2016 Title 24 Part 6 Essentials
Nonresidential Standards

Mechanical Requirements

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Selby Energy, Inc.
Course Goal & Objectives

Help you apply the 2016 Title 24 Building Energy Efficiency Standards

- Identify major differences between the 2013 and 2016 California Nonresidential Building Energy Efficiency Standards mechanical requirements
- Determine mechanical requirements for nonresidential new construction, additions, and alterations
- Identify the primary mechanical compliance forms and related documents
Course Focus

- What do you want to get out of today’s session?
- What are your “top two” topics you want to be sure we cover?

Your ideas
Your goals
Your experience
Your questions
Your chance to share with peers
Your chance to practice new skills

2016 Nonresidential Standards Essentials for Energy Consultants
What’s New

- Welcome
- What’s New
  - Mechanical Controls
  - Dynamic Prescriptive Forms
- Energy Standards Key Concepts
  - Overview of Occupancy Groups
  - Mandatory, Prescriptive, Performance: Defining the Difference
  - Nonresidential Compliance Forms: Overview
  - When Standards are Triggered
  - Additions and Alterations: Defining the Difference
- Nonresidential Mechanical Requirements
  - Nonresidential Mechanical Overview
  - Types of Systems
  - Mandatory Requirements
  - Prescriptive Approach
- Course Conclusion
Course Conventions

Mandatory

$120.1(a)
- All enclosed spaces are normally used are normally ventilated in accordance with the ventilation requirements of the CBC (California Building Code).

$120.1(b)
- Every space in a building designed to have an exit by either:
  - Natural ventilation
  - Mechanical ventilation

Prescriptive

Prescriptive Fenestration Requirements
- Based on window type
- No longer climate zone criteria

Performance

Performance Approach
- Approved Performance software for 2016 Standards:
  - CBC
  - IES Virtual Environment Title-24 Feature Pack
  - EnergyPro
  - Simergy T24 Module
- Proposed building complies if TDV energy use of Proposed Design is less than the Standard Design
- Performance approach allows a custom description of building features for many tradeoff opportunities
  - Different compliance software may limit the definition of certain features, such as overhang shading or other compliance credits

*NOTE: The list of approved software changes over time. Please check the CEC site for the latest information:
http://www.energy.ca.gov/title24/2016standards/2016_computer_prog_list.html
Structure/Organization of the Standards

- **Subchapters 1 – 2**: All Occupancies
- **Subchapters 3 – 6**: Nonres, High-Rise Res, & Hotel/Motel Occupancies
- **Subchapters 7 – 9**: Low-Rise Residential
- **Appendix 1-A**: Standards & Documents Referenced in the Standards

2016 Nonresidential Standards Essentials for Energy Consultants
A new website developed by the Statewide Codes & Standards Program to help you meet the requirements of Title 24, Part 6

We offer **FREE**

**Ace Tools™**
A variety of tools to help you identify the forms, installation techniques, and building energy standards relevant to building projects in California

**Ace Training™**
Classroom and online trainings on Title 24, Part 6.

**Ace Resources™**
Fact Sheets, Trigger Sheets, Checklists, and FAQs to help you understand when Title 24, Part 6 is “triggered” and how to correctly comply when it is

Coming soon: Learning Portal customized to your individual needs

visit us at
www.EnergyCodeAce.com

2016 Nonresidential Standards Essentials for Energy Consultants
Fast & Easy Access to the Standards

Navigate the Standards with ease

- Key word and full-phrase search capabilities
- Hyperlinked tables
- Links to related Sections and to Compliance Manuals
- Glossary function

SEE IT IN ACTION

2016 Nonresidential Standards Essentials for Energy Consultants
List Servers (Automated E-mail Groups) Hosted by the California Energy Commission

In general, exposure to lists is governed by the California Energy Commission’s Privacy Policy. These lists are not to be used for bulk mailings. Please direct your contact requests to the appropriate individual.

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unsubscribe listname

Other Useful Links

Download the Blueprint Newsletter:
www.energy.ca.gov/energy/bpr

Download CEC Factsheets:
www.energy.ca.gov/energy/factsheets

Approved ATTCPs:
www.energy.ca.gov/title24/attcp

Approved HERS Providers:
www.energy.ca.gov/HERS/providers.html

Approved Compliance Software:
www.energy.ca.gov/title24/2016standards/2016_compliance.htm

List Server & Newsletter

Main conduit for stakeholder communication: www.energy.ca.gov/listservers/
(Subscribe to Building Standards & Blueprint Newsletter)

CEC Hotline

Monday–Friday, 8 a.m. to noon, 1 p.m. to 4:30 p.m.
1-800-772-3300 (CA), (916) 654-5106 (Outside CA)
Email: Title24@energy.ca.gov

Other Useful Links

Download CEC Factsheets:
www.energy.ca.gov/energy/factsheets

Approved ATTCPs:
www.energy.ca.gov/title24/attcp

Approved HERS Providers:
www.energy.ca.gov/HERS/providers.html

Approved Compliance Software:
www.energy.ca.gov/title24/2016standards/2016_compliance.htm

2016 Nonresidential Standards Essentials for Energy Consultants
What’s New

- Welcome

What’s New

- Mechanical Controls
- Dynamic Prescriptive Forms

- Energy Standards Key Concepts
- Nonresidential Mechanical, Covered Processes, and Electrical Standards
- Course Conclusion
Mandatory Direct Digital Controls (DDC) 120.2(j)

- Refer to Table 120.2-A for application

Mandatory Optimum Start/Stop Controls 120.2(k)

- The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint, the outdoor air temperature, and the amount of time prior to scheduled occupancy.

