# NYCECC HVAC 1 OVERVIEW: 2016 NYC Energy Conservation Code

## Effective October 3, 2016



NYC Buildings

*presented by*
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# ACKNOWLEDGEMENTS

## One City: Built to Last

We wish to acknowledge Mayor Bill de Blasio for his commitment to 80% reduction of Greenhouse Gas Emissions by 2050, over 2005 levels.

- A sweeping plan to retrofit public and private buildings to reduce the City's contributions to climate change.
- This makes New York the largest city to commit to the 80% reduction by 2050.
- It charts a long-term path for investment in renewable sources of energy and a total transition from fossil fuels.

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# INTRODUCTION

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

## This HVAC 1 OVERVIEW Module addresses:

- Technical issues and strategies related to the 2016 NYCECC
- Applicability of the 2016 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.

# OVERVIEW: TRAINING MODULE ORGANIZATION

- The HVAC-1 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.

# OVERVIEW: SLIDE NAVIGATION GUIDE

## Look for the following icons:

The **NYC Buildings** logo takes you to the 2016 NYCECC 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.

# OVERVIEW: SLIDE NAVIGATION GUIDE

## Look for the following icons:

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.

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.

# HVAC 1 OVERVIEW: MODULE MENU

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# HVAC 1 OVERVIEW: MODULE MENU

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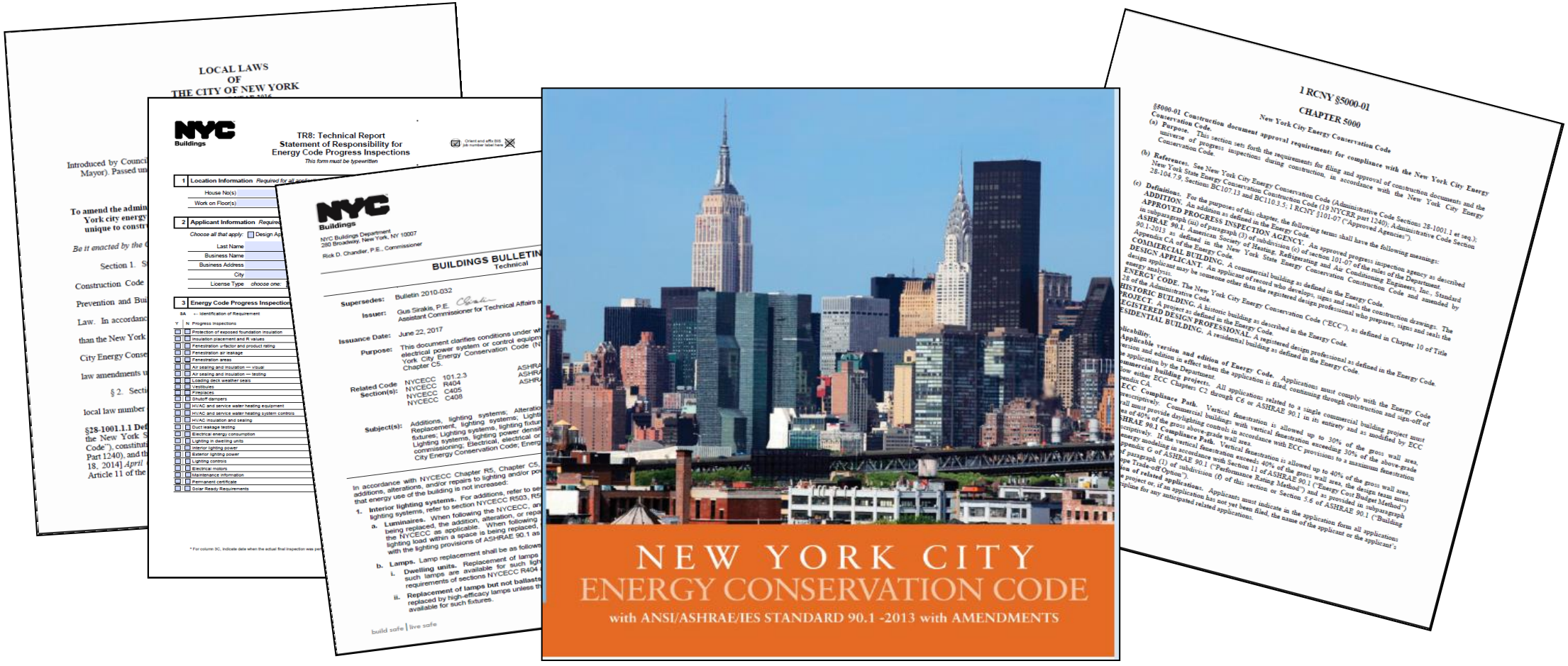
# 1. WHAT'S NEW IN THE NYCECC

## Slides 10 to 17



# 1. WHAT'S NEW IN THE NYCECC: OVERVIEW

## In this section you will learn about:

- Key changes and additions in the 2016 NYCECC related to HVAC systems;
- Current NYC Local Laws affecting Energy Code compliance;
- Current Rules and Bulletins affecting Energy Code compliance.

# 1. WHAT'S NEW IN THE NYCECC

## What are the major changes in the new Code (Sections C403 & C404)?

### 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 2016 NYCECC OR 2016 NYCECC (Appendix CA – ASHRAE 90.1-2013 as modified by NYC)
  - Compliance with NYCECC Chapter 1 still required for all commercial projects including ones that follow 2016 NYCECC Appendix CA – ASHRAE 90.1-2013 as modified by NYC
- HVAC loads calculation methodology
  - References ASHRAE/ACCA Standard183



*Applicability: C5 & DOB Bulletin 2017-005; ASHRAE 90.1 Alternative: C401.1 & C401.2; HVAC Loads: C403.2.1 & C403.2.2*

# 1. WHAT'S NEW IN THE NYCECC: KEY UPDATES

## What are the major changes in the new Code (Sections C403 & C404)?

### Equipment Efficiency Updates:

- Minimum efficiency increased for PTACs, PTHPs, Room AC
- Increased minimum efficiency requirements for all equipment types, except all classes of absorption chillers
- Increased minimum IEER for air-cooled products
- New tables which specify the minimum efficiency requirements for variable refrigerant flow systems and computer room systems
- Limitation on centrifugal fan open-circuit cooling towers



*Equipment Efficiency: Tables C403.2.3 (1 to 5) & C404.2; DCV: C403.2.6.1; ERV: C403.2.7*

# 1. WHAT'S NEW IN THE NYCECC: KEY UPDATES

## What are the major changes in the new Code (Sections C403 & C404)?

### Ventilation Air Controls:

- Demand Control Ventilation (DCV) required
  - Zones larger than 500 $ft^2$, AND
  - Occupant load averaging 25 people / 1000 $ft^2$ or higher
- Energy Recovery Ventilation (ERV) system now a mandatory requirement (2 new exceptions added)
  - Now required on ALL ventilation systems operating not less than 8,000 hours per year



