2016 Nonresidential HVAC Overview

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Todays Training Outline

- Training Goals
- Standards Background
  - ✓ CEC History
  - ✓ 2016 Standards Overview
  - ✓ Future Energy and GHG Goals
- Energy Standards Basics
  - ✓ Mandatory Requirements Overview
  - ✓ Compliance Overview
  - ✓ Navigating The Standards
  - ✓ Demonstrating Compliance
- Nonresidential HVAC Meat and Potatoes
  - ✓ Mandatory Requirements
  - ✓ Prescriptive and Performance Requirements
  - ✓ Additions and Alterations
- Enforcement
- Resources

Goals for this Training

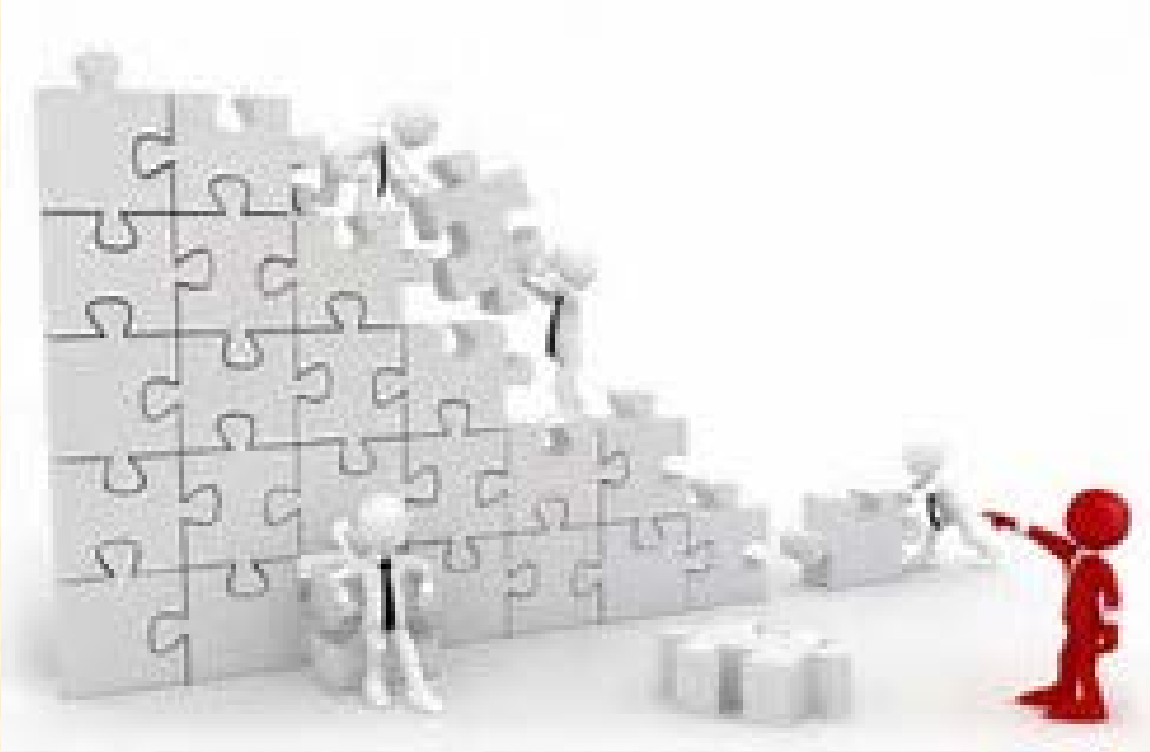
- **Basic understanding of the following:**
  - Structure of the Standards
  - Application of mandatory requirements
  - The difference between prescriptive and performance compliance
  - Mechanical forms
  - Nonresidential HVAC performance compliance

- **General understanding of following:**
  - Mandatory requirements related to nonresidential HVAC
  - Nonresidential HVAC prescriptive requirements

QUESTIONS…

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

Energy Standards Background

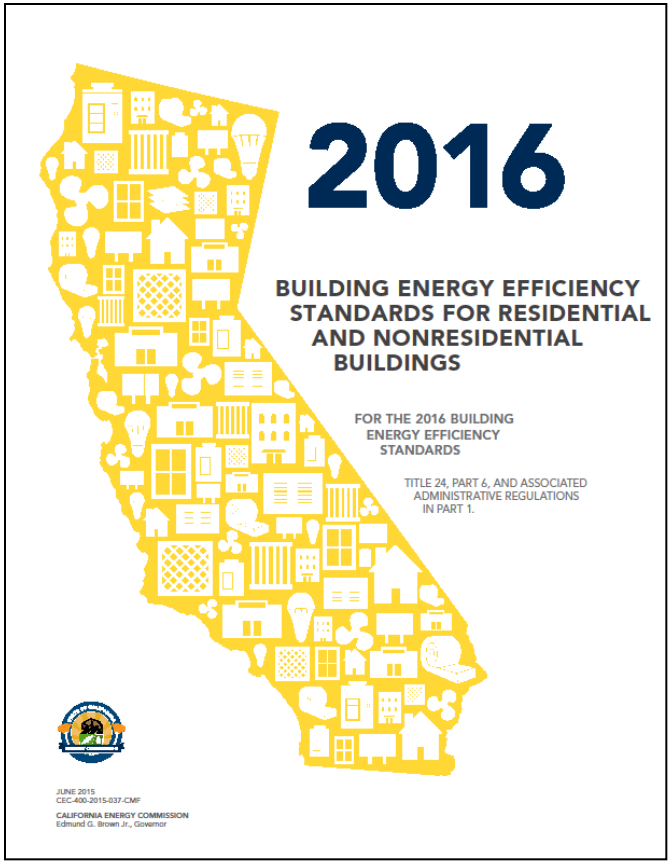


A Little CEC History

- **Our governing document is Section 25402 of the Public Resources Code, also known as the <u>Warren-Alquist Act</u>**
  - Signed into law in 1974 by Ronald Reagan and launched by Jerry Brown in 1975
  - The act created the Energy Commission in 1974 and gave it authority to develop and maintain Building Energy Efficiency Standards
  - Mandates Building Efficiency Standards and requires the building departments to enforce them through the permit process
  - Requires the Standards and new requirements to be cost effective over the economic life of the structure
  - Requires the Energy Commission to update the Standards periodically (about every 3 years)

2016 Building Energy Efficiency Standards

- **Effective January 1, 2017**
  - Building permit applications submitted on or after this date
- **Applies to all projects**
  - Newly constructed buildings
  - Additions
  - Alterations



Summary of 2016 Major Changes

- **Envelope U-factors**
  - Maximum values lowered
- **Indoor and outdoor lighting**
  - Power allowances reduced
  - Indoor lighting alterations
- **Equipment efficiencies**
  - Minimum efficiencies increased (based on federal standards)
- **HVAC Controls**
  - Door and window interlocks to turn HVAC off automatically
  - Direct digital controls to the zone
- **Covered Processes**
  - New requirements for elevators and escalators/moving walkways

2016 Documents

- **Building Energy Efficiency Standards**
- **Reference Appendices**
- **Residential and Nonresidential Compliance Manuals**
- **Alternative Calculation Method (ACM) Manuals**
- **All docs. available online at:** www.energy.ca.gov/title24

2016 Nonresidential Energy Savings

- **Overall, 5% more efficient than 2013 Standards**
  - Electricity Savings = 192 GWHs
  - Demand Reduction = 80 MW
  - Gas Savings = (0.9) Mtherms

What the Future Holds

- **<u>AB 32</u> – Reduces GHGs and carbon footprint**
- **<u>SB 350</u> – Doubles efficiency and increases renewable energy to 50%**
- **<u>CPUC/CEC Strategic Plan:</u>**
  - ZNE goal for residential buildings by 2020
  - ZNE goal for nonresidential buildings by 2030

Energy Standards will "evolve/expand" and become more stringent to reach these goals

QUESTIONS…

About CEC or Standards?

Energy Standards Basics

Energy Standards Basics Topics

- **Mandatory Measures**
- **Prescriptive Compliance Approach**
- **Performance Compliance Approach**
- **Navigating The Standards**
  - Structure of the code (Part 1 and Part 6)
  - Navigation features in the electronic PDF
- **Demonstrating Compliance**
  - What type of forms are there
  - When are they required
  - Smart form features

Mandatory Measures

- **Must always be met or exceeded**
- **Establish minimum level of energy efficiency and/or performance**
- **Apply to the different building components**
  - Envelope
  - Lighting
  - HVAC
- **Sometimes are superseded by more stringent prescriptive requirements**

Prescriptive Compliance

- **Set of predefined efficiency requirements that must <u>ALL</u> be met or exceeded**
- **Separate compliance for each "group" of building components**
- **Simplest approach, but less flexible**
- **Establishes baseline for Standard building budget under Performance Approach**

Performance Compliance

- **Also known as the computer method**
- **Requires the use of Energy Commission approved software**
- **Most flexible approach, allows for trade-offs**
- **Proposed Design TDV energy ≤ Standard Design TDV energy budget**
- **Modeling, budgets, assumptions, etc. located in the Nonresidential ACM Reference Manual**

Navigating The Standards

TITLE 24 - THE CALIFORNIA BUILDING STANDARDS CODE

- **Part 1 (Administrative Code)**
  - Chapter 10: the administrative requirements
- **Part 6 (Energy Code)**
  - Subchapters 1 through 9
  - Mostly referred to by Section numbers
  - These are the technical requirements

BSC Code Book

Title 24, Part 1 (Chapter 10)

Section Title	Section #
Scope	10-101
Definitions	10-102
Permit, Certificate, Informational, and Enforcement Requirements for Designers, Installers, Builders, Manufacturers, and Suppliers	10-103
Nonresidential Lighting Controls Acceptance Test Training and Certification	10-103.1
Nonresidential Mechanical Acceptance Test Training and Certification	10-103.2
Exceptional Designs	10-104
Enforcement by the Commission	10-105
Locally Adopted Energy Standards	10-106

Subchapter Title	Section #
Interpretations	10-107
Exemption	10-108
Compliance Software, Alternative Component Packages, Exceptional Methods, Data Registries and Data Input Software, Alternative Residential Field Verification Protocols, and Electronic Document Repositories	10-109
Procedures for Consideration of Applications Under Sections 10-104, 10-106, 10-108, and 10-109	10-110
Certification and Labeling of Fenestration Product U-Factors, Solar Heat Gain Coefficients, Visible Transmittance and Air Leakage	10-111
Criteria for Default Tables	10-112
Certification and Labeling of Roofing Product Reflectance and Emittance	10-113
Determination of Outdoor Lighting Zones and Administrative Rules for Use	10-114

Title 24, Part 6

Subchapter	Subchapter Title	Sections
1	**All Occupancies** - General Provisions	§100.0 - §100.2
2	All Occupancies - **Mandatory** Requirements for the Manufacture, Construction and Installation of Systems, Equipment, and Building Components	§110.0 - §110.11
3	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies and Covered Processes - **Mandatory** Requirements	§120.0 - §120.9
4	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Mandatory** Requirements for Lighting Systems and Equipment, and Electrical Power Distribution Systems	§130.0 - §130.5
5	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Performance and Prescriptive Compliance Approaches** for Achieving Energy Efficiency	§140.0 - §140.9
6	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Additions, Alterations, and Repairs**	§141.0 - §141.1
7	Low-Rise Residential Buildings - **Mandatory** Features and Devices	§150.0
8	Low-Rise Residential Buildings - **Performance and Prescriptive Compliance Approaches**	§150.1
9	Low-Rise Residential Buildings - **Additions and Alterations** to Existing Low-Rise Residential Buildings	§150.2

Navigation Features

- **Easy Navigation Features Added**
  - Section and Table references hyperlinked throughout Energy Standards.
  - Table 100.0-A separated with section hyperlinks.
  - Chapter hyperlinks in Nonresidential Compliance Manual.
  - Links work both online and in the downloaded version.

TABLE 100.0-A APPLICATION OF STANDARDS

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
General Provisions for All Buildings		100.0, 100.1, 100.2, 110.0			
Nonresidential, High-Rise Residential, And Hotels/Motels	General	120.0	140.0, 140.2	140.0, 140.1	141.0
	Envelope (conditioned)	110.6, 110.7, 110.8,120.7	140.3		
	Envelope (unconditioned process spaces)	N.A.	140.3(c)		
	HVAC (conditioned)	110.2, 110.5, 120.1, 120.2, 120.3, 120.4, 120.5, 120.8	140.4		
	Water Heating	110.3, 120.3, 120.8, 120.9	140.5		
	Indoor Lighting (conditioned, process spaces)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6		
	Indoor Lighting (unconditioned and parking garages)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6	N.A.	
	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7		
	Electrical Power Distribution	110.11, 130.5	N.A.		
	Pool and Spa Systems	110.4, 110.5, 150.0(p)	N. A.		141.0
	Solar Ready Buildings	110.10	N.A.		141.0(a)
Covered Processes[1]	Envelope, Ventilation, Process Loads	110.2, 120.6	140.9	140.1	120.6, 140.9
Signs	Indoor and Outdoor	130.0, 130.3	140.8	N.A.	141.0, 141.0(b)2H
Low-Rise Residential	General	150.0	150.1(a, c)	150.1(a), 150.1(b)	150.2(a), 150.2(b)
	Envelope (conditioned)	110.6, 110.7, 110.8, 150(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g)			
	HVAC (conditioned)	110.2, 110.5, 150.0(h), 150.0(i), 150.0(j), 150.0(m), 150.0(o)			
	Water Heating	110.3, 150.0(j, n)			
	Indoor Lighting (conditioned, unconditioned and parking garages)	110.9, 130.0, 150.0(k)			
	Outdoor Lighting	110.9, 130.0,150.0(k)			
	Pool and Spa Systems	110.4, 150.0(p)	N. A.	N.A.	150.2(a), 150.2(b)
	Solar Ready Buildings	110.10	N. A.	N.A.	N.A.

[1] Nonresidential, high-rise and hotel/motel buildings that contain covered processes may conform to the applicable requirements of both occupancy types listed in this table.

Demonstrating Compliance

How To Demonstrate Compliance

- **Compliance demonstration starts with compliance documents (forms).**
  - Completed by designers, consultants, builders, contractors, technicians, HERS raters, ATTs, etc.
  - Submitted to enforcement agencies for verification at different stages of construction.
  - There are four form categories.
    - Certificate of Compliance (NRCC)
    - Certificate of Installation (NRCI)
    - Certificate of Acceptance (NRCA)
    - Certificate of Verification (NRCV)
  - There are several sub-categories of each related to the building component – MCH, ENV, LTI, …etc.

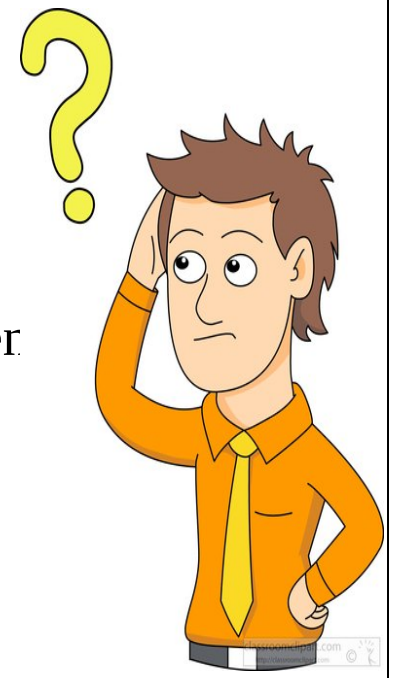
What is the NRCC?

- **Nonresidential Certificate of Compliance**
  - Used to demonstrate compliance of the design.
  - Completed by designer, architect, energy consultant, engineer, etc.
  - Required with or on plans at permit.
  - Plans Examiner verifies NRCC matches specs on plans.

What is the NRCI?

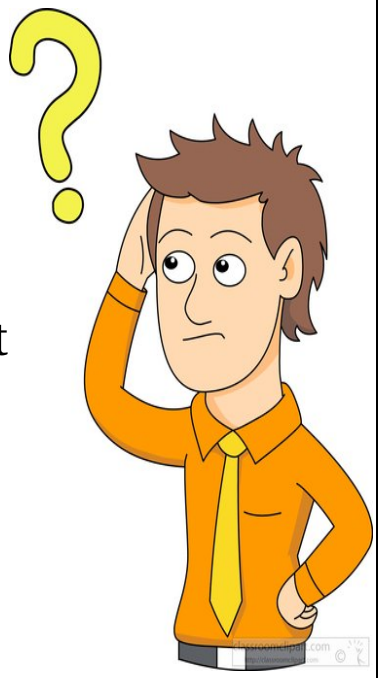
- **Nonresidential Certificate of Installation**
  - Confirms compliance at installation.
  - Completed by builder or installing contractor.
  - Required for Final Inspection.
  - Field Inspector verifies installed equipment and efficienc meet design documentation (NRCC forms) and plans.

What is the NRCA?



- **Nonresidential Certificate of Acceptance**
  - Confirms compliance with acceptance testing requiremer at installation (HVAC, lighting, etc.).
  - Completed by builder/installing contractor, OR an Acceptance Test Technician (ATT) when required.
  - Required for Final Inspection.
  - Field Inspector verifies applicable tests and forms are completed and signed.

What is the NRCV?



- **Nonresidential Certificate of Verification**
  - Confirms compliance with HERS testing requirements at installation (duct leakage & hot water piping).
  - Completed by certified HERS rater, and forms must be registered with an approved HERS Provider.
  - Required for Final Inspection.
  - Field Inspector verifies testing and forms are completed, signed, and registered.

Where can I find the forms?

Appendix A of the 2016 Nonresidential Compliance Manual

Home » 2015publications » CEC-400-2015-033 » appendices » forms

2016 Nonresidential Compliance Manual - Appendix A, Single Forms

Parent Directory

If needed, the original forms are provided below in the Static Documents folder.

If a PDF doesn't open when you select the link, or if the f Where can I find the forms?

- Use a different browser, such as Internet Explorer (IE)
- Configure your browser to use Adobe to open PDF files
- Right-click on the link to the form, select "Save...as" and save the file to your computer (e.g., save to your desktop), then locate the saved file to open

To ensure the most updated form is downloaded, delete your internet browsing history to clear your cache.

