

## SUBCHAPTER 3

# NONRESIDENTIAL, HIGH-RISE RESIDENTIAL HOTEL/MOTEL OCCUPANCIES, AND COVERED PROCESSES—MANDATORY REQUIREMENTS

### SECTION 120.0 GENERAL

Sections 120.1 through 120.9 establish requirements for the design and installation of building envelopes, ventilation, space-conditioning and service water-heating systems and equipment in nonresidential, high-rise residential and hotel/motel buildings as well as covered processes that are within the scope of Section 100.0(a).

**NOTE:** The requirements of Sections 120.1 through 120.9 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 120.1 through 120.9 also apply to additions or alterations to existing buildings.

### SECTION 120.1 REQUIREMENTS FOR VENTILATION

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the requirements of Sections 120.1(a) through 120.1(e).

#### (a) General requirements.

1. All enclosed spaces in a building shall be ventilated in accordance with the requirements of this section and the *California Building Code*.

**Exception to Section 120.1(a)1:** Refrigerated warehouses and other spaces or buildings that are not normally used for human occupancy and work.

2. The outdoor air-ventilation rate and air-distribution assumptions made in the design of the ventilating system shall be clearly identified on the plans required by Section 10-103 of Title 24, Part 1.

**(b) Design requirements for minimum quantities of outdoor air.** Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:

#### 1. Natural ventilation.

- A. Naturally ventilated spaces shall be permanently open to and within 20 feet of operable wall or roof openings to the outdoors, the openable area of which is not less than 5 percent of the conditioned floor area of the naturally ventilated space. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening.

**Exception to Section 120.1(b)1A:** Naturally ventilated spaces in high-rise residential dwelling units and hotel/motel guest rooms shall be open to and within 25 feet of operable wall or roof openings to the outdoors.

- B. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied.

2. **Mechanical ventilation.** Each space that is not naturally ventilated under Item 1 above shall be ventilated with a mechanical system capable of providing an outdoor air rate no less than the larger of:

- A. The conditioned floor area of the space times the applicable ventilation rate from Table 120.1-A; or

- B. 15 cfm per person times the expected number of occupants. For meeting the requirement in Section 120.1(b)2B for spaces without fixed seating, the expected number of occupants shall be either the expected number specified by the building designer or one half of the maximum occupant load assumed for egress purposes in the *California Building Code*, whichever is greater. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the *California Building Code*.

**Exception to Section 120.1(b)2:** Transfer air. The rate of outdoor air required by Section 120.1(b)2 may be provided with air transferred from other ventilated spaces if:

- A. None of the spaces from which air is transferred have any unusual sources of indoor air contaminants; and
- B. The outdoor air that is supplied to all spaces combined is sufficient to meet the requirements of Section 120.1(b)2 for each space individually.

**(c) Operation and control requirements for minimum quantities of outdoor air.**

1. **Times of occupancy.** The minimum rate of outdoor air required by Section 120.1(b)2 shall be supplied to each space at all times when the space is usually occupied.

**Exception 1 to Section 120.1(c)1:** Demand control ventilation. In intermittently occupied spaces that do not have processes or operations that generate dusts, fumes, mists, vapors or gasses and are not provided with local exhaust ventilation (such as indoor operation of internal combustion engines or areas designated for unvented food service preparation), the rate of outdoor air may be reduced if the ventilation system serving the space is controlled by a demand control ventilation device complying with Section 120.1(c)4 or by an occupant sensor ventilation control device complying with Section 120.1(c)5.

**Exception 2 to Section 120.1(c)1:** Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(b)2 for up to 30 minutes at a time if the average rate for each hour is equal to or greater than the required ventilation rate.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 120.1(b)2 or three complete air changes shall be supplied to the entire building during the one-hour period immediately before the building is normally occupied.
3. **Required demand control ventilation.** HVAC systems with the following characteristics shall have demand ventilation controls complying with Section 120.1(c)4:
  - A. They have an air economizer; and
  - B. They serve a space with a design occupant density, or a maximum occupant load factor for egress purposes in the *California Building Code*, greater than or equal to 25 people per 1,000 square feet (40 square feet or less per person); and
  - C. They are either:
    - i. Single zone systems with any controls; or
    - ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level.

**Exception 1 to Section 120.1(c)3:** Classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1,000 square feet as specified by Section 120.1(b)2B, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.

**Exception 2 to Section 120.1(c)3:** Where space exhaust is greater than the design ventilation rate specified in Section 120.1(b)2B minus 0.2 cfm per square foot of conditioned area.

**Exception 3 to Section 120.1(c)3:** Spaces that have processes or operations that generate dusts, fumes, mists, vapors or gases and are not provided with local exhaust ventilation, such as indoor operation of internal combustion engines or areas designated for unvented food service preparation, or beauty salons shall not install demand control ventilation.

**Exception 4 to Section 120.1(c)3:** Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people as specified by Section 120.1(b)2B.

**Exception 5 to Section 120.1(c)3:** Spaces with an area of less than 1,500 square feet complying with Section 120.1(c)5.

4. **Demand control ventilation devices.**
  - A. For each system with demand control ventilation, CO<sub>2</sub> sensors shall be installed in each room that meets the criteria of Section 120.1(c)3 with no less than one sensor per 10,000 square feet of floor

space. When a zone or a space is served by more than one sensor, a signal from any sensor indicating that CO<sub>2</sub> is near or at the setpoint within a space shall trigger an increase in ventilation to the space;

- B. CO<sub>2</sub> sensors shall be located in the room between 3 feet and 6 feet above the floor or at the anticipated height of the occupants heads;
- C. Demand ventilation controls shall maintain CO<sub>2</sub> concentrations less than or equal to 600 ppm plus the outdoor air CO<sub>2</sub> concentration in all rooms with CO<sub>2</sub> sensors;

**Exception to Section 120.1(c)4C:** The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 120.1(b)2 regardless of CO<sub>2</sub> concentration.

- D. Outdoor air CO<sub>2</sub> concentration shall be determined by one of the following:
  - i. CO<sub>2</sub> concentration shall be assumed to be 400 ppm without any direct measurement; or
  - ii. CO<sub>2</sub> concentration shall be dynamically measured using a CO<sub>2</sub> sensor located within 4 feet of the outdoor air intake.
- E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in Table 120.1-A times the conditioned floor area for spaces with CO<sub>2</sub> sensors, plus the rate required by Section 120.1(b)2 for other spaces served by the system, or the exhaust air rate, whichever is greater.
- F. CO<sub>2</sub> sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section 120.1(b)2 to the zone serviced by the sensor at all times that the zone is occupied.
- G. The CO<sub>2</sub> sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.

5. **Occupant sensor ventilation control devices.** When occupancy sensor ventilation devices are required by Section 120.2(e)3 or when meeting Exception 5 to Section 120.1(c)3, occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present in accordance with the following:

- A. Occupant sensors shall meet the requirements in Section 110.9(b)4 and shall have suitable coverage and placement to detect occupants in the entire space ventilated. Occupant sensors controlling lighting may be used for ventilation as long as the venti-

lation signal is independent of daylighting, manual lighting overrides or manual control of lighting. When a single zone damper or a single zone system serves multiple rooms, there shall be an occupancy sensor in each room and the zone is not considered vacant until all rooms in the zone are vacant.

