

SUBCHAPTER 3

NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS FOR SPACE- CONDITIONING AND SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT

SECTION 120 – SPACE-CONDITIONING AND SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT — GENERAL

Sections 121 through 129 establish requirements for the design and installation of space-conditioning and service water-heating systems and equipment in nonresidential, high-rise residential, and hotel/motel buildings subject to Title 24, Part 6. All such buildings shall comply with the applicable provisions of Sections 121 through 129.

SECTION 121 – REQUIREMENTS FOR VENTILATION

(a) General Requirements.

1. All enclosed spaces in a building that are normally used by humans shall be ventilated in accordance with the requirements of this section and the CBC.
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% 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 121(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 121-A; or
 - B. 15 cfm per person times the expected number of occupants.

For meeting the requirement in Section 121(b)2B for spaces without fixed seating, the expected number of occupants shall be either the expected number specified by the building designer or one half of the maximum occupant load assumed for egress purposes in the CBC, whichever is greater. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the CBC.

EXCEPTION to Section 121(b)2:- Transfer air. The rate of outdoor air required by Section 121(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 sufficient¹ to meet the requirements of Section 121(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 121(b)2 shall be supplied to each space at all times when the space is usually occupied.

EXCEPTION 1 to Section 121(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 121(c)4.

EXCEPTION 2 to Section 121(c)1: -Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 121(b)2 for up to five minutes each hour if the average rate for each hour is equal to or greater than the required ventilation rate.

NOTE: VAV must comply with Section 121(c)1 at minimum supply airflow.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 121(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 121(c)4:

- A. They have an air economizer; and
- B. They serve a space with a design occupant density, or a maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1000 ft² (40 square foot per person); and

EXCEPTION 1 to Section 121(c)3B:- Classrooms, ~~patient areas of health care facilities, and~~ call centers, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.

EXCEPTION 2 to Section 121(c)3B: -Where space exhaust is greater than the design ventilation rate specified in 121(b)2B minus 0.2 cfm per ft² of conditioned area.

EXCEPTION 3 to Section 121(c)3B: 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).

EXCEPTION 4 to Section [TM] 121(c)3B: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people per 121(b)2B.

C. They are either:²

- i. Single zone systems with any controls; or
- ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level.

4. **Demand Control Ventilation Devices.**

- A. For each system with demand control ventilation, CO₂ sensors shall be installed in each room that meets the criteria of 121(c)3B with no less than one sensor per 10,000 ft² -of floor space. When a zone or a space is served by more than one sensor, signal from any sensor indicating that CO₂ is near or at the setpoint within a space, shall trigger an increase in ventilation to the space;
- B. CO₂ sensors shall be located in the room between 3 ft and 6 ft above the floor or at the anticipated height of the occupants heads;

- C. Demand ventilation controls shall maintain CO₂ concentrations less than or equal to 600 ppm plus the outdoor air CO₂ concentration in all rooms with CO₂ sensors;

EXCEPTION to Section 121(c)4C: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 121(b)2 regardless of CO₂ concentration.

- D. Outdoor air CO₂ concentration shall be determined by one of the following:

- i. CO₂ concentration shall be assumed to be 400 ppm without any direct measurement; or
- ii. CO₂ concentration shall be dynamically measured using a CO₂ sensor located within four feet³ 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 121-A times the conditioned floor area for spaces with CO₂ sensors, plus the rate required by 121(b)2 for other spaces served by the system, or the exhaust air rate whichever is greater;

- F. CO₂ sensors shall be certified by the manufacturer to ~~have an accuracy~~ be accurate within \pm 75 ppm at a 1000 ppm concentration when measured at sea level and 25⁰C, factory calibrated or calibrated at start-up, and certified by the manufacturer to require calibration no more frequently than once every 5 years.

G. The CO₂ sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.

- (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 121(b)2, the outdoor air shall be ducted to discharge either:

1. Within five 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.** 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 121(b)2; or (2) the rate required for make-up of exhaust systems that are required for a process, for control of odors, or for the removal of contaminants within the space.

