 60°F and 105°F ✦ Where heat transfer without insulation will not increase energy use ✦ Where pipes penetrate framing
	§120.4(a)-(f) Ducts and Plenums: Distribution systems must meet air distribution system duct and plenum material, insulation, marking and protection requirements.	✦ Licensed Healthcare Facilities to meet California Mechanical Code
	§120.4(g) Duct Sealing: Air distribution duct leakage sealing must not exceed 6% as confirmed through field verification for a constant volume, single-zone HVAC system serving < 5,000 ft² of conditioned space. New duct systems NOT subject to duct sealing of the Energy Code must meet CMC §603.10.1	✦ When ≤ 25% of the total surface area of duct system is outdoors or in unconditioned spaces (including unconditioned space under a roof that does not meet Prescriptive insulation requirements or that has fixed vents or openings) ✦ Licensed Healthcare Facilities to meet California Mechanical Code
Air Handling Unit (AHU): Performance	§110.2(f) Low Leakage Air Handling Unit: The manufacturer must certify to the CEC that the air-handling unit meets the specifications in Joint Reference Appendix JA9 when low leakage air-handlers used in Performance Approach.	No exceptions
Computer Rooms: Mandatory	§120.6(j) Mandatory Requirements for Computer Rooms: Requirements include reheat controls, adiabatic humidification, and fan control when unitary AC > 60,000 Btuh and for each chilled water fan system.	No exceptions
Computer Rooms: Prescriptive	§140.9(a) Prescriptive Requirements for Computer Rooms: Requirements include economizers (air and water), fan power consumption, air containment and alternating current-output uninterruptible power supply (UPS).	No exceptions

(Continued)

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
Economizer: Mandatory	§120.2(i) Economizer Fault Detection and Diagnostics (FDD): FDD is required for air handlers with a mechanical cooling capacity > 33,000 Btuh and an installed air economizer.	✦ FDD algorithms based in DDC systems are not required to be certified to the CEC.
Economizer: Prescriptive	§140.4(e) Economizer: Economizer requirements apply for each cooling air handler that has a design total mechanical cooling capacity > 33,000 Btuh, or for chilled-water cooling systems without a fan or that use induced airflow that has a cooling capacity greater than the systems per Table 140.4-E Chilled Water System Cooling Capacity. When an air economizer is used, then it is required to meet the design requirements of §140.4(e)2. When a water economizer is used, then it is required to meet the design requirements of §140.4(e)3.	✦ Special outside air filtration and treatment that make economizers unfeasible ✦ When an economizer will increase time dependent valuation (TDV) energy use ✦ System serving dwelling units or hotel or motel guest rooms ✦ Comfort cooling system that meets Table 140.4-F Economizer Trade-Off Table for Cooling Systems ✦ Computer room that meets §140.9(a) Prescriptive Requirements for Computer Rooms ✦ Air handler that has a design total mechanical cooling capacity < 54,000 Btuh where ventilation is provided by a dedicated outdoor air system (DOAS) with exhaust air heat recovery in accordance with §140.4(p) Dedicated Outdoor Air Systems (DOAS) ✦ When the use of an air economizer in controlled environment horticulture (CEH) spaces will affect carbon dioxide enrichment systems
Electric Resistance Heating: Prescriptive	§140.4(g) Electric Resistance Heating: Electric resistance heating systems must not be used for space heating.	✦ When supplemental to a heating system that has ≥ 60% site-solar or recovered energy ✦ When supplemental to a heating system in which a heat pump satisfies > 75% of the heating load ✦ Total capacity < 10% of total design output serving the entire building ✦ Capacity ≤ 3 kW serving the entire building, not including the supplemental heat pump exception above ✦ When no natural gas available, CFA ≤ 5,000 ft² (excluding hotel and motel buildings) and no mechanical cooling and serves the entire building ✦ When operating as emergency backup to gas heating equipment
Fans: Mandatory	§120.2(f) Dampers: Outdoor air supply and exhaust equipment must be installed with dampers that automatically close upon fan shutdown.	✦ When continuous operation is required ✦ Where there is gravity or other nonelectrical equipment with readily accessible manual damper control ✦ At combustion air intakes and shaft vents ✦ When prohibited by other provisions of law
	§120.10 Mandatory Requirements for Fans: Each fan or fan array with a combined motor nameplate horsepower > 1.00 hp or with a combined fan nameplate electrical input power > 0.89 kW must have a fan energy index (FEI) of ≥ 1.00 at fan system design conditions.	✦ Embedded fans that are part of the equipment listed under §110.1 Mandatory Requirements for Appliances, §110.2 Mandatory Requirements for Space-Conditioning Equipment, computer room air conditioners as defined in 10 CFR 431, and DX-DOAS units ✦ Embedded fans and embedded fan arrays with a combined motor nameplate horsepower of ≤ 5 hp or with a fan system electrical input power of ≤ 4.1 kW ✦ Circulation fans, ceiling fans and air curtains ✦ Fans that are intended to only operate during emergency conditions