Prescriptive HVAC Shut-off Sensors for Windows and Doors 140.4(n)

- If windows or doors are left open for more than five minutes, sensors will adjust thermostats to disable the HVAC equipment.
What's New: Dynamic Forms

New dynamic PDF forms include:

- Text input fields
- Auto-calculating fields
- Ability to add rows to input tables

Download forms here:

2016 Nonresidential Standards Essentials for Energy Consultants
Energy Standards Key Concepts

- Welcome
- What’s New

**Energy Standards Key Concepts**

- Overview of Occupancy Groups
- Mandatory, Prescriptive, Performance: Defining the Difference
- Nonresidential Compliance Forms: Overview
- When Standards are Triggered
- Additions and Alterations: Defining the Difference

- Nonresidential Mechanical, Covered Processes, and Electrical Standards
- Course Conclusion
Nonresidential Standards cover all nonresidential occupancies, as well as high-rise residential and all hotel and motel occupancies.

<table>
<thead>
<tr>
<th>Occupancy Group</th>
<th>Example</th>
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<tbody>
<tr>
<td>A</td>
<td>Assembly</td>
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<td></td>
<td>Theaters, churches</td>
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<td>B</td>
<td>Businesses</td>
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<td></td>
<td>Office buildings</td>
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<tr>
<td>E</td>
<td>Educational facilities</td>
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<td></td>
<td>K-12 schools</td>
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<td>F</td>
<td>Factories, low &amp; moderate hazard</td>
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<tr>
<td>H</td>
<td>High hazard facilities</td>
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<td>M</td>
<td>Mercantile</td>
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<td></td>
<td>Grocery store, department store</td>
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<tr>
<td>R</td>
<td>Residential</td>
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<td></td>
<td>Apartment buildings with four or more habitable stories, hotels/motels,</td>
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<td></td>
<td>long-term care facilities</td>
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<tr>
<td>S</td>
<td>Storage, low &amp; moderate hazard</td>
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<tr>
<td>U</td>
<td>Utility</td>
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<tr>
<td></td>
<td>Garages, towers</td>
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Check Your Understanding

Which of these are covered by Nonresidential Standards?

<table>
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<tr>
<th>Building Type</th>
<th>Status</th>
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<tr>
<td>Residences in high-rise buildings</td>
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<tr>
<td>Hospitals</td>
<td>No</td>
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<tr>
<td>Long-term care facilities</td>
<td>Yes</td>
</tr>
<tr>
<td>Nursing homes</td>
<td>No *</td>
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<tr>
<td>Schools</td>
<td>Yes</td>
</tr>
<tr>
<td>Theaters</td>
<td>Yes</td>
</tr>
<tr>
<td>Medical office buildings</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Parts of a nursing home may need to comply with the Standards, while other parts of the building would be exempt because they are considered as Group I per the CBC.
Primary Areas of Standards Enforcement

Complying with key areas of the Standards drives impact

Envelopes (ENV)
- Insulation
- Fenestration
- Exterior Shading
- Cool Roof

Mechanical (MCH)
- HVAC Equipment
- Thermostats and Controls
- Ventilation
- Duct and Pipe Insulation
- Service Hot Water Equipment

Lighting (LTI, LTO, LTS)
- Indoor Lighting
- Outdoor Lighting
- Lighting Controls
- Sign Lighting

2016 Nonresidential Standards Essentials for Energy Consultants
Benefits of Increased Energy Efficiency

- Lower energy costs
- Reliable delivery
- Increased comfort
- Improved environment

What Good Does Title 24 Do?

2016 Building Energy Efficiency Code applies to any California building permit granted after January 1, 2017

Projected Savings from 2016 Standards

- Energy Savings (Nonres):
  - 31.2 Gigawatt-hours electricity annual savings
  - 1.55 Million Therms natural gas annual savings
- Emission Reduction (Nonres)
  - 13.7 thousand tons CO$_{2E}$
  - 20.6 tons NO$_x$
  - 0.68 tons SO$_x$
- Water Savings (Overall)
  - 330 Million gallons annual savings

Benefits of Increased Energy Efficiency

A Source: CEC Publication Number 400-2015-012 (February 2015)

2016 Nonresidential Standards Essentials for Energy Consultants
Mandatory Measures, Prescriptive Approach, Performance Approach: Defining the Difference
Two Ways to Comply with the Standards

Prescriptive Approach
- ENV: no tradeoffs
- MCH: no tradeoffs
- LTI: no tradeoffs
No tradeoffs between ENV, MCH, and LTI

Performance Approach
- Standard Design
- Proposed Design
  - Tradeoffs
    - ENV
    - MCH
    - LTI