- B. One hour prior to normal scheduled occupancy, the occupancy sensor ventilation control shall allow pre-occupancy purge as described in Section 120.1(c)2.
- C. Within 30 minutes after being vacant for all rooms served by a zone damper on a multiple zone system, and the space temperature is between the heating and cooling setpoints, then no outside air is required and supply air shall be zero.
- D. Within 30 minutes after being vacant for all rooms served by a single zone system, the single zone system shall cycle off the supply fan when the space temperature is between the heating and cooling setpoints.
- E. In spaces equipped with an occupant sensor, when vacant during hours of expected occupancy and the occupied ventilation rate required by Section 120.1(b)2 is not provided, then the system or zone controls shall cycle or operate to maintain the average outdoor air rate over an averaging period of 120 minutes equal to 25 percent of the rate listed in Table 120.1-A.

**Exception to Section 120.1(c)5:** If demand control ventilation is implemented as required by Section 120.1(4).

(d) **Ducting for zonal heating and cooling units.** Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit, which then supplies the air to a space in order to meet the requirements of Section 120.1(b)2, the outdoor air shall be ducted to discharge either:

1. Within 5 feet of the unit; or
2. Within 15 feet of the unit, substantially toward the unit, and at a velocity not less than 500 feet per minute.

(e) **Design and control requirements for quantities of outdoor air.**

1. All mechanical ventilation and space-conditioning systems shall be designed with and have installed ductwork, dampers and controls to allow outside air rates to be operated at the larger of (1) the minimum levels specified in Section 120.1(b)1; or (2) the rate required for make-up of exhaust systems that are required for an exempt or covered process, for control of odors, or for the removal of contaminants within the space.
2. All variable air volume mechanical ventilation and space-conditioning systems shall include dynamic controls that maintain measured outside air ventilation rates within 10 percent of the required outside air ventilation rate at both full and reduced supply airflow conditions. Fixed minimum damper position is not considered to be dynamic and is not an allowed control strategy.

3. Measured outdoor air rates of constant volume mechanical ventilation and space-conditioning systems shall be within 10 percent of the required outside air rate.

**TABLE 120.1-A  
MINIMUM VENTILATION RATES**

TYPE OF USE	CFM PER SQUARE FOOT OF CONDITIONED FLOOR AREA
Auto repair workshops	1.50
Barber shops	0.40
Bars, cocktail lounges and casinos	0.2
Beauty shops	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Ventilation rates specified by the <i>California Building Code</i>
Hotel guest rooms (less than 500 ft <sup>2</sup> )	30 cfm/guest room
Hotel guest rooms (500 ft <sup>2</sup> or greater)	0.15
Retail stores	0.20
All others	0.15

**SECTION 120.2  
REQUIRED CONTROLS FOR SPACE-  
CONDITIONING SYSTEMS**

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.2(a) through 120.2(k).

(a) **Thermostatic controls for each zone.** The supply of heating and cooling energy to each space-conditioning zone or dwelling unit shall be controlled by an individual thermostatic control that responds to temperature within the zone and that meets the applicable requirements of Section 120.2(b). An energy management control system (EMCS) may be installed to comply with the requirements of one or more thermostatic controls if it complies with all applicable requirements for each thermostatic control.

**Exception to Section 120.2(a):** An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if:

1. All zones are also served by an interior cooling system;
2. The perimeter system is designed solely to offset envelope heat losses or gains;
3. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and
4. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

(b) **Criteria for zonal thermostatic controls.** The individual thermostatic controls required by Section 120.2(a) shall meet the following requirements as applicable:

1. Where used to control comfort heating, the thermostatic controls shall be capable of being set, locally or remotely, down to 55°F or lower.

2. Where used to control comfort cooling, the thermostatic controls shall be capable of being set, locally or remotely, up to 85°F or higher.
3. Where used to control both comfort heating and comfort cooling, the thermostatic controls shall meet Items 1 and 2 and shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

**Exception to Section 120.2(b)3:** Systems with thermostats that require manual changeover between heating and cooling modes.

4. Thermostatic controls for all single zone, air conditioners and heat pumps shall comply with the requirements of Section 110.2(c) and Reference Joint Appendix JA5 or, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section 120.2(h).

**Exception 1 to Section 120.2(b)4:** Systems serving exempt process loads that must have constant temperatures to prevent degradation of materials, a process, plants or animals.

**Exception 2 to Section 120.2(b)4:** Package terminal air conditioners, package terminal heat pumps, room air conditioners and room air conditioner heat pumps.

**(c) Hotel/motel guest room and high-rise residential dwelling unit thermostats.**

1. Hotel/motel guest room thermostats shall:
  - A. Have numeric temperature setpoints in °F and °C; and
  - B. Have setpoint stops, which are accessible only to authorized personnel, such that guest room occupants cannot adjust the setpoint more than ±5°F (±3°C); and
  - C. Meet the requirements of Section 150.0(i).

**Exception to Section 120.2(c)1:** Thermostats that are integrated into the room heating and cooling equipment.

2. High-rise residential dwelling unit thermostats shall meet the requirements of Section 150.0(i).

**(d) Heat pump controls.** All heat pumps with supplementary electric resistance heaters shall be installed with controls that comply with Section 110.2(b).

**(e) Shut-off and reset controls for space-conditioning systems.** Each space-conditioning system shall be installed with controls that comply with the following:

1. The control shall be capable of automatically shutting off the system during periods of nonuse and shall have:
  - A. An automatic time switch control device complying with Section 110.9(c), with an accessible manual override that allows operation of the system for up to 4 hours; or
  - B. An occupancy sensor; or
  - C. A 4-hour timer that can be manually operated.

**Exception to Section 120.2(e)1:** Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches and theaters equipped with 7-day programmable timers.

2. The control shall automatically restart and temporarily operate the system as required to maintain:
  - A. A setback heating thermostat setpoint if the system provides mechanical heating; and

**Exception to Section 120.2(e)2A:** Thermostat setback controls are not required in nonresidential buildings in areas where the Winter Median of Extremes outdoor air temperature determined in accordance with Section 140.4(b)4 is greater than 32°F.

- B. A setup cooling thermostat setpoint if the system provides mechanical cooling.

**Exception to Section 120.2(e)2B:** Thermostat setup controls are not required in nonresidential buildings in areas where the Summer Design Dry Bulb 0.5 percent temperature determined in accordance with Section 140.4(b)4 is less than 100°F.

3. Multipurpose room less than 1,000 square feet, classrooms greater than 750 ft<sup>2</sup> and conference, convention, auditorium and meeting center rooms greater than 750 square feet that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following during unoccupied periods:

- A. Automatically set up the operating cooling temperature set point by 2°F or more and set back the operating heating temperature set point by 2°F or more; and
  - B. Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.

**Exception 1 to Sections 120.2(e)1, 2, 3:** Where it can be demonstrated to the satisfaction of the enforcing agency that the system serves an area that must operate continuously.

