2019 Energy Code

Covered Processes Overview

California Energy Commission, Efficiency Division

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September 2020

QUESTIONS…

- **If you have questions, please feel free to ask at anytime:**
  - During class
  - The end of class; or
  - After class

Goals for this Training

- **Identify the individual covered processes.**
- **Get a little familiar with each covered process.**
  - Know when the Energy Code applies to each covered process.
  - Understand key terminology related to each covered process.
  - Learn which covered processes are mandatory and which are prescriptive.
  - Gain a general understanding of the requirements for each covered process.

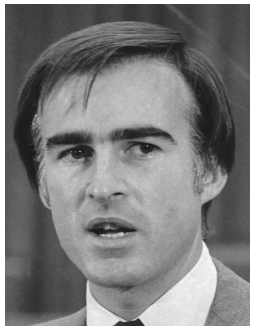
Source: https://www.fortunebuilders.com/real-estate-goals/

Energy Code Background

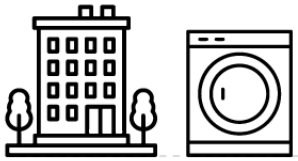
CALIFORNIA ENERGY COMMISSION WARREN-ALQUIST BUILDING

Source: http://www.durabilityanddesign.com/news/?fuseaction=view&id=7805&nl_versionid=2060

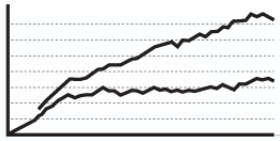
1974: WARREN-ALQUIST ACT PASSED



Created the Energy Commission



Set building and appliance efficiency standards

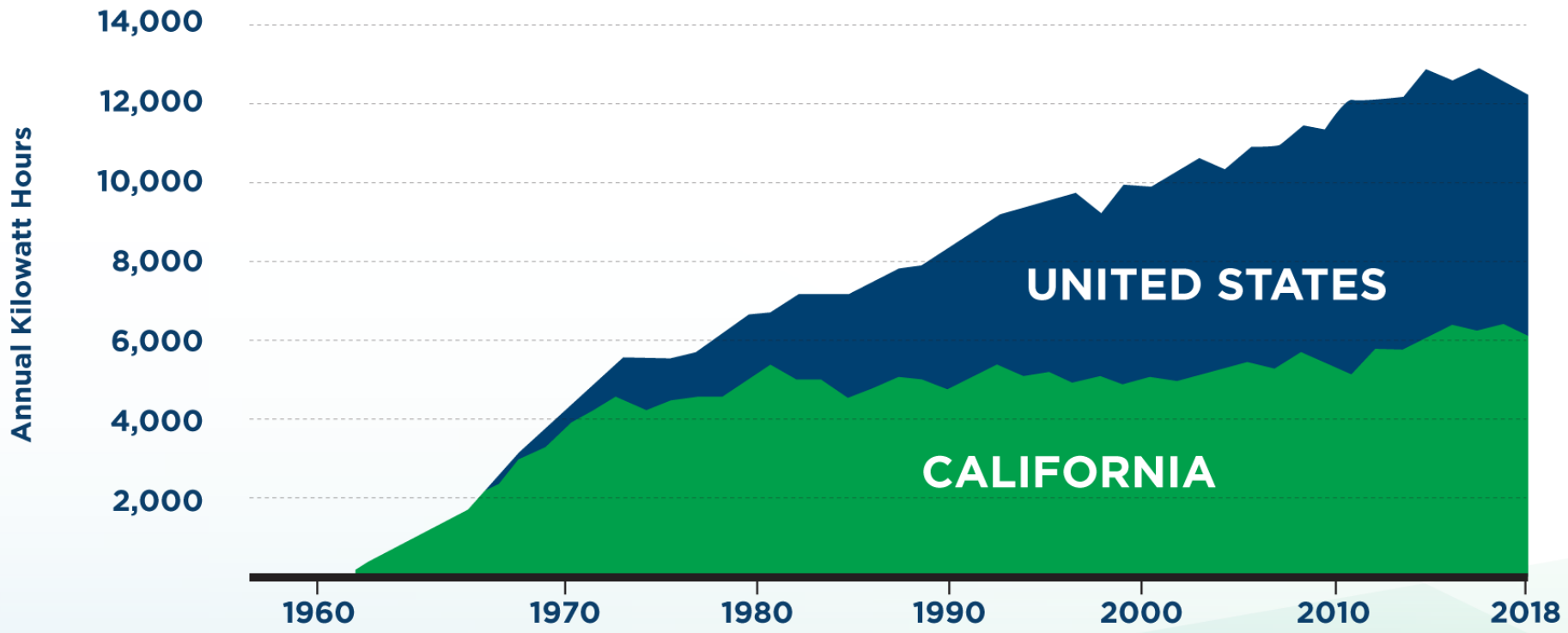


Forecast electricity demand

Support R&D into non-conventional energy sources

CA VS. U.S. ENERGY USE

Californians use **half** the per capita electricity as the rest of the U.S.



Source: California Energy Commission

2019 Documents

- Building Energy Efficiency Standards
- Residential Compliance Manual
- Nonresidential Compliance Manual
- Reference Appendices
- All docs. available online at:

www.energy.ca.gov/title24

Energy Code Requirements

- **Mandatory measures**
  - Minimum efficiency requirements must always be met.
  - Can never be traded off.
- **Prescriptive measures**
  - Predefined efficiency requirements.
  - May supersede mandatory measures.
  - Different requirements for newly constructed buildings, additions, and alterations.

Source: http://clipart-library.com/clipart/864003.htm

Compliance Approaches

- **Prescriptive Approach**
  - Simple approach, no trade-offs.
  - Each building component (LTG, ENV, MCH) must meet specific requirements.
  - Standard building baseline.
- **Performance Approach**
  - Most flexible approach, allows for trade-offs.
  - Must meet all mandatory requirements.
  - Requires the use of CEC approved software.

Source: California Energy Commission Video

What are “Covered Processes?”

- **Code §100.1 Definitions:**
  - Process:
    - An activity or treatment that is not related to the space conditioning, lighting, service water heating or ventilation of a building as it relates to human occupancy.
  - Covered Processes:
    - Processes that is regulated under Part 6, §120.6 and §140.9, which includes computer rooms, data centers, elevators, escalators and moving walkways, laboratories, enclosed parking garages, commercial kitchens, refrigerated warehouses, commercial refrigeration, compressed air systems, and process boilers.
  - Exempt Process:
    - A process that is not a covered process regulated under Part 6.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

What are “Covered Processes?”

- **Code §100.1 Definitions - continued:**
  - Process Load:
    - An energy load resulting from a process.
  - Process Space:
    - A nonresidential space that is designed to be thermostatically controlled to maintain a process environment temperature less than 55º F or to maintain a process environment temperature greater than 90º F for the whole space that the system serves, or that is a space with a space-conditioning system designed and controlled to be incapable of operating at temperatures above 55º F or incapable of operating at temperatures below 90º F at design conditions.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

What are “Covered Processes?”

- **Code §100.1 Definitions - continued :**
  - Conditioned Space:
    - An enclosed space within a building that is directly conditioned or indirectly conditioned.
  - Directly Conditioned Space:
    - enclosed space that is provided with wood heating, mechanical heating that has a capacity exceeding 10 Btu/hr-ft², or mechanical cooling that has a capacity exceeding 5 Btu/hr-ft², . Directly conditioned space does not include process space. (See “process space.”)
  - Indirectly Conditioned Space:
    - An enclosed space that (1) is not directly conditioned space; and (2) either (a) has a thermal transmittance area product (UA) to directly conditioned space exceeding that to the outdoors or to unconditioned space and does not have fixed vents or openings to the outdoors or to unconditioned space, or (b) is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

Covered Processes History

2008	2013	2016	2019
§126	§120.6	§120.6	§120.6
❖ Refrigerated Warehouses	❖ Refrigerated Warehouses	❖ Refrigerated Warehouses	❖ Refrigerated Warehouses
	❖ Commercial Refrigeration	❖ Commercial Refrigeration	❖ Commercial Refrigeration
	❖ Enclosed Parking Garages	❖ Enclosed Parking Garages	❖ Enclosed Parking Garages
	❖ Process Boilers	❖ Process Boilers	❖ Process Boilers
	❖ Compressed Air Systems	❖ Compressed Air Systems	❖ Compressed Air Systems
		❖ Elevators	❖ Elevators
		❖ Escalators and Moving Walkways	❖ Escalators and Moving Walkways
	§140.9	§140.9	§140.9
	❖ Computer Rooms	❖ Computer Rooms	❖ Computer Rooms
	❖ Commercial Kitchens	❖ Commercial Kitchens	❖ Commercial Kitchens
	❖ Laboratory Exhaust Systems	❖ Laboratory Exhaust Systems	❖ Laboratory and Factory Exhaust Systems

2019 Covered Processes Today

§120.6 Mandatory Requirements

§120.6(a) Refrigerated Warehouses

§120.6(b) Commercial Refrigeration

§120.6(c) Enclosed Parking Garages

§120.6(d) Process Boilers

§120.6(e) Compressed Air Systems

§120.6(f) Elevators

§120.6(g) Escalators and Moving Walkways

§140.9 Prescriptive Requirements

§140.9(a) Computer Rooms

§140.9(b) Commercial Kitchens

§140.9(c) Laboratory and factory Exhaust Systems

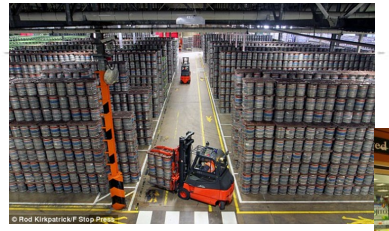
§141.1 Additions and Alterations

§141.1 Covered Processes Additions and Alterations

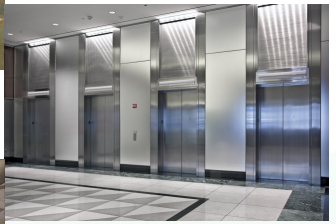
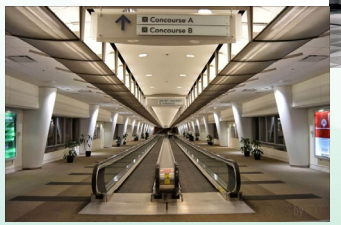
§120.6
Mandatory Requirements for Covered Processes

§120.6 - Mandatory Requirements for Covered Processes

- §120.6(a) - Refrigerated Warehouses
- §120.6(b) - Commercial Refrigeration
- §120.6(c) - Enclosed Parking Garages
- §120.6(d) - Process Boilers
- §120.6(e) - Compressed Air Systems
- §120.6(f) - Elevators
- §120.6(g) - Escalators and Moving Walkways





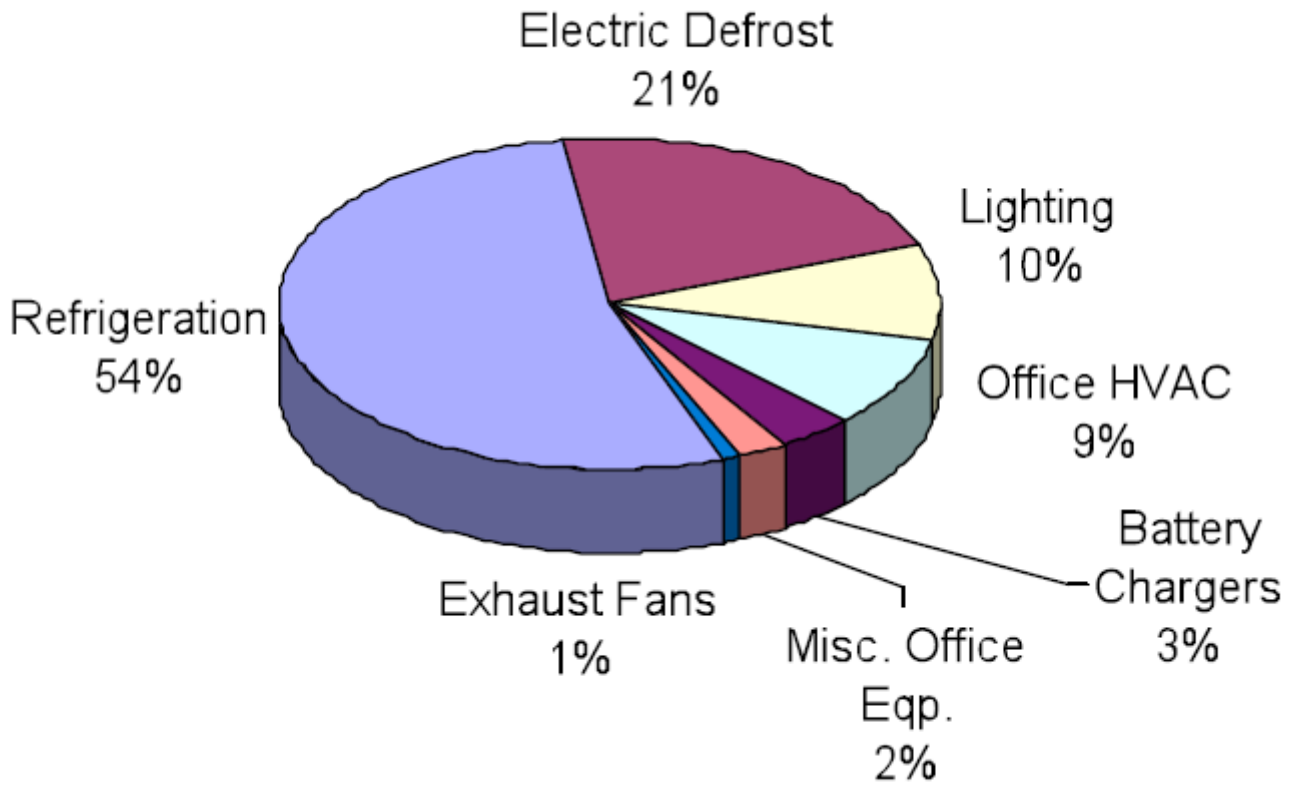




Source: https://www.dailymail.co.uk/news/article-2074150/Britains-biggest-brewery-Molson-Coors-prepares-shift-19m-pints-Christmas.html

§120.6(a) - Refrigerated Warehouses

§120.6(a) - Refrigerated Warehouses

- **Electrical Demand by End Use**



Source: Lawrence Berkeley National Lab report: “Opportunities for Energy Efficiency and Automated Demand Response in Industrial Refrigerated Warehouses in California”.

What is a “Refrigerated Warehouse?”

- **Related §100.1 Definitions:**
  - Refrigerated Warehouse
    - A building or a space greater than or equal to 3,000 ft^2 constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55°F or less.
  - Refrigerated Space
    - A space constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55°F or less.
  - Condenser Specific Efficiency
    - The full load condenser Total Heat of Rejection (THR) capacity at standardized conditions divided by the fan input electric power (including but not limited to spray pump electric input power for evaporative condensers) at 100 percent rated fan speed.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§120.6(a) - Refrigerated Warehouses

- **Energy Code Applicability**
  - A refrigerated space ≥ to 3,000 ft^2 must meet the applicable requirements of all sections in §120.6(a).
  - Multiple refrigerated spaces that have a summed total ≥ to 3,000 ft^2 and are collectively served by the same refrigeration system compressor(s) and condenser(s) must also meet all the requirements of §120.6(a) listed above.
  - Refrigerated Spaces < 3,000 ft^2 served by a stand-alone system are not covered by T24, Part 6. These spaces are considered walk-in coolers and freezers and are regulated by the Appliance Efficiency Regulations in T20 and federal standards.

Pop Quiz Time!

A 15,000 ft^2 building has four 2,500 ft^2 refrigerated spaces.

1. One of the four 2,500 ft^2 space is served by a stand-alone refrigeration system.
2. Three 2,500 ft^2 spaces have their own evaporators but use a common condenser and compressor group.

A. What sections of §120.6(a) apply to #1?

None. This space is regulated under Title 20.