*Equipment Efficiency: Tables C403.2.3 (1 to 5) & C404.2; DCV: C403.2.6.1; ERV: C403.2.7*

# 1. WHAT'S NEW IN THE NYCECC: KEY UPDATES

## What are the major changes in the new Code (Sections C403 & C404)?

### Economizers:

- Required on systems greater than 54,000 BTU/h
- Eliminated the high efficiency exception when following NYCECC
- Added a total building limit on systems without economizers
  - For example, Individual systems < 54,000 BTU/h are only exempt from providing an economizer if the total capacity of systems in the building without economizers does not exceed 300,000 BTU/h
- Added new Fault Detection Diagnostic (FDD) controls for economizers



*Equipment Efficiency: Tables C403.2.3 (1 to 5) & C404.2; DCV: C403.2.6.1; ERV: C403.2.7*

# 1. WHAT'S NEW IN THE NYCECC: KEY UPDATES

**What are the major changes in the new Code (Sections C403 & C404)?**

## Fans & Air Intakes/Exhausts:

- Added fan efficiency grade (FEG) requirement for fan greater than 5hp
- Added requirement for kitchen hood exhaust systems
- New requirements for condenser fans over 7.5hp
- Additional part load requirements for fans on cooling systems > 65,000 BTU/h

## Commissioning:

- New requirements for commissioning heating, cooling, ventilation, refrigeration, renewable, and service water heating systems



*Kitchen Exhaust Systems: C403.2.8; Fan Control: C403.4.1; Fan Efficiency: C403.2.12.3; Shutoff Dampers: C403.2.4.3*

# 1. WHAT'S NEW IN THE NYCECC: RULES & 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 2017-005

Web link: https://www1.nyc.gov/assets/buildings/bldgs_bulletins/bb_2017-005.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 don't increase energy use
  - Replacing equipment parts not regulated



*NYCECC: C503.1; R403, C404; 1 RCNY 5000-01; ASHRAE 90.1: 6.1.1.2, 6.1.1.3, 7.1.1.2, Sections, 6.7 & 10; Loads: C403.2.1 & C403.2.2*

# 2. CODE APPLICABILITY

## Slides 18 to 26

# 2. CODE APPLICABILITY: 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.

# 2. CODE APPLICABILITY: DIFFERENT WORK SCOPES

## What's the Terminology used by DOB related to Code Applicability?

### Exemptions

- Exemptions define specific building types, applications, or building elements that are not required to meet the Code, and are addressed in the PW1 form when they constitute the entire application (1 through 4 below, as listed on the PW1)

- The following are the ONLY allowed exemptions to the NYCECC:
  1. Historic buildings (per NYCECC Section C501.6, LL 91 of 2016, LL 125 of 2016, 1 RCNY § 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



*Historic-Buildings: C202, C501.6; LL 91 of 2016; LL 125 of 2016; 1 RCNY §5000-01;*
*Low Energy Buildings: NYCECC R402.1 & C402.1.1;*
*Form PW1*

# 2. CODE APPLICABILITY: DIFFERENT WORK SCOPES

## What's the Terminology used by DOB related to Code Applicability?

### Exemptions *(continued)*

2. 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) and the scope of work is limited to the envelope.

3. Temporary structures under BC § 3103 and 28-111.1
   - The following work types, categorized as not affecting energy use:
     - Buildings certified as eligible for the designations above
     - City level FA (fire alarm), FP (fire suppression in a range hood), SD (standpipe), FS (fuel storage), EQ (construction equipment), CC (curb cut), OT/BPP (builder's pavement plan), OT/FPP (fire protection plan)

4. A post-approval amendment of an application that is exempt under a prior edition of the Energy Code

*(*Numbers correspond to the exemptions listed on the PW1, Section 10)*



*Historic-Buildings: C202, C501.6; LL 91 of 2016; LL 125 of 2016; 1 RCNY §5000-01;*
*Low Energy Buildings: NYCECC R402.1 & C402.1.1; Form PW1*

# 2. CODE APPLICABILITY: DIFFERENT WORK SCOPES

## 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 C503, Alterations, apply only if they do not result in increased energy use of the building
  - There are 7 exceptions in this section; NONE apply to HVAC Systems
  - See Buildings Bulletin 2017-005 for HVAC requirements and exceptions related to additions, alterations, renovations or repairs

### Existing Buildings:

- Alterations filed as new buildings, per Admin Code 28-101.4.5, must comply as for new building
- 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 R4, but remember:
    - Per R403.8, HVAC and SHW systems serving more than 3 dwelling units are subject to the applicable requirements under Chapters C403, C404, in lieu of R403
  - Commercial occupancies per Chapter C4 or Appendix CA (ASHRAE 90.1-2013 with NYC amendments)



*NYC Admin Code 101.4.5, NYCECC: C503, C505.1, C503.2, C402.1.1, R403.8, NYC DOB Buildings Bulletin: 2017-005*

# 2. CODE APPLICABILITY: DIFFERENT WORK SCOPES

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

### Additions:

- New work on equipment and systems (or portions) must comply (Bulletin 2017-005)
- Additions can comply stand-alone, or with existing building as single entity

### Alterations, Renovations, and Repairs (Bulletin 2017-005):

- 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

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.

### 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



*NYCECC: C503, C505.1, C503.2, C402.1.1, R403.8, NYC DOB Buildings Bulletin: 2017-005*

# 2. CODE APPLICABILITY: 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 2017-005

**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

# 2. CODE APPLICABILITY: SCENARIOS 1, 2, 3

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

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**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[illegible]er Bulletin 2017-005

**Q3:** **If a burner is switched from oil to gas, there is a d[illegible]t 3% in efficiency. Is this required to meet Code?**

**A:** **Not Required**

- Exception allowed as parts replacem[illegible]

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.