**Exception 2 to Sections 120.2(e)1, 2, 3:** Where it can be demonstrated to the satisfaction of the enforcing agency that shutdown, setback and setup will not result in a decrease in overall building source energy use.

**Exception 3 to Sections 120.2(e)1, 2, 3:** Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

**Exception 4 to Sections 120.2(e) 1 and 2:** Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

**Exception 5 to Section 120.2(e)3:** If demand control ventilation is implemented as required by Sections 120.1(c)3 and 120.1(c)4.

4. Hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, setpoints are set up at least +5°F (+3°C) in cooling mode and set down at least -5°F (-3°C) in heating mode.

**(f) Dampers for air supply and exhaust equipment.**

Outdoor air supply and exhaust equipment shall be installed with dampers that automatically close upon fan shutdown.

**Exception 1 to Section 120.2(f):** Where it can be demonstrated to the satisfaction of the enforcing agency that the equipment serves an area that must operate continuously.

**Exception 2 to Section 120.2(f):** Gravity and other non-electrical equipment that has readily accessible manual damper controls.

**Exception 3 to Section 120.2(f):** At combustion air intakes and shaft vents.

**Exception 4 to Section 120.2(f):** Where prohibited by other provisions of law.

**(g) Isolation area devices.** Each space-conditioning system serving multiple zones with a combined conditioned floor area of more than 25,000 square feet shall be designed, installed and controlled to serve isolation areas.

1. Each zone, or any combination of zones not exceeding 25,000 square feet, shall be a separate isolation area.
2. Each isolation area shall be provided with isolation devices, such as valves or dampers, that allow the supply of heating or cooling to be reduced or shut off independently of other isolation areas.
3. Each isolation area shall be controlled by a device meeting the requirements of Section 120.2(e)1.

**Exception to Section 120.2(g):** A zone need not be isolated if it can be demonstrated to the satisfaction of the enforcement agency that the zone must be heated or cooled continuously.

**(h) Automatic demand shed controls.** HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for noncritical zones as follows:

1. The controls shall have a capability to remotely set up the operating cooling temperature set points by four degrees or more in all noncritical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
2. The controls shall have a capability to remotely set down the operating heating temperature set points by four degrees or more in all noncritical zones on signal from a centralized contact or software point within an EMCS.
3. The controls shall have capabilities to remotely reset the temperatures in all noncritical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
4. The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.

5. The controls shall have the following features:

- A. Disabled. Disabled by authorized facility operators; and
- B. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and
- C. Automatic demand shed control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in Subsections 120.2(h)1 and 120.2(h)2, for noncritical zones during the demand response period.

**(i) Economizer fault detection and diagnostics (FDD).**

All newly installed air-cooled packaged direct-expansion units with an air handler, mechanical cooling capacity greater than 54,000 Btu/hr with an installed air economizer shall include a stand alone or integrated Fault Detection and Diagnostics (FDD) system in accordance with Subsections 120.2(i)1 through 120.2(i)8.

1. The following temperature sensors shall be permanently installed to monitor system operation: outside air, supply air, and when required for differential economizer operation a return air sensor, and
2. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F; and
3. The controller shall have the capability of displaying the value of each sensor; and
4. The controller shall provide system status by indicating the following conditions:
  - A. Free cooling available;
  - B. Economizer enabled;
  - C. Compressor enabled;
  - D. Heating enabled, if the system is capable of heating; and
  - E. Mixed-air low limit cycle active.
5. The unit controller shall manually initiate each operating mode so that the operation of compressors, economizers, fans and heating system can be independently tested and verified; and
6. Faults shall be reported in one of the following ways:
  - A. Reported to an Energy Management Control System regularly monitored by facility personnel.
  - B. Annunciated locally on one or more zone thermostats, or a device within five (5) feet of zone thermostat(s), clearly visible, at eye level, and meeting the following requirements:
    - i. On the thermostat, device, or an adjacent written sign, display instructions to contact appropriate building personnel or an HVAC technician; and
    - ii. In buildings with multiple tenants, the annunciation shall either be within property manage-

ment offices or in a common space accessible by the property or building manager.

C. Reported to a fault management application which automatically provides notification of the fault to a remote HVAC service provider.

7. The FDD system shall detect the following faults:

- A. Air temperature sensor failure/fault;
- B. Not economizing when it should;
- C. Economizing when it should not;
- D. Damper not modulating; and
- E. Excess outdoor air.

8. The FDD System shall be certified by the Energy Commission as meeting requirements of Subsections 120.2(i)1 through 120.2(i)7 in accordance with Section 110.0 and JA6.3.

(j) **Direct Digital Controls (DDC).** Direct Digital Controls to the zone shall be provided as specified by Table 120.2-A.

The provided DDC system shall meet the control logic requirements of Sections 120.1(c) and 120.2(h), and be capable of the following:

- 1. Monitoring zone and system demand for fan pressure, pump pressure, heating and cooling;
- 2. Transferring zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers;
- 3. Automatically detecting the zones and systems that may be excessively driving the reset logic and generate an alarm or other indication to the system operator;
- 4. Readily allow operator removal of zones(s) from the reset algorithm;
- 5. For new buildings, trending and graphically displaying input and output points; and

6. Resetting heating and cooling setpoints in all noncritical zones upon receipt of a signal from a centralized contact or software point as described in Section 120.2(h).

(k) **Optimum start/stop controls.** Space conditioning systems with DDC to the zone level shall have optimum start/stop controls. The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint, the outdoor air temperature, and the amount of time prior to scheduled occupancy. Mass radiant floor slab systems shall incorporate floor temperature onto the optimum start algorithm.

**SECTION 120.3  
REQUIREMENTS FOR PIPE INSULATION**

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.3(a) through 120.3(c).

(a) **General requirements.** The piping conditions listed below for space-conditioning and service water-heating systems with fluid temperatures listed in Table 120.3-A, shall have the amount of insulation specified in Subsection (c):

- 1. **Space cooling systems.** All refrigerant suction, chilled water and brine lines.
- 2. **Space heating systems.** All steam, steam condensate and hot water lines.
- 3. **Service water-heating systems.**
  - A. Recirculating system piping, including the supply and return piping of the water heater.
  - B. The first 8 feet of hot and cold outlet piping for a nonrecirculating storage system.
  - C. The inlet pipe between the storage tank and a heat trap in a nonrecirculating storage system.
  - D. Pipes that are externally heated.

**TABLE 120.2-A  
DDC APPLICATIONS AND QUALIFICATIONS**

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

**TABLE 120.3-A  
PIPE INSULATION THICKNESS**

FLUID TEMPERATURE RANGE, (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)						
			< 1	1 to < 1.5	1.5 to < 4	4 to < 8	8 and larger		
			INSULATION THICKNESS REQUIRED (in inches)						
Space heating, hot water systems (steam, steam condensate and hot water) and service water heating systems (recirculating sections, all piping in electric trace tape systems, and the first 8 feet of piping from the storage tank for nonrecirculating systems)									
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0		
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5		
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0		
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0		
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5		
Space cooling systems (chilled water, refrigerant and brine)									
40-60	0.21-0.27	75	Nonres 0.5	Res 0.75	Nonres 0.5	Res 0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5	1.5	

Insulation conductivity shall be determined in accordance with ASTM C335 at the mean temperature listed in Table 120.3-A, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F.