Compliance Documentation

2016 Nonresidential Standards Essentials for Energy Consultants
Performance Approach

$\text{Approved Performance software for 2016 Standards:*}$

- CBECC-Com
- IES Virtual Environment Title-24 Feature Pack*
- EnergyPro
- Simergy T24 Module*

$\text{Proposed building complies if TDV energy use of Proposed Design \leq the Standard Design}$

$\text{Performance approach allows a custom description of building features for many tradeoff opportunities}$

- Different compliance software may limit the definition of certain features, such as overhang shading or other compliance credits

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http://www.energy.ca.gov/title24/2016standards/2016_computer_prog_list.html

2016 Nonresidential Standards Essentials for Energy Consultants
Check Your Understanding

1. Must Mandatory Measures **always** be met or exceeded?

   a. Yes

   b. No

   c. Depends on the Mandatory Measure

Mandatory Measures must be met or exceeded — always.
- Sometimes the Prescriptive Requirements call for measures that are more efficient than the minimum Mandatory levels.
Nonresidential Compliance Forms: Overview

- Compliance Forms and Worksheets
- Installation Certificates
- Certificates of Acceptance
- HERS Verification Certificate of Field Verification and Diagnostic Testing
A list of forms and descriptions is available in the Nonresidential Compliance Manual - Appendix A, or they can be downloaded here: http://www.energy.ca.gov/2015publications/CEC-400-2015-033/appendices/forms/NRCC/
Certificate of Compliance (NRCC)

Describes the proposed energy features necessary for compliance

- In other words an “I Promise to install these features”
- Must be submitted for plan check
- Applies to prescriptive and performance compliance approach
- Used from design phase until occupancy
- Field inspection checklists completed by building inspector
- Must be updated then submitted for approval to the building department if features change during construction

2016 Nonresidential Standards Essentials for Energy Consultants
Certificate of Installation (NRCI)

Describes the installed energy features necessary for compliance

- In other words an “I actually installed these features”
- Prepared and signed by one or more installing contractors; or by “chief person responsible for construction” – must be licensed individual
- Declares they have reviewed Certificate of Compliance, that applicable requirements have been met, and that copy will be posted for building department and must be transmitted to building owner
- Must include the date in which the enforcement agency issued the permit
- Must list relevant plans/specifications that encompass scope of responsibility for installation

Title 24 Part 6 Essentials — Nonresidential Standards for Plans Examiners and Building Inspectors
Verification that equipment is functioning properly
- Must be posted on site or given to Field Inspectors
- Prepared and signed by field technicians under the responsible charge of a licensed contractor or design professional
- May require a certified acceptance test technician (ATT) (i.e. lighting controls)
- Acceptance forms for lighting must be electronic (no hand filled out forms) and include the ATT Providers stamp

Certificate of Acceptance (NRCA)
Acceptance Test Technicians (ATT)

- ATT required by 2016 code
- ATT types:
  - Lighting Controls (Section 130.4)
  - Mechanical (Section 120.5)
- Trained professionals, building specialists
  - Certified by authorized Certification Providers
  - Perform nonresidential acceptance tests and complete all acceptance test documentation
Acceptance Test Employer and Provider

- Acceptance Test Employer
  - Lighting Controls or Mechanical
  - Employs ATTs

- Acceptance Test Technician Certification Provider (ATTCP)
  - Agency, organization, or entity approved by the Energy Commission to train and certify Acceptance Test Technicians and Employers
  - Provides QA, support for techs, education
  - Two types of Certification Providers: Lighting Controls and Mechanical Systems
Under Prescriptive Approach, certain conditions may trigger a HERS duct leakage test §140.4 (l).

Under Performance Approach, the duct leakage testing is optional — may be used for compliance credit.

Only the NRCV compliance forms associated with HERS measures require HERS registration number for final permit.

**HERS Duct Leakage Test**
- Must be verified by certified HERS Rater
- If test results show compliance, NRCC-MCH-04 is registered with HERS Provider
- Registered copy provided to Inspector

Title 24 Part 6 Essentials — Nonresidential Standards for Plans Examiners and Building Inspectors
Do all of the compliance forms (NRCC, NRCI, NRCA & NRCV) need to have a HERS registration number for final permit?

a. Yes, if there are any HERS measures associated with the project, all of the forms must be registered with a HERS provider

b. No, just the NRCV associated with the specific HERS measure
When Standards Are Triggered
Permits: Primary Driver for Codes

- A permit that involves a component covered by the Standards must show compliance during the permit process
  - Entire building permit
  - HVAC changeout permits
  - Process permits (e.g., commercial refrigeration, etc.)
  - Outdoor lighting systems permit
  - Signs permit
  - Tenant improvement permit
  - Permit to make “modernizations” or other alteration

- The Standards apply to buildings conditioned by mechanical heating and/or mechanical cooling, and also to lighting and skylights in unconditioned space
### Conditioned vs. Unconditioned Space

**Conditioned space**

Must meet Standards for all new construction and any area that is being altered:
- Indoor and outdoor lighting
- Envelope
- **Mechanical**
  - Plumbing
  - Covered process
  - Solar ready
  - Commissioning
  - Electrical

**Unconditioned space**

Must meet Standards for all new construction and any area that is being altered:
- Indoor and outdoor lighting
- Skylighting (sometimes)
- Covered process
- Solar ready
- Electrical

*2016 Nonresidential Standards Essentials for Energy Consultants*
Additions and Alterations: Defining the Difference
Any change to a building’s water heating system, space conditioning system, indoor lighting system, outdoor lighting system, sign lighting, or envelope that is not an addition.