# 2. CODE APPLICABILITY: 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

# 3. CODE FUNDAMENTALS

## Slides 27 to 33

# 3. CODE FUNDAMENTALS: OVERVIEW

## In this section you will learn about:

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

# 3. CODE FUNDAMENTALS: CLIMATE ZONES

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

## All NYC Boroughs are in climate zone 4-A:

- Refer to Figure C301.1
- 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: Figure C301.1; Design Conditions: C302; Cooling Towers: C403.2.3, Economizers: C403.3; Fan control: C403.4.1*

# 3. CODE FUNDAMENTALS: HVAC DISCIPLINE

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

**C401.2 Application (Compliance Options)**

**Requirements of 2016 NYCECC Chapter 1 apply to all options**

**NYCECC**
**Prescriptive**
**(COMCheck or Tabular Analysis)**

C402: Envelope
C403: Mechanical systems
C404: Service water heating (mandatory)
C405: Electrical power and lighting systems
C406: Additional Efficiency Package Options
C408: System Commissioning

**Appendix CA (ASHRAE 90.1-2013)**
**Prescriptive (COMCheck/Tabular)**
**or Total Building Perf. (EN 1)**

Sec. 5: Building envelope
Sec. 6: HVAC/Commissioning
Sec. 7: Service water heating
Sec. 8: Power
Sec. 9: Lighting
Sec. 10: Other equipment

**OR**

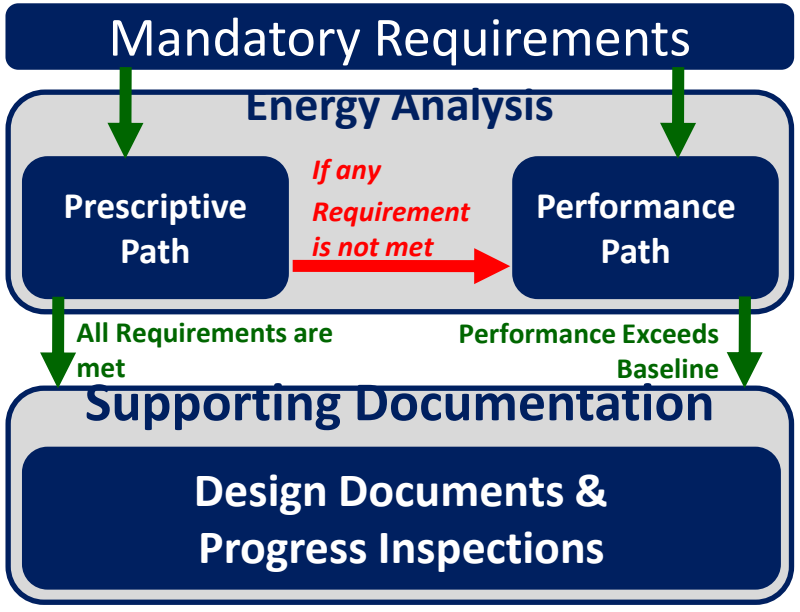
Sec.11: Energy Cost Budget Method

**OR**

Appendix G: Performance Rating Method

# 3. CODE FUNDAMENTALS: 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 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 or Performance Rating Method

# 3. CODE FUNDAMENTALS: HVAC DISCIPLINE

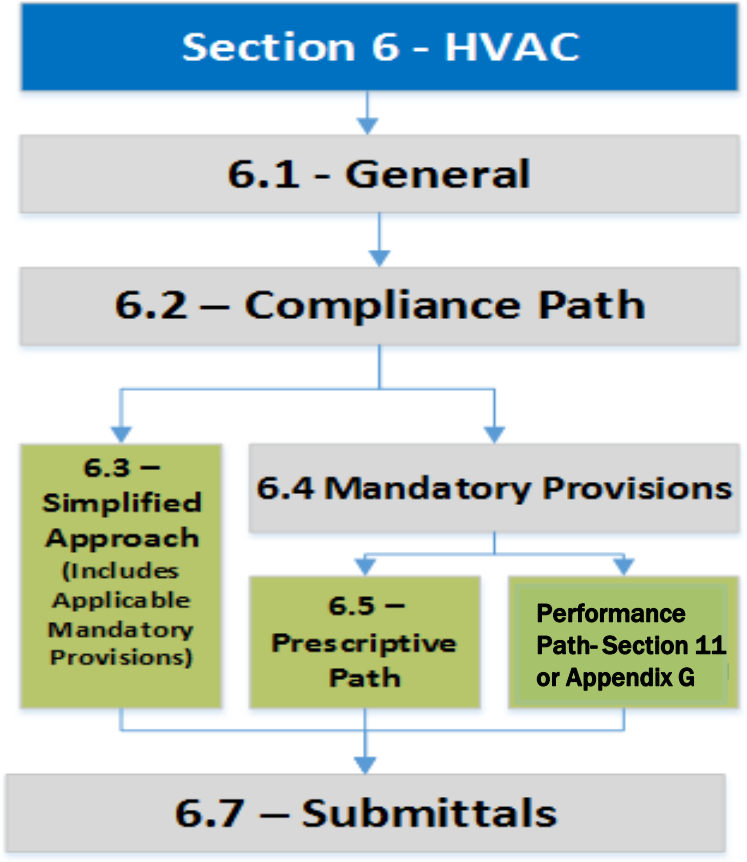
## How is the NYCECC organized within HVAC?