Name	last modified Color dates added today	Size
Dynamic Forms	Oct 03, 2017	4 kb
NRCA	Mar 16, 2017	4 kb
NRCC	Oct 03, 2017	4 kb
NRCI	Mar 16, 2017	4 kb
NRCV	Aug 16, 2017	4 kb
Static Documents	Jun 20, 2016	4 kb

http://www.energy.ca.gov/2015publications/CEC-400-2015-033/appendices/forms/

Nonresidential Mechanical Forms

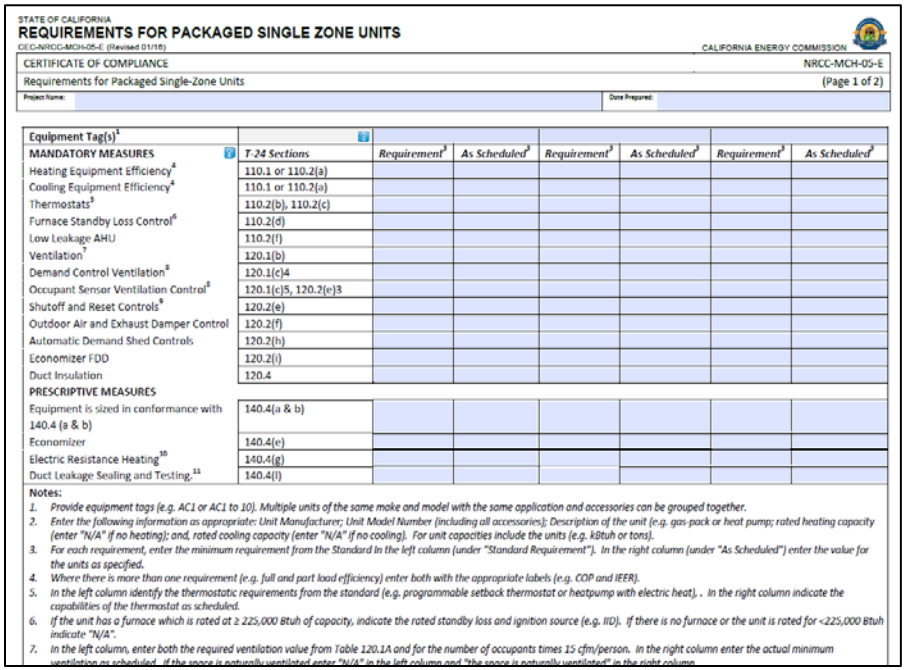
- NRCC-MCH (Certificate of Compliance)
  - NRCC-MCH-01-E Prescriptive - Mechanical Systems
  - NRCC-MCH-02-E Prescriptive - HVAC System Requirements
  - NRCC-MCH-03-E Prescriptive - Mechanical Ventilation and Reheat
  - NRCC-MCH-04-E Prescriptive - Required Acceptance Tests
  - NRCC-MCH-05-E Prescriptive - Requirements for Packaged Single Zone Units
  - NRCC-MCH-06-E Maximum Cycles of Concentration Worksheet
- NRCI-MCH (Certificate of Installation)
  - NRCI-MCH-01-E - Mechanical
- NRCV-MCH (Certificate of Verification)
  - NRCV-MCH-04a-H Duct Leakage Diagnostic Test - New System
  - NRCV-MCH-04c-H Duct Leakage Diagnostic Test - Low Leakage Air-Handling Units
  - NRCV-MCH-04d-H Duct Leakage Diagnostic Test - Altered (Existing) System
  - NRCV-MCH-04e-H Duct Leakage Diagnostic Test - Sealing of All Accessible Leaks

Nonresidential Mechanical Forms

- NRCA-MCH (Certificate of Acceptance)
  - NRCA-MCH-02-A - Outdoor Air Acceptance
  - NRCA-MCH-03-A - Constant Volume, Single Zone, Unitary (Packaged & Split) Systems
  - NRCA-MCH-04-H - Air Distribution Duct Leakage
  - NRCA-MCH-05-A - Air Economizer Controls Acceptance
  - NRCA-MCH-06-A - Demand Control Ventilation (DVC) Systems Acceptance
  - NRCA-MCH-07-A - Supply Fan Variable Flow Controls (VFC) Acceptance
  - NRCA-MCH-08-A - Valve Leakage Test
  - NRCA-MCH-09-A - Supply Water Temperature Reset Controls Acceptance
  - NRCA-MCH-10-A - Hydronic System Variable Flow Controls Acceptance
  - NRCA-MCH-11-A - Automatic Demand Shed Control Acceptance
  - NRCA-MCH-12-A - Fault Detection & Diagnostics for Packaged DX Units
  - NRCA-MCH-13-A - Automatic FDD for Air Handling & Zone Terminal Units
  - NRCA-MCH-14-A - Distributed Energy Storage DX AC Systems Acceptance
  - NRCA-MCH-15-A - Thermal Energy Storage (TES) System Acceptance
  - NRCA-MCH-16-A - Supply Air Temperature Reset Controls Acceptance
  - NRCA-MCH-17-A - Condenser Water Temperature Reset Controls Acceptance
  - NRCA-MCH-18-A - Energy Management Control System (EMCS) Acceptance

Dynamic "Smart" Forms

- ALL forms fillable
  - Interactive instructions
- New dynamic* NRCC forms
  - Scope specific
  - Auto fill
  - Conduct auto-calculations
  - Add and delete table rows



STATE OF CALIFORNIA
REQUIREMENTS FOR PACKAGED SINGLE ZONE UNITS
CEC-NRCC-MCH-05-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	NRCC-MCH-05-E
Requirements for Packaged Single-Zone Units	(Page 1 of 2)
Project Name:	Date Prepared:

Equipment Tag(s)[1]							
MANDATORY MEASURES	*T-24 Sections*	*Requirement*[3]	*As Scheduled*[3]	*Requirement*[3]	*As Scheduled*[3]	*Requirement*[3]	*As Scheduled*[3]
Heating Equipment Efficiency[4]	110.1 or 110.2(a)						
Cooling Equipment Efficiency[4]	110.1 or 110.2(a)						
Thermostats[5]	110.2(b), 110.2(c)						
Furnace Standby Loss Control[6]	110.2(d)						
Low Leakage AHU	110.2(f)						
Ventilation[7]	120.1(b)						
Demand Control Ventilation[8]	120.1(c)4						
Occupant Sensor Ventilation Control[8]	120.1(c)5, 120.2(e)3						
Shutoff and Reset Controls[9]	120.2(e)						
Outdoor Air and Exhaust Damper Control	120.2(f)						
Automatic Demand Shed Controls	120.2(h)						
Economizer FDD	120.2(i)						
Duct Insulation	120.4						
PRESCRIPTIVE MEASURES							
Equipment is sized in conformance with 140.4 (a & b)	140.4(a & b)						
Economizer	140.4(e)						
Electric Resistance Heating[10]	140.4(g)						
Duct Leakage Sealing and Testing,[11]	140.4(l)						

Notes:

1. *Provide equipment tags (e.g. AC1 or AC1 to 10). Multiple units of the same make and model with the same application and accessories can be grouped together.*
2. *Enter the following information as appropriate: Unit Manufacturer; Unit Model Number (including all accessories); Description of the unit (e.g. gas-pack or heat pump; rated heating capacity (enter "N/A" if no heating); and, rated cooling capacity (enter "N/A" if no cooling). For unit capacities include the units (e.g. kBtuh or tons).*
3. *For each requirement, enter the minimum requirement from the Standard in the left column (under "Standard Requirement"). In the right column (under "As Scheduled") enter the value for the units as specified.*
4. *Where there is more than one requirement (e.g. full and part load efficiency) enter both with the appropriate labels (e.g. COP and IEER).*
5. *In the left column identify the thermostatic requirements from the standard (e.g. programmable setback thermostat or heatpump with electric heat), . In the right column indicate the capabilities of the thermostat as scheduled.*
6. *If the unit has a furnace which is rated at ≥ 225,000 Btuh of capacity, indicate the rated standby loss and ignition source (e.g. IID). If there is no furnace or the unit is rated for <225,000 Btuh indicate "N/A".*
7. *In the left column, enter both the required ventilation value from Table 120.1A and for the number of occupants times 15 cfm/person. In the right column enter the actual minimum ventilation as scheduled. If the space is naturally ventilated enter "N/A" in the left column and "The space is naturally ventilated" in the right column.*

** Converting all NRCCs by end of 2018*

Note about the Nonresidential Data Registry

- **<u>All</u> nonresidential forms are required to be registered (§10-103)**
  - Contingent upon approval of a nonresidential data registry.
  - To date, no such registry has been approved.
  - This means that registration is not required at this time.
  - No application has been submitted as of yet to review.

Code Quiz:

- What are the four types of forms and in what order are they typically used?
  1. NRCC – Certificate of Compliance
  2. NRCI – Certificate of Installation
  3. NRCA – Certificate of Acceptance
  4. NRCV – Certificate of Verification

- Which compliance approach offers the ability to trade off energy features?
  a) Performance Compliance Approach
  b) Prescriptive Compliance Approach

- Can you trade off higher energy efficient features with the mandatory measures when using the Performance Approach?
  a) Yes
  b) No
  c) Maybe

QUESTIONS…

About Compliance Approaches, Navigation?

The Meat and Potatoes of Nonresidential HVAC

Title 24, Part 6

Subchapter	Subchapter Title	Sections
1	**All Occupancies** - General Provisions	§100.0 - §100.2
2	All Occupancies - **Mandatory** Requirements for the Manufacture, Construction and Installation of Systems, Equipment, and Building Components	§110.0 - §110.11
3	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies and Covered Processes - **Mandatory** Requirements	§120.0 - §120.9
4	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Mandatory** Requirements for Lighting Systems and Equipment, and Electrical Power Distribution Systems	§130.0 - §130.5
5	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Performance and Prescriptive Compliance Approaches** for Achieving Energy Efficiency	§140.0 - §140.9
6	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Additions, Alterations, and Repairs**	§141.0 - §141.1
7	Low-Rise Residential Buildings - **Mandatory** Features and Devices	§150.0
8	Low-Rise Residential Buildings - **Performance and Prescriptive Compliance Approaches**	§150.1
9	Low-Rise Residential Buildings - **Additions and Alterations** to Existing Low-Rise Residential Buildings	§150.2

Part 6 Nonresidential HVAC Sections

Subchapter	Subchapter Title	Section	Section Title
2	**All Occupancies** - **Mandatory** Requirements for Systems and Equipment	§110.1	Mandatory requirements for Appliances
		§110.2	Mandatory requirements for Space Conditioning Equipment
		§110.5	Pilot Lights Prohibited
3	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies and Covered Processes - **Mandatory** Requirements	§120.1	Requirements for Ventilation
		§120.2	Required Controls for Space-Conditioning Systems
		§120.3	Requirements for Pipe Insulation
		§120.4	Requirements for Air Distribution Systems, Ducts and Plenums
		§120.5	Required Nonresidential Mechanical System Acceptance
		§120.8	Nonresidential Building Commissioning
		§120.9	Mandatory Requirements for Commercial Boilers
5	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Performance and Prescriptive Compliance**	§140.1	Performance Approach: Energy Budget
		§140.2	Prescriptive Approach
		§140.4	Prescriptive Requirements for Space Conditioning Systems
6	Nonresidential, High-Rise Residential, Hotel/Motel Occupancies - **Additions, Alterations, and Repairs**	§141.0	Additions, Alterations, and Repairs to Existing Nonresidential, High-Rise Residential, and Hotel/Motel Buildings

Subchapter 2

All Occupancies

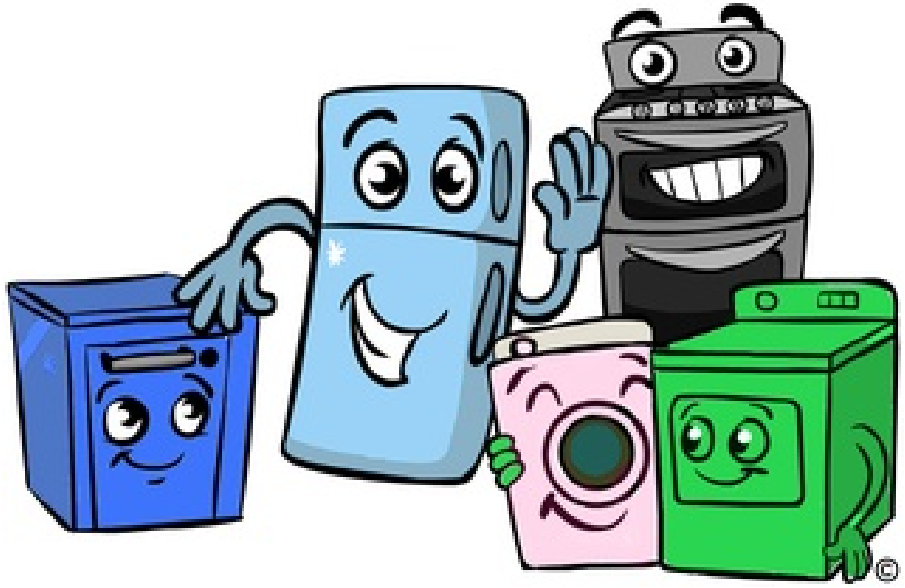
Mandatory Requirements for the Manufacture, Construction and Installation of Systems, Equipment and Building Components

(Sections §110.0 -§110.11)

§110 Series
All Occupancies Mandatory HVAC Requirements

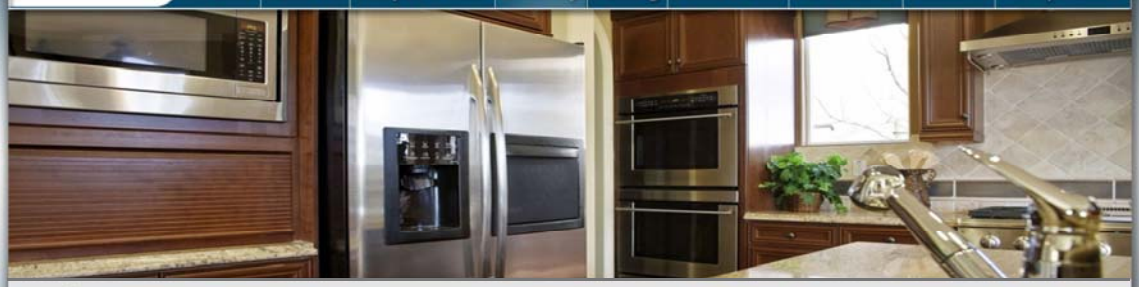
- **§110.1 - Mandatory Requirements for Appliances**
- **§110.2 - Mandatory Requirements for Space Conditioning Equipment**
- **§110.5 - Natural Gas Central Furnaces, Cooking Equipment, and Pool and Spa Heaters: Pilot Lights Prohibited**

§110.1 – Mandatory Requirements for Appliances



§110.1 – Mandatory Requirements for Appliances

- **Systems, equipment and appliances may be installed only if they are certified and listed as follows:**
  - If the item is covered by Title 20, it must meet the Title 20 efficiency requirements and be listed in the Title 20 database (MAEDBS).
  - Items having efficiency requirements in Title 24, Part 6 must be listed in one of the following:
    - Title 20 database
    - Federal database
    - Approved trade association database such as AHRI
  - If the equipment cannot be listed, you must demonstrate efficiency conformance per the procedures outlined in Section 10-109 of Part 1.



Title 20 Appliance Efficiency Program

Regulations & Rulemakings

- **Current Appliance Efficiency Regulations**
- Current Appliance Efficiency Rulemakings
- Historical Rulemakings

Outreach & Education

- News, Fact Sheets, FAQs
- Program Bulletins
- Webinar Documents

Featured Links

- 2017 Section 100 Appliance Efficiency Standards HVI 916 Test Method Update (2017-AAER-16)
- Residential Pool Pump and Motor Combinations and Replacement Residential Pool Pump Motors, Regulatory Advisory
- 2016 California Quality LED Lamp Specifications 3.0 (16-AAER-04)
- Appliance Efficiency Regulations For Lamps, Regulatory Advisory
- Consumer Cooking Products, Regulatory Advisory (Updated)

Upcoming Events

December 21, 2017
Webinar: Upcoming Title 20 Lighting Standards

January 24, 2018
Staff Workshop on Commercial Clothes Dryer Test Procedure

Modernized Appliance Efficiency Database System (MAEDBS)

- **MAEDBS Log In**
- Quick Search
- Advanced Search
- Company Search (Third Party and Test Labs)
- Certification Packets
- Instructions for Submitting Appliance Data
- MAEDBS Enhancements and Updates

List Servers

Automated E-Mail Notifications

- Appliances
- Title 20 Compliance Assistance

First name:

Last name:

Email address:

You will receive an email requesting that you confirm your subscription

Send Reset

Contact Us

- Toll Free: 888-838-1467
- Outside California: 916-651-7100 (9 AM to 4:30 PM PST)
- E-mail: Appliances@energy.ca.gov

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§110.2 - Mandatory Requirements for Space Conditioning Equipment

§110.2 - Mandatory Requirements for Space Conditioning Equipment

- **All equipment covered in this section must be certified by the manufacturer.**
  - **(a)** All equipment listed in Table 110.2-A through Table 110.2-K must meet the applicable efficiencies when tested per the listed test procedure.
    - There are exceptions for some water chilling packages, some positive displacement chillers and equipment serving **refrigerated warehouses** or **commercial refrigeration**. See §110.2(a) for details.

§110.2 - Mandatory Requirements for Space Conditioning Equipment

- **(b)** Heat pumps with supplementary electric resistance heaters must have controls that:
  - **Prevent supplementary heater** operation when the heating load can be met by the heat pump alone.
  - The **cut-on and cut-off temperatures** for the electric resistance heating must be lower than the heat pump cut-on and cut-off temperatures.

❖ There are exceptions for defrost, transient periods, and room air conditioner heat pumps.

§110.2 - Mandatory Requirements for Space Conditioning Equipment

- **(c)** Thermostat Requirements
  - All unitary systems without an EMCS must have a **setback thermostat** that can be programed with at least four temperature setpoints within 24 hours.
  - Thermostats for heat pumps must also control **supplementary electric resistance** heaters as discussed on the previous slide.

❖ Exceptions: Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air conditioner heat pumps are **not required** have to have setback thermostats.

§110.2 - Mandatory Requirements for Space Conditioning Equipment

- **(d)** Gas- and Oil-Fired Furnace ≥ 225,000 Btu/h must have controls to limit Standby Loss:
  - They must have an **intermittent ignition or interrupted device** (IID).
  - They must have either **power venting** or a **flue damper**.
  - A **vent damper** is permissible with furnaces using combustion air from the conditioned space.
  - All furnaces not located within the conditioned space must have **jacket heat losses** not exceeding 0.75 percent of the input rating.

§110.2 - Mandatory Requirements for Space Conditioning Equipment

- **(e)** Cooling towers ≥ 150 tons must have the following:
  - Conductivity or Flow-based controls that **maximize cycles of concentration** based on local water quality and an approved calculator using a **Langelier Saturation Index** (LSI) of 2.5 or less.
  - The NRCC-MCH-06 form is used to document this and must be signed by the Professional Engineer (P.E.) of Record.
  - Have a **flow meter** with an analog output for flow either hardwired or available through a gateway on the makeup water line and have an **overflow alarm**.
  - They must be equipped with **Efficient Drift Eliminators** that achieve drift reduction to 0.002 percent of the circulated water volume for counter-flow towers and 0.005 percent for cross-flow towers.
  - Nonresidential Compliance Manual subchapter 4.6.1.1 is a good resource for cooling tower water conservation information.

§110.2 – Mandatory Requirements for Space Conditioning Equipment

- **(f)** Low leakage air handler compliance credit:
  - The air handler must be listed on the Energy Commission's list of certified products.
  - After installation, the system and attached ducts must be leak tested by a **HERS rater** and the compliance documentation uploaded to the **HERS Registry**.
  - Credit is only available if the performance method is used.

