BUILDING HVAC (1) REQUIREMENTS

MANDATORY REQUIREMENTS AND SIMPLE HVAC SYSTEMS

CHAPTER 5

COMMERCIAL ENERGY EFFICIENCY

2011 New York City Energy Conservation Code

Effective December 28, 2010

Acknowledgements

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This training module was developed by:

Viridian | Energy & Environmental, LLC

Introduction

Welcome to the New York City Department of Buildings Energy Code Training Modules!

This **HVAC-1: Mandatory Requirements and Simple HVAC Systems** Module addresses:

- Technical issues and strategies related to the 2011 NYCECC
- Applicability of the 2011 NYCECC
- NYC DOB Energy Code submission requirements
- NYC DOB Progress Inspection requirements

This module addresses HVAC criteria related to all commercial building types, including Group R buildings: R-1 uses (any height); R-2 and R-3, when over 3 stories.

HVAC criteria related to low-rise residential buildings are covered under the NYC DOB Residential Training Module.

Training Module Organization

- The HVAC-1: Mandatory Requirements and Simple HVAC Systems Module has been divided into a number of smaller sub-topics. These can be accessed either in-sequence or out-of-sequence through links in the main "Menu" slide.
- Each sub-topic begins with a brief overview of the issues to be reviewed, and many end with a set of summary questions or exercises.
- Many of the sub-topics are organized in a Q & A format. Code-related questions are posed at the top of a slide, with answers provided below, or in the following sequence of slides.

Slide Navigation Guide

Look for the following icons:

The **NYC Buildings** logo takes you to the NYCECC 2011 Training Modules home page.

The **Menu** icon takes you to the main menu page within each module.

The **Attention** icon brings up Callouts with key points and additional information.

The **Links** icon takes you to related DOB web pages or other resources.

The **Documentation** icon addresses DOB documentation issues and requirements.

The **Inspection** icon addresses DOB Progress Inspection issues and requirements.

The **Code Reference** icon refers to relevant Code sections.

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The slides are enhanced with special icons that will help to focus on key points, or serve as links to external resources. The Attention icon brings up Callouts (like this one) with key points and additional information.

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HVAC-1 Module Menu

Slide Navigation

Click on sub module to navigate directly to corresponding slides

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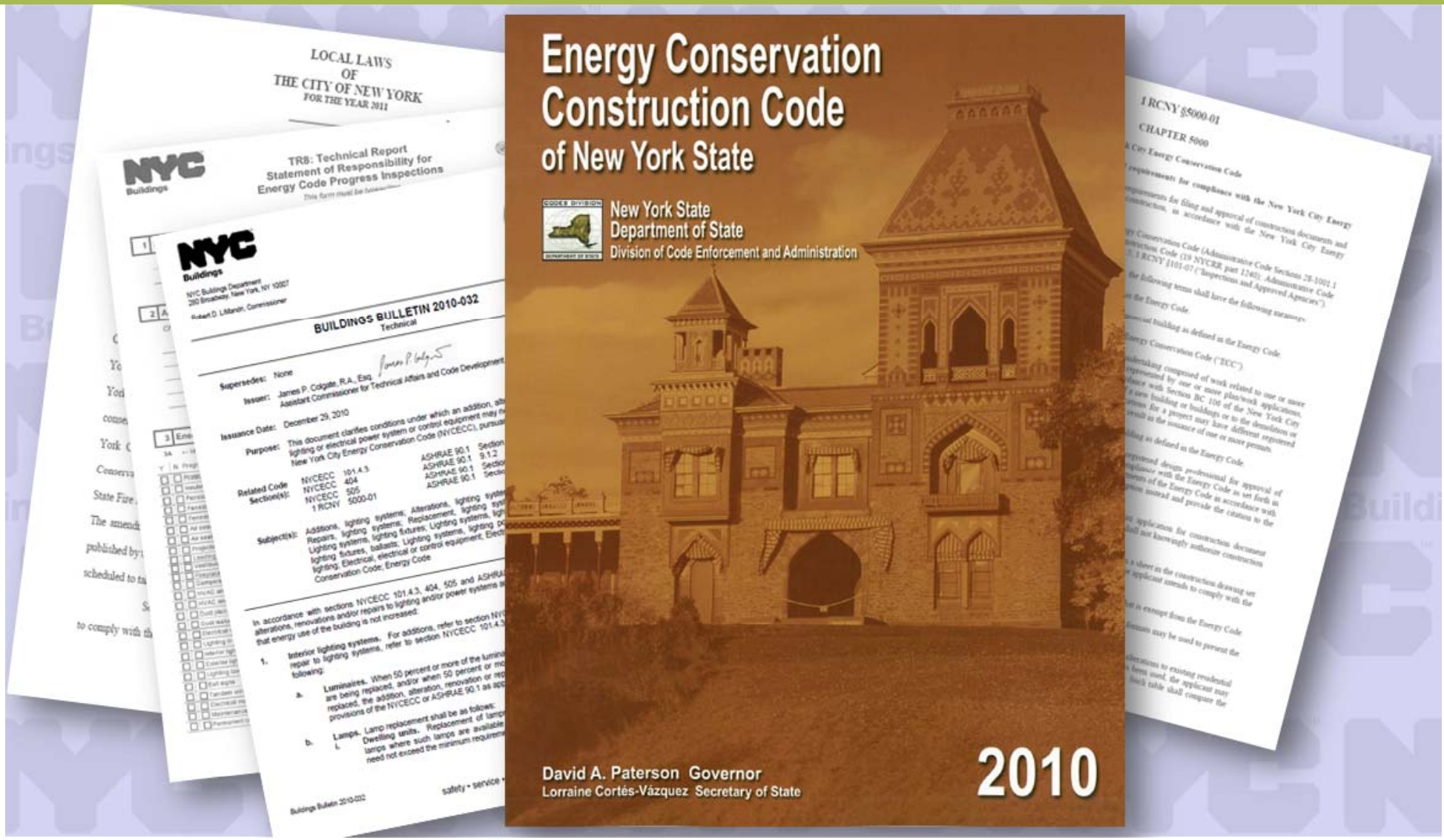
The main menu slide is interactive; clicking on each line item will take you to the respective sub-module. Use this feature to navigate throughout the presentation. The menu icon at the bottom right corner of each slide will always bring the you back to the main menu slide.

Building HVAC Requirements - 1

Slides 8 to 13

1. What's New in the NYCECC



1. What's New in the NYCECC

Slides 7 to 12

Sub-Module Overview

In this section you will learn about:

- Key changes and additions in the 2011 NYCECC related to HVAC systems;
- Current NYC Local Laws affecting Energy Code compliance;
- Current Rules and Bulletins affecting Energy Code compliance.

Key Updates for the 2011 NYCECC

? **What are the major changes in the new Code (Sections 503 & 504)?**

Simplified, Streamlined & More Comprehensive:

- All new buildings, renovations & alterations are required to comply
- Compliance is required for all sections (Envelope, Lighting, HVAC, etc) in their entirety.
  - All sections of **2011 NYCECC Chapter 5** OR All sections in **ASHRAE 90.1 (2007)**
  - Compliance with **NYCECC Chapters 1, 2, 3, 6** still required for all commercial projects including ones that follow ASHRAE 90.1 (2007)
- Climate zone classifications are simplified
  - Single zone for all NYC boroughs, both residential & commercial (Zone 4-A)
- Commercial building definition (Group R) expanded
  - Now includes Group R-3 over 3 stories
- HVAC loads calculation methodology is revised
  - Now references **ASHRAE/ACCA Standard183**

Applicability: 101.4.3 & DOB Bulletin 2010-031; ASHRAE 90.1 Alternative: 501.1 & 501.2; Group R: chapter 2 Definitions; HVAC Loads: 503.2.1 & 503.2.2

Key Updates for the 2011 NYCECC

? **What are the major changes in the new Code (Sections 503 & 504)?**

Equipment Efficiency Updates:

- Packaged AC & Heat Pumps efficiency are revised
  - Minimum efficiency increased 9% to 30%
  - Through-the-Wall AC category has been added (NAECA)
- Water-cooled centrifugal Chillers
  - Revised adjustment (NPLV) and exceptions for non-ARI conditions
  - Exception for secondary coolants with freeze point 27°F or less
- Increase in efficiency for gas-fired storage water heater less than 75,000 Btu/h
- Increase in insulation requirement for unfired storage tanks

Ventilation Air Controls:

- Demand Control Ventilation (DCV) required
  - Zones larger than 500 ft^2, AND
  - Occupant load averaging 40 people / 1000 ft^2 or higher
- Energy Recovery Ventilation (ERV) required
  - Supply airflow greater than 5,000 cfm, AND
  - Minimum Outdoor Air (OA) at 70% or greater

Equipment Efficiency: Tables 503.2.3 (1 to 5) & 504.2; DCV: 503.2.5.1; ERV: 503.2.6

Key Updates for the 2011 NYCECC

? **What are the major changes in the new Code (Sections 503 & 504)?**

Fans & Air Intakes / Exhausts:

- Fan power limits & sizing requirements added
  - Limits apply if total system fan power exceeds 5 HP (nameplate)
  - Motor selection restrictions based on Brake Horse Power
- Application requiring motorized dampers expanded
  - Discharge damper prohibition reduced
  - Permitted only for VAV fans less than 10 HP

Added Requirements for Heating Systems Outside Building:

- Radiant system & occupancy sensor or timer control requirements
- Snow melt system controls and application
- Swimming pools- heater efficiency, controls, pool covers

Fans:503.2.10; Swimming pools: 504.7; Outside heating: 503.2.11; Snow melt: 503.2.4.5

Rules and Bulletins

? What energy code related rules & bulletins affect HVAC systems?

1 RCNY§5000-01

- Specifies requirements related to:
  - Professional Responsibility
  - Supporting Documentation
  - Mandatory Requirements
  - Progress Inspections

Buildings Bulletin 2010–031

Web link: http://www.nyc.gov/html/dob/downloads/bldgs_bulletins/bb_2010-031.pdf

- Additional interpretations on addition, alteration, renovation or repair to HVAC and/or service water heating systems
  - Covered work includes:
    - » Replacing head-end equipment
    - » Replacing terminal equipment (unless compliant equipment won't work)
    - » Replacing duct work & piping (unless insufficient space or access)
    - » Sealing and insulating ducts, piping and penetrations
  - Exceptions are allowed for scenarios that doesn't increase energy use
  - Replacing equipment parts not regulated.

Building HVAC Requirements - 1

Slides 14 to 20

2. Code Applicability

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2. Code Applicability

Slides 15 to 20

Sub-Module Overview

In this section you will learn about:

- DOB terminology related to NYCECC applicability
- Differences in applicability for new construction, additions, alterations, renovations, and repairs
- Allowable exemptions and exceptions

Applicability for Different Scopes of Work

? What types of projects are required to comply with commercial HVAC section?

Exemptions:

- Exemptions define specific building types or building elements that are not required to meet the Code.
- The following are the **only** allowed exemptions to the NYCECC:
  - Historic buildings (per NYCECC 101.4.2, LL1 of 2011, §5000-01)
    - National- or State-designated historic buildings
    - Buildings certified as contributing buildings within a National or State historic district
    - Buildings certified as eligible for the designations above
    - City level certification does not qualify for exemptions
  - The **envelopes** of unconditioned or "low-energy" buildings or spaces (Low energy is <3.4 BTU/H or 1 watt/SF peak design rate for space conditioning)
  - Temporary buildings under Administrative Code §28-111 and §BC 3203
  - The following work types, which are categorized as not affecting energy use:
    - FA (fire alarm), FP (fire suppression in a range hood), SD (standpipe), SP (sprinklers), FS (fuel storage), EQ (construction equipment), CC (curb cut), OT/BPP (Builder's Pavement Plan), OT/FPP (Fire Protection Plan)

NYCECC: 101.4.3, 101.4.4 & 101.4.5, 101.5.2, 403.7,
NYC DOB Buildings Bulletin: 2010-031

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Note that this exception is only for the envelope. HVAC and lighting systems must still comply with applicable requirements.

NYCECC: 101.4.3, 101.4.4 & 101.4.5, 101.5.2, 403.7,
NYC DOB Buildings Bulletin: 2010-031

Applicability for Different Scopes of Work

? What types of projects are required to comply with commercial HVAC section?

Exceptions:

- Exceptions are conditions under which specific provisions of the Code may not be required
- Exceptions to Section NYCECC 101.4.3, Alterations, apply only if they do not result in increased energy use of the building.
  - There are 8 exceptions in this section; NONE apply to HVAC Systems.
  - See Buildings Bulletin 2010-031 for HVAC requirements and exceptions related to additions, alterations, renovations or repairs.

Existing Buildings:

- Change in occupancy or use that increases energy use must comply as for new building
- Change in space conditioning from unconditioned to conditioned must comply as for new building

Mixed Occupancy:

- Each occupancy shall be considered separately.
  - Residential occupancies per Chapter 4, but remember:
    - » Per 403.7, HVAC and SHW systems serving more than 3 dwelling units are subject to the applicable requirements under Chapter 5
  - Commercial occupancies per Chapter 5

Applicability for Different Scopes of Work

? What types of projects are required to comply with commercial HVAC section?

Additions:

- New work on equipment and systems (or portions) must comply (Bulletin 2010-031)
- Additions can comply stand-alone, or with existing building as single entity.

Alterations, Renovations, and Repairs (Bulletin 2010-031):

- Only applies to new scope; unaltered portions are not required to be brought up to Code
- Equipment replacement (whole or partial) limited to scope of work including:
  - Head-end equipment
  - Terminal equipment
  - Controls systems & devices
  - Sealing and insulation of duct work and piping
- Replacing of a whole system must comply
- Partial replacement of a system
- Distribution runs or zones must comply, but compliance limited to original scope of work
- Replacement parts not regulated by Energy Code
- Exceptions apply

Exceptions must be proposed by applicants as part of their Energy Analysis NYCECC submission. The rationale for the exception and the applicable section of the NYCECC and/or Buildings Bulletin must be referenced.

NYCECC: 101.4.3, 101.4.4 & 101.4.5, 403.7,
NYC DOB Buildings Bulletin: 2010-031

Existing Buildings: Scenarios: 1, 2, 3

? What types of HVAC alterations need to comply with the new Energy Code?

Q1: Replacement of a single Boiler which is part of the multiple Boiler arrangement.

A: Required

- Individual Boilers must meet Code during replacement if they are isolated by valves & have their own safety controls

Q2: Replacement of a single Boiler which is part of the modular Boiler arrangement.

A: Depends (Applies to modular Boilers and Cast Iron Sectional Boilers)

- A modular Boiler consists of multiple small Boilers attached together forming a single header and has a single high limit (less than 3.4MBTUH) and low-water cutoff for all modules
- May be considered a repair and subject to exception under Bulletin 2010-031.

Q3: If a burner is switched from oil to gas, there is a drop of about 3% in efficiency. Is this required to meet Code?

A: Not Required

- Exception allowed as parts replacement

Existing Buildings: Scenarios: 1, 2, 3

2. Code Applicability

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However, if more then 50% of modules need to be replaced ,then typical practice would be to consider replacing/upgrading the entire boiler; which would be subject to code efficiency requirements

Existing Buildings: Scenarios: 4, 5, 6 & 7

? What types of HVAC alterations need to comply with the new Energy Code?

Q4: An R-22 based Chiller is being retrofitted to non-ozone based refrigerant

A: Not Required

- The scope may be limited to compressors, heat exchanger and controls replacement.
- This is considered as replacement of parts and so are allowed exception.

Q5: Conversion of a Constant Air Volume to a Variable Air Volume system

A: Required

- All components associated with scope of work must comply.

Q6: Replacement of electric heat with hydronic baseboard radiant heat

A: Required

Q7: The tenant fit out for partial floor involves rezoning and relocation of terminal devices

A: Required

- Includes associated ducting, piping and terminal devices

Building HVAC Requirements - 1

Slides 21 to 31

3. Code Fundamentals

3. Code Fundamentals

Slides 19 to 31

Sub-Module Overview

In this section you will learn about:

- Understand Code structure, climate zone impacts for HVAC discipline;
- Differentiate between simple and complex HVAC;
- Compliance & documentation requirements for the three compliance methods – Prescriptive, Total Building Performance and ASHRAE alternative.

General Criteria: Climate Zones

? **How to determine climate zone and its impact in HVAC discipline?**

All NYC Boroughs are in climate zone 4-A:

- Refer Table 301.1 for climate zones by County
- ASHRAE climate zone is also 4-A

HVAC Load calculations requirements:

- Indoor Design Temperatures
  - Cooling minimum 75°F
  - Heating maximum 72°F

There is no exception within the code for special spaces that require different conditions (e.g., operating rooms). Designers would have to request exceptions on a case-by-case basis.

Climate specific HVAC requirements:

- For Economizers: Size threshold
- For Cooling towers: Type & operation

Climate Zones: 301.1; Design Conditions: 302;
Cooling Towers: 503.4.3.3.2.1, Economizers: 503.3.1

General Criteria: HVAC Discipline

? **What are the applicable compliance paths in the NYCECC ?**

501.2 Application (Compliance Options)

Requirements of 2011 NYCECC chapters 1, 2, 3 & 6 applies to all options

NYCECC

Prescriptive

(COMCheck or Tabular Analysis)

502: Envelope

503: Mechanical systems

504: Service water heating

505: Electrical power and lighting systems

NYCECC

506: Total Building Performance (EN 1)

502.4: Air leakage

502.5: Vapor retarders

503.2: HVAC mandatory requirements

504 Service water heating

505.2: Lighting controls

505.3: Tandem wiring

505.4: Exit signs

505.6: Exterior lighting

505.7: Tenant electric Sub-meters in dwelling units

ASHRAE 90.1-2007

Prescriptive (COMCheck/Tabular) or Total Building Perf. (EN 1)

Sec. 5: Building envelope

Sec. 6: HVAC

Sec. 7: Service water heating

Sec. 8: Power

Sec. 9: Lighting

Sec. 10: Other equipment

Sec.11: Energy Cost Budget method Normative Append. A-D

HVAC – Compliance Options

? **How to demonstrate compliance for HVAC discipline ?**

Mandatory:

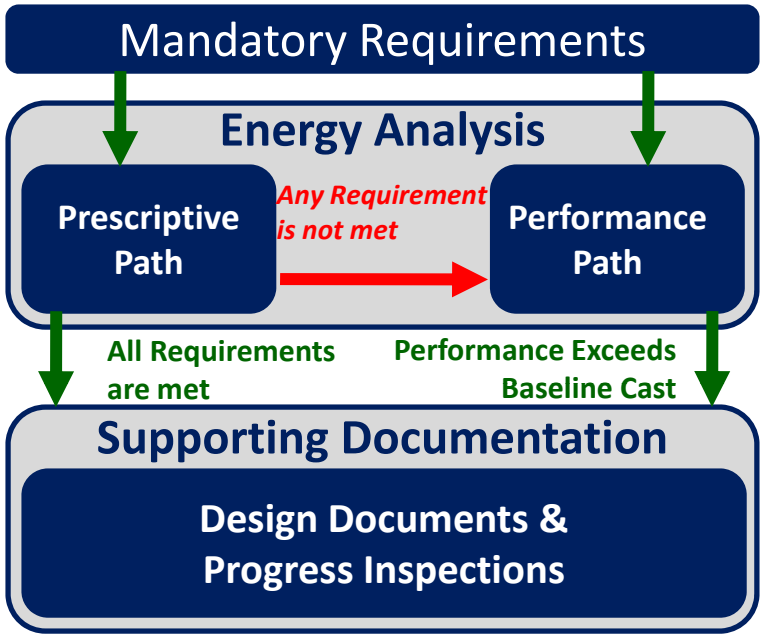
- Compliance required for all criteria identified in mandatory section.
- Required efficiency values, control sequences, energy features and calculations must be submitted

Prescriptive Path:

- Additional criteria based on Simple or Complex HVAC must be followed
- **Trade-off within discipline is not available in HVAC**

Performance Path:

- Trade-off allowed for prescriptive requirements on total building performance basis
- Energy Analysis using approved software program following Energy Cost Budget method



General Criteria: HVAC Discipline

? **How is the NYCECC organized within HVAC?**

503.2. Mandatory Requirements

1. Load Calculations
2. System Sizing
3. Heating & Cooling Equipment Efficiencies
4. HVAC Controls
5. Ventilation (DCV)
6. Energy Recovery
7. Duct & Plenum Insulation & Sealing
8. Piping Insulation
9. HVAC Completion (Air & Water Balancing, Manuals)
10. Air System Design & Control (F.P.L., Motor Size)
11. Outdoor Heating Systems

503.3. Simple Systems

503.4. Complex Systems

HVAC Types: 503.3 Simple System

? **What are the differences between simple & complex systems per Code?**

Simple System:

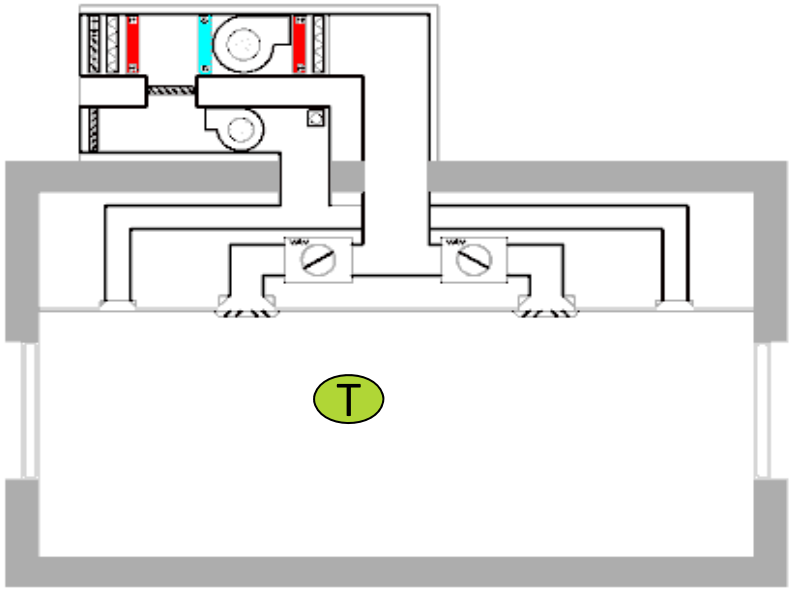
- Systems providing cooling & heating
  - Unitary or packaged equipment
    - » Non Hydronic (no pipes to the unit)
  - Each unit is dedicated to a single zone, controlled by a single thermostat located in the zone

System providing heating only:

- Two-pipe heating systems serving one or more zones & no cooling system is installed

What is regulated:

- Equipment efficiency
- Fan energy
- Economizer
- DCV
- Heat recovery



Simple Systems Examples

(*Each unit serves a single zone)*

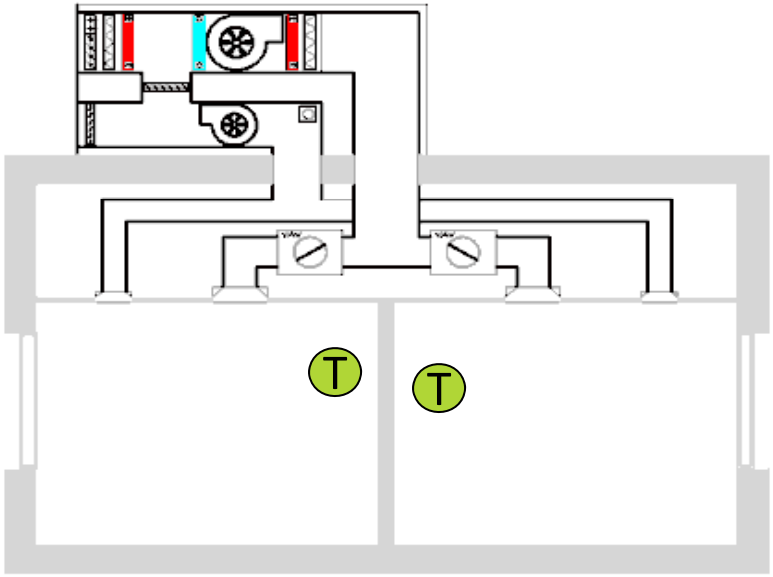
- **Roof Top DX or Heat Pump units**
- **Split AC**
- **Packaged Terminal Heat Pump (PTAC)**
- **Through-wall AC units**
- **Air Source Heat Pumps**
- **Furnaces, etc.**

HVAC Types: 503.4. Complex Systems

? **What are the differences between simple & complex systems per Code?**

Complex Systems:

- Any system serving multiple zones (air-based or water-based distribution)
  - Except Two-pipe heating-only systems
- Systems that have secondary terminal devices
- Packaged systems with external heating and / or cooling delivered via hydronic distribution
- Built-up systems / non-packaged systems
- Systems that are not simple systems



Complex Systems Examples

- **Multi-Zone systems**
- **Chilled water/ hot water / steam based central systems**
- **Two-pipe change over systems**
- **Four-pipe systems**
- **Water loop Heat Pump systems**

HVAC Type: Complex Systems - 2

? What are typically regulated aspects in complex HVAC systems?

Primary Heating & Cooling Equipment:

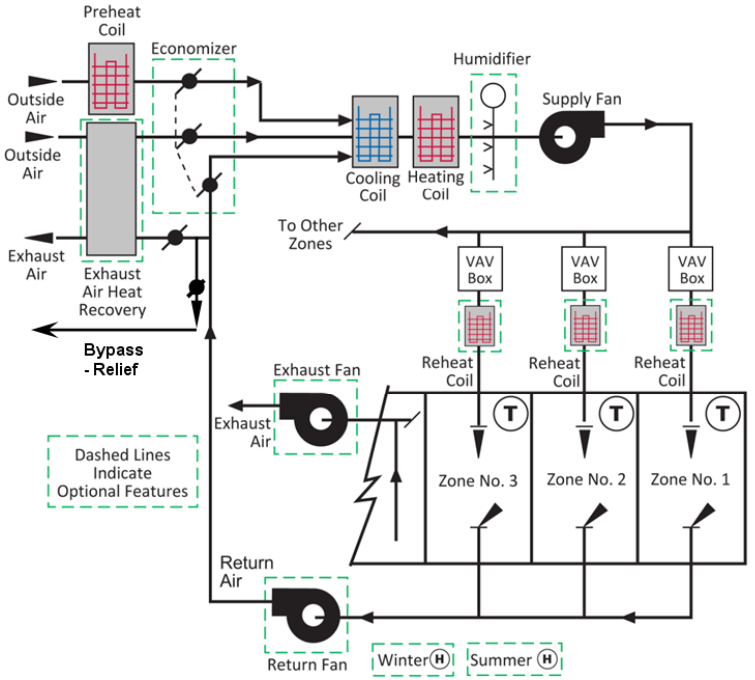
- Equipment efficiency

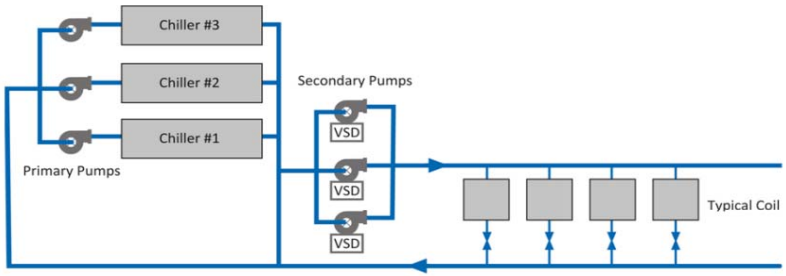
Secondary Air Distribution System:

- Fan energy
- Economizer
- Heat recovery
- Ventilation (Demand Control)
- Thermostats & temperature controls
- Airflow control & pressure

Secondary Hydronic Distribution System:

- Chilled water flow rates & temperatures
- Condenser water flow rates & temperatures
- Hydronic loop flow control & pressure





HVAC Type: Scenario 1, 2, 3, 4

? Determine if the following are simple or complex HVAC types?

Q1: 50,000 retail area served by 15 Roof Top Units (RTU) serving the single large area and are collectively controlled by multiple thermostats located in different aisles.

A: Complex HVAC (More than one thermostat per zone)

Q2: A 3000 ft^2 office building served by a single Roof Top AC & Furnace. The space is divided into two thermostatically controlled zones.

A: Complex HVAC

Q3: A 5-story multifamily residential complex provided with a central two-pipe heating system (e.g., baseboard radiation) serving multiple zones and no AC is provided.