TABLE 121-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 CBC
Hotel guest rooms (less than 500 ft²-sq.-ft.)	30 cfm/guest room
Hotel guest rooms (500- ft²-sq.-ft. or greater)	0.15
Retail stores	0.20
All others	0.15

SECTION 122 – REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS

Space-conditioning systems shall be installed with controls that comply with the applicable requirements of Subsections (a) through (h).

- (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 122(b).

EXCEPTION to Section 122(a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if:

- A. All zones are also served by an interior cooling system;
- B. The perimeter system is designed solely to offset envelope heat losses or gains;
- C. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and
- D. 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 Subsection (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 55⁰F or lower.
- 2. Where used to control comfort cooling, the thermostatic controls shall be capable of being set, locally or remotely, up to 85⁰F 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 5⁰F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

EXCEPTION to Section 122(b)3: -Systems with thermostats that require manual changeover between heating and cooling modes.

- 4. Thermostatic controls for all unitary single zone, air conditioners, heat pumps, and furnaces, shall comply with the ~~Programmable Communicating setback~~ Thermostat ~~(PCT)~~ requirements of Section 112(c) or, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section 122(h).

EXCEPTION to Section 122(b):⁵ -Systems serving zones that must have constant temperatures to prevent degradation of materials, a process, ~~or~~ plants or animals.

(c) **Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats.** Hotel/motel guest room thermostats shall have:

1. Numeric temperature setpoints in °F; and
2. Setpoint stops accessible only to authorized personnel, to restrict over-heating and over-cooling.

High-rise residential dwelling unit thermostats shall meet the control requirements of Section 150(i).

(d) **Heat Pump Controls.** All heat pumps with supplementary electric resistance heaters shall be installed with controls that comply with Section 112(b).

(e) **Shut-off and Reset Controls for Space-conditioning Systems.** Each space-conditioning system shall be installed with controls that comply with Items 1 and 2 below:

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 119(c), with an accessible manual override that allows operation of the system for up to four hours; or
 - B. An occupancy sensor; or
 - C. A four-hour timer that can be manually operated.

EXCEPTION to Section 122(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 122(e)2A: Thermostat setback controls are not required in [nonresidential buildings in \[TM2\]](#) areas where the Winter Median of Extremes outdoor air temperature determined in accordance with Section 144(b)4 is greater than 32°F.

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

EXCEPTION to Section 122(e)2B: Thermostat setup controls are not required in [nonresidential buildings in \[TM3\]](#) areas where the Summer Design Dry Bulb 0.5 percent temperature determined in accordance with Section 144(b)4 is less than 100°F.

EXCEPTION 1 to Section 122(e): -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 Section 122(e): -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 Section 122(e): -Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

EXCEPTION 4 to Section 122(e): -Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

(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 122(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 122(f): - Gravity and other nonelectrical equipment that has readily accessible manual damper controls.

EXCEPTION 3 to Section 122(f):- At combustion air intakes and shaft vents.

EXCEPTION 4 to Section 122(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 122(e)1.

EXCEPTION to Section 122(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 Controls⁶.** HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for non-critical zones as follows:

1. The controls shall have a capability to remotely setup the operating cooling temperature set points by four degrees or more in all non-critical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
2. The controls shall remotely setdown the operating heating temperature set points by four degrees or more in all non critical zones on signal from a centralized contact or software point within an EMCS.⁷
3. The controls shall have capabilities to remotely reset the temperatures in all non critical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
4. The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.

⁸SECTION 123 – REQUIREMENTS FOR PIPE INSULATION

The piping for all space-conditioning and service water-heating systems with fluid temperatures listed in TABLE 123-A shall have the amount of insulation specified in Subsection (a) or (b). Insulation conductivity shall be determined in accordance with ASTM C-335 at the mean temperature listed in TABLE 123-A, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F.

Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind, including 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.

Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed.

EXCEPTION 1 to Section 123: -Factory-installed piping within space-conditioning equipment certified under Section 111 or 112.