Manufacturer Certification for Equipment, Products and Devices

Manufacturers certify to the Energy Commission that the following listed equipment, products or devices meet the indicated requirements under Title 24, Part 6 and associated appendices. The Energy Commission makes no claim that the listed equipment, products or devices meet the indicated requirements or, if tested, will confirm the indicated results. By being included on these lists, the Energy Commission confirms only that a manufacturer certification has been submitted and accepted.

Manufacturer Certified Equipment, Products and Devices Classifications

- Air Economizers
- Airflow Measurement Apparatus - Forced Air Systems
- Airflow Measurement Apparatus - Ventilation Systems
- Air-to-Water Heat Pump Systems
- Economizer Fault Detection and Diagnostics
- Intermittent Mechanical Ventilation Systems
- Low Leakage Air-Handling Unit
- Occupant Controlled Smart Thermostats

If you have questions about the Standards and documents, please contact the Energy Standards Hotline.

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§110.5 - Natural Gas Central Furnaces, Cooking Equipment, and Pool and Spa Heaters: Pilot Lights Prohibited

§110.5 - Natural Gas Central Furnaces, Cooking Equipment, and Pool and Spa Heaters: Pilot Lights Prohibited

- **Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:**
  - Fan-type central furnaces.
  - Household cooking appliances.
    - EXCEPTION: Household cooking appliances without an electrical supply voltage connection and in which each pilot consumes less than 150 Btu/hr.
  - Pool heaters.
  - Spa heaters.

All Occupancies Mandatory Requirements

- Code Quiz:
  - Is this thermostat allowed for gravity gas wall heaters or room air conditioners?
    - ✓ Yes

  - Is it allowed for a unitary forced air system?
    - ✓ No

All Occupancies Mandatory Requirements

- Code Quiz:
  - In order to be legally installed in California, space conditioning equipment with requirements in the Standards must…what?
    a) Meet the listed efficiency requirements.
    b) Be listed in an approved database.
    c) Both a and b.

All Occupancies Mandatory Requirements

- **Takeaways from all occupancies mandatory requirements**
  - Title 24, Part 6 requires all equipment with efficiency requirements to be listed in an **approved database** to legally be installed in California.
  - Heat pumps must have controls **limiting supplementary electric heaters**.
  - Central type systems must have an EMCS or certified **setback thermostat**.
  - Gas- and Oil-Fired Furnaces must have controls to **limit Standby Losses**.
  - Cooling towers ≥ 150 tons are required to have **water saving controls** for maximum cycles of concentration, overflow, and water drift loss.
  - Continuously burning **pilot lights are prohibited** on natural gas forced air furnaces, kitchen appliances and pool and spa heaters.
  - These requirements are **mandatory** and are applicable to **all buildings**.
  - Always check for exceptions.

Subchapter 3

Nonresidential, High-Rise Residential, Hotel/Motel Occupancies, and Covered Processes

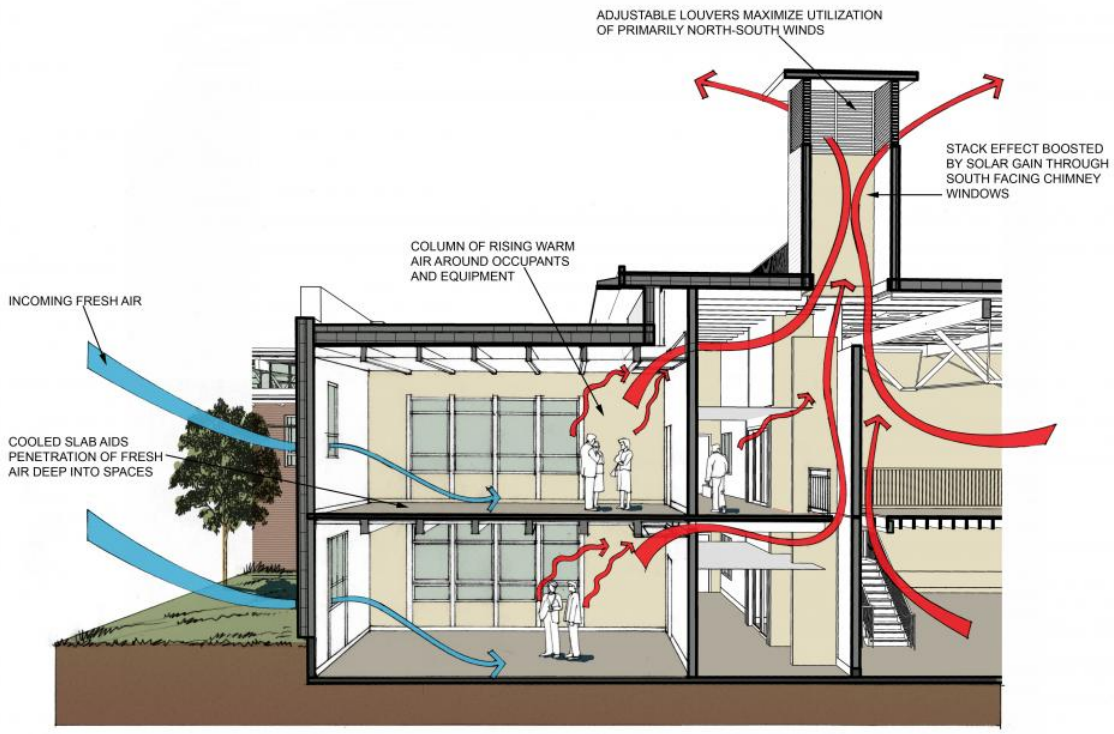
Mandatory Requirements

(Sections §120.0 -§120.9)

§120 Series
Nonresidential, High-Rise Residential, Hotel/Motel Occupancies Mandatory Requirements

- **§120.1 - Requirements for Ventilation**
- **§120.2 - Required Controls for Space Conditioning Systems**
- **§120.3 - Requirements for Pipe Insulation**
- **§120.4 - Requirements for Air Distribution Systems, Ducts and Plenums**
- **§120.5 - Required Nonresidential Mechanical System Acceptance**
- **§120.8 - Nonresidential Building Commissioning**
- **§120.9 - Mandatory Requirements for Commercial Boilers**

§120.1 – Requirements for Ventilation



Ventilation Background

- **CEC is <u>required by law</u> to ensure building standards are consistent with Health and Safety Code §105400 and §105410, which both concern public health.**
- **These requirements are not tied to the Warren-Alquist Act (PRC Section 25402).**
- **Ventilation requirements are the only requirements in Part 6 not required to be cost effective.**

§120.1 – Requirements for Ventilation

- **§120.1 requires enclosed spaces to be ventilated with outdoor air as outlined in this section <u>and</u> Part 4 (CMC) of Title 24.**
- **Where there is an inconsistency between Part 6 and Part 4, the most stringent requirement must be implemented.**
- **Natural or mechanical ventilation may be used to meet ventilation requirements.**
- **Spaces or buildings not normally used for human occupancy and work such as refrigerated warehouses are exempt – <u>but, designers should use common sense</u>.**

§120.1 – Requirements for Ventilation

- **(b)1. Natural ventilation**
  - The openable area that supplies outside air must not be less than 5 percent of the conditioned floor area of the ventilated space.
  - Where openings are covered with louvers or other obstructions, openable is based on the unobstructed area through the opening.
  - The operable openings must be readily accessible to building occupants whenever the space is occupied.
  - Nonresidential ventilated space must be within 20 feet of the operable openings.
  - High-rise residential and hotel/motel ventilated spaces must be within 25 feet of the operable openings.
  - Ventilated spaces must be permanently open.

§120.1 – Requirements for Ventilation

- **(b)2. Mechanical Ventilation**
  - ➢ Minimum required mechanical ventilation to be supplied to each space must be the larger of the following:
    - The conditioned floor area of the space times the ventilation rate from Table 120.1-A; or 15 cfm/person times expected # of occupants.
    - The requirement in the CMC.
    - We have done the math for you in Table 4-14 in the Nonresidential Compliance Manual.
  - ❖ Outdoor air may be provided with air transferred from other ventilated spaces if both of the following are satisfied:
    - ✓ The transfer air has no unusual indoor air contaminants.
    - ✓ The system must have capacity to supply all spaces **at the same time**.

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

TABLE 120.1-A MINIMUM VENTILATION RATES

TYPE OF USE	CFM PER SQUARE FOOT OF CONDITIONED FLOOR AREA
Auto Repair Workshops	1.50
Barber Shops	0.40
Bars, cocktail lounges, and casinos	0.20
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 ft^2)	30 cfm/guest room
Hotel guest rooms (500 ft^2 or greater)	0.15
Retail stores	0.20
All others	0.15

Table 4-14: Required Minimum Ventilation Rate per Occupancy

	Occupancy	Use	CBC Occupancy Load (ft²/occ)	CBC Occupancy Load (occ/1000 ft²)[A]	CBC Based Ventilation (cfm/ft²)[B]	Ventilation from Table 120.1-A (cfm/ft²)	Required Ventilation (larger of CBC or Table 120.1-A) (cfm/ft²)
1)	Aircraft Hangars		500	2	0.02	0.15	0.15
2)	Auction Rooms		See Section 1004.4			0.15	n.a.
3)	Assembly Areas (Concentrated Use)						
		Auditoriums	See Section 1004.4			0.15	n.a.
		Bowling Lane	5 persons per lane			0.15	n.a.
		Bowling Center[5] (all other spaces)	7	142.86	1.07	0.15	1.07
		Churches & Chapels (Religious Worship)	7	142.86	1.07	0.15	1.07
		Dance Floors	5	200	1.50	0.15	1.50
		Lobbies	15	66.67	0.50	0.15	0.50
		Lodge Rooms	7	142.86	1.07	0.15	1.07
		Reviewing Stands	15	66.67	0.50	0.15	0.50
		Stadiums	See Section 1004.4			0.15	n.a.
		Theaters - All	See Section 1004.4			0.15	n.a.
		Waiting Areas	15	66.67	0.50	0.15	0.50
4)	Assembly Areas (Non-concentrated Use)						
		Conference & Meeting Rooms[1]	15	66.67	0.50	0.15	0.50
		Dining Rooms/Areas	15	66.67	0.50	0.15	0.50
		Drinking Establishments[2]	15	66.67	0.50	0.20	0.50
		Exhibit/Display Areas	15	66.67	0.50	0.15	0.50
		Gymnasiums/Sports Arenas	15	66.67	0.50	0.15	0.50
		Lounges	15	66.67	0.50	0.20	0.50
		Stages and Platform	15	66.67	0.50	0.15	0.50
		Gaming, Keno, Slot Machine and Live Games Areas	11	90.91	0.68	0.20	0.68
5)	Auto Repair Workshops		100	10	0.08	1.50	1.50
6)	Barber & Beauty Shops		100	10	0.08	0.40	0.40
7)	Children's Homes & Homes for Aged		120	8.33	0.06	0.15	0.15
8)	Classrooms		20	50	0.38	0.15	0.38
9)	Courtrooms		40	25	0.19	0.15	0.19
10)	Dormitories		50	20	0.15	0.15	0.15
11)	Dry Cleaning (Coin-Operated)		100	10	0.08	0.30	0.30
12)	Dry Cleaning (Commercial)		100	10	0.08	0.45	0.45
13)	Exercise Rooms		50	20	0.15	0.15	0.15
14)	Garage, Parking		200	5	0.04	0.15	0.15
15)	Healthcare Facilities:	Sleeping Rooms	120	8.33	0.06	0.15	0.15
		Treatment Rooms	240	4.17	0.03	0.15	0.15

(Cont) Table 4-14: Required Minimum Ventilation Rate per Occupancy

	Occupancy	Use	CBC Occupancy Load (ft²/occ)	CBC Occupancy Load (occ/1000 ft²)[A]	CBC Based Ventilation (cfm/ft²)[B]	Ventilation from Table 120.1-A (cfm/ft²)	Required Ventilation (larger of CBC or Table 120.1-A) (cfm/ft²)
16)	Hotels and Apartments						
		Hotel Function Area	7	142.86	1.07	0.15	1.07
		Hotel Lobby	100	10	0.08	0.15	0.15
		Hotel Guest Room (<500 ft²)[3]	200	5	0.04	n.a.[3]	n.a.[3]
		Hotel Guest Room (≥500 ft²)	200	5	0.04	0.15	0.15
		High-rise Residential[4]	200	5	0.04	n.a.[4]	n.a.[4]
17)	Kitchen (Commercial)		200	5	0.04	0.15	0.15
18)	Library:	Reading Rooms	50	20	0.15	0.15	0.15
		Stack Areas	100	10	0.08	0.15	0.15
19)	Locker Rooms		50	20	0.15	0.15	0.15
20)	Manufacturing		200	5	0.04	0.15	0.15
21)	Mechanical Equipment Room		300	3.33	0.03	0.15	0.15
22)	Nurseries for Children - Day Care		35	28.57	0.21	0.15	0.21
23)	Offices:	Office	100	10	0.08	0.15	0.15
		Bank/Financial Institution	100	10	0.08	0.15	0.15
		Medical & Clinical Care	100	10	0.08	0.15	0.15
24)	Retail:	Sales, Wholesale Showrooms	30	33.33	0.25	0.20	0.25
		Basement and Ground Floor	30	33.33	0.25	0.20	0.25
		Upper Floors	60	16.67	0.13	0.20	0.20
		Grocery	30	33.33	0.25	0.20	0.25
		Malls, Arcades, & Atria	30	33.33	0.25	0.20	0.25
25)	School Shops & Vocational Rooms		50	20	0.15	0.15	0.15
26)	Skating Rinks:	Skate Area	50	20	0.15	0.15	0.15
		On Deck	15	66.67	0.50	0.15	0.50
27)	Swimming Pools:	Pool Area	50	20	0.15	0.15	0.15
		On Deck	15	66.67	0.50	0.15	0.50
28)	Transportation Function Area		30	33.33	0.25	0.15	0.25
29)	Warehouses, Industrial & Commercial Storage/Stockrooms		500	2	0.02	0.15	0.15
30)	All Others -- Including Unknown, Corridors, Restrooms, & Support Areas Commercial & Industrial Work		100	10	0.08	0.15	0.15

Footnotes:

1. Includes Convention & Civic Meeting Areas.
2. Bars, Cocktail & Smoking Lounges, Casinos.
3. Guestrooms less than 500 ft² use 30 cfm/guestroom.
4. High-rise Residential - for habitable areas not ventilated with Natural Ventilation, cfm=(0.06 cfm/ft² + 5 cfm/occ). Default occupancy for dwelling units shall be two persons for studio and one-bedroom units, with one additional person for each additional bedroom.
5. Bowling centers, allow 5 persons for each lane including 15 feet of approach.

Equations:

A. CBC Occupancy Load Equation:

$$Number\ of\ occupants/1000ft^2 = \frac{1000}{ft^2/occupant}$$

B. CBC Based Ventilation Equation:

$$cfm/ft^2 = 15\ cfm \times \frac{\left(\frac{Occupants/1000\ ft^2}{2}\right)}{1000}$$

§120.1 – Requirements for Ventilation

- **(c) Operation and control requirements**
  - **1.** The minimum outdoor air must be supplied when space is usually occupied, unless:
    - The space is intermittently occupied and controlled with an **Occupancy Sensor** (OS) or **Demand Control Ventilation** (DCV).
    - A temporary reduction is allowed for up to 30 minutes at a time if the average rate for each hour is ≥ the required rate. (DCV or OS not required)
  - **2.** A pre-occupancy purge is required in the hour prior to occupancy. The **lesser** of the following must be provided to the entire building:
    - The minimum required rate of outdoor air.
    - Three complete air changes.
    - ❖ Not required in spaces not normally occupied or with natural ventilation

§120.1 – Requirements for Ventilation

- **(c) Operation and control requirements – cont.**
  - **3.** Demand Control Ventilation is required on HVAC systems if they have **all** the following characteristics:
    - They have an air economizer.
    - They have an occupant density of 25 per 1,000 ft^2 or more for egress.
    - Either a single zone system, or a multiple zone system with Direct Digital Controls (DDC) to the zone level.
    - The area is 150 ft^2 or larger.
    - The design occupancy level is 10 people or more.

❖There are several exceptions to demand control ventilation (§120.1(c)3) related to airborne contaminates, space type, occupant density, exhaust rate, and size.

§120.1 – Requirements for Ventilation

- **(c) Operation and control requirements – cont.**
  - **4.** Demand Control Ventilation Devices (CO_2 Sensors) are required in spaces with DCV meeting §120.1(c)3
    - CO_2 sensors are required in each room with no less than one per 10,000 ft².
    - When a zone or a space is served by more than one sensor, a high CO_2 signal from any sensor in the zone or space must trigger a ventilation increase.
    - CO_2 sensors must be located between 3 ft and 6 ft above the floor or at the anticipated height of the occupants heads.
    - CO_2 must be maintained to 600 ppm or less **plus** the outdoor air CO_2 concentration, **but** the space ventilation rate does not have to be exceeded.
    - Outdoor air CO_2 must be determined by assuming 400 ppm, or measuring with a CO_2 sensor located within 4 feet of the outdoor air intake.

§120.1 – Requirements for Ventilation

- **(c) Operation and control requirements – cont.**
  - **4.** Demand Control Ventilation Devices - continued:
    - Manufacturers must certify the sensors accuracy and calibration for no more than once every 5 years.
    - If a sensor fails, the system must reset to supply the minimum outside air to the zone served by the sensor when the zone is occupied.
    - Sensor readings for each zone must be displayed continuously, and must be recorded on systems with DDC to the zone level.

§120.1 – Requirements for Ventilation

- **(c) Operation and control requirements – cont.**
  - **5.** Requirements for Occupant Sensor Ventilation Control Devices:
    - Per section 120.2(e)3, occupant sensor control devices are required for the following spaces unless they have operations that generate harmful dust, fumes, vapors or gasses:
      - ✓ Multipurpose rooms less than 1,000 ft^2;
      - ✓ Classrooms greater than 750 ft^2.
      - ✓ Conference, convention, auditorium and meeting rooms greater than 750 ft^2.

❖Exception: Occupancy sensor ventilation control is not required if DCV is required.

§120.1 – Requirements for Ventilation

- **(c) Operation and control requirements – cont.**
  - **5.** Requirements for Occupant Sensor Ventilation Control Devices – cont.
    - They must be placed so they can detect occupants in the entire space.
    - Occupant sensors controlling lighting may be used for ventilation as long as the ventilation signal is independent of daylighting and manual controls.
    - When a single zone damper or a single zone system serves multiple rooms, each room must have a sensor.
    - A zone is not considered vacant until all rooms in the zone are vacant.
    - The sensor must reduce the ventilation within 30 minutes after being vacant.
    - When vacant during normal occupancy hours, spaces must receive at least 25 percent of the ventilation rate listed in Table 120.1-A over period of 120 minutes.

§120.1 – Requirements for Ventilation

- **(d) Ducting for Zonal Heating and Cooling Units**
  - Where a return plenum is used to supply outdoor air, the exhaust air must be ducted to discharge either:
    - Within 5 feet of the intake; or
    - Within 15 feet of the intake, substantially toward the intake, and at a velocity not less than 500 feet per minute.