B. What sections of §120.6(a) apply to #2?

All sections apply: §120.6(a)1, 2, 3, 4, 5, 6, and 7

C. Suppose each 2,500 ft^2 space is served by its own stand-alone system. What sections of §120.6(a) apply to each space?

None. All spaces are regulated under Title 20.

D. Suppose the 15,000 ft^2 building has one single 10,000 ft^2 refrigerated space but is served by four refrigeration systems that can be independently controlled. What sections of §120.6(a) apply?

It is one single refrigerated space >3,000 ft^2 so all sections apply: §120.6(a)1, 2, 3, 4, 5, 6, and 7

§120.6(a) - Refrigerated Warehouses

- **Lets look into the subsections of §120.6(a)**
  - §120.6(a)1 - Insulation
  - §120.6(a)2 - Underslab Heating
  - §120.6(a)3 - Evaporators
  - §120.6(a)4 - Condensers
  - §120.6(a)5 - Compressors
  - §120.6(a)6 - Infiltration Barriers
  - §120.6(a)7 - Refrigeration System Acceptance

§120.6(a) - Refrigerated Warehouses

- **§120.6(a)1 - Insulation**
  - Insulation requirements are outlined in Table 120.6-A

TABLE 120.6-A REFRIGERATED WAREHOUSE INSULATION

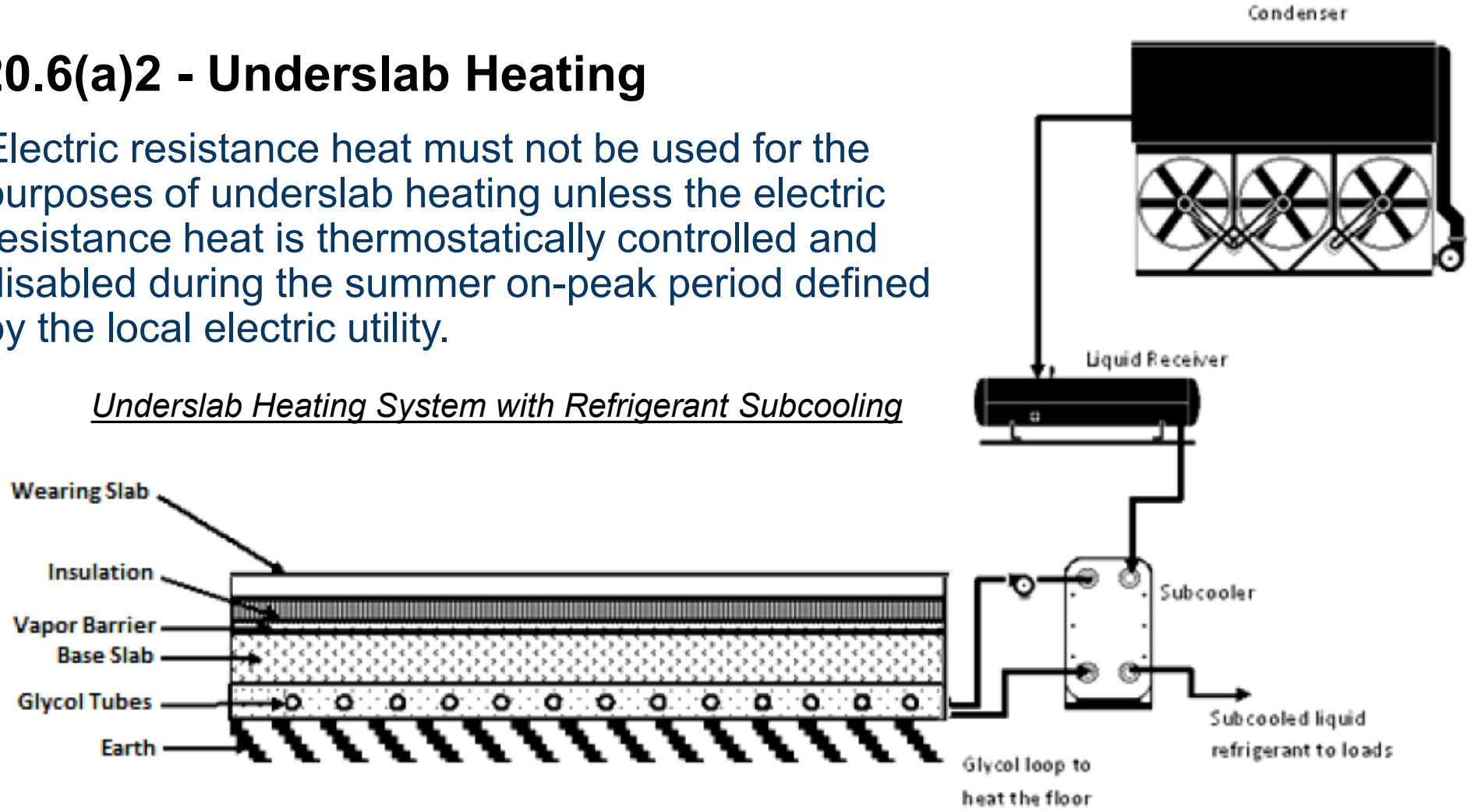
SPACE	SURFACE	MINIMUM R-VALUE (°F·hr·sf/Btu)
Freezers	Roof/Ceiling	R-40
Freezers	Wall	R-36
Freezers	Floor	R-35
Freezers	Floor with all heating from productive refrigeration capacity[1]	R-20
Coolers	Roof/Ceiling	R-28
Coolers	Wall	R-28

[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.

§120.6(a) - Refrigerated Warehouses

- **§120.6(a)2 - Underslab Heating**
  - Electric resistance heat must not be used for the purposes of underslab heating unless the electric resistance heat is thermostatically controlled and disabled during the summer on-peak period defined by the local electric utility.

Underslab Heating System with Refrigerant Subcooling



§120.6(a) - Refrigerated Warehouses

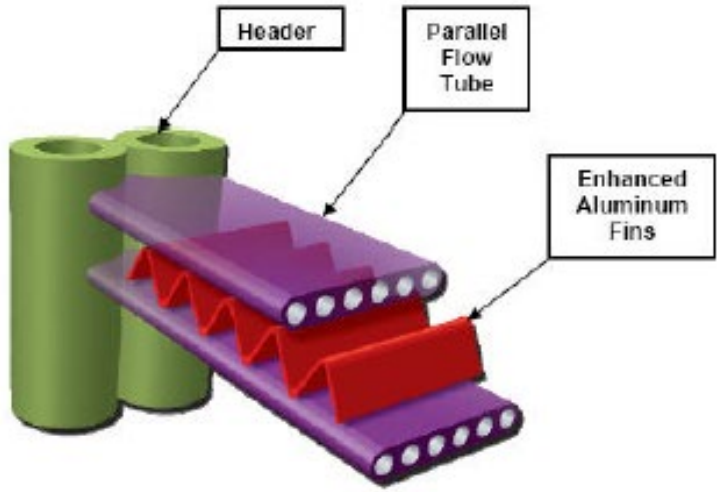
- **§120.6(a)3 - Evaporators**
  - Single phase fan motors less than 1 HP and less than 460 volts must be Electronically Commutated Motors (ECM) or have a minimum efficiency of 70%.
  - Evaporator fans served by either a suction group with multiple compressors or a single compressor with variable capacity capability:
    - Must be variable speed controls; and
    - Controls must respond to space temperature or humidity
  - Evaporator fans served by a single compressor without variable capacity must utilize controls to reduce airflow by at least 40 percent for at least 75 percent of the time when the compressor is not running.
  - There are exceptions. See §120.6(a)3.

§120.6(a) - Refrigerated Warehouses

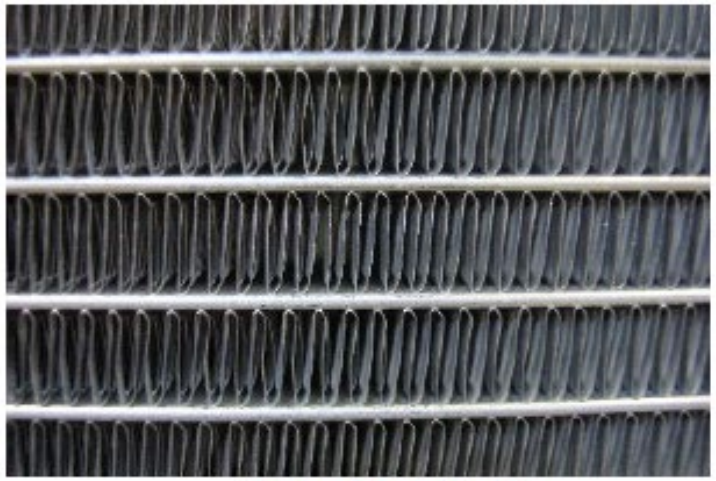
- **§120.6(a)4 - Condensers**
  - The design maximum saturated condensing temperature:
    - Evaporative-cooled condensers and water-cooled condensers served by fluid coolers or cooling towers:
      - Design wetbulb temperature plus 20°F where the design wetbulb is ≤ 76°F.
      - Design wetbulb temperature plus 19°F where the design wetbulb is between 76°F and 78°F.
      - Design wetbulb temperature plus 20°F where the design wetbulb is ≥ 78°F.
    - Air cooled condensers 100 HP and larger:
      - Freezers: The design drybulb temperature plus 10°F.
      - Coolers: The design drybulb temperature plus 15°F.
    - Adiabatic condensers:
      - Freezers: The design drybulb temperature plus 20°F.
      - Coolers: The design drybulb temperature plus 30°F.

§120.6(a) - Refrigerated Warehouses

- **§120.6(a)4 – Condensers – cont.**
  - Minimum condensing temperature setpoint must be 70°F or less.
  - Condensing temperature must be reset in response to ambient conditions.
  - Air-cooled condensers must have a fin density no greater than 10 fins per inch unless it is a micro-channel condensers.



Microchannel Design


Microchannel coil

§120.6(a) - Refrigerated Warehouses

- **§120.6(a)4 - Condensers – cont.**
  - Condenser fans:
    - Must be continuously variable speed.
    - Fan power must meet the specific efficiency requirements listed in TABLE 120.6-B.
    - Speed of fans serving a common condenser high side must be controlled in unison.

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

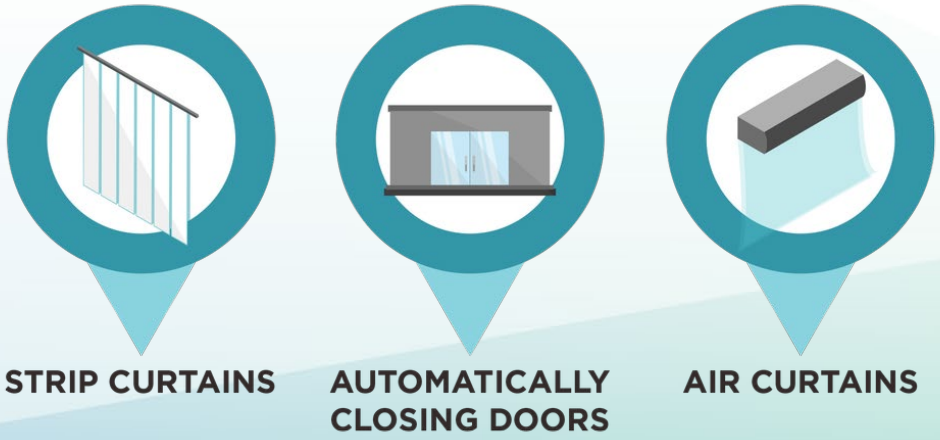
CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM EFFICIENCY	RATING CONDITION
Outdoor Evaporative-Cooled with THR Capacity > 8,000 MBH	All	350 Btuh/Watt	100°F Saturated Condensing Temperature (SCT), 70°F Outdoor Wetbulb Temperature
Outdoor Evaporative-Cooled with THR Capacity < 8,000 MBH and Indoor Evaporative-Cooled	All	160 Btuh/Watt	100°F Saturated Condensing Temperature (SCT), 70°F Outdoor Wetbulb Temperature
Outdoor Air-Cooled	Ammonia	75 Btuh/Watt	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
Outdoor Air-Cooled	Halocarbon	65 Btuh/Watt	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
Adiabatic Dry Mode	Halocarbon	45 Btuh/Watt	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
Indoor Air-Cooled	All	Exempt	Exempt

§120.6(a) - Refrigerated Warehouses

- **§120.6(a)5 - Compressors**
  - Compressors must be designed to operate at a minimum condensing temperature of 70°F or less.
  - Open-drive screw compressors with a design saturated suction temperature (SST) of 28°F or lower that discharges to the system condenser pressure must control compressor speed in response to the refrigeration load.
  - Screw compressors with nominal electric motor power greater than 150 HP must include the ability to automatically vary the compressor volume ratio (Vi) in response to operating pressures.
  - Of course, there are exceptions. See §120.6(a)5.

§120.6(a) - Refrigerated Warehouses

- **§120.6(a)6 - Infiltration Barriers**
  - Passageways between freezers and higher-temperature spaces, and passageways between coolers and non-refrigerated spaces, must have
    - Strip curtains; or
    - Automatically-closing door; or
    - An air curtain designed by the manufacturer for use in the passageway and temperature where it is used.
  - Of course, there are exceptions. See §120.6(a)6.



§120.6(a) - Refrigerated Warehouses

- **§120.6(a)7 - Refrigeration System Acceptance**
  - Acceptance testing is required for the following equipment and systems per the procedures in the Reference Nonresidential Appendix NA7.10. :
    - Electric resistance underslab heating systems tested in accordance with NA7.10.1.
    - Evaporator fan motor controls tested in accordance with NA7.10.2.
    - Evaporative condensers tested in accordance with NA7.10.3.1.
    - Air-cooled condensers tested in accordance with NA7.10.3.2.
    - Adiabatic condensers tested in accordance with NA7.10.3.3
    - Variable speed compressors tested in accordance with NA7.10.4.

§120.6(a) - Refrigerated Warehouses

- **Takeaways**
  - The Energy Code applies to the following spaces:
    - Refrigerated spaces 3,000 sf or larger; or
    - Where the sum of all spaces with a common refrigeration system is 3,000 sf or larger.
  - Insulation levels in walls ceilings and floors depend on space temperature.
  - Controls on underslab electric heating or use an underslab heating system utilizing productive refrigeration.
  - Evaporator fans must be continuously variable and have controls that respond to the space conditions.
  - Condenser fans must be continuously variable and meet specific efficiency requirements.
  - Condenser condensing temperature must be capable of resetting based on ambient conditions.

§120.6(a) - Refrigerated Warehouses

- **Takeaways – cont.**
  - Air-cooled condensers must have a condenser fin density of no less than 10 fins per inch unless it is a microchannel type.
  - Compressors have requirements for minimum condensing temperature setpoint, speed control and volume ratio control.
  - Passageways between spaces of different temperatures must have infiltration barriers.
  - Refrigeration system acceptance testing is required.
  - These requirements are all mandatory.

QUESTIONS…

About Refrigerated Warehouses

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Source: https://en.wikipedia.org/wiki/Refrigeration

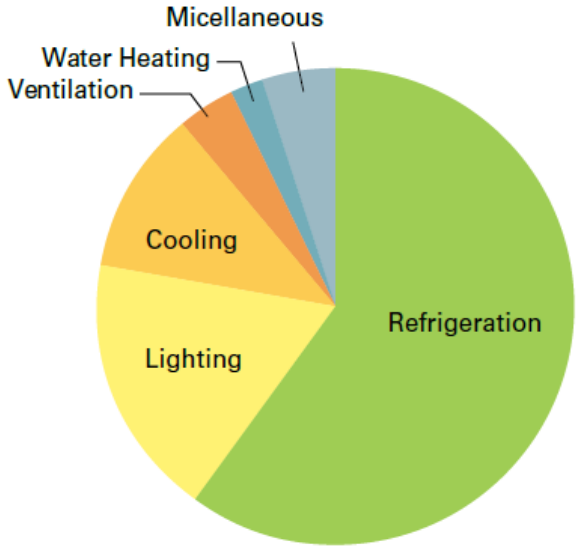
§120.6(b) - Commercial Refrigeration

§120.6(b) – Commercial Refrigeration

- **Electricity use in buildings with commercial refrigeration such as a supermarket**

Supermarket Electricity Use[1]

Refrigeration	60%
Lighting	18%
Cooling	11%[1]
Ventilation	4%[1]
Water Heating	2%
Miscellaneous	5%[1]



1 Source: National Renewable Energy Laboratory 2008 (average industry numbers)

What is “Commercial Refrigeration?”