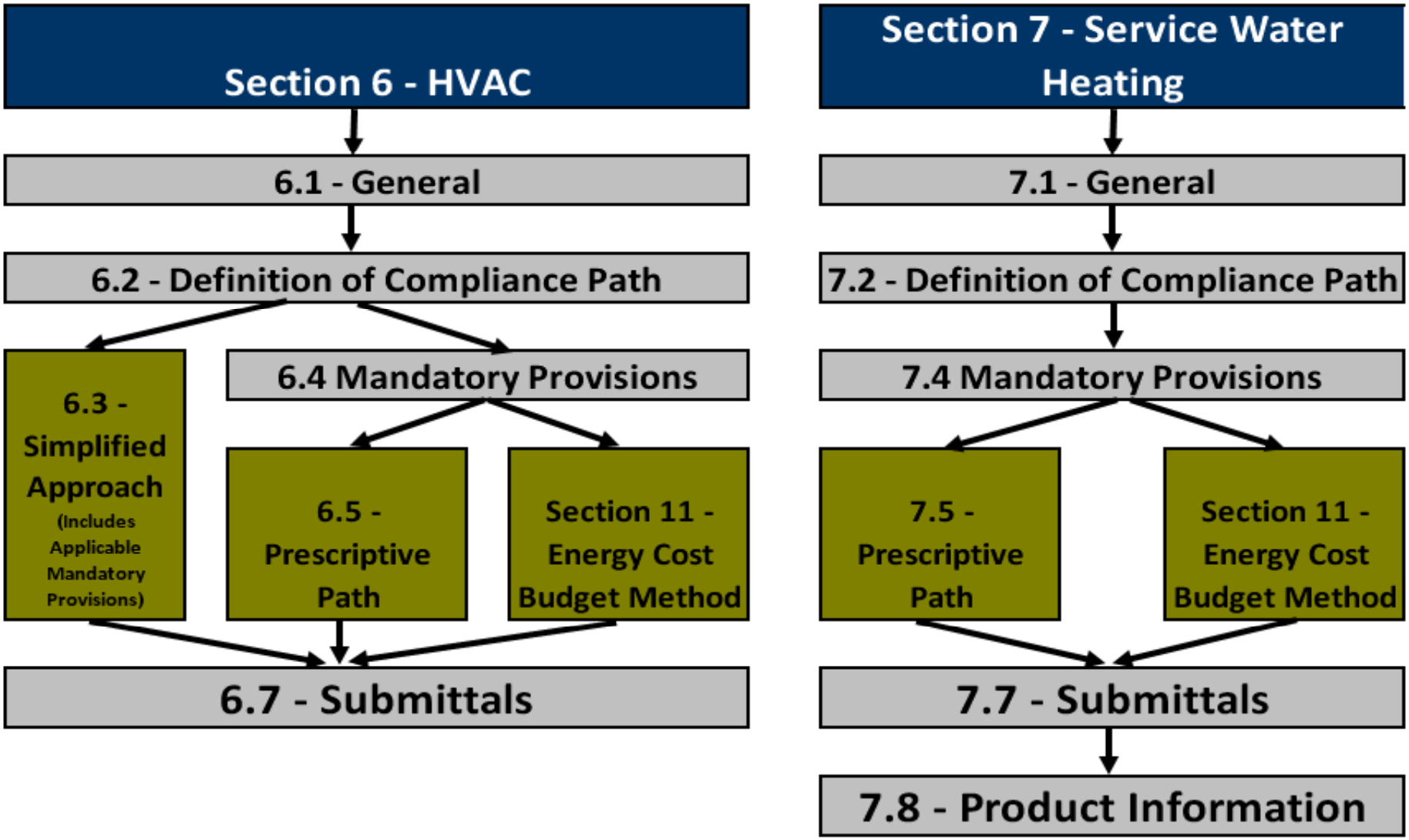
A: Simple HVAC

Q4: In the multi family example (Q3), no central AC is provided, individual packaged through-the-wall AC is provided to each unit with dedicated thermostat in addition to two-pipe heating system (e.g., baseboard radiation, hot water coil).

A: Complex HVAC

ASHRAE 90.1 (2007)

? How is the ASHRAE 90.1 organized within HVAC?



4. HVAC Metrics

Slides 30 to 47

Sub-Module Overview

In this section you will learn about:

- Cooling & heating capacity and efficiency metrics for different equipment classes;
- Load calculation requirements and standards.

Cooling Capacity Metrics

? **How is cooling capacity / size measured?**

Cooling Capacity / Size:

- Measured in Btu/h or tons
- Alternative common metrics:
  - 1 Ton = 12,000 Btu/h = 3.516 kW
  - 1 MBH = 1,000 Btu/h
- Used for AC, Heat pumps, Chillers, etc

Cooling Loads:

- Sensible load
  - Effect: Dry bulb temperature reduction
- Latent load (Dehumidification)
  - Effect: Humidity reduction
- Cooling system must be sized to address BOTH loads properly

Drawings must list sensible & total cooling capacities

Sensible Load Sources

Heat gain from envelope (including solar), lighting, equipment

Portion from people (225 to 710 Btu/h per person based on activity)

Latent Load Sources

Humidity in infiltration, ventilation air & space sources (e.g., plants, cooking)

Portion from people (105 to 1090 Btu/h per person based on activity)

Equipment Efficiency: Tables 503.2.3 (1 to 5) & 504.2;
Inspection: 1 RCNY §5000-01: IB

Heating Capacity Metrics

? How is heating capacity / size measured?

Heating Capacity / Size:

- Measured in Btu/h
- Alternative common metrics:
  - 1 MBH = 1000 Btu/h
  - 1 mmBtu/h = 1 million Btu/h
  - 1 Boiler HP = 33,475 Btu
- Used for Boilers, Furnaces & Heat pumps

Heating Load:

- Sensible heating load
  - Effect: Dry bulb temperature Increase
- Humidification load (in special spaces)
  - Effect: Enthalpy & wet bulb temperature increase

Installed capacity & efficiency of cooling & heating equipment must be verified for all major equipment & minimum of 15% of minor equipment. Sizing must match with approved drawings & load calculations

Sensible Load Sources

Heat loss through envelope, particularly glass & via air leakage

Latent Load Sources

Dryness in ventilation air

Equipment Efficiency: Tables 503.2.3 (1 to 5) & 504.2;
Inspection: 1 RCNY §5000-01: IIB3

Vapor Compression Cycle

? How is the cooling effect produced?

Also known as Refrigeration Cycle

- Refrigerants change phase between liquid & vapor by controlling temperature & pressure.
- Heat is absorbed during evaporation & released during condensation. This is used to create refrigeration or cooling effect.

1. Compressor

- Low pressure, low temperature refrigerant vapor is compressed creating high pressure, high temperature vapor

2. Condenser

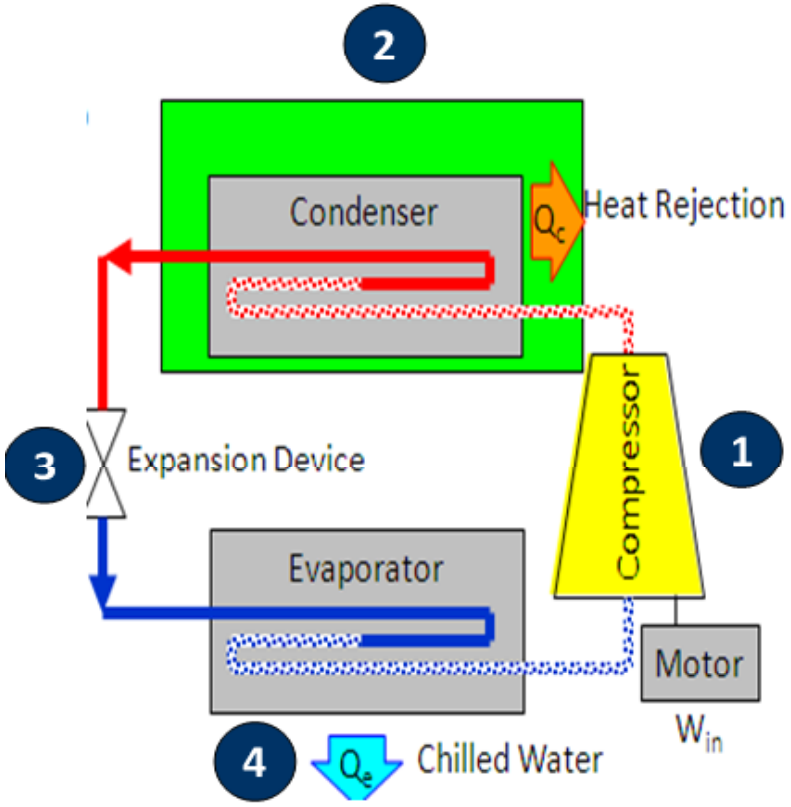
- High temperature vapor passes through a condenser coil rejecting heat to air or water, condensing into a high pressure, high temperature liquid

3. Thermostatic Expansion Valve (TXV)

- As the refrigerant expands through a valve, it becomes a low pressure, low temperature liquid

4. Evaporator

- The low temperature liquid refrigerant passes through an evaporator coil absorbing heat from air (DX) or water (Chiller), evaporating into a low pressure, low temperature vapor



Energy Use in Vapor Compression Cycle

? **What are the major energy using components in an AC Unit?**

Compressor Energy:

- Mechanically driven compressor, largest energy user of AC unit

Fans at Evaporator:

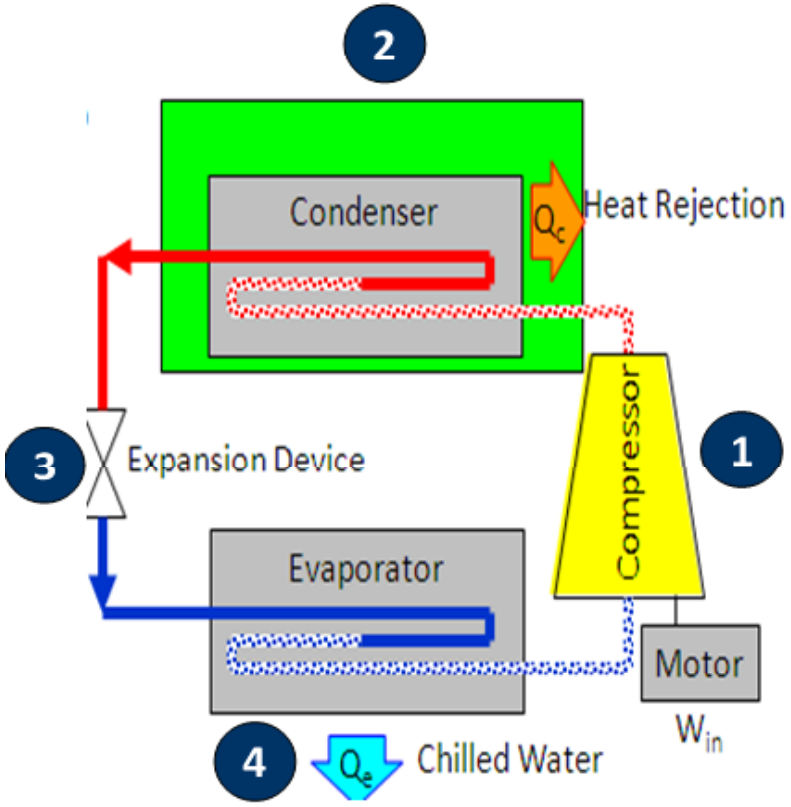
- Coil exposed to space (or load) to absorb heat & provide cooling
- Fans used for moving air over the coil

Fans at Condenser:

- Coil exposed to heat sink to reject heat
- Fans used for moving air over the coil

Controls:

- Electrical energy required for valves & control features



Cooling Efficiency Metric: EER

? Define metrics used for cooling system efficiency in Medium / Large packaged AC Units:

EER (Energy Efficiency Ratio):

- Metric measures efficiency at full load scenario and at AHRI standard design conditions
- Higher is better

EER = Net Peak Cooling Capacity (kBtu/h)
Electric Input (kW)

- Electric Input = Compressor kW + Condenser & Evaporator fan kW + Controls kW
- Supply Fan kW may be included as well if applicable

Standard Design Conditions

Ambient: 95F outside dry-bulb

Return Air: 80F dry-bulb & 67F wet-bulb

These rating conditions are representative of climate zone 4

EER Limitations

Part load performance is not represented

Less representative for extreme climates

Impact of temperature of cabinet or excessive fan power requirements are not captured in ratings

NYCECC Tables 503.2.3(1), (2), (3) & (6)

Cooling Efficiency Metric: IPLV

? **How is cooling system efficiency measured for part load conditions?**

IPLV (Integrated Part Load Value):

- Efficiency metric for various part load scenarios
  - Load points: 100%, 75%, 50% & 25%
  - Accounts for cycling losses
- Calculated weighted average value for whole year in different loading scenarios
  - Mandatory for larger units (less than240 kBtu air-cooled unitary & less than135 kBtu for non-unitary condensing units)
  - Optional for units greater than or equal to 65kBtu (5.4 Tons)
  - Used only if units have partial loading capacities (multiple compressors or multi-stage compressors)
- Higher IPLV indicates better performance in part load conditions
  - On an average, buildings are at full load only for 1% to 2% of cooling period

IPLV applicable to units have capacity modulation & greater than 20 tons

IPLV metric is replaced by IEER metric in ASHRAE. Manufacturers were required to test using IEER starting January 01, 2010. There are no conversion factors between IEER and IPLV

Part Load	IPLV		IEER	
% Load	% Hours	Air Temp	% Hours	Air Temp
100	1%	80	2%	95
75	42%	80	62%	81.5
50	45%	80	24%	68
25	12%	80	12%	65

Cooling Efficiency Metric: SEER

What performance metric is used for small commercial or residential-scale AC units?

SEER (Seasonal Energy Efficiency Ratio):

- Applies to units less than 65kBtu (5.4 Tons)
- Combines peak load & part load performance
- Calculated weighted average value for whole year in different loading scenarios
  - Total cooling (in Btu) during the normal cooling season as compared to the total electric energy input (in watt-hours) consumed during the same period

Standard Test Conditions

Tests at steady states at 95°F, 82°F and cycling at 82°F

Max & Min SEER Values

Max SEER Available in the US Market in 2010 : 23

Cooling Efficiency Metric: Scenarios

? Which cooling efficiency metrics apply for the following systems?

Q1: 4-Ton Split AC unit

A: **SEER**

(EER can be used additionally)

Q2: 11-Ton Roof-Top AC Unit

A: **EER**

(IPLV can be used additionally)

Q3: 25-Ton DX Air Handler

A: **EER + IPLV**

Installed capacity & efficiency of cooling & heating equipment must be verified during progress inspection for all major equipment & minimum of 15% of minor equipment. Sizing must match approved drawings & load calculations.

Standard Rating Conditions: AHRI

? Under what testing conditions / standards is HVAC equipment rated?

AHRI 210/240-2008:

- Unitary Air-Conditioning & Air-Source Heat Pump
- Less than 65,000 Btu/h or 5.42 Tons
- Cooling & heating capacity
- EER, SEER, HSPF
  - For single phase units, NAECA (National Appliance Energy Conservation Act of 1987) applies

AHRI 340/360-2007:

- Commercial and industrial, Unitary Air-Conditioning and Heat Pump Equipment (Air & Water Cooled)
- Equal to or greater than 65,000 Btu/h or 5.42 Tons
- EER, IEER, IPLV, COP

Standard Rating Conditions:

- Outdoor: 95°F DB & 75°F WB
- Indoor (return air): 80°F DB & 67°F WB
- Other conditions for maximum & low operating conditions, IPLV, IEER, scenarios with variable speed fans, multistage compressors (refer AHRI standards)

Table 503.2.3(1)

	Unitary Air Conditioners & Condensing Units, Electrically Operated, Minimum Efficiency Requirements	Cooling Efficiency (w/ Electric Heat)	Cooling Efficiency (Non Electric Heat)	Test Procedure
Air Cooled	Through-The-Wall >30,000 Btu/h or >2.5 Tons	12 SEER		NAECA & AHRI 210/240
	<65,000 Btu/h or <5.42 Tons	13 SEER		
	65,000 Btu/h to 135,000 Btu/h or 5.42 Tons to 11.30 Tons	11.2 EER	11.0 EER	AHRI 340/360
	135,000 Btu/h to 240,000 Btu/h or 11.30 Tons to 20.00 Tons	11.0 EER	10.8 EER	
	240,000 Btu/h to 760,000 Btu/h or 20.00 Tons to 63.30 Tons	10.0 EER 9.7 IPLV	9.8 EER 9.5 IPLV	
	> 760,000 Btu/h or > 63.30 Tons	9.7 EER 9.4 IPLV	9.5 EER 9.2 IPLV	
Water & Evaporatively Cooled	<65,000 Btu/h or <5.42 Tons	12.1 EER		NAECA & AHRI 210/240
	65,000 Btu/h to 135,000 Btu/h or 5.42 Tons to 11.30 Tons	11.5 EER	11.3 EER	AHRI 340/360
	135,000 Btu/h to 240,000 Btu/h or 11.30 Tons to 20.00 Tons	11.0 EER	10.8 EER	
	>240,000 Btu/h or >20.00 Tons	11.5 EER	11.3 EER	

Heating Efficiency Metric: HSPF

Define heating efficiency metric used in small packaged heat pumps.

HSPF (Heating Seasonal Performance Factor):

- Total heating (in Btu) during the normal heating season as compared to the total electric energy input (in watt-hours) consumed during the same period
- Applies to Heat Pump units less than 30kBtu/h
- Calculated weighted average value for whole year in different loading scenarios
  - Combines peak load and part load performance.

Code Required HSPF: 7.4

Limitation:

- Includes impact of electric resistance heater

Standard Test Conditions

AHRI-210/240

Steady state and cycling at 3 scenarios

47°F DB & 43°F WB

35°F DB & 33°F WB

17°F DB & 15°F WB

Max HSPF Values

Available in US Market in 2010: 18

Heating Efficiency Metric: COP

What performance metric is used for verifying heating efficiency in large heat pumps?

COP (Coefficient of Performance):

- Ratio of the rate of heat added to the rate of energy input in consistent units
- Typically used for heat pumps, but can be used for any type of equipment
- Heat pumps have COP greater than 1
- Fossil fuel and electric resistance heat have COP less than 1
- AHRI 340/360 & AHRI/ASHRAE-13256-1 covers Water Source Heat Pumps

Code required COP: 3.1 to 4.2

Standard Test Conditions

Air Source: AHRI-340/360

- 47°F DB & 43°F WB, Outdoor Air
- 70°F Return Air

Water Source: AHRI/ASHRAE-13256-1

- Water: Boiler

  68°F Entering Water
- Ground Water: Open Loop

  50°F Entering Water
- Ground Source: Closed Loop

  32°F Entering Water

Heating Efficiency Metric: AFUE, E_t & E_c

? **What metrics are used for measuring heating efficiency in furnaces?**

AFUE (Annual Fuel Utilization Efficiency):

- Ratio of annual output energy to annual input energy
  - Similar to SEER concept
  - Used for Furnaces (less than 225,000 Btu/h) & Boilers (less than 300,000 Btu/h)

AFUE = Heat Delivered / Heat content of fuel consumed @ annual basis

E_c (Combustion Efficiency):

- Measures total heat produced by combustion processes
  - Accounts for energy lost by flue.
  - Typically used for Furnaces less than 225,000 Btu/h & Boilers less than 300,000 Btu/h

E_c = Heat Produced / Heat content of fuel consumed @ steady state

E_t (Thermal Efficiency):

- Measures total useful heat produced by Boiler or Furnace that is transferred to the heating delivery system
  - Accounts of flue losses & jacket losses.
  - Typically used for large capacity Furnaces & medium capacity Boilers

E_t = Heat Delivered / Heat content of fuel consumed @ steady state

Equipment Efficiency: Tables 503.2.3 (4) & (5); Inspection: 1 RCNY §5000-01: IIB3

HVAC Sizing: Peak Loads

What method / Standard should HVAC sizing calculations follow?

ANSI / ASHRAE / ACCA Standard 183:

- Provides fundamental principles to be used for calculation of **Peak Design** heating and cooling loads in individual thermal zones in buildings
  - Standard not applicable for low-rise residential buildings
- Calculations must be performed on each project
  - Rules of thumb cannot be used as basis of sizing
- Commercial load calculation programs typically incorporate one of these approved methods
- Peak design load may not reflect peak system size: Diversity factors, system losses, gains & engineering judgment can impact actual sizing

Code official may review calculations:

Use of approved Methods in Standard 183

Reasonableness of assumptions

HVAC Sizing: Equipment & System Sizing

What is regulated in HVAC sizing calculations?

Energy Recovery:

- If provided, must be accounted in system sizing per ASHRAE HVAC System & Equipment Handbook

ASHRAE Handbooks:

- Provide guidelines for deriving equipment sizing from peak load calculation

Equipment & System sizing shall not exceed the loads calculated:

- Not an issue when multiple equipment are in place with capability to optimize and stage to match loads

- System gains & losses and load diversity will affect system sizing when compared to peak zone loads.
- Compare zone peak loads to the capacity of single zone systems or terminal devices for reasonable agreement.

5. Unitary Equipment

Slides 48 to 59

Sub-Module Overview

In this section you will learn about:

- Various classes of unitary cooling and heating equipment and their efficiency requirements;
- Prescriptive features and control requirements associated with unitary equipment; and
- Overview of special conditions and equipment not covered by Codes.

Unitary Equipment

5. Unitary Equipment ? **Which types of HVAC equipment qualify as unitary equipment?**

Factory Packaged Refrigerant Based Units:

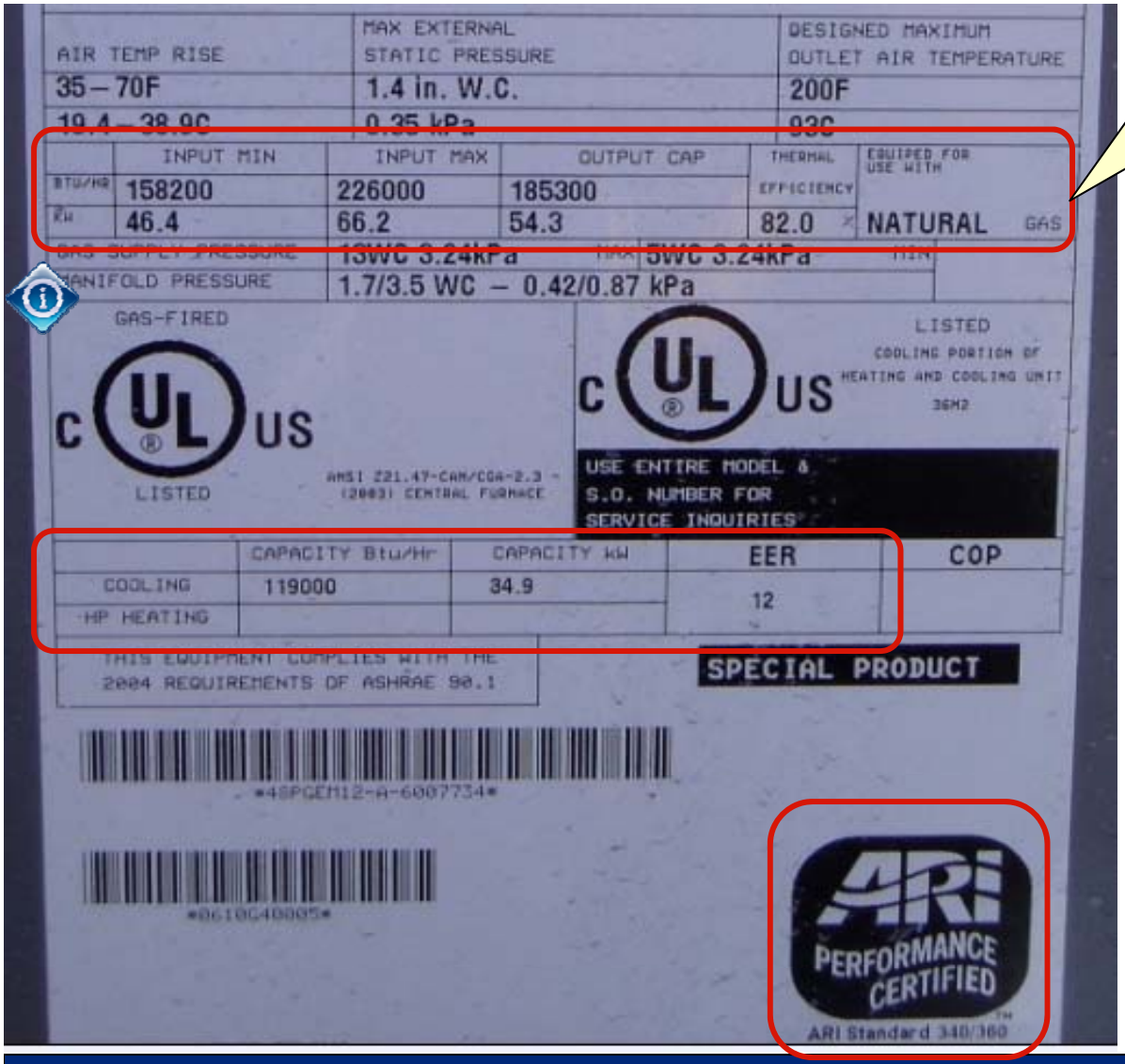
- Roof Top Units (RTU)
- Single packaged units
- Self contained Direct Expansion (DX) units
- Heat Pumps (vertical / horizontal / consoles configurations)
  - Include compressor, evaporator (or cooling coil), condenser & fan(s) all enclosed inside one box.
  - Provide cooling with optional heating, air filtration, dehumidification, humidification.
  - Efficiency ratings furnished by manufacturer for whole system: energy consumed by compressor, fans & controls.
  - For large units with total nameplate system fan HP greater than 5 HP, require compliance with fan power allowance.
    - » System Fan includes: Supply + Return + Exhaust Fans

Performance Requirements: 503.2.3; Fan Power Allowance: 503.2.10

Unitary Equipment

5. Unitary Equipment

What are key inspection items for a simple HVAC - unitary equipment?



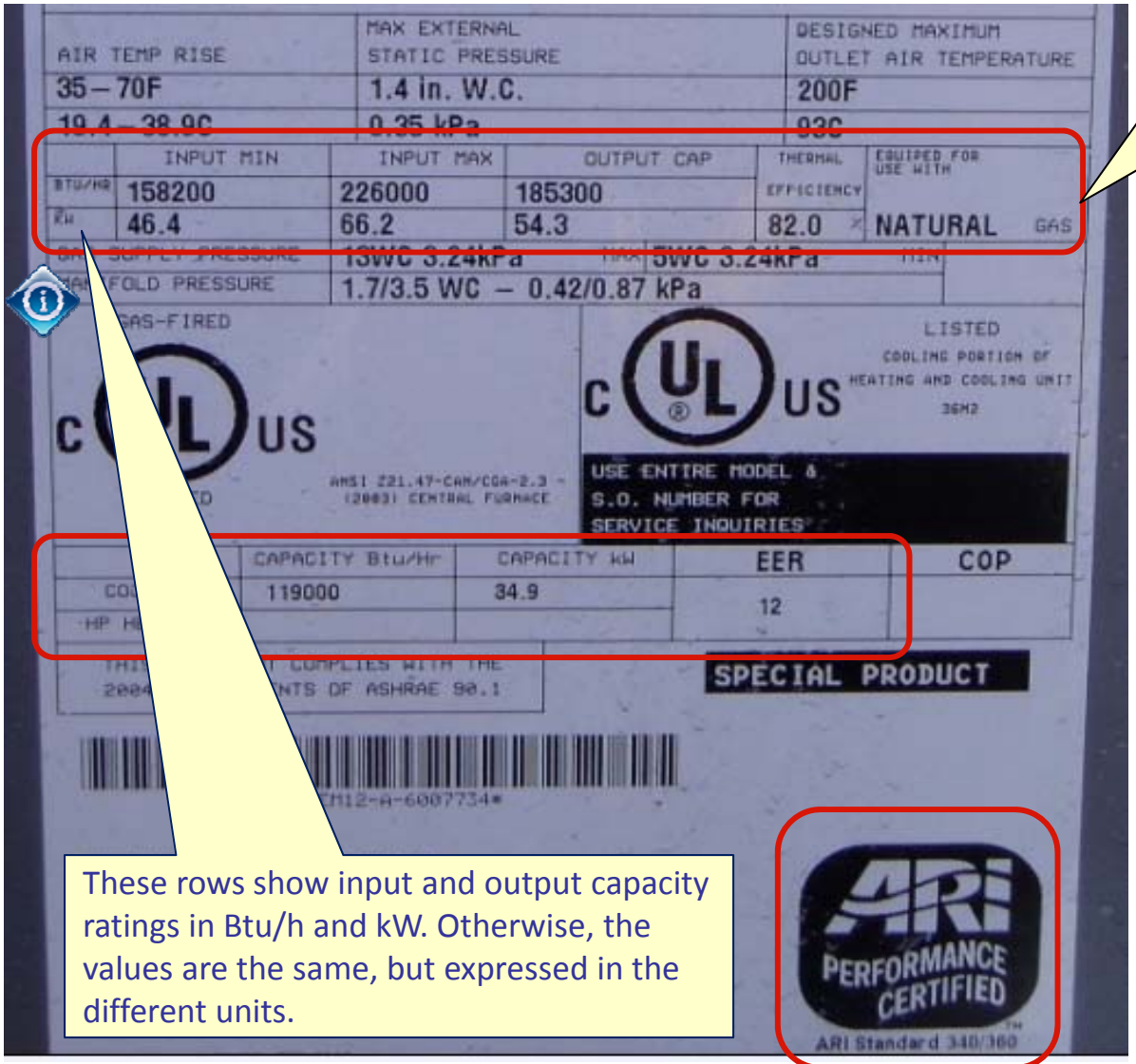
Equipment nameplate will provide heating and cooling capacity, efficiency and rating method / standard

Visual inspection of economizer intake & test for functionality & proper operation

Unitary Equipment

5. Unitary Equipment

What are key inspection items for a simple HVAC - unitary equipment?