EXCEPTION 2 to Section 123: -Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

EXCEPTION 3 to Section 123: -Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

EXCEPTION 4 to Section 123:- Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

EXCEPTION 5 to Section 123: 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.

- (a) For insulation with a conductivity in the range shown in TABLE 123-A for the applicable fluid temperature range, the insulation shall have the applicable thickness shown in TABLE 123-A.
- (b) For insulation with a conductivity outside the range shown in TABLE 123-A for the applicable fluid temperature range, the insulation shall have a minimum thickness as calculated with EQUATION 123-A:

EQUATION 123-A 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 123-A, inches.
- K = Conductivity of alternate material at the mean rating temperature indicated in TABLE 123-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 123-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

TABLE 123-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)					
			Runouts up to 2	1 and less	1.25-2	2.50-4	5-6	8 and larger
			INSULATION THICKNESS REQUIRED (in inches)					
Space heating systems (steam, steam condensate and hot water)								
Above 350	0.32-0.34	250	1.5	2.5	2.5	3.0	3.5	3.5
251-350	0.29-0.31	200	1.5	2.0	2.5	2.5	3.5	3.5
201-250	0.27-0.30	150	1.0	1.5	1.5	2.0	2.0	3.5
141-200	0.25-0.29	125	0.5	1.5	1.5	1.5	1.5	1.5
105-140	0.24-0.28	100	0.5	1.0	1.0	1.0	1.5	1.5
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 105	0.24-0.28	100	0.5	1.0	1.0	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)								
40-60	0.23-0.27	75	0.5	0.5	0.5	1.0	1.0	1.0
Below 40	0.23-0.27	75	1.0	1.0	1.5	1.5	1.5	1.5

SECTION 124 – REQUIREMENTS FOR AIR DISTRIBUTION SYSTEM DUCTS AND PLENUMS

- (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, 602, 603, 604, 605, and Standard 6-5, incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

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

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

Portions of supply-air ducts that are not in one of these spaces, including ducts buried in concrete slab, shall be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 605) 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. 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 tests C-731 (extrudability after aging) and D-2202 (slump test on vertical surfaces), incorporated herein by reference.
 - iii. Sealants for exterior applications shall pass ASTM tests C-731, C-732 (artificial weathering test), and D 2202, 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 barriers, or other duct components) and tested C-values at 75⁰=F mean temperature at the installed thickness, in accordance with ASTM C-518 or ASTM C-177, incorporated herein by reference, and certified pursuant to Section 118.
- (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 barriers, or other duct components), based on the tests in Section 124(c) and the installed thickness determined by Section 124(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 125 – REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

- (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 building department 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 144(k)-1, 144(k)2 and 144(k)3, or
 - B. They are part of a system that meets the criteria of 149(b)1D
 4. Air economizers shall be tested in accordance with NA7.5.4.

EXCEPTION to Section 125(a)4: -Air economizers installed by the HVAC system manufacturer and certified to the Commission as being factory calibrated and tested are not required to be field tested per NA7.5.4.2.
 5. Demand control ventilation systems required by 121(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 per 144(j)2 or 144(j)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. [CSO5]
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.](#)

SECTION 126 – MANDATORY REQUIREMENTS FOR REFRIGERATED WAREHOUSES ⁹

A refrigerated warehouse with ~~the~~ total cold storage and frozen storage area exceeding 3,000 square feet shall meet the requirements of this section.

EXCEPTION 1 to Section 126: A refrigerated space less than 3,000 square feet shall meet the Appliance Efficiency Regulations for walk-in refrigerators or freezers.

EXCEPTION 2 to Section 126: [Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling or freezing of products with evaporator cooling capacities greater than 240 Btu/hr-ft² \(2 tons per 100 ft²\).](#)

- (a) **Insulation Requirements.** Exterior surfaces of refrigerated warehouses shall be insulated at least to the R-values in Table 126-A.