For details: §141.0(b); Compliance Manual (1.7.13, pages 1-16 to 1-17)

Differences

Alterations

For details: §141.0(b); Compliance Manual

Additions

Reconstruction or renewal of any part of an existing building for the purpose of its maintenance

Repairs may not increase the preexisting energy consumption of the required component, system, or equipment

2016 Nonresidential Standards Essentials for Energy Consultants
Check Your Understanding

When does a change of occupancy require action under the Standards?

a. If the new occupancy requires alterations to the building’s envelope, mechanical, or lighting systems, or covered processes.

b. Anytime there is a new tenant in a nonresidential building
Nonresidential Standards cover all nonresidential occupancies, as well as high-rise residential and all hotel and motel occupancies.

Two ways to comply:
- Prescriptive Approach—Relatively simple but inflexible
- Performance Approach—Relatively complex but flexible (computer method)

Compliance forms and worksheets for Prescriptive and Performance Approaches

Addition—Any change to a building that increases both conditioned floor area and conditioned volume

Alteration—Any change to a building’s envelope, mechanical, or lighting systems that is not an addition
Nonresidential Mechanical, Covered Processes, & Electrical Standards

- Welcome
- What’s New
- Energy Standards Key Concepts

**Nonres Mechanical**
- Nonresidential Mechanical Overview
- Types of Systems
- Mandatory Requirements
- Prescriptive Approach

- Course Conclusion
Nonresidential Mechanical Overview

- Why Important
- Definitions
HVAC System Goals

- Work with a good envelope to provide thermal comfort
- Maintain good indoor air quality through adequate ventilation with filtration
- Save money!

Goal: Provide healthy and comfortable spaces delivered in an efficient and effective way

2016 Nonresidential Standards Essentials for Energy Consultants
Why Title 24 Part 6 is Important for Commercial HVAC Installations

Average small commercial building electricity usage in California

- Lighting, 30%
- HVAC, 28%
- Refrigeration, 18%
- Misc., 13%
- Computers, 5%
- Office equipment, 3%
- Water heating, 2%
- Cooking, 1%

2016 Nonresidential Standards Essentials for Energy Consultants
Building Mechanical components include:

- Heating and cooling systems (HVAC)
  - Equipment
  - Distribution systems
  - Controls

- Water heating systems
  - Equipment
  - Distribution systems
  - Controls

- Pool and spa equipment
  (not included in this course)

Note: Evaporative coolers, while a part of mechanical systems, do not meet the definition of “mechanical cooling” per the Standards

2016 Nonresidential Standards Essentials for Energy Consultants
Types of Systems

- Simple vs. Complex Systems
- Categories of Requirements
Simple vs. Complex HVAC Systems

**Simple Mechanical Systems**
- Common small commercial unitary or packaged systems serving a single zone
- Two-pipe, heating only systems serving one or more zones

**Complex Mechanical Systems**
- Built-up systems that include:
  - Air-cooled chillers
  - Water-cooled chillers
  - Boilers
- Packaged systems:
  - Serving multiple zones
  - With variable air volume
- Water source heat pumps

2016 Nonresidential Standards Essentials for Energy Consultants
NRCC-MCH-01-E: Mechanical Systems Certificate of Compliance

- If submitted, all pages of the form are required to appear on the plans
- Sections required for every job: Mechanical compliance declaration (A) and required acceptance tests MCH-02A to 11 A (B); other sections (C) required only where applicable or are optional

See the following pages in your workbook for a full-size version of this form

2016 Nonresidential Standards Essentials for Energy Consultants
### Certificate of Compliance:

#### Basic Information
- Project name
- Date prepared

#### Compliance Forms and Worksheets Checklist
- Certificates of Compliance checkboxes
- Equipment Summaries

#### Mechanical Acceptance Forms
- Checkboxes to indicate which forms apply

---

**1. Basic Information**

- **Project name**
- **Date prepared**

**2. Compliance Forms and Worksheets Checklist**

- Certificates of Compliance checkboxes
- Equipment Summaries

**3. Mechanical Acceptance Forms**

- Checkboxes to indicate which forms apply

---

**2016 Nonresidential Standards Essentials for Energy Consultants**

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### NRCC-MCH-01-E MCH-01-E (pg. 1 of 3)

#### Certificate of Compliance:

---

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<th>Equipment Requiring Testing or Verification</th>
<th>MCH-02-A</th>
<th>MCH-03-A</th>
<th>MCH-04-A</th>
<th>MCH-05-A</th>
<th>MCH-06-A</th>
<th>MCH-07-A</th>
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</tbody>
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Add row | Remove Last
# Certificate of Compliance

## Basic Information
- Project name
- Date prepared

## Mechanical HVAC Acceptance Forms
- Checkboxes to indicate which apply and are attached

### Basic Information

<table>
<thead>
<tr>
<th>Project name</th>
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<td>NRCC-MCH-01-E</td>
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### Mechanical HVAC Acceptance Forms

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<td>Storage DXAC</td>
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<tr>
<td>Systems</td>
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<tr>
<td>Thermal Energy Storage</td>
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<td>(TES) Systems</td>
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<tr>
<td>Supply Air Temperature</td>
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<tr>
<td>Reset Controls</td>
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<tr>
<td>Condenser Water</td>
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<td>Reset Controls</td>
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<tr>
<td>EOMS</td>
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</tr>
</tbody>
</table>
Certificate of Compliance

Basic Information
- Project name
- Date prepared

Declaration Statements
- Documentation Author’s information and signature

2016 Nonresidential Standards Essentials for Energy Consultants
Mandatory Requirements
Standards §110.2(a) outlines efficiency requirements.