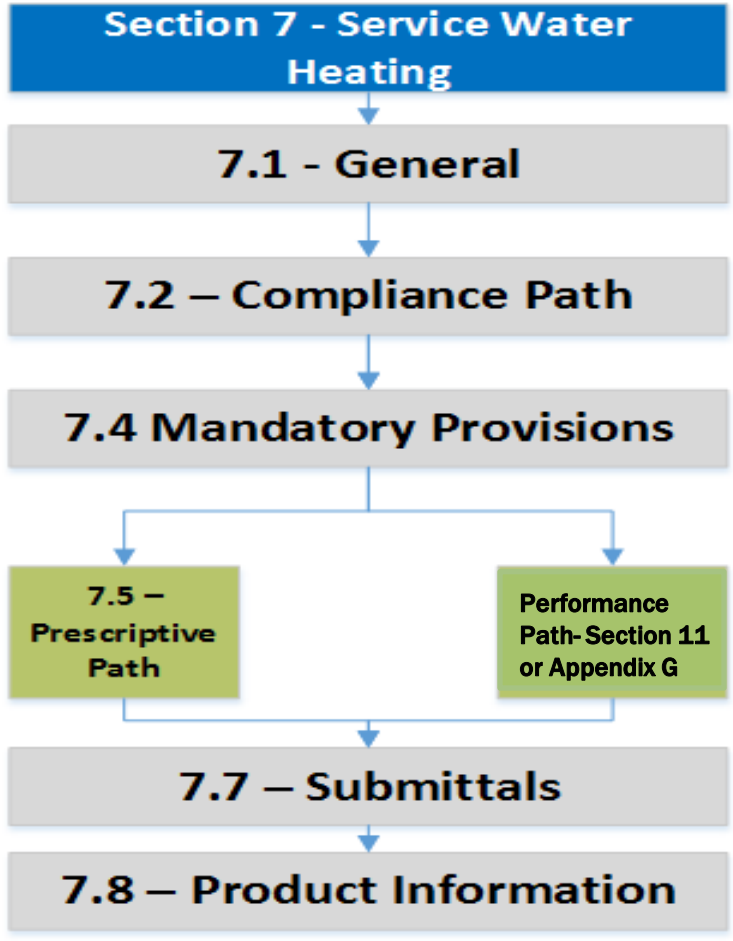
**C403.2Mandatory Requirements**

1. Load Calculations
2. System Sizing
3. Heating & Cooling Equipment Efficiencies
4. HVAC Controls
5. Hot Water Boiler Outdoor Temperature Set-back Control
6. Ventilation (DCV)
7. Energy Recovery
8. Kitchen Exhaust System
9. Duct & Plenum Insulation & Sealing
10. Piping Insulation
11. Mechanical Systems Commissioning and Completion Requirements
12. Air System Design & Control (F, P, L, Motor Size)
13. Outdoor Heating Systems
14. Refrigeration Equipment Performance
15. Walk-in Coolers, Walk-in Freezers, Refrigerated Warehouse Coolers and Refrigerated Warehouse Freezers
16. Walk-in coolers and Walk-in Freezers
17. Refrigerated Display Cases
18. Automatic Control of HVAC in Hotel/Motel Guest Rooms

# 3. CODE FUNDAMENTALS: ASHRAE 90.1 (2013)

## How is HVAC/Service Water Heating organized within ASHRAE 90.1-2013?



# 4. HVAC METRICS

## Slides 34 to 49

# 4. HVAC METRICS: OVERVIEW

## In this section you will learn about:

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

# 4. HVAC METRICS: COOLING CAPACITY

## How is cooling capacity/size measured?

**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)*

## 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



*Equipment Efficiency: Tables C403.2.3 (1 to 12) & C404.2; Inspection: 1 RCNY§5000-01: IIB*

# 4. HVAC METRICS: HEATING CAPACITY

## How is heating capacity/size measured?

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*

## Heating Capacity/Size:

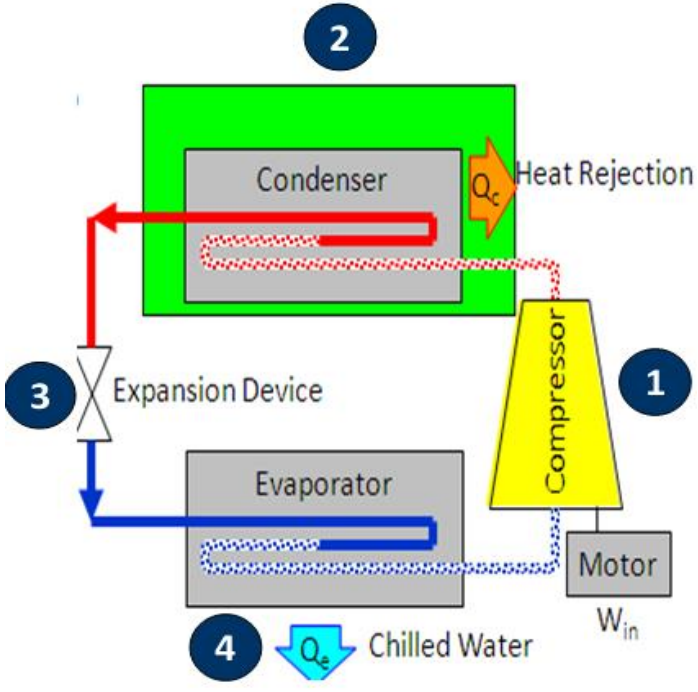
- Measured in Btu/h
- Alternative common metrics:
  - 1 MBH = 1000 Btu/h
  - 1 mmBtu/h = 1 million Btu/h
  - 1 Boiler HP = 33,475 Btu
- Used for Boilers, Furnaces & Heat pumps

## Heating Load:

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

# 4. HVAC METRICS: 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)

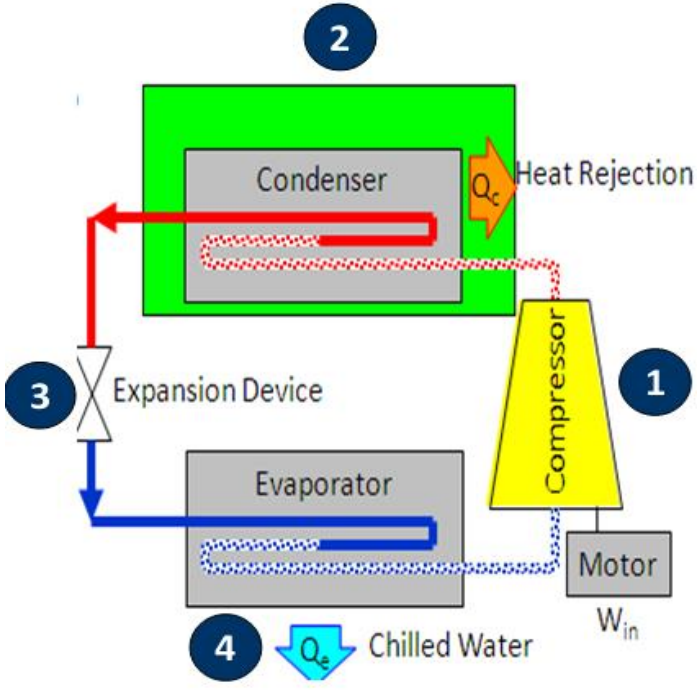
- As the refrigerant expands through a valve, it becomes a low pressure, low temperature liquid

### 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

# 4. HVAC METRICS: 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

# 4. HVAC METRICS: COOLING EFFICIENCY 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: 95° F outside dry-bulb

Return Air: 80 ° F dry-bulb & 67 ° F 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

# 4. HVAC METRICS: COOLING EFFICIENCY IEER

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

### IEER (Integrated Energy Efficiency Ratio):

- 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 most air conditioners and heat pumps greater than or equal to 65,000 BTU/h
  - Requires units to have partial loading capacities (multiple compressors or multi-stage compressors)
- Higher IEER indicates better performance in part load conditions
  - On an average, buildings are at full load only for 1% to 2% of cooling period

IPLV is another part load metric, similar to IEER, and geared towards chillers.

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 |

# 4. HVAC METRICS: COOLING EFFICIENCY SEER

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

## SEER (Seasonal Energy Efficiency Ratio):

- Applies to units less than 65 kBtu (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 2019: 26

# 4. HVAC METRICS: COOLING EFFICIENCY 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 + IEER**

**Q3:** 25-Ton DX Air Handler

**A:** **EER + IEER**

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.