These rows show input and output capacity ratings in Btu/h and kW. Otherwise, the values are the same, but expressed in the different units.

Equipment nameplate will provide heating and cooling capacity, efficiency and rating method / standard

Visual inspection of economizer intake & test for functionality & proper operation

Split Systems

What possible combinations of indoor and outdoor units are covered?

Split Systems:

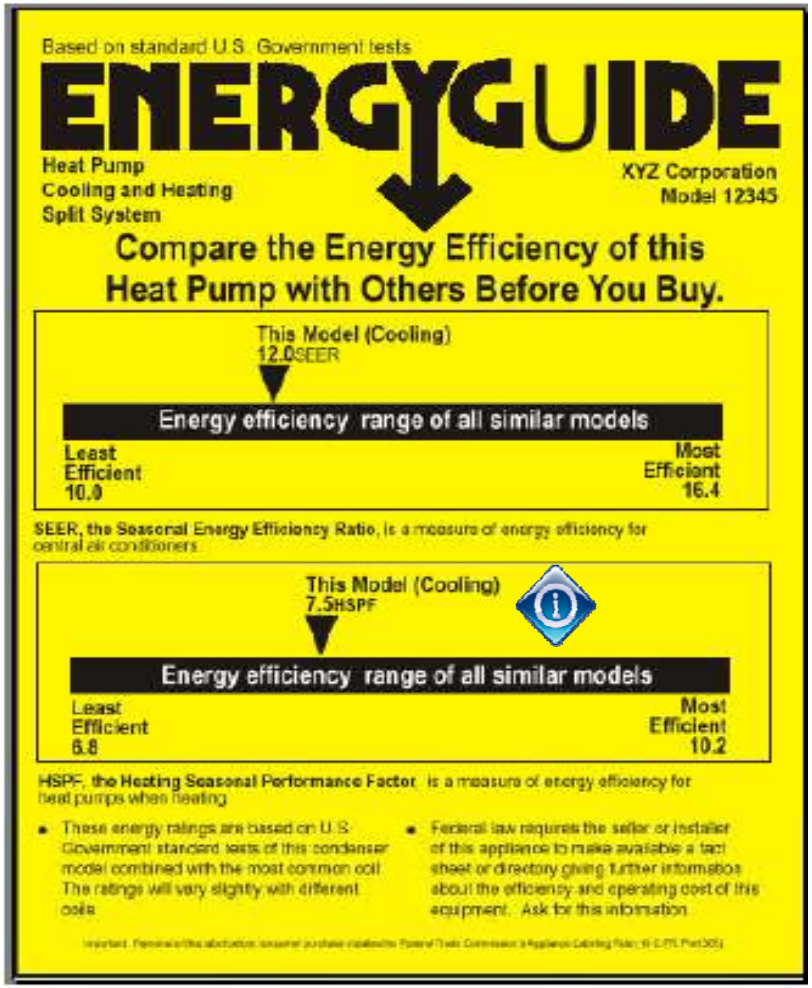
- Indoor Unit: Air Handler & Evaporator
- Outdoor Unit (Condensing Unit): Compressor, Condenser, Condenser fan
- Different manufacturers for different components are possible.
  - **Note:** Capacity & efficiency must be determined for whole system based on proposed combinations, not individual components
- Multi split: Multiple indoor coils matched with a single outdoor condenser coil & each indoor coil can operate independent of the other
  - Up to 5 indoor units for per outdoor coil are covered by AHRI 210/240 Standard
  - Units with more than 5 indoor units & capacity greater than 135,000 Btu/h must follow efficiency at condensing unit level per AHRI 365 Standard

Heat Pumps

What possible combinations of indoor and outdoor units are covered?

Heat Pump:

- Cooling & heating derived from Vapor Compression Cycle
  - Refrigeration cycle operated in reverse to provide heating
  - Cooling mode – Heat is rejected to sink
    - » Supplemental cooling: Usually fluid cooler or cooling tower if sink is not capable of rejecting all the heat.
  - Heating mode– Heat is absorbed from source
    - » Supplemental heating: Usually electric resistance heat or hot water loop from Boiler if source does not have sufficient heat
- Heat pump classifications based on sink / source for heat:
  - Air Source: Air cooled
  - Water Source: Water loop with Boiler & Cooling Tower
  - Groundwater Source: Open loop geothermal well
  - Ground Source: Closed loop geothermal well


Based on standard U.S. Government tests

ENERGYGUIDE

Heat Pump
Cooling and Heating
Split System

XYZ Corporation
Model 12345

Compare the Energy Efficiency of this Heat Pump with Others Before You Buy.

This Model (Cooling)
12.0SEER

Energy efficiency range of all similar models

Least Efficient 10.0 — Most Efficient 16.4

SEER, the Seasonal Energy Efficiency Ratio, is a measure of energy efficiency for central air conditioners

This Model (Cooling)
7.5HSPF

Energy efficiency range of all similar models

Least Efficient 6.8 — Most Efficient 10.2

HSPF, the Heating Seasonal Performance Factor, is a measure of energy efficiency for heat pumps when heating

- These energy ratings are based on U.S. Government standard tests of this condenser model combined with the most common coil. The ratings will vary slightly with different coils.
- Federal law requires the seller or installer of this appliance to make available a fact sheet or directory giving further information about the efficiency and operating cost of this equipment. Ask for this information.

Heat Pumps

5. Unitary Equipment ? **What possible combinations of indoor and outdoor units are covered?**

Heat Pump:

- Cooling & heating derived from Vapor Compression Cycle
  - Refrigeration cycle operated in reverse to provide heating
  - Cooling mode – Heat is rejected to sink
    - » Supplemental cooling: Usually fluid cooler or cooling tower if sink is not capable of rejecting all the heat.
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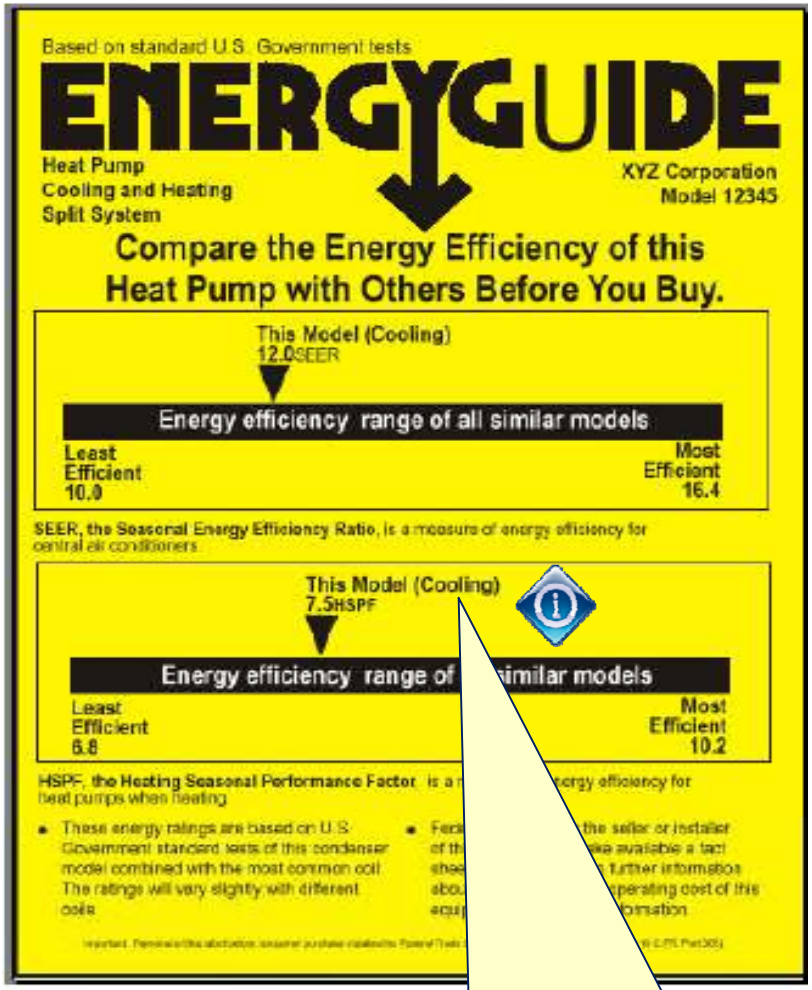


Incorrectly labeled. Should read “Heating”.

Heat Pump: Unitary & Applied

Are there any other mandatory requirements for heat pumps?

Efficiency Requirements

- Air Cooled less than 65KBtu (5.41 Tons) units
  - 30% increase in minimum cooling efficiency
  - 13% increase in minimum heating efficiency
  - A new category for through-the-wall units is added

Supplemental Electric Resistance Heat

- EER & IPLV are increased by 0.2 if electric-resistance heat is not provided
- Controls (w/ electric resistance heat)
  - Required to limit electric heat to defrost period or when the heat pump is unable to meet load using refrigeration cycle.
    - » Electric heat operation is very expensive, so this is a good economic strategy

Efficiency: 503.2.3, Thermostatic controls: 503.2.4.1.1., Hydronic heat pump requirements: 503.4.3.3.3

Prescriptive Efficiency: Exercise

5. Unitary Equipment ? **Determine efficiency metrics for each of the following pieces of equipment:**

Q1: 8-Ton air-cooled Roof Top Unit with Electric Heat?

A: **SEER:** Not applicable, unit greater than 65kBtu/h
EER: 11.2
IPLV: No requirement

Q2: 8-Ton water-cooled Roof Top Unit with hot water coil?

A: **SEER:** Not applicable, unit greater than 65kBtu/h
EER: 11.3
IPLV: No requirement

Q3: 18-Ton air-cooled Split unit with 8 indoor coils?

A: **SEER:** Not applicable, unit greater than 65kBtu/h
EER: 10.1 @ condensing unit
IPLV: 11.2 @ condensing unit

Review of manufacturers data & visual inspection for equipment sizing, efficiency & performance factors required for all major equipment units and at least 15% of minor equipment units.

Equipment efficiency: Table 503.2.3 (1) & (6) & Progress inspections: 1 RCNY §5000-01, IIB3

Boilers: Small Capacity Units

5. Unitary Equipment

What are size and efficiency requirements for small boilers?

Small-Capacity Boilers:

Under 300,000 Btu/h (9 HP)

- Gas-fired: 80% AFUE (Water)
  75% AFUE (Steam)
- Oil-fired: 80% AFUE (All)

Medium-Capacity Boilers:

300 MBtu/h (9 HP) to 2.5 mmBtu/h (75 HP)

- Required efficiency must be achieved at Boiler's **minimum operating capacity** as allowed by controls
- Gas-fired: 75% E_t & 80% E_c
- Oil-fired: 78% E_t & 83% E_c

High-Capacity Gas-Fired Boilers:

2,500,000 Btu/h (75 HP) & higher

- Gas-fired: 80% E_c
- Oil-fired: 83% E_c

Review of manufacturers data & visual inspection for equipment sizing, efficiency & performance factors required for all major equipment units

ASHRAE 90.1: Efficiency rating for medium sized units only includes thermal efficiency (E_t)

Available efficiency in 2010:

80% AFUE to 99% AFUE

Features to enhance Boiler efficiency:

1. Sealed combustion
2. Modulating burner / intermittent electronic ignition
3. Power vent
4. Condensing heat exchanger
5. Jacket insulation upgrade

Boiler efficiency: Table 503.2.3(5); ASHRAE 90.1: Table 6.8.1F; Progress inspections: 1 RCNY §5000-01, IIB3

Boilers Controls

What are required controls for boiler system operation?

Multiple Boiler Controls:

- Multiple packaged Boilers per loop require automatic controls to sequence Boilers
- Single Boiler per loop, greater than 500,000 Btu/h capacity requires multi-staged or modulating burner

Boiler Part Load Controls:

Required if capacity greater than 300,000 Btu/h

- Vary temperature: Boiler water reset control by 25%
  - Reset supply water temperature by 25% of design delta T.
  - Use Outdoor Air (OA) temperature or return water temperature to drive reset

  OR

- Vary flow rate:
  - Variable Speed Drive pumps or multi-staged pumps

Multiple Boiler controls: 503.4.3, Part Load Controls: 503.4.3.4;

Furnaces

What are the efficiency and energy feature requirements for furnaces?

Warm Air Furnaces:

- Gas- or Oil-fired
- Includes combination warm air furnaces / AC units
- Efficiency rated in E_t (AFUE is alternate for units less than 225,000 Btu/h)
- Vent requirements:
  - Power vents or
  - Flue damper or
  - Vent damper (if combustion air is drawn from conditioned space)

Duct Furnace & Unit heaters:

- Gas- or Oil-fired
- Efficiency rated in E_c

Efficiency Rating Limitation:
Furnace fan is not accounted for in combustion or thermal efficiency calculations.

Construction drawings must indicate motorized dampers.

Visual inspection of Outdoor Air (OA) intake and exhaust openings for presence of motorized dampers

Furnace efficiency: Table 503.2.3(4); Motorized Dampers: 502.4.4; ASHRAE 90.1: 6.3.4.4.(4); 1 RCNY §5000-01: IIB2

Heating Equipment: Not Covered in Code

5. Unitary Equipment ? **What types of commercially available equipment are not covered in the Code?**

Electric Resistance:

- Operating limitation for Heat Pumps with supplemental electric heat
- Air Conditioning efficiency (SEER/EER/IPLV) more stringent for systems with electric heat

Direct-Fired Infrared (IR) Heaters

Heated Air Curtains

Chiller Heaters

Solar Air or Water Heaters

Slide 58

AV3 Some of these need to be listed in the code. Electric heat should not be allowed unless there are exceptions. This has been a big loop hole in the code and these are fairly common in the market place. Since there is no code requirement, every equipment is marketed as energy efficienct. Hope fully the code picks this up in the next round.

Arun vedhathiri, 1/27/2011

Heating: Outside the Building

5. Unitary Equipment ? **Are there any requirements of heating systems in exterior spaces/applications?**

Only Radiant System Allowed, such as

- Hydronic: Heated radiant slabs (two-pipe)
- Steam radiators
- Low- / medium- / high-intensity direct-fired radiant heaters.

Controls Requirements

- Occupancy-based controls or timer-based controls to turn off automatically when no occupants are present

6. Outdoor Air Ventilation

Slides 60 to 71

Sub-Module Overview

In this section you will learn about:

- Design ventilation rates;
- Demand-Controlled Ventilation (DCV) requirements, exceptions and application strategies; and
- Energy-Recovery Ventilation (ERV) requirements, exceptions and application strategies.

Economizers

5. Unitary Equipment ? **Is there a requirement to incorporate economizer to utilize free cooling?**

Economizer Function:

- Use Outdoor Air (OA) (air side) or condenser water (water side) to cool the space, reducing or eliminating compressor energy
- Integrated: Compressor operation allowed when 100% Economizer is insufficient to meet entire cooling load

Code Requirement:

- Economizer required when AC load or AC unit size is greater than 54,000 Btu/h or 4.5 Tons
  - Applies to individual unitary units (and)
  - Aggregate of individual unitary units if they serve the same space
- Total capacity of all units without an Economizer cannot exceed 480,000 Btu/h cooling capacity per building

2011 NYCECC is neutral about allowed Economizer control type

ASHRAE allows following controls types if Economizer is provided:

1. Fixed dry bulb
2. Fixed enthalpy
3. Electronic enthalpy
4. Differential enthalpy
5. Dew-point and dry-bulb temperatures

Prohibited Control:

1. Differential dry bulb

Simple systems: 503.3.1; Complex systems: 503.4.1
ASHRAE: Table 6.5.1

Economizers

5. Unitary Equipment ? **Under what special circumstances is economizers are not required?**

Economizer Exceptions:

- Air- or evaporatively cooled systems serving spaces with open-case refrigeration
- Systems that require special air filtration for acceptable ventilation air quality
- ASHRAE 90.1-07 does not require Economizers for climate zone 4-A (NYC)

Visual inspection of Economizer intakes & damper and controls must be tested for functionality & proper operation in appropriate conditions as part of progress inspections

Simple systems: 503.3.1; Complex systems: 503.4.1
ASHRAE: Table 6.5.1

Economizer: Scenarios 1, 2

5. Unitary Equipment ? **Per Code, what are the minimum requirements that trigger use of economizers?**

Q1: A 20,000 ft^2 office building is served by RTUs: 10 units, each of 2-ton capacity & 10 units each of 4-ton capacity. Is Economizer required?

A: Yes, the total capacity of all units exceed 480,000 Btu/h or 40 Tons. Economizer is required at least for 5 of the 4-Ton units

Q2: A 20,000 ft^2 office building is served by mini ductless split AC units, 10 units @ 2 tons each & 10 units @ 4 tons each. Is Economizer required ?

A: Yes, use whole building method to prove compliance if the performance of the proposed exceeds baseline where at least 5 of the 4-ton units must be Economizers

Ventilation Rates

6. Ventilation Requirements ? **Which Standard applies for determining minimum ventilation rates?**

- Follow New York City Mechanical Code for fresh air requirements
  - Ventilation rates must equal or exceed requirements
  - Note: Safety Codes may require more generous Outdoor Air (OA) rates which must be followed
- Fresh air can be introduced by natural or mechanical means
  - Natural: Operable windows, doors, skylights, louvers
  - Mechanical: Supply, and return or exhaust fans
- If Outdoor Air (OA) is mechanically provided, the ventilation system must be capable of reducing the OA volume to minimum Code required levels

Demand Controlled Ventilation

6. Ventilation Requirements ? **Is the ventilation rate maintained as constant or variable?**

Code Requirement:

- Required for spaces greater than 500 ft² with an average occupant load of 40 persons / 1000 ft² and with at least one of the following:
  - Air-side Economizer
  - Automatic modulating control of OA damper OR
  - Design OA greater than 3000 CFM or higher

- **Exceptions:**
  - Systems with Energy Recovery
  - Multiple-zone systems without DDC
  - System with design OA flow less than 1200 CFM
  - Spaces where Supply Air minus Make-up Air / Transfer Air is less than 1200 CFM

Spaces With Estimated Occupancy Exceeding 40 Persons / 1000 Sf.	
Sports & Amusement	**Theatres**
Ballrooms & Discos	Auditoriums
Blowling Alleys (Seating Areas)	Lobbies
Game Rooms	Stages, Studios
Spectator Areas	Ticket Booths
Education	**Hotels, Motels, Resorts & Dorms**
Auditoriums	Assembly Rooms
Classrooms	Conference Rooms
Music Rooms	Gambling Casinos
Food & Beverage Service	**Transportation**
Bars, Cocktail Lounges	Platforms
Cafeteria, Fast Food	Waiting Rooms
Dining Rooms	Vehicles
Offices	**Correctional Facilities**
Conference Rooms	Dining Halls
Reception Areas	Guard Stations
Telecommunication Centers & Data Entry	Source: NYCMC

DCV: 503.2.5.1

The table above indicates highly occupied spaces as defined in the Energy and Mechanical Codes. These spaces are candidates for DCV.

Demand Controlled Ventilation

6. Ventilation Requirements ? **Is the ventilation rate maintained as constant or variable?**

Code Requirement:

- Required for spaces greater than 500 ft² with an average occupant load of 40 persons / 1000 ft² and with at least one of the following:
  - Air-side Economizer
  - Automatic modulating control of C
  - OR
  - Design OA greater than 3000 CFM

These are important exceptions!
Many single zone systems have less than 1200 cfm of OA, AND many spaces over 500 ft² may have less than 1200 cfm of supply air.
Example: Classroom:
1000ft² x 50 people / 1000 ft² x 15 CFM / person = 750 OA CFM

- **Exceptions:**
  - Systems with Energy Recovery
  - Multiple-zone systems without DDC
  - System with design OA flow less than 1200 CFM
  - Spaces where Supply Air minus Make-up Air / Transfer Air is less than 1200 CFM

Spaces With Estimated Occupancy Exceeding 40 Persons / 1000 Sf.	
Sports & Amusement	**Theatres**
Ballrooms & Discos	Auditoriums
Blowling Alleys (Seating Areas)	Lobbies
Game Rooms	Stages, Studios
Food & Beverage Service	**Transportation**
Bars, Cocktail Lounges	Platforms
Cafeteria, Fast Food	Waiting Rooms
Dining Rooms	Vehicles
Offices	**Correctional Facilities**
Conference Rooms	Dining Halls
Reception Areas	Guard Stations
Telecommunication Centers & Data Entry	Source: NYCMC

DCV: 503.2.5.1

The table above indicates highly occupied spaces as defined in the Energy and Mechanical Codes. These spaces are candidates for DCV.

Demand Controlled Ventilation

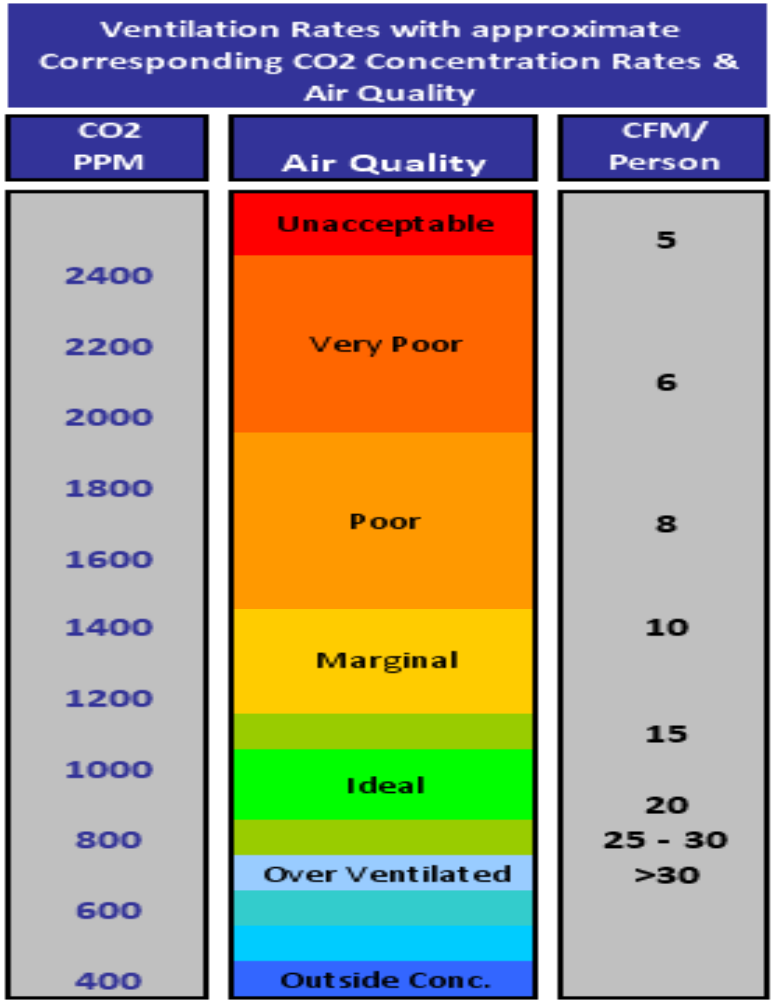
6. Ventilation Requirements ? **Which Standard applies for determining minimum ventilation rates?**

Function

- Develop energy efficiency strategy for large spaces with highly variable occupancy
- Vary the amount of fresh air based on real-time measurement of actual occupancy
- Reduces unnecessary volume of outdoor air resulting in lower heating, cooling & dehumidification loads

Technology

- Occupant density judged by CO2 readings by wall- or duct-mounted sensors
- Optimum is 600 PPM differential with outdoor ambient air, or approximately 1000 PPM absolute within zone



DCV: 503.2.5.1

The figure above illustrates the effectiveness of ventilation air quality associated with varying levels of CO_2 concentration.

Demand Controlled Ventilation

What are typical challenging situations for DCV application?

Existing Buildings:

- Pneumatic controls & actuators may need to be upgraded to electronic controls or DDC
- Dampers most likely will need repairs / upgrades to ensure modulation is accurate
- Utilize open – close sequence with a trigger range if dynamic control is not feasible

Complex (VAV) Systems:

- May require complex calculations & control sequences for outside air distribution with multiple critical zones impacting system performance
- Rigorous commissioning may be required to ensure all spaces are adequately ventilated

Demand Controlled Ventilation

What are typical challenging situations for DCV application?

Existing Buildings:

- Pneumatic controls & actuators may need to be upgraded to electronic controls or DDC
- Dampers most likely will need repairs / upgrades to ensure modulation is accurate
- Utilize open – close sequence with a trigger range if dynamic control is not feasible

Complex (VAV) Systems:

- May require complex calculations & control sequences for outside air distribution with multiple critical zones impacting system performance
- Rigorous commissioning may be required to ensure all spaces are adequately ventilated

Visual inspection of 20% or more of DCV controls required.

Must satisfy inspection requirements prior to final electrical and construction inspections.

Testing shall also be undertaken.

Commissioning following "ASHRAE Guideline 1" may be required.

DCV – Scenarios 1, 2 & 3

Which of the Following Scenarios are Required to Install DCV?

Scenarios:

S1: Building is served by Split AC systems and a Dedicated Outside Air System (DOAS) with design ventilation rate 2500 CFM

A: Not Required
Pre-requisite criteria are not met:
#1: No Economizer: Dedicated OA is only sized for fresh-air ventilation loads
#2: Modulating control of OA damper is usually not found in DOAS
#3: Design OA is less than 3000 CFM

S2: Building is equipped with VAV system and an air-side Economizer. Individual zones have stand-alone thermostats that control respective VAV boxes. No DDC is present.

A: Not required
Exception #2: Without DDC control, fresh air in multi-zone systems cannot be supplied accurately

S3: Packaged Roof Top Unit (RTU) serves three classrooms each 1000 ft^2. Each zone has a stand-alone thermostat and air delivery is via DDC Variable Air Volume boxes. The system has Economizer controls. Does the Code require DCV for this RTU?

A: The Design OA is 2,250cfm, but system has Economizer.
The system does not qualify for exceptions related to energy recovery, DDC control, or minimum system OA.
Depends upon the design airflow for each space.

Energy Recovery Ventilation (ERV) Systems

When is ERV required?

Requirement for ERV:

- Individual fan system 5000 CFM or greater

  AND
- 70% or greater outside air (OA)

ERV Efficiency Requirement:

- Minimum of 50% total energy recovery

ERV Construction / Control Requirement:

- Must incorporate a bypass or
- Accommodate Economizer capability to permit free cooling

Pressure drop credit available for Fan Power Limit Calculation – refer to Fan Power System slides

Energy Recovery Ventilation: Exceptions

What are allowable exceptional conditions for waiving ERV requirement?

Exceptions for ERV requirement:

- Where prohibited by NYC Construction Codes
- Lab fume hood systems
  - VAV supply and hood with turn-down volume to 50% or less;

  OR
  - At least 75% direct make-up air heated to 2°F or less, or cooled to 3°F or more of room temperature AND no humidification or dehumidification controls
- Spaces without cooling AND heated to 60°F or lower space temperature
- Site recovered heat or solar energy for 60% of Outdoor Air (OA) heating
- Series-style Energy Recovery Ventilation is used for dehumidification

Photo: Courtesy of DOE/NREL

Visual inspection of 20% or more of Energy Recovery Ventilation systems & associated controls are required.

Testing shall also be undertaken at appropriate season for verifying functionality.

Energy Recovery Ventilation Systems

What are the available technology options for energy recovery?

Energy Recovery Ventilator Types:

- Recovers both sensible and latent energy
  - Desiccant Wheels
  - Liquid Desiccants

Heat Recovery Ventilator (Alternative):

- Recovers only sensible energy
  - Heat-pipe Heat Exchangers
  - Plate Heat Exchangers
  - Run-around Coils

Note that it often very difficult to achieve code compliant performance requirements with these type of energy recovery systems.

7. Mandatory Controls

In this section you will learn about:

- Zone-level controls including programmable thermostats, set-back and shut-off controls;
- Unitary equipment level controls; and
- System-level controls including reheat, damper & hydronic controls that apply to simple and complex HVAC.

Thermostat Controls - Zones

How does zoning impact thermostat placement?

Zone-Level Control:

- Each zone should have an individual thermostat
- Multiple perimeter zones allowed to share thermostat if:
  - The zones have independent perimeter system for envelope loads
  - Each orientation requires independent thermostat
  - The thermostat is located in the zone

System-Level Control:

- Humidity control device required if humidification or dehumidification is provided.