(Continued)

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

<table>
<tr><th>System Feature</th><th>Requirements</th><th>Exceptions</th></tr>
<tr><td rowspan="2">Fans: Prescriptive</td><td>§140.4(c) Fan Systems: Each fan system moving air into, out of, or between conditioned spaces or circulating air for the purpose of conditioning air within a space must meet the requirements of §140.4(c)1 Fan Power Budget, §140.4(c)2 Variable Air Volume (VAV) Systems and §140.4(c)3 Fractional HVAC Motors for Fans.</td><td>✦ Fan system power caused solely by process loads</td></tr>
<tr><td>§140.4(m) Fan Control: Cooling systems in the table below must be designed to vary the indoor fan airflow as a function of load.<table><tr><th>Cooling System Type</th><th>Fan Motor Size</th><th>Cooling Capacity</th></tr><tr><td>DX Cooling</td><td>Any</td><td>≥ 65,000 Btuh</td></tr><tr><td>Chilled Water and Evaporative</td><td>≥ 1/4 hp</td><td>Any</td></tr></table></td><td>✦ Chilled water or evaporative systems with all fan motors < 1 hp, if not used for ventilation air and if all fans cycle with load
✦ Licensed Healthcare Facilities</td></tr>
<tr><td>Furnaces: Mandatory</td><td>§110.2(d) Gas-Fired and Oil-Fired Furnace Standby Loss Controls: These furnaces require standby loss controls when input ratings are ≥ 225,000 Btuh.
§110.5 Natural Gas Central Furnaces: Pilot lights prohibited for fan-type central furnaces.</td><td>No exceptions</td></tr>
<tr><td>Heat Pumps: Mandatory</td><td>§§110.2(b) and 120.2(d) Controls for Heat Pumps with Supplementary Electric Resistance Heaters</td><td>✦ When supplementary during defrost, or transient periods if controls preclude unnecessary operation and room
✦ Room AC heat pumps</td></tr>
<tr><td rowspan="4">Ventilation: Mandatory

(continued on next page)</td><td>§120.1(a) Ventilation and Indoor Air Quality: All occupiable spaces in high-rise residential buildings, hotel and motel buildings, and nonresidential buildings must comply with the applicable requirements of §120.1(a) through §120.1(h).</td><td>✦ Licensed Healthcare Facilities ventilation to meet California Mechanical Code.</td></tr>
<tr><td>§120.1(c)1 requires 2" MERV-13, or equal, air filtration for mechanical systems that supply air to an occupiable space through > 10 ft. of ductwork; supply-only ventilation and makeup air systems providing outside air to occupiable space; and supply side of balanced ventilation systems (including heat or energy recovery systems) providing outside air to occupiable space.</td><td>✦ Heat or energy recovery filter location may be downstream of a system thermal conditioning component, provided the system is equipped with ancillary filtration upstream of the system's thermal conditioning component.
✦ Licensed Healthcare Facilities ventilation to meet California Mechanical Code.</td></tr>
<tr><td>§120.1(c)2 Natural Ventilation must be designed per 120.1(c)2A through 120.1(c)2C and include a mechanical ventilation system.</td><td>✦ Licensed Healthcare Facilities ventilation to meet California Mechanical Code.</td></tr>
<tr><td>§120.1(c)3 Mechanical Ventilation must be provided for all occupiable spaces greater than or equal to Equation 120.1-F or 120.1-G, whichever is applicable.</td><td>✦ Licensed Healthcare Facilities ventilation to meet California Mechanical Code.</td></tr>
<tr><td>§120.1(c)4 Exhaust Ventilation will be provided for conditioned spaces per Table 120.1-B</td><td>✦ Licensed Healthcare Facilities ventilation to meet California Mechanical Code.</td></tr>
</table>

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HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirementss

System Feature	Requirements	Exceptions
(continued from previous page) **Ventilation: Mandatory**	§120.1(d) Operation and Control Requirements for Minimum Quantities of Outdoor Air: The following requirements apply: ✦ §§120.1(d)1 and 2 – Times of occupancy including pre-occupancy period ✦ §§120.1(d)3 and 4 – Demand Control Ventilation (CO_2 sensors): When occupant density demand ≥ 25 people per 1,000 ft² and either an air economizer, ventilation system that modulates outside air control or airflow rate is > 3,000 CFM ✦ §120.1(d)5 – Occupancy Sensor Ventilation Controls: Tied to when lighting occupancy sensors are required for the space type per §130.1(c)5 Occupancy Sensing Lighting Controls and §130.1(c)6C Full or Partial Off Occupant Lighting Controls AND IF Table 120.1-A Minimum Ventilation Rates allows for the ventilation to be reduced to 0 CFM (supported with footnote "F" within the table) ◊ Based on the above, the following spaces are required to support reducing the ventilation to 0 while in occupied standby mode per §120.2(e)3 Occupant Sensing Zone Controls: • Lecture or postsecondary classrooms • Multiuse assembly rooms < 1,000 ft² • Conference or meeting rooms • Corridors • Office spaces of any size ◊ When a single-zone damper or a single-zone system serves multiple rooms: There must be an occupant sensor in each room, and the zone must not be considered vacant until all rooms in the zone are vacant. All rooms served by the system must be allowed to reduce ventilation to 0 CFM per Table 120.1-A Minimum Ventilation Rates.	✦ Exceptions to §§120.1(d)1 and 2: ◊ Intermittently occupied spaces using demand control ventilation device complying with §120.1(d)4 Demand Control Ventilation Devices or occupant sensors per §120.1(d)5 Occupant Sensor Ventilation Control Devices: Temporary reduction is allowed up to 30 minutes at a time if hourly average meets requirements. ◊ Licensed Healthcare Facilities ventilation to meet California Mechanical Code. ✦ Exceptions to §§120.1(d)3: ◊ Exhaust > ventilation rate per §120.1(c) Nonresidential and Hotel/Motel Buildings minus 0.2 CFM ft² of conditioned floor area. ◊ Processes or operations that generate unhealthy environments. ◊ Space < 150 ft² or occupancy < 10 people per §120.1(c)3 Mechanical Ventilation. ◊ Licensed Healthcare Facilities ventilation to meet California Mechanical Code. ✦ Exception to §120.1(d)5: ◊ Licensed Healthcare Facilities ventilation to meet California Mechanical Code.
	§120.1(e) Ducting for Zonal Heating and Cooling Units: When return plenum used to distribute outdoor air to a zonal heating or cooling unit the outdoor air to be ducted to discharge within 5 ft. of the unit or within 15 ft. of the unit, substantially toward the unit, and at a velocity not less than 500 feet per minute.	No exceptions
(continued on next page)	§120.1(f) Design and Control Requirements for Quantities of Outdoor Air must meet design criteria of §120.1(f).	No exceptions

(Continued)

HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements

System Feature	Requirements	Exceptions
(continued from previous page)	§120.1(g) Air Classification and Recirculation Limitations: Air classification and recirculation limitations of air must be based on the air classification as listed in Table 120.1-A or C.	No exceptions
Ventilation: Mandatory	§120.1(h) Ventilation Only Mechanical Systems: These requirements apply to systems serving unconditioned spaces.	✦ Does not apply to systems serving conditioned spaces. HVAC systems without mechanical heating or cooling must meet §120.1(f) Dampers for Air Supply and Exhaust Equipment.
	§120.6(c) Mandatory Requirements for Enclosed Parking Garages: These apply when the exhaust rate is ≥ 10,000 CFM.	✦ Any garage, or portion of a garage, where > 20% of the vehicles that are expected to be stored have nongasoline combustion engines ✦ Additions to existing garages where < 10,000 CFM of new exhaust capacity is being added.
	§120.6(f) Mandatory Requirements for Elevators: < 0.33 watts per cfm when there is no space conditoning; when unoccupied cab stopped and unoccupied with doors closed >15 minutes, ventilation to be switched off until cab operation resumes; when cabin stuck, ventilation to be operational when passengers in the cabin.	✦ Licensed Healthcare Facilities
Ventilation: Prescriptive	§140.4(o) Exhaust System Transfer Air Requirements: These apply for conditioned supply air delivered to any space with mechanical exhaust.	✦ Biosafety labs class 3 or higher ✦ Vivarium spaces ✦ When positive pressure must be maintained per codes and standards ✦ When makeup transfer air is higher than available transfer airflow rate and a negative pressure relationship to those spaces is required ✦ Licensed Healthcare Facilities
	§140.4(p) Dedicated Outdoor Air Systems (DOAS): These systems, such as a DX-DOAS, HRV or ERV unit, are required to condition, temper or filter 100% outdoor air separate from local or central space-conditioning systems serving the same space.	No exceptions
	§140.4(q) Exhaust Air Heat Recovery: This applies when outdoor air supply fans meet requirements, based on Climate Zone, of Table 140.4-J Energy Recovery Requirements by Climate Zone and Percent Outdoor Air at Full Design Airflow (< 8,000 hours per year) or Table 140.4-K Energy Recovery Requirements by Climate Zone and Percent Outdoor Air at Full Design Airflow (≥ 8,000 hours per year).	✦ Systems meeting §140.9(c) Prescriptive Requirements for Laboratory and Factory Exhaust Systems ✦ Systems serving spaces that are not cooled and that are heated < 60°F ✦ Where > 60% of the outdoor air heating energy is provided from site-recovered energy in Climate Zone 16 ✦ Systems in Climate Zone 15: Sensible recovery ratio requirements at heating design conditions are exempted. Systems in Climate Zone 1: Sensible recovery ratio requirements at cooling design conditions are exempted. ✦ Where the sum of the airflow rates exhausted and relieved within 20 ft of each other is < 75% of the design outdoor airflow rate, excluding exhaust air that is either used for another energy recovery system, not allowed by the California Mechanical Code (Title 24, Part 4) (CMC) for use in energy recovery systems with leakage potential, or of Class 4 as specified in §120.1(g) Air Classification and Recirculation Limitations ✦ Systems expected to operate < 20 hours per week