# 4. HVAC METRICS: STANDARD RATING CONDITIONS: AHRI

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

**TABLE C403.2.3(1)**
**MINIMUM EFFICIENCY REQUIREMENTS:**
**ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS**

| EQUIPMENT TYPE | SIZE CATEGORY | HEATING SECTION TYPE | SUBCATEGORY OR RATING CONDITION | MINIMUM EFFICIENCY Before 1/1/2016 | MINIMUM EFFICIENCY As of 1/1/2016 | TEST PROCEDURE[a] |
|---|---|---|---|---|---|---|
| Air conditioners, air cooled | < 65,000 Btu/h[b] | All | Split System | 13.0 SEER | 13.0 SEER | AHRI 210/240 |
| | | | Single Package | 13.0 SEER | 14.0 SEER[c] | |
| Through-the-wall (air cooled) | ≤ 30,000 Btu/h[b] | All | Split system | 12.0 SEER | 12.0 SEER | |
| | | | Single Package | 12.0 SEER | 12.0 SEER | |
| Small-duct high-velocity (air cooled) | < 65,000 Btu/h[b] | All | Split System | 11.0 SEER | 11.0 SEER | |
| Air conditioners, air cooled | ≥ 65,000 Btu/h and < 135,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.2 EER 11.4 IEER | 11.2 EER 12.8 IEER | AHRI 340/360 |
| | | All other | Split System and Single Package | 11.0 EER 11.2 IEER | 11.0 EER 12.6 IEER | |
| | ≥ 135,000 Btu/h and < 240,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 11.0 EER 11.2 IEER | 11.0 EER 12.4 IEER | |
| | | All other | Split System and Single Package | 10.8 EER 11.0 IEER | 10.8 EER 12.2 IEER | |
| | ≥ 240,000 Btu/h and < 760,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 10.0 EER 10.1 IEER | 10.0 EER 11.6 IEER | |
| | | All other | Split System and Single Package | 9.8 EER 9.9 IEER | 9.8 EER 11.4 IEER | |
| | ≥ 760,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 9.7 EER 9.8 IEER | 9.7 EER 11.2 IEER | |
| | | All other | Split System and Single Package | 9.5 EER 9.6 IEER | 9.5 EER 11.0 IEER | |
| Air conditioners, water cooled | < 65,000 Btu/h[b] | All | Split System and Single Package | 12.1 EER 12.3 IEER | 12.1 EER 12.3 IEER | AHRI 210/240 |
| | ≥ 65,000 Btu/h and < 135,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 12.1 EER 12.3 IEER | 12.1 EER 13.9 IEER | AHRI 340/360 |
| | | All other | Split System and Single Package | 11.9 EER 12.1 IEER | 11.9 EER 13.7 IEER | |
| | ≥ 135,000 Btu/h and < 240,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 12.5 EER 12.5 IEER | 12.5 EER 13.9 IEER | |
| | | All other | Split System and Single Package | 12.3 EER 12.5 IEER | 12.3 EER 13.7 IEER | |
| | ≥ 240,000 Btu/h and < 760,000 Btu/h | Electric Resistance (or None) | Split System and Single Package | 12.4 EER 12.6 IEER | 12.4 EER 13.6 IEER | |
| | | All other | Split System and | 12.2 EER | 12.2 EER | |

## 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, 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, IEER, scenarios with variable speed fans, multistage compressors (refer AHRI standards)

# 4. HVAC METRICS: HEATING EFFICIENCY HSPF

**Define heating efficiency metric used in small packaged heat pumps.**

**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 2019: 13.5

## 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 65 kBtu/h
- Calculated weighted average value for whole year in different loading scenarios
  - Combines peak load and part load performance

## Code Required HSPF: 6.8 to 8.2

## Limitation:

- Includes impact of electric resistance heater

# 4. HVAC METRICS: HEATING EFFICIENCY COP

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

### 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

## 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 & ISO-13256-1 cover Water Source Heat Pumps

## Code required COP: 2.5 to 4.3

# 4. HVAC METRICS: HEATING EFFICIENCY COP

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

$$AFUE = \frac{\text{Heat Delivered}}{\text{Heat content of fuel consumed @ annual basis}}$$

## 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)

$$E_t = \frac{\text{Heat Delivered}}{\text{Heat content of fuel consumed @ steady state}}$$

## $E_t$ (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, and Steam boilers greater than 2,500,000 Btu/h

$$E_c = \frac{\text{Heat Produced}}{\text{Heat content of fuel consumed @ steady state}}$$

## $E_c$ (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, unit heaters & Hot Water Boilers greater than 2,500,000 Btu/h

# 4. HVAC METRICS: SIZING – PEAK LOADS

**What method / Standard should HVAC sizing calculations follow?**

Code official may review calculations:

**Use of approved Methods in Standard 183**

**Reasonableness of assumptions**

## 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

# 4. HVAC METRICS: SIZING – EQUIPMENT & SYSTEMS

## What is regulated in HVAC sizing calculations?

- 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.

### 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



*Equipment Sizing: C403.2.1 & C403.2.2;*
*Inspection: 1 RCNY§5000-01: IIB3*

# 5. UNITARY EQUIPMENT: OVERVIEW

Slides 50 to 63

**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.

# 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
  - or 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: C403.2.3;*
*Fan Power Allowance: C403.2.12*