(b) **Insulation protection.** Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, including but not limited to, the following:

1. Insulation exposed to weather shall be installed with a cover suitable for outdoor service. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material.
2. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall have a Class I or Class II vapor retarder. All penetrations and joints of which shall be sealed.

(c) **Insulation thickness**

1. For insulation with a conductivity in the range shown in Table 120.3-A for the applicable fluid temperature range, the insulation shall have the applicable thickness shown in Table 120.3-A.
2. For insulation with a conductivity outside the range shown in Table 120.3-A for the applicable fluid temperature range, the insulation shall have a minimum thickness as calculated:

**INSULATION THICKNESS EQUATION**

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

where:

T = minimum insulation thickness for material with conductivity K, inches.

PR = pipe actual outside radius, inches.

t = insulation thickness from Table 120.3-A, inches.

K = conductivity of alternate material at the mean rating temperature indicated in Table 120.3-A for the applicable fluid temperature range, in Btu-inch per hour per square foot per °F.

k = The lower value of the conductivity range listed in Table 120.3-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

**Exception 1 to Section 120.3:** Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

**Exception 2 to Section 120.3:** Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

**Exception 3 to Section 120.3:** Gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

**Exception 4 to Section 120.3:** Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

**Exception 5 to Section 120.3:** Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing.

**SECTION 120.4  
REQUIREMENTS FOR AIR DISTRIBUTION  
SYSTEM DUCTS AND PLENUMS**

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.4(a) through 120.4(f).

(a) **CMC compliance.** All air distribution system ducts and plenums, including but not limited to building cavities, mechanical closets, air-handler boxes and support platforms used as ducts or plenums, shall be installed, sealed and insulated to meet the requirements of the CMC Sections 601.0, 602.0, 603.0, 604.0, and 605.0, and ANSI/SMACNA-006-2006 HVAC *Duct Construction Standards Metal and Flexible*, 3rd Edition incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than  $\frac{1}{4}$  inch, the combination of mastic and either mesh or tape shall be used.

Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum installed level of R-8:

1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

Portions of supply-air ducts that are not in one of these spaces, including ducts buried in concrete slab, shall be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 605.0) or be enclosed in directly conditioned space.

**(b) Duct and plenum materials.**

**1. Factory-fabricated duct systems.**

- A. All factory-fabricated duct systems shall comply with UL 181 for ducts and closure systems, including collars, connections and splices, and be labeled as complying with UL 181. UL 181 testing may be performed by UL laboratories or a laboratory approved by the Executive Director.
- B. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181 and UL 181A.
- C. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 and UL 181B.
- D. Joints and seams of duct systems and their components shall not be sealed with cloth-back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

**2. Field-fabricated duct systems.**

- A. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems shall comply with UL 181. All pressure-sensitive tapes, mastics, aerosol sealants or other closure systems used for installing field-fabricated duct systems shall meet the applicable requirements of UL 181, UL 181A and UL 181B.

**B. Mastic sealants and mesh.**

- i. Sealants shall comply with the applicable requirements of UL 181, UL 181A and UL 181B, and be nontoxic and water resistant.
- ii. Sealants for interior applications shall pass ASTM C731 (extrudability after aging) and D2202 (slump test on vertical surfaces), incorporated herein by reference.
- iii. Sealants for exterior applications shall pass ASTM tests C731, C732 (artificial weathering test), and D2202, incorporated herein by reference.
- iv. Sealants and meshes shall be rated for exterior use.

**C. Pressure-sensitive tape.** Pressure-sensitive tapes shall comply with the applicable requirements of UL 181, UL 181A and UL 181B.

**D. Joints and seams of duct systems and their components** shall not be sealed with cloth-back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

**E. Drawbands used with flexible duct.**

- i. Drawbands shall be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.
- ii. Drawbands shall have a minimum tensile strength rating of 150 pounds.
- iii. Drawbands shall be tightened as recommended by the manufacturer with an adjustable tensioning tool.

**F. Aerosol-sealant closures.**

- i. Aerosol sealants shall meet the requirements of UL 723 and be applied according to manufacturer specifications.
- ii. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.

(c) All duct insulation product *R*-values shall be based on insulation only (excluding air films, vapor retarders or other duct components) and tested *C*-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C518 or ASTM C177, incorporated herein by reference, and certified pursuant to Section 110.8.

(d) The installed thickness of duct insulation used to determine its *R*-value shall be determined as follows:

1. For duct board, duct liner and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
2. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.
3. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.



(e) Insulated flexible duct products installed to meet this requirement must include labels, in maximum intervals of 3 feet, showing the thermal performance *R*-value for the duct insulation itself (excluding air films, vapor retarder or other duct components), based on the tests in Section 120.4(c) and the installed thickness determined by Section 120.4(d)3.

(f) **Protection of insulation.** Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, but not limited to the following:

Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

### SECTION 120.5 REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.5(a) through 120.5(b).

(a) Before an occupancy permit is granted, the following equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements:

1. Outdoor air ventilation systems shall be tested in accordance with NA7.5.1.
2. Constant volume, single zone unitary air conditioning and heat pump unit controls shall be tested in accordance with NA7.5.2.
3. Duct systems shall be tested in accordance with NA7.5.3 where either:
  - A. They are new duct systems that meet the criteria of Sections 140.4(k)1, 140.4(l)2 and 140.4(l)3, or
  - B. They are part of a system that meets the criteria of Section 141.0(b)2D.
4. Air economizers shall be tested in accordance with NA7.5.4.

**Exception to Section 120.5(a)4:** Air economizers installed by the HVAC system manufacturer and certified to the Commission as being factory calibrated and tested are exempt from the Functional Testing section of the air economizer controls acceptance test as described in NA7.5.4.2.

5. Demand control ventilation systems required by Section 120.1(c)3 shall be tested in accordance with NA7.5.5.
6. Supply fan variable flow controls shall be tested in accordance with NA7.5.6.
7. Hydronic system variable flow controls shall be tested in accordance with NA7.5.7 and NA7.5.9.

8. Boiler or chillers that require isolation controls as specified by Section 140.4(k)2 or 140.4(k)3 shall be tested in accordance with NA7.5.7.
9. Hydronic systems with supply water temperature reset controls shall be tested in accordance with NA7.5.8.
10. Automatic demand shed controls shall be tested in accordance with NA7.5.10.
11. Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units shall be tested in accordance with NA7.5.11.
12. Automatic fault detection and diagnostics (FDD) for air handling units and zone terminal units shall be tested in accordance with NA7.5.12.
13. Distributed Energy Storage DX AC Systems shall be tested in accordance with NA7.5.13.
14. Thermal Energy Storage (TES) Systems shall be tested in accordance with NA7.5.14.
15. Supply air temperature reset controls shall be tested in accordance with NA7.5.15.
16. Water-cooled chillers served by cooling towers with condenser water reset controls shall be tested in accordance with NA7.5.16.
17. When an energy management control system is installed, it shall functionally meet all of the applicable requirements of Part 6.