- **Code §100.1 Definitions:**
  - Refrigerated Case:
    - A manufactured commercial refrigerator or freezer, including but not limited to display cases, reach-in cabinets, meat cases, and frozen food and soda fountain units.
  - Freezer:
    - A space designed to be capable of operation at less than 28°F.
  - Cooler:
    - A space to be capable of operation at a temperature greater than or equal to 28°F but less than 55°F.
  - Condenser Specific Efficiency:
    - The full load condenser Total Heat of Rejection (THR) capacity at standardized conditions divided by the fan input electric power (including but not limited to spray pump electric input power for evaporative condensers) at 100 percent rated fan speed.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§120.6(b) – Commercial Refrigeration

- **§120.6(b) Applicability**
  - Retail food stores ≥ 8,000 ft^2 of conditioned floor area must meet the requirements of §120.6(b):
    - Condensers - §120.6(b)1
    - Compressor Systems - §120.6(b)2
    - Refrigerated Display Cases - §120.6(b)3
    - Refrigeration Heat Recovery - §120.6(b)4

§120.6(b) – Commercial Refrigeration

- **§120.6(b)1 - Condensers**
  - Condenser fans must be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.
  - Air-cooled condensers must use variable setpoint control logic to reset the saturated condensing temperature (SCT) based on ambient dry bulb temperature.
  - Evaporative-cooled condensers must use variable setpoint control logic based on ambient wet bulb temperature.
  - Adiabatic condensers must use variable setpoint control logic based on ambient drybulb temperature while operating in dry mode.
  - The SCT for adiabatic condensers must be less than or equal to:
    - The design drybulb temperature plus 20°F for systems serving freezers;
    - The design drybulb temperature plus 30°F for systems serving coolers.
  - The minimum condensing temperature setpoint must be ≤ 70°F.

§120.6(b) – Commercial Refrigeration

- **§120.6(b)1 - Condensers – cont.**
  - Fan-powered condensers must 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 [a]	RATING CONDITION
Evaporative-Cooled	160 Btuh/W	100°F Saturated Condensing Temperature (SCT), 70°F Entering Wetbulb Temperature
Air-Cooled	65 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature
Adiabatic Dry Mode	45 Btu/W (halocarbon)	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature
[a] See Section 100.1 for definition of condenser specific efficiency.		

  - Air-cooled condensers must have a condenser fin density no greater than 10 fins per inch unless it is a microchannel condensers.

§120.6(b) – Commercial Refrigeration

- **§120.6(b)2 - Compressor Systems**
  - Floating suction pressure control:
    - Compressors and multiple-compressor suction groups must use **floating suction pressure** logic to reset the target saturated suction temperature based on the temperature of the display cases or walk-ins.
  - Liquid subcooling
    - Required for low temperature compressor systems with a design cooling capacity ≥ 100,000 Btu/hr and a design saturated suction temperature of -10°F or lower.
    - The subcooled liquid temperature must be maintained continuously at ≤ 50°F at the exit of the subcooler.
    - Subcooling load may be handled by compressor economizer ports, or by using a suction group operating at a saturated suction temperature of 18°F or higher.
  - Of course, there are exceptions. See §120.6(b)2.

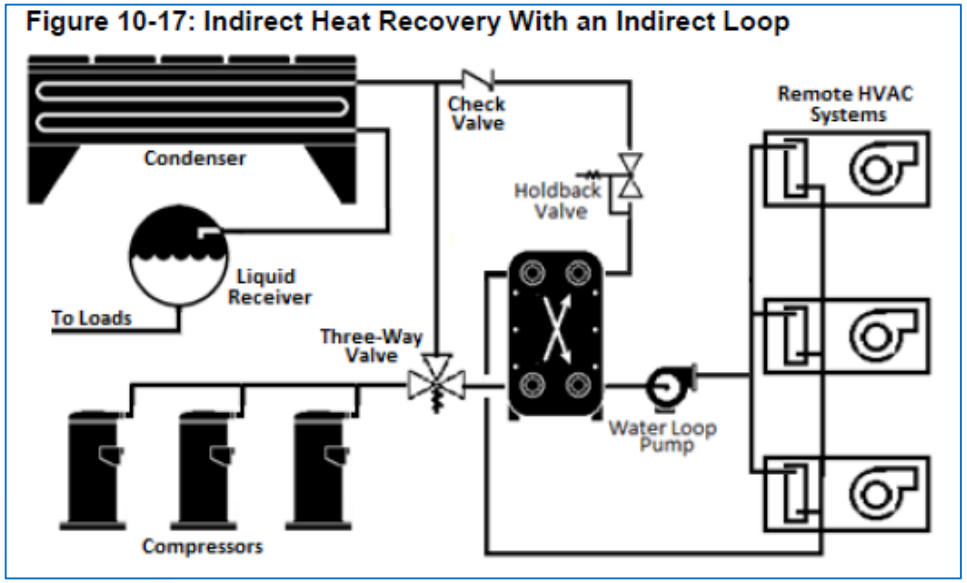
§120.6(b) - Commercial Refrigeration

- **§120.6(b)3 - Refrigerated Display Cases**
  - Lighting in refrigerated display cases, and lights on glass doors installed on walk-in coolers and freezers must be controlled by one of the following:
    - Automatic time switch controls to turn off lights during nonbusiness hours; or
    - 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.
  - Of course, there are exceptions. See §120.6(b)3.

Source: http://officialpsds.com/store-isle-jpg-76kkyq

§120.6(b) - Commercial Refrigeration

- **§120.6(b)4 - Refrigeration Heat Recovery**
  - HVAC systems must utilize heat recovery from refrigeration system(s) for space heating.
  - Must use at least 25 percent of the design THR of all refrigeration systems with an individual Total Heat of Rejection of ≥ 150,000 Btu/h.
  - The increase in hydrofluorocarbon refrigerant charge associated with refrigeration heat recovery equipment and piping must be no greater than 0.35 lbs per 1,000 Btu/h of heat recovery heating capacity.
  - Of course, there are exceptions. See §120.6(b)4.



Quiz Questions

What is the minimum conditioned floor area needed to trigger the Energy Code?

a) 3,000 ft^2

b) 5,000 ft^2

c) 8,000 ft^2

d) Any size

What is the minimum fin density per inch allowed for a condenser?

a) 1

b) 10

c) 100

d) No minimum with a microchannel

e) b or d

§120.6(b) - Commercial Refrigeration

- **Takeaways**
  - The code applies to all retail food stores with conditioned floor area ≥ 8,000 ft^2.
  - Condenser fans must be continuously variable speed and must meet the specific efficiency requirements listed in Table 120.6-C.
  - Condensers must have controls using variable setpoint control logic.
  - Condenser fin density of no less than 10 fins per inch unless microchannel type.
  - Compressors have floating suction pressure logic and liquid subcooling requirements.
  - Display cases have lighting control requirements.
  - Refrigeration system heat recovery for space heating is required for some systems.
  - All requirements are mandatory.

QUESTIONS…

About Commercial Refrigeration

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Source: http://universalcontrol.com/garage-ventilation-automation/

§120.6(c) - Enclosed Parking Garages

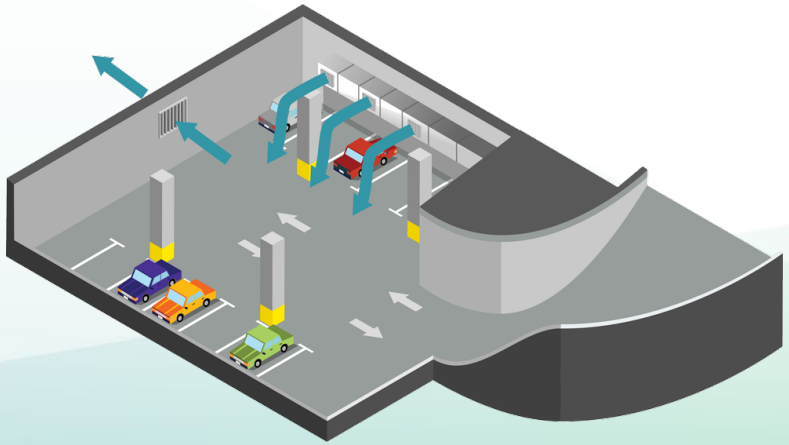
What is an “Enclosed Parking Garage?”

- **Code §100.1 Definitions:**
  - Parking Garage Building
    - A building with building floor areas used for parking vehicles, and consists of at least a roof over the parking area enclosed with walls on all sides. The building includes areas for vehicle maneuvering to reach designated parking spaces. If the roof of a parking structure is also used for parking, the section without an overhead roof is considered an outdoor parking lot instead of a parking garage.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§120.6(c) - Enclosed Parking Garages

- **§120.6(c) Applicability**
  - The Energy Code applies to mechanical ventilation systems for enclosed parking garages where the total design exhaust rate for the garage is ≥ 10,000 cfm.
  - Of course, there are exceptions:
    - EXCEPTION 1 to §120.6(c): Any garage, or portion of a garage, where more than 20 percent of the vehicles expected to be stored have non-gasoline combustion engines.
    - EXCEPTION 2 to §120.6(c): Additions and alterations to existing garages where less than 10,000 cfm of new exhaust capacity is being added.



§120.6(c) - Enclosed Parking Garages

- **Enclosed parking garages must meet or exceed the following Requirements:**
  - They must automatically detect contaminant levels and stage fans or modulate fan airflow rates to 50 percent or less of design capacity when CO levels are low.
  - Have controls and/or devices that result in fan motor demand of no more than 30 percent of design wattage at 50 percent of design airflow.
  - Carbon Monoxide (CO) must be monitored with CO sensors:
    - At least one CO sensor per 5,000 ft^2.
    - At least two sensors per proximity zone. A proximity zone is an area that is isolated from other areas either by a floor or other impenetrable obstruction.
    - Sensor located in the highest expected concentration locations.

Quiz Question

In a 5,000 ft^2 enclosed parking garage designed primarily for gas combustion engine vehicles, how many CO sensors are required?

a) None

b) Two

c) Four

d) Not enough information

- Is the design exhaust 10,000 cfm or more?
- How many proximity zones?

Quiz Question

In a 15,000 ft^2 single proximity zone enclosed parking garage where 20 percent of the spaces are for electric vehicles and has a 20,000 cfm design exhaust flow, how many CO sensors are required?

a) Two

b) Three

c) Four

d) The Energy Code does not apply

e) Not enough information

§120.6(c) - Enclosed Parking Garages

- **§120.6(c) Requirements cont.**
  - CO concentration at all sensors is maintained at 25 ppm or less.
  - The ventilation rate must be at least 0.15 cfm/ft^2 when the garage is scheduled to be occupied.
  - The system must maintain the garage at negative or neutral pressure relative to other occupiable spaces when the garage is scheduled to be occupied.
  - CO sensors have quality requirements:
    - Certified by the manufacturer to be accurate within plus or minus 5 percent of measurement.
    - Certified by the manufacturer to drift no more than 5 percent per year.
    - Certified by manufacturer to need calibration no more than once a year.
    - Factory calibrated.
    - Monitored by a control system that will reset to design ventilation rates and transmit an alarm to the facility operators. For details on sensor failure criteria see §120.6(c)7E.

§120.6(c) - Enclosed Parking Garages

- **§120.6(c) Requirements cont.**
  - Parking Garage Ventilation System Acceptance.
    - Before an occupancy permit is granted for a parking garage system subject to §120.6(c), the system must be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.12.

§120.6(c) - Enclosed Parking Garages

- **Takeaways**
  - The Energy Code applies to parking garages with a design exhaust rate of 10,000 cfm or greater.
  - There are speed and power reduction control requirements for exhaust fans.
  - The exhaust fan controls must be linked to CO sensors.
  - The CO sensors have location and quantity requirements.
  - The CO sensors have quality requirements.
  - There must be a control system to monitor sensor failure and transmit an alarm to the facility operators.
  - The parking garage ventilation system requires acceptance testing.
  - All requirements are mandatory.

QUESTIONS…

About Enclosed Parking Garages

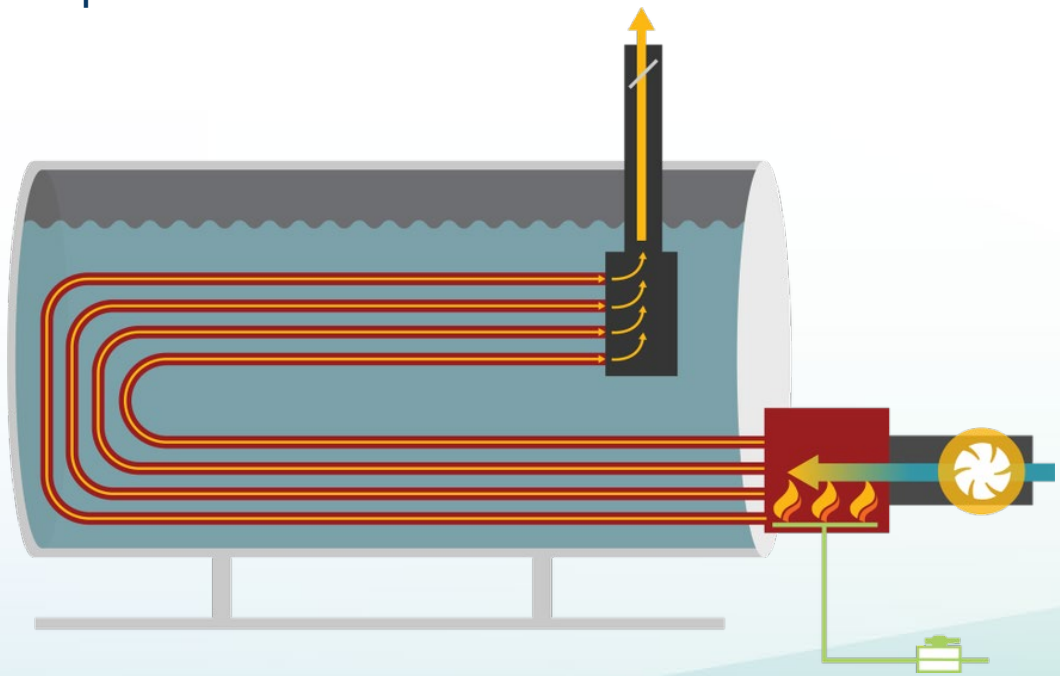
Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Source: https://www.process-heating.com/articles/90444-internal-counterflow-device-improves-efficiency-of-packaged-boilers

§120.6(d) - Process Boilers

What is a “Process Boiler?”

- **Code §100.1 Definitions:**
  - Process Boiler
    - A type of boiler with a capacity (rated maximum input) of 300,000 (Btu/h) or more that serves a process.