# 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

# 5. UNITARY EQUIPMENT

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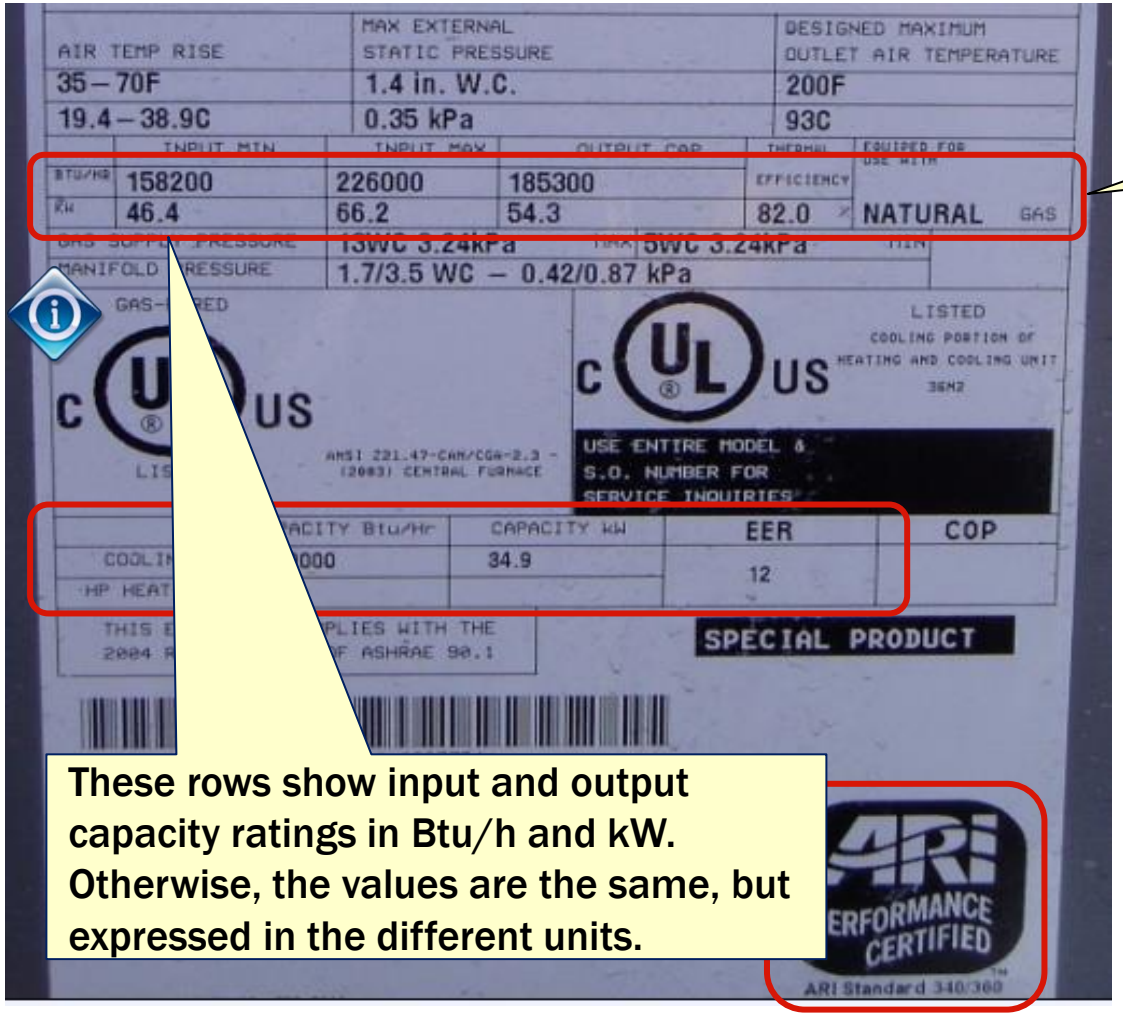



These rows show input and output capacity ratings in Btu/h and kW. Otherwise, the values are the same, but expressed in the different units.

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

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

# 5. UNITARY EQUIPMENT: SPLIT SYSTEMS

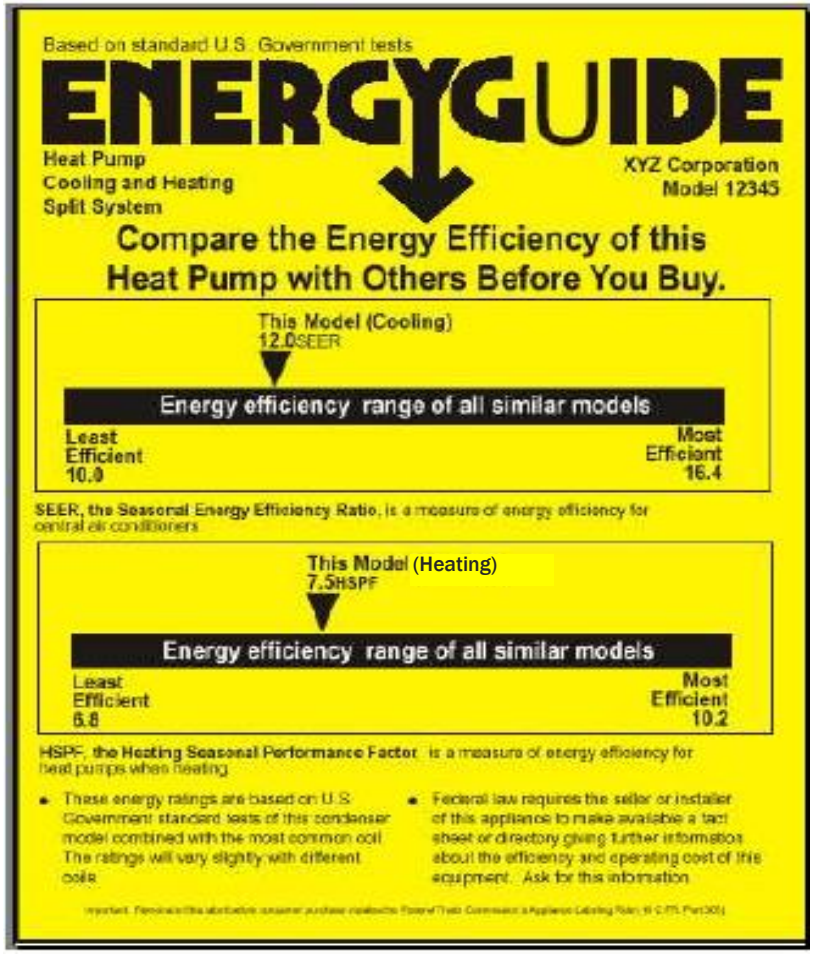
**What possible combinations of indoor and outdoor units are covered?**

## 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

# 5. UNITARY EQUIPMENT: HEAT PUMPS

**What possible combinations of indoor and outdoor units are covered?**


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 (Heating)
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

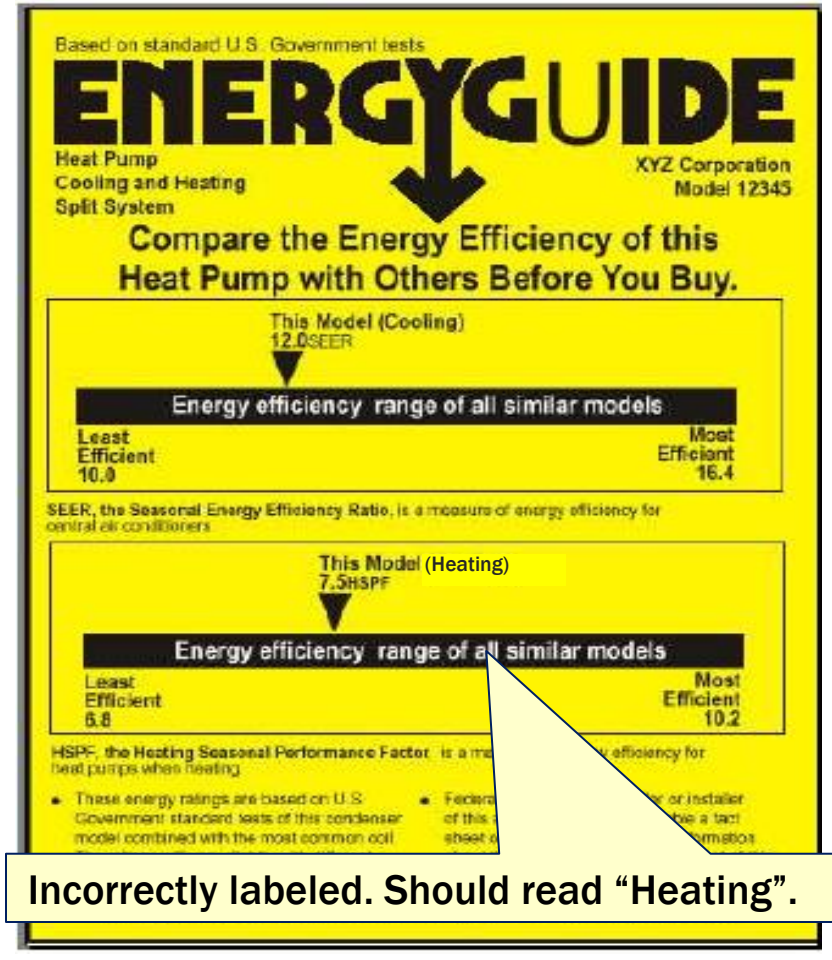
- These energy ratings are based on U.S. Government standard tests of this condenser model combined with the most common coil. The ratings will vary slightly with different coils.
- Federal law requires the seller or installer of this appliance to make available a fact sheet or directory giving further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