(b) When certification is required by Title 24, Part 1, Section 10-103.2, the acceptance testing specified by Section 120.5(a) shall be performed by a certified mechanical acceptance test technician (CMATT). If the CMATT is operating as an employee, the CMATT shall be employed by a certified mechanical acceptance test employer. The CMATT shall disclose on the certificate of acceptance a valid CMATT certification identification number issued by an approved acceptance test technician certification provider. The CMATT shall complete all certificate of acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.

**Note:** Authority cited: Sections 25402, 25402.1 and 25213 *Public Resources Code*. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910 *Public Resources Code*.

### SECTION 120.6 MANDATORY REQUIREMENTS FOR COVERED PROCESSES

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.6(a) through 120.6(g).

(a) **Mandatory requirements for refrigerated warehouses.**

Refrigerated warehouses that are greater than or equal to 3,000 square feet shall meet the requirements of Subsections 1, 2, 3, 6 and 7 of Section 120.6(a).

Refrigerated spaces that are less than 3,000 square feet shall meet the requirements of the Appliance Efficiency Regulations for walk-in coolers or freezers contained in the Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601 through 1608).

Refrigerated spaces that (i) comprise a total of 3,000 square feet or more; and (ii) are collectively served by the same refrigeration system compressor(s) and condenser(s) shall meet the requirements of Subsections 4, 5 and 7 of Section 120.6(a).

1. **Insulation requirements.** Exterior surfaces of refrigerated warehouses shall be insulated at least to the R-values in Table 120.6-A.

**TABLE 120.6-A REFRIGERATED WAREHOUSE INSULATION**

SPACE	SURFACE	MINIMUM R-VALUE (°F-hr-sf/Btu)
Freezers	Roof/ceiling	R-40
	Wall	R-36
	Floor	R-35
	Floor with all heating from productive refrigeration capacity <sup>1</sup>	R-20
Coolers	Roof/ceiling	R-28
	Wall	R-28

1. All underslab heating is provided by a heat exchanger that provides refrigerant subcooling or other means that result in productive refrigeration capacity on the associated refrigerated system.

2. **Underslab heating.** Electric resistance heat shall not be used for the purposes of underslab heating.

**Exception to Section 120.6(a)2:** Underslab heating systems controlled such that the electric resistance heat is thermostatically controlled and disabled during the summer on-peak period defined by the local electric utility.

3. **Evaporators.** New fan-powered evaporators used in coolers and freezers shall conform to the following:

A. Single phase fan motors less than 1 hp and less than 460 Volts in newly installed evaporators shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions.

B. Evaporator fans served either by a suction group with multiple compressors or by a single compressor with variable capacity capability shall be variable

speed and the speed shall be controlled in response to space temperature or humidity.

**Exception 1 to Section 120.6(a)3B:** Addition, alteration or replacement of less than all of the evaporators in an existing refrigerated space that does not have speed-controlled evaporators.

**Exception 2 to Section 120.6(a)3B:** Coolers within refrigerated warehouses that maintain a controlled atmosphere for which a licensed engineer has certified that the types of products stored will require constant operation at 100 percent of the design airflow.

**Exception 3 to Section 120.6(a)3B:** Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products, including but not limited to spaces with design cooling capacities of greater than 240 Btu/hr-ft<sup>2</sup> (2 tons per 100 square feet).

- C. Evaporator fans served by a single compressor that does not have variable capacity shall utilize controls to reduce airflow by at least 40 percent for at least 75 percent of the time when the compressor is not running.

**Exception to Section 120.6(a)3C:** Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products [space with design cooling capacities of greater than 240 Btu/hr-ft<sup>2</sup> (2 tons per 100 square feet)].

4. **Condensers.** New fan-powered condensers on new refrigeration systems shall conform to the following:

A. Design saturated condensing temperatures for evaporative-cooled condensers and water-cooled condensers served by fluid coolers or cooling towers shall be less than or equal to:

- i. The design wetbulb temperature plus 20°F in locations where the design wetbulb temperature is less than or equal to 76°F;
- ii. The design wetbulb temperature plus 19°F in locations where the design wetbulb temperature is between 76°F and 78°F; or
- iii. The design wetbulb temperature plus 18°F in locations where the design wetbulb temperature is greater than or equal to 78°F.

**Exception to Section 120.6(a)4A:** Compressors and condensers on a refrigeration system for which more

**TABLE 120.6-B FAN-POWERED CONDENSERS – MINIMUM EFFICIENCY REQUIREMENTS**

CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM EFFICIENCY	RATING CONDITION
Outdoor evaporative cooled with THR Capacity > 8,000 MBH	All	350 Btuh/Watt	100°F saturated condensing temperature (SCT), 70°F outdoor wetbulb temperature
Outdoor evaporative cooled with THR Capacity < 8,000 MBH and indoor evaporative cooled	All	160 Btuh/Watt	
Outdoor air cooled	Ammonia	75 Btuh/Watt	105°F saturated condensing temperature (SCT), 95°F outdoor drybulb temperature
	Halocarbon	65 Btuh/Watt	
Indoor air cooled	All		Exempt

than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

B. Design saturated condensing temperatures for air-cooled condensers shall be less than or equal to the design drybulb temperature plus 10°F for systems serving freezers and shall be less than or equal to the design drybulb temperature plus 15°F for systems serving coolers.

**Exception 1 to Section 120.6(a)4B:** Condensing units with a total compressor horsepower less than 100 HP.

**Exception 2 to Section 120.6(a)4B:** Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or/freezing, or process refrigeration cooling for other than a refrigerated space.

C. All condenser fans for evaporative-cooled condensers or fans on cooling towers or fluid coolers shall be continuously variable speed, and the condensing temperature control system shall control the speed of all fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

D. All condenser fans for air-cooled condensers shall be continuously variable speed, and the condensing temperature or pressure control system shall control the speed of all condenser fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

E. Condensing temperature reset. The condensing temperature set point of systems served by air-cooled condensers shall be reset in response to ambient drybulb temperature. The condensing temperature set point of systems served by evaporative-cooled condensers or water-cooled condensers (via cooling towers or fluid coolers) shall be reset in response to ambient wetbulb temperatures.

**Exception to Section 120.6(a)4E:** Condensing temperature control strategies approved by the Executive Director that have been demonstrated to provide at least equal energy savings.

F. Fan-powered condensers shall meet the condenser efficiency requirements listed in Table 120.6-B. Condenser efficiency is defined as the total heat of rejection (THR) capacity divided by all electrical input power including fan power at 100 percent fan speed, and power of spray pumps for evaporative condensers.

G. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

**Exception to Section 120.6(a)4G:** Micro-channel condensers.

5. **Compressors.** Compressor systems utilized in refrigerated warehouses shall conform to the following:

A. Compressors shall be designed to operate at a minimum condensing temperature of 70°F or less.

B. New open-drive screw compressors in new refrigeration systems with a design saturated suction temperature (SST) of 28°F or lower that discharges to the system condenser pressure shall control compressor speed in response to the refrigeration load.