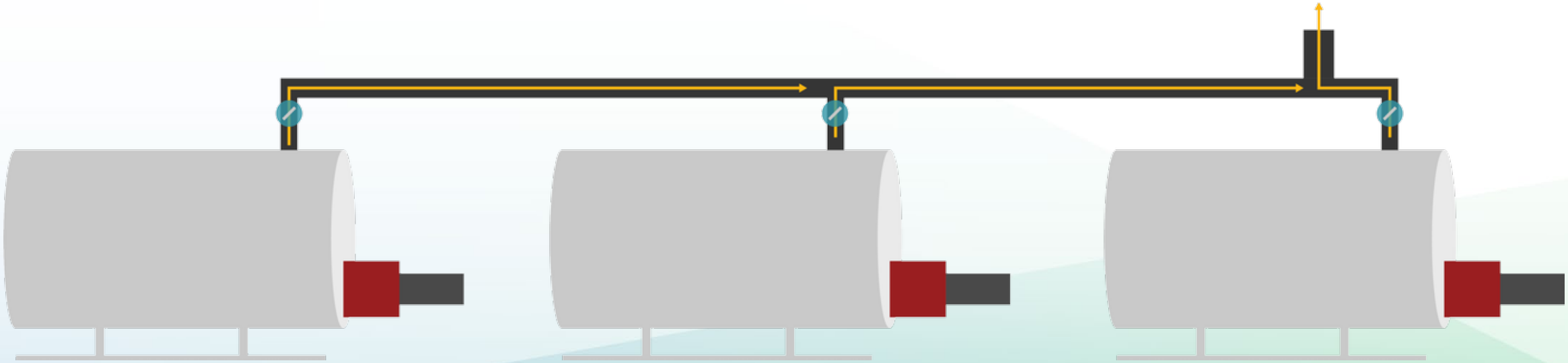
Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§120.6(d) - Process Boilers

- **§120.6(d) Applicability**
  - Process boilers that have an input capacity of 2.5 MMBtu/h (2,500,000 Btu/hr) or greater with a non-positive vent static pressure; or
  - process boilers where one stack serves two or more boilers that have a combined input capacity of 2.5 MMBtu/h (2,500,000 Btu/h)per stack; or
  - process boilers with combustion air fan motors 10 HP or larger.
  - Believe it or not, there are no exceptions!

§120.6(d) - Process Boilers

- **§120.6(d) Requirements**
  - Combustion air positive shut-off must be provided on all newly installed process boilers as follows:
    - Process boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, where the boiler is designed with a non-positive vent static pressure.
    - All process boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h.



§120.6(d) - Process Boilers

- **§120.6(d) Requirements cont.**
  - Process boiler combustion air fans with motors 10 horsepower or larger must meet one of the following for newly installed boilers:
    - The fan motor must be driven by a variable speed drive; or
    - The fan motor must 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.
  - 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):
    - Must 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 must 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.

§120.6(d) - Process Boilers

- **§120.6(d) Requirements cont.**
  - Newly installed process boilers with an input capacity greater than 10 MMBtu/h (10,000,000 Btu/h):
    - Must 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 percent to 100 percent.
    - Combustion air volume must 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.

§120.6(d) - Process Boilers

- **Takeaways**
  - Combustion air positive shutoff requirements.
  - Combustion air fans with motors 10 horsepower or larger must be variable speed and have controls to reduce airflow and power.
  - Limits on excess oxygen levels in the exhaust gas.
  - The requirements for Process Boilers are all mandatory.

QUESTIONS…

About Process Boilers

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Source: http://www.a10air.com/products/air-compressors/breathing-air-compressor-systems-components/

§120.6(e) - Compressed Air Systems

What is a “Compressed Air System?”

- **§100.1 Definitions:**
  - Compressed Air System
    - A system of at least one compressor providing compressed air at 40 psig or higher.
  - Trim Compressor
    - A compressor that is designated for part-load operation, handling the short-term variable trim load of end uses, in addition to the fully loaded base compressors.
  - Primary Storage
    - Compressed air storage located upstream of the distribution system and any pressure flow regulators.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§120.6(e) - Compressed Air Systems

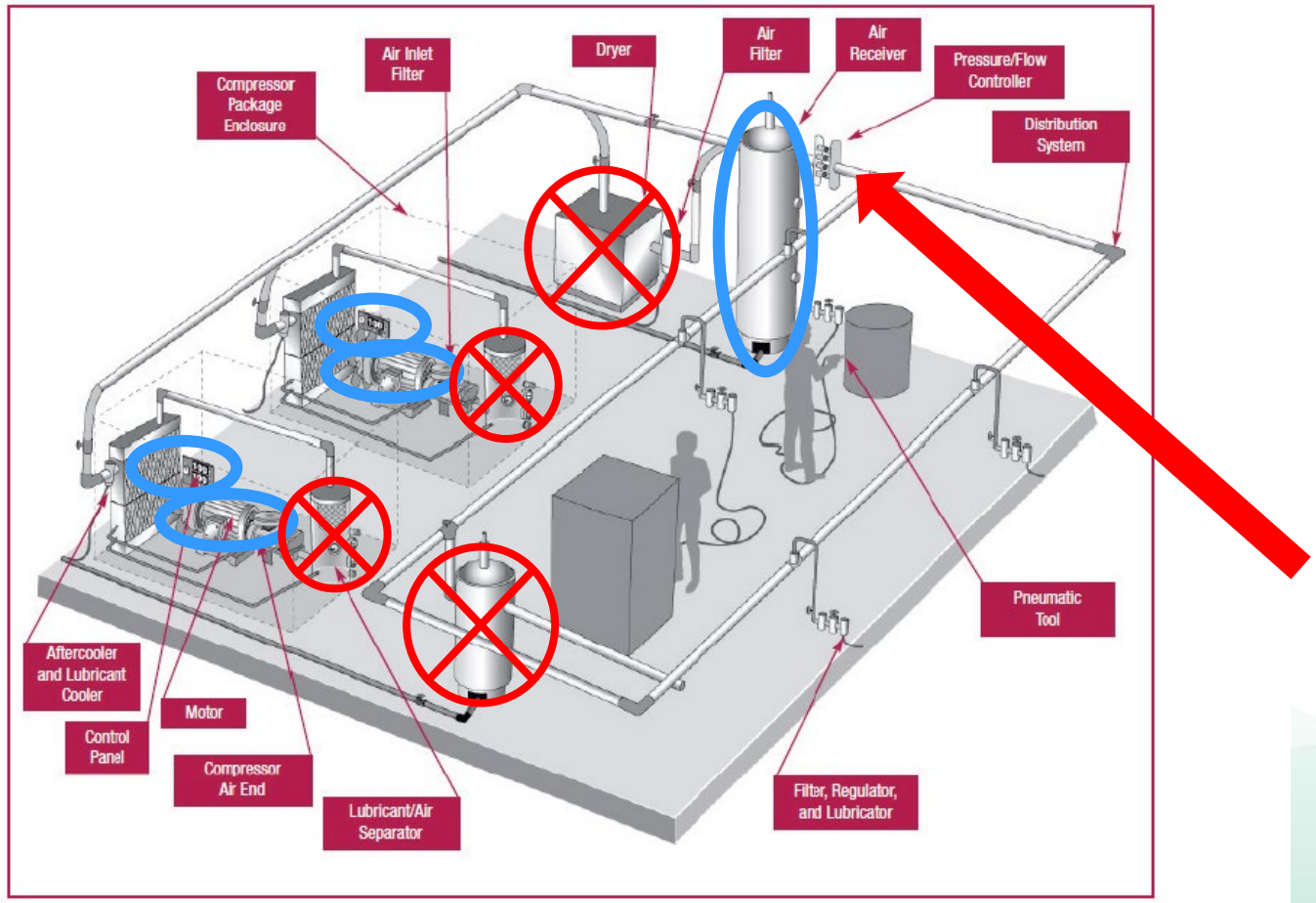
- **§120.6(e) Applicability**
  - All new, and all additions or alterations of compressed air systems (as defined in §100.1) where the total combined online horsepower (hp) of the compressor(s) is 25 hp or more.
  - The requirements apply to the compressors and related controls that provide compressed air and do not apply to any equipment or controls that use or process the compressed air.
    - §120.6(e)1 - Trim Compressor and Storage
    - §120.6(e)2 – Controls
    - §120.6(e)3 – Compressed Air System Acceptance

❖Exception 1 exempts alterations of existing compressed air systems that include one or more centrifugal compressors.

❖Exception 2 exempts compressed Air Systems with medical gas serving healthcare facilities.

§120.6(e) - Compressed Air Systems

- §120.6(e) Applicability

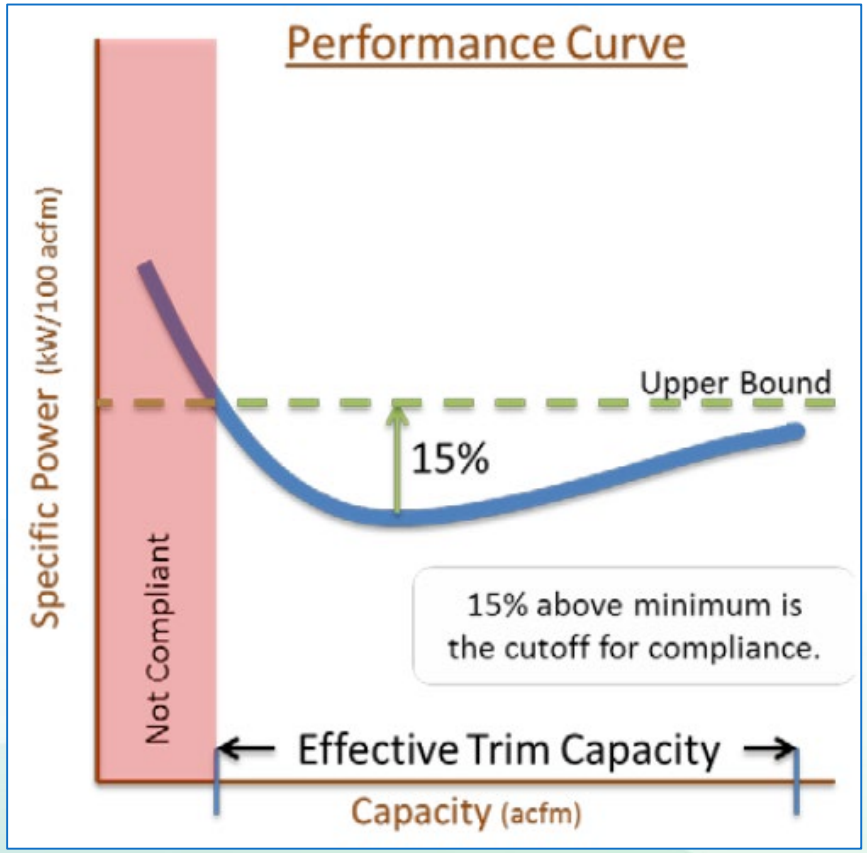


Source: Improving Compressed Air System Performance: A Sourcebook for Industry, USDOE 2003

§120.6(e) - Compressed Air Systems

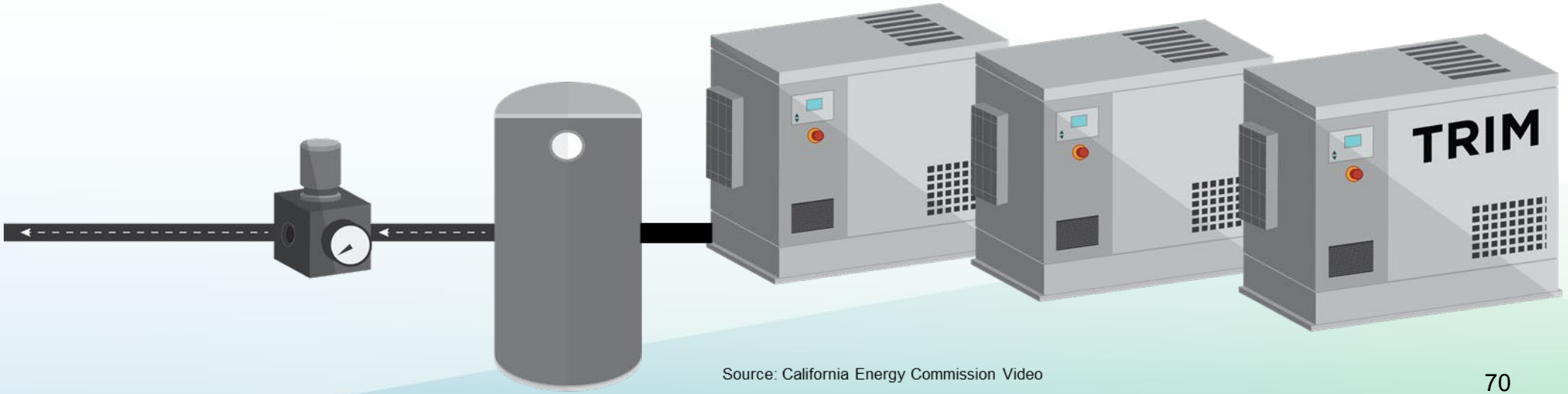
- **§120.6(e)1 - Trim Compressor and Storage**
  - The compressed air system must be equipped with an appropriately sized trim compressor and primary storage to provide acceptable performance across the range of the system and to avoid control gaps.
  - There are two ways to comply with trim compressor requirements:
    - Option 1: Use a variable speed drive (VSD) that is at least 1.25 times the size of the largest gap between the most efficient use order of all compressors.
    - Option 2: (Without a VSD) Have a compressor or set of compressors with a 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.

Option 2: Determination of Effective Trim Capacity From a Compressor Curve



§120.6(e) - Compressed Air Systems

- **§120.6(e)1 - Trim Compressor and Storage – cont.**
  - The size of the primary air storage depends on weather or not there is a Variable Speed Drive (VSD) trim compressor.
    - Option 1 for systems with a VSD: The primary storage must be 1 gallon per actual cubic feet per minute (acfm) of the largest trim compressor.
    - Option 2 for systems without a VSD: The system must include primary storage of at least 2 gallons per acfm of the largest trim compressor.
  - Of course, there are exceptions. See §120.6(e)1 for details.



Source: California Energy Commission Video

§120.6(e) - Compressed Air Systems

- **§120.6(e)2 - Controls**
  - Compressed air systems with more than one compressor and a combined horsepower rating > 100 hp, must have controls that choose the most energy efficient combination of compressors based on the air demand measured by a sensor.
- **§120.6(e)3 - Compressed Air System Acceptance**
  - Before an occupancy permit is granted the system must be tested and a Certificate of Acceptance submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in Reference Nonresidential Appendix NA 7.13.

§120.6(e) - Compressed Air Systems

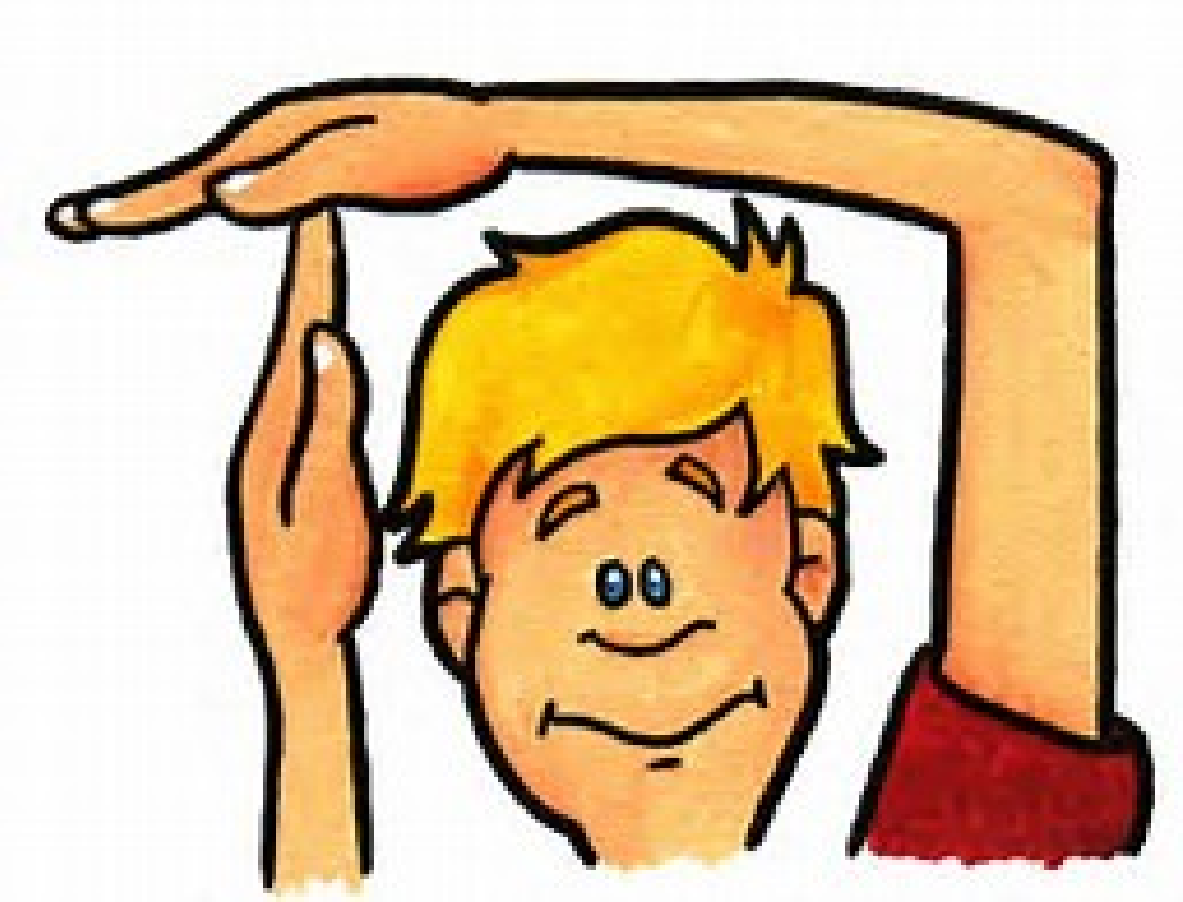
- **Takeaways**
  - There are trim compressor capacity requirements.
  - There are primary storage size requirements based on whether the system has a VSD trim compressor or not.
  - There are control requirements for large systems more than 100 hp to optimally stage compressors.
  - There are acceptance test requirements for all covered Compressed Air Systems.
  - Requirements for all covered Compressed Air Systems are mandatory.