Table 11. *HVAC Wet and Dry System Components at the Zonal Level – New Construction and Additions: Mandatory, Prescriptive, and Performance Energy Code Requirements*

Alterations

Energy Code Triggers for Zonal System Alterations

Alterations to zonal systems require different Energy Code compliance measures depending on the scope of work. Project scopes range from replacing whole systems to replacing or repairing individual components.

Tables 12 through 15 below cover Energy Code triggers for some, but not all, common Alterations to air handling system controls (Table 12), air handling system equipment (Table 13), air-handling system ventilation and distribution (Table 14), and single-zone, direct expansion (DX) packaged units and split systems (Table 15). The trigger tables cross-reference proposed project scopes (shown in the left column) to the applicable Mandatory and Prescriptive Energy Code requirements.

Note that the Energy Code sections listed for Alterations also apply to New Construction and Additions because §141.0(b)2 for altered systems incorporates many of those other Energy Code requirements.

Mandatory Requirement ***Prescriptive Requirement*** ***Performance Approach***

Air Handling System Alterations Trigger Table - Controls

Project Scope	Controls [1] (page 29)			
	Thermostat §§110.2(c), 120.2(a) Occupancy and Pre-occupancy Outside Air §§120.1(d)1-2 Shut-off and Reset Controls for Space-conditioning Systems [3] §§120.2(e)1, 120.2(e)2 Isolation Area Devices [4] §120.2(g)	Demand Shed §§120.2(h), 141.0(b)2Ei Direct Digital Control (DDC) *(When DDC exists)* §120.2(j) Optimum Start/Stop *(When there is existing DDC at the zonal level)* §120.2(k)	Demand Control Ventilation §§120.1(c)3-4, 120.1(d), 141.0(b)2D	Space-conditioning Zone Controls [5] §140.4(d) Supply Air Temperature Reset Controls §140.4(f)
Replace (1) Air Handling Unit (AHU)	**YES**	**YES**	**YES** [7]	**YES**
Replace All AHU's	**YES**	**YES**	**YES** [7]	**YES**
Add (1) AHU – Serving Existing Zones	**YES**	**YES**	**YES** [7]	**YES**
Replace Heating or Cooling Coil(s)	**YES**	No	No	**YES**
Replace or Repair AHU Control(s)	No	No	No	No
Add VAV Box(es) and New Ducting	**YES**	No	**YES** [7]	**YES**
Replace, Move or Repair an Existing VAV Box(es)	No	No	No	No
Add Ducting	No	No	No	No
Move or Replace Ducting	No	No	No	No

✦ ***Footnotes for this table are found on page 29. Click on individual footnote numbers above to be redirected to the specific footnote.***

Table 12. *Air Handling System Alterations Trigger Table - Controls*

Air Handling System Alterations Trigger Table - Equipment

Project Scope	Equipment [2] (page 29)		
	Fan Energy Index *(When fan or fan array > 1 hp or combined input power > 0.89 kW)* [6] §120.10 Fan Power Budget *(When fan or fan array input power ≥ 1.0 kW)* §§140.4(c), 141.0(b)2C Fan Control [3] §140.4(m)	Heating and Cooling Load Calculations §140.4(b) Exhaust Air Heat Recovery §140.4(q)	Economizers *(When cooling air handler with mechanical cooling capacity > 33,000 Btuh, or chilled-water cooling systems with a fan or that use induced airflow meeting capacity of Table 140.4-E)* §140.4(e) Economizer Fault Detection and Diagnostics (FDD) *(When new AHU, VAV boxes, or valves)* §120.2(i)
Replace (1) Air Handling Unit (AHU)	**YES**	No	**YES**
Replace All AHU's	**YES**	No	**YES**
Add (1) AHU – Serving Existing Zones	**YES**	**YES**	**YES**
Replace Heating or Cooling Coil(s)	No	No	**YES**
Replace or Repair AHU Control(s)	No	No	No
Add VAV Box(es) and New Ducting	No	No	**YES - FDD**
Replace, Move or Repair an Existing VAV Box(es)	No	No	No
Add Ducting	No	No	No
Move or Replace Ducting	No	No	No