**Exception 1 to Section 120.6(a)5B:** Refrigeration plants with more than one dedicated compressor per suction group.

**Exception 2 to Section 120.6(a)5B:** Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

C. New screw compressors with nominal electric motor power greater than 150 HP shall include the ability to automatically vary the compressor volume ratio (Vi) in response to operating pressures.

6. **Infiltration barriers.** Passageways between freezers and higher-temperature spaces, and passageways between coolers and nonrefrigerated spaces, shall have an infiltration barrier consisting of strip curtains, an automatically-closing door or an air curtain designed by the manufacturer for use in the passageway and temperature for which it is applied.

**Exception 1 to Section 120.6(a)6:** Openings with less than 16 square feet of opening area.

**Exception 2 to Section 120.6(a)6:** Dock doorways for trailers.

7. **Refrigeration system acceptance.** Before an occupancy permit is granted for a new refrigerated warehouse, or before a new refrigeration system serving a refrigerated warehouse is operated for normal use, the following equipment and systems shall be certified as meeting the acceptance requirements for code compliance, as specified by the Reference Nonresidential Appendix NA7. A certificate of acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements:

A. Electric resistance underslab heating systems shall be tested in accordance with NA7.10.1.

B. Evaporators fan motor controls shall be tested in accordance with NA7.10.2.

C. Evaporative condensers shall be tested in accordance with NA7.10.3.1.

D. Air-Cooled condensers shall be tested in accordance with NA7.10.3.2.

E. Variable speed compressors shall be tested in accordance with NA7.10.4.

**(b) Mandatory requirements for commercial refrigeration.**

Retail food stores with 8,000 square feet or more of conditioned area, and that utilize either:

Refrigerated display cases, or

Walk-in coolers or freezers connected to remote compressor units or condensing units, shall meet the requirements of Subsections 1 through 4.

**1. Condensers serving refrigeration systems.** Fan-powered condensers shall conform to the following requirements:

A. All condenser fans for air-cooled condensers, evaporative-cooled condensers, air- or water-cooled fluid coolers or cooling towers shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.

B. The refrigeration system condenser controls for systems with air-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature.

C. The refrigeration system condenser controls for systems with evaporative-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient wetbulb temperature.

**Exception to Section 120.6(b)1B and C:** Condensing temperature control strategies approved by the executive director that have been demonstrated to provide equal energy savings.

D. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

E. Fan-powered condensers shall meet the specific efficiency requirements listed in Table 120.6-C.

**TABLE 120.6-C  
FAN-POWERED CONDENSERS –  
SPECIFIC EFFICIENCY REQUIREMENTS**

CONDENSER TYPE	MINIMUM SPECIFIC EFFICIENCY <sup>a</sup>	RATING CONDITION
Evaporative cooled	160 Btuh/Watt	100°F saturated condensing temperature (SCT), 70°F outdoor wetbulb temperature
Air cooled	160 Btuh/Watt	105°F saturated condensing temperature (SCT), 95°F outdoor drybulb temperature

a. See Section 100.1 for definition of condenser specific efficiency.

**Exception 1 to Section 120.6(b)1E:** Condensers with a total heat rejection capacity of less than 150,000 Btuh at the specific efficiency rating condition.

**Exception 2 to Section 120.6(b)1E:** Stores located in Climate Zone 1.

**Exception 3 to Section 120.6(b)1E:** Existing condensers that are reused for an addition or alteration.

F. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

**Exception 1 to Section 120.6(b)1F:** Microchannel condensers.

**Exception 2 to Section 120.6(b)1F:** Existing condensers that are reused for an addition or alteration.

**Exception to Section 120.6(b)1:** New condensers replacing existing condensers when the attached compressor system total heat of rejection does not increase and less than 25 percent of both the attached compressors and the attached display cases are new.

**2. Compressor systems.** Refrigeration compressor systems and condensing units shall conform to the following requirements:

A. Compressors and multiple-compressor suction groups shall include control systems that use floating suction pressure logic to reset the target saturated suction temperature based on the temperature requirements of the attached refrigeration display cases or walk-ins.

**Exception 1 to Section 120.6(b)2A:** Single compressor systems that do not have continuously variable capacity capability.

**Exception 2 to Section 120.6(b)2A:** Suction groups that have a design saturated suction temperature of 30°F or higher, or suction groups that comprise the high stage of a two-stage or cascade system or that primarily serve chillers for secondary cooling fluids.

B. Liquid subcooling shall be provided for all low temperature compressor systems with a design cooling capacity equal or greater than 100,000 Btu/hr with a design saturated suction temperature of -10°F or lower, with the subcooled liquid temperature maintained continuously at 50°F or less at the exit of the subcooler, using compressor economizer port(s) or a separate medium or high temperature suction group operating at a saturated suction temperature of 18°F or higher.

**Exception 1 to Section 120.6(b)2B:** Low temperature cascade systems that condense into another refrigeration system rather than condensing to ambient temperature.

**Exception to Section 120.6(b)2A and 2B:** Existing compressor systems that are reused for an addition or alteration.

**3. Refrigerated display cases.** Lighting in refrigerated display cases, and lights on glass doors installed on walk-in coolers and freezers shall be controlled by one of the following:

A. Automatic time switch controls to turn off lights during nonbusiness hours. Timed overrides for any line-up or walk-in case may only be used to turn the lights on for up to one hour. Manual overrides shall

time-out automatically to turn the lights off after one hour.

- B. Motion sensor controls on each case that reduce display case lighting power by at least 50 percent within 30 minutes after the area near the case is vacated.

4. **Refrigeration heat recovery.**

- A. HVAC systems shall utilize heat recovery from refrigeration system(s) for space heating, using no less than 25 percent of the sum of the design total heat of rejection of all refrigeration systems that have individual total heat of rejection values of 150,000 Btu/h or greater at design conditions.

**Exception 1 to Section 120.6(b)4A:** Stores located in Climate Zone 15.

**Exception 2 to Section 120.6(b)4A:** HVAC systems or refrigeration systems that are reused for an addition or alteration.

- B. The increase in hydrofluorocarbon refrigerant charge associated with refrigeration heat recovery equipment and piping shall be no greater than 0.35 lbs per 1,000 Btu/h of heat recovery heating capacity.

(c) **Mandatory requirements for enclosed parking garages.**

Mechanical ventilation systems for enclosed parking garages where the total design exhaust rate for the garage is greater than or equal to 10,000 cfm shall conform to all of the following:

1. Automatically detect contaminant levels and stage fans or modulate fan airflow rates to 50 percent or less of design capacity, provided acceptable contaminant levels are maintained.
2. Have controls and/or devices that will result in fan motor demand of no more than 30 percent of design wattage at 50 percent of design airflow.
3. CO shall be monitored with at least one sensor per 5,000 square feet, with the sensor located in the highest expected concentration locations, with at least two sensors per proximity zone. A proximity zone is defined as an area that is isolated from other areas either by floor or other impenetrable obstruction.
4. CO concentration at all sensors is maintained at  $\leq 25$  ppm or less at all times.
5. The ventilation rate shall be at least 0.15 cfm/ft<sup>2</sup> when the garage is scheduled to be occupied.
6. The system shall maintain the garage at negative or neutral pressure relative to other occupiable spaces when the garage is scheduled to be occupied.
7. CO sensors shall be:
  - A. Certified by the manufacturer to be accurate within plus or minus 5 percent of measurement.
  - B. Factory calibrated.