QUESTIONS…

About Compressed Air Systems

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Time for a Break?



Source: https://guardtechbd.com/lift-escalator/

§120.6(f) - Elevators

§120.6(f) - Elevators

- **§120.6(f) Applicability**
  - Applies to all new and alterations of elevators except in healthcare facilities.

Source: California Energy Commission Video

§120.6(f) - Elevators

- **§120.6(f)**
  - Lighting power density (LPD) must be ≤ 0.6 watts/ft^2 (does not include interior signal lighting and interior display lighting).
  - Ventilation fans for cabs without A/C must be ≤ 0.33 watts/cfm at maximum speed.
  - Automatic shutoff controls for lights and ventilation when stopped and unoccupied for over 15 minutes.
    - Lighting & ventilation must remain operational in the event that the cabin is stuck and occupied.
  - Acceptance testing per Usually say "Referen onresidential Appendix NA7.14 is required.

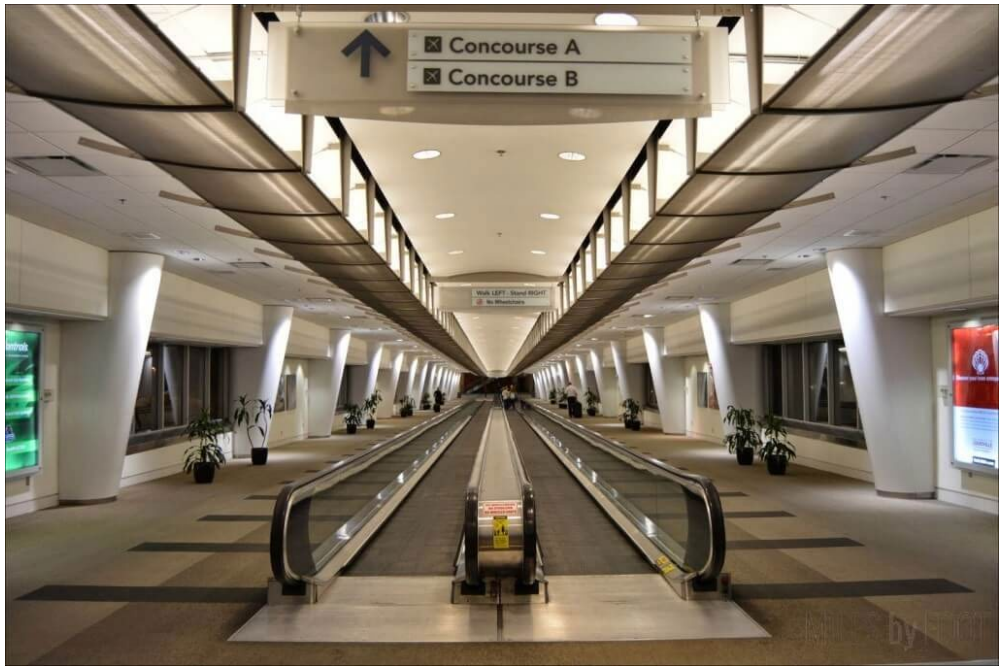
§120.6(f) - Elevators

- **Takeaways**
  - LPD must be ≤ 0.6 watts/ft^2.
  - Ventilation fans for cabs without A/C must be ≤ 0.33 watts/cfm.
  - Automatic shutoff controls for lights and ventilation when stopped and unoccupied.
  - Acceptance testing per NA7.14 is required.
  - All requirements are mandatory.

QUESTIONS…

About Elevators

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/



Source: http://www.milesbyfoot.com/2015/04/walking-windy-city-part-1.html

§120.6(g) - Escalators and Moving Walkways

What is an “Escalator or Moving Walkway?”

- **§100.1 Definitions:**
  - Baggage Area :
    - A room or area in a transportation facility such as an airport where the travelers reclaim their baggage.
  - Ticketing Area:
    - A room or area in a transportation facility such as an airport or a train station where travelers purchase tickets, check in baggage, or inquire about travel information.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§120.6(g) - Escalators and Moving Walkways

- **§120.6(g) Applicability**
  - Applies to Escalators and moving walkways located in airports, hotels, and transportation function areas.

§120.6(g) - Escalators and Moving Walkways

- **§120.6(g)**
  - Required to meet speed, acceleration, and passenger detection requirements per ASME A17.1-2013/CSA B44-13.
  - Acceptance testing per NA7.15 is required.

Source: wwwtelcosensors.com/solutions/industries/elevators

§120.6(g) - Escalators and Moving Walkways

- **ASME A17.1-2013/CSA B44-13 Requirements**
  - Applicable to both Moving Walkways and Escalators:
    - Acceleration must not exceed 1.0 ft/s^2 while occupied.
    - Passenger detection at both ends of the escalator/walkway allowing time to reach full speed before the passenger arrives.
    - Sound a warning signal to passengers approaching from the wrong direction.
    - Must slow to a minimum speed of 10 ft/min when not conveying passengers after 3 times the time needed to go between landings.
  - Moving Walkways maximum speed:
    - Walkways with slopes less than or equal to 8 degrees: maximum allowable speed is 180 ft/min.
    - Walkways with slope above 8 and less than or equal to 12 degrees: maximum allowable speed is 140 ft/min.
    - More than 12 degrees of slope is considered an escalator.
  - Escalators maximum speed allowable speed is 100 ft/min.

§120.6(g) - Escalators and Moving Walkways

- **Takeaways**
  - Applicable to escalators and moving walkways in airports, hotels, and transportation function areas.
  - There are maximum speed requirements based on the slope.
  - The maximum acceleration while occupied is 1.0 ft/s^2.
  - Minimum speed is 10 ft/min when not conveying passengers.
  - Passenger detection is required at both ends.
  - Acceptance testing is required.
  - All requirements are mandatory.

QUESTIONS…

About Escalators and Moving Walkways

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

§140.9
Prescriptive Requirements for Covered Processes

§140.9 - Prescriptive Requirements for Covered Processes

- §140.9(a) - Computer Rooms
- §140.9(b) - Commercial Kitchens
- §140.9(c) - Laboratory and Factory Exhaust Systems

Source: https://www.pcworld.com/article/2065300/data-centers-play-fast-and-loose-with-reliability-credentials.html

§140.9(a) - Computer Rooms

What is a “Computer Room?”

- **§100.1 Definitions:**
  - Computer Room
    - A room whose primary function is to house electronic equipment and that has a design equipment power density exceeding 20 watts/ft^2 (215 watts/m^2) of conditioned floor area.
  - Data Center
    - A building whose primary function is to house computer room(s).
  - Recool
    - The cooling of air that has been previously heated by space-conditioning equipment or systems serving the same building.
  - Reheat
    - The heating of air that has been previously cooled by cooling equipment or supplied by an economizer.

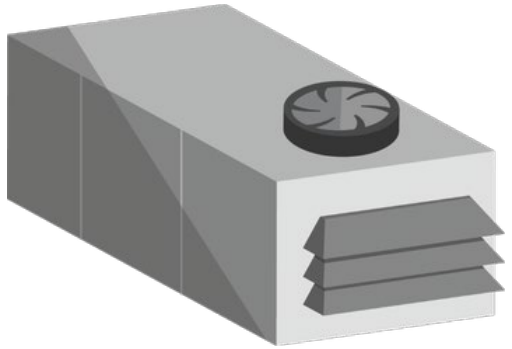
Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

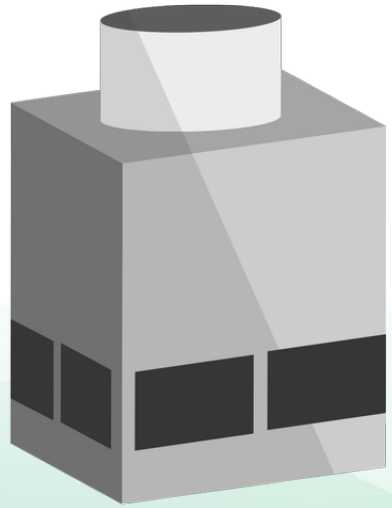
§140.9(a) - Computer Rooms

- **§140.9(a) Applicability**
  - This section is applicable to all spaces meeting the computer room definition (more than 20 watts/ft^2).
    - §140.9(a)1 – Economizers
    - §140.9(a)2 – Reheat
    - §140.9(a)3 – Humidification
    - §140.9(a)4 - Power Consumption of Fans
    - §140.9(a)5 - Fan Control
    - §140.9(a)6 - Containment
  - If you do not wish to comply with all of these prescriptive requirements, the performance method must be utilized.

§140.9(a) - Computer Rooms

- **§140.9(a)1 - Economizers.**
  - Each individual cooling system primarily serving computer room(s) must include either:
    - An integrated air economizer:
      - Must be capable of providing 100 percent of the system cooling load at outside air temperatures of 55°F dry-bulb/50°F wet-bulb and below; and
      - Must be equipped with fault detection and diagnostics (FDD) as specified in §120.2(i)
    - An integrated water economizer:
      - Must be capable of providing 100 percent of the expected system cooling load at outside air temperatures of 40°F dry-bulb/35°F wet-bulb and below.
  - Of course, there are exceptions. See §140.9(a)1 for details.



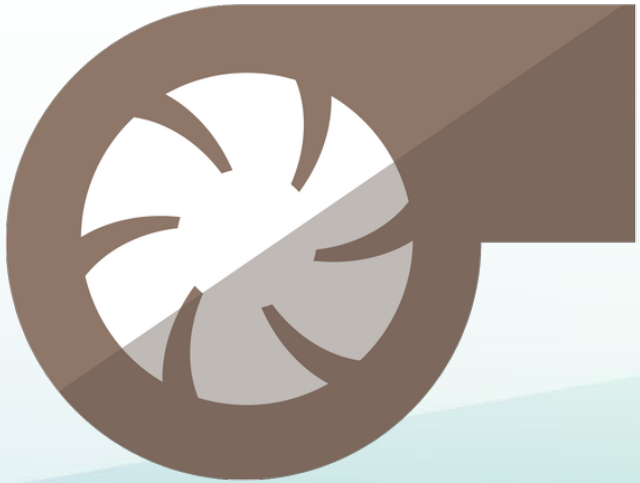


§140.9(a) - Computer Rooms

- **§140.9(a)2 - Reheat.**
  - Each zone must have controls that prevent reheating, recooling and simultaneous heating and cooling to the same zone.
- **§140.9(a)3 - Humidification.**
  - Nonadiabatic humidification (e.g. steam, infrared) is prohibited. Only adiabatic humidification (e.g. direct evaporative, ultrasonic) is permitted.
- **§140.9(a)4 - Power Consumption of Fans.**
  - The total fan power at design conditions of each fan system must not exceed 27 W/kBtu·h of net sensible cooling capacity.

§140.9(a) - Computer Rooms

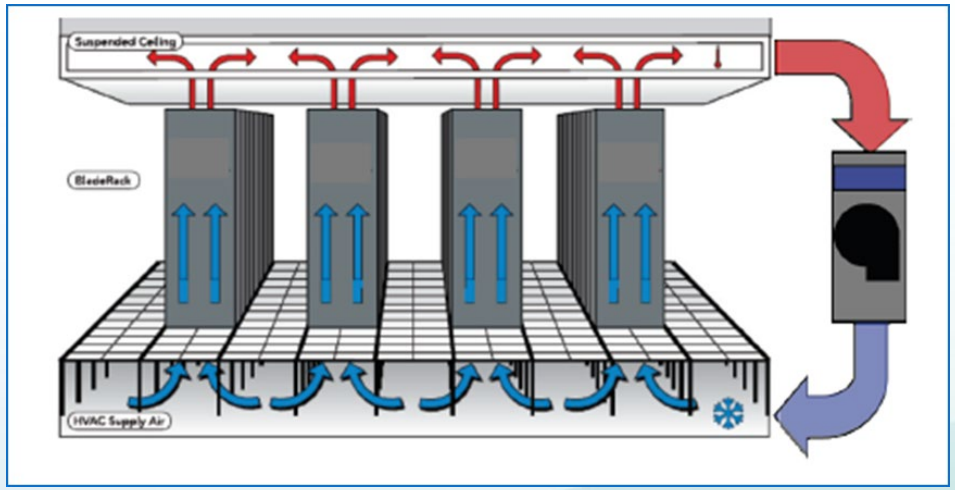
- **§140.9(a)5 - Fan Control.**
  - Each unitary air conditioner with a mechanical cooling capacity exceeding 60,000 Btu/hr and each chilled water fan system must be designed to:
    - Vary the airflow rate as a function of actual load; and
    - Must have controls and/or devices (such as two-speed or variable speed control) that will result in fan motor demand of no more than 50 percent of design wattage at 66 percent of design fan speed.



§140.9(a) - Computer Rooms

- **§140.9(a)6 - Containment.**
  - Computer rooms with air-cooled computers in racks and a design load > 175 kW/room must have air barriers minimizes computer discharge air to recirculate back to computer inlets.
  - Of course, there are exceptions. See §140.9(a)6 for details.
    - Expansion of existing computer rooms.
    - Computer racks with a design load less than 1 kW/rack.

Example of Aisle Containment Using Chimney Racks



Example of Aisle Containment Using Hard Partitions and Doors

Quiz Question

Which of the following are mandatory requirements for computer rooms?

a) Economizer air

b) Prevention of reheating and recooling

c) Adiabatic humidification

d) a) and b)

e) a), b) and c)

f) None of the above

There are no mandatory requirements for computer rooms. They are all prescriptive.

Quiz Question

Which of the following are <u>prescriptive</u> requirements for computer rooms?

a) Economizer air

b) Prevention of reheating and recooling

c) Adiabatic humidification

d) a) and b)

e) a), b) and c)

f) None of the above

§140.9(a) - Computer Rooms

- **Takeaways**
  - The Energy Code apply if the power density exceeds 20 watts/ft^2.
  - Reheating and recooling are not allowed.
  - Only adiabatic humidification is allowed.
  - Fan power must not exceed 27 W/kBtu·h of net sensible cooling capacity.
  - Fan controls are required to reduce fan speed based on load requirements.
  - Containment systems are required in rooms greater than 175 kW/room.
  - These are prescriptive requirements only.