Reference: 503.2.4.1

Thermostat Controls - Set Point Restrictions

How to avoid frequent switching between heating and cooling in a space:

Set Point Overlap Restriction:

- Applies if thermostat controls both heating and cooling equipment
  - Important when multiple systems serve a single space:
    - » Reduce perimeter heating systems to avoid conflict with central air cooling systems
    - » Avoid excessive reheat and optimize sub-cooling
- 5°F dead band for change-over between providing cooling and heating
  - Equipment (single-zone system or terminal device) must be shut off or capacity reduced to minimum.
    - » Intent: Avoid unnecessary reheating or recooling at the dead band range

Visual inspection required in 20% or higher sample of units for effective operation of set point overlap restrictions, dead band

Reference: 503.2.4.2

Thermostat Controls: Off Hour Controls

What are temperature set back requirements?

Off-Hour Controls:

- Thermostatic Set-Back
  - Each zone shall have automatic time clock or programmable control system for set-back
  - Exceptions:
    - » Zones that operate continuously; Data centers, operating theatres, etc
    - » Zones with small loads peak less than 6800 Btu/h or 0.57 Tons & manual shut-down is provided
  - Capability to set back to 55°F (Winter) & 85°F (Summer)
    - » Pick up loads to be considered
    - » Use advanced DDC functions like predictive and adaptive sequences for effective utilization of set-back controls

	Cooling	Heating
Set Point	75°F	70°F
Set Back	85°F	55°F

Visual inspection required in 20% or higher sample of units for effective operation of set points, set-backs and off-hour controls

Code only requires that thermostat be capable of set-back to the prescribed temperatures or greater in summer and lower in winter.

Actual set-back values used in the field are not established by Code, but must be listed in sequences of operation, and checked during progress inspections.

Thermostat Controls: Automatic Set-Back/Shut-Down

What are required memory and control features in the thermostats?

Thermostat - Automatic Set-Back & Shut-Down:

- Automatic Start-Stop capability
  - Intent: Avoid unnecessary conditioning of space during unoccupied period
- Seven (7) independent daily schedules per week
- Retain programming & time setting during loss of power for 10 hours
- Manual over-ride for temporary adjustment, up to 2 hours or occupancy-sensor based set-back controls
  - Intent: Prevent changes to programming of master schedule for short- term events

Reference: 503.2.4.3.1, 503.2.4.3.2

Outside Air Damper Requirements & Controls

? **What scenarios require motorize dampers?**

Motorized Damper Requirements:

- Outdoor Air (OA) supply & exhaust ducts must have motorized dampers with automatic shut-off when system or space not in use.

- Gravity dampers allowed if building is less than 3 floors or air volume is less than 300 CFM

Snow / Ice Melt System Controls

What are the control requirements for snow/ice melt systems?

Controls Requirement:

- Compliance required If snow melt system's energy (hot water or electricity or fuel) is supplied from building
- Automatic shut-off when pavement temperature is above 50°F AND no precipitation
  - Use pavement temperature sensor & snow / precipitation detector
- Provision for automatic or manual shut-off control when Outdoor Air (OA) temperature is above 40°F

8. Distribution Systems

Sub-Module Overview

In this section you will learn about:

- Fan power allowance calculations and taking credits for special devices;
- Duct and pipe insulation requirements.

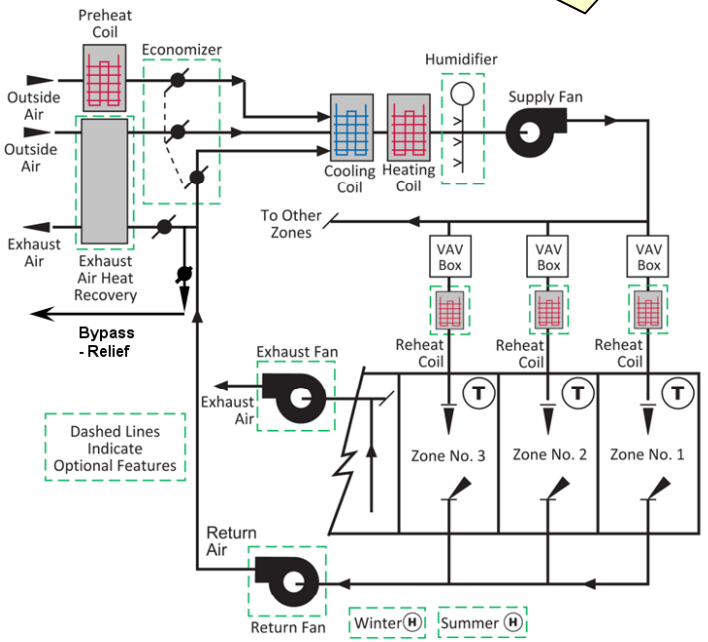
Fan Power Limit - 1

What is regulated in ventilation system fans?

MANDATORY REQUIREMENT

- Fans are typically the second largest energy user in HVAC system
- **At system level:**
  - Total allowance for system fan power
    - » Applies to fan systems if total name plate HP greater than 5 HP
    - » Allowance for all fans combined:
    - » Supply + Return + Exhaust
  - **Exceptions:**
    - » Individual exhaust fans less than 1 HP (name plate)
    - » Fume hood exhaust fans
      - However, allowance is reduced for remaining fans
- **At individual fan level:**
  - » First available motor size greater than fan brake HP
    - Fan BHP must be indicated on schedules

Total fan power limit applies to all fans combined per system:
Supply + Return + Exhaust



Fan System power: 503.2.10, Tables 503.1.10(1) & (2)

Fan Power Limit - 2

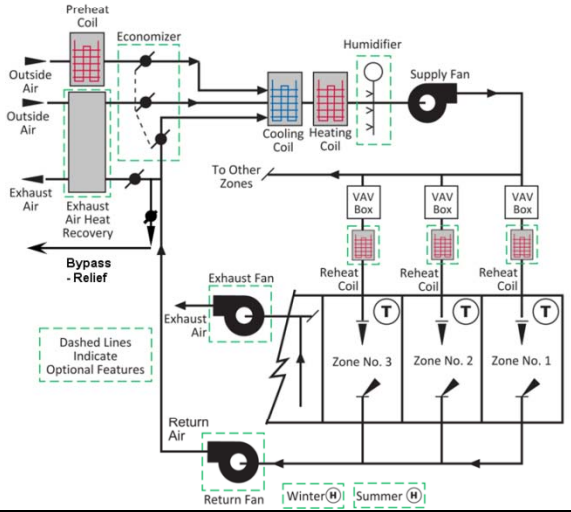
How is fan sizing or power allowance calculated?

Fan Power Calculations:

- Different multiplication factors for Constant Air Volume (CAV) and Variable Air Volume (VAV) systems
  - VAV multipliers can be used for CAV systems in Hospital & Lab systems with flow control devices on exhaust or return
- **Option 1: Name Plate HP Limit**
  - No credit for special features that increase fan power requirements
  - HP = CFM_s x K
- **Option 2: System BHP Limit**
  - Additional allowances for special features based on an adjustment (A)
  - BHP = CFM_s x K + A
  - A = Sum of PD x CFM_d / 4131

Table 503.2.10.1(1)		Fan Power Limitation	
Option	Limit	Constant Volume	Variable Volume
1	Allowable Fan System Nameplate Motor hp	hp <= CFMs x 0.0011	hp <= CFMs x 0.0015
2	Allowable Fan System bhp	bhp <= CFMs x 0.00094 + A	bhp <= CFMs x 0.0013 + A

CFMs	Max. design supply air flow @ rated conditions
CFMd	Max. flow rate through a device
hp	Max. combine motor name plate horsepower
bhp	Max. combined break horsepower
A	Sum of [PD x CFMd / 4131]
PD	Total of all applicable pressure drop adjustment



Fan System power: 503.2.10, Tables 503.1.10(1) & (2)

Fan Power Limit - 2

How is fan sizing or power allowance calculated?

Fan Power Calculations:

- Different multiplication factors for Constant Air Volume (CAV) and Variable Air Volume (VAV) systems
  - VAV multipliers can be used for CAV systems in Hospital & Lab systems with flow control devices on exhaust or return
- **Option 1: Name Plate HP Limit**
  - No credit for special features that increase fan power requirements
  - HP = CFM_s x K
- **Option 2: System BHP Limit**
  - Additional allowances for special [illegible] based on an adjustment (A)
  - BHP = CFM_s x K + A
  - A = Sum of PD x CFM_d / 4131

Table 503.2.10.1(1)		Fan Power Limitation	
Option	Limit	Constant Volume	Variable Volume
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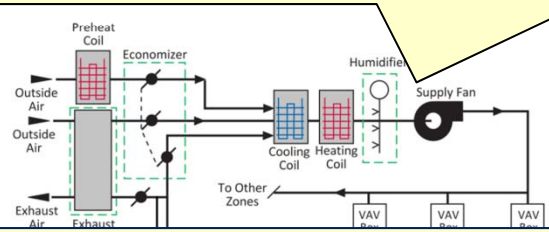
CFMd	Max. flow rate through a device
hp	Max. combine motor name plate horsepower
bhp	Max. combined break horsepower
A	Sum of [PD x CFMd / 4131]
PD	Total of all applicable pressure drop adjustment

Total Fan Power Limit applies to all fans combined per system:
Supply + Return + Exhaust



NYCECC does not define CFM_d. Per ASHRAE 90.1-2007, which defines CFM_d as the airflow through the device.
For example, if there is heat recovery for only the min. OA, then the CFM_d is based on min. OA CFM, not the supply CFM of the unit.

Fan System power: 503.2.10, Tables 503.1.10(1) & (2)

Fan Power Limit - 3

How does the presence of special devices in air system impact fan power?

Pressure Drop Adjustment:

- 10 Credits:
  - Fully Ducted Return / Exhaust
  - Return / Exhaust airflow control
  - Exhaust treatment
  - Filters MERV 9 & higher
  - Heat Recovery
  - Evaporative humidifier / coolers
  - Sound Attenuation

AND

Fume Hood Exhaust Exception:

- No exhaust side credits allowed for devices or ducts
- AND
- The calculation must DEDUCT 1 in w.c.

Table 503.2.10.1(1)	Fan Power Limitation: Pressure Drop Adjustment
Device	**PD Adjustment**
Credits	
Fully Ducted Return and/or exhaust air system	0.5 in. w.c.
Return and/or exhaust airflow control devices	0.5 in. w.c.
Exhaust filters, scrubbers or other exhaust treatment	PD @ design condition
Particulate filteration credit Merv 9 thru 12	0.5 in. w.c.
Particulate filteration credit Merv 13 thru 15	0.9 in. w.c.
Particulate filteration credit Merv 16 & greater & electronically enhanced filters	PD @ 2x clean filter at design condition
Carbon & other gas phase filters	PD @ clean filter at design condition
Heat recovery device	PD @ design condition
Evaporative humidified / cooler in series with another cooling coil	PD @ design condition
Sound attenuation section	0.15 in. w.c.
Deductions	
Fume hood exhaust exception	1.0 in. w.c.

Fan Power Limit - 3

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Pressure Drop Adjustment:

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  - Fully Ducted Return / Exhaust
  - Return / Exhaust airflow control
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  - Filters MERV 9 & higher
  - Heat Recovery
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Ca… other gas phase filters	PD @ clean filter at design condition
Heat …y device	PD @ design condition
Evapora… idified / cooler in series with another cooling co…	PD @ design condition
Sound attenua…	0.15 in. w.c.
Deductions	
Fume hood exhaust	1.0 in. w.c.

The credit refers to terminal units that control return and exhaust airflow. These include VAV exhaust boxes, and air control valves. CFM_d would be the airflow through these devices.

CFM_d would be the exhaust airflow through the fume hood exhaust system.

Ducts & Plenum Construction

? What are construction, insulation and testing requirements for ducts?

Insulation Requirements:

- R-5 if located in unconditioned space within the building enclosure (outside thermal envelope)
- R-8 if located outside the building
- R-8 within the building envelope assembly between the duct and the outside

Air Sealing Requirements:

- NYC Mechanical Code, SMACNA Duct construction standards, UL 181A or UL 181B
- Welds, Gaskets, Mastic (Adhesive), Mastic plus-embedded-fabric systems, Tapes are allowed methods for air-sealing ducts
- Leak Testing (for High-Pressure Duct systems):
  - SMACNA HVAC Air Duct Leakage Test Manual
  - Air Leakage Rate (CL) less than 6.0
    - » $CL = F \times P^{0.65}$
    - » F = Measured Leakage Rate in CFM/100 ft^2 duct surface
    - » P = Static Pressure of test

Pressure (in. w.c.)	Duct System Classification	Special Requirements
> 3.0	**High Pressure**	Typical insulation & Air Sealing & Drawing Notation + Leak Test
> 2.0 & ≤ 3.0	**Medium Pressure**	Typical insulation & Air Sealing & Drawing Notation
≤ 2.0	**Low Pressure**	Typical insulation & Air Sealing & Drawing Notation

Image Courtesy of DOE / NREL

Table 503.2.10.1(2)

Ducts & Plenum Construction

What are construction, insulation and testing requirements for ducts?

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Pressure (in. w.c.)	Duct System Classification	Special Requirements
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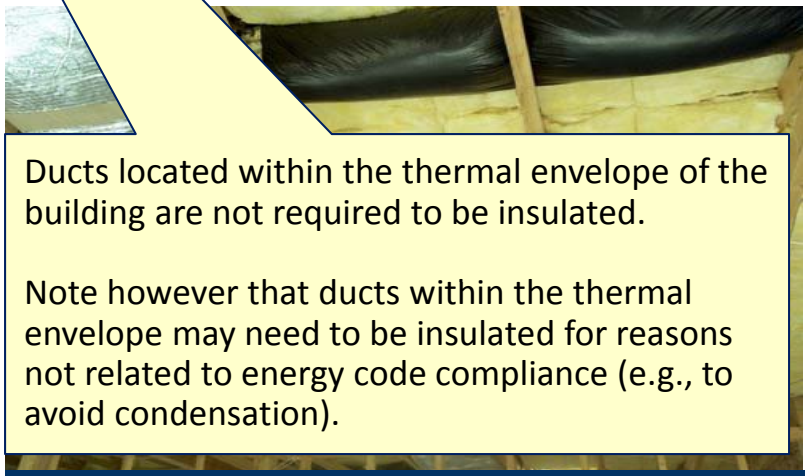
> 2.0 & ≤ 3.0	**Medium Pressure**	Typical insulation & Air Sealing & Drawing Notation
0	**Low Pressure**	Typical insulation & Air Sealing & Drawing Notation



Ducts located within the thermal envelope of the building are not required to be insulated.

Note however that ducts within the thermal envelope may need to be insulated for reasons not related to energy code compliance (e.g., to avoid condensation).

Image Courtesy of DOE / NREL

Piping Insulation

What are minimum insulation requirement for pipes?

HVAC System piping to be insulated:

- 1.5” of insulation for any chilled water, brine & refrigerant pipes, and steam and hot water pipes ≤ 1.5” diameter
- 3” of insulation for steam pipe > 1.5” diameter
- 2” of insulation for hot water pipe > 1.5” diameter
- Exceptions
  - Factory-installed piping with HVAC equipment, fan coils, unit ventilators
  - Piping with fluids between 55°F to 105°F
  - Piping with fluids not heated or cooled using fossil fuels (or electric power)
  - Run-out piping between control valve & coil
  - IF ≤ 4’ length AND ≤1” diameter

Thickness based on insulation conductivity < 0.27 (Btu/inch)/(h-ft2-F).

The code includes an adjustment calculation for insulations with other conductivities.

HVAC System Completion

? What is required for balancing and O&M manuals?

Air System Balancing:

- Each supply air outlet and zone terminal device must be equipped with means for air balancing
- Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (7.46 kW) and larger

Hydronic System Balancing:

- Individual hydronic heating and cooling coils must have a means for balancing and pressure test connections

Manuals:

- The construction documents must require an O&M manual be provided to the building owner by the mechanical contractor. The manual must include:
  - Equipment capacity (input and output) and required maintenance actions.
  - Equipment O&M manuals.
  - HVAC system control maintenance and calibration information, including:
    - » Wiring diagrams, schematics, and control sequence descriptions.
    - » Desired or field-determined set points shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.
  - A complete written narrative of how each system is intended to operate.

9. Case Study Exercise

Slides 86 to 91

Sub-Module Overview

In this section you will learn about:

- The minimum Code requirements for an example of a mid-sized auditorium;
- Applicable inspection items

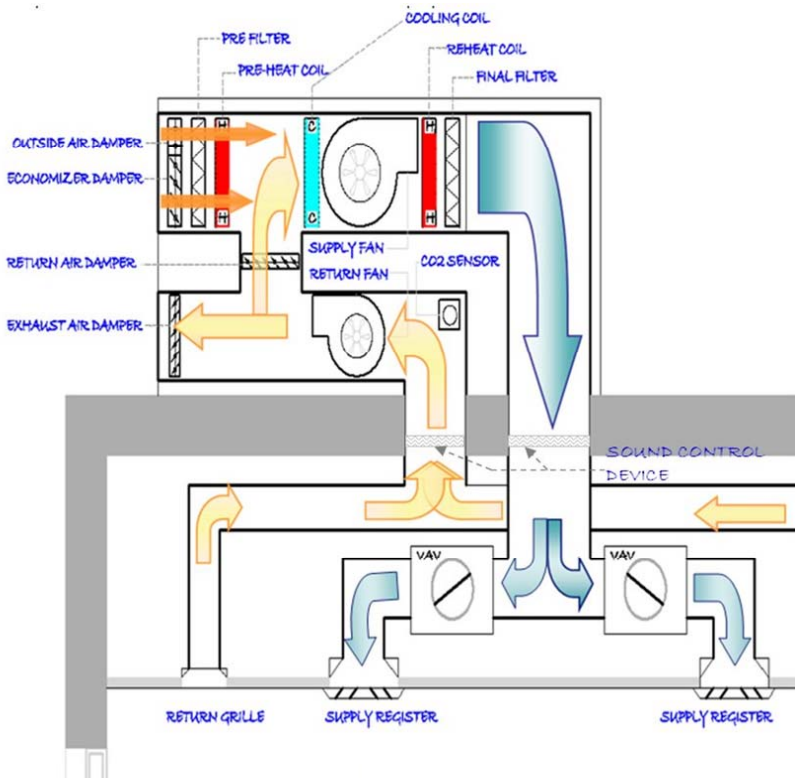
Case – 1: Description

? What are Energy Code requirements for the following systems?:

Proposed System:

- Space Type:
  - 2000 ft2 Auditorium
- Proposed AC / Heating System
  - 20 Ton Air Cooled DX Roof Top Unit
  - 500 MBH gas fired furnace
  - Variable Air Volume control
  - Powered by supply and return fans
  - Ducted supply and return
- Fresh Air
  - Total design supply air is 8,000 CFM and design Outdoor Air (OA) is 4,500 CFM;
  - System is specified with MERV 8 pre filter and MERV 13 final filter; and
  - Sound attenuation section is incorporated in the supply & return duct to mitigate supply fan's noise.

What are minimum compliance requirements for this system?

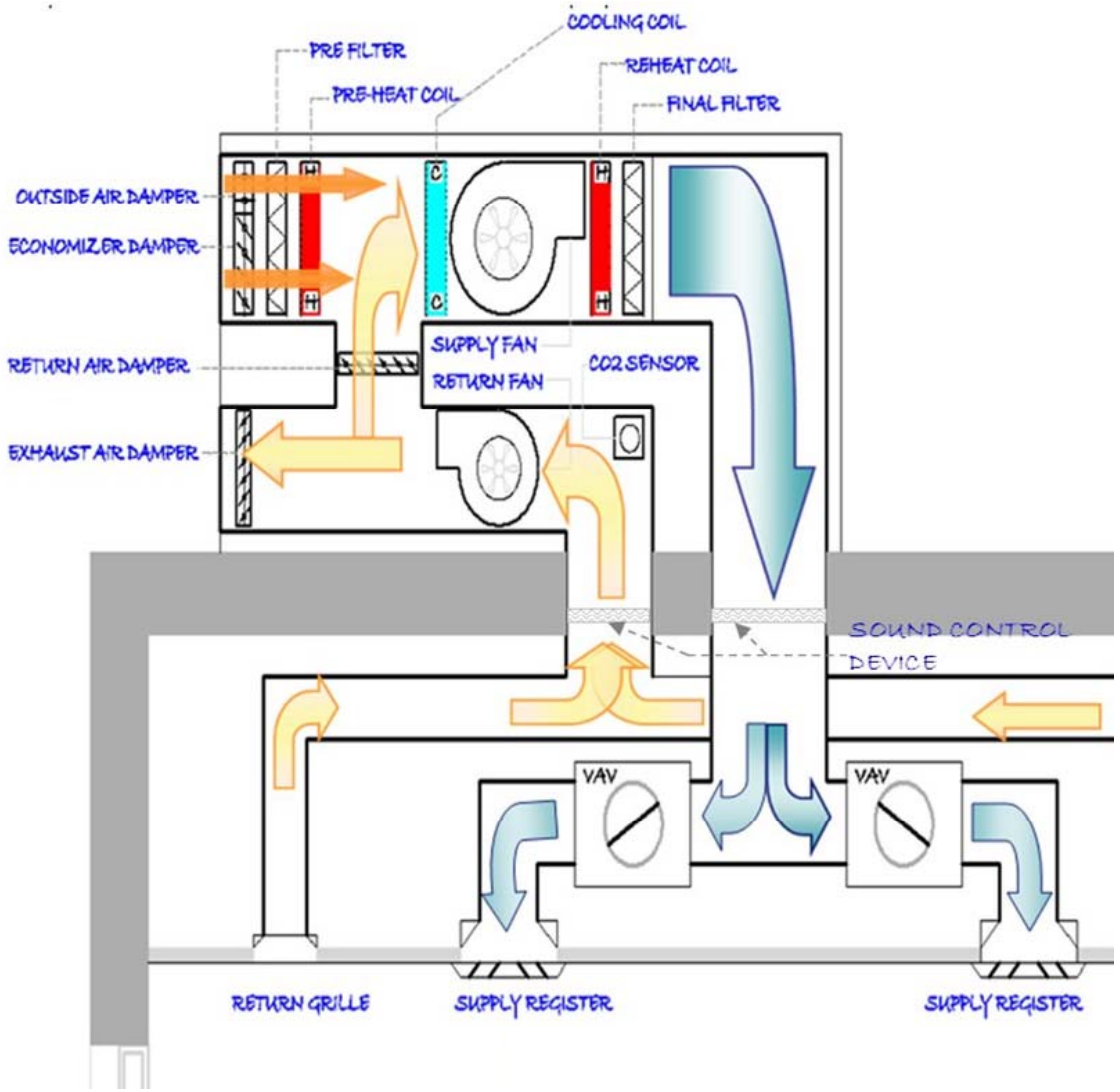


Case – 1: Solution 1

? **Summarize applicable regulated features**

Key Requirements:

- Cooling & Heating Equipment Efficiency
- Economizer
- Damper Controls
- Demand Controlled Ventilation
- Fan Power Allowance
  - Supply + Return fan
  - Pressure credit for MERV 13 filter, ducted supply & return, sound attenuation
- Thermostat Controls

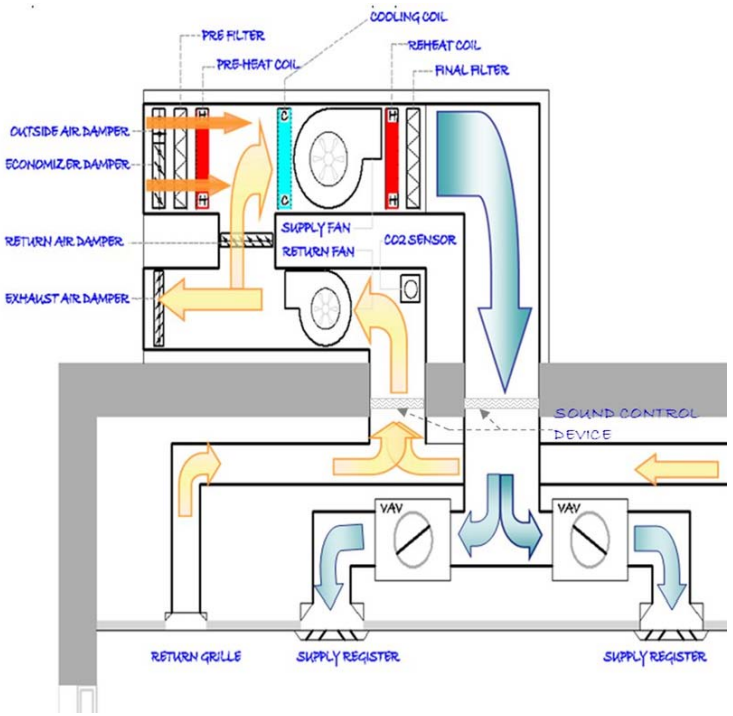


Case – 1: Solution 2

? **Determine equipment sizing & efficiency requirements**

Required Equipment Sizing & Efficiency:

- Load Calculations:
  - Calculation method must follow procedures as prescribed in ASHRAE/ACCA 183 Standard
    - » Single equipment, so no exception
    - » Load sizing based on 75˚F Cooling & 72˚F Heating set points
- HVAC Type: Simple
  - Single packaged unit serving one zone
- Cooling Efficiency
  - EER: 9.8 & IPLV: 9.5
  - Includes 0.2 EER allowance for non-electric heat
  - Hot Gas Bypass: Allowed if the unit has multistep unloading and limited to 50% capacity
- Heating Efficiency
  - 80% Et



Case – 1: Solution 2

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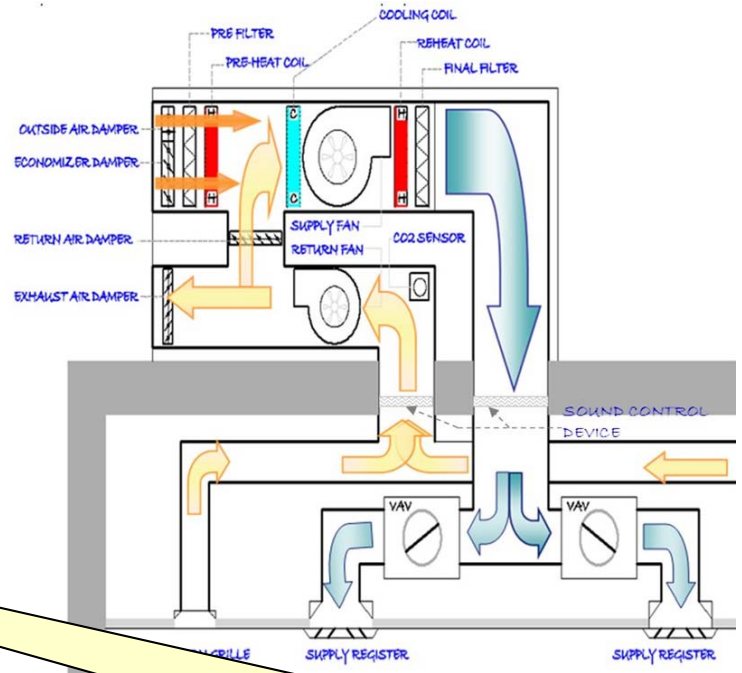
- HVAC Type: Simple
  - Single packaged unit serving one zone
- Cooling Efficiency
  - EER: 9.8 & IPLV: 9.5
  - Includes 0.2 EER allowance for non-electric heat
  - Hot Gas Bypass: Allowed if the unit has multistep unloading and limited to 50% capacity
- Heating Efficiency
  - 80% Et

Verify unit sizing is within reasonable range from zone peak load calculations



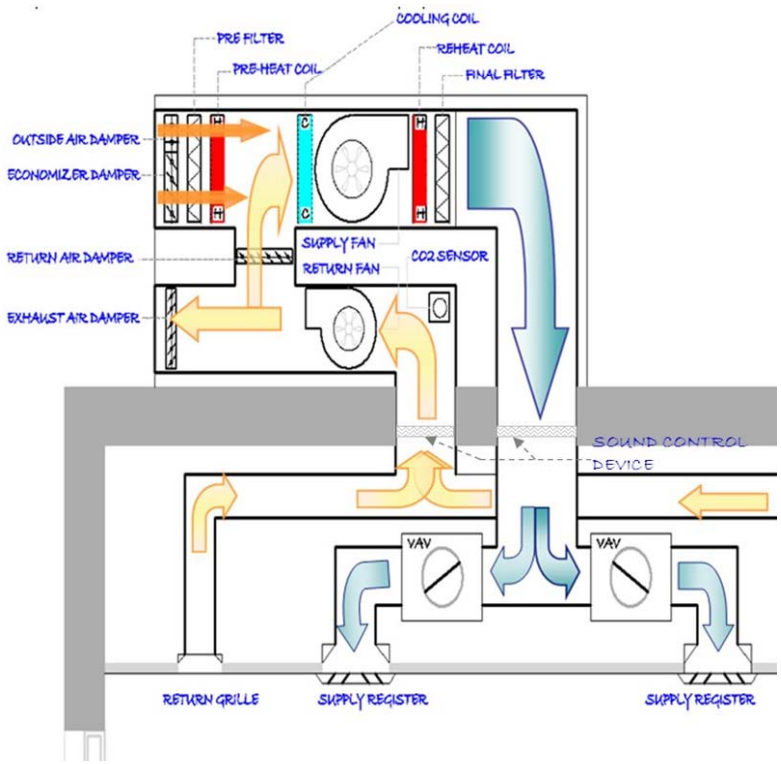
Verify efficiency values in drawings and at name plate during progress inspections