✦ ***Footnotes for this table are found on page 29. Click on individual footnote numbers above to be redirected to the specific footnote.***

Table 13. *Air Handling System Alterations Trigger Table - Equipment*

Air Handling System Alterations Trigger Table - Ventilation and Distribution

Project Scope	Ventilation	Distribution	
	Ventilation Calculations §120.1 Dampers for Outside Air Supply [8] §120.2(f)	Duct Insulation, Materials and Protection §120.4(a)-(f)	Duct Sealing *(Required under Title 24, Part 6 for constant volume systems serving one zone < 5,000 ft² and with > 25% ducts outside conditioned space, otherwise meet CMC §603.10.1)* §§120.4(g), 141.0(b)2D, 141.0(b)2Eii
Replace (1) Air Handling Unit (AHU)	**YES**	No	**YES**
Replace All AHU's	**YES**	No	**YES**
Add (1) AHU – Serving Existing Zones	**YES**	No	**YES**
Replace Heating or Cooling Coil(s)	No	No	**YES**
Replace or Repair AHU Control(s)	No	No	No
Add VAV Box(es) and New Ducting	**YES**	**YES**	**YES**
Replace, Move or Repair an Existing VAV Box(es)	No	No	No
Add Ducting	No	**YES**	**YES**
Move or Replace Ducting	No	No	No

Table 14. *Air Handling System Alterations Trigger Table - Ventilation and Distribution*

Trigger Tables 12 to 14 Footnotes

1 ***Not Required:*** *Occupant Sensing Zone Control §120.2(e)3*

2 ***Not Required:*** *Single-zone Heat Pump Space Heating §§140.4(a)2; 141.0(b)2C*

3 *Licensed Healthcare Facilities exempt.*

4 *Zones designed to be conditioned continuously are exempt.*

5 *Exceptions: Zones with special pressurization relationships or cross-contamination control needs; Zones served by space-conditioning systems in which at least 75% of the energy for reheating, or providing warm air in mixing systems, is provided from a site-recovered or site-solar energy source; Zones in which specific humidity levels are required to satisfy exempt process loads; Zones with a peak supply-air quantity of 300 cfm or less; Systems serving healthcare facilities.*

6 *Exceptions: Embedded fan that are part of the equipment listed under §110.1, §110.2, or DX-DOAS units; Embedded fans and embedded fan arrays with a combined motor nameplate horsepower of 5 hp or less or with a fan system electrical input power of 4.1 kW or less; Circulation fans, ceiling fans and air curtains; Fans that are intended to only operate during emergency conditions.*

7 *Demand ventilation controls complying with §120.1(d)3 are required for a space with a design occupant density, or a maximum occupant load factor for egress purposes in the CBC, ≥ 25 people per 1,000 ft² (≤ 40 ft² per person) if the ventilation system serving the space has one or more of the following: An air economizer; or modulating outside air control; or design outdoor airflow rate > 3,000 cfm.*

Exceptions: Where space exhaust is greater than the design ventilation rate specified in §120.1(c)3 minus 0.2 cfm per ft² of conditioned area; Spaces that have processes or operations that generate dusts, fumes, mists, vapors, or gases and are not provided with local exhaust ventilation, such as indoor operation of internal combustion engines or areas designated for unvented food service preparation, daycare sickrooms, science labs, barber shops or beauty and nail salons must not install demand control ventilation; Spaces with an area of < 150 ft², or a design occupancy of < 10 people as specified by §120.1(c)3.

8 *Exceptions: Equipment that serves an area that must operate continuously; Gravity and other nonelectrical equipment that has readily accessible manual damper controls; At combustion air intakes and shaft vents; Where prohibited by other provisions of law.*

Single-zone, Direct Expansion (DX) — Packaged Unit and Split System Alterations Trigger Table