## Heat 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

# 5. UNITARY EQUIPMENT: HEAT PUMPS

**What possible combinations of indoor and outdoor units are covered?**




## Heat Pump:

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  - Water Source: Water loop with Boiler & Cooling Tower
  - Groundwater Source: Open loop geothermal well
  - Ground Source: Closed loop geothermal well

# 5. UNITARY EQUIPMENT: HEAT PUMPS

**Are there any other mandatory requirements for heat pumps?**

## Efficiency Requirements

- Increased minimum IEER for air-cooled products, and increased minimum EER and COP requirements for water-cooled product classes. Add brine-to-water equipment types.

## Supplemental Electric Resistance Heat

- 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: C403.2.3, Thermostatic controls: C403.2.4.1.1, Hydronic heat pump requirements: C403.4.2.3.3*

# 5. UNITARY EQUIPMENT: PRESCRIPTIVE EFFICIENCY EXERCISE

**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**
**IEER: 12.8**

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

**A:** **SEER:** Not applicable, unit greater than 65kBtu/h

**EER: 11.9**
**IEER: 13.7**

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

**A:** **SEER:** Not applicable, unit greater than 65kBtu/h

EER: 10.5 @ condensing unit
IEER: 11.8 @ condensing unit

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

# 5. UNITARY EQUIPMENT: SMALL CAPACITY BOILERS

## 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: 80% $E_t$ (water)
  77% – 79% $E_t$ (steam)
- Oil-fired: 82% $E_t$ (water)
  81% $E_t$ (steam)

### High-Capacity Gas-Fired Boilers: 2,500,000 Btu/h (75 HP) & higher

- Gas-fired: 82% $E_c$ (water)
  77%-79% $E_t$ (steam)
- Oil-fired: 84% $E_c$ (water)
  81% $E_t$ (steam)

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 2017:**

**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 C403.2.3(5); ASHRAE 90.1: Table 6.8.1-6;*
*Progress inspections: 1 RCNY§5000-01, IIB3*

# 5. UNITARY EQUIPMENT: BOILER CONTROLS

## What are required controls for boiler system operation?

### Multiple Boiler Controls:

- Multiple packaged Boilers per loop require automatic controls to sequence Boilers
- Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature
- Single Boiler per loop, greater than 500,000 Btu/h capacity requires multi-staged or modulating burner
- Boiler systems with design input of greater than 1,000,000 Btu/h (293 kW) shall comply with the turndown ratio specified in Table C403.4.2.5

### Boiler Part Load Controls: Required if capacity greater than or equal to 500,000 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: C403.4.2,*
*Part Load Controls: C403.4.2.4*

# 5. UNITARY EQUIPMENT: 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)

**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

## Duct Furnace & Unit heaters:

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



*Furnace efficiency: Table C403.2.3(4);*
*Motorized Dampers: C403.2.4.3;*
*ASHRAE 90.1: 6.4.3.4.1; 1 RCNY§5000-01: IIB2*

# 5. UNITARY EQUIPMENT: NOT COVERED IN CODE

**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

# 5. UNITARY EQUIPMENT: HEATING OUTSIDE THE BUILDING

**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. VENTILATION REQUIREMENTS: OVERVIEW

Slides 64 to 78

**In this section you will learn about:**

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

# 6. VENTILATION REQUIREMENTS: ECONOMIZERS

**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 cooling capacity of all units without an Economizer cannot exceed 300,000 Btu/h per building, regardless of the type of cooling system

**New requirements for integrated economizer control.**

**ASHRAE allows following controls types if Economizer is provided:**

1. Fixed dry bulb
2. Fixed enthalpy
3. Differential enthalpy with fixed dry-bulb temperature



*Economizers: C403.3; ASHRAE:, High Limit –Shutoff: Table 6.5.1.1.3*

# 6. VENTILATION REQUIREMENTS: ECONOMIZERS

**Under what special circumstances are economizers not required?**

## Economizer Exceptions:

- Spaces with open-case refrigeration
- Cooling systems designed to operate less than 20 hours/week
- Spaces with humidification requirements for specific process needs
- High efficiency cooling systems with at least 42% efficiency improvement (ASHRAE only)

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



*Economizer: C403.3; ASHRAE: Table 6.5.1.1.3*

# 6. VENTILATION REQUIREMENTS: ECONOMIZERS – SCENARIOS 1, 2

**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 the building is 720,000 BTU/h or 60 tons. Since each system is less than 54,000 BTU/h and the capacity of all units exceeds 300,000 Btu/h or 25 Tons, economizers are only required on at least 420,000 BTU or 35 tons of equipment.

**Q2:** A 20,000 ft2 multifamily building is served by VRF systems: 4 outdoor units @ 10 ton capacity each, and each outdoor unit has 5 indoor units of 2 tons each. Is Economizer required?

**A:** Yes, the total capacity of the building is 480,000 BTU/h or 40 tons. Since the capacity of each indoor system is less than 54,000 BTU/h and the capacity of all units exceeds 300,000 BTU/h or 25 Tons, economizers are required on at least 180,000 BTU or 15 tons of equipment.