Tables 110.2-A through 110.2-K list efficiency requirements for various equipment types.

Tables 110.2-A and 110.2-B have most common equipment.

See following pages for full-size version of these tables.

§110.2(a), Excerpts from Appliance code and T24 Standards Tables 110.2-A & 110.2-B

Air Conditioners (Packaged Units and Split systems)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Size Category</th>
<th>Min. Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Conditioners, air-cooled, both split system and single package</td>
<td>Single Phase</td>
<td>&lt; 45 kBtu/hr</td>
</tr>
<tr>
<td></td>
<td>&gt; 45 kBtu/hr</td>
<td>11.7 EER 14.0 SEER</td>
</tr>
<tr>
<td></td>
<td>Three Phase</td>
<td>&lt; 65 kBtu/hr</td>
</tr>
<tr>
<td></td>
<td>≥ 65 kBtu/hr to &lt; 135 kBtu/hr</td>
<td>11.2 EER 12.9 IEER</td>
</tr>
<tr>
<td></td>
<td>≥ 135 kBtu/hr to &lt; 240 kBtu/hr</td>
<td>11.0 EER 12.4 IEER</td>
</tr>
</tbody>
</table>

Gas-Fired Central Furnaces

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Size Category</th>
<th>Min. Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas-Fired Furnaces</td>
<td>&lt; 225,000 Btu/h</td>
<td>Weatherized 81 AFUE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Weatherized 80 AFUE</td>
</tr>
<tr>
<td></td>
<td>≥ 225,000 Btu/h</td>
<td>80 Thermal Efficiency</td>
</tr>
</tbody>
</table>

2016 Nonresidential Standards Essentials for Energy Consultants
Air Cooled Unitary and Applied Heat Pumps

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Size Category</th>
<th>Min. Cooling Efficiency</th>
<th>Min. Heating Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split system and single package</td>
<td>Single Phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 65 kBtu/hr</td>
<td>14.0 SEER</td>
<td>Split system: 8.2 HSPF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Packaged: 8.0 HSPF</td>
</tr>
<tr>
<td></td>
<td>Three Phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 65 kBtu/hr</td>
<td>13.0 SEER</td>
<td>7.7 HSPF</td>
</tr>
<tr>
<td></td>
<td>≥ 65 kBtu/hr to &lt;135 kBtu/hr</td>
<td>11.0 EER(^1)</td>
<td>3.3 COP</td>
</tr>
<tr>
<td></td>
<td>≥ 135 kBtu/hr to &lt;240 kBtu/hr</td>
<td>10.6 EER(^1)</td>
<td>3.2 COP</td>
</tr>
</tbody>
</table>

\(^1\) Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.
§120.1(a)

- All enclosed spaces in a building that are normally used by humans shall be ventilated in accordance with the requirements of this section and the CBC (California Building Code)

§120.1(b)

- Every space in a building shall be designed to have outdoor air ventilation by either:
  - Natural ventilation
  - Mechanical ventilation
Mandatory Measures: Ventilation (cont.)

Expected Number of Occupants
- No fixed seating — the greater of:
  - Number specified by designer
  - 50% of max. occupants per CBC
- With fixed seating — per CBC

Standards § 120.1 (b) 2
Mechanical Ventilation system must be capable of providing during hours of occupancy outdoor air rate no less than the larger of:
- Minimum ventilation rates for occupancy types
- 15 cfm per person times the expected number of occupants

### Compliance Manual Table 4-14 – Required Minimum Ventilation Rate per Occupancy

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Use</th>
<th>CBC Occupancy Load (ft³/occ)</th>
<th>CBC Occupancy Load (occ/1000 ft²)</th>
<th>CBC Based Ventilation (cfm/ft²)</th>
<th>Ventilation from Table 121-A (cfm/ft²)</th>
<th>Required Ventilation (larger of CBC or Table 121-A) (cfm/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Assembly Areas (Concentrated Use)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Assembly Areas (Concentrated Use)</td>
<td>Churches &amp; Chapels (Religious Worship)</td>
<td>7</td>
<td>143</td>
<td>1.07</td>
<td>0.15</td>
<td>1.07</td>
</tr>
<tr>
<td>17) Library: Reading Rooms</td>
<td></td>
<td>50</td>
<td>20</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>22) Offices: Office</td>
<td></td>
<td>100</td>
<td>10</td>
<td>0.08</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

*This table reference in the Nonresidential compliance manual refers to an older table number. The current number for this table, as it appears in the Standards, is 120.1-A.