§120.1 – Requirements for Ventilation

- **(e) Design and Control Requirements for Outdoor Air**
  - **1.** Systems must be designed with and have ductwork, dampers, and controls to supply the larger of:
    - (1) The required outside air rates; or
    - (2) The rate required for make-up of exhaust systems that are required for processes, for control of odors, or for the removal of contaminants.
  - **2.** VAV systems measured outside air ventilation rates must be within 10 percent of the required rate. **Fixed minimum damper position is not considered to be dynamic and is not allowed**.

§120.1 – Requirements for Ventilation

- **Enforcement**
  - Permit and Plan Review:
    - Multi zone systems:
      - ✓ Verify NRCC-MCH-01 shows ventilation equipment and test requirements.
      - ✓ Verify NRCC-MCH-02 shows the applicable mandatory and prescriptive requirements, related equipment and where they are addressed in the design documentation.
      - ✓ NRCC-MCH-03 shows the ventilation requirements and calculations data.

      Note: In lieu of NRCC-MCH-03, the required outdoor ventilation rates and airflows may be shown on the plans or the calculations can be presented in a spreadsheet.
    - Single zone, packaged systems:
      - ✓ Verify NRCC-MCH-04 shows appropriate ventilation test requirements.
      - ✓ Verify NRCC-MCH-05 shows the mandatory and prescriptive requirements, the related equipment and where it is addressed in the design documentation.

§120.1 – Requirements for Ventilation

- **Enforcement** - cont.
  - Permit and Plan Review – cont.:
    - Natural Ventilation
      - ✓ Verify the NRCC-MCH-01 shows the location in the design plans of the naturally ventilated spaces and related operable openings.
      - ✓ Verify the design plan spaces meet the mandatory requirements for openable area and distance per §120.1(b)1.
    - Performance Compliance
      - ✓ Verify the NRCC-PRF-MCH-DETAILS section of the NRCC-PRF-01 includes all zones in the plans.
      - ✓ Verify NRCC-PRF-MCH-DETAILS areas match plan areas.
      - ✓ Verify occupant densities listed on NRCC-PRF-MCH-DETAILS meet the requirements of 120.1(a).

      Note: Calculations performed by the software are most likely correct if the data was entered correctly and completely.

§120.1 – Requirements for Ventilation

- **Enforcement – cont.**
  - Field Inspection:
    - NRCI-MCH-01
      - ✓ Verify this form shows the location of ventilation test results (NRCA forms).
      - ✓ May sign each line after test results have been verified (for your own reference).
    - Verify NRCA-MCH-02 Outdoor Air Acceptance is complete and consistent with NRCC and design plan documents for ventilation and equipment.
    - If Demand Control Ventilation is used, verify NRCA-MCH-06 is complete and accurate.
    - If natural ventilation is used, operable openings and space dimensions should be compared to plan requirements.

Note: If performance method is used, the NRCI and NRCA documents are still required.

§120.1 – Requirements for Ventilation

- Quiz Question:
  - Where are the required ventilation rates derived from?
    a) Table 120.1-A.
    b) 15 cfm per the expected number of occupants.
    c) The mechanical code requirements.
    d) The greater of all the above.
    e) The greater of a) and c).
- Quiz Question:
  - How many CO_2 sensors are required in a 15,000 ft² space without demand control ventilation?
    a) None.
    b) One.
    c) Two.

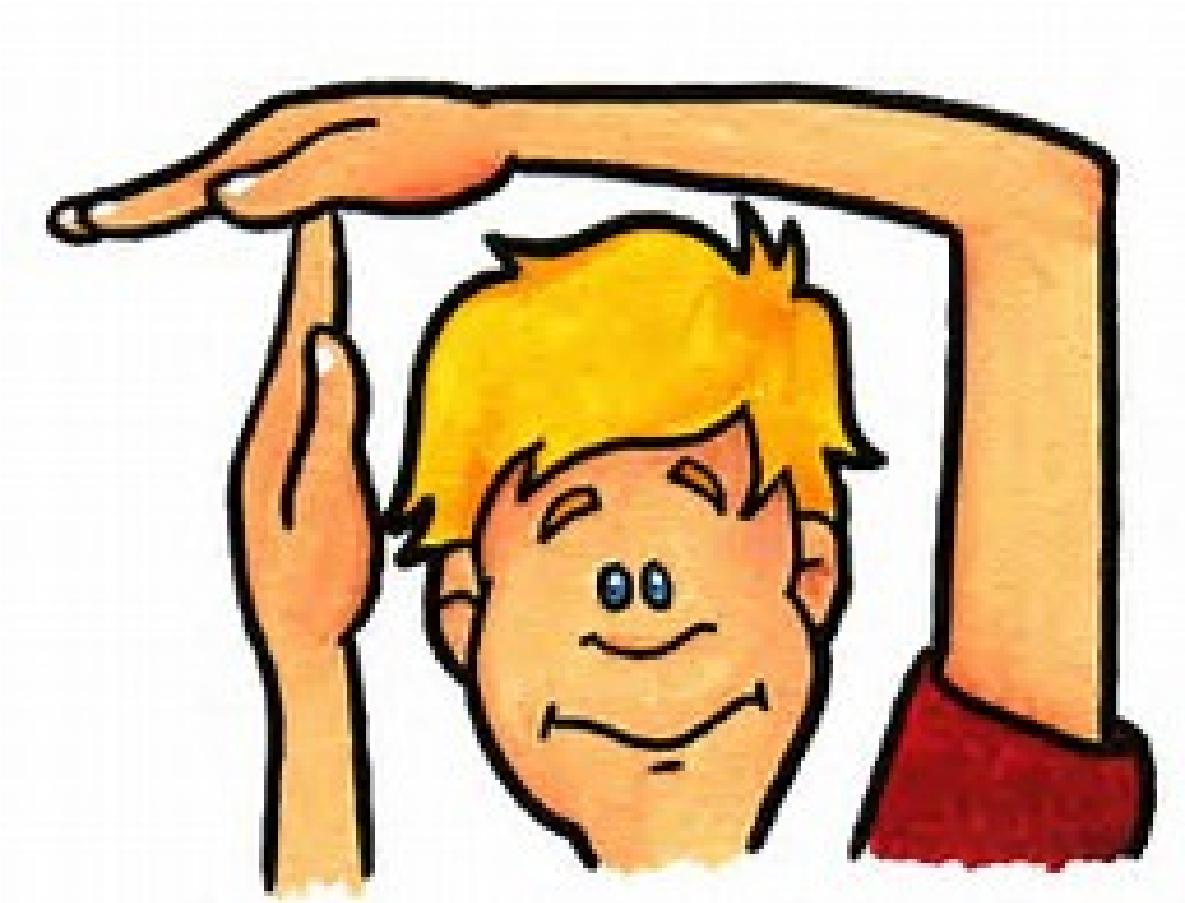
§120.1 – Requirements for Ventilation

- Quiz Question:
  - Can transfer air be the only source of ventilation air for a space?
    a) Yes.
    b) No.
- Quiz Question:
  - When is ventilation to a space NOT required?
    a) In spaces not normally used by humans.
    b) When a space is scheduled to be unoccupied.
    c) Intermittently with DCV or occupancy sensors.
    d) Ventilation is always required.
    e) a), and b).
    f) a), b), and c).

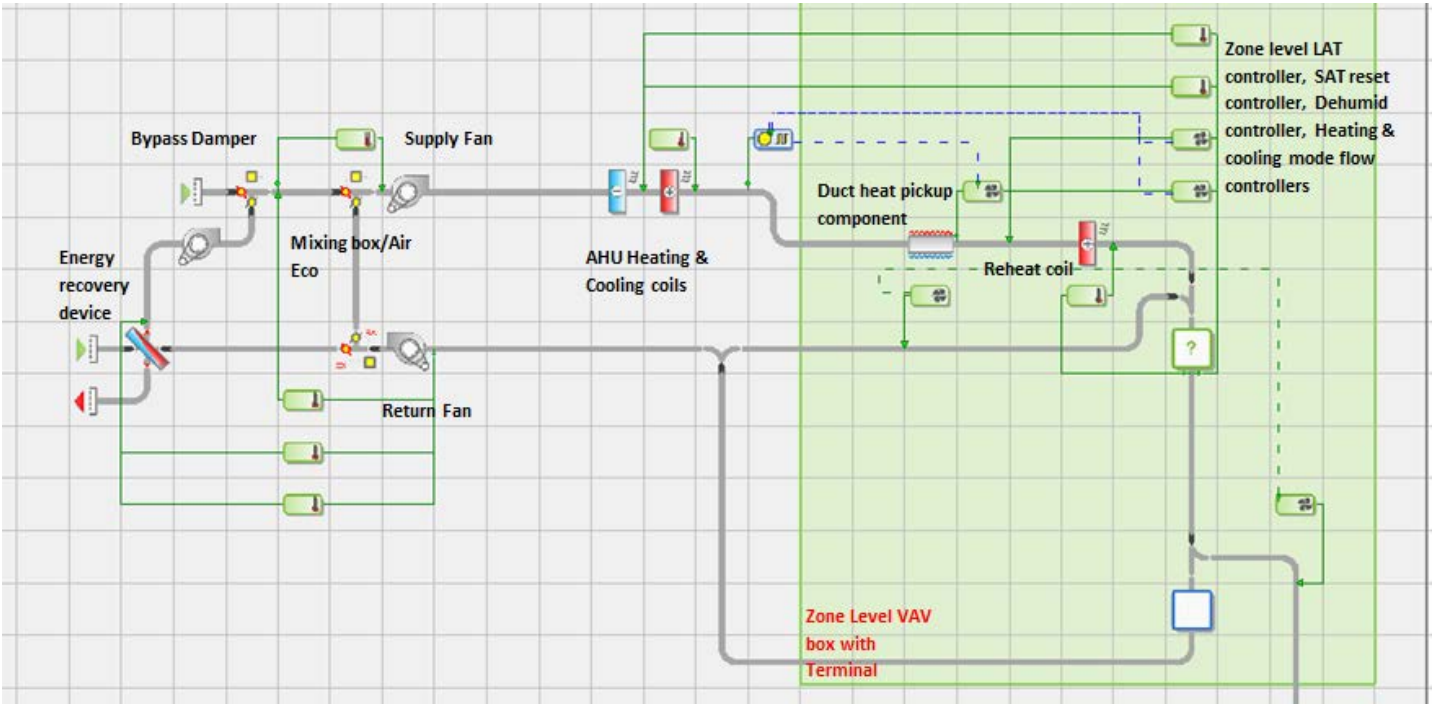
§120.1 – Requirements for Ventilation

- **Takeaways for Ventilation**
  - Natural or mechanical ventilation is required for all spaces and buildings unless it is not normally occupied.
  - For mechanical ventilation, the highest rate of ventilation from Part 6 and Part 4 must be supplied to each space.
  - All rooms in a demand control ventilation zone must have CO_2 sensors.
  - Occupant sensing controls must be listed in the Title 20 database.
  - Occupant sensors for ventilation control are not required in areas with DCV, but may still be required for space conditioning.
  - There are functional and location requirements for CO_2 sensors and occupant sensors.
  - A preoccupancy purge is required in the hour before scheduled occupation.

Time for a Break?



§120.2 – Required Controls for Space Conditioning Equipment



§120.2 – Required Controls for Space Conditioning Equipment

- **§120.2 is applicable to nonresidential, high-rise residential, and hotel/motel buildings and covers the following controls:**

✓ Zonal Thermostatic Controls

✓ Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats

✓ Heat Pump Controls

✓ Shut-off and Reset Controls

✓ Isolation Area Devices

✓ Dampers for Air Supply and Exhaust Equipment

✓ Automatic Demand Shed Controls

✓ Economizer Fault Detection and Diagnostics (FDD)

✓ Direct Digital Controls (DDC)

✓ Optimum Start/Stop Controls

§120.2 – Required Controls for Space Conditioning Equipment

- **(a) Thermostatic Controls for Each Zone**
  - ➢ Each zone or dwelling unit must have an individual thermostatic control or be controlled by an Energy Management Control System (EMCS).
  - ❖ There is an exception for an independent perimeter heating or cooling system to serve more than one zone without individual thermostatic controls. See Exception to 120.2(a) for details.

§120.2 – Required Controls for Space Conditioning Equipment

- **(b) Criteria for Zonal Thermostatic Controls**
  - Thermostats must be able to set temperatures to the following:
    - Down to 55°F or lower for heating
    - Up to 85°F or higher for cooling
  - If used for both heating and cooling it must also have a **dead band** of at least 5°F where space conditioning is shut off or reduced to a minimum.
    - EXCEPTION: Systems with thermostats that require **manual changeover** between heating and cooling modes do not need a dead band.

§120.2 – Required Controls for Space Conditioning Equipment

- **(b) Criteria for Zonal Thermostatic Controls – cont.**
  - Thermostatic controls for all single zone systems must have either:
    - An Occupant Controlled Smart Thermostat (OCST) certified to the Energy Commission per Reference Joint Appendix JA5 requirements; **or**
    - Demand Shed Controls as described in §120.2(h), if equipped with DDC to the zone level.

❖ EXCEPTION: Systems serving exempt process loads that must have constant temperatures to prevent degradation of materials, a process, plants or animals.

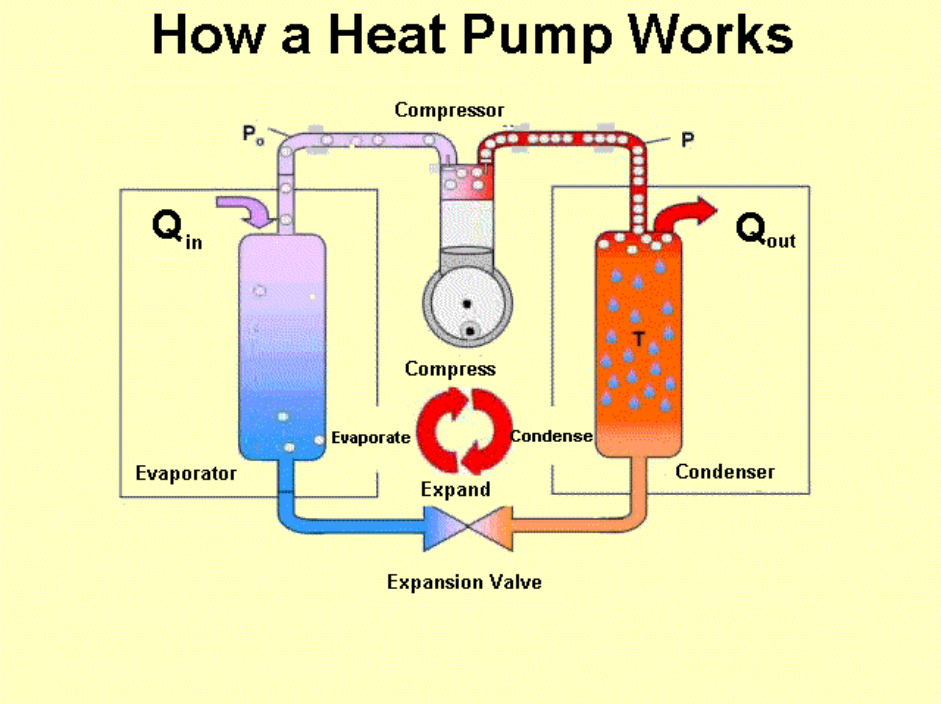
❖ EXCEPTION: Package terminal air conditioners, package terminal heat pumps, room air conditioners, and room air conditioner heat pumps.

§120.2 – Required Controls for Space Conditioning Equipment

- **(c) Hotel/Motel & High-rise Res. Dwelling Unit Thermostats**
  - **Hotel/motel guest room** thermostats must have all the following:
    - Numeric temperature setpoints in °F and °C.
    - Setpoint stops which prevent guest room occupants from adjusting the setpoint more than ±5°F (±3°C).
    - Must be an EMCS or setback thermostat.
    - EXCEPTION: Thermostats that are integrated into the room heating and cooling equipment.
  - **High-rise residential** dwelling units must be controlled by an EMCS, or setback thermostat.

§120.2 – Required Controls for Space Conditioning Equipment

- **(d) Heat Pump Controls**
  - All heat pumps with supplementary electric resistance heaters must have controls that comply with Section 110.2(b).



§120.2 – Required Controls for Space Conditioning Equipment

- **(e) Shut-off and Reset Controls**
  - **1.** The controls must be able to automatically shut off the system during periods of nonuse and must have **one** of the following:
    - An automatic time switch control listed in the Title 20 database (MAEDBS), with an accessible manual override for up to 4 hours; **or**
    - An occupancy sensor; **or**
    - A 4-hour timer that can be manually operated.

❖ EXCEPTION: Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches, and theaters equipped with 7-day programmable timers.

§120.2 – Required Controls for Space Conditioning Equipment

- **(e) Shut-off and Reset Controls – cont.**
  - **2.** When turning the system on after a shutdown, controls must automatically restart the system to maintain:
    - A setback heating thermostat setpoint if the system provides heating;
    - A setup cooling thermostat setpoint if the system provides cooling.

❖EXCEPTION for cooling: Where the Summer Design Dry-Bulb 0.5 percent temperature per JA2 is less than 100°F.

❖EXCEPTION for heating: Where the Winter Median of Extremes outdoor air temperature per JA2 is greater than 32°F.

§120.2 – Required Controls for Space Conditioning Equipment

- **(e) Shut-off and Reset Controls – cont.**
  - **3. Occupant sensors** must be installed in the following spaces unless they have operations that generate dusts, fumes, vapors or other contaminates:
    - Multipurpose rooms less than 1,000 ft^2,
    - Classrooms greater than 750 ft^2, and
    - Conference, convention, auditorium and meeting center rooms greater than 750 ft^2.
  - When space is not occupied, sensor(s) must trigger the following actions:
    - Automatically setup the cooling set point by at least 2°F and setback the heating set point by at least 2˚F; **and**
    - Automatically reset the minimum required ventilation rate as described in Section 120.1(c)5.

§120.2 – Required Controls for Space Conditioning Equipment

- **(e) Shut-off and Reset Controls – cont.**
  - **4.** Hotel and motel guest rooms must have captive card key, occupancy sensing, or automatic controls that adjust setpoints by 5°F, no longer than 30 minutes after the room has been vacated.

  - There are several exceptions to 120.2(e) shut-off and reset controls

§120.2 – Required Controls for Space Conditioning Equipment

- **(f) Dampers for Air Supply and Exhaust Equipment**
  - Outdoor air supply and exhaust equipment must have **dampers that automatically close** upon fan shutdown, **except**:
    - When the equipment serves an area that must operate continuously.
    - When it is a gravity type or other nonelectrical equipment with readily accessible manual damper controls.
    - At combustion air intake and shaft vents.
    - When it is prohibited by other provisions of law.

§120.2 – Required Controls for Space Conditioning Equipment

- **(g) Isolation Area Devices**
  - Systems serving multiple zones for a CFA > 25,000 ft^2 must have isolation areas.
    - Each zone, or any combination of zones not exceeding 25,000 ft^2, is considered a separate isolation area.
    - Each isolation area must have 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.
    - Each isolation area must have shut-off and reset controls such as an automatic time switch, occupancy sensor, or a 4-hour manual timer.
  - EXCEPTION: Zones that must be heated or cooled continuously do not need to be isolated.