Case – 1: Solution 3

? **List applicable efficiency features**

Efficiency Features & Controls:

- Economizer: Required
  - Cooling capacity greater than 54,000 Btu/h or 4.5 Tons
  - Ventilation Rate: NYC Mechanical Code
  - 2,000 ft^2 x 150 people/1000 ft^2 x 15 cfm/person = 4,500 CFM
- Demand Control Ventilation: Required
  - Space greater than 500 ft^2 AND occupant density is greater than 40 person/1000 ft^2
- Energy Recovery: Not required
  - Design Outside Air volume less than 70% of system volume
- Damper Control
  - Motorized Outdoor Supply Air & Exhaust damper w/ automatic shut-off for unoccupied periods
    - » Outside Air Volume greater than 300 CFM
- Thermostatic Controls:
  - 5°F Dead band
  - Automatic setback
  - Programmable for auto shut off with 7 unique day schedules



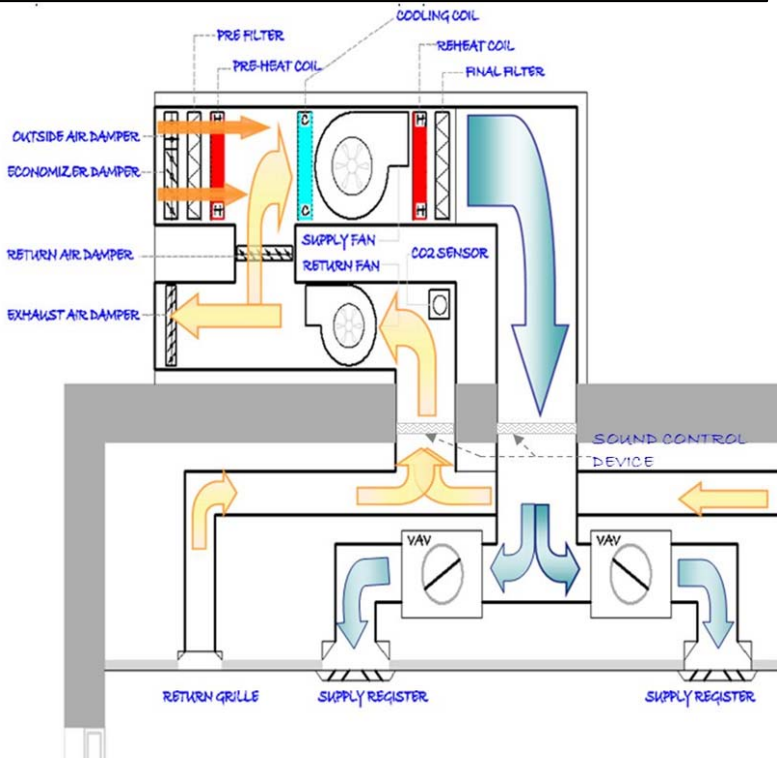
Case – 1: Solution 3

? **List applicable efficiency features**

Efficiency Features & Controls:

- Economizer: Required
  - Cooling capacity greater than 54,000 Btu/h or 4.5 Tons
  - Ventilation Rate: NYC Mechanical Code
  - 2,000 ft^2 x 150 people/1000 ft^2 x 15 cfm/person = 4,500 CFM
- Demand Control Ventilation: Required
  - Space greater than 500 ft^2 AND occupant density is greater than 40 person/1000 ft^2
- Energy Recovery: Not required
  - Design Outside Air volume less than 70% of system volume
- Damper Control
  - Motorized Outdoor Supply Air & Exhaust damper w/ automatic shut-off for unoccupied periods
    - » Outside Air Volume greater than 300 CFM
- Thermostatic Controls:
  - 5°F Dead band
  - Automatic setback
  - Programmable for auto shut off with 7 unique day schedules

Verify operation of Economizer (seasonal test), DCV sensors, motorized dampers & thermostatic controls at progress inspections



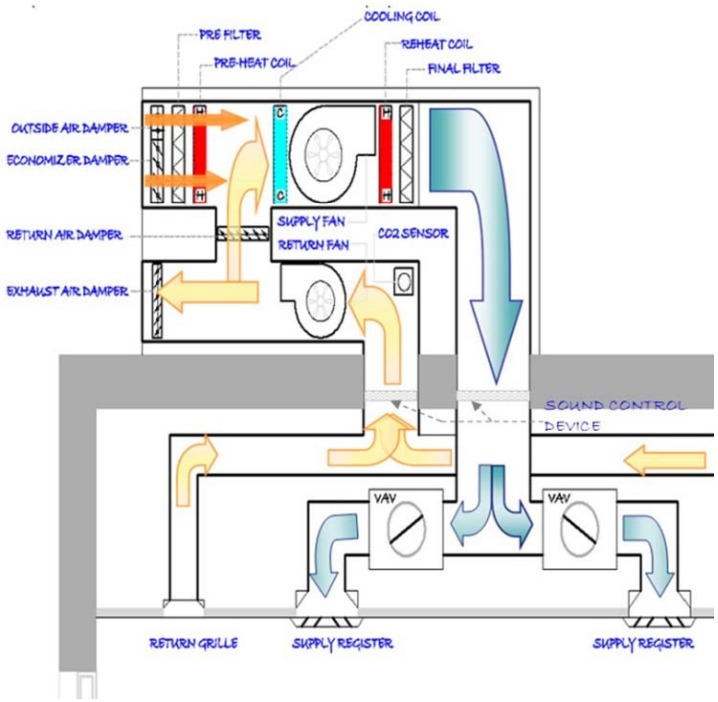
Case – 1: Solution 4

? **Determine sizing & efficiency requirements**

Fans & Ducts:

- Fan Power Allowance
  - Compliance required as total Fan system's name plate HP exceeds 5 HP.
- Option 1: Fan System Name Plate HP:
  Supply = 10 HP; Return = 5.0 HP
  Total 15 HP (total for all fans)
  - Allowance VAV: (8000 x 0.0015) = 12.0
- Option 2: Fan System BHP:
  Supply = 8 BHP; Return = 4 BHP
  Total 12 BHP (total for all fans)
  - Allowance VAV: (8000 x 0.0013 + 3.29) = 13.69 BHP

Device	PD Credit	CFMd	A @Device
Fully Ducted Return / Exhaust	0.5	8000	0.97
Particulate filtration credit: MERV 13	0.9	8000	1.74
Sound Attenuation Device - Supply	0.15	8000	0.29
Sound Attenuation Device - Return	0.15	8000	0.29
A = Sum of [PD credit x CFMd / 4131]		Total A	**3.29**



Duct Pressure Classification:

- Medium Pressure: 2.75 in. W.C.
  - Less than 3.0 in. W.C. – Testing is not required

Case – 1: Solution 4

? **Determine sizing & efficiency requirements**

Fans & Ducts:

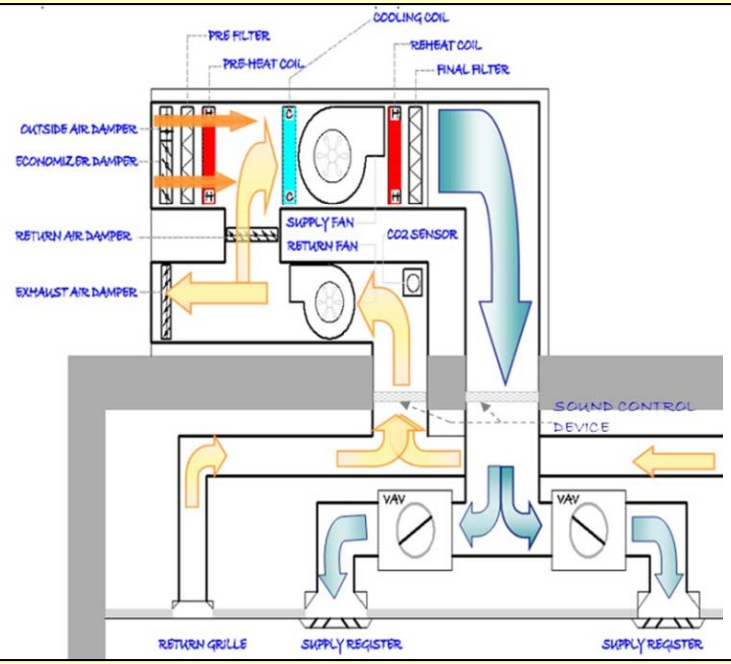
- Fan Power Allowance
  - Compliance required as total Fan system's name plate HP exceeds 5 HP.
- Option 1: Fan System Name Plate HP:
  Supply = 10 HP; Return = 5.0 HP
  Total 15 HP (total for all fans)
  - Allowance VAV: (8000 x 0.0015) = 12.0
- Option 2: Fan System BHP:
  Supply = 8 BHP; Return = 4 BHP
  Total 12 BHP (total for all fans)
  - Allowance VAV: (8000 x 0.0013 + 3.29) = 13.69 BHP

Device	PD Credit	CFMd	A @Device
Fully Ducted Return / Exhaust	0.5	8000	0.97
Particulate filtration credit: MERV 13	0.9	8000	1.74
Sound Attenuation Device - Supply	0.15	8000	0.29
Sound Attenuation Device - Return	0.15	8000	0.29
A = Sum of [PD credit x CFMd / 4131]		Total A	**3.29**

Duct Pressure Classification:

- Medium Pressure: 2.75 in. W.C.
  - Less than 3.0 in. W.C. – Testing is not required

Review calculations and verify fan motor sizes on drawings & at Progress Inspections



Progress Inspection and testing of controls – thermostats & set points, Economizer, DCV, VAV fan operation, dampers, visual inspection of duct air sealing

Building HVAC and Service Hot Water (SHW)

Slides 92 to 119

10. Submissions & Inspections

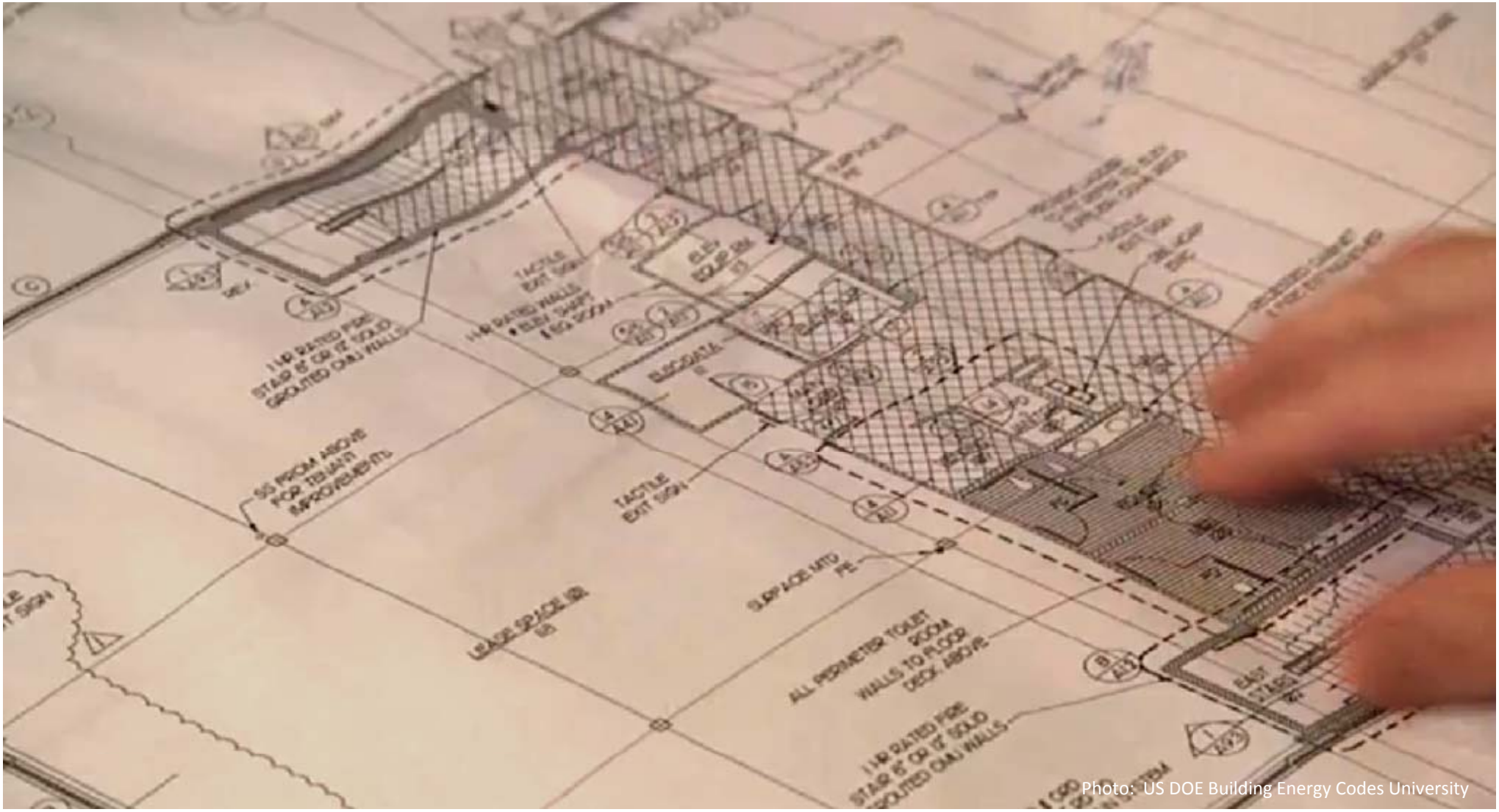


Photo: US DOE Building Energy Codes University

10. Submissions & Inspections

Learning Objectives

In this section you will learn about:

- HVAC and SHW related requirements for NYCECC Submissions, including:
  - Energy Analysis, and
  - Supporting Documentation
- Applicable Progress Inspections associated with HVAC and SHW Systems.

NYCECC and Applications

? What are the application requirements related to the NYCECC?

Per 1 RCNY §5000-01:

- A Professional Statement
- An Owner Statement
- An Energy Analysis
- Supporting Documentation, including required Progress Inspections

This HVAC Module addresses only Energy Analysis, Supporting Documentation, and Progress Inspection issues. A full overview of the required submission documents, including Professional and Owner Statements, is included under the NYCECC Administrative Overview module in this series.

Energy Analysis

? What types of Energy Analysis are allowed?

Per 1 RCNY §5000-01:

- Tabular Analysis
- COMcheck software
- Energy Modeling
- Alternative Formats

? **How should the HVAC/SHW be addressed in the Energy Analysis?**

Option 1: Tabular Analysis

- The Tabular Analysis compares proposed values of each NYCECC-regulated item in the scope of work with the respective prescriptive values required by the Code.
  - Applicable to New Buildings, Additions, or Alterations
  - Demonstrates Prescriptive Compliance
  - Can be used with either NYCECC or ASHRAE 90.1

Sample Tabular Analysis - 1

Examples of notes for commercial alterations / renovations

NYCECC Citation	Provision	Item Description	Proposed Design Value	Code Prescriptive Value	Supporting Documentation
Building Mechanical Systems		Building Mechanical Systems			
503.2	Mandatory Provisions	Mandatory Provisions			
503.2.1	Calculation of heating and cooling loads	Minimum and maximum temperatures for interior design load calculations	N/A	ASHRAE/ACCA 183 ASHRAE HVAC Systems and Equipment Handbook, chapter 3 Energy Code	Signed and Sealed statement from Engineer certifying compliance with Energy Code
503.2.2	Equipment and system sizing	Heating and cooling equipment shall not exceed calculated loads		Heating and cooling equipment shall not exceed calculated loads	Signed and Sealed statement from Engineer certifying compliance with Energy Code
503.2.3	HVAC Equipment Performance Requirements	HVAC Equipment Performance Requirements			
Table 503.2.3(1)	Unitary air conditioners, condensing units, electrically operated, minimum efficiency requirements	Split System 5 ton air cooled AC unit, AC-1	12.0 EER	11.2 EER	Split System AC units schedule, drawing M-300
Table 503.2.3(1)	Unitary air conditioners, condensing units, electrically operated, minimum efficiency requirements	Through the Wall AC unit, 1 ton, AC-2	12.5 SEER	12.0 SEER	Through the wall AC units schedule, drawing M-300
Table 503.2.3(2)	Unitary and applied heat pumps, electrically operated, minimum efficiency requirements	3 ton air cooled heat pump, single package, HP-1	13.2 SEER	13.0 SEER	AC units schedule, drawing M-300
Table 503.2.3(3)	Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps	PTAC (Cooling Mode) Replacement, 12,000 BTU, PTAC-1	9.8 EER	10.9-(12000/1000) EER=8.344 EER	PTAC AC units schedule, drawing M-301
Table 503.2.3(4)	Warm air furnaces and combination warm air furnaces/air-conditioning units, warm air duct furnaces and unit heaters	N/A	N/A	N/A	N/A
Table 503.2.3(5)	Boilers, Gas and Oil Fired	Oil fired, 250,000 Btu input, B-1	82% AFUE	80% AFUE	Boiler schedule, drawing M-301
Table 503.2.3(6)	Condensing Units, Electrically operated	N/A	N/A	Table 503.2.3(6)	N/A

Sample Tabular Analysis - 1

Examples of notes for commercial alterations / renovations

NYCECC Citation	Provision	Item Description	Proposed Design Value	Code Prescriptive Value	Supporting Documentation
Building Mechanical Systems		Building Mechanical S			
503.2	Mandatory Provisions	Mandatory Provisions			
503.2.1	Calculation of heating and cooling loads	Minimum and maximum temperatures for interior de load calculations		E HVAC ndbook,	Signed and Sealed statement from Engineer certifying compliance with Energy Code
503.2.2	Equipment and system sizing	Heating and cooling equipn shall not exceed calculated		nent shall s	Signed and Sealed statement from Engineer certifying compliance with Energy Code
503.2.3	HVAC Equipment Performance Requirements	HVAC Equipment Performance Requirements			
Table 503.2.3(1)	Unitary air conditioners, condensing units, electrically operated, minimum efficiency requirements	Split System 5 ton air cooled AC unit, AC-1	12.0 EER	11.2 EER	Split System AC units schedule, drawing M-300
Table 503.2.3(1)	Unitary air conditioners, condensing units, electrically operated, minimum efficiency requirements	Through the Wall AC unit, 1 ton, AC-2	12.5 SEER	12.0 SEER	Through the wall AC units schedule, drawing M-300
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Table 503.2.3(3)	Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps	PTAC (Cooling Mode) Replacement, 12,000 BTU, PTAC-1	9.8 EER	10.9-(12000/1000) EER=8.344 EER	PTAC AC units schedule, drawing M-301
Table 503.2.3(4)	Warm air furnaces and combination warm air furnaces/air-conditioning units, warm air duct furnaces and unit heaters	N/A	N/A	N/A	N/A
Table 503.2.3(5)	Boilers, Gas and Oil Fired	Oil fired, 250,000 Btu input, B-1	82% AFUE	80% AFUE	Boiler schedule, drawing M-301
Table 503.2.3(6)	Condensing Units, Electrically operated	N/A	N/A	Table 503.2.3(6)	N/A

Applicants must include reference to the applicable Supporting Documentation for EACH item within the Tabular Analysis.

Sample Tabular Analysis - 2

10. Submissions & Inspections

Examples of notes for commercial alterations / renovations

NYCECC Citation	Provision	Item Description	Proposed Design Value	Code Prescriptive Value	Supporting Documentation
503.4.5.1	Single duct VAV system, terminal devices	N/A	N/A	Terminal devices shall be capable of reducing primary supply air before reheating or recooling takes place	N/A
503.4.5.2	Dual duct and mixing VAV systems, terminal devices	N/A	N/A	Terminal devices shall be capable of reducing air from one duct to a minimum before mixing takes place	N/A
503.4.5.3	Single fan dual duct and mixing VAV systems, economizers	N/A	N/A	Individual dual duct or mixing heating and cooling systems with a single fan and capacities greater than 90,000 Btu/h shall not be equipped with air economizers	N/A
503.4.5.4	VAV System with Multiple Zone, supply-air temperature reset controls*	N/A	N/A	Control system shall automatically reset supply-air temperature in response to building load or O.A. temperature	N/A
503.4.6	Heat Recovery for Service Water Heating for systems*	N/A	N/A	Provide condenser water heat recovery, required for 24 hr/day operations, with water cooled systems over 6 million btu/h	N/A
503.4.7, table 503.4.7	Hot Gas Bypass Limitation	N/A	N/A	Hot gas bypass is allowed only on systems with multiple steps of unloading or continuous capacity modulation. Allowed Bypass capacity per table 503.4.7	N/A
Service Water Heating					
504	Service Water Heating				
504.2	Equipment Performance Efficiency	Domestic Water Heater, DWH-1	80% Et, instantaneous Gas, 210,000 Btu/h	Shall meet efficiency requirements of table 504.2	See plumbing schedules, drawing P-300
504.3	Temperature Controls	Temperature Controls	Holby Valve, mixed water temperature set for 90 degrees F.	Controls shall allow 110 degree F set point for dwellings, and 90 degrees F for other occupancies. Lavatories in public restrooms shall be limited to 110 degrees F	See plumbing schedules, drawing P-300
504.4	Heat Traps	N/A	N/A	Water heating equipment shall be provided with heat traps on the supply and discharge piping if not integrated with equipment	N/A
504.5	Pipe Insulation	Pipe Insulation	1" insulation shall be used on all hot water service piping	Automatic circulating hot water systems-1" insulation. First 8' pipe in non-circulating systems without integral heat traps-0.5" insulation. Conductivity for insulation shall not exceed 0.27 Btu/inch/hxft^2xF	See plumbing specification drawings, P-500

? How should the HVAC/SHW be addressed in the Energy Analysis?

Option 2: COMcheck submissions

- COMcheck software, available for free from the US Department of Energy, can be used to prepare Energy Code compliance calculations.
  - Lists all Mandatory and Prescriptive Compliance requirements related to HVAC and SHW systems
  - Only New York State ECCC or ASHRAE-90.1 COMcheck forms are permitted (not IECC)
  - Downloads: http://www.energycodes.gov/software.stm

Sample COMcheck

Section 3: Mechanical Systems List

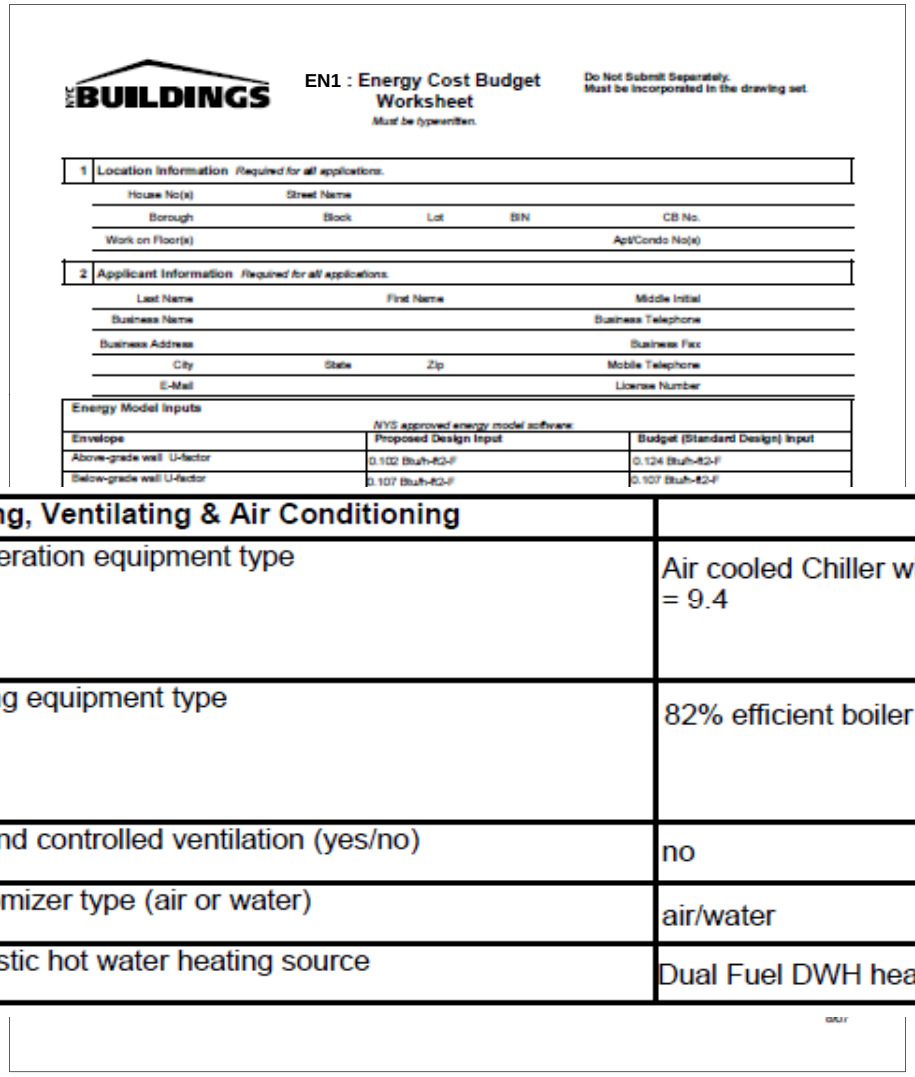
Quantity	System Type & Description
1	AC-1 HVAC unit (Single Zone) : Heating: 1 each - Central Furnace, Gas, Capacity = 648 kBtu/h, Efficiency = 89.00% Ec Cooling: 1 each - Rooftop Package Unit, Capacity = 301 kBtu/h, Efficiency = 10.10 EER, Air-Cooled Condenser, Air Economizer
1	AHU-1 (Multiple-Zone) : Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 295 kBtu/h Cooling: 1 each - Hydronic Coil, Capacity = 296 kBtu/h, Water Economizer
1	AC-2/CU-2 (Single Zone) : Cooling: 1 each - Split System, Capacity = 18 kBtu/h, Efficiency = 13.50 SEER, Air-Cooled Condenser
1	AC-3/CU-3 (Single Zone) : Cooling: 1 each - Split System, Capacity = 60 kBtu/h, Efficiency = 13.50 SEER, Air-Cooled Condenser, Air Economizer
1	PTAC-1 (Single Zone) : Heating: 1 each - Other, Hot Water, Capacity = 12 kBtu/h Cooling: 1 each - Packaged Terminal Unit, Capacity = 10 kBtu/h, Efficiency = 11.20 EER, Air-Cooled Condenser
1	HP-1 (Single Zone) : Packaged Terminal Heat Pump Heating Mode: Capacity = 16 kBtu/h, Efficiency = 2.96 COP Cooling Mode: Capacity = 10 kBtu/h, Efficiency = 11.25 EER
1	FUR-1 (Single Zone) : Heating: 1 each - Duct Furnace, Gas, Capacity = 43 kBtu/h, Efficiency = 85.00% Ec
1	ASHP-1 (Single Zone) : Split System Heat Pump Heating Mode: Capacity = 87 kBtu/h, Efficiency = 3.32 COP Cooling Mode: Capacity = 100 kBtu/h, Efficiency = 11.20 EER, Air Economizer
1	WSHP-1 (Single Zone) : Water Source Heat Pump Heating Mode: Capacity = 108 kBtu/h, Efficiency = 4.30 COP Cooling Mode: Capacity = 100 kBtu/h, Efficiency = 13.50 EER, Water Economizer

All HVAC systems and details should use the same identification and keying in the Energy Analysis and the Supporting Documentation (Drawings and Schedules) for clear cross-reference.

Option 3: Energy Cost Budget Worksheet

- Either NYCECC Section 506 or the Energy Cost Budget Method of ASHRAE 90.1 can be used to demonstrate compliance.
  - Applicable to New Buildings, Additions, or Alterations
  - Requires computer energy modeling, using software programs approved by the Secretary of State of New York State and the NYC Commissioner of Buildings (e.g., DOE-2.1E, VisualDOE, Energy Plus, eQuest)
  - Compliance is demonstrated using the **EN1** form

Sample EN1 – HVAC & SHW Input



NYC BUILDINGS

EN1 : Energy Cost Budget Worksheet

Must be typewritten.

Do Not Submit Separately.
Must be incorporated in the drawing set.

1 Location Information *Required for all applications.*

House No(s) | Street Name

Borough | Block | Lot | BIN | CB No.