Project Scope	Controls 1 (page 31)		Equipment 2 (page 31)					Ventilation		Distribution		
	Thermostat 3 §110.2(c) §120.2(a) Demand Shed 4 §110.12(a)-(b) §120.2(b) §141.0(b)2E Occupancy and Pre-occupancy Outside Air §120.1(d)1-2 Shut-off, Reset and Isolation §120.2(e), (g)	Demand Control Ventilation 5 §120.1(c)3-4 §120.1(d) §141.0(b)2D	Minimum Cooling Efficiency 6 §110.2(a)	Minimum Heating Efficiency Heat Pump Controls 6 §110.2(a)-(b)	Equipment Sizing (per load calculations) §140.4(a) Heating or Cooling Load Calculations §140.4(b)	Fan Energy Index 7 §120.10(a) Fan Power 8 §140.4(c) §141.0(b)2C Fan Control 9 §140.4(m) Exhaust Air Heat Recovery 10 §140.4(q)	Economizer 11 §140.4(e) §141.0(b)2C	Ventilation Calculations 12 (Replaced HVAC system provides ventilation) §120.1	Supply and Exhaust Dampers (HVAC provides ventilation) §120.2(f)	Air Filtration 13 §120.1(c)	Duct Insulation 14 §120.4(a)-(f)	Duct Seal and Test §120.4(g) §141.0(b)2D §141.0(b)2E
Whole Package Unit or Split System without Altered Ducts	**YES**	No	**YES**	**YES** 19	No 15	**YES**	**YES**	**YES**	**YES**	No	No	**YES** 16
New or Replacement Whole Package or Split System and New Ducts	**YES**	**YES** 18	**YES**	**YES** 19	No 15	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES** 16 17
Split System Outdoor Condensing Unit	**YES**	No	**YES**	**YES** 19	No	No	No	No	No	No	No	No
Split System, Air Handler, or Cooling or Heating Coil	**YES**	No	**YES**	**YES** 19	No	**YES** 20	**YES** 21	No	No	No	No	**YES** 16
Cooling Coil of Packaged System	**YES**	No	**YES**	No	No	No	No	No	No	No	No	No
New or Replacement Ducts 22	No	No	No	No	No	No	No	**YES**	No	No	**YES**	**YES** 16 17
Extended Ducts	No	No	No	No	No	No	No	No	No	No	**YES**	**YES** 16
Repairs (Changing Motors or Compressors, etc). 23	No	No	No	No	No	No	No	No	No	No	No	No

✦ ***Footnotes for this table are found on the following page. Click on individual footnote numbers above to be redirected to the specific footnote.***

Table 15. *Single-zone, Direct Expansion (DX) — Packaged Unit and Split System Alterations Trigger Table*

Trigger Table 15 Footnotes

1 ***Not Required***. *Occupancy Sensor Control §120.1(d)5; 120.2(e)3*

2 ***Not Required***. *Single-zone Heat Pump Space Heating §140.4(a)2; §141.0(b)2C. Fault Detection and Diagnostics (FDD) §120.2(i); §141.0(b)2*

3 Thermostats also must comply with requirements of Joint Reference Appendix (JA5) per §120.2(b)4 (Mandatory for single-zone air conditioners and heat pumps) and §141.0(b)2Ei (Prescriptive). All heat pumps with supplementary electric resistance heaters must be installed with controls that comply with §110.2(b) Heat Pump Controls.

4 If the altered unit has direct digital control (DDC) to the zone level, the requirements of §§110.12(a), 110.12(b) and 120.2(h) must be met. Otherwise, the altered unit's thermostatic controls must comply with Joint Reference Appendix JA5, which also includes demand shed control requirements.

5 If the system has an airside economizer, modulating outside air control or a design flow rate > 3,000 CFM and serves a high-density space (≥ 25 people per 1,000 ft^2) as supported by Table 402.1 of *2022 California Mechanical Code*, demand control ventilation (DCV) is required.

6 For minimum efficiency tables ≥ 65,000 Btuh, see Table 110.2-A: Unitary AC and Condensers, Table 110.2-B: Unitary Heat Pumps and Table 110.2-I: Warm-Air Furnace. If there is a single-zone heat pump < 65,000 Btuh or central air conditioner < 65,000 Btuh, see the Energy Code Ace™ *Equipment Minimum Efficiencies: Quick Reference* at energycodeace.com/resources/?itemId=67830.

7 Fan energy index (FEI) requirements in §120.10(a) may apply if each fan or fan array at fan system design conditions either (1) has a combined motor nameplate horsepower is greater than 1 hp (or combined electrical nameplate input power greater than 0.89 kW) and is not listed under §§110.1, 110.2 or 120.10(a) or (2) has embedded fans or fan arrays > 5 hp. Exceptions may apply.

8 For each fan system that includes at least one fan or fan array with fan electrical input power ≥ 1 kW, fan power requirements of §140.4(c)1 may apply. Additional fan power allowances are available for Alterations per §141.0(b)2C.

9 Direct expansion (DX) cooling systems with ≥ 65,000 Btuh cooling capacity require a minimum of two stages of fan control. Systems that include an air-side economizer require a minimum of two stages of fan control during economizer operation. All systems required to control the space temperature by modulating the airflow to the space have fan power limits at 66% speed.

10 For some fan system designs where supply outdoor air is ≥ 2,000 CFM, exhaust air heat recovery may be required as specified in §140.4(q).

11 For Alterations, an economizer is required if a single package unit is > 33,000 Btuh (about 3 tons). All other replacements of variable refrigerant flow (VRF), split system, or any systems that are not single package units ≥ 54,000 Btuh and in which the air handler is being replaced, an economizer is required. (Note that this is a CEC-authorized correction to the 2022 Energy Code.) Exceptions may apply if using Table 140.4-F Economizer Trade-Off Table for Cooling Systems.