QUESTIONS…

About Computer Rooms

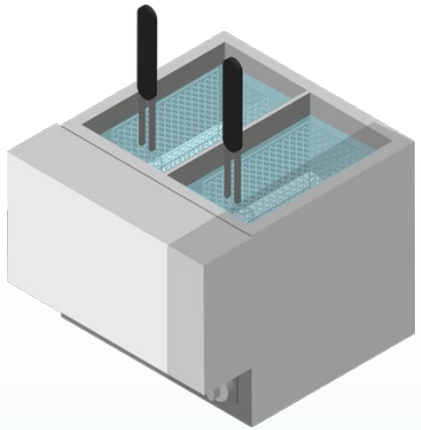
Source:
https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Source: https://www.aps-hoods.com/

§140.9(b) - Commercial Kitchens

What is a “Commercial Kitchen?”

- **§100.1 Definitions:**
  - Kitchen/Food Preparation
    - A room or area with cooking facilities or an area where food is prepared.
  - Food Preparation Equipment
    - Cooking equipment intended for commercial use, including coffee machines, espresso coffee makers, conductive cookers, food warmers including heated food servers, fryers, griddles, nut warmers, ovens, popcorn makers, steam kettles, ranges, and cooking appliances for use in commercial kitchens, restaurants, or other business establishments where food is dispensed.



Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

What is a “Commercial Kitchen?”

- **§100.1 Definitions – cont.:**
  - Replacement Air
    - Air that is used to replace air removed from a building through an exhaust system. Replacement air may be derived from one or more of the following: makeup air, portions of supply air, transfer air, or infiltration air.
  - Makeup Air
    - Outdoor air that is intentionally conveyed by openings or ducts into the building from the outside; is supplied to the vicinity of an exhaust hood; and replaces air, vapor and contaminants being exhausted by the exhaust hood. Makeup air is generally filtered and fan-forced, and it may be heated or cooled. Makeup air may be delivered through openings or ducts integral to the exhaust hood.
  - Transfer Air
    - Air transferred, whether actively by fans or passively by pressure differentials, from one room to another within a building through openings.

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

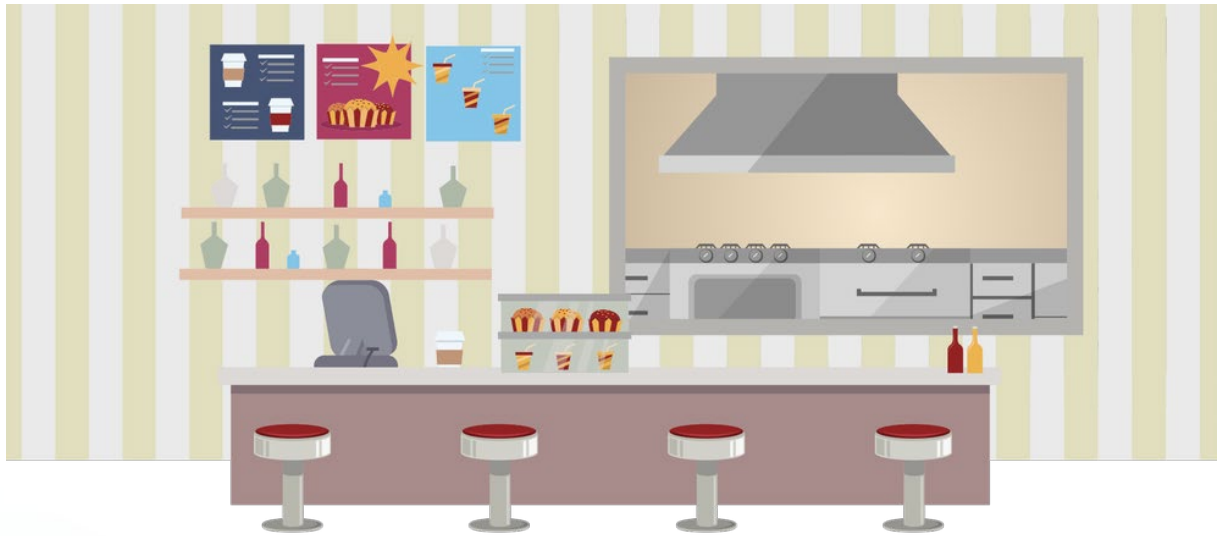
What is a “Commercial Kitchen?”

- **ASHRAE Standard 154-2011 Definitions:**
  - Type I Hood
    - A hood used for collecting and removing convective heat, grease particulate, condensable vapor, and smoke.
  - Type II Hood:
    - A hood that collects and removes steam, heat, and products of combustion where grease or smoke is not present.
  - Appliance Duty Level
    - Light: cooking process requiring exhaust airflow rate < 200 cfm/ft
    - Medium: cooking process requiring exhaust rate of 200 to 300 cfm/ft
    - Heavy: cooking process requiring exhaust rate of 300 to 400 cfm/ft
    - Extra Heavy: cooking process requiring exhaust rate > 400 cfm/ft

Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§140.9(b) - Commercial Kitchen

- **§140.9(b) Applicability**
  - This section is applicable to all commercial kitchens with at least one exhaust hood.
    - §140.9(b)1 – Kitchen Exhaust System
    - §140.9(b)2 – Kitchen Ventilation
    - §140.9(b)3 – Kitchen Exhaust System Acceptance
  - If it is desired not to comply with these prescriptive requirements, the performance method must be utilized.



§140.9(b) - Commercial Kitchen

- **§140.9(b)1 - Kitchen Exhaust System.**
  - Replacement air directly into the hood cavity of kitchen exhaust hoods (AKA short circuit hoods) can't exceed 10 percent of the hood airflow rate.
  - For total Type I and Type II hood exhaust airflow rates greater than 5,000 cfm, each Type I hood must have an exhaust rate that complies with TABLE 140.9-A.

TABLE 140.9-A MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH

Type of Hood	Light Duty Equipment	Medium Duty Equipment	Heavy Duty Equipment	Extra Heavy Duty Equipment
Wall-mounted Canopy	140	210	280	385
Single Island	280	350	420	490
Double Island	175	210	280	385
Eyebrow	175	175	Not Allowed	Not Allowed
Backshelf / Passover	210	210	280	Not Allowed

§140.9(b) - Commercial Kitchen

- **§140.9(b)2A - Kitchen Ventilation**
  - Mechanically cooled or heated makeup air delivered to any space with a kitchen hood must not exceed the greater of:
    - The supply flow required to meet the space heating and cooling load; or
    - The hood exhaust flow minus the available transfer air from adjacent spaces.
      - Available transfer air is the outdoor ventilation air serving adjacent spaces that is not needed and that would otherwise be relieved from the building.
  - This requirement does not apply to existing makeup air units not being replaced as part of an addition or alteration.

§140.9(b) - Commercial Kitchen

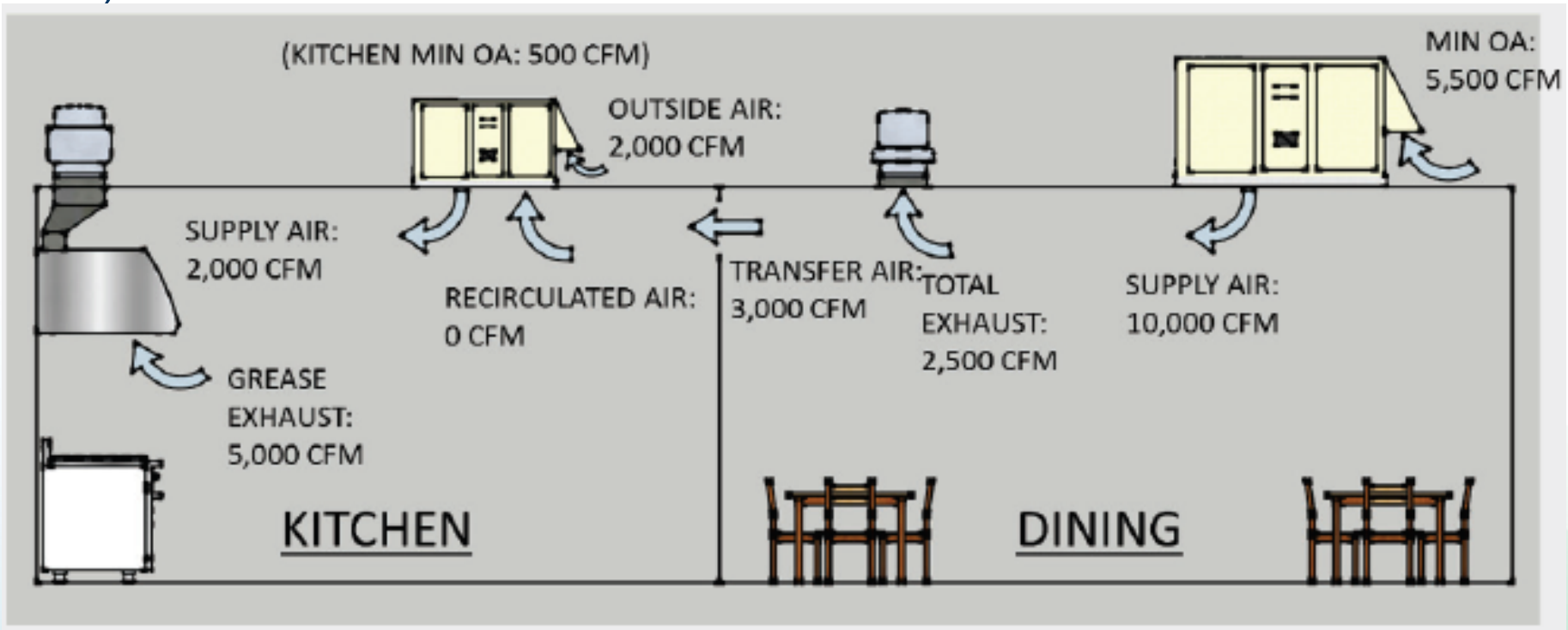
- **§140.9(b)2B - Kitchen Ventilation - cont.**
  - A kitchen/dining facility having a total Type I and Type II kitchen hood exhaust airflow rate greater than 5,000 cfm must have one of the following:
    - At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or
    - Have a demand ventilation system on at least 75% of the exhaust air (and control requirements per §140.9(b)2Bii ; or
    - Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on at least 50 percent of the total exhaust airflow; or
    - A minimum of 75 percent of makeup air volume that is unheated or heated to no more than 60°F; and uncooled or cooled without the use of mechanical cooling.

Quiz question

This kitchen requires 2,000 cfm for cooling and has a demand ventilation system on 100% of the exhaust. Does it comply with the requirements in §140.9(b)2A and B?

a) Yes

b) No



§140.9(b) - Commercial Kitchen

- **§140.9(b)3 – Kitchen Exhaust System Acceptance**
  - System Acceptance Testing applies only to kitchens with Type I Hoods (see Reference Nonresidential Appendix NA7.11 for test procedure).
  - The equipment and systems must be certified per the requirements in Reference Nonresidential Appendix NA7.11.

§140.9(b) - Commercial Kitchen

- **Takeaways**
  - The Energy Code applies if it is a commercial kitchen with at least one exhaust hood.
  - There are maximum flow rates allowed for Type I exhaust hoods.
  - There are maximum flow rates allowed for makeup air.
  - For exhaust flows greater than 5,000 cfm, there are additional requirements to have makeup air, demand ventilation OR energy recovery devices.
  - Acceptance testing is required for systems with Type I hoods.
  - These are all prescriptive requirements.

QUESTIONS…

About Commercial Kitchens

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

Source: https://www.labconco.com/articles/high-performance-lab-ventilation

§140.9(c) - Laboratory and Factory Exhaust Systems

What is a “Laboratory or Factory Exhaust System?”

- **§100.1 Definitions:**
  - Scientific Laboratory Area
    - A room or area where research, experiments, and measurement in medical and physical sciences are performed requiring examination of fine details. The area may include workbenches, countertops, scientific instruments, and associated floor spaces. Scientific laboratory does not refer to film, computer, and other laboratories where scientific experiments are not performed.
  - Factory
    - A building, structure or space designated as Factory Group F that is used for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations.

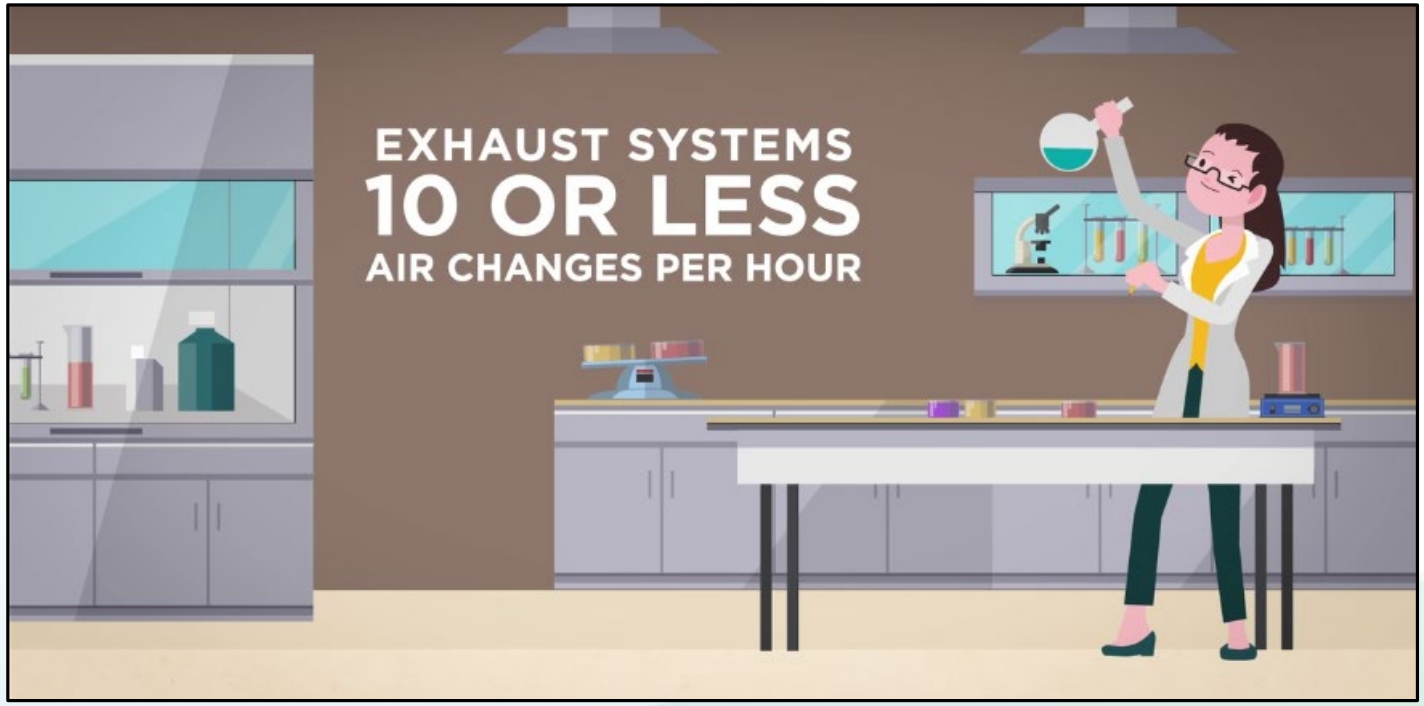
Source: https://classroomclipart.com/clipart-view/Clipart/People/man-scratching-head-with-question-clipart_jpg.htm

§140.9(c) - Laboratory and Factory Exhaust Systems

- **§140.9(c) Applicability**
  - There are four sections in §140.9(c) and each has its own applicability requirements:
    - §140.9(c)1 - Airflow Reduction Requirements
      - Laboratory exhaust systems with a minimum rate of 10 ACH or less
    - §140.9(c)2 - Exhaust System Transfer Air
      - All laboratory and factory systems
    - §140.9(c)3 - Fan System Power Consumption
      - Laboratory or factory systems greater than 10,000 cfm
    - §140.9(c)4 - Fume Hood Automatic Sash Closure
      - Laboratories with VAV and fume hoods with vertical sashes with fume hood intensities shown in Table 140.9-B

§140.9(c) - Laboratory and Factory Exhaust Systems

- **§140.9(c)1 - Airflow Reduction Requirements**
  - This section only applies to laboratories with exhaust systems where the minimum circulation rate to comply with code or accreditation standards is 10 ACH or less.