Work on Floor(s) | Apt/Condo No(s)

2 Applicant Information *Required for all applications.*

Last Name | First Name | Middle Initial

Business Name | Business Telephone

Business Address | Business Fax

City | State | Zip | Mobile Telephone

E-Mail | License Number

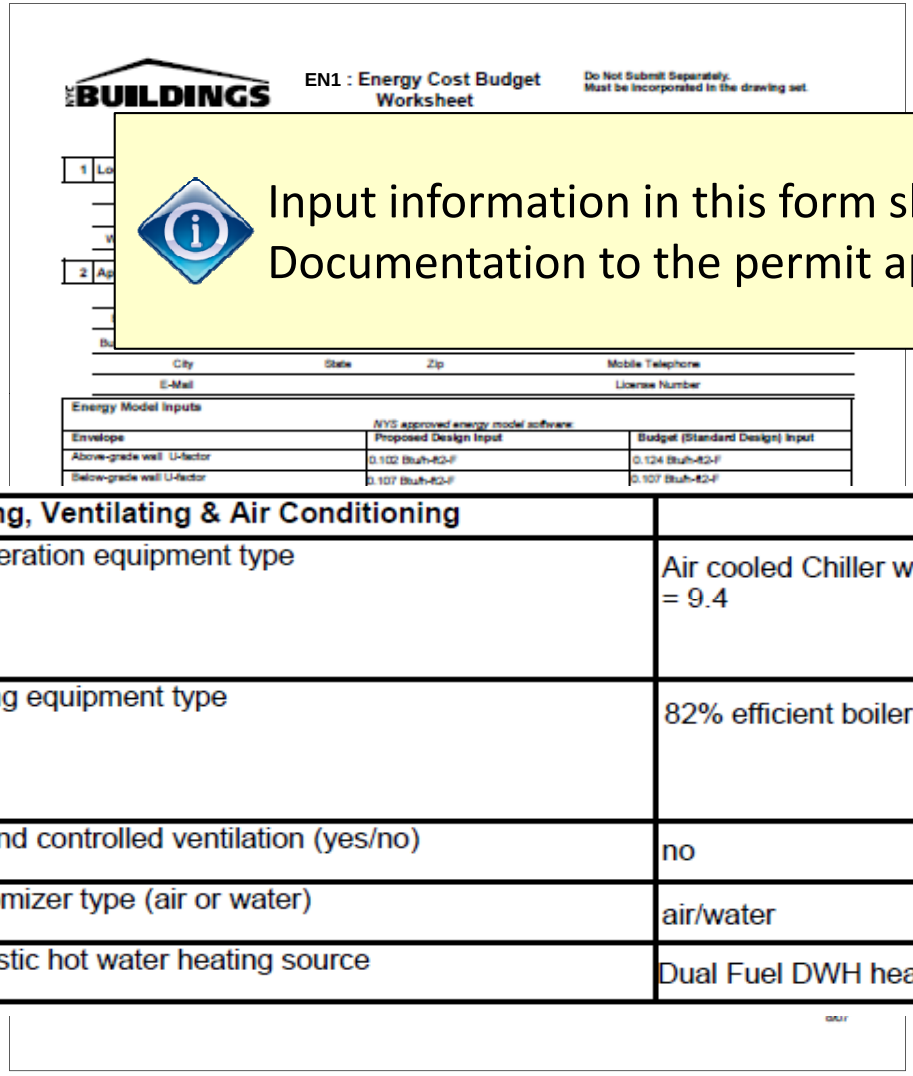
Energy Model Inputs

NYS approved energy model software

Envelope	Proposed Design Input	Budget (Standard Design) Input
Above-grade wall U-factor	0.102 Btu/h-ft2-F	0.124 Btu/h-ft2-F
Below-grade wall U-factor	0.107 Btu/h-ft2-F	0.107 Btu/h-ft2-F

Heating, Ventilating & Air Conditioning		
Refrigeration equipment type	Air cooled Chiller with multiple compressors, EER = 9.4	Air cooled, packaged DX units EER = 9.3-10.3
Heating equipment type	82% efficient boiler w/ modulating flame controls	80% efficient boiler w/ on-off controls
Demand controlled ventilation (yes/no)	no	no
Economizer type (air or water)	air/water	none
Domestic hot water heating source	Dual Fuel DWH heater	Natural Gas DWH heater

Sample EN1 – HVAC & SHW Input



BUILDINGS

EN1 : Energy Cost Budget Worksheet

Do Not Submit Separately.
Must be incorporated in the drawing set.

1 Lo

2 Ap

City State Zip Mobile Telephone

E-Mail License Number

Energy Model Inputs

NYS approved energy model software

Envelope	Proposed Design Input	Budget (Standard Design) Input
Above-grade wall U-factor	0.102 Btu/h-ft2-F	0.124 Btu/h-ft2-F
Below-grade wall U-factor	0.107 Btu/h-ft2-F	0.107 Btu/h-ft2-F

Input information in this form should be reflected in the Supporting Documentation to the permit application.

Heating, Ventilating & Air Conditioning		
Refrigeration equipment type	Air cooled Chiller with multiple compressors, EER = 9.4	Air cooled, packaged DX units EER = 9.3-10.3
Heating equipment type	82% efficient boiler w/ modulating flame controls	80% efficient boiler w/ on-off controls
Demand controlled ventilation (yes/no)	no	no
Economizer type (air or water)	air/water	none
Domestic hot water heating source	Dual Fuel DWH heater	Natural Gas DWH heater

Sample EN1 – HAVC & SHW Input

NYC BUILDINGS

EN1 : Energy Cost Budget Worksheet

Do Not Submit Separately.
Must be incorporated in the drawing set.

1 Location Information
House No(s)
Borough
Work on Floor(s)
2 Applicant Information
Last Name
Business Name
Business Address
City
E-Mail
Energy Model Inputs
Envelope
Above-grade wall U-factor
Below-grade wall U-factor
Roof construction U-factor
Exterior floor U-factor
Slab-on-grade construction (yes
Window-to-gross wall ratio
Average fenestration assembly
Average fenestration assembly
Fixed shading devices (yes/no)
Automated movable shading de
Lighting
Average ambient lighting power
Lighting occupant sensor contro
Automatic daylighting controls
Exterior lighting power (tradable
Exterior lighting power (non-trac
Heating, Ventilating & Air Co
Refrigeration equipment type
Heating equipment type
Demand controlled ventilation
Economizer type (air or water)
Domestic hot water heating sou

Energy Cost Budget Conformance	Proposed Design Output	Budget (Standard Design) Output
Annual Regulated Energy Cost ($)	1,458,109	1,477,272
Annual Regulated Energy Use (BTU/GSF)	44,161	48,006
Annual Regulated Energy Cost Per Sq. Ft. ($/GSF)	2.31	2.34

Energy Model Output Breakdown

Energy Use Breakdown	Proposed Design Output (% BTU/yr)	Budget (Standard Design) Output (% BTU/yr)
Heating	24.2%	32.9
Cooling	13.9%	7.7
Heat rejection	3.9%	2.4%
Fans	8.9%	8.6%
Pumps	1.2%	2.2%
Lighting	19.3%	19.4%
Unregulated loads (e.g., plug loads, elevators, escalators, kitchen, process equipment, exterior lighting)	28.5%	26.9%
Total	100%	100%

Sample EN1 – HAVC & SHW Input

BUILDINGS

EN1 : Energy Cost Budget Worksheet

Do Not Submit Separately.
Must be incorporated in the drawing set.

1 Location Information
House No(s)
Borough
Work on Floor(s)

2 Applicant Information
Last Name
Business Name
Business Address

Energy Cost Budget Conformance	Proposed Design Output	Budget (Standard Design) Output
Annual Regulated Energy Cost ($)	1,458,109	1,477,272
Annual Regulated Energy Use (BTU/GSF)	44,161	48,006
Annual Regulated Energy Cost Per Sq. Ft. ($/GSF)	2.31	2.34

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Fans	8.9%	8.6%
Pumps	1.2%	2.2%
Lighting	19.3%	19.4%
Unregulated loads (e.g., plug loads, elevators, escalators, kitchen, process equipment, exterior lighting)	28.5%	26.9%
Total	100%	100%

The overall regulated annual energy use and annual energy cost of the Proposed and Budget building designs are summarized at the end of the EN1 form.

Supporting Documentation

? What type of Supporting Documentation should be provided?

Supporting Documentation should:

- Support the values submitted in the Energy Analysis;
- Verify mandatory requirements of the NYCECC are met; and
- Provide a listing and detailed description of the applicable progress inspections required based on the scope of work of the project.

HVAC and SHW documentation should be sure to include:

- **ALL** plans, details, notes, and sequences of operation demonstrating that systems, equipment, components, and control sensors meet performance and operating requirements as developed in the Energy Analysis.

Supporting Documentation

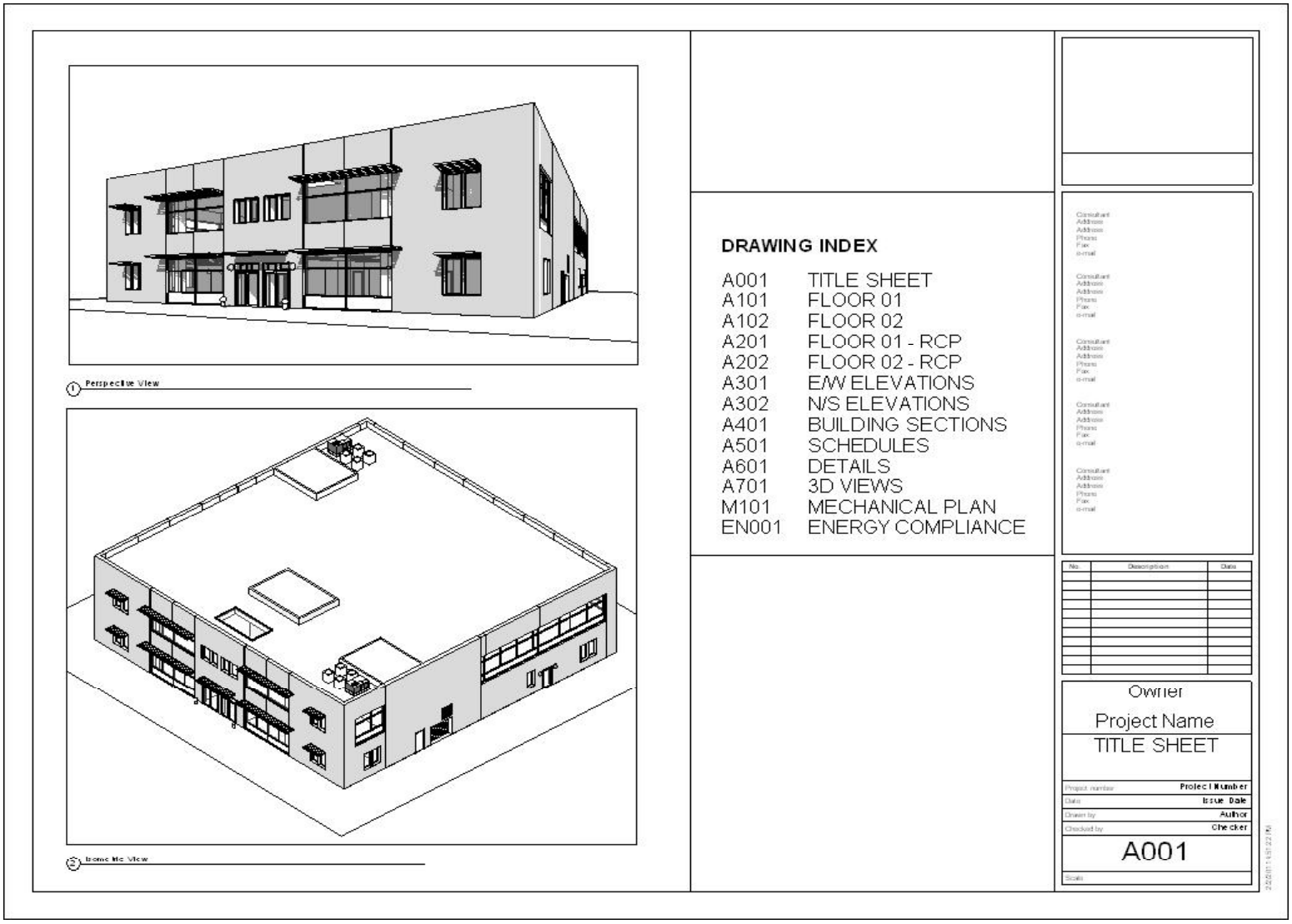
? **What type of Supporting Documentation should be provided?**

Supporting Documentation for HVAC and SHW:

- Floor plans showing:
  - Terminal Units
  - Controls
  - Duct work and piping
  - HVAC equipment
- Mechanical schedules showing:
  - HVAC equipment (terminal units, pumps, fans, energy recovery)
  - Design operating temperatures
  - Performance values (flow rates, efficiencies, nhp)
- Equipment details showing:
  - Coils, terminal units, including:
    - » Valves
    - » Dampers
    - » Sensors
- Control diagrams showing:
  - Sequences of operation with operating set-points
  - Control valves, dampers and sensors

Sample Supporting Documentation

Sample Building: New Office Facility



1 Perspective View

2 Isometric View

DRAWING INDEX

A001	TITLE SHEET
A101	FLOOR 01
A102	FLOOR 02
A201	FLOOR 01 - RCP
A202	FLOOR 02 - RCP
A301	E/W ELEVATIONS
A302	N/S ELEVATIONS
A401	BUILDING SECTIONS
A501	SCHEDULES
A601	DETAILS
A701	3D VIEWS
M101	MECHANICAL PLAN
EN001	ENERGY COMPLIANCE

Owner

Project Name

TITLE SHEET

Project Number

Issue Date

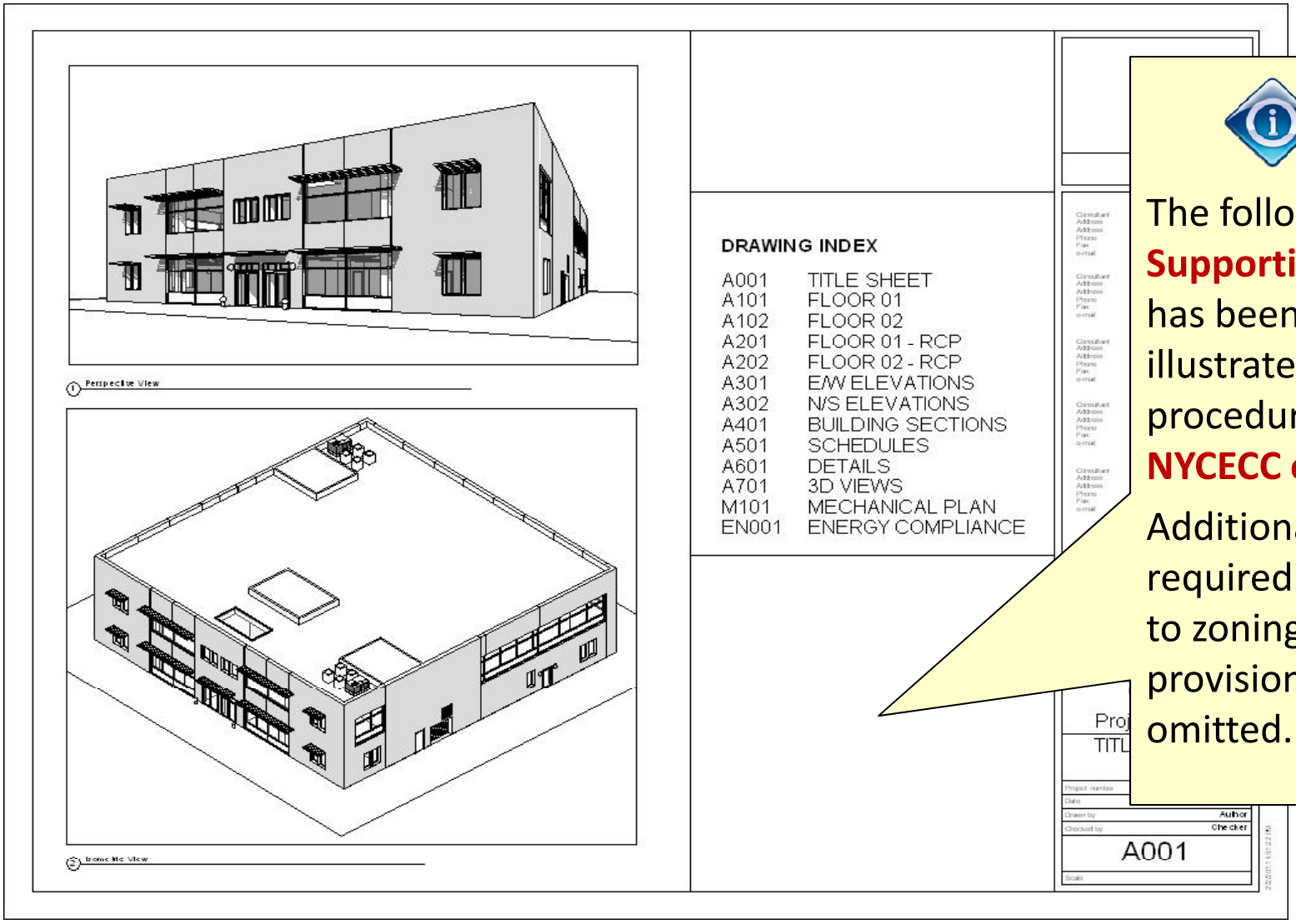
Author

Checker

A001

Sample Supporting Documentation

Sample Building: New Office Facility



The following **Sample Supporting Documentation** has been developed to illustrate compliance procedures related to **the NYCECC only.**

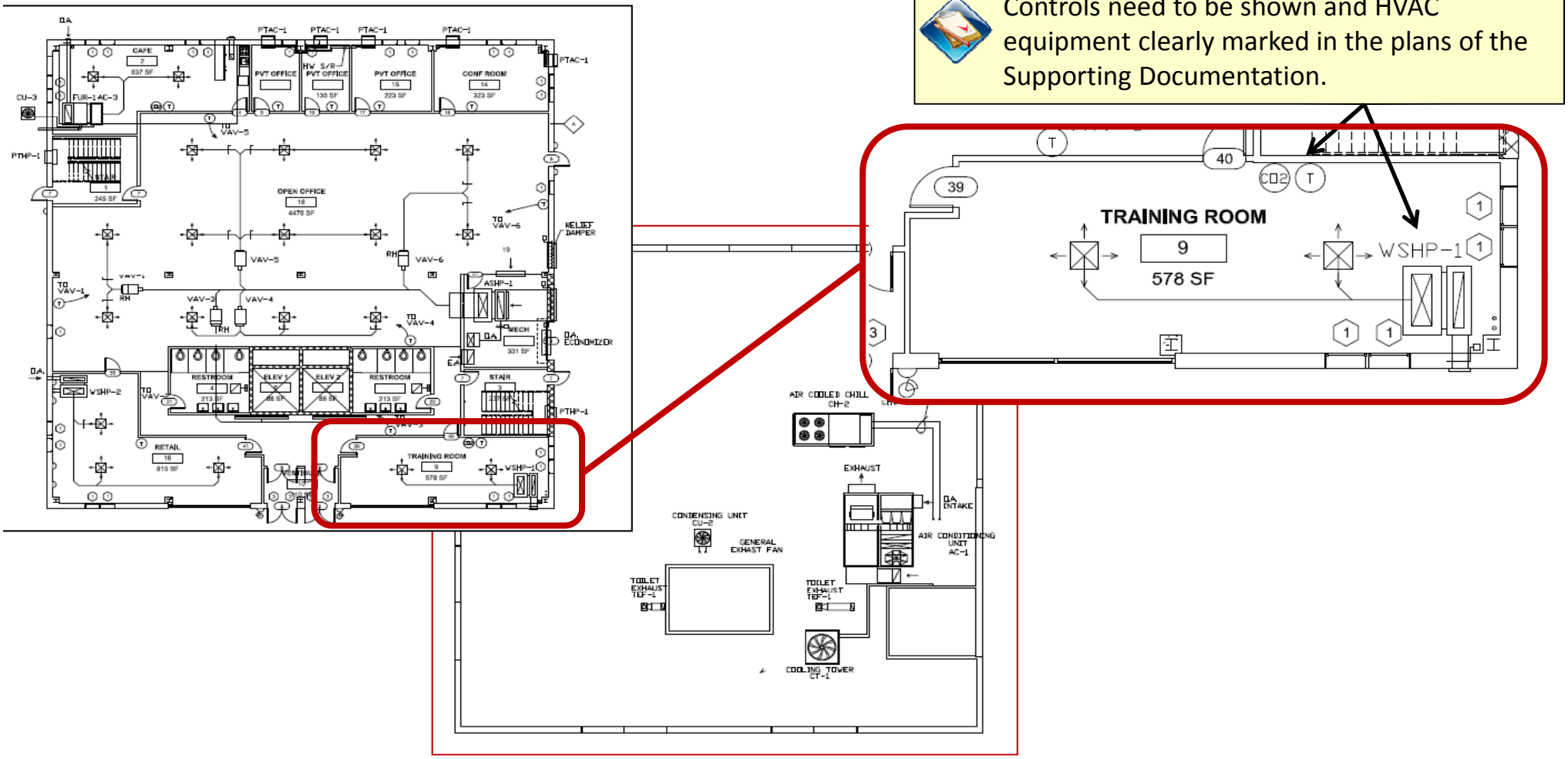
Additional Information required by the DOB related to zoning and other Code provisions is intentionally omitted.

Sample Supporting Documentation

10. Submissions & Inspections

1st FLOOR PLAN

Controls need to be shown and HVAC equipment clearly marked in the plans of the Supporting Documentation.



ROOF PLAN

Sample Supporting Documentation

10. Submissions & Inspections

BOILER SC

UNIT NO.	GAS			EFFICIENCY. (%) (1)	GPM	FLUE OUTLET SIZE (IN)	FUEL	TYPE	W PR
	INPUT MBH	OUTPUT MBH	MIN. OPER GAS PRESS (IN.WG)						
B-1	600	534	16.5	89	60	8	GAS / OIL	HOT WATER	

AIR HANDLING UNIT SCHEDULE

UNIT NO.	LOCATION	SERVICE	FAN DATA										CC
			TOTAL CFM	O.A. CFM	EXT. S.P. IN W.C.	TOTAL S.P. IN W.C.	RPM	FILTER	MOTOR (1)		TOTAL MBH	SENSIBLE MBH	EN
									BHP	HP			DB °F
AHU-1	ROOF	OFFICE	10000	1200	1.5	3.50	–	MERV 13	8.47	10	296	247	77

INCREMENTAL WALL AIR-COOLED AC UNITS (PTAC) SC

UNIT NO.	MODEL	CFM	COOLING		HEATING				
			TOTAL CAPACITY BTU/H	EER (1)	TOTAL CAPACITY BTU/H	HOT WATER			
						EWT F°	LWT F°	FLOW GPM	
PTAC-1	MODEL	350	9,500	11.2	12,140	190	170	1.2	

VAV-B	DESV-8	900	0.053	180	160
VAV-C	DESV-10	1400	0.07	180	160
VAV-D	DESV-12	2000	0.08	180	160
VAV-E	DESV-14	3000	0.077	180	160
VAV-F	DESV-16	4000	0.078	180	160

NOTES:
1. MIN DELTA P IS THE STATIC PRESSURE DIFFERENCE ACI
2. SEE PLANS FOR QUANTITIES & APPROPRIATE VAV SIZE
3. SEE PLANS FOR APPROPRIATE UNITS TO HAVE REHEAT
4. MINIMUM CLOSING FOR VAV-1 SHALL BE 30%.

Mechanical Schedules

Sample Supporting Documentation

10. Submissions & Inspections

BOILER SC

UNIT NO.	GAS INPUT MBH	GAS OUTPUT MBH	GAS MIN. OPER GAS PRESS (IN.WG)	EFFICIENCY (%) (1)	GPM	FLUE OUTLET SIZE (IN)	FUEL GAS / OIL	TYPE
B-1	600	534	16.5	89	60	8	GAS	HOT WATER

AIR HANDLING UNIT SCHEDULE

UNIT NO.	LOCATION	SERVICE	FAN DATA: TOTAL CFM	O.A. CFM	EXT. S.P. IN W.C.	TOTAL S.P. IN W.C.	RPM	FILTER	MOTOR: BHP	MOTOR: HP	TOTAL MBH	SENSIBLE MBH	EN DB °F
AHU-1	ROOF	OFFICE	10000	1200	1.5	3.50	–	MERV 13	8.47	10	296	247	77

Schedules shall clearly indicate performance values, and provide sufficient information to confirm compliance with NYCECC requirements.

INCREMENTAL WALL AIR-COOLED AC UNITS

UNIT NO.	MODEL	CFM	COOLING: TOTAL CAPACITY BTU/H	COOLING: EER (1)	HEATING: TOTAL CAPACITY BTU/H	HOT WATER: EWT °F	HOT WATER: LWT °F	HOT WATER: FLOW GPM
PTAC-1	MODEL	350	9,500	11.2	12,140	190	170	1.2

VAV-B	DESV-8	900	0.053	180	160
VAV-C	DESV-10	1400	0.07	180	160
VAV-D	DESV-12	2000	0.08	180	160
VAV-E	DESV-14	3000	0.077	180	160
VAV-F	DESV-16	4000	0.078	180	160

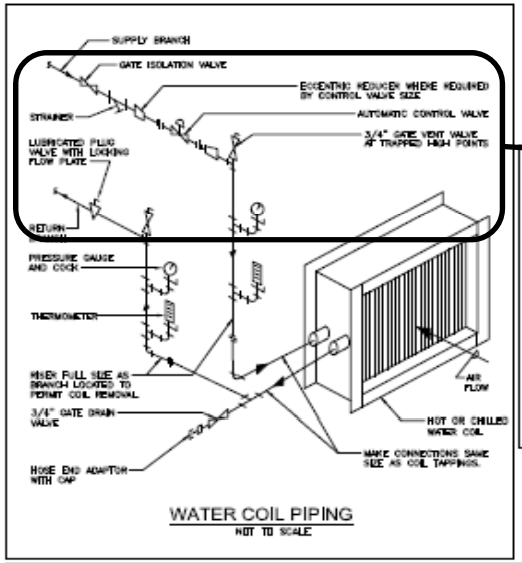
NOTES:
1. MIN DELTA P IS THE STATIC PRESSURE DIFFERENCE ACI
2. SEE PLANS FOR QUANTITIES & APPROPRIATE VAV SIZE
3. SEE PLANS FOR APPROPRIATE UNITS TO HAVE REHEAT
4. MINIMUM CLOSING FOR VAV-1 SHALL BE 30%.