- C. Certified by the manufacturer to drift no more than 5 percent per year.

- D. Certified by the manufacturer to require calibration no more frequently than once a year.

- E. Monitored by a control system. The system shall have logic that automatically checks for sensor failure by the following means. Upon detection of a failure, the system shall reset to design ventilation rates and transmit an alarm to the facility operators.

- i. If any sensor has not been calibrated according to the manufacturer's recommendations within the specified calibration period, the sensor has failed.

- ii. During unoccupied periods the system compares the readings of all sensors, e.g., if any sensor is more than 15 ppm above or below the average of all sensors for longer than four hours, the sensor has failed.

- iii. During occupied periods the system compares the readings of sensors in the same proximity zone, e.g., if the 30 minute rolling average for any sensor in a proximity zone is more than 15 ppm above or below the 30 minute rolling average for other sensor(s) in that proximity zone, the sensor has failed.

8. **Parking garage ventilation system acceptance.**

Before an occupancy permit is granted for a parking garage system subject to Section 120.6(c), the following equipment and systems shall be certified as meeting the acceptance requirements for code compliance, as specified by the Reference Nonresidential Appendix NA7. A certificate of acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.12.

**Exception 1 to Section 120.6(c):** Any garage, or portion of a garage, where more than 20 percent of the vehicles expected to be stored have nongasoline combustion engines.

**Exception 2 to Section 120.6(c):** Additions and alterations to existing garages where less than 10,000 cfm of new exhaust capacity is being added.

(d) **Mandatory requirements for process boilers.**

1. Combustion air positive shut-off shall be provided on all newly installed process boilers as follows:
  - A. All process boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
  - B. All process boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).
2. Process boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:
  - A. The fan motor shall be driven by a variable speed drive; or

- B. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.
- 3. Newly installed process boilers with an input capacity of 5 MMBtu/h (5,000,000 Btu/h) to 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent. Combustion air volume shall be controlled with respect to firing rate or measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.
- 4. Newly installed process boilers with an input capacity greater than 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 3.0 percent by volume on a dry basis over firing rates of 20 to 100 percent. Combustion air volume shall be controlled with respect to measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

**(e) Mandatory requirements for compressed air systems.**

All new compressed air systems, and all additions or alterations of compressed air systems where the total combined online horsepower (hp) of the compressor(s) is 25 horsepower or more shall meet the requirements of Subsections 1 through 3. These requirements apply to the compressors and related controls that provide compressed air and do not apply to any equipment or controls that use or process the compressed air.

**Exception to Section 120.6(e):** Alterations of existing compressed air systems that include one or more centrifugal compressors.

- 1. **Trim compressor and storage.** The compressed air system shall be equipped with an appropriately sized trim compressor and primary storage to provide acceptable performance across the range of the system and to avoid control gaps. The compressed air system shall comply with Subsection A or B below.
  - A. The compressed air system shall include one or more variable speed drive (VSD) compressors. For systems with more than one compressor, the total combined capacity of the VSD compressor(s) acting as trim compressors must be at least 1.25 times the largest net capacity increment between combinations of compressors. The compressed air system shall include primary storage of at least one gallon per actual cubic feet per minute (acfm) of the largest trim compressor; or
  - B. The compressed air system shall include a compressor or set of compressors with total effective trim capacity at least the size of the largest net capacity increment between combinations of compressors, or the size of the smallest compressor, whichever is larger. The total effective trim capacity of single compressor systems shall cover at least the range

from 70 to 100 percent of rated capacity. The effective trim capacity of a compressor is the size of the continuous operational range where the specific power of the compressor (kW/100 acfm) is within 15 percent of the specific power at its most efficient operating point. The total effective trim capacity of the system is the sum of the effective trim capacity of the trim compressors. The system shall include primary storage of at least 2 gallons per acfm of the largest trim compressor.

**Exception 1 to Section 120.6(e)1:** Compressed air systems in existing facilities that are adding or replacing less than 50 percent of the online capacity of the system.

**Exception 2 to Section 120.6(e)1:** Compressed air systems that have been approved by the Energy Commission Executive Director as having demonstrated that the system serves loads for which typical air demand fluctuates less than 10 percent.

- 2. **Controls.** Compressed air systems with more than one compressor online, having a combined horsepower rating of more than 100 hp, must operate with a controller that is able to choose the most energy efficient combination of compressors within the system based on the current air demand as measured by a sensor.
- 3. **Compressed air system acceptance.** Before an occupancy permit is granted for a compressed air system subject to Section 120.6(e), the following equipment and systems shall be certified as meeting the acceptance requirements for code compliance, as specified by the Reference Nonresidential Appendix NA7. A certificate of acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA 7.13.

**(f) Mandatory requirements for elevators.**

- 1. The light power density for the luminaires inside the elevator cab shall be no greater than 0.6 watts per square foot.
- 2. Elevator cab ventilation fans for cabs without space conditioning shall not exceed 0.33 watts per CFM as measured at maximum speed.
- 3. When the elevator cab is stopped and unoccupied with doors closed for over 15 minutes, the cab interior lighting and ventilation fans shall be switched off until elevator cab operation resumes.
- 4. Lighting and ventilation shall remain operational in the event that the elevator cabin gets stuck when passengers are in the cabin.
- 5. **Elevator Lighting and Ventilation Control Acceptance.** Before an occupancy permit is granted for elevators subject to 120.6(f), the following equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.14.

**Exception 1 to Section 120.6(f)1:** Interior signal lighting and interior display lighting are not included in the calculation of lighting power density.

**(g) Mandatory requirements for escalators and moving walkways.**

1. Escalators and moving walkways located in airports, hotels, and transportation function areas shall automatically slow to the minimum permitted speed in accordance with ASME A17.1/CSA B44 when not conveying passengers.
2. Escalators and Moving Walkways Acceptance. Before an occupancy permit is granted for escalators and moving walkways subject to 120.6(g), the following equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.15.

**SECTION 120.7  
MANDATORY INSULATION REQUIREMENTS**

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements in Sections 120.7(a) through 120.7(c).

**(a) Roof/Ceiling insulation.** The opaque portions of the roof/ceiling that separates conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

1. **Metal building.** The weighted average *U*-factor of the roof assembly shall not exceed 0.098.
2. **Wood framed and others.** The weighted average *U*-factor of the roof assembly shall not exceed 0.075.
3. **Insulation placement.** Insulation installed to limit heat loss and gain from conditioned spaces to unconditioned spaces shall comply with the following:
  - A. Insulation shall be installed in direct contact with a continuous roof or ceiling, which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of the finished ceiling; and
  - B. When insulation is installed at the roof in nonresidential buildings, fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed and the space between the ceiling and the roof is either directly or indirectly conditioned space and shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements; and
  - C. Insulation placed on top of a suspended ceiling with removable ceiling panels shall not be used to meet the Roof/Ceiling requirement of Sections 140.3 and 141.0.