§140.9(c) - Laboratory and Factory Exhaust Systems

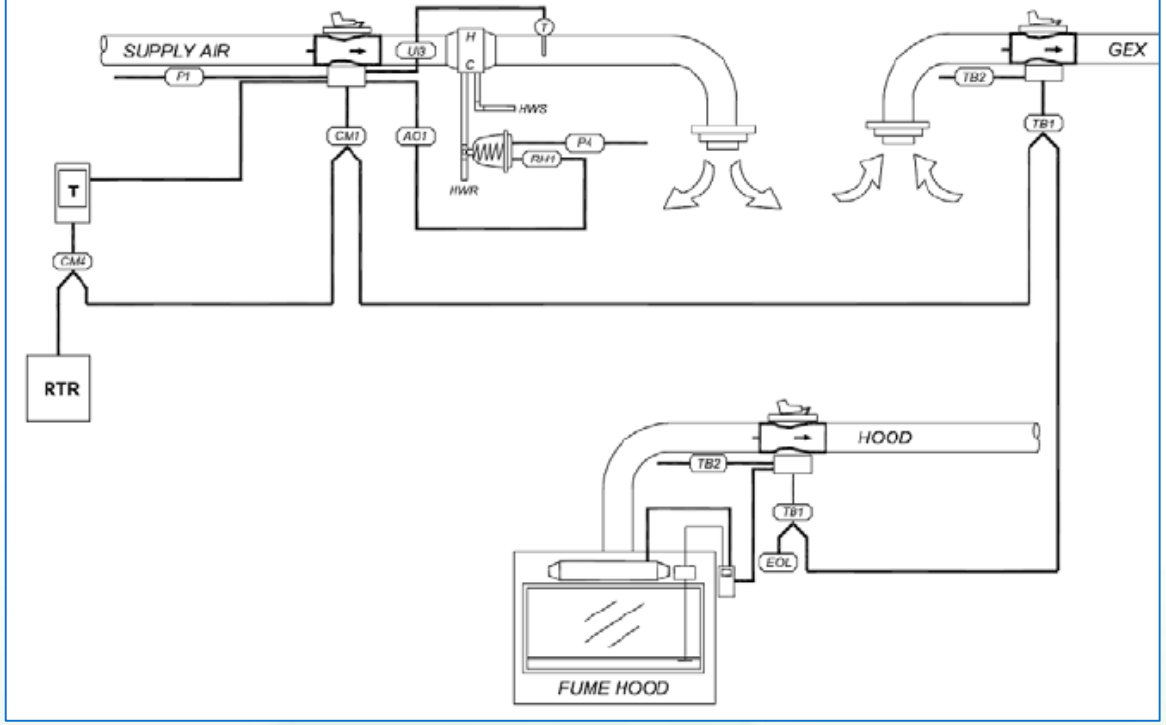
- **§140.9(c)1 - Airflow Reduction Requirements - cont.**
  - Exhaust and makeup airflow must be balanced to achieve the larger of the following:
    - The regulated minimum circulation rate; or
    - The minimum required to maintain pressurization requirements.

EXCEPTIONS:

Exception 1 to §140.9(c)1: Laboratory exhaust systems serving zones where constant volume is required by the Authority Having Jurisdiction, facility Environmental Health & Safety department or other applicable code.

Exception 2 to §140.9(c)1: New zones on an existing constant volume exhaust system.

Figure 10-39: Zone Components For a VAV Lab



§140.9(c) - Laboratory and Factory Exhaust Systems

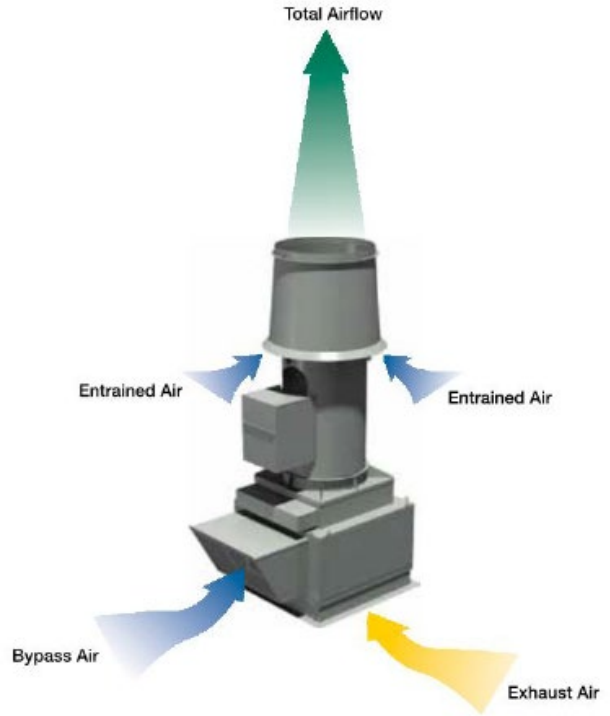
- **§140.9(c)2 - Exhaust System Transfer Air**
  - All mechanical exhaust system must comply with the requirements of §140.4(o).
    - Conditioned supply air delivered to any space must not exceed the greater of:
      - The supply flow required to meet the space heating or cooling load; or
      - The ventilation rate required by the authority having jurisdiction, the facility Environmental Health and Safety Department, or by §120.1(c)3; or
      - The mechanical exhaust flow minus the available transfer air from a space or return air plenums on the same floor and same smoke or fire compartment, and within 15 ft.

EXCEPTIONS to §140.4(o):

1. Biosafety laboratories classified level 3 or higher
2. Vivarium spaces
3. Spaces that are required to maintain positive pressure
4. Spaces where the exhaust makeup need exceeds the available transfer airflow and where the spaces have a required negative pressure relationship.
5. Healthcare facilities

§140.9(c) - Laboratory and Factory Exhaust Systems

- **§140.9(c)3 - Fan System Power Consumption**
  - New laboratory or factory exhaust systems greater than 10,000 CFM must comply with A, B, C, or D below:
    - A. All discharge requirements in ANSI Z9.5-2012
    - B. Exhaust fan power must be no greater than the following:
      - 0.85 watts per cfm of systems with filtration, scrubbers, or other air treatment devices; or
      - 0.65 watts per cfm of exhaust air for all other systems
    - C. Variable volume flow rate based on the measured 5-minute averaged wind speed and direction from a calibrated anemometer. (See §140.9(c)3C for details)
    - D. Variable volume flow rate based on measured contaminant levels with sensors in all exhaust plenums. (See §140.9(c)3D for details)



Source: 2019 CASE Report: Variable Exhaust Flow Control

§140.9(c) - Laboratory and Factory Exhaust Systems

- **§140.9(c)4 - Fume Hood Automatic Sash Closure**
  - VAV vertical sash fume hoods in fume hood intensive laboratories as described in Table 140.9-B, must have automatic sash closure systems with the following:
    - A dedicated zone sensor that closes the sash within 5 minutes of no detection.
    - Controls preventing automatic closing when a force of no more than 10 lbs. is detected.
    - Equipped with an obstruction sensor that prevents automatic closing when obstructions are in the sash opening.
    - Capable of being configured in a Manual Open Mode where detection of people in the area near the fume hood by the zone sensor does not open the sash.
    - Fume hood acceptance testing per Reference Nonresidential Appendix NA7.17.

Table 140.9-B Fume Hood Intensive Laboratories

Occupied Minimum Ventilation ACH	≤ 4	> 4 and ≤ 6	> 6 and ≤ 8	> 8 and ≤ 10	> 10 and ≤ 12	> 12 and ≤ 14
Hood Density (linear feet per 10,000 ft^3 of laboratory space	≥ 6	≥ 8	≥ 10	≥ 12	≥ 14	≥ 16

§140.9(c) - Laboratory and Factory Exhaust Systems

- **Takeaways**
  - Airflow reduction requirements for systems designed for 10 ACH or less:
    - Controls to coordinate exhaust and makeup air to maintain minimum ACH or pressurization.
    - There is an exception for systems requiring constant volume.
  - All mechanical exhaust system must comply with exhaust system transfer air requirements of §140.4(o).
  - New exhaust systems greater than 10,000 CFM have fan power requirements:
    - Meet ANSI Z9.5-2012; or
    - 0.85 Watts/cfm for systems with air treatment devices or 0.65 Watts/cfm for all others; or
    - VAV flow rate based on measured wind speed or plenum contaminate levels
  - VAV laboratory fume hoods with vertical sashes located in fume hood intensive laboratories have automatic closing requirements with acceptance testing.
  - These are prescriptive requirements.

QUESTIONS…

About Laboratory and Factory Exhaust Systems

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

NRCC-PRC-E Dynamic Form Review

Plans Examiner

- **NRCC-PRC-E Certificate of Compliance**
  - Table **A. GENERAL INFORMATION**

STATE OF CALIFORNIA

Process Systems

NRCC-PRC-E (Created 11/19) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE				NRCC-PRC-E
Table Instructions: Include any process systems that are within the scope of the permit application and are demonstrating compliance with mandatory requirements in §120.6, or prescriptive requirements in §140.9. This compliance document is used for newly constructed, addition and alteration projects.				
Project Name:	Example		Report Page:	Page 1 of 7
Project Address:	123 Comply Street		Date Prepared:	2020-07-15

A. GENERAL INFORMATION

01	Project Location (city)	Sacramento	04	Total Conditioned Floor Area	40,000
02	Climate Zone	12	05	Total Unconditioned Floor Area	100,000
03	Occupancy Types Within Project:		06	# of Stories (Habitable Above Grade)	2

☑ Office	☐ Retail	☑ Non-refrigerated Warehouse
☐ Hotel/ Motel	☐ School	☐ Healthcare Facility
☐ High-Rise Residential	☐ Relocatable Class Bldg	☐ Other (Write In):

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- **NRCC-PRC-E Certificate of Compliance**
  - Table **B. PROJECT SCOPE**

B. PROJECT SCOPE	
Table Instructions: Include any process systems listed below within the scope of the permit application that are demonstrating compliance with mandatory requirements in §120.6 or prescriptive requirements in §140.9.	
My project consists of (check all that apply):	
01	02
☐ Refrigerated Spaces <3,000 ft² Total (no Title 24, Pt 6 requirements)	☑ Elevator Lighting & Ventilation Controls (mandatory §120.6(f))
☐ Refrigerated Spaces ≥3,000 ft² Total (mandatory §120.6(a))	☐ Escalator & Moving Walkway Speed Controls (mandatory §120.6(g))
☐ Food Stores > 8,000 ft² cfa (mandatory §120.6(b))	☑ Computer Rooms > 20W/ft² Power Density (prescriptive §140.9(a))[1]
☑ Enclosed Parking Garage Exhaust ≥ 10,000 cfm (mandatory §120.6(c))	☐ Commercial Kitchen Ventilation/Exhaust (prescriptive §140.9(b))[1]
☑ Newly Installed Process Boilers (mandatory §120.6(d))	☐ Laboratory Exhaust/Factory Exhaust & Fume Hood (prescriptive §140.9(c))[1]
☐ Compressed Air Systems Combined HP ≥ 25 (mandatory §120.6(e))	
[1] *FOOTNOTES: These building features can comply using the performance method. If using the performance method for these features, compliance should be demonstrated on the NRCC-PRF-E compliance document.*	

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- **NRCC-PRC-E Certificate of Compliance**
  - Table **C. COMPLIANCE RESULTS**

C. COMPLIANCE RESULTS										
Table Instructions: If any cell on this table says "DOES NOT COMPLY" or "COMPLIES with Exceptional Conditions" refer to Table D. for guidance.										
01	02	03	04	05	06	07	08	09	10	11
Refrigerated Warehouse/ Space §120.6(a)	Commercial Refrigeration §120.6(b)	Parking Garage Exhaust §120.6(c)	Process Boilers §120.6(d)	Compressed Air Systems §120.6(e)	Elevators §120.6(f)	Escalators & Moving Walkways §120.6(g)	Computer Rooms §140.9(a)	Commercial Kitchens §140.9(b)	Laboratory Exhaust §140.9(c)	**Compliance Results**
(See Table F)	(See Table G)	(See Table H)	(See Table I)	(See Table J)	(See Table K)	(See Table L)	(See Table M)	(See Table N)	(See Table O)	
		Yes	Yes		Yes		Yes			**COMPLIES WITH EXCEPTIONAL CONDITIONS**

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- **NRCC-PRC-E Certificate of Compliance**
  - Table **D. COMPLIANCE RESULTS** and Table **E. ADDITIONAL REMARKS**

D. EXCEPTIONAL CONDITIONS
This table is auto-filled with uneditable comments because of selections made or data entered in tables throughout the form.
Table K indicates one or more elevators which have designed ventilation Watts/cfm greater than the maximum Watts/cfm allowed. Please revise Table K to demonstrate compliance.

E. ADDITIONAL REMARKS
This table includes remarks made by the permit applicant to the Authority Having Jurisdiction.
This is where any remarks are written to assist the plan check.

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- **NRCC-PRC-E Certificate of Compliance**
  - Tables F through O are covered process specific tables
    - Table **F. REFRIGERATED WAREHOUSE/SPACES**
    - Table **G. COMMERCIAL REFRIGERATION**
    - Table **H. ENCLOSED PARKING GARAGE EXHAUST**
    - Table **I. PROCESS BOILER**
    - Table **J. COMPRESSED AIR SYSTEMS**
    - Table **K. ELEVATOR LIGHTING AND VENTILATION**
    - Table **L. ESCALATORS AND MOVING WALKWAYS SPEED CONTROLS**
    - Table **M. COMPUTER ROOM SYSTEM SUMMARY**
    - Table **N. COMMERCIAL KITCHEN EXHAUST AND VENTILATION**
    - Table **O. LABORATORY AND FACTORY EXHAUST AND FUME HOODS**

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- **NRCC-PRC-E Certificate of Compliance**
  - Table **H. ENCLOSED PARKING GARAGE EXHAUST** - example

H. ENCLOSED PARKING GARAGE EXHAUST

Table Instructions: Complete the following table for enclosed garage ventilation/exhaust systems with an exhaust rate ≥ 10,000 cfm to demonstrate compliance with mandatory requirements found in §120.6(c).

	Yes	Exceptions
01	☐	Garage is expected to have vehicles with non-gasoline combustion engines for > 20% of the parked vehicles per Exception 1 to §120.6(c)
02	☐	Project scope includes an addition or alteration to an existing garage where < 10,000 cfm of new exhaust capacity is being added Exception 2 to §120.6(c)
	Yes	Requirements
03	✓	Exhaust fan control modulates airflow rates ≤ 50% design capacity when contaminant levels are maintained per §120.6(c)1
04	✓	Fan control or device allows fan motor demand ≤ 30% design wattages at 50% of design airflow per §120.6(c)2
05	✓	Design includes monitoring CO with a sensor density ≥ 1 per 5,000 ft² per §120.6(c)3
06	✓	CO sensors are located in the highest expected concentration locations, with at least two per proximity zone per §120.6(c)3
07	✓	Design CO sensor setpoint ≤ 25 ppm per §120.6(c)4
08	✓	Occupied garage design maintains negative pressurization per §120.6(c)6
09	✓	Designed occupied total ventilation rate ≥ 0.15 CFM/ ft² §120.6(c)5

	10	11	12	13	14
	Fan Name	Parking Garage Area (ft²)	Ventilation Fan Rate (CFM)	Minimum Ventilation Rate Required (CFM)	Compliant?
	Garage Fan1	20,000	3,500	3,000	Yes

Reset | Add Ventilation Fan | Remove Last

	Indicate where in the construction documents these requirements can be verified	A1

Plans Examiner

- **NRCC-PRC-E Certificate of Compliance**
  - Table **I. PROCESS BOILER** - example

I. PROCESS BOILER

Table Instructions: Complete the following table to demonstrate compliance with mandatory requirements found in §120.6(d) for newly installed (including moved) process boilers.