§120.2 – Required Controls for Space Conditioning Equipment

- Code Quiz:
  - A 100,000 ft^2 building needs to have 80,000 ft^2 continuously conditioned. How many isolation zones are required?
    a) One
    b) Two
    c) Three
    d) Four

§120.2 – Required Controls for Space Conditioning Equipment

- **(h) Automatic Demand Shed Controls**
  - Automatic Demand Shed Controls are required in **non-critical zones** on HVAC systems **with DDC to the zone** level and must have the capability to perform the following operations:
    - Remotely **increase cooling** or **reduce heating** set points by 4 degrees or more on a signal from a centralized contact or software point within an EMCS.
    - Remotely **reset** the temperatures back to the original setpoints.
    - The controls must provide an **adjustable rate of change** for the temperature setup and reset.
  - The system must allow **authorized facility operators** to perform all these demand shed operations.

§120.2 – Required Controls for Space Conditioning Equipment

- **(h) Automatic Demand Shed Controls – cont.**
  - The system must also have the **capability** to receive a **demand response signal** to conduct a centralized **demand shed** that resets the setpoints by 4 degrees or more for the demand response period.
  - **Demand Response Signal** is a signal sent by the local utility or Independent System Operator (ISO) to a customer, indicating an approach of a price limit or a request to modify electricity consumption, for a limited time period.

§120.2 – Required Controls for Space Conditioning Equipment

- **(i) Economizer Fault Detection and Diagnostics (FDD)**
  - Economizer FDD is required for all newly installed air-cooled packaged direct-expansion units with the following:
    - Cooling capacity greater than 54,000 Btu/hr
    - An air economizer
  - Temperature sensors must be permanently installed to monitor:
    - Outside air
    - Supply air
    - Return air
  - Temperature sensors must have an accuracy of ±2°F in the range of 40°F to 80°F.
  - The controller must be capable of displaying the value of **each** sensor.

§120.2 – Required Controls for Space Conditioning Equipment

- **(i) Economizer Fault Detection and Diagnostics (FDD) – cont.**
  - The controller must provide system status by indicating the following conditions:
    - Free cooling available;
    - Economizer enabled;
    - Compressor enabled;
    - Heating enabled, if the system is capable of heating; **and**
    - Mixed air low limit cycle active.
  - The unit controller must have the capability to **manually initiate** each operating mode so that the **operation** of compressors, economizers, fans, and heating systems can be **independently** tested and verified.

§120.2 – Required Controls for Space Conditioning Equipment

- **(i) Economizer Fault Detection and Diagnostics (FDD) – cont.**
  - Faults must be reported in **one** of the following ways:
    - Reported to an EMCS that is regularly monitored by facility personnel.
    - Annunciated locally on one or more zone thermostats, or a device within five (5) feet of zone thermostat(s), clearly visible, at eye level, and meeting the following requirements:
      - ✓ On the thermostat, device, or an adjacent written sign, display instructions to contact appropriate building personnel or an HVAC technician; and
      - ✓ In buildings with multiple tenants, the annunciation must either be within property management offices or in a common space accessible by the facilities manager.
    - Reported to a fault management application which automatically provides notification of the fault to a remote HVAC service provider.

§120.2 – Required Controls for Space Conditioning Equipment

- **(i) Economizer Fault Detection and Diagnostics (FDD) – cont.**
  - The FDD system must detect the following faults:
    - Air temperature sensor failure/fault;
    - Not economizing when it should be;
    - Economizing when it should not be;
    - Damper not modulating; and
    - Excess outdoor air.
  - The FDD systems must be **certified** to the Energy Commission as meeting all of these requirements.

§120.2 – Required Controls for Space Conditioning Equipment

- **(j) Direct Digital Controls (DDC)**
  - DDC must be provided as specified in Table 120.2-A.

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

§120.2 – Required Controls for Space Conditioning Equipment

- **(j) Direct Digital Controls (DDC) – cont.**
  - The DDC system must meet the control logic requirements for ventilation in 120.1(c), demand shed requirements in 120.2(h), and the following:
    - **Monitoring** zone and system demand for fan pressure, pump pressure, heating and cooling;
    - **Transferring** demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers;
    - Automatically **detecting** the zones and systems that may be excessively driving the reset logic and generate an alarm or other indication to the system operator;
    - Allow for **operator removal** of zones(s) from the reset algorithm;
    - For new buildings, **trending and graphical displaying** of input and output points.

§120.2 – Required Controls for Space Conditioning Equipment

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

§120.2 – Required Controls for Space Conditioning Equipment

- Code Quiz:
  - Which of the following occupancies require an OCST certified per JA5?
    a) Nonresidential buildings
    b) Hotel/motel guest rooms
    c) High-rise Residential units
    d) a), b), and c)
    e) a) and b) only
  - Can an EMCS be used to control a high-rise residential dwelling unit?
    a) Yes
    b) No

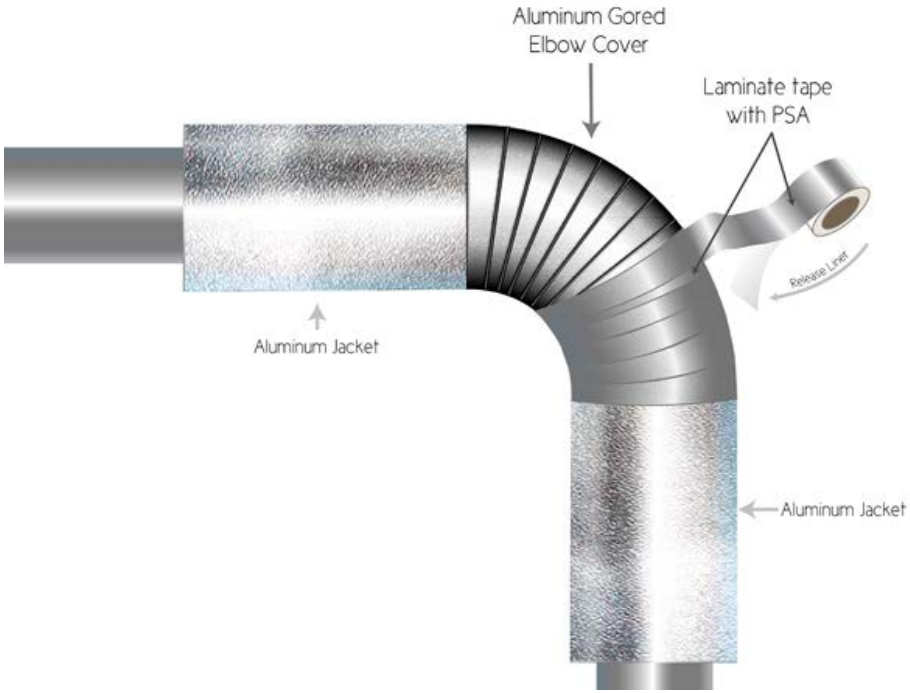
§120.2 – Required Controls for Space Conditioning Equipment

- **Takeaways for Required Controls**
  - High-rise residential dwellings must have a setback thermostat or EMCS with setback capability.
  - Hotel/Motel guest rooms must have the following controls:
    - EMCS or setback thermostat, unless it is integrated into the room unit.
    - Allow guests to adjust setpoint no more than ±5°F.
    - Captive card or occupancy sensing that automatically adjusts setpoint 5°F within 30 minutes of vacancy.

§120.2 – Required Controls for Space Conditioning Equipment

- **Takeaways for Required Controls – cont.**
  - Nonresidential systems must have the following controls:
    - Each zone must have an OCST or DDC to the zone with demand shed controls.
    - Controls to automatically shut off the system during periods of non-use.
    - Controls must restart the system to normal operations after shut down.
    - Some spaces are required to have occupancy sensors.
    - Air supply and exhaust equipment need dampers.
    - Isolation area devices are required on spaces larger than 25,000 ft^2.
    - Systems with DDC to the zone are required to have demand shed capabilities.
    - On systems larger than 54,000 Btu/hr., economizers are required to have FDD.
    - DDC to the zone controls are required on systems 300 kBtu/h and larger.

§120.3 – Requirements for Pipe Insulation



§120.3 – Requirements for Pipe Insulation

- **General Requirements**
  - Insulation is required on the following:
    - Space cooling refrigerant suction, chilled water and brine lines.
    - Space heating systems steam, steam condensate and hot water lines.
  - Insulation thickness levels are specified in Table 120.3-A.
  - If the conductivity is outside the range listed in Table 120.3-A, the calculation method shown in §120.3(c)2 must be used.
  - Example

$$T = PR[(1 + t/PR)^{K/k} - 1]$$

Where:

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

PR = Pipe actual outside radius, inches.

t = Insulation thickness required, inches (at fluid temperature).

K = Conductivity of alternate material at the mean rating temperature indicated in the table for the applicable fluid temperature range, in Btu-in./(h-ft² -°F).

k = The lower value of the conductivity range listed in the table for the applicable fluid temperature, Btu-in/(h-ft² -°F).

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

Energy Standards Table 120.3-A

Question

What is the required thickness for calcium silicate insulation on a 4 inches diameter pipe carrying a 300°F fluid?

Answer

PR = 2"
t = 4.5" (from the table for a 4" pipe with 300°F fluid)
K = 0.40 (Btu-in.)/(h-ft²-°F) (from calcium silicate insulation manufacturer's conductivity data at 200°F)
k = 0.29 (Btu-in.)/(h-ft²-°F) (the lower value of the range for conductivity for 300°F fluid)

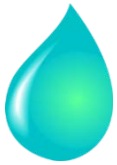
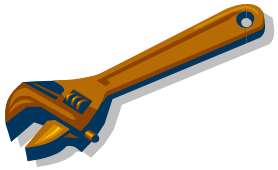
$$T = PR[(1 + t/PR)^{K/k} - 1]$$

$$T = 2[(1 + 4.5/2)^{(0.40/0.29)} - 1]$$

T = 8.2 inches minimum

§120.3 – Requirements for Pipe Insulation

- **Insulation Protection**
  - Insulation must be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind.
    - Sunlight
    - Wind
    - Moisture
    - Equip. Maint.

  - Insulation exposed to weather must be **water retardant** and provide **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 must have a **Class I or Class II vapor retarder**.
  - All penetrations and joints must be sealed.

§120.3 – Requirements for Pipe Insulation

- **Exceptions to §120.3 pipe insulation requirements**
  - Factory-installed piping within space conditioning equipment certified under Section 110.1 or 110.2.
  - Piping with a design operating temperature range between **60°F and 105°F**.
  - Gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.
  - Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.
  - **Piping that penetrates framing members** is not be required to have pipe insulation for the distance of the framing penetration.
  - Metal piping that penetrates metal framing must use grommets, plugs, wrapping or other insulation to prevent contact with the metal framing.

§120.3 – Requirements for Pipe Insulation

- **Takeaways for Pipe Insulation**
  - Insulation is required on HVAC lines outside the range of 60°F to 105°F.
  - Thickness is based on Table 120.3-A or the calculation method shown in §120.3(c)2.
  - Outdoor insulation must be protected from the elements.

§120.4 - Requirements for Ducts and Plenums

§120.4 - Requirements for Ducts and Plenums

- **(a) Duct Insulation and Sealing**
  - All air distribution systems must be installed, sealed and insulated to meet the requirements of the CMC and ANSI/SMACNA-006-2006 *HVAC Duct Construction Standards - Metal and Flexible*, 3rd Edition.
  - This includes the following:
    - Ducts
    - Plenums
    - Building cavities
    - Mechanical closets
    - Air-handler boxes
    - Support platforms used as ducts or plenums

§120.4 - Requirements for Ducts and Plenums

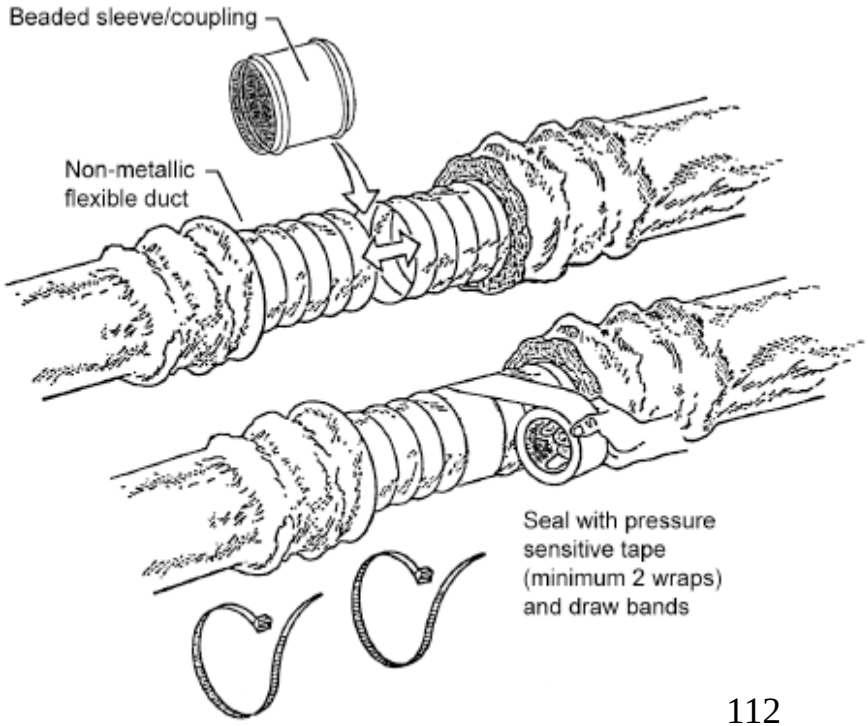
- **Duct Insulation and Sealing – cont.**
  - Connections of metal ducts and the inner core of flexible ducts must be mechanically fastened.
  - Openings must be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the requirements of UL 181, 181A, or 181B.
  - If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape must be used.

§120.4 - Requirements for Ducts and Plenums

- **(a) Duct Insulation and Sealing – cont.**
  - Supply and return ducts located in the following spaces must be insulated to a minimum of R-8:
    - Outdoors;
    - In a space between the roof and an insulated ceiling;
    - Directly under a roof with fixed vents or openings to the outside or unconditioned spaces;
    - In an unconditioned crawlspace;
    - In other unconditioned spaces.
  - Parts of supply ducts not located in one of these spaces, including buried in concrete slab, must be insulated to a minimum of R-4.2.
  - Parts of the ducts enclosed in directly conditioned spaces do not need to be insulated.

§120.4 - Requirements for Ducts and Plenums

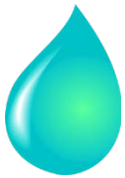
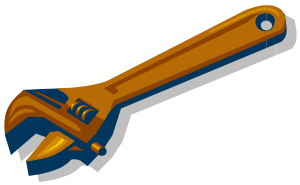
- **(b) Duct and Plenum Materials**
  - The energy code has several UL and ASTM material testing and performance requirements for the following:
    - Factory-fabricated ducts
    - Field-fabricated ducts
    - Tapes
    - Mastics and mesh
    - Aerosol sealants
    - Drawbands
    - Insulation R-values
  - See §120.4 for test requirements.



§120.4 - Requirements for Ducts and Plenums

- **(f) Protection of Insulation**
  - Insulation must be protected from sunlight, moisture, equipment maintenance, and wind.
  - Insulation exposed to weather must be protected by aluminum, sheet metal, painted canvas, or plastic cover.
  - Cellular foam insulation must be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation.

- Sunlight
- Wind
- Moisture
- Equip. Maint.

§120.4 - Requirements for Ducts and Plenums

- **Takeaways for Ducts and Plenums**
  - R-8 insulation is required in unconditioned spaces and outside
  - R-4.2 insulation is required for supply ducts everywhere else
  - Insulation is not required inside directly conditioned space
  - Duct and sealing materials must be UL or ASTM tested as applicable
  - Insulation must have protection from the elements

§120.5 – Required Nonresidential Mechanical System Acceptance

§120.5 – Required Mechanical System Acceptance

- **Acceptance testing is required for HVAC, indoor/outdoor lighting, site-built fenestration, and covered processes**
- **When applicable, acceptance tests must be specified on respective NRCC form at permit**
- **Field technician must report results of acceptance testing on respective NRCA-MCH form at final inspection**
- **Test procedures are located in Reference Nonresidential Appendix NA7**
- **Field technicians performing testing for HVAC will need to be a CMATT when thresholds are satisfied**
- **For a list of required Acceptance Tests, see §120.5.**

SECTION 120.5 – REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

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

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

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

   EXCEPTION to Section 120.5(a)4: Air economizers installed by the HVAC system manufacturer and certified to the Commission as being factory calibrated and tested are exempt from the Functional Testing section of the Air Economizer Controls acceptance test as described in NA7.5.4.2.
5. Demand control ventilation systems required by Section 120.1(c)3 shall be tested in accordance with NA7.5.5
6. Supply fan variable flow controls shall be tested in accordance with NA7.5.6
7. Hydronic system variable flow controls shall be tested in accordance with NA7.5.7 and NA7.5.9
8. Boiler or chillers that require isolation controls as specified by Section 140.4(k)2 or 140.4(k)3 shall be tested in accordance with NA7.5.7
9. Hydronic systems with supply water temperature reset controls shall be tested in accordance with NA7.5.8
10. Automatic demand shed controls shall be tested in accordance with NA7.5.10.
11. Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units shall be tested in accordance with NA7.5.11.
12. Automatic Fault Detection and Diagnostics (FDD) for air handling units and zone terminal units shall be tested in accordance with NA7.5.12.
13. Distributed Energy Storage DX AC Systems shall be tested in accordance with NA7.5.13.
14. Thermal Energy Storage (TES) Systems shall be tested in accordance with NA7.5.14.
15. Supply air temperature reset controls shall be tested in accordance with NA7.5.15.
16. Water-cooled chillers served by cooling towers with condenser water reset controls shall be tested in accordance with NA7.5.16.
17. When an Energy Management Control System is installed, it shall functionally meet all of the applicable requirements of Part 6.

§120.8 – Nonresidential Building Commissioning

§120.8 – Nonresidential Building Commissioning

- **Conditioned nonresidential buildings and spaces <u>10,000 ft^2 or more</u> must comply with all applicable sections in §120.8 .**
  - (b) Owner's or owner representative's project requirements
  - (c) Basis of design
  - (d) Design phase design review
  - (e) Commissioning measures shown in the construction documents
  - (f) Commissioning plan
  - (g) Functional performance testing
  - (h) Documentation and training
  - (i) Commissioning report

§120.8 – Nonresidential Building Commissioning

- **Buildings <u>less than 10,000 ft^2</u> must comply with only the following sections:**
  - (d) Design Phase Design Review
  - (e) Commissioning Measures Shown in the Construction Documents

- **Commissioning requirements also apply to nonresidential spaces within hotel/motel and high-rise residential buildings based on the square footage of the nonresidential spaces.**

§120.8 – Nonresidential Building Commissioning

- **(b) Owner's or Owner Representative's Project Requirements (OPR)**
  - The energy-related expectations and requirements of the building must be documented before the design phase begins.
  - There are specific requirements the OPR should document including energy goals, building hours, and ventilation requirements.
- **(c) Basis of Design (BOD)**
  - A written explanation of how the design meets the OPR.
  - Completed at the design phase and updated as necessary during the design and construction phases.
  - There are specific requirements the BOD should document including HVAC systems and controls.