TABLE 126-A REFRIGERATED WAREHOUSE INSULATION

SPACE	SURFACE	MINIMUM R-VALUE (°F·hr·sf/Btu)
Frozen Storage	Roof/Ceiling	R-36
	Wall	R-36
	Floor	R-36
Cold Storage	Roof/Ceiling	R-28
	Wall	R-28

- (b) **Underslab heating.** Electric resistance heat shall not be used for the purposes of underslab heating.

EXCEPTION to Section 126(b): 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.

- (c) **Evaporators.** Fan-powered evaporators used in coolers and freezers shall conform to the following:

1. Single phase fan motors less than 1 horsepower and less than 460 Volts shall be electronically commutated motors.
2. Evaporator fans shall be variable speed and the speed shall be controlled in response to space conditions.

EXCEPTION to Section 126(c)2: [Evaporators served by a single compressor without unloading capability.](#)

- (d) **Condensers.** Fan-powered condensers shall conform to the following:

1. Condensers for systems utilizing ammonia shall be evaporatively cooled.
2. [Condensing temperatures for evaporatively cooled condensers under design conditions, including but not limited to condensers served by systems with cooling towers](#) shall be less than or equal to:

- A. the design wetbulb temperature plus 20⁰F in locations where the design wetbulb temperature is less than or equal to 76⁰F,
 - B. the design wetbulb temperature plus 19⁰F in locations where the design wetbulb temperature is between 76⁰F and 78⁰F, or
 - C. the design wetbulb temperature plus 18⁰F in locations where the design wetbulb temperature is greater than or equal to 78⁰F.
3. Condensing temperatures for air-cooled condensers under design conditions shall be less than or equal to the design drybulb temperature plus 10⁰F for systems serving frozen storage and shall be less than or equal to the design drybulb temperature plus 15⁰F for systems serving cold storage.

Exception to 126(d)3. Unitary condensing units.

4. All condenser fans for evaporative condensers shall be continuously variable speed, and the condensing temperature control system shall control the speed of all condenser fans serving a common condenser loop in unison. The minimum condensing temperature setpoint shall be less than or equal to 70⁰F.
 5. 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 loop in unison. The minimum condensing temperature setpoint shall be less than or equal to 70⁰F, or reset in response to ambient drybulb temperature or refrigeration system load.
 6. All single phase condenser fan motors less than 1 horsepower and less than 460 V shall be either permanent split capacitor or electronically commutated motors.
- (e) **Compressors.** Compressor systems utilized in refrigerated warehouses shall conform to the following:
1. Compressors shall be designed to operate at a minimum condensing temperature of 70⁰F or less.
 2. The compressor speed of a screw compressor greater than 50 hp shall be controllable in response to the refrigeration load or the input power to the compressor shall be controlled to be less than or equal to 60% of full load input power when operated at 50% of full refrigeration capacity.

EXCEPTION to Section 126 (e) 2: Refrigeration plants with more than one dedicated compressor per suction group.

~~EXCEPTION to Section 126: Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling or freezing of products.~~

SECTION 127 – RESERVED.

SECTION 128 – RESERVED.

SECTION 129 – RESERVED.

¹ Edits for clarification only.

² Changes made from Hydeman, DDC to the Zone Level 2: Demand Shed Controls, http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/2006-07-11_DDC_LEVEL2.PDF.

³ Edits for clarification only.

⁴ Section 121(f) has been moved to Section 125.

⁵ The GTA proposal is the same as the Automatic Demand Shed Controls in 122(h). The 122(h) controls are also complementary to the proposed PCT requirement (122(b)4)

- ⁶ Changes from Hydeman, DDC to the Zone Level 2: Demand Shed Controls,
http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/2006-07-11_DDC_LEVEL2.PDF.
- ⁷ Added to be consistent with the GTA proposal.
- ⁸ 122(i) (previously 122(h)) has been moved to 125.
- ⁹ From AEC, Refrigerated Warehouses CASE Report,
http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/2006-02-15_DRAFT_REP_PG&E.PDF