01	02	03	04	05
Name or Item Tag	Rated Input Capacity per Boiler (Btu/h)	Combustion Air Shutoff §120.6(d)1	Fan Controls §120.6(d)2	Stack Design and Controls §120.6(d)3 & §120.6(d)4
Boiler1	≥ 5 to <10 MMBtuh per boiler	Combustion air positive shut-off provided	Variable speed drive provided	Designed and controlled per §120.6(d)

Reset | Add Row | Remove Last

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- **NRCC-PRC-E Certificate of Compliance**
  - Table **K. ELEVATOR LIGHTING AND VENTILATION** - example

K. ELEVATOR LIGHTING AND VENTILATION

Table Instructions: Complete the following table for elevator lighting and ventilation to demonstrate compliance with mandatory requirements found in §120.6(f) for each individual elevator.

01	02	03	04	05	06	07	08
Lighting §120.6(f)1 & §120.6(f)3							
Elevator Name or Item Tag	Elevator Area (ft^2)	Fixture Name or Item Tag	Watts per Fixture	Number of Fixtures	Power per Design (W)	Maximum Power Allowed[1] (W)	Controls
Elevator 1	25	LED1	5	2	10	15	Occupancy sensors provided
		Total Design Watts			10	15	
					Add Fixture	Remove Last Fixture	

09	10	11	12	13	14	15
Name or Item Tag	Conditioned Cab?	Ventilation §120.6(f)1 & §120.6(f)3				
		Fan Power (Watts)	Design Airflow (CFM)	Design Watts per CFM	Maximum Watts per CFM Allowed	Controls
Elevator 1	No	10	50	0.2	0.33	Occupancy sensors provided
					Reset / Add Elevator / Remove Last	

[1] *FOOTNOTE: 0.6 watts per ft^2 allowed per §120.6(f)1. Interior signal lighting and display lighting not included in power density calculation.*

16	Indicate where in the construction documents these requirements can be verified	Page A2

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- **NRCC-PRC-E Certificate of Compliance**
  - Table **P. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION**

P. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Table Instructions: Selections have been made based on information provided in previous tables of this document. If any selection needs to be changed, please explain why in Table E. Additional Remarks. These documents must be provided to the building inspector during construction and can be found online at https://ww2.energy.ca.gov/title24/2019standards/2019_compliance_documents/Nonresidential_Documents/NRCA/.

YES	NO	Form/Title	Field Inspector	
			Pass	Fail
●	○	NRCI-PRC-01-E Covered Process	☐	☐

Plans Examiner /Field Inspector

- **NRCC-PRC-E Certificate of Compliance**
  - Table **Q. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE**

Q. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Table Instructions: Selections have been made based on information provided in previous tables of this document. If any selection needs to be changed, please explain why in Table E. Additional Remarks. These documents must be provided to the building inspector during construction and can be found online at https://ww2.energy.ca.gov/title24/2019standards/2019_compliance_documents/Nonresidential_Documents/NRCA/.

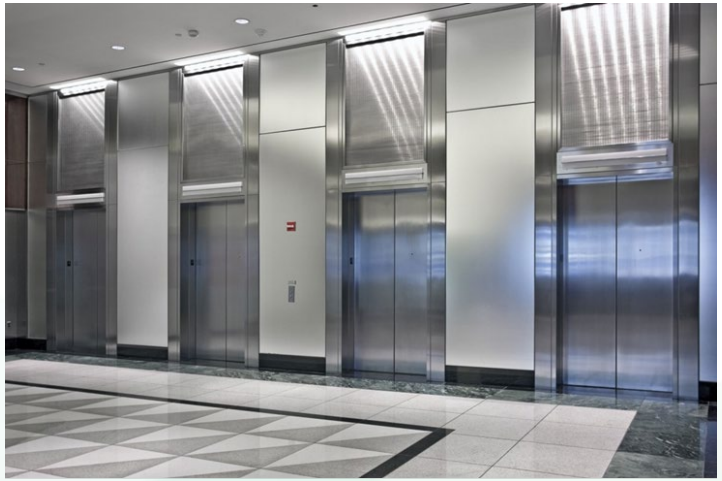
YES	NO	Form/Title	Field Inspector	
			Pass	Fail
○	●	NRCA-PRC-01-F Compressed Air Systems	☐	☐
○	●	NRCA-PRC-02-F Kitchen Exhaust	☐	☐
●	○	NRCA-PRC-03-F Garage Exhaust	☐	☐
○	●	NRCA-PRC-04-F Refrigerated Warehouses - Evaporator Fan Motor Controls	☐	☐
○	●	NRCA-PRC-05-F Refrigerated Warehouses - Evaporative Condenser Controls	☐	☐
○	●	NRCA-PRC-06-Refrigerated Warehouses - Air Cooled Condenser Controls	☐	☐
○	●	NRCA-PRC-16-Refrigerated Warehouses - Adiabatic Condenser Controls	☐	☐
○	●	NRCA-PRC-07 Refrigerated Warehouses - Variable Speed Compressor	☐	☐
○	●	NRCA-PRC-08-F Refrigerated Warehouses - Electric Resistance Underslab Heating System	☐	☐
●	○	NRCA-PRC-12-F Elevator Lighting & Ventilation Controls	☐	☐
○	●	NRCA-PRC-13-F Escalators & Moving Walkways Speed Controls	☐	☐
○	●	NRCA-PRC-14-F Lab Exhaust Ventilation Systems	☐	☐
○	●	NRCA-PRC-15-F Fume Hood Automatic Sash Closure Systems	☐	☐

Field Inspector

- **Verify Certificate of Installation**
  - NRCI-PRC-01-E is required for all Covered Processes and is the only NRCI form for Covered Processes.

Source: http://universalcontrol.com/garage-ventilation-automation/

Source: https://www.process-heating.com/articles/90444-internal-counterflow-device-improves-efficiency-of-packaged-boilers



Source: https://guardtechbd.com/lift-escalator/

QUESTIONS…

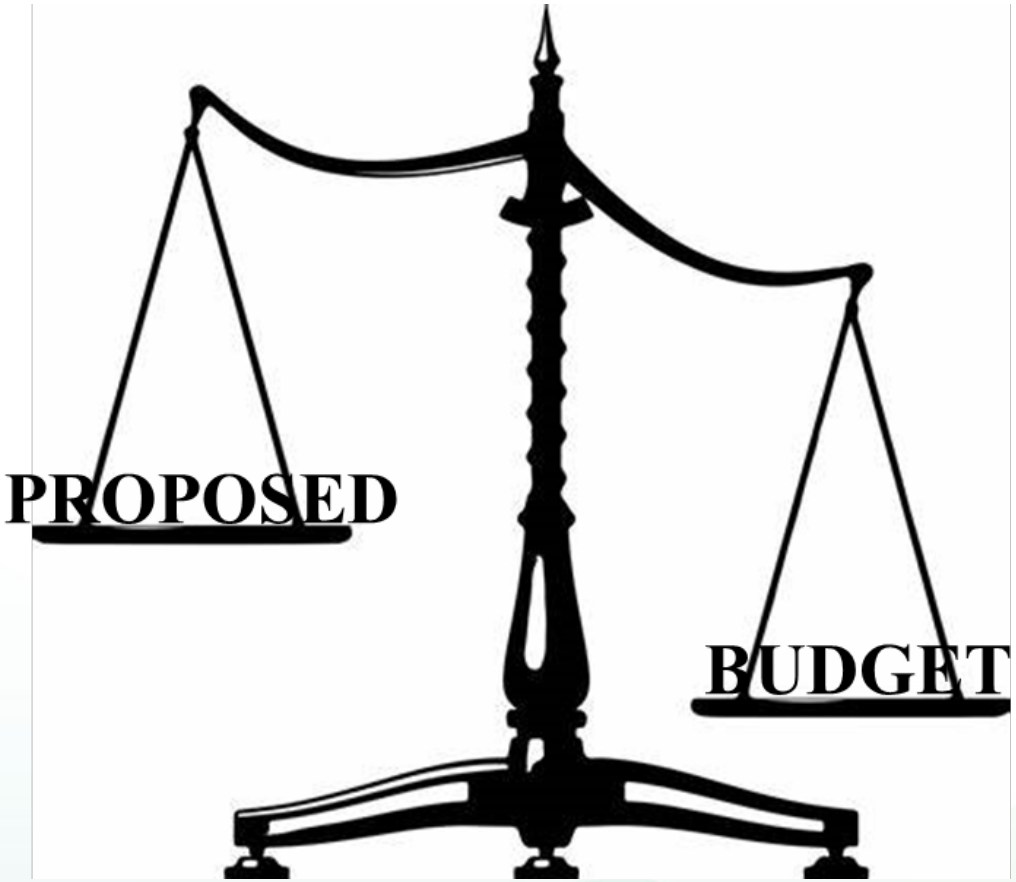
About Covered Processes

Source: https://solopracticeuniversity.com/2017/05/25/time-to-ask-us-your-questions-about-creating-and-building-a-solosmall-firm-practice/

RESOURCES

Compliance Software

- **Used to demonstrate compliance with the Energy Codes when using the Performance Approach**
- **CBECC-Com is free to the public**
- **More information at:** https://www.energy.ca.gov/title24/2019standards/2019_computer_prog_list.html



Acceptance Test Technician Certification Providers (ATTCP)

- **Lighting ATTCPs**
  - California Advanced Lighting Controls Training Program (CALCTP)
  - National Lighting Contractors Association of America (NLCAA)
- **Mechanical ATTCPs**
  - National Energy Management Institute Committee (NEMIC)
  - National Environmental Balancing Bureau (NEBB)
  - California State Pipe Trades Council (CSPTC)
  - Refrigeration Service Engineers Society (RSES)

More information at: http://www.energy.ca.gov/title24/attcp/

Blueprint

- Email Newsletter
- Published quarterly
- Clarifications on frequently asked questions
- http://www.energy.ca.gov/efficiency/blueprint/

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BLUEPRINT

CALIFORNIA ENERGY COMMISSION

EFFICIENCY DIVISION

IN THIS ISSUE

2019 Energy Code: Focus on Lighting

California's Building Energy Efficiency Standards (Energy Code) have continued to evolve since 1978. Statewide over the past 40 years, the Energy Code has not only helped save energy, but has also saved Californians billions of dollars on their utility bills.

The 2019 Energy Code went into effect on January 1, 2020, and brought some significant changes to residential and nonresidential buildings. For the first time, newly constructed homes are required to utilize a photovoltaic (PV) system to generate renewable energy. Overall, single-family homes will use 53 percent less energy than those built under the 2016 Energy Code, after accounting for more rigorous efficiency measures and renewable energy generation.

Nonresidential buildings will use 30 percent less energy than those built under the 2016 Energy Code. A significant portion of those savings are attributed to changes in the lighting requirements.

Nonresidential Lighting Changes

The biggest change is to the prescriptive indoor and outdoor lighting power allowances. Under the 2016 Energy Code, high performance T8 linear fluorescent lighting was used as the baseline for indoor lighting power density (LPD) calculations. Under the 2019 Energy Code, the baseline is LED lighting. The shift to LED lighting has significantly reduced LPDs. On average, indoor LPDs have been reduced by 28 percent when utilizing the area category method of compliance. This accounts for the single largest energy savings of all changes in the 2019 Energy Code. Because LED lighting is already widely used in the industry, this may not have a substantial effect on the way lighting systems are designed. It will, however, effect the overall energy consumption of these buildings, allowing less energy trade-offs between lighting and other aspects of the building, like the building envelope.

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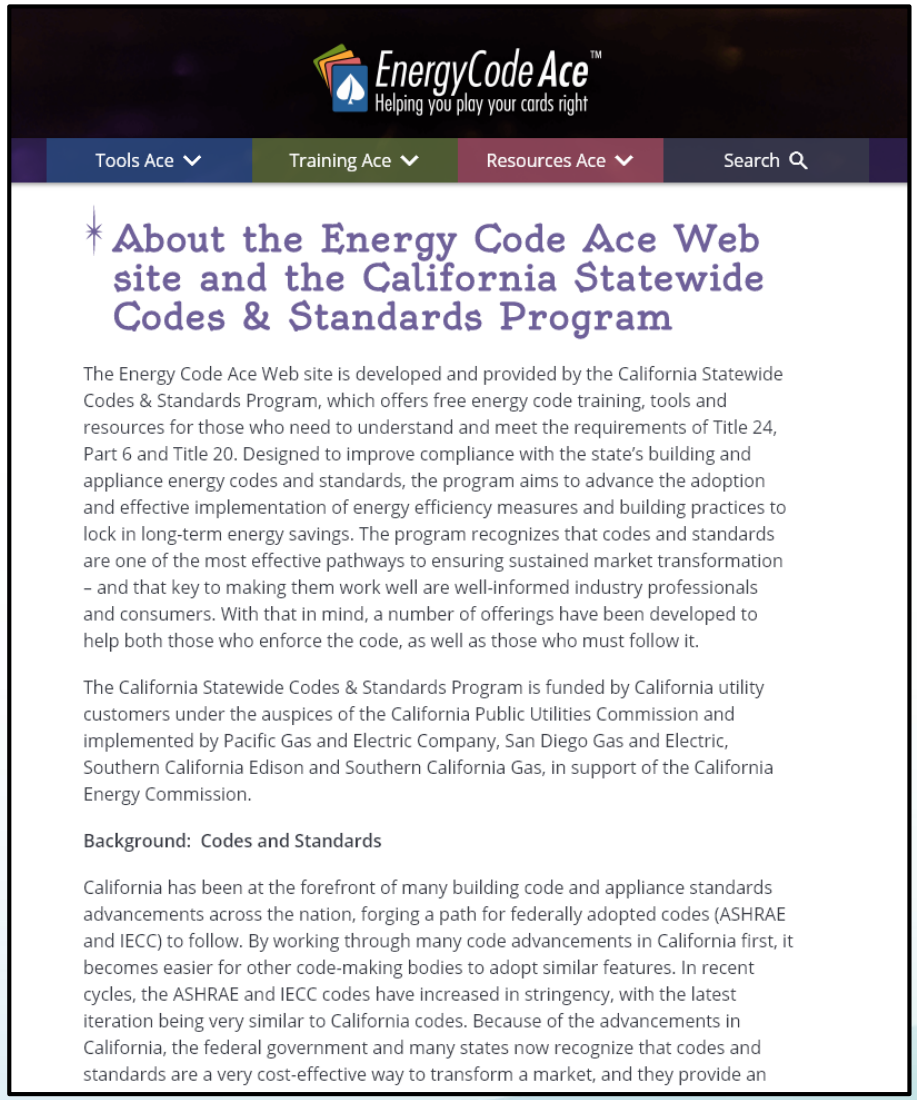
Online Resources Program (ORC)

http://www.energy.ca.gov/title24/orc/

Energy Code Ace



- **Forms & Resource tools**
- **Free training (in person and online)**
- **Checklists, Trigger Sheets for building departments**
- **https://energycodeace.com/**

Energy Hotline

- **Toll-free in California**
- **Open Monday through Friday**
  - 8:00 a.m. to noon, and 1:00 p.m. to 4:30 p.m.
- **Call at:**
  - 1-800-772-3300 (In CA)
  - (916) 654-5106 (Outside CA)
- **Email at:** Title24@energy.ca.gov

Email Lists

- **Main conduit for communicating with stakeholders**
- **Sign up at:**
  - http://www.energy.ca.gov/listservers/
- **Subscribe to the following Efficiency Lists:**
  - Building Standards
  - Blueprint
- **Respond to confirmation email within 24 hours**

THANK YOU!

Kelly Morairty

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