§120.8 – Nonresidential Building Commissioning

- **(d) Design Phase Design Review**
  - The design review consists of the following:
    - ✓ **Design Review Kickoff** to discuss the project scope, schedule, NRCC-CXR documentation and coordination of team activities to support compliance.
    - ✓ **Construction Documents Design Review is** where the reviewer verifies the construction documents meet the design requirements as shown in the NRCC-CXR checklists.
  - Reviews may be conducted and signed off by:
    - ✓ **< 10,000 ft^2**: the building design engineer or architect
    - ✓ **10,000 ft^2 to 50,000 ft^2**: an in-house engineer or architect not associated with the project, or a third party engineer, architect, or contractor
    - ✓ **> 50,000 ft^2**: a third party engineer, architect, or contractor
    - ✓ Buildings > **10,000 ft^2** with complex mechanical systems: a third party engineer, architect, or contractor.

CODES, CMC is the 2013 California Mechanical Code.

CODES, CPC is the 2013 California Plumbing Code.

COEFFICIENT OF PERFORMANCE (COP), COOLING, is the ratio of the rate of net heat removal to the rate of total energy input, calculated under designated operating conditions and expressed in consistent units, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

COEFFICIENT OF PERFORMANCE (COP), HEATING, is the ratio of the rate of net heat output to the rate of total energy input, calculated under designated operating conditions and expressed in consistent units, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

COEFFICIENT OF PERFORMANCE (COP), HEAT PUMP is the ratio of the rate of useful heat output delivered by the complete heat pump unit (exclusive of supplementary heating) to the corresponding rate of energy input, in consistent units and as determined using the applicable test method in Appliance Efficiency Regulations or Section 110.2.

COMBUSTION AIR POSITIVE SHUT-OFF is a means of restricting air flow through a boiler combustion chamber during standby periods, used to reduce standby heat loss. A flue damper and a vent damper are two examples of combustion air positive shut-off devices.

COMBUSTION EFFICIENCY is a measure of the percentage of heat from the combustion of gas or oil that is transferred to the medium being heated or lost as jacket loss.

COMMERCIAL BOILER is a type of boiler with a capacity (rated maximum input) of 300,000 Btus per hour (Btu/h) or more and serving a space heating or water heating load in a commercial building.

COMMISSION is the California State Energy Resources Conservation and Development Commission.

COMPLEX MECHANICAL SYSTEMS: are systems that include 1) fan systems each serving multiple thermostatically controlled zones; or 2) built-up air handler systems (non-unitary or non-packaged HVAC equipment); or 3) hydronic or steam heating systems; or 4) hydronic cooling systems. Complex systems are NOT the following: (a) unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C, and 110.2-E that each serve one zone, or (b) two-pipe, heating only systems serving one or more zones.

COMPLIANCE SOFTWARE is software that has been approved pursuant to Section 10-109 of Part 1 of Title 24 of the California Code of Regulations, to demonstrate compliance with the performance approach of Part 6.

COMPRESSED AIR SYSTEM is a system of at least one compressor providing compressed air at 40 psig or higher.

COMPUTER ROOM is a room within a building 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.

CONDENSER SPECIFIC EFFICIENCY is 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.

CONDITIONED FLOOR AREA (CFA) is the floor area (in square feet) of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.

CONDITIONED SPACE is space in a building that is either directly conditioned or indirectly conditioned.

CONDITIONED SPACE, DIRECTLY is an enclosed space that is provided with wood heating, is provided with mechanical heating that has a capacity exceeding 10 Btu/hr-ft^2, or is provided with mechanical cooling that has a capacity exceeding 5 Btu/hr-ft^2, unless the space-conditioning system is designed for process space or process load. (See “process load” and “process space.”)

CONDITIONED SPACE, INDIRECTLY is enclosed space, including, but not limited to, unconditioned volume in atria, 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.

CONDITIONED VOLUME is the total volume (in cubic feet) of the conditioned space within a building.

§120.8 – Nonresidential Building Commissioning

- **(e) Commissioning measures shown in the construction documents**
  - Complete descriptions of requirements necessary for commissioning must be included with the construction documents (plans and specifications).
- **(f) Commissioning Plan**
  - During the design phase, a commissioning plan must be completed to document how the project will be commissioned.
  - The plan must include general project information, commissioning goals, systems to be commissioned, and plans to test systems and components.
- **(g) Functional performance testing**
  - Functional performance tests must demonstrate installation and operation of systems per the acceptance test requirements in Section 120.5.

§120.8 – Nonresidential Building Commissioning

- **(h) Documentation and Training**. A Systems Manual and Systems Operations Training must be completed.
  - **Systems Manual**. A manual of the operational aspects of the building must be completed and delivered to the building owner and facilities operator.
  - **Systems Operations Training**. Training of the maintenance staff for each equipment type or system must be documented in the commissioning report.
- **(i) Commissioning Report**.
  - A complete report of commissioning process activities undertaken through the design and construction must be provided to the owner.
  - The report documents the commissioning process and test results.
  - The report should include confirmation that commissioned systems meet the conditions of the OPR, BOD, and contract documents.

§120.8 – Nonresidential Building Commissioning

- **Enforcement**
  - Permit and Plan Review:
    - Verify completion of applicable NRCC-CXR-01-E through NRCC-CXR-04-E, and signature page, NRCC-CXR-05-E.
    - Receive a copy of the OPR and BOD, or verify NRCC-CXR-01-E indicates they were reviewed at Design Review Kickoff.
    - Commissioning measures are received with the construction documents.
    - Receipt of a copy of the Commissioning Plan.
  - Field Inspection:
    - Review NRCA/NRCV acceptance test documents.
    - Verify System Manual is on site and complete.
    - Verify training plan exists and review training attendance forms.
    - Verify Commissioning Report is on site and complete.

§120.8 – Nonresidential Building Commissioning

- Code Quiz:
  - When is commissioning required?
    a) Nonresidential buildings and spaces greater than 10,000 ft^2.
    b) Nonresidential buildings and spaces less than 10,000 ft^2.
    c) Both a) and b).

  - Who can conduct a design review for a building > 50,000 ft^2?
    a) A third party engineer, architect, or contractor.
    b) In-house engineer or architect not associated with the project.
    c) Both a) and b).

§120.8 – Nonresidential Building Commissioning

- **Takeaways for Commissioning**
  - **Design Review and Commissioning Measures are required for all nonresidential buildings regardless of size.**
  - **OPR, BOD, Commissioning Plan, Systems Manual, Training and Commissioning Report are also required for nonresidential buildings and spaces > 10,000 ft^2.**
  - **Nonresidential spaces of Hotel/Motel and High-rise Residential buildings also require commissioning.**
  - **Commissioning compliance documents must be signed by a <u>licensed</u> engineer, architect or contractor.**
  - **Building size and equipment type (simple or complex) determines who can or must sign off.**

§120.9 – Requirements for Commercial Boilers

What is a "Commercial Boiler"??

- **Standards §100.1 Definitions:**
  - Commercial Boiler
    - A type of boiler with a capacity (rated maximum input) of 300,000 Btus per hour (Btu/h) or more and serving a space heating or water heating load in a commercial building.

§120.9 – Requirements for Commercial Boilers

- **Mandatory Requirements for Commercial Boilers**
  - Combustion air positive shut-off is required on all newly installed boilers as follows:
    - All boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
    - All boilers served by one stack (2+ boilers) with a total combined input of 2.5 MMBtu/h (2,500,000 Btu/h).
  - Combustion air fan motors 10 horsepower or larger must have **one** of the following:
    - Variable speed drive motor; or
    - 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.

§120.9 – Requirements for Commercial Boilers

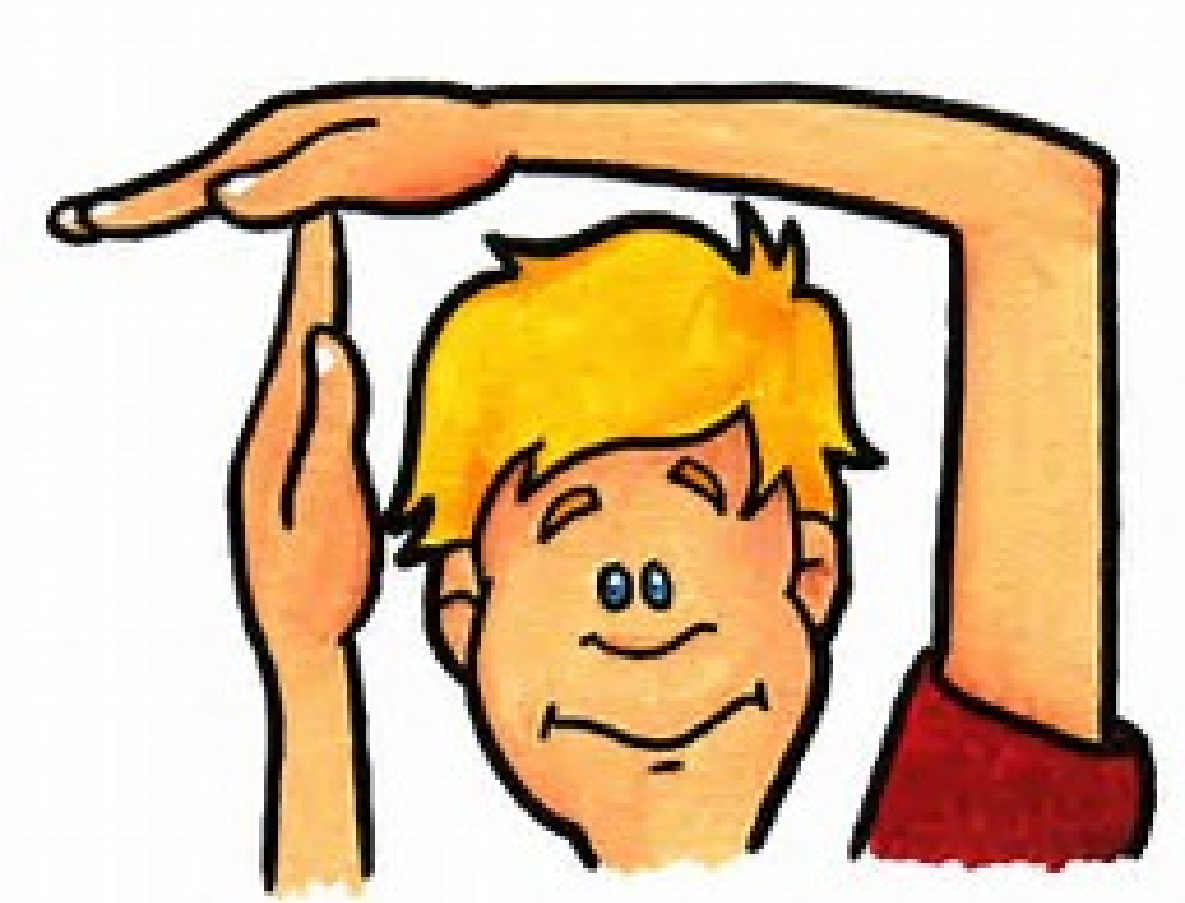
- **Mandatory Requirements for Commercial Boilers**
  - Boilers with 5 MMBtu/h (5,000,000 Btu/h) input and greater must control **excess (stack-gas) oxygen** concentrations.
    - Must be less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent.
    - Combustion air volume must be controlled with respect to firing rate or flue gas oxygen concentration.
    - Use of a common gas and combustion air control linkage or jack shaft is prohibited.

❖ EXCEPTION: Boilers with steady state full-load thermal efficiency 85 percent or higher are exempt.

§120.9 – Requirements for Commercial Boilers

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

Time for a Break?



Subchapter 5

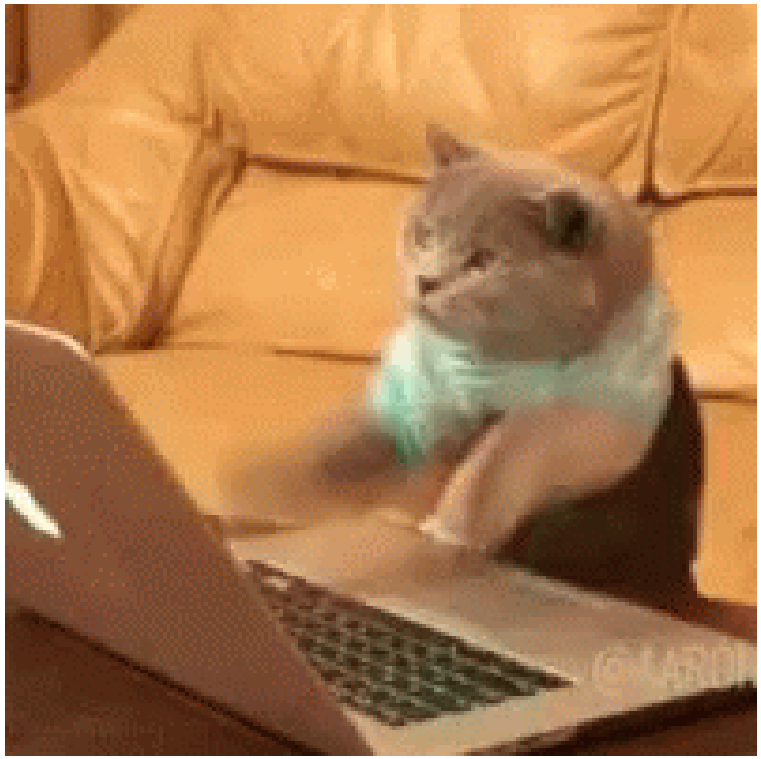
Nonresidential, High-Rise Residential, and Hotel/Motel Occupancies—Performance and Prescriptive Compliance Approaches for Achieving Energy Efficiency

(Sections §140.0 - §140.9)

§140 Series
Performance and Prescriptive Compliance

- **§140.1 - Performance Approach: Energy Budget**
- **§140.2 - Prescriptive Approach**
- **§140.4 - Prescriptive Requirements for Space Conditioning Systems**

§140.1 – Performance Approach: Energy Budgets



§140.1 – Performance Approach: Energy Budgets

- **A building complies with the performance approach if the energy budget calculated for the Proposed Design Building is no greater than the energy budget calculated for the Standard Design Building.**

§140.1 – Performance Approach: Energy Budgets

- Energy Budget for the **Standard Design** Building.
  - The energy budget for the Standard Design Building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The energy budget is the sum of the TDV energy for space conditioning, indoor lighting, mechanical ventilation, service water heating, and covered process loads.
- Energy Budget for the **Proposed Design** Building.
  - The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space conditioning, indoor lighting, mechanical ventilation and service water heating and covered process loads.
- **Calculation** of Energy Budget.
  - The TDV energy for both the Standard Design Building and the Proposed Design Building shall be computed by Compliance Software certified for this use by the Energy Commission. The processes for Compliance Software approval are documented in the **Nonresidential ACM Approval Manual**.

§140.4 – Prescriptive Requirements for Space Conditioning Systems

§140.4 – Prescriptive Requirements for HVAC

- **§140.4 covers the following prescriptive topics:**
  - Sizing and Equipment Selection
  - Calculations
  - Power Consumption of Fans
  - Space Conditioning Zone Controls
  - Economizers
  - Supply Air Temperature Reset Controls
  - Electric Resistance Heating
  - Heat Rejection Systems
  - Minimum Chiller Efficiency
  - Limitation of Air-Cooled Chillers
  - Hydronic System Measures
  - Air Distribution System Duct Leakage Sealing
  - Fan Control
  - Mechanical System Shut-off

§140.4 – Prescriptive Requirements for HVAC

- **(a) Sizing and Equipment Selection**
  - Heating and cooling equipment must be the smallest size, within the available options of the desired equipment line, necessary to meet the design heating and cooling loads of the building.
    - EXCEPTION: Where it can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building TDV energy use.
    - EXCEPTION: Standby equipment with controls that allow the standby equipment to operate only when the primary equipment is not operating.
    - EXCEPTION: Multiple units of the same equipment type, such as multiple chillers and boilers, having combined capacities exceeding the design load, if they have controls that sequence or otherwise optimally control the operation of each unit based on load.

§140.4 – Prescriptive Requirements for HVAC

- **(b) Calculations**

  - Heating and cooling **design loads** are determined in accordance with the ASHRAE Handbook, Fundamentals Volume, or as specified in a method approved by the Energy Commission.
  - Other calculation methods such as ACCA, SMACNA, etc., are acceptable as long as they are based on ASHRAE.
  - **Indoor** design conditions are determined in accordance with ASHRAE Standard 55 or ASHRAE Handbook, Fundamentals Volume.
  - **Outdoor** design conditions are selected from Reference Joint Appendix JA2, which is based on climate data from ASHRAE.

§140.4 – Prescriptive Requirements for HVAC

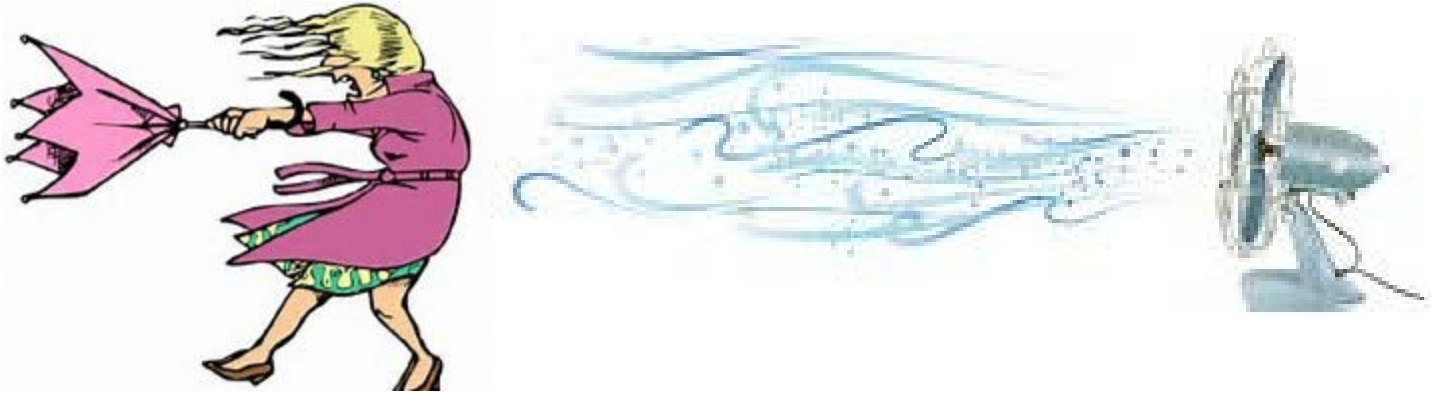
- **(b) Calculations – cont.**
  - Load calculations must include the following:
    - Outdoor air ventilation
    - Envelope thermal conductance and air leakage
    - Solar heat gain
    - Shading such as overhangs
    - People loads based on occupant density
    - Process loads
    - Lighting loads
    - Any anticipated miscellaneous loads

§140.4 – Prescriptive Requirements for HVAC

- **(b) Calculations – cont.**
  - **Safety factor**. Design loads may be increased by up to 10 percent to account for unexpected loads or changes in space usage.
  - **Other loads**.
    - Loads such as warm-up or cool-down are based on the heat capacity of the building and contents, the degree of setback, and desired recovery time.
    - They may be assumed to be no more than 30 percent for heating and 10 percent for cooling of the steady-state design loads.
    - The steady-state load may include the 10 percent safety factor.