12 The ventilation calculation requirement applies only if the system is serving as the mechanical ventilation source.

13 An air-conditioning system requires a minimum 2" MERV 13 filter or 1" MERV 13 filter sized in accordance with Equation 120.1-A. Filter racks or grilles must use gaskets, sealing, or other means to close gaps around inserted filters and prevent air from bypassing the filter.

14 Ducts in indirectly conditioned space require R-4.2 insulation. Ducts outside conditioned space require R-8 insulation. Ducts in directly conditioned space do not require insulation.

15 When the proposed system capacity does not match the existing system capacity, heating or cooling load calculations and system sizing requirements apply.

16 Duct sealing and testing requirements apply if a system is constant air volume (CAV) single-zone and serves < 5,000 ft^2 of conditioned floor area and > 25% of the duct surface is in unconditioned space. Exceptions may apply.

17 New or completely replaced duct systems and ventilation systems serving facilities not triggered by Footnote (16) must instead be sealed and then tested in accordance with the *2022 California Mechanical Code* §603.9.2.

18 Demand control ventilation (DCV) is required only if the system, ducts and all controls are replaced.

19 If a split system operates as a heat pump, heating efficiency must meet Mandatory requirements in §110.2(a) plus the supplemental electric resistance heater control requirements of §110.2(b). If gas-fired or oil-fired furnaces are used, standby loss controls requirements of §110.2(d) may apply.

20 Fan control requirements in §140.4(m) do not apply.

21 Economizer requirements in §§140.4(e) and 141.0(b)2C must be met if the air handler is replaced.

22 If 75% or more of existing ducts are replaced, it is considered a new duct system.

23 For nonresidential HVAC systems, a change in motors, compressors, condenser coil and other items are considered a Repair and do not trigger the Energy Code. However, Repairs must not increase the pre-existing energy consumption of the repaired component, system, or equipment.

Acceptance Tests

Depending upon the scope of a small commercial HVAC project, the Energy Code may require acceptance testing. Each acceptance test must be performed by a Certified Mechanical Acceptance Test Technician (CMATT) who is trained and certified by an Acceptance Test Technician Certification Provider Program (ATTCP). CMATTs must show that they have a minimum of three years of experience working in the area of testing that they will perform.

Mandatory Requirement

Acceptance Tests: Packaged Units — Single-zone, Constant Air Volume, and Split Systems

Project Scope	Form NRCA-MCH-02-A Ventilation Systems: Adequate OSA: When HVAC provides ventilation	Form NRCA-MCH-03-A Constant-volume, Single-zone Unitary AC and Heat Pump: Proper system temperature scheduling and controls for DX units	Form NRCA-MCH-04-A NRCV-MCH-04-H Air Distribution Systems: [1] Duct leakage rate	Form NRCA-MCH-05-A Air Economizer Controls: Proper operation of economizer controls	Form NRCA-MCH-06-A Demand Control Ventilation: Proper operation of DCV controls	Form NRCA-MCH-11-A Demand Shed Controls: Demand response [2]
Whole Package Unit	**YES**	**YES**	**YES**	**YES** [3]	**YES** [4]	**YES**
Entire Split System	**YES**	**YES**	**YES**	**YES** [3]	**YES** [4]	**YES**
New or Replacement Ducts and Whole Package Unit or Split System	**YES**	**YES**	**YES**	**YES** [3]	**YES** [4]	**YES**
Air Handler, or Cooling or Heating Coil, or Outdoor Condensing Unit	No	**YES**	**YES**	No	No	**YES**
Ductwork	No	No	**YES**	No	No	No

1 Duct sealing and testing requirements apply if a system is constant air volume (CAV) single-zone and serves < 5,000 ft^2 of conditioned floor area and > 25% of the duct surface is in unconditioned space. When new or completely replaced duct systems and ventilation systems do not serve a constant air volume (CAV) system < 5,000 ft^2 and have > 25% of ducts outside conditioned space, they must instead be sealed and then tested in accordance with the *California Mechanical Code* §603.9

2 The acceptance test requirement only applies if the unit has direct digital controls (DDC) controls.

3 If the system has a factory-installed economizer that is certified operational by the manufacturer to the California Energy Commission's economizer quality control requirements, the in-field functional tests do not have to be conducted. Regardless of whether the economizer is field- or factory-installed, complete the construction inspection, including the compliance with high temperature lockout temperature setpoints.

4 If system is single-zone with any controls or multi-zone with direct digital controls (DDC), has an airside economizer, and serves a high-density space (≥ 25 people per 1,000 ft^2), the acceptance test requirements apply. If replacing a packaged system that provided ventilation with any system that does not, mechanical ventilation must be provided to the space(s).