**Exception to Section 120.7(a)3:** When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.

**NOTE:** Vents, that do not penetrate the roof deck, that are designed for wind resistance for roof membranes are not within the scope of Section 120.7(a)3B.

**(b) Wall insulation.** The opaque portions of walls that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 7 below:

1. **Metal building.** The weighted average *U*-factor of the wall assembly shall not exceed 0.113.
2. **Metal framed.** The weighted average *U*-factor of the wall assembly shall not exceed 0.151.
3. **Light mass walls.** A 6-inch or greater hollow core concrete masonry unit shall have a *U*-factor not to exceed 0.440.
4. **Heavy mass walls.** An 8-inch or greater hollow core concrete masonry unit shall have a *U*-factor not to exceed 0.690.
5. **Wood framed and others.** The weighted average *U*-factor of the wall assembly shall not exceed 0.110.
6. **Spandrel panels and opaque curtain wall.** The weighted average *U*-factor of the spandrel panels and opaque curtain wall assembly shall not exceed 0.280.
7. **Demising walls.** The opaque portions of framed demising walls shall meet the requirements of Item A or B below:
  - A. Wood framed walls shall be insulated to meet a *U*-factor not greater than 0.099.
  - B. Metal framed walls shall be insulated to meet a *U*-factor not greater than 0.151.

**(c) Floor and soffit insulation.** The opaque portions of floors and soffits that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 and 2 below:

1. **Raised mass floors.** Shall have a minimum of 3 inches of lightweight concrete over a metal deck, or the weighted average *U*-factor of the floor assembly shall not exceed 0.269.
2. **Other floors.** The weighted average *U*-factor of the floor assembly shall not exceed 0.071.
3. **Heated slab floor.** A heated slab floor shall be insulated to meet the requirements of Section 110.8(g).

**Exception to Section 120.7:** A dedicated building used solely as a data center that has a total covered process load exceeding 750 kW.

## SECTION 120.8 NONRESIDENTIAL BUILDING COMMISSIONING

Nonresidential buildings with conditioned space of 10,000 square feet or more, shall comply with the applicable requirements of Sections 120.8(a) through 120.8(i) in the building design and construction processes. All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding those related solely to covered processes.

Nonresidential buildings with conditioned space of less than 10,000 square feet shall comply with the design review requirements specified in Sections 120.8(d), and shall include any measures or requirements necessary for completing this review in the construction documents in a manner consistent with Section 120.8(e).

**NOTE:** Nonresidential buildings include nonresidential spaces such as nonresidential function areas within hotel/motel and high-rise residential buildings. The requirements of Section 120.8 apply based on the square footage of the nonresidential spaces.

The commissioning described in this Section is in addition to any commissioning required by Title 24, Part 11, Section 5.410.2, 5.410.4 and subsections.

(a) **Summary of commissioning requirements.** Commissioning shall include completion of the following items:

1. Owner's or owner representative's project requirements;
2. Basis of design;
3. Design phase design review;
4. Commissioning measures shown in the construction documents;
5. Commissioning plan;
6. Functional performance testing;
7. Documentation and training; and
8. Commissioning report.

(b) **Owner's or Owner Representative's Project Requirements (OPR).** The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

1. Energy efficiency goals;
2. Ventilation requirements;
3. Project documentation requirements, including facility functions and hours of operation, and need for after hours operation;
4. Equipment and systems expectations; and
5. Building envelope performance expectations.

(c) **Basis of design (BOD).** A written explanation of how the design of the building systems and components meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and con-

struction phases. The basis of design document shall cover the following systems and components:

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls;
3. Water heating systems and controls; and
4. Any building envelope component considered in the OPR.

(d) **Design phase design review.**

1. **Design reviewer requirements.** The design reviewer shall be the signer of the Design Review Kickoff Certificate(s) of Compliance and Construction Document Design Review Checklist Certificate(s) of Compliance as specified in Part 1 Section 10-103(a)1.
2. **Design review kickoff.** During the schematic design phase of the building project, the owner or owner's representative, design team and design reviewer must meet to discuss the project scope, schedule and how the design reviewer will coordinate with the project team. The building owner or owner's representative shall include the Design Review Kickoff Certificate of Compliance form in the certificate of compliance documentation (as specified in Part 1 Section 10-103).
3. **Construction documents design review.** The construction documents design review Checklist Certificate of Compliance shall list the items checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner or owner's representative shall include this form in the certificate of compliance documentation (as specified in Part 1 Section 10-103).

(e) **Commissioning measures shown in the construction documents.** Complete descriptions of all measures or requirements necessary for commissioning shall be included in the construction documents (plans and specifications). Commissioning measures or requirements shall be clear, detailed and complete to clarify the commissioning process.

(f) **Commissioning plan.** Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The commissioning plan shall include the following:

1. General project information; and
2. Commissioning goals; and
3. Systems to be commissioned; and
4. Plans to test systems and components, which shall include:
  - A. An explanation of the original design intent; and
  - B. Equipment and systems to be tested, including the extent of tests; and
  - C. Functions to be tested; and
  - D. Conditions under which the test shall be performed; and



**SECTION 120.9  
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- E. Measurable criteria for acceptable performance; and
- F. Commissioning team information; and
- G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.
- > (g) **Functional performance testing.** Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the acceptance test requirements in Sections 120.5, 130.4 and 140.9. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.
- > (h) **Documentation and training.** A systems manual and systems operations training shall be completed.
  - 1. **Systems manual.** Documentation of the operational aspects of the building shall be completed within the systems manual and delivered to the building owner or representative and facilities operator. The systems manual shall include the following:
    - A. Site information, including facility description, history and current requirements; and
    - B. Site contact information; and
    - C. Instructions for basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log; and
    - D. Description of major systems; and
    - E. Site equipment inventory and maintenance notes; and
    - F. A copy of all special inspection verifications required by the enforcing agency or the standards.
  - 2. **Systems operations training.** The training of the appropriate maintenance staff for each equipment type or system shall be documented in the commissioning report. Training materials shall include the following:
    - A. System and equipment overview (i.e., what the equipment is, what it does and with what other systems or equipment it interfaces)
    - B. Review and demonstration of operation, servicing and preventive maintenance procedures
    - C. Review of the information in the systems manual
    - D. Review of the record drawings on the systems and equipment
- > (i) **Commissioning report.** A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or owner's representative.

- (a) Combustion air positive shut-off shall be provided on all newly installed boilers as follows:
    - 1. All boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
    - 2. All boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).
  - (b) Boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:
    - 1. The fan motor shall be driven by a variable speed drive, or
    - 2. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.
  - (c) Newly installed boilers with an input capacity 5 MMBtu/h (5,000,000 Btu/h) and greater shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 to 100 percent. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.
- Exception to Section 120.9(c):** Boilers with steady state full-load thermal efficiency 85 percent or higher.