Mechanical Schedules

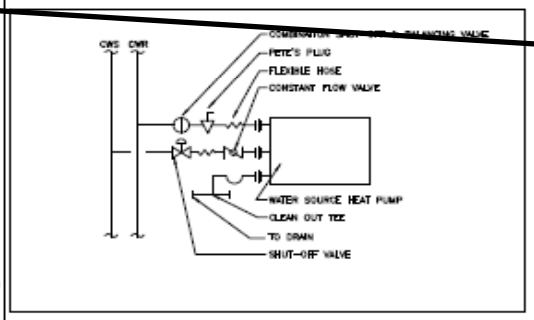
Sample Supporting Documentation

10. Submissions & Inspections

Mechanical Details



WATER COIL PIPING
NOT TO SCALE



WATER SOURCE HEAT PUMP PIPING
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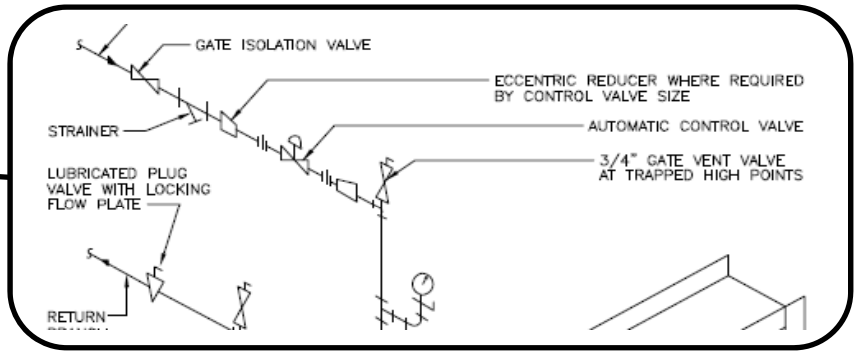

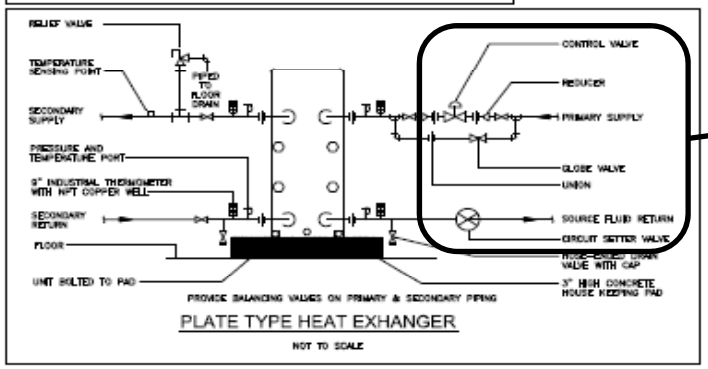

PLATE TYPE HEAT EXHANGER
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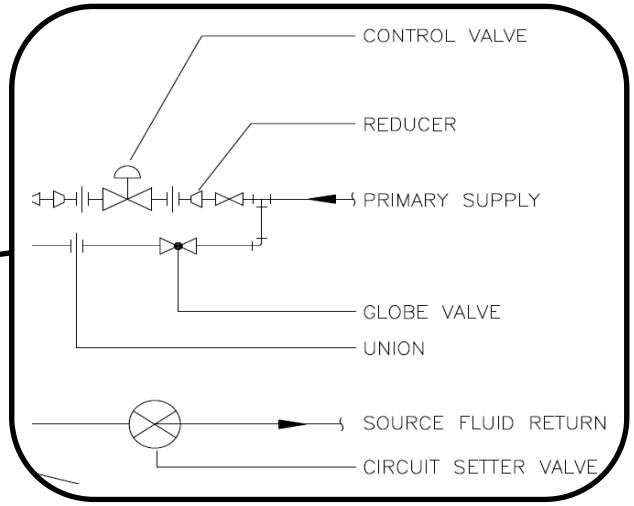
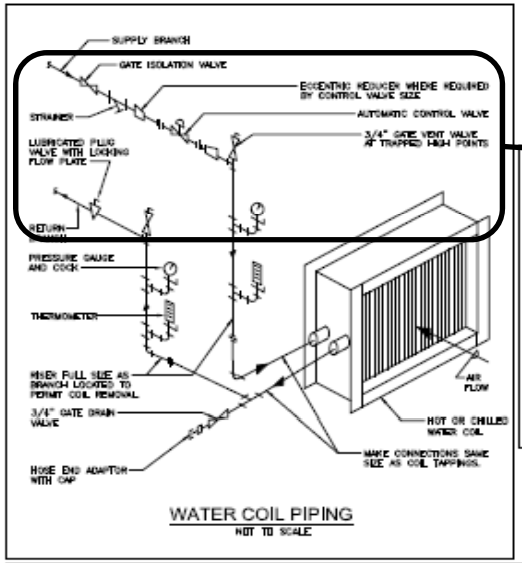
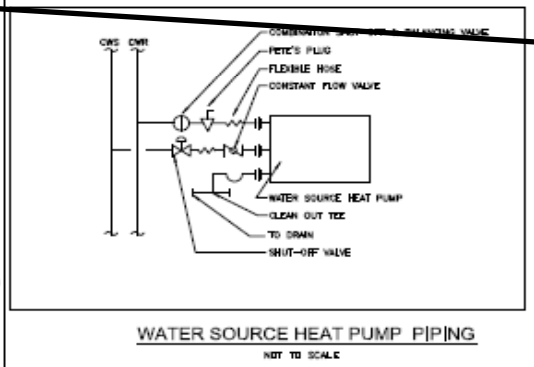


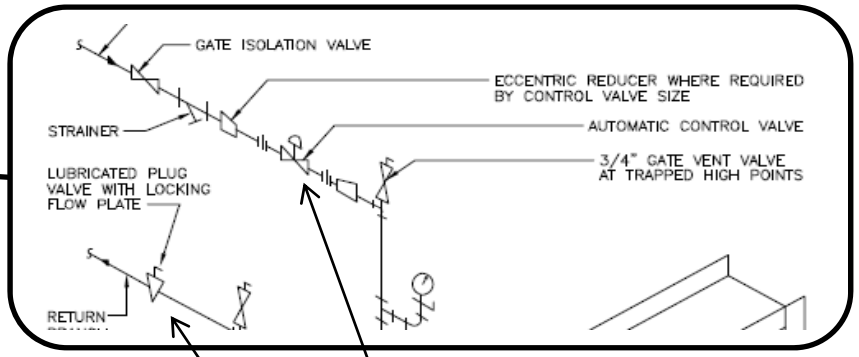
Sample Supporting Documentation

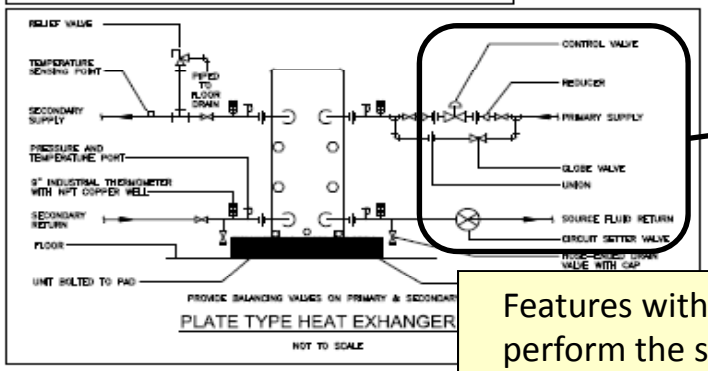
10. Submissions & Inspections

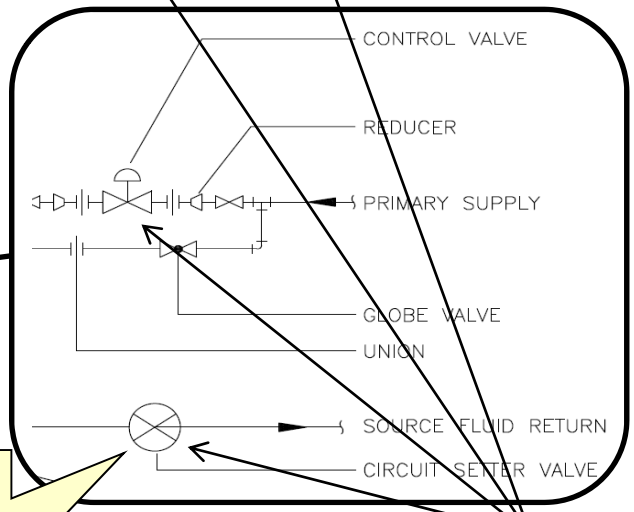
Mechanical Details











Features with different names may perform the same function with respect to Code compliance. For example, a "circuit setter" and "plug valve with locking flow plate" serve the purpose of both balancing valves.

Details need to show control and balancing features.

Sample Supporting Documentation

10. Submissions & Inspections

ENERGY COMPLIANCE NOTES:

THE FOLLOWING STATEMENTS AND REQUIREMENTS INDICATE THAT THE SYSTEM AS DESIGNED IN THESE CONSTRUCTION DOCUMENTS COMPLY TO THE 2010 NEW YORK CITY ENERGY CONSERVATION CODE (NYCECC). THE CONTRACTOR SHALL INSTALL SYSTEMS, ACCESSORIES, AND COMPONENTS, PROGRAMMING AND ANY OTHER MATERIALS AS REQUIRED TO MEET THE CONSTRUCTION DOCUMENTS AND THE STATEMENTS AND REQUIREMENTS IN THIS SECTION.

1. CONTRACTOR SHALL PROVIDE CONNECTIONS AND DEVICES TO MEASURE AND BALANCE WATER FLOW AND PRESSURE FOR ALL HYDRONIC HEATING AND COOLING COILS.

2. FOR ALL SUBMITTALS, FAN MOTORS SHALL BE NO LARGER THAN THE FIRST AVAILABLE MOTOR SIZE GREATER THAN THE BRAKE HP. THE FAN BRAKE HP SHALL BE INDICATED ON THE PRODUCT SUBMITTALS TO ALLOW FOR COMPLIANCE VERIFICATION. FOR FANS LESS THAN 6 BRAKE HP, WHERE THE FIRST AVAILABLE MOTOR LARGER THAN THE BRAKE HP HAS A NAMEPLATE RATING WITHIN 50% OF THE BRAKE HP, THE NEXT LARGER NAMEPLATE MOTOR SIZE MAY BE SELECTED. FOR FANS 6 BRAKE HP AND LARGER, WHERE THE FIRST AVAILABLE MOTOR LARGER THAN THE BRAKE HP HAS A NAMEPLATE RATING WITHIN 30% OF THE BRAKE HP, THE NEXT LARGER NAMEPLATE MOTOR SIZE MAY BE SELECTED.

3. PROVIDE INSULATION FOR DOMESTIC WATER HEATER RECIRCULATING SYSTEM PIPING, INCLUDING THE SUPPLY AND RETURN PIPING OF THE CIRCULATING TANK TYPE WATER HEATER.

4. PROVIDE AUTOMATIC TIME SWITCHES FOR RECIRCULATING HOT WATER SYSTEMS SET TO SWITCH OFF THE TEMPERATURE MAINTENANCE SYSTEM DURING EXTENDED PERIODS WHEN HOT WATER IS NOT REQUIRED.

5. RECIRCULATING PUMPS USED TO MAINTAIN STORAGE TANK WATER TEMPERATURE, SHALL BE EQUIPPED WITH CONTROLS LIMITING OPERATION TO THE START OF THE HEATING CYCLE TO A MAXIMUM OF 5 MINUTES AFTER THE END OF THE HEATING CYCLE.

6. EACH HEATING OR COOLING SYSTEM SERVING A SINGLE ZONE SHALL HAVE ITS OWN TEMPERATURE CONTROL DEVICE.

7. THE SYSTEM AND ZONE CONTROL SHALL BE A PROGRAMMABLE THERMOSTAT OR OTHER AUTOMATIC CONTROL MEETING THE FOLLOWING CRITERIA (FOR ALL SYSTEMS OVER 6,800 BTU/HR CAPACITY):
   a. CAPABLE OF SETTING BACK TEMPERATURE TO 55°F DURING HEATING AND SETTING UP TO 85°F DURING COOLING
   b. CAPABLE OF AUTOMATICALLY SETTING BACK OR SHUTTING DOWN SYSTEMS DURING UNOCCUPIED HOURS USING 7 DIFFERENT DAY SCHEDULES
   c. HAVE AN ACCESSIBLE 2-HOUR OCCUPANT OVERRIDE
   d. HAVE A BATTERY BACK-UP CAPABLE OF MAINTAINING PROGRAMMED SETTINGS FOR AT LEAST 10 HOURS WITHOUT POWER.
   e. THERMOSTATS CONTROLLING BOTH HEATING AND COOLING SHALL BE MANUAL CHANGE OVER OR SHALL BE CAPABLE OF MAINTAINING A 5°F DEAD BAND (A RANGE OF TEMPERATURE WHERE NO HEATING OR COOLING IS PROVIDED).

8. ALL DUCTS SHALL BE INSTALLED TO CODE REQUIREMENTS MEETING A PRESSURE CLASS OF 2" AND LESS.

9. AIR DUCTS AND PLENUMS SHALL BE INSULATED TO THE FOLLOWING LEVELS:
   a. SUPPLY AND RETURN AIR DUCTS FOR CONDITIONED AIR LOCATED IN UNCONDITIONED SPACES (SPACES NEITHER HEATED NOR COOLED) SHALL BE INSULATED WITH A MINIMUM OF R-5. UNCONDITIONED SPACES INCLUDE ATTICS, CRAWL SPACES, UNHEATED BASEMENTS, AND UNHEATED GARAGES.
   b. SUPPLY AND RETURN AIR DUCTS AND PLENUMS SHALL BE INSULATED TO A MINIMUM OF R-8 WHEN LOCATED OUTSIDE THE BUILDING.
   c. WHEN DUCTS ARE LOCATED WITHIN EXTERIOR COMPONENTS (E.G., FLOORS OR ROOFS), MINIMUM R-8 INSULATION IS REQUIRED ONLY BETWEEN THE DUCT AND THE BUILDING EXTERIOR.
   DUCT INSULATION IS NOT REQUIRED ON DUCTS LOCATED WITHIN EQUIPMENT.
   DUCT INSULATION IS NOT REQUIRED WHEN THE DESIGN TEMPERATURE DIFFERENCE BETWEEN THE INTERIOR AND EXTERIOR OF THE DUCT OR PLENUM DOES NOT EXCEED 15°F.

10. MECHANICAL FASTENERS AND SEALS, MASTICS, OR GASKETS SHALL BE USED WHEN CONNECTING DUCTS TO FANS AND OTHER AIR DISTRIBUTION EQUIPMENT, INCLUDING MULTIPLE-ZONE TERMINAL UNITS.

11. ALL JOINTS, LONGITUDINAL AND TRANSVERSE SEAMS, AND CONNECTIONS IN DUCTWORK SHALL BE SECURELY FASTENED AND SEALED WITH WELDS, GASKETS, MASTIC (ADHESIVES), MASTIC PLUS EMBEDDED FABRIC SYSTEMS, OR TAPES INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. TAPES AND MASTICS SHALL BE LISTED AND LABELED IN ACCORDANCE WITH UL 181A AND SHALL BE MARKED "181A-P" FOR PRESSURE SENSITIVE TAPE, "181A-M" FOR MASTIC OR "181A-H" FOR HEAT-SENSITIVE TAPE. TAPES AND MASTICS USED TO SEAL FLEXIBLE AIR DUCTS AND FLEXIBLE AIR CONNECTORS SHALL COMPLY WITH UL 181B AND SHALL BE MARKED "181B-FX" FOR PRESSURE-SENSITIVE TAPE OR "181B-M" FOR MASTIC. UNLISTED DUCT TAPE IS NOT PERMITTED AS A SEALANT ON ANY DUCTS.

12. ALL PIPES SERVING SPACE-CONDITIONING SYSTEMS SHALL BE INSULATED AS FOLLOWS:

HOT WATER PIPING FOR HEATING SYSTEMS >= 105 F:
1 1/2 IN. FOR PIPES <=1 1/2-IN. NOMINAL DIAMETER,
2 IN. FOR PIPES >1 1/2-IN. NOMINAL DIAMETER,

CHILLED WATER, REFRIGERANT, AND BRINE PIPING SYSTEMS <=55 F:
1 1/2 IN. INSULATION FOR PIPES <=1 1/2-IN. NOMINAL DIAMETER,
1 1/2 IN. INSULATION FOR PIPES >1 1/2-IN. NOMINAL DIAMETER,
PIPE INSULATION CONDUCTIVITY SHALL BE 0.27 BTU.IN/(H-FT2-°F) OR LESS

STEAM PIPING:
1 1/2 IN. INSULATION FOR PIPES <=1 1/2-IN. NOMINAL DIAMETER,
3 IN. INSULATION FOR PIPES >1 1/2-IN. NOMINAL DIAMETER.

PIPE INSULATION IS NOT REQUIRED FOR FACTORY-INSTALLED PIPING WITHIN HVAC EQUIPMENT.
PIPE INSULATION IS NOT REQUIRED FOR PIPING WITHIN ROOM FAN-COIL (WITH AHRI440 RATING) AND UNIT VENTILATORS (WITH AHRI840 RATING).
PIPE INSULATION IS NOT REQUIRED FOR RUNOUT PIPING NOT EXCEEDING 4 FT IN LENGTH AND 1 IN. IN DIAMETER BETWEEN THE CONTROL VALVE AND HVAC COIL.

13. SERVICE HOT WATER PIPING, SHALL BE INSULATED TO 1/2 IN. IF PIPE LESS THAN 1-1/2 IN. NOMINAL DIAMETER, LARGER PIPE SHALL BE INSULATED TO 1 IN., PIPE INSULATION CONDUCTIVITY SHALL BE 0.27 BTU.IN/(H-FT2-°F) OR LESS.

14. OPERATION AND MAINTENANCE DOCUMENTATION SHALL BE PROVIDED TO THE OWNER THAT INCLUDES AT LEAST THE FOLLOWING INFORMATION:
   a. EQUIPMENT CAPACITY (INPUT AND OUTPUT) AND REQUIRED MAINTENANCE ACTIONS
   b. EQUIPMENT OPERATION AND MAINTENANCE MANUALS
   c. HVAC SYSTEM CONTROL MAINTENANCE AND CALIBRATION INFORMATION, INCLUDING WIRING DIAGRAMS, SCHEMATICS, AND CONTROL SEQUENCE DESCRIPTIONS. DESIRED OR FIELD-DETERMINED SET POINTS SHALL BE PERMANENTLY RECORDED ON CONTROL DRAWINGS, AT CONTROL DEVICES, OR, FOR DIGITAL CONTROL SYSTEMS, IN THE PROGRAMMING COMMENTS
   d. COMPLETE NARRATIVE OF HOW EACH SYSTEM IS INTENDED TO OPERATE.

15. TEMPERATURE CONTROL SHALL BE PROVIDED TO LIMIT THE MAXIMUM TEMPERATURE OF WATER DELIVERED FROM LAVATORY FAUCETS IN PUBLIC FACILITY RESTROOMS TO 110°F.

16. HOT WATER SPACE-HEATING SYSTEMS WITH A CAPACITY EXCEEDING 300 KBTU/H SUPPLYING HEATED WATER FOR COMFORT CONDITIONING SYSTEMS INCLUDE CONTROLS THAT AUTOMATICALLY RESET SUPPLY WATER TEMPERATURES BY REPRESENTATIVE BUILDING LOADS (INCLUDING OUTSIDE AIR TEMPERATURE.

17. BALANCING DEVICES ARE PROVIDED IN ACCORDANCE WITH IMC (2009) 603.17.

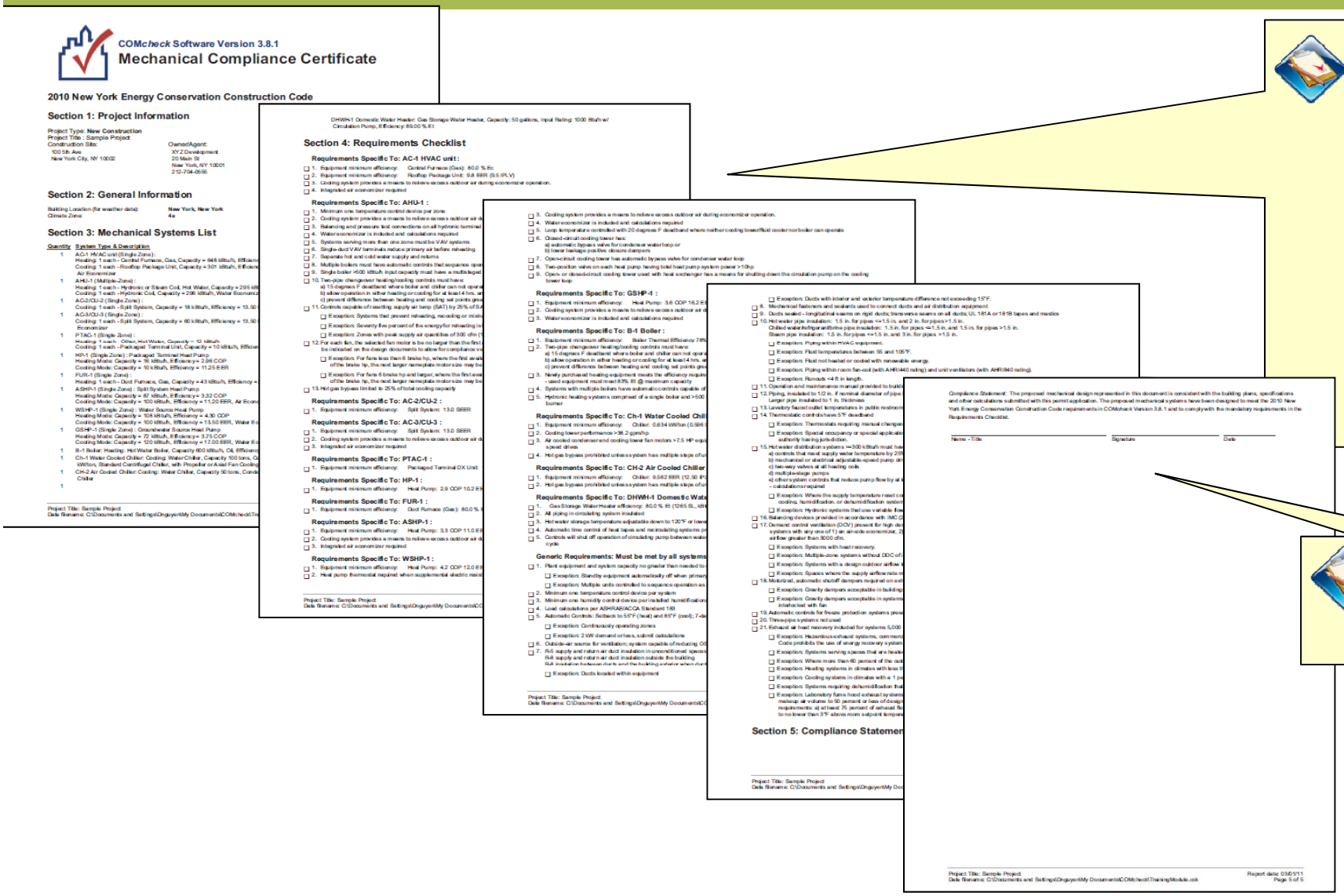
18. OUTDOOR AIR SUPPLY AND EXHAUST SYSTEMS SHALL HAVE MOTORIZED DAMPERS THAT AUTOMATICALLY SHUT WHEN THE SYSTEMS OR SPACES SERVED ARE NOT IN USE. DAMPERS ARE CAPABLE OF AUTOMATICALLY SHUTTING OFF DURING PRECOCCUPANCY BUILDING WARM-UP, COOL-DOWN, AND SETBACK, EXCEPT WHEN VENTILATION REDUCES ENERGY COSTS (E.G., NIGHT PURGE) OR WHEN VENTILATION MUST BE SUPPLIED TO MEET CODE REQUIREMENTS. BOTH OUTDOOR AIR SUPPLY AND EXHAUST AIR DAMPERS MUST HAVE A MAXIMUM LEAKAGE RATE OF 3 CFM/FT2 AT 1.0 IN W.G. WHEN TESTED IN ACCORDANCE WITH AMCA STANDARD 500.

Mechanical/Energy Code Compliance Notes

Notes shall contain Code requirements not shown elsewhere in documents. Note number and drawings should be indexed/referenced to Code citation in the Energy Analysis.

Sample Energy Analysis

COMcheck Report



COMcheck Software Version 3.8.1
Mechanical Compliance Certificate

2010 New York Energy Conservation Construction Code

Section 1: Project Information

Section 2: General Information

Section 3: Mechanical Systems List

Section 4: Requirements Checklist

Section 5: Compliance Statemen

Confirm that Code compliance path is consistent with the rest of the application, and be sure to check-off the applicable Certification Requirements in the COMcheck Summary.

Sign and Seal the COMcheck Summary

Sample Progress Inspection List

10. Submissions & Inspections

	Inspection/Test	Frequency (minimum)	Reference Standard (See NYCECC Chapter 6) or Other Criteria	NYCECC or Other Citation
IIB	**Mechanical and Service Water Heating Inspections**			
IIB1	**Fireplaces:** Provision of combustion air and tight-fitting fireplace doors shall be verified by visual inspection.	Prior to final construction inspection	Approved construction documents; ANSI Z21.60 (see also MC 904), ANSI Z21.50	303.1.5; BC 2111; MC Chapters 7, 9; FGC Chapter 6
IIB2	**Outdoor air intakes and exhaust openings:** Dampers for stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be visually inspected to verify that such dampers, except where permitted to be gravity dampers, comply with approved construction drawings. Manufacturer's literature shall be reviewed to verify that the product has been tested and found to meet the standard.	As required during installation	Approved construction documents; AMCA 500D	502.4.4
IIB3	**HVAC, service water heating and pool equipment sizing and performance:** Equipment sizing, efficiencies and other performance factors of all major equipment units, as determined by the applicant of record, and no less than 15% of minor equipment units, shall be verified by visual inspection and, where necessary, review of manufacturer's data. Pool heaters and covers shall be verified by visual inspection.	Prior to final plumbing and construction inspection	Approved construction documents	503.2, 504.2, 504.7
IIB4	**HVAC system controls and economizers and service hot water system controls:** No less than 20% of each type of required controls and economizers shall be verified by visual inspection and tested for functionality and proper operation.	After installation and prior to final electrical and construction inspection, except that for controls with seasonally dependent functionality, such testing shall be performed before sign-off for issuance of a Final Certificate of Occupancy	Approved construction documents, including control system narratives; ASHRAE Guideline 1: The HVAC Commissioning Process, where applicable	503.2.4, 503.2.5.1, 503.2.11, 503.3, 503.4, 504.3, 504.6, 504.7
IIB5	**Duct, plenum and piping insulation and sealing:** Installed duct and piping insulation shall be visually inspected to verify proper insulation placement and values. Joints, longitudinal and transverse seams and connections in ductwork shall be visually inspected for proper sealing.	After installation and prior to closing shafts, ceilings and walls	Approved construction documents; SMACNA Duct Construction Standards, Metal and Flexible; UL 181A or UL 181B	503.2.7, 503.2.8, 504.5;

Sample Progress Inspection List

10. Submissions & Inspections

	Inspection/Test	Frequency (minimum)	Reference Standard (See NYCECC Chapter 6) or Other Criteria	NYCECC or Other Citation
IIB	**Mechanical and Service Water Heating Inspections**			
IIB1	**Fireplaces:** Provision of combustion air and tight-fitting fireplace doors shall be verified by visual inspection.	Prior to final construction inspection	Approved construction documents; ANSI Z21.60 (see also MC 904), ANSI Z21.50	303.1.5; BC 2111; MC Chapters 7, 9; FGC Chapter 6
IIB2	**Outdoor air intakes and exhaust openings:** Dampers for stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be visually inspected to verify that such dampers, except where permitted to be gravity dampers, comply with approved construction drawings. Manufacturer's literature shall be reviewed to verify that the product has been tested and found to meet the standard.	As required during installation	Approved construction documents; AMCA 500D	502.4.4
IIB3	**HVAC, service water heating and pool equipment sizing and performance:** Equipment sizing, efficiencies and other performance factors of all major equipment units, as determined by the applicant of record, and no less than 15% of minor equipment units, shall be verified by visual inspection and, where necessary, review of manufacturer's data. Pool heaters and covers shall be verified by visual inspection.	Prior to final plumbing and construction inspection	Approved construction documents	503.2, 504.2, 504.7
IIB4	**HVAC system controls and economizers and service hot water system controls:** No less than 20% of each type of required controls and economizers shall be verified by visual inspection and tested for functionality and proper ope	After installation and prior to final electrical and construction inspection, except that for controls with seasonally dependent functionality, such testing shall be	Approved construction documents, including control system narratives; ASHRAE Guideline 1: The HVAC Commissioning Process, where applicable	503.2.4, 503.2.5.1, 503.2.11, 503.3, 503.4, 504.3, 504.6, 504.7
IIB5	**Duct, plenum and piping insulation and sealing:** placement and values. Joints, longitudinal and t sealing.			

A Progress Inspections Table must be included in the Supporting Documentation drawings, noting all applicable inspections to be performed based on the scope of work, plus Reference Standards and NYCECC Citations.

The design applicant must also include contract language requiring the contractor to identify time in the construction schedule for the progress inspections.

Progress Inspections - Review

? **What are the applicable Progress Inspections for HVAC & SHW?**

Inspection / Test	Frequency
Fireplaces Provision of combustion air and tight-fitting fireplace doors shall be **verified by visual inspection**.	Prior to final construction inspection
Outdoor Air Intakes and Exhaust Openings Dampers for stair and elevator shaft vents and other Outdoor Air (OA) intakes and exhaust openings integral to the building envelope shall be **visually inspected** to verify that such dampers, except where permitted to be gravity dampers, comply with approved construction drawings. **Manufacturer's literature shall be reviewed** to verify that the product has been tested and found to meet the standard.	As required during installation
HVAC, Service Water and Pool Equipment Sizing Equipment sizing, efficiencies and other performance factors of all major equipment units, as determined by the applicant of record, and no less than 15% of minor equipment units, shall be **verified by visual inspection and, where necessary, review of manufacturer's data**. Pool heaters and covers shall be verified by visual inspection.	Prior to final plumbing and construction inspection

Progress Inspections - Review

10. Submissions & Inspections

? What are the applicable Progress Inspections for HVAC & SHW?