§140.4 – Prescriptive Requirements for HVAC

- **(c) Power Consumption of Fans**
  - Constant volume fan systems.
    - The total **fan power index** at design conditions of **each fan system** with total horsepower over 25 hp cannot exceed **0.8 watts per cfm** of supply air.



§140.4 – Prescriptive Requirements for HVAC

- **(c) Power Consumption of Fans – cont.**
  - Variable air volume (VAV) systems.
    - The total **fan power index** at design conditions of **each fan system** with total horsepower over 25 hp cannot exceed **1.25 watts per cfm** of supply air.
    - Static pressure sensors used to control VAV fans:
      - ✓ Must be located in a position such that the control setpoint is ≤ 1/3 of the design static pressure of the fan.
      - ✓ For systems with multiple duct branches you must provide separate sensors in each major branch and control the fan to satisfy the sensor with the greatest demand.
    - Systems with DDC to the zone, static pressure setpoints must reset to the zone needing the most pressure.

§140.4 – Prescriptive Requirements for HVAC

- **(c) Power Consumption of Fans – cont.**
  - Air-treatment or filtering systems.
    - For systems with air-treatment or filtering systems, calculate the total adjusted fan power index using Equation 140.4-A:

Adjusted total fan power index = (Fan power index) x (Fan adjustment)

$$\text{Fan Adjustment} = 1 - \left(\frac{SP_a - 1}{SP_f} \right)$$

WHERE:

SP_a = Air pressure drop across the air-treatment or filtering system.

SP_f = Total pressure drop across the fan.

§140.4 – Prescriptive Requirements for HVAC

- **(c) Power Consumption of Fans – cont.**
  - Fractional HVAC Motors for Fans.
    - HVAC motors for fans that are < 1 hp and ≥ 1/12 hp must be electronically-commutated motors (ECM) or have a minimum motor efficiency of 70 percent.
    - These motors must also have the means to adjust motor speed for either balancing or remote control.
    - Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.
    - ❖EXCEPTION: Motors in fan-coils and terminal units that operate only when providing heating to the space served.
    - ❖EXCEPTION: Motors in space conditioning equipment certified under Section 110.1 or 110.2.

§140.4 – Prescriptive Requirements for HVAC

- **(d) Space Conditioning Zone Controls**
  - ➢ Each zone must have controls preventing the following:
    - Reheating
    - Recooling
    - Simultaneous heating and cooling to the same zone.
  - ❖ There are several exceptions for space conditioning zone controls listed in §140.4(d) related to pressurization requirements, use of solar energy, exempt process loads and low peak air supply.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers**
  - Each cooling air handler that has a design total mechanical cooling capacity over 54,000 Btu/hr must include either:
    - An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air; or
    - A water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Energy Commission, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.
  - There are several exceptions listed in §140.4(e)1 related to air filtration, affect on other systems, hotel/motel and high-rise residential dwellings, exceptional efficiency, and computer rooms.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - If an economizer is prescriptively required, it must have controls that:
    - Prevent an increase in the building heating energy use during normal operation.
      - EXCEPTION: Systems that provide 75 percent of the annual energy used for mechanical heating from **site-recovered energy or a site-solar** energy source.
    - Capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - Air economizers must be a type listed in, and have **high limit shutoff** controls complying with Table 140.4-B.

TABLE 140.4-B AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type[a]	Climate Zones	Required High Limit (Economizer Off When):	
		Equation[b]	Description
Fixed Dry Bulb	1, 3, 5, 11-16	$T_{OA} > 75°F$	Outdoor air temperature exceeds 75°F
	2, 4, 10	$T_{OA} > 73°F$	Outdoor air temperature exceeds 73°F
	6, 8, 9	$T_{OA} > 71°F$	Outdoor air temperature exceeds 71°F
	7	$T_{OA} > 69°F$	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	$T_{OA} > T_{RA}°F$	Outdoor air temperature exceeds return air temperature
	2, 4, 10	$T_{OA} > T_{RA}-2°F$	Outdoor air temperature exceeds return air temperature minus 2°F
	6, 8, 9	$T_{OA} > T_{RA}-4°F$	Outdoor air temperature exceeds return air temperature minus 4°F
	7	$T_{OA} > T_{RA}-6°F$	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	$h_{OA} > 28$ Btu/lb[c] or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[c] or Outdoor air temperature exceeds 75°F

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - Air economizer air **damper requirements:**
    - **Warranty**. 5-year manufacturer warranty of economizer assembly.
    - **Damper reliability testing**. Suppliers of economizers shall certify that the economizer assembly, including but not limited to outdoor air damper, return air damper, drive linkage, and actuator, have been tested and are able to open and close against the rated airflow and pressure of the system for 60,000 damper opening and closing cycles.
    - **Damper leakage**. Economizer outdoor air and return air dampers shall have a maximum leakage rate of 10 cfm/sf at 250 Pascals (1.0 in. w.g.) when tested in accordance with AMCA Standard 500-D. The economizer **outside air and return air damper leakage rates shall be certified to the Energy Commission** in accordance with Section 110.0.
    - **Adjustable setpoint**. If the high-limit control is fixed dry-bulb or fixed enthalpy + fixed dry-bulb then the control shall have an adjustable setpoint.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - Air economizer air damper requirements – cont.
    - **Sensor accuracy**. Outdoor air, return air, mixed air, and supply air sensors must be **calibrated** within the following accuracies.
      - ✓ Dry-bulb and wet-bulb temperatures accurate to ±2°F over the range of 40°F to 80°F.
      - ✓ Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb.
      - ✓ Relative humidity (RH) accurate to ±5 percent over the range of 20 percent to 80 percent RH.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - Air economizer air damper requirements – cont.
    - **Sensor calibration data**. Data used for controlling the economizer must be plotted on a sensor performance curve.
    - **Sensor high limit control**. Sensors used for the high limit control must be located to prevent false readings, including shielding from sunlight.
    - **Relief air system**. Relief air systems must be able to provide 100 percent outside air without over-pressurizing the building.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - Requirements for all prescriptive economizers
    - Unit controls must have **capacity controls** interlocked with economizer controls such that the economizer is at 100 percent open position when mechanical cooling is on and does not begin to close until the leaving air temperature is less than 45°F.
    - Direct Expansion **(DX) units** > 65,000 Btu/hr that **control the capacity** of the mechanical cooling **directly based on occupied space temperature** must have a **minimum of 2 stages** of mechanical cooling capacity.

§140.4 – Prescriptive Requirements for HVAC

- **(e) Economizers – cont.**
  - Requirements for all prescriptive economizers – cont.
    - All other DX units must comply with the following:
      - ✓ Have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means except at the lowest stage of mechanical cooling capacity.
      - ✓ Comply with the requirements in Table 140.4-C

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

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement
≥ 65,000 Btu/h and < 240,000 Btu/h	3 stages	≤ 35% full load
≥ 240,000 Btu/h	4 stages	≤ 25% full load

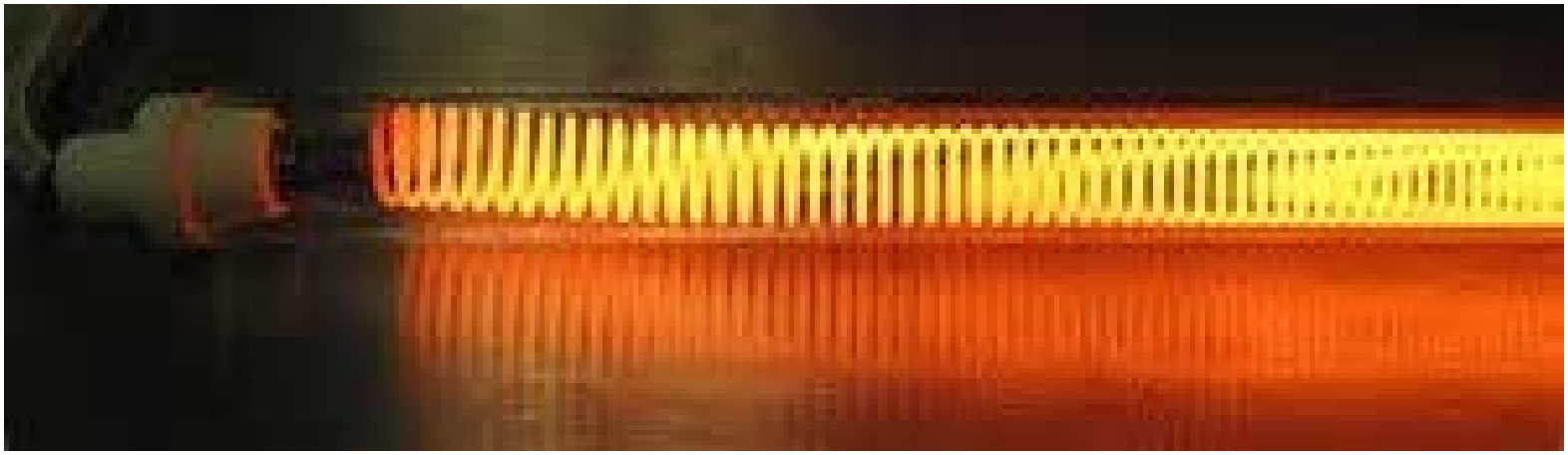
§140.4 – Prescriptive Requirements for HVAC

- **(f) Supply Air Temperature (SAT) Reset Controls**
  - Space conditioning systems **supplying multiple zones** must include controls that **automatically reset supply-air temperatures**.
  - **Air distribution** systems for **zones likely to have constant loads** must be designed for air flows resulting from the fully reset SAT.
  - **SAT** reset controls must be:
    - In response to representative building loads or to outdoor air temperature.
    - At least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

❖ There are some exceptions for certain zonal controls and process humidification requirements.

§140.4 – Prescriptive Requirements for HVAC

- **(g) Electric Resistance Heating**
  - Electric resistance heating systems cannot be used for space heating.
    - There are exceptions related to solar power, heat pumps, percentage of total building design output, maximum wattage, and building features.



§140.4 – Prescriptive Requirements for HVAC

- **(h) Heat Rejection Systems**
  - This section applies to **heat rejection equipment** used in comfort cooling systems such as air-cooled and evaporative **condensers**, and open and closed-circuit **cooling towers**.
  - Fan Speed Control
    - Each fan powered by a motor of 7.5 hp (5.6 kW) or larger must have the capability to operate at 2/3 of full speed or less.
    - Have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device.
    - ❖ Of course, there are exceptions to fan speed controls. See §140.4(h)2.

§140.4 – Prescriptive Requirements for HVAC

- **(h) Heat Rejection Systems – cont.**
  - Tower Flow Turndown
    - Open cooling towers with multiple condenser water pumps must be designed so that all cells can be run in parallel with the larger of:
      - ✓ The flow that is produced by the smallest pump; **or**
      - ✓ 50 percent of the design flow for the cell.
  - Limitation on Centrifugal Fan Cooling Towers
    - Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply, and 75°F outdoor wet-bulb temperature, must use propeller fans and cannot use centrifugal fans.
    - ❖ There are exceptions to the limitation on centrifugal fan cooling towers. See §140.4(h)4.

§140.4 – Prescriptive Requirements for HVAC

- **(h) Heat Rejection Systems – cont.**
  - Multiple Cell Heat Rejection Equipment
    - Multiple cell heat rejection equipment with variable speed fan drives shall:
      - ✓ Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components.
      - ✓ Control all operating fans to the same speed.
      - ✓ Minimum fan speed is to be based on the manufacturer's specifications.
      - ✓ Staging of fans is allowed once the fans are at their minimum operating speed.

§140.4 – Prescriptive Requirements for HVAC

- **(i) Minimum Chiller Efficiency**
  - Chillers must meet or exceed Path B from Table 110.2-D.
    - There are exceptions to minimum chiller efficiency requirements related to electrical service size, chillers with heat recovery systems, thermal energy storage and quantity.

§140.4 – Prescriptive Requirements for HVAC

- **(j) Limitation of Air-Cooled Chillers**
  - Chilled water plants cannot have more than 300 tons of capacity provided by air-cooled chillers.
    - There are exceptions related to poor water quality, thermal energy storage and certified high efficient air-cooled chillers.

§140.4 – Prescriptive Requirements for HVAC

- **(k) Hydronic System Measures**
  - 1. Hydronic Variable Flow Systems
    - HVAC chilled and hot water pumping must have **variable fluid flow** and be **capable of reducing pump flow rates** to no more than the larger of:
      - ✓ 50 percent or less of the design flow rate; **or**
      - ✓ The minimum flow required by the equipment manufacturer.
    - There are exceptions:
      - ❖ Systems that include no more than three control valves.
      - ❖ Systems having a total pump system power less than or equal to 1.5 hp.

§140.4 – Prescriptive Requirements for HVAC

- **(k) Hydronic System Measures – cont.**
  - 2. Chiller Isolation
    - System with **more than one chiller**, must have provisions so that flow through any chiller is **automatically shut off** when that chiller is off while still **maintaining flow** through other operating chiller(s).
    - Chillers that are piped **in series** for the purpose of increased temperature differential **are considered to be one** chiller.
  - 3. Boiler Isolation
    - Hot water plants with **more than one** boiler, must have provisions so that flow through any boiler is automatically shut off when that boiler is shut off while **maintaining flow** through other operating boiler(s).

§140.4 – Prescriptive Requirements for HVAC

- **(k) Hydronic System Measures – cont.**
  - 4. Chilled and Hot Water Temperature Reset Controls
    - Systems with a design capacity exceeding 500,000 Btu/hr supplying chilled or heated water must have controls that automatically reset supply water temperatures as a function of building loads or outside air temperature.
    - EXCEPTION: Hydronic systems using variable flow to reduce pumping energy without taking an exception to Section 140.4(k)1 for variable flow.
  - 5. Water-Cooled Air Conditioner and Hydronic Heat Pump Systems
    - Water circulation systems serving one or both systems, that have total pump system power exceeding 5 hp must have **variable flow controls** that meet the requirements of Section 140.4(k)6 (next slide).
    - Each air conditioner or heat pump must have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

§140.4 – Prescriptive Requirements for HVAC

- **(k) Hydronic System Measures – cont.**
  - 6. Variable Flow Controls
    - Individual pumps serving variable flow systems and having a motor horsepower exceeding 5 hp:
      - ✓ Must have variable speed control that reduces pump motor demand to no more than 30 percent of design wattage at 50 percent water flow.
      - ✓ The pumps must be controlled as a function of required differential pressure.
    - Pressure Sensor Location and Setpoint.
      - ✓ For systems without direct digital control of individual coils reporting to the central control panel, differential pressure must be measured at the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.
      - ✓ For systems with direct digital control of individual coils with a central control panel, the static pressure set point must be reset based on the valve requiring the most pressure, and the setpoint must be no less than 80 percent open. Pressure sensors may be mounted anywhere.

❖ There are exceptions to variable flow controls. See §140.4(k)6.

§140.4 – Prescriptive Requirements for HVAC

- **(k) Hydronic System Measures – cont.**
  - 7. Hydronic Heat Pump (WLHP) Controls
    - WLHPs with central devices for heat rejection and heat addition must have controls that provide for a heat pump water supply temperature **deadband** of **at least 20°F** between initiation of heat rejection and heat addition.

❖ EXCEPTION: Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20°F are allowed.

§140.4 – Prescriptive Requirements for HVAC

- **(l) Air Distribution System Duct Leakage Sealing**
  - Duct systems must be sealed to a leakage rate ≤ 6 percent of the nominal air handler airflow rate as **verified by a HERS rater** in accordance with Reference Nonresidential Appendices NA1 and NA2 **if all the following are met**:
    - The space is served by a constant volume, single zone system.
    - The space conditioning system serves less than 5,000 ft^2.
    - Has more than 25 percent of the duct surface area in the following spaces:
      - ✓ Outdoors; **or**
      - ✓ Under a roof that has a U-factor greater than the U-factor of the ceiling, **or**
      - ✓ Under a roof that does not meet the requirements of Section 140.3(a)1B, **or**
      - ✓ Under a roof that has fixed openings to the outside or unconditioned spaces; **or**
      - ✓ In an unconditioned crawlspace; **or**
      - ✓ In other unconditioned spaces.

§140.4 – Prescriptive Requirements for HVAC

- **(m) Fan Control**
  - Each cooling system listed in Table 140.4-D must vary the indoor fan airflow as a function of load.

TABLE 140.4-D FAN CONTROL SYSTEMS

Cooling System Type	Fan Motor Size	Cooling Capacity
DX Cooling	any	≥ 65,000 Btu/hr
Chilled Water and Evaporative	≥ 1/4 HP	any

§140.4 – Prescriptive Requirements for HVAC

- **(m) Fan Control – cont.**
  - DX and chilled water cooling systems that control the mechanical cooling directly based on occupied space temperature must have the following:
    - ✓ At least 2 stages of fan control with ≤ 66 percent speed on stage 1.
    - ✓ Draw no more than 40 percent of full speed fan power when operating at 66 percent speed.
  - All other systems, including but not limited to DX cooling systems and chilled water systems that control the space temperature by modulating the airflow to the space, must have proportional fan control to no more than 30 percent of the fan full speed power draw at 50 percent air flow.
  - Systems that include an air side economizer to meet 140.4(e)1 must have a minimum of two speeds of fan control during economizer operation.

❖ There are exceptions related to motors with less than 1 hp.

§140.4 – Prescriptive Requirements for HVAC

- **(n) Mechanical System Shut-off**
  - ➢ Any directly conditioned space with operable wall or roof openings to the outdoors must have interlock controls.
  - ➢ When operable openings are open for more than 5 minutes, the controls for those spaces must do the following:
    - ▪ Disable or reset the setpoint to 55°F for mechanical heating, **and**
    - ▪ Disable or reset the temperature setpoint to 90°F for mechanical cooling.
  - ❖ Exceptions: They are not required on doors with automatic closing devices or spaces without thermostatic control.

§140.4 – Prescriptive Requirements for HVAC

- Code Quiz:
  - Load calculations are based on which of the following?
    a) ACCA
    b) ASHRAE
    c) SMACNA
    d) All of the above
  - When do fan power index requirements apply?
    a) Each fan > 25 hp.
    b) Each fan system > 25 hp.
    c) Both a) and b).

§140.4 – Prescriptive Requirements for HVAC

- Code Quiz:
  - When is an economizer mandatory?
    a) On systems with cooling capacity over 54,000 Btu/hr.
    b) On all VAV systems.
    c) Both a) and b).
    d) Not mandatory.
  - When is an economizer required prescriptively?
    a) On systems with cooling capacity over 54,000 Btu/hr.
    b) On all VAV systems.
    c) Both a) and b).