2016 Nonresidential Standards Essentials for Energy Consultants
Demand Control Ventilation (DCV)

- Required for systems that:
  - Have airside economizer
  - Serve a high density space
    \( \geq 25 \) people per 1,000 ft\(^2\)
  - Zoning...
    - Is single zone with any controls
    - Is multiple zone with DDC (direct digital controls) to the zone level
- Requires sensor in each high density space

**Exception 3 to Section 120.1(c)3:**

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

“High density space” is defined by CBC, not anticipated occupancy

Mandatory Measure: Controls

2016 Nonresidential Standards Essentials for Energy Consultants
In the following spaces NOT controlled by DCV, occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present:

- Multipurpose room <1000 ft²
- Classrooms >750 ft²
- Conference, convention, auditorium and meeting center rooms >750 ft²

This scenario requires an additional control sequence for built-up VAV systems or a thermostat that can accept an occupancy sensor input and has three scheduling modes (occupied, standby, and unoccupied) for packaged equipment.
When a commercial AC unit is replaced, (or in certain cases altered), it is required that all thermostats must have the capability to respond to DR signals from utility companies over the Internet.

- Single zone air conditioners and heat pumps – Appendix JA5, Occupant Controlled Smart Thermostat (OCST)
- If equipped with DDC to the Zone level - Automatic Demand Shed Controls §120.2(h)

They must have either built-in communications or modules allowing them to plug into the facility's internal network.

- §120.2(a) requires a setback thermostat for any new zones in additions or new zones created in an alteration
- §120.2(b) requires that new thermostats required by §120.2(a) meet the minimum requirements
Applies to all space conditioning systems

Requires that new systems in alterations and additions have scheduling and setback controls

Must be capable of:

- Automatic “shut off” during periods of non-use
- Automatic restart and temporary operation as required to maintain specified heating and cooling set points
Outdoor air supply and exhaust equipment must incorporate dampers that automatically close when fans shut down.

Dampers may either be motorized or gravity type.

Outside air dampers must automatically close when the fan is not operating (applies when a new system or air handling unit is replaced in conjunction with an addition or alteration).

**Exceptions to §120.2(f):**

Auto closing dampers aren’t required if:

- It can be proven that the area served requires continuous HVAC operation
- Located at combustion air intakes and shaft vents
- Prohibited by other provisions of law

“Zone Damper” by Atlant is licensed under CC BY 2.0
http://en.wikipedia.org/wiki/File:Zone_Damper_1.jpg
Applies to:
- HVAC Systems with zone level direct digital control (DDC)
- Non-critical zones

Must:
- Have the capability to remotely set down the operating heating and cooling temperature set points by 4º or more
- Reset temperatures back to original set point
- Have disabled, manual control and auto-control options

Direct digital controls (DDC) that operate at the zone level must be programmed to enable non-critical loads to be shed during electricity emergencies

Applies to additions and alterations anytime DDC are installed that operate at the zone level

Critical Zone
A zone serving a process where zone temperature set point reset during a demand shed event might disrupt the process

Examples include:
- Data centers
- Telecom/PBX rooms
- Laboratories

2016 Nonresidential Standards Essentials for Energy Consultants
For all newly installed air-cooled unitary direct-expansion units, equipped with an economizer and with mechanical cooling capacity at AHRI conditions of greater than or equal to 54,000 Btu/hr

- Includes packaged, split systems, heat pumps, and variable refrigerant flow (VRF), where the VRF capacity is defined by that of the condensing unit
DDC being capable of the following, in addition to meeting the control logic of ventilation control (120.1(c)) and automatic demand shed control (120.2(h))

- Monitoring demand for fan/pump pressure, heating & cooling and then transferring that information to system controllers
- Detecting systems excessively driving the reset logic and generate alarms
- Providing trending and input/output point graphic displays (new building only)
- Resetting setpoint after a demand shed event (120.2(h))
## Table 120.2-A: When DDC To Be Provided

<table>
<thead>
<tr>
<th>New Applications</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air handling system and all zones served by the system</td>
<td>Individual systems supplying more than three zones and with design heating or cooling capacity of 300 kBtu/h and larger</td>
</tr>
<tr>
<td>Chilled water plant and all coils and terminal units served by the system</td>
<td>Individual plants supplying more than three zones and with design cooling capacity of 300 kBtu/h (87.9 kW) and larger</td>
</tr>
<tr>
<td>Hot water plant and all coils and terminal units served by the system</td>
<td>Individual plants supplying more than three zones and with design heating capacity of 300 kBtu/h (87.9 kW) and larger</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alterations/Additions Applications</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAV boxes or other zone terminal units</td>
<td>Where existing zones served by the SAME air handling, chilled water, or hot water systems that have DDC</td>
</tr>
<tr>
<td>AH system or fan coil</td>
<td>Where existing AH or fan coil(s) served by the SAME chilled water, or hot water systems have DDC</td>
</tr>
<tr>
<td>New AH unit and ALL new zones served by unit</td>
<td>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</td>
</tr>
<tr>
<td>New or upgraded chilled water plant and/or hot water plant</td>
<td>Where all chillers and/or boilers are new and plant design cooling and/or heating capacity is 300 kBtu (87.9 kW) and larger</td>
</tr>
</tbody>
</table>
A building experiences delays in dropping down its temperature at the beginning of the setback period, and increasing its temperature at the end of the setback period.