Inspection / Test	Frequency
HVAC System Controls and Economizers and Service Hot Water System Controls **No less than 20% of each type of required controls and Economizers** shall be **verified by visual inspection and tested** for functionality and proper operation. Such controls shall include, but are not limited to: -Thermostatic -Set point overlap restriction -Off-hour -Shutoff damper -Snow-melt system -Demand control systems -Outdoor heating systems -Zones -Economizers -Air systems -Variable air volume fan -Hydronic systems -Heat rejection equipment fan speed -Complex mechanical systems serving multiple zones -Ventilation -Energy recovery systems -Hot gas bypass limitation -Temperature -Service water heating -Hot water system -Pool heater and time switches -Exhaust hoods -Radiant heating systems Controls with seasonally dependent functionality: Controls whose complete operation cannot be demonstrated due to prevailing weather conditions typical of the season during which progress inspections will be performed shall be permitted to be signed off for the purpose of a Temporary Certificate of Occupancy with only a visual inspection, provided, however, that the progress inspector shall perform a supplemental inspection where the controls are visually inspected and tested for functionality and proper operation during the next immediate season thereafter. The owner shall provide full access to the progress inspector within two weeks of the progress inspector's request for such access to perform the progress inspection. For such supplemental inspections, the Department shall be notified by the approved progress inspection agency of any unresolved deficiencies in the installed work within 180 days of such supplemental inspection.	After installation and prior to final electrical and construction inspection, except that for controls with seasonally dependent functionality, such testing shall be performed before sign-off for issuance of a Final Certificate of Occupancy

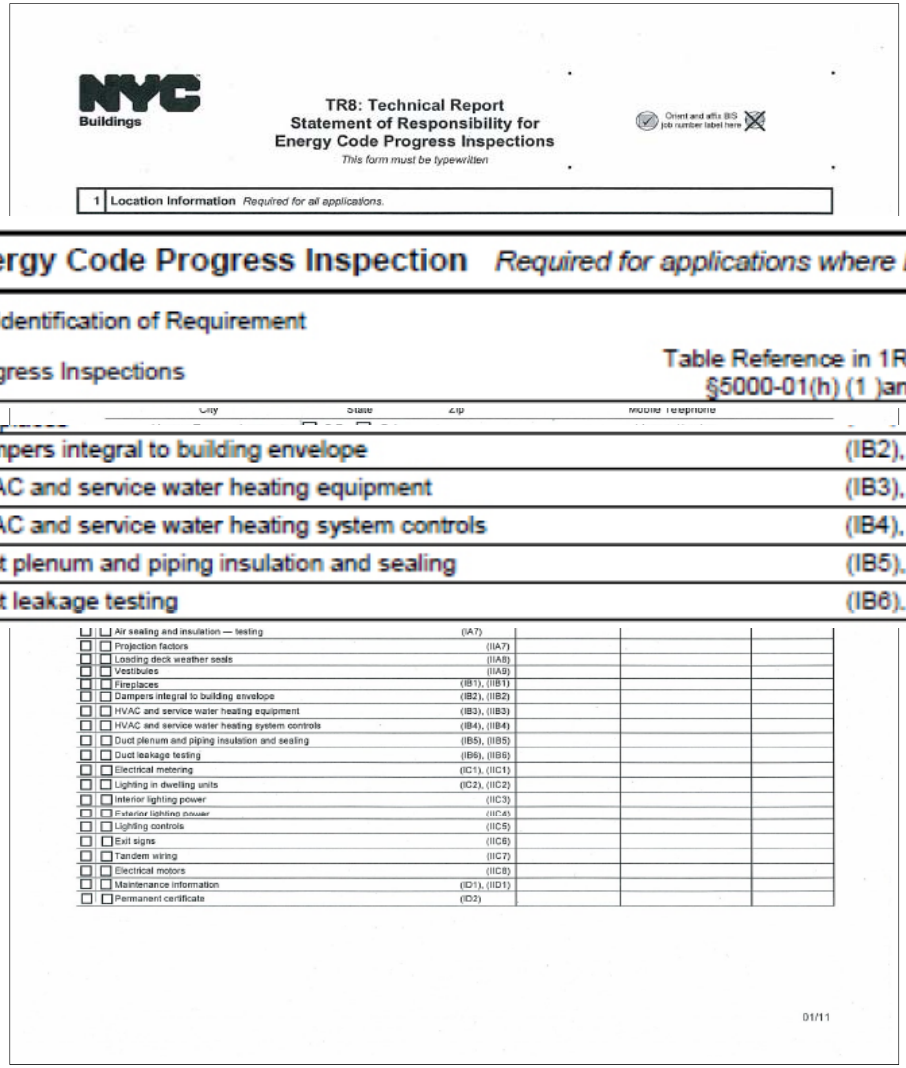
Progress Inspections - Review

? **What are the applicable Progress Inspections for HVAC & SHW?**

Inspection / Test	Frequency
Duct, Plenum and Piping Insulation and Sealing Installed duct and piping insulation shall be **visually inspected to verify proper insulation placement and values**. Joints, longitudinal and transverse seams and connections in ductwork shall be **visually inspected** for proper sealing.	After installation and prior to closing shafts, ceilings and walls
Air Leakage Testing for High-pressure Duct Systems For duct systems designed to operate at static pressures in excess of 3 inches w.g. (746 Pa), **representative sections, as determined by the progress inspector, totaling at least 25% of the duct area**, per NYCECC 503.2.7.1.3, **shall be tested** to verify that actual air leakage is below allowable amounts.	After installation and sealing and prior to closing shafts, ceilings and walls

Progress Inspections – TR8 Report

10. Submissions & Inspections



NYC Buildings

TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections
This form must be typewritten

Orient and affix BIS job number label here

1 **Location Information** *Required for all applications.*

3 Energy Code Progress Inspection *Required for applications where Energy Code Compliance Progress Inspection is marked Yes on TR1*

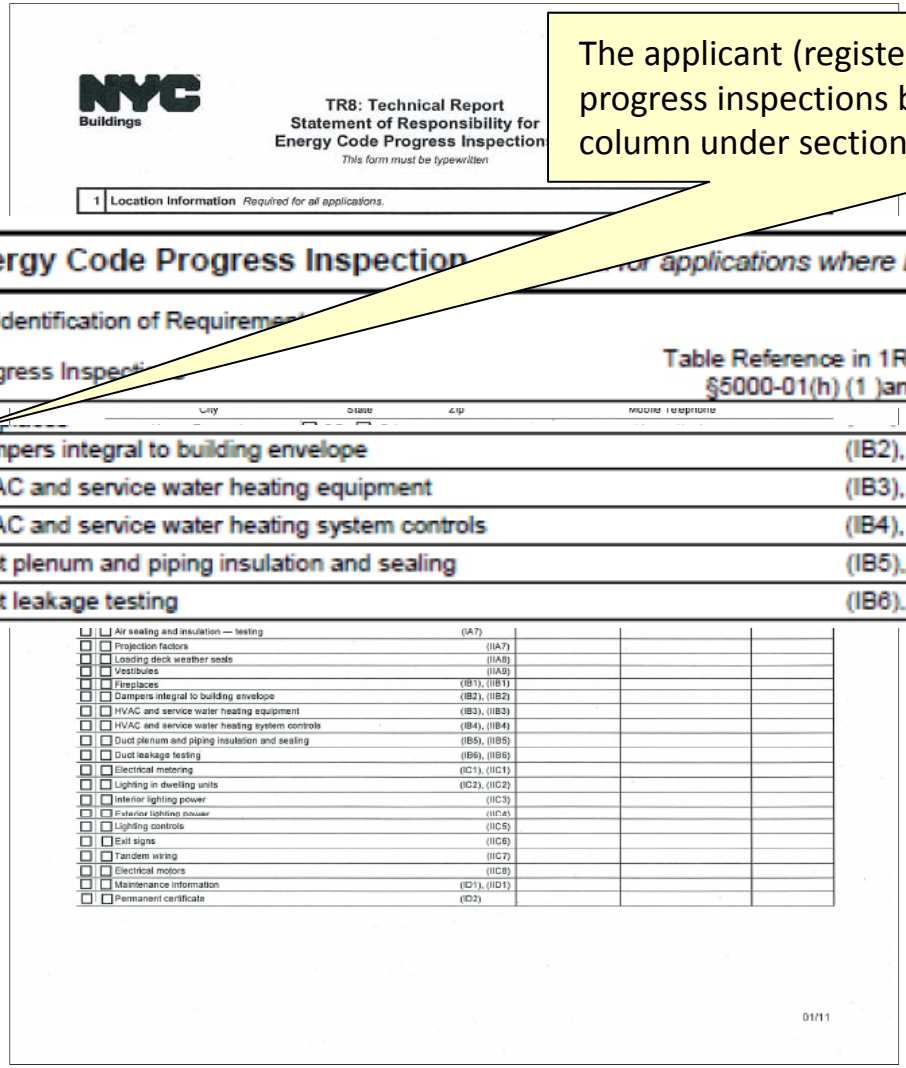
3A ← Identification of Requirement			3B Identification of Responsibilities	3C Certificate of Complete Inspections / Tests	3D Withdraw Responsibilities
Y	N Progress Inspections	Table Reference in 1RCNY §5000-01(h) (1)and (2)	Initial & Date	Initial & Date	Initial & Date
☐	☐ Dampers integral to building envelope	(IB2), (IIB2)			
☐	☐ HVAC and service water heating equipment	(IB3), (IIB3)			
☐	☐ HVAC and service water heating system controls	(IB4), (IIB4)			
☐	☐ Duct plenum and piping insulation and sealing	(IB5), (IIB5)			
☐	☐ Duct leakage testing	(IB6), (IIB6)			

☐ ☐ Air sealing and insulation — testing	(IA7)			
☐ ☐ Projection factors	(IIA7)			
☐ ☐ Loading deck weather seals	(IIA8)			
☐ ☐ Vestibules	(IIA9)			
☐ ☐ Fireplaces	(IB1), (IIB1)			
☐ ☐ Dampers integral to building envelope	(IB2), (IIB2)			
☐ ☐ HVAC and service water heating equipment	(IB3), (IIB3)			
☐ ☐ HVAC and service water heating system controls	(IB4), (IIB4)			
☐ ☐ Duct plenum and piping insulation and sealing	(IB5), (IIB5)			
☐ ☐ Duct leakage testing	(IB6), (IIB6)			
☐ ☐ Electrical metering	(IC1), (IIC1)			
☐ ☐ Lighting in dwelling units	(IC2), (IIC2)			
☐ ☐ Interior lighting power	(IIC3)			
☐ ☐ Exterior lighting power	(IIC4)			
☐ ☐ Lighting controls	(IIC5)			
☐ ☐ Exit signs	(IIC6)			
☐ ☐ Tandem wiring	(IIC7)			
☐ ☐ Electrical motors	(IIC8)			
☐ ☐ Maintenance information	(ID1), (IID1)			
☐ ☐ Permanent certificate	(ID2)			

01/11

Progress Inspections – TR8 Report

10. Submissions & Inspections



TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspection
This form must be typewritten

1 Location Information *Required for all applications.*

3 Energy Code Progress Inspection *for applications where Energy Code Compliance Progress Inspection is marked Yes on TR1*

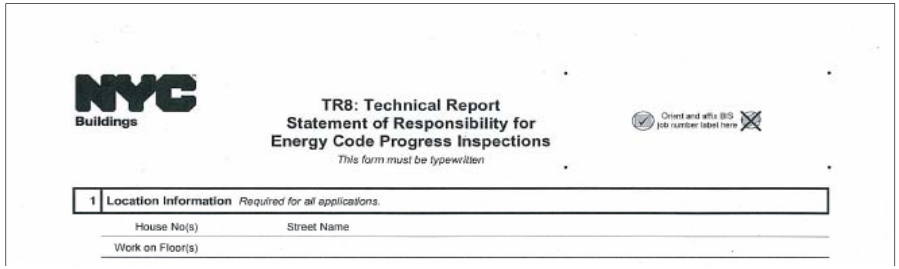
3A ← Identification of Requirement			3B Identification of Responsibilities	3C Certificate of Complete Inspections / Tests	3D Withdraw Responsibilities
Y	N	Progress Inspecti…	Table Reference in 1RCNY §5000-01(h) (1)and (2)	Initial & Date	Initial & Date	Initial & Date
☐	☐	Dampers integral to building envelope	(IB2), (IIB2)			
☐	☐	HVAC and service water heating equipment	(IB3), (IIB3)			
☐	☐	HVAC and service water heating system controls	(IB4), (IIB4)			
☐	☐	Duct plenum and piping insulation and sealing	(IB5), (IIB5)			
☐	☐	Duct leakage testing	(IB6), (IIB6)			

☐	☐	Air sealing and insulation — testing	(IA7)	
☐	☐	Projection factors	(IIA7)	
☐	☐	Loading deck weather seals	(IIA8)	
☐	☐	Vestibules	(IIA9)	
☐	☐	Fireplaces	(IB1), (IIB1)	
☐	☐	Dampers integral to building envelope	(IB2), (IIB2)	
☐	☐	HVAC and service water heating equipment	(IB3), (IIB3)	
☐	☐	HVAC and service water heating system controls	(IB4), (IIB4)	
☐	☐	Duct plenum and piping insulation and sealing	(IB5), (IIB5)	
☐	☐	Duct leakage testing	(IB6), (IIB6)	
☐	☐	Electrical metering	(IC1), (IIC1)	
☐	☐	Lighting in dwelling units	(IC2), (IIC2)	
☐	☐	Interior lighting power	(IIC3)	
☐	☐	Exterior lighting power	(IIC4)	
☐	☐	Lighting controls	(IIC5)	
☐	☐	Exit signs	(IIC6)	
☐	☐	Tandem wiring	(IIC7)	
☐	☐	Electrical motors	(IIC8)	
☐	☐	Maintenance information	(ID1), (IID1)	
☐	☐	Permanent certificate	(ID2)	

01/11

The applicant (registered professional) defines the required progress inspections by checking “Y” or “N” in the left-hand column under section 3 of the TR8 form.

Prior to Permit, the designated Progress Inspector must initial and date each inspection they will be responsible for, and sign/seal under section 5 of the TR8 form. If multiple Progress Inspectors are involved in a project, each one must submit a signed/sealed TR8 for their scope of inspection services.



Buildings

TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections
This form must be typewritten

Orient and affix BIS job number label here

1 **Location Information** *Required for all applications.*

House No(s) Street Name

Work on Floor(s)

6 Inspection Applicant's Certification of Completion

☐ I have completed the items specified herein and certify the following (check one only):

- ☐ All work performed substantially conforms to approved construction documents and has been performed in accordance with applicable provisions of the New York City Energy Conservation Code and other designated rules and regulations.
- ☐ All work performed substantially conforms to approved construction documents and has been performed in accordance with applicable provisions of the New York City Energy Conservation Code and other designated rules and regulations, except as indicated in the attached report.

I am aware of the additional sanctions imposed on false filings by §28-211.1.2 of the Administrative Code.

☐ **Withdrawal of Applicant:** I am withdrawing responsibility for the items of progress inspections and/or tests indicated herein and herewith submit the results or status of the work performed to date.

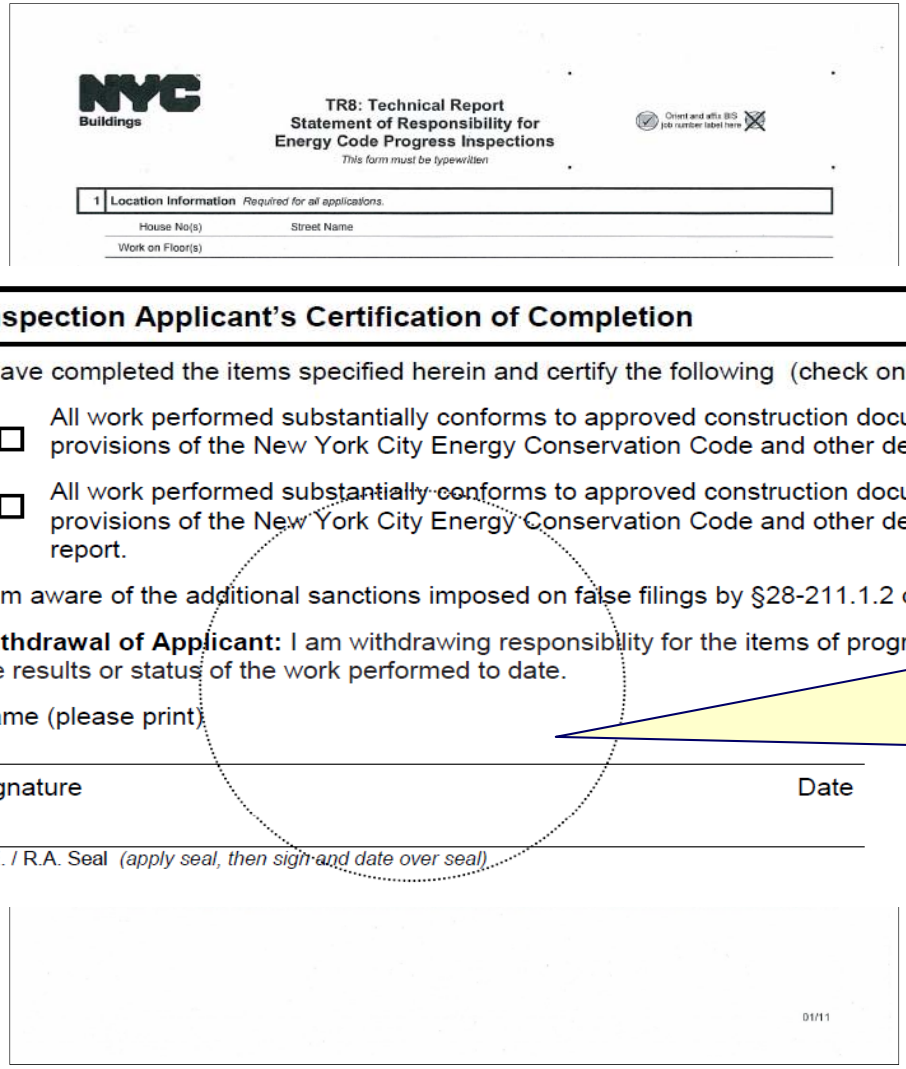
Name (please print)

Signature Date

P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

01/11

10. Submissions & Inspections



NYC Buildings

TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections
This form must be typewritten

Orient and affix BIS job number label here

1 **Location Information** *Required for all applications.*

House No(s) Street Name

Work on Floor(s)

6 Inspection Applicant's Certification of Completion

☐ I have completed the items specified herein and certify the following (check one only):

☐ All work performed substantially conforms to approved construction documents and has been performed in accordance with applicable provisions of the New York City Energy Conservation Code and other designated rules and regulations.

☐ All work performed substantially conforms to approved construction documents and has been performed in accordance with applicable provisions of the New York City Energy Conservation Code and other designated rules and regulati
report.

I am aware of the additional sanctions imposed on false filings by §28-211.1.2 of the Administrative Code.

☐ **Withdrawal of Applicant:** I am withdrawing responsibility for the items of progress inspecti
the results or status of the work performed to date.

Name (please print)

Signature Date

P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

01/11

Upon completion of the applicable inspections, the Progress Inspector initials and dates each inspection performed (column 3C). Any inspections assigned to the Progress Inspector that are not performed are adressed through column 3D (withdraw responsibilities). Final signatures and seals are provided in section 6 of the TR8 form.

Progress Inspections – Back-up

Per NYC Administrative Code §28-116.2.3:

- A record of all inspections shall be kept by the person performing the inspection.
  - The commissioner can require inspection reports to be filed with the Department.
  - Records of inspections shall be maintained for a period of six years after sign-off, or for such other period of time as the commissioner may require
  - Records of inspections shall be made available to the DOB upon request.

EN2 Form:

- This DOB form is signed by the progress inspector, certifying that the values in either the last approved Energy Analysis or in the as-built Energy Analysis represent values in the constructed building.

VSD Controller

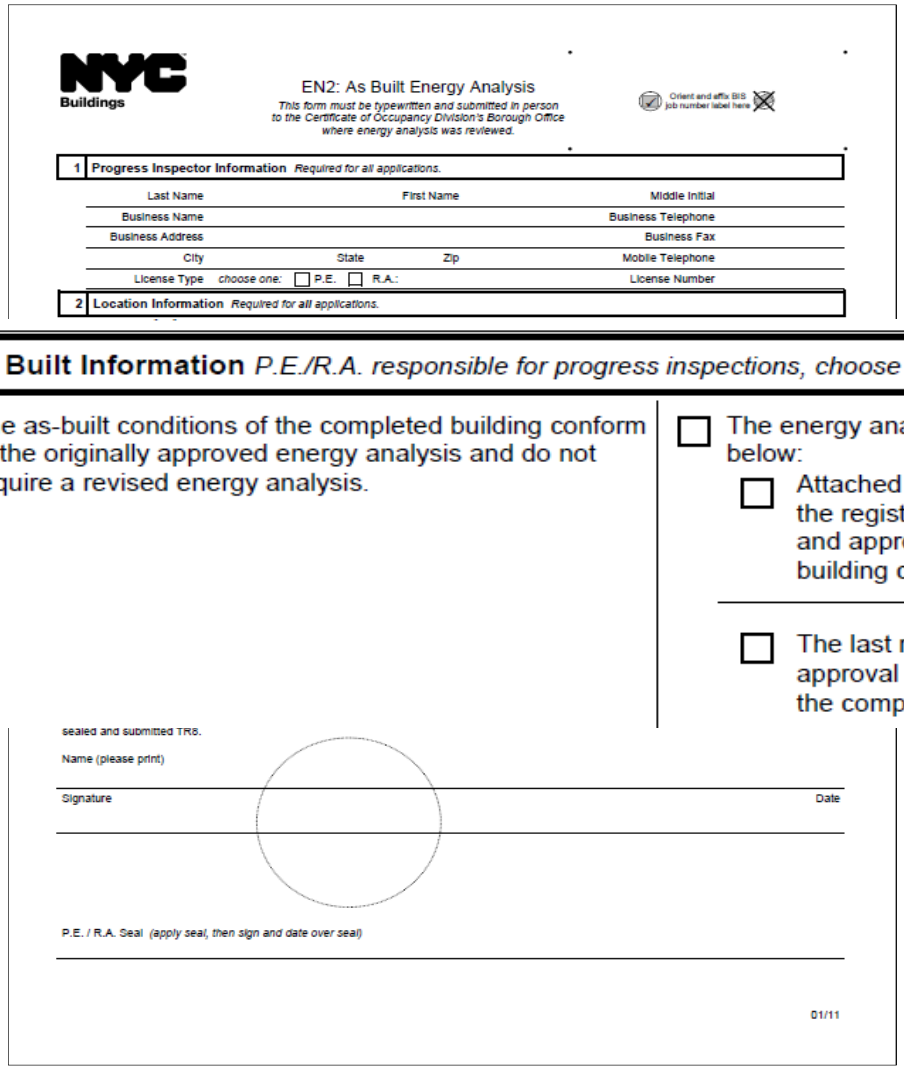
CO2 Sensor & Thermostat

While a specific format is not stated, inspection records can include:

- Logs, reports, meeting minutes
- Photographs
- Annotated Drawings

Progress Inspections – EN2 Form

10. Submissions & Inspections



NYC Buildings

EN2: As Built Energy Analysis

This form must be typewritten and submitted in person to the Certificate of Occupancy Division's Borough Office where energy analysis was reviewed.

Orient and affix BIS job number label here

1 Progress Inspector Information *Required for all applications.*

Last Name | First Name | Middle Initial

Business Name | Business Telephone

Business Address | Business Fax

City | State | Zip | Mobile Telephone

License Type *choose one:* ☐ P.E. ☐ R.A.: | License Number

2 Location Information *Required for all applications.*

3 As Built Information *P.E./R.A. responsible for progress inspections, choose one below and sign/seal.*

☐ The as-built conditions of the completed building conform to the originally approved energy analysis and do not require a revised energy analysis.

☐ The energy analysis has been revised according to *one* of the statements below:

- ☐ Attached is a revised energy analysis, prepared, signed and sealed by the registered design professional who prepared the previously submitted and approved energy analysis. The as-built conditions of the completed building conform to this revised energy analysis.
- ☐ The last revised energy analysis was submitted and approved as a post approval amendment on _____(date). The as-built conditions of the completed building conform to this revised energy analysis.

sealed and submitted TR8.

Name (please print)

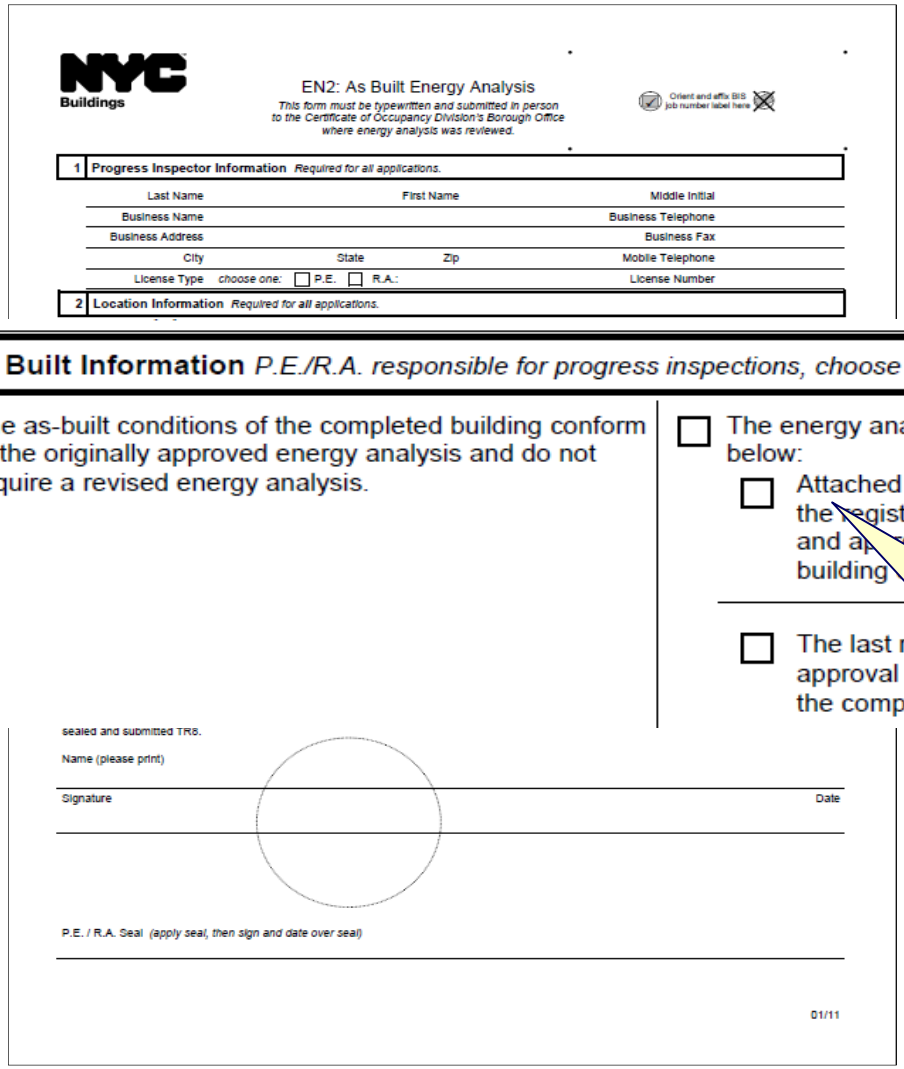
Signature | Date

P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

01/11

Progress Inspections – EN2 Form

10. Submissions & Inspections



NYC Buildings

EN2: As Built Energy Analysis

This form must be typewritten and submitted in person to the Certificate of Occupancy Division's Borough Office where energy analysis was reviewed.

Orient and affix BIS job number label here

1 Progress Inspector Information *Required for all applications.*

Last Name | First Name | Middle Initial

Business Name | Business Telephone

Business Address | Business Fax

City | State | Zip | Mobile Telephone

License Type *choose one:* ☐ P.E. ☐ R.A.: | License Number

2 Location Information *Required for all applications.*

3 As Built Information *P.E./R.A. responsible for progress inspections, choose one below and sign/seal.*

☐ The as-built conditions of the completed building conform to the originally approved energy analysis and do not require a revised energy analysis.

☐ The energy analysis has been revised according to *one* of the statements below:

☐ Attached is a revised energy analysis, prepared, signed and sealed by the registered design professional who prepared the previously submitted and approved energy analysis. The as-built conditions of the completed building conform to this revised energy analysis.

☐ The last revised energy analysis was submitted and approved as a post approval amendment on _____(date). The as-built conditions of the completed building conform to this revised energy analysis.

sealed and submitted TR8.

Name (please print)

Signature | Date

P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

01/11

The Progress Inspectors and design applicants will need to coordinate to ensure that the as-built conditions and approved energy analysis are consistent. An as-built energy analysis update may be required.

HVAC Requirements

Slides 120 to 123

11. Resources

Resources and Links

6. Resources

The resources below have been referenced in this module

Resource	Link
Local Law 1 of 2011	http://www.nyc.gov/html/dob/downloads/pdf/ll1of2011.pdf
Local Law 48 of 2010	http://www.nyc.gov/html/dob/downloads/pdf/ll48of2010.pdf
1 RCNY §5000-01	http://www.nyc.gov/html/dob/downloads/rules/1_RCNY_5000-01.pdf
1 RCNY §101-07	http://www.nyc.gov/html/dob/downloads/rules/1_RCNY_101-07.pdf
Buildings Bulletins	http://www.nyc.gov/html/dob/html/reference/buildings_bulletin.shtml
EN1, EN2, and TR8 Forms	http://www.nyc.gov/html/dob/html/forms/forms_energy.shtml
REScheck/COMcheck	http://www.energycodes.gov/software.stm
PlaNYC	http://www.nyc.gov/html/planyc2030/html/home/home.shtml
New York City Construction Codes	http://www2.iccsafe.org/states/newyorkcity/

DOB Assistance

Questions on the NYCECC can be submitted to the DOB at:

EnergyCode@buildings.nyc.gov

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Company or Individual	Slide Numbers
Samantha Modell	120