NOTE: *For Nonresidential HVAC systems, a change in blower motor, compressor, or condenser coil is considered a Repair and does not trigger the Energy Code. However, Repairs must not increase the pre-existing energy consumption of the repaired component system or equipment.*

AC *= air conditioning;* ***DCV*** *= demand control ventilation;* ***DX*** *= direct expansion;* ***HVAC*** *= heating, ventilation and air conditioning;* ***OSA*** *= outside air.*

Table 16. *Acceptance Tests: Packaged Units — Single-zone, Constant Air Volume, and Split Systems*

HVAC Dry System Acceptance Testing Requirements

System Feature	Ventilation (Conditioned Spaces)	HVAC Controls	Distribution	Economizers	Parking Garage Ventilation	Elevator Ventilation
Outdoor Air NA7.5.1 / NRCA-MCH-02-A	**YES**	No	No	No	No	No
Constant Volume, Single-zone AC or HP Controls NA7.5.2 / NRCA-MCH-03-A	No	**YES**	No	No	No	No
Air Distribution Systems NA7.5.3 / NRCA-MCH-04-A	No	No	**Ducting YES**	No	No	No
Air Economizers NA7.5.4 / NRCA-MCH-05-A	No	No	No	**YES** *Unless certified factory installed economizer used*	No	No
Demand Control Ventilation NA7.5.5 / NRCA-MCH-06-A	**YES** *When Applicable*	No	No	No	No	No
Supply Fan Variable Speed Flow Controls NA7.5.6 / NRCA-MCH-07-A	No	No	**Variable Speed Fans YES**	No	No	No
Automatic Demand Shed Control NA7.5.10 / NRCA-MCH-11-A	No	**YES**	No	No	No	No
FDD NA7.5.11 / NRCA-MCH-12-A or NA7.5.12 / NRCA-MCH-13-A	No	No	No	**YES**	No	No
Supply Air Temperature Reset Controls NA7.5.15 / NRCA-MCH-16-A	No	**YES**	No	No	No	No
EMCS §120.5(a)17 / NRCA-MCH-18-A	No	**YES**	No	No	No	No
Parking Garage Ventilation NA7.12 / NRCA-PRC-03-F	No	No	No	No	**YES**	No
Elevator Lighting and Ventilation Controls NA7.14 / NRCA-PRC-12-F	No	No	No	No	No	**YES**

Table 17. *HVAC Dry System Acceptance Testing Requirements*

HVAC Dry System Verification Testing Requirements

System Feature	Distribution
Duct Systems NA1.9 and NA2.1 NRCV-MCH-20-H	**YES**

Table 18. *HVAC Dry System Verification Testing Requirements*

HVAC Wet System Acceptance Testing Requirements

System Feature	Hydronic System Controls	Thermal Energy Storage (TES)	Cooling Tower and Chillers
Valve Leakage Test NA7.5.7 NRCA-MCH-08-A	**YES**	No	No
Supply Water Temp. Reset Controls NA7.5.8 NRCA-MCH-09-A	**YES**	No	No
Hydronic System Variable Flow Controls NA7.5.9 NRCA-MCH-10-A	**YES**	No	No
Thermal Energy Storage (TES) Systems NA7.5.14 NRCA-MCH-15-A	No	**YES**	No
Condenser Water Supply Temp. Reset Controls NA7.5.16 NRCA-MCH-17-A	No	No	**YES**

Table 19. *HVAC Wet System Acceptance Testing Requirements*

For More Information

CALIFORNIA ENERGY COMMISSION

www.energy.ca.gov
Learn more about the California Energy Commission (CEC) and its programs on its website.

2022 Building Energy Efficiency Standards
Explore the main CEC web portal for the 2022 Energy Code, including information, documents, and historical information.

2022 Building Energy Efficiency Standards Summary
Download this visual summary of the Energy Code's purpose, current changes, and impact.

Energy Code Hotline
Call: 1-800-772-3300 (Free)
Email: Title24@energy.ca.gov

Online Resource Center
Use these online resources developed for building and enforcement communities to learn more about the Energy Code.

2022 Nonresidential and Multifamily Compliance Manual, Ch. 8, 11, Appendix D
Check out the 2022 Nonresidential and Multifamily Compliance Manual for more information on the Energy Code from the CEC.

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- PG&E HPWH video series

Resources

www.energycodeace.com/resources
Downloadable materials provide practical and concise guidance on how and when to comply with California's building and appliance energy efficiency standards.

Of Special Interest:

Fact Sheets for Buildings

- *2022 Residential Space Heating/Cooling and Water Heating Equipment Minimum Efficiencies*
- *2022 Designing Single-family Homes to Run on Clean Energy*
- *2022 Residential Electric Readiness*
- *2022 Single-family Buildings Just the Basics: HERS Verification*

Fact Sheets for Appliances

- *MAEDbS 101*

Check EnergyCodeAce.com for our latest 2022 tools, training and resources!

Create an account on the Energy Code Ace site and select an industry role for your profile in order to receive messages about all our offerings!

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