This function learns the response of the system in order to calculate a start and stop time for the system so that the building is comfortable when the occupied period begins.

Space conditioning systems with DDC to the zone level shall have optimum start/stop controls.
### Mandatory measures: Duct Insulation

<table>
<thead>
<tr>
<th>Type of Duct Project</th>
<th>Mandatory Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>New or replacement</td>
<td>• Installed and sealed per §120.4(a)</td>
</tr>
<tr>
<td>All new ducts</td>
<td>• R-8 in unconditioned space [§120.4(a)]</td>
</tr>
<tr>
<td></td>
<td>• R-4.2 in indirectly conditioned space or buried in concrete slab [§120.4(a)]</td>
</tr>
<tr>
<td></td>
<td>• No insulation requirements for ducts in conditioned space [§120.4(a)]</td>
</tr>
<tr>
<td>Altered</td>
<td>• For all new sections — same as for “all new ducts” above</td>
</tr>
</tbody>
</table>
### Mandatory Measures: Acceptance Testing

§120.5 Before an occupancy permit is granted, equipment and systems must be certified (Acceptance Tests)

<table>
<thead>
<tr>
<th>Form Name</th>
<th>Test Focus</th>
<th>Application</th>
<th>Ref Append</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRCA-MCH-02-A: Outdoor Air</td>
<td>Adequate OSA</td>
<td>New units</td>
<td>NA 7.5.1.2</td>
</tr>
<tr>
<td>NRCA-MCH-03-A: Constant-volume, Single-zone Unitary A/C and Heat Pumps</td>
<td>Proper system temperature scheduling and controls for DX units</td>
<td>New units (packaged, split, and heat pump)</td>
<td>NA 7.5.2</td>
</tr>
<tr>
<td>NRCA-MCH-04-H: Duct Leakage</td>
<td>Duct leakage rate</td>
<td>New, added or replaced ducts on single-zone unit serving ≤ 5,000 ft², if ≥ 25% duct surface area in unconditioned space</td>
<td>NA 7.5.3.1 (inspection) NA 2.1.4 (duct leakage testing)</td>
</tr>
<tr>
<td>NRCA-MCH-05-A: Air Economizer Controls</td>
<td>Proper operation of economizer controls</td>
<td>New equipment with air economizer; Does not apply to factory installed &amp; certified economizers</td>
<td>NA 7.5.4</td>
</tr>
<tr>
<td>NRCA-MCH-06-A: Demand Control Ventilation Systems</td>
<td>Proper operation of DCV controls</td>
<td>New units</td>
<td>NA 7.5.5</td>
</tr>
<tr>
<td>NRCA-MCH-11-A: Demand Shed Controls</td>
<td>Demand response (Automatic Demand Shed Control)</td>
<td>New units (packaged, split, and heat pump) — only if system includes DDC</td>
<td>NA 7.5.10.1</td>
</tr>
<tr>
<td>NRCA-MCH-12-F</td>
<td>FDD (Fault detection and diagnostics)</td>
<td>New packaged direct expansion</td>
<td>NA 7.5.5</td>
</tr>
</tbody>
</table>
You are putting in a new packaged unit serving a single zone system serving a church. The unit has an airside economizer.

Is demand control ventilation (DCV) required?

a. Yes
b. No
c. Not enough information

DCV is required for systems that have an airside economizer and serve a single zone that is considered a “high density space” (≥25 people per 1,000 ft²) by the California Building Code (CBC).

Referring to the occupancy/ventilation to chart presented earlier (under “Ventilation”), we see that a church has a maximum occupancy of 143 people per 1,000 ft² — definitely a “high density space.”
Prescriptive Approach
§140.4(a) Sizing and Equipment Selection

Equipment must be the smallest size that:

- Is available in the desired equipment line
- Meets the design heating and cooling loads calculated in accordance with ASHRAE standards

Example:

- **ACCA Manual N:** Commercial Load Calculation
- **ACCA Manual CS:** Commercial Applications, Systems & Equipment Selection
Heating and cooling equipment operate most efficiently when properly sized.

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.

Can oversize by:
- 43% heating (1.10 safety x 1.30 other loads)
- 21% cooling (1.10 safety x 1.10 other loads)

Equipment sizing calculations must be made using CEC-approved methodologies, inputs, and assumptions.