§140.4 – Prescriptive Requirements for HVAC

- **Takeaways for Prescriptive Requirements**
  - **Heating and cooling loads must be calculated based on ASHRAE.**
  - **A safety factor increase is allowed.**
  - **Fan power index requirements for motors over 25 hp and efficiency requirements for motors less than 1 hp.**
  - **Zonal controls required to prevent reheat, recooling and mixing.**
  - **Economizers are required on cooling air handlers over 54,000 Btu/hr.**
  - **Economizers have leakage, warranty and certification requirements.**
  - **Multi-zone systems are required to have SAT reset controls.**
  - **Heat rejection systems have requirements for fan and pump controls and motor efficiencies.**

§140.4 – Prescriptive Requirements for HVAC

- **Takeaways for Prescriptive Requirements – cont.**
  - **Chiller efficiencies must meet path B in Table 110.2-D.**
  - **Limited to no more than 300 tons of air cooled chiller capacity.**
  - **Hydronic systems have requirements for isolation, variable flow control, and temperature reset.**
  - **Single zone systems less than 5,000 ft^2 may need HERS duct testing.**
  - **DX, chilled water and evaporative cooling systems have fan motor control requirements.**
  - **Mechanical shut-off devices are required for operable openings to spaces with thermostatic controls.**
  - **Prescriptive requirements may be "traded off" when using the performance approach.**

Subchapter 6
Nonresidential, High-Rise Residential, Hotel/Motel Occupancies – Additions, Alterations, and Repairs

(Sections §141.0 - §141.1)

§141.0 Additions, Alterations, and Repairs

- **§141.0(a) – Additions**
- **§141.0(b) – Alterations**
- **§141.0(c) – Repairs**

§141.0(a) – Additions

§141.0(a) – Additions

- **1. Prescriptive approach.**
  - Newly installed space conditioning systems installed in an addition must meet the applicable prescriptive requirements of §140.4 and all applicable mandatory requirements as discussed in previous sections.

§141.0(a) – Additions

- **2. Performance approach**
  - All applicable mandatory measures must be achieved or exceeded.
  - Either the **addition alone** meets or exceeds the standard energy budget; **or**
  - The **existing plus addition** approach can be taken; or
  - The **existing, plus addition, plus alteration** approach can be taken.
    - The **standard design** is:
      - ✓ The combination of the existing building's remaining unaltered components;
      - ✓ The existing building altered components that are the more efficient in TDV energy of either the existing conditions, or the requirements of Section 141.0(b)2;
      - ✓ Plus the proposed addition's TDV energy.
    - The **proposed design** is:
      - ✓ The combination of the existing building's unaltered components and the altered component's energy features, plus the proposed energy features of the addition.

§141.0(a) – Additions

- **Exceptions for additions:**
  - ❖ When expanding existing systems, existing systems and equipment need not comply with current requirements **except for duct sealing**.
  - ❖ Duct Sealing. When ducts are extended from an existing duct system to serve the addition, the **existing duct system and the extended ducts** shall meet the applicable requirements specified in Section 141.0(b)2D.
  - ❖ There are exceptions allowing expansion of existing systems with electric heat when adding VAV boxes to the addition. See Exception 2 to Section 141.0(a).

§141.0(b) – Alterations

§141.0(b)2 - Alterations: Prescriptive Approach

- **C. New or Replacement Space Conditioning Systems or Components**
  - New Systems or components **except** new or replacement ducts must meet the requirements of section §140.4 applicable to the systems or components being altered.
    - Exceptions:
      - Replacements of equivalent or lower capacity electric resistance space heaters for high-rise residential apartment units.
      - Replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.
      - Mechanical system shut-off devices in §140.4(n) are not required for new or replacement space conditioning systems.
      - Economizer FDD in §120.2(i) is not required for alterations of space conditioning systems or components.

§141.0(b)2 - Alterations: Prescriptive Approach

- **D. Altered Duct Systems**
  - New or replacement ducts serving an existing building must meet the requirements for ducts and plenums in §120.4.
  - If the space conditioning system meets the criteria of Section140.4(l), the duct system must be tested by a HERS rater per the following:
    - Entirely new or replacement duct systems directly connected to the air handler must have leakage ≤ 6 percent of the system air handler per NA2.1.4.2.1.

NOTE: Entirely new or replacement duct systems means at least 75 percent new duct material. Up to 25 percent may consist of reused parts from the building's existing duct system, including registers, grilles, boots, air handlers, coils, plenums, and ducts, if the reused parts are accessible for sealing.

§141.0(b)2 - Alterations: Prescriptive Approach

- **D. Altered Duct Systems – cont.**
  - HERS testing – cont.:
    - If the new ducts are an **extension** of an existing duct system, the combined **new and existing** duct system shall meet one of the following requirements:
      - ✓ Leakage ≤ **15 percent** per NA2.1.4.2.1; or
      - ✓ If it is not possible to comply with the 15 percent duct leakage, then all **accessible** leaks must be sealed and verified through a visual inspection and a **smoke test** performed by a certified HERS Rater per NA2.1.4.2.2.

❖ Exception: Existing ducts constructed, insulated or sealed with asbestos.

§141.0(b)2 - Alterations: Prescriptive Approach

- **E. Altered Space Conditioning Systems**
  - When replacing the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil:
    - The existing thermostat shall be replaced with an Occupant Controlled Smart Thermostat (OCST) that complies with Reference Joint Appendix JA5; **and**
    - If the system meets the criteria of Sections 140.4(l)1, 2 and 3, the connected duct system shall be sealed and tested as discussed previously.
      - Exception: Ducts documented to have been previously tested by a HERS Rater.
      - Exception: Existing duct systems constructed, insulated or sealed with asbestos.

§141.0(b)3 – Alterations: Performance Approach

- **Performance Approach**
  - The altered space conditioning system and any newly installed equipment serving the alteration, shall meet the applicable mandatory requirements.
  - The standard design for an altered component shall be the higher efficiency of existing conditions or the prescriptive alteration requirements stated previously.
  - For components not being altered, the standard design shall be based on the existing conditions.
  - The proposed design shall be based on the actual values of the altered components.

§141.0(b) – Alterations

- **Exceptions to Alterations**
  - ❖ When HVAC systems are altered, the existing systems and equipment need not comply with the current requirements.
  - ❖ When existing systems or components are moved in a building, the existing systems or components need not comply with the current requirements.
  - ❖ There are exceptions allowing expansion of existing systems with electric heat when adding VAV boxes to the addition. See Exception 3 to Section 141.0(b).

§141.0(c) – Repairs

- **A repair is the reconstruction or renewal for the purpose of maintenance of any component, system, or equipment of an existing building.**
- **Replacement of any component, system, or equipment for which there are requirements in the Standards is considered an alteration and not a repair.**
- **Repairs do not have requirements under Part 6 except they shall not increase the preexisting energy consumption of the repaired component, system, or equipment.**

§141.0 – Additions, Alterations and Repairs

- Code Quiz:
  - Is economizer FDD per 120.2(i) required on an altered system?
    a) No
    b) Yes because it is a mandatory measure
    c) Only when an economizer is added or replaced.
    d) All of the above
  - An OCST is required for alterations to a duct system?
    a) True.
    b) False.

§141.0 – Additions, Alterations, and Repairs

- **Takeaways for Additions, Alterations, and Repairs**
  - All mandatory measures apply to new and altered components.
  - Existing systems and equipment are not required to meet current code.
  - Duct testing is required on existing ducts in some cases.
  - Altered systems other than ducts, require an OCST.
  - Always check the exceptions.

QUESTIONS…

About Additions, Alterations or Repairs?

Enforcement

Enforcement Process

Permit Application

- NRCC Forms and CXR Forms on/with plans and signed by the proper person.
- The OPR and BOD or verify NRCC-CXR-01-E indicates they were reviewed.
- Commissioning measures included with the construction documents.
- Commissioning Plan.

Plan Check

- Verify plans reflect the requirements of the energy compliance documents.

Construction Inspection

- Verify mechanical system and documentation for systems that cannot be verified at final.

Final Inspection

- Review NRCA/NRCV forms and compare to NRCC forms and installed equipment.
- Verifies System Manual and Commissioning Report are on site and complete.
- Verifies training plan and training attendance forms.

Enforcement Process

- **How do I know what mandatory and prescriptive measures are required?**

2016 ENERGY CODE

Ace Resources | Title 24, Part 6 Triggers

Nonresidential

New HVAC: Simple and Complex Systems

HVAC Simple Systems

	Mandatory Requirements								Prescriptive Requirements			
Space Conditioning Equipment [A]	Zone Thermostat[F] §120.2(a), (b) Setback Capable[G]	DCV[H] §120.1(c)	Heat Pump Controls[I] §120.2(d)	Shutoff and Reset[J] §120.2(e)	Ventilation Dampers §120.2(f) Automatic close upon fan shutdown[L]	Isolation Devices[N] §120.2(g)	Demand Shedding[O] §120.2(h)	Economizer FDD[P] §120.2(i)	Zone Control[Q] §140.4(d)	Supply Temperature Reset[R] §140.4(f)	Economizer[P, S] §140.4(e)1- 5	Variable Flow Control[T] §140.4(k)6 §140.4(m)
Package Terminal Air Conditioner [B,C]	YES[D]	YES	no	YES[K]	YES	no	YES	YES	YES	YES	no	YES[U]
Unitary Air Conditioners and Condensing Units [D]	YES	YES	no	YES[K]	YES	no	no	YES	no	no	YES	YES[U]
Unitary Heat Pumps [E]	YES	YES	YES	YES[K]	YES	no	no	YES	no	no	YES	YES[U]
Applied Heat Pumps[E]	YES	YES	YES	YES[K]	YES	YES	YES	YES	YES	no	YES	YES[U]
Forced Air Furnace	YES	YES	no	YES[K]	YES[M]	no	YES	no	no	no	no	no
Unit Heater	YES	no	no	YES[K]	no	no	no	no	no	no	no	no

Enforcement Process

- **How do I know what acceptance tests are required?**

Acceptance Tests: HVAC Simple Systems

The measures below trigger these acceptance tests	NRCA-MCH-02-A Outdoor Air	NRCA-MCH-03-A Constant Volume, Single-zone, Unitary A/C and HP	NRCA-MCH04-A Air Distribution Duct Leakage	NRCA-MCH-05-A Air Economizer Controls	NRCA-MCH-06-A Demand Control Ventilation	NRCA-MCH-07-A Supply Fan VFD	NRCA-MCH-08-A Valve Leakage	NRCA-MCH-11-A Automatic Demand Shed	NRCA-MCH-12-A Fault Detection and Diagnostic for DX Systems	NRCA-MCH-13-A Fault Detection and Diagnostic for AHUs	NRCA-MCH-16-A Supply Air Temp Reset	NRCA-MCH-18-A[A] Energy Management Control System
Zone T-Stats	no	YES	no	no	no	no	no	no	no	no	no	YES
DCV	YES	YES	no	YES	YES	YES	no	no	no	no	no	YES
Heat Pump Controls	no	YES	no	no	no	no	no	no	no	no	no	no
Shutoff and Reset	no	YES	no	no	no	no	no	YES	no	no	no	YES
Ventilation Dampers	YES	YES	YES	YES	no	YES	no	no	no	no	no	YES
Isolation Devices	no	YES	YES	no	no	no	YES	no	no	no	no	YES
Demand Shedding	no	no	no	no	no	no	no	YES	no	no	no	YES
Economizer and/or FDD	YES	YES	no	YES	no	YES	no	no	YES	YES	no	YES
Zone Control	no	YES	no	no	no	no	YES	YES	no	no	no	YES
Supply Temp. Reset	no	no	no	no	no	no	no	no	no	no	YES	YES
Variable Flow Control	no	no	no	no	no	YES	YES	no	no	no	no	YES
Duct Systems	YES	no	YES	no	no	no	no	no	no	no	no	no

Let's finish with some Resources

Online Resource Center (ORC)

Online Resource Center

The Online Resource Center is provided to assist the building community and enforcement agencies with Building Energy Efficiency Standards (Energy Standards) compliance. Energy Standards apply to newly constructed buildings, as well as additions and alterations for existing buildings. Presently, the Energy Standards are updated every three years.

To assist in the compliance process, we provide compliance documents and free Public Domain Compliance Software programs for commercial and residential buildings. Training and links to the Energy Standards and compliance software are available on the Energy Commission website and at utility training centers throughout the state. To help direct you to an appropriate resource, Energy Commission and external resource information are provided on this page.

Building Energy Efficiency Standards

2016 Energy Standards

2013 Energy Standards

Past Energy Standards

Energy Standards Information and Training Materials

Overview

Commissioning

Covered Processes

Follow

Energy Standards Questions?

- Energy Standards Hotline

Energy Standards Booth Handouts

- Handouts - 02212017 (zip file, 507 mb)
- Help with the zip file

Forms

- 2016 Residential Compliance Forms
- 2016 Nonresidential Compliance Forms

Trainings & Events

- Energy Standards Outreach & Education Schedule
- Utility Sponsored Training Schedules

Subscribe

Building Standards List Serve

Automated Email Notifications

First name:

Last name:

Email address:

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

2016 Approved HERS Providers

- **Nonresidential HVAC duct leakage testing**
  - CalCERTS
  - CHEERS

More information at:
http://www.energy.ca.gov/HERS/providers.html

Approved ATTCPs

- **Mechanical ATTCPs**
  - National Energy Management Institute Committee (NEMIC) (replaced Testing, Adjusting, and Balancing Bureau (TABB))
  - National Environmental Balancing Bureau (NEBB)
  - The California State Pipe Trades Council (CSPTC)

More information at:

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

Blueprint

- Email Newsletter
- Published quarterly
- Clarifications on frequently asked questions

Issue 113 | March – April 2016

BLUEPRINT

California Energy Commission
Efficiency Division

In This Issue

- New Mechanical Acceptance Test Technician Certification Provider
- Small Duct High Velocity Space Conditioning Systems
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- Residential Water Heating Options
- EnergyPro Version 7.0
- Alternative Path for Complying with Lighting Alteration Requirements
- Lighting Standards to Save Californians More Than $4 Billion in Electricity Costs
- Q&A
  - Illuminated Areas
  - Track Lighting Alterations
  - Compliance Documents
  - Townhouses and Duplexes
  - Commissioning
- Energy Code Ace Training Schedule

New Mechanical Acceptance Test Technician Certification Provider

On January 13, 2016, the California Energy Commission (Energy Commission) approved the National Environmental Balancing Bureau (NEBB), as a mechanical Acceptance Test Technician Certification Provider (ATTCP).

This gives NEBB the authority to train, certify, and oversee acceptance test technicians (ATTs) and their employers. NEBB will train and certify ATTs to perform all 17 mechanical acceptance tests required in the *2013 Building Energy Efficiency Standards* (Energy Standards).

The Conditions of Approval are available for review in the **Executive Director's recommendation**.

For more information, please visit: **http://energy.ca.gov/title24/attcp/**.

Small Duct High Velocity Space Conditioning Systems

Small duct high velocity (SDHV) systems may be used to comply with the Energy Standards. The following is a list of requirements with direction on how SDHV systems can comply with the low-rise residential requirements of the Energy Standards.

Mandatory Requirements

United States Department of Energy Standards:

SDHV systems manufactured on or after January 23, 2006, and before January 1, 2015, must have a minimum Seasonal Energy Efficiency Ratio (SEER) of 11, and a minimum Heating Seasonal Performance Factor (HSPF) of 6.8.

SDHV systems manufactured on or after January 1, 2015, must have a minimum SEER of 12, and a minimum HSPF of 7.2.

Energy Standards:

Section 150.0(m)13B - Single zone systems that use forced air ducts to supply cooled air to an occupiable space must either meet minimum airflow and fan efficacy requirements, or meet the return duct and grille sizing requirements of **TABLES 150.0-C or 150.0-D**.

NOTE: The return duct and grille sizing alternative will likely be the method chosen for compliance when installing a SDHV system.

Section 150.0(m)15 - Specific to systems with multiple thermostatically controlled zones, this section requires the same mandatory airflow and fan efficacy requirements as **Section 150.0(m)13B**. However, it does not have the same duct and grille sizing alternative. If such systems cannot satisfy the airflow and fan efficacy requirements of this section, compliance must be demonstrated via the performance approach.

The duct leakage and insulation requirements apply as with any other system.

Prescriptive Requirements

The refrigerant charge and duct insulation requirements apply as with any other system.

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www.energy.ca.gov/efficiency/blueprint/

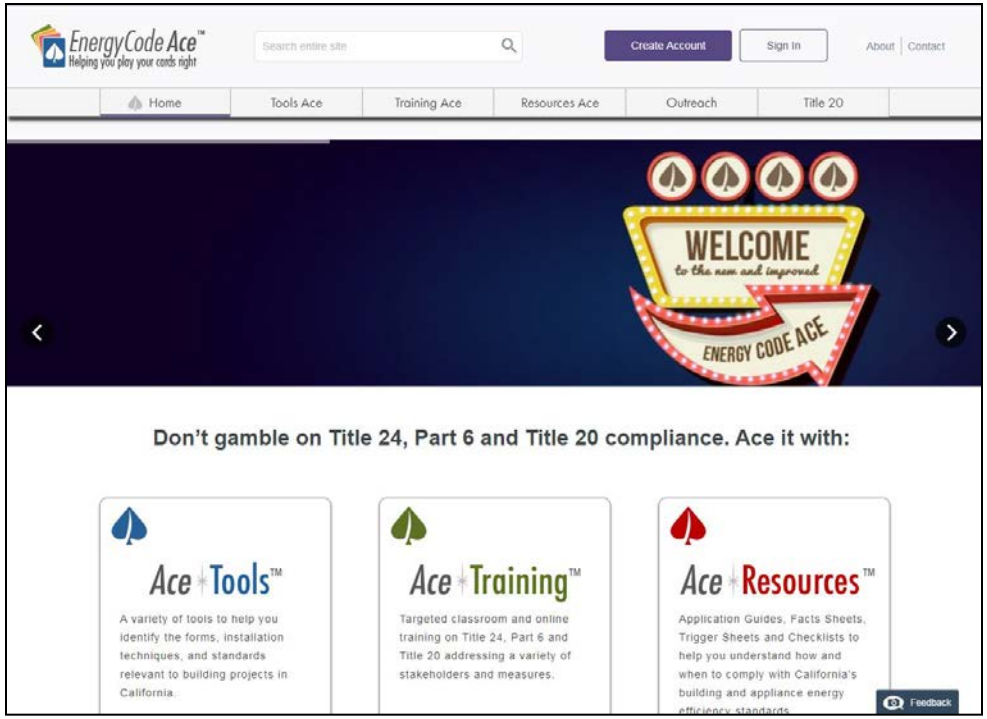
Email Lists

- Receive updates on the Energy Standards
- Sign up
  - www.energy.ca.gov/listservers/
- Subscribe to the following Efficiency Lists
  - Building Standards
  - Blueprint
- Respond to confirmation email within 24 hours

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)
- Or, email at: Title24@energy.ca.gov

Energy Code Ace



- Forms & Resource tools
- Free training in person and online
- Checklists, Trigger Sheets for building departments

www.energycodeace.com

QUESTIONS…

About Resources?

The End

THANK YOU VERY MUCH!!!