Refer to §140.4(b) for the list of rules.
Total fan power index

- Regulated when total fan system horsepower demand exceeds 25 hp at design conditions

**Constant Air Volume (CAV) systems**

- Maximum 0.8 watts per cfm of supply air

**Variable Air Volume (VAV) systems**

- Maximum 1.25 watts per cfm supply air

---

**Total fan system power** equals the sum of the power of all fans in the system that are required to operate at design conditions with the exception of fan power solely from air treatment and filtration

---

2016 Nonresidential Standards Essentials for Energy Consultants
Space Conditioning Zone Controls

Goal:
Minimize reheating, recooling, or simultaneous cooling and heating

Space Conditioning Controls

- The following minimums must be met before reheat and recooling
  - **Minimum VAV Flow = 20%**
    if zone has direct digital controls (DDCs)
  - **Minimum VAV Flow = 30%**
    if zone has no DDC
- Cannot go below the minimum ventilation rate
- Can modulate flow back up to 50% in heating mode, i.e. dual maximum control
Economizers

- Required for systems with > 54 kBtu/h cooling cap:
  - Air economizer capable of modulating outside-air and return-air dampers to supply 100% of the design supply air quantity as outside-air
  - Or
  - A water economizer capable of providing 100 percent of the expected system cooling load

- Exceptions apply

Economizer trade-off for increased cooling system efficiency according to Table 140.4-A
Space-conditioning systems supplying heated or cooled air to multiple zones shall include controls that automatically reset supply-air temperatures:

1. In response to representative building loads or to outdoor air temperature; and
2. At least 25% of the difference between the design supply-air temperature and the design room air temperature.

Air distribution systems serving zones that are likely to have constant loads, such as interior zones, shall be designed for the air flows resulting from the fully reset supply air temperature.

Figure 4-19 – Energy Efficient Supply Air Temperature Reset Control for VAV Systems

Supply air reset is required for VAV reheat systems even if they have VSD fan controls.
Electric resistance heating systems shall not be used for space heating.

- Does not apply to heat pumps.
- Exceptions apply.
Heat Rejection Systems

- Applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers
  - Fan Speed Control
  - Tower Flow Turndown
  - Limitation on Centrifugal Fan Cooling Towers
  - Multiple cell heat rejection equipment
- Exceptions apply
- Water consumption requirements may apply

2016 Nonresidential Standards Essentials for Energy Consultants
Chilled water plants shall not have more than 300 tons provided by air-cooled chillers.

Exceptions apply (see Table 110.2-D).
Hydronic System Measures

- Hydronic Variable Flow Systems
- Chiller Isolation
- Boiler Isolation
- Chilled and Hot Water Temperature Reset Controls
- Water-Cooled Air Conditioner and Hydronic Heat Pump Systems
- Variable Flow Controls
- Hydronic Heat Pump (WLHP) Controls

§140.4(k) 2016 Nonresidential Standards Essentials for Energy Consultants
Prescriptive duct sealing and testing, applies to duct systems:

- Connected to CV, single zone, space conditioning system; 

  and 

- Serves <5000 ft² floor area;

  and 

- Has >25% of the ducts located outside the conditioned space

Duct leakage verified by a HERS rater

Duct leakage testing applies to altered duct systems as well as new duct systems
§140.4(m): Indoor Fan Air Control

- For DX and chilled water systems, the supply fan:
  - Must have at least two stages or
  - Variable speed drives
  - Controls must modulate down to a minimum of 2/3 of the full fan speed or lower at low cooling demand, and draw ≤40% fan power at full speed

- All other systems
  - Limit the fan motor demand to no more than 30% of design wattage at 50% design air volume

**Indoor Fan Airflow Control**

<table>
<thead>
<tr>
<th>System Type</th>
<th>Minimum Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX Cooling (any fan size)</td>
<td>≥65,000 BTUH</td>
</tr>
<tr>
<td>Chilled Water/Evaporative</td>
<td>≥1/4 HP</td>
</tr>
</tbody>
</table>

2016 Nonresidential Standards Essentials for Energy Consultants
New in 2016: Prescriptive HVAC Shut-off Sensors for Windows and Doors

- Automatically adjusts the thermostat to disable HVAC equipment when windows and doors are left open for more than 5 min.
- Must disable or reset the temperature setpoint to 55 degrees for heating and 90 degrees for cooling.
Check Your Understanding

1. Cooling equipment can be “oversized” by how much?

   a. 43%
   b. 21%
   c. 10%
   d. Cannot be oversized

Note that 43% is the HEATING value (1.3 x 1.1)

21% cooling — OR smallest available in product line (1.10 safety x 1.10 other loads)
2. An individual packaged unit has over 54,000 Btu/hr cooling capacity.

Is an economizer required when using the prescriptive approach?

a. No

b. Yes

Exceptions do apply per §140.4(e)
Wrap Up

- **You can make a difference:**
  - Lower commercial energy costs and help ensure reliable energy supply

- What you learned today will help you:
  - Help ensure compliance with the 2016 Standards
  - Focus your efforts on “high value” issues
  - Use the available documentation and tools effectively

2016 Nonresidential Standards Essentials for Energy Consultants
Thank you for participating today

Please remember to complete the Course Evaluation form

We welcome your opinions about what you liked about this class and your suggestions for improving it

<table>
<thead>
<tr>
<th>Contact</th>
<th>Role</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brian Selby</td>
<td>Instructor</td>
<td><a href="mailto:brian@selbyenergyinc.com">brian@selbyenergyinc.com</a></td>
<td>209-352-2281</td>
</tr>
<tr>
<td>Jill Marver</td>
<td>Statewide Lead</td>
<td><a href="mailto:jkz1@pge.com">jkz1@pge.com</a></td>
<td>925-415-6844</td>
</tr>
<tr>
<td>Energy Code Ace</td>
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<td></td>
</tr>
</tbody>
</table>