# 6. VENTILATION REQUIREMENTS: VENTILATION RATES

**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**

# 6. VENTILATION REQUIREMENTS: DEMAND CONTROLLED VENTILATION

## Is the ventilation rate maintained as constant or variable?

### Code Requirement

- Required for spaces greater than 500 $ft^2$ with an average occupant load of 25 persons/ 1000 $ft^2$ 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
  - Ventilation provided for process loads only

| Spaces With Estimated Occupancy Exceeding 25 Persons / 1000 sf. | |
|---|---|
| **Sports & Amusement** | **Theatres** |
| Disco/Dance floors | Auditoriums |
| Bowling Alleys (seating areas) | Lobbies |
| **Spectator Areas** | Stages, Studios |
| **Health Club/Aerobics room** | Ticket Booths |
| **Education** | **Hotels, Motels, Resorts, and Dormitories** |
| Auditoriums | Multipurpose Assembly |
| Music/Theatre/Dance | Conference/Meeting |
| Smoking Lounges | Gambling Casinos |
| Classrooms (age 9 plus) | Lobbies/Prefunction |
| Lecture Classroom | |
| Lecture Hall (fixed seats) | |
| Multiuse Assembly | |
| **Food & Beverage Service** | **Transportation** |
| Bars, Cocktail Lounges | Platforms |
| Cafeteria, Fast Food | Transportation Waiting |
| Dining Rooms | |
| **Offices** | **Correctional Facilities** |
| Conference Rooms | Day Room |
| Reception Areas | Booking/Waiting |
| Telephone/Data Entry | |

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

# 6. VENTILATION REQUIREMENTS: DEMAND CONTROLLED VENTILATION

## Is the ventilation rate maintained as constant or variable?

### Code Requirement

- Required for spaces greater than 500 $ft^2$ with an average occupant load of 25 persons/ 1000 $ft^2$ and with at least one of the following:
  - Air-side Economizer
  - Automatic modulating control of OA d
  - OR
  - Design OA greater than 3000

- 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
  - Ventilation provided for process loads only

**These are important exceptions!**
Many single zone systems have less than 1200 cfm of OA, AND many spaces over 500 $ft^2$ may have less than 1200 cfm of supply air.

Example: Classroom:

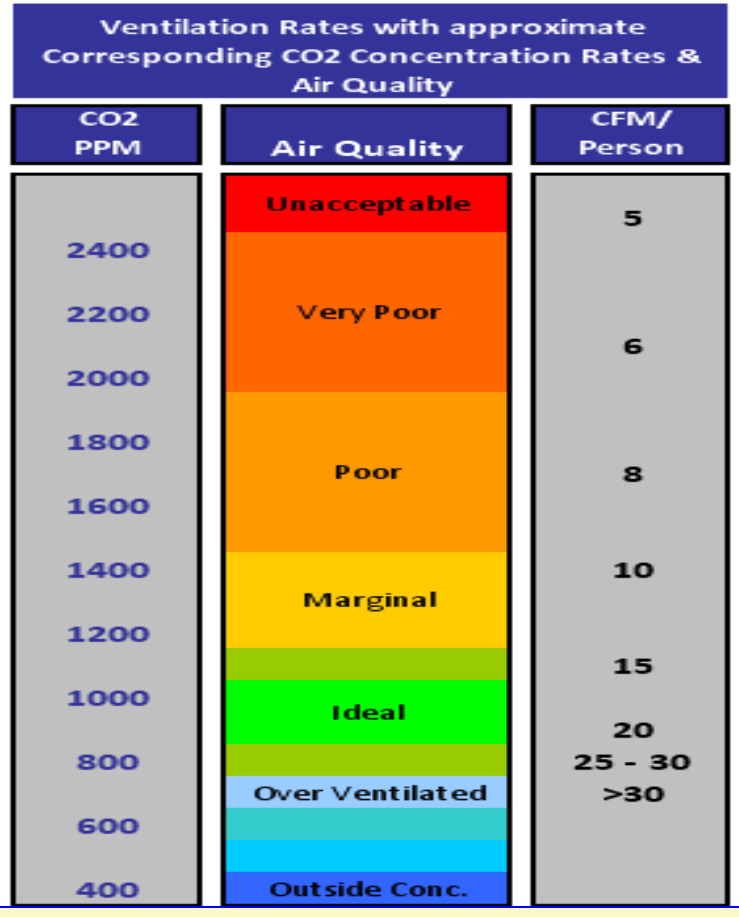
1000 $ft^2$ x 50 people / 1000 $ft^2$ x 15 CFM / person = 750 OA CFM

| Spaces With Estimated Occupancy Exceeding 25 Persons / 1000 sf. | |
|---|---|
| **Sports & Amusement** | **Theatres** |
| Disco/Dance floors | Auditoriums |
| Bowling Alleys (seating areas) | Lobbies |
| **Spectator Areas** | Stages, Studios |
| **Health Club/Aerobics room** | Ticket Booths |
| **Education** | **Hotels, Motels, Resorts, and** |
| **Food & Beverage Service** | **Transportation** |
| Bars, Cocktail Lounges | Platforms |
| Cafeteria, Fast Food | Transportation Waiting |
| Dining Rooms | |
| **Offices** | **Correctional Facilities** |
| Conference Rooms | Day Room |
| Reception Areas | Booking/Waiting |
| Telephone/Data Entry | |

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

# 6. VENTILATION REQUIREMENTS: DEMAND CONTROLLED VENTILATION

## Which Standard applies for determining minimum ventilation rates?




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

## 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 $CO_2$ readings by wall- or duct-mounted sensors
- Optimum is 600 PPM differential with outdoor ambient air, or approximately 1000 PPM absolute within zone

# 6. VENTILATION REQUIREMENTS: DEMAND CONTROLLED VENTILATION

**Which Standard applies for determining minimum ventilation rates?**

## 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

# 6. VENTILATION REQUIREMENTS: DEMAND CONTROLLED VENTILATION

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## 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: C403.2.6.1 & 1 RCNY§5000-01: IIB4

# 6. VENTILATION REQUIREMENTS: DCV – SCENARIOS 1, 2, 3

## Which of the Following Scenarios are Required to Install DCV?

**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**

# 6. VENTILATION REQUIREMENTS: DCV – SCENARIOS 1, 2, 3

## Which of the Following Scenarios are Required to Install DCV?

**S3:** Packaged Roof Top Unit (RTU) serves three classrooms each 1000 ft2. 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 2,250 CFM, 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.

# 6. VENTILATION REQUIREMENTS: ENERGY RECOVERY VENTILATION (ERV) SYSTEMS

## When is ERV required?

### Requirement for ERV:

- Two tables: One for ventilating systems operating less than 8,000 hrs. per year and the other for systems operating not less than 8,000 hrs. per year

### 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*



*ERV: C403.2.7, Table C403.2.7 (1) & (2) & Inspection requirements: 1 RCNY§5000-01: IIB4*

# 6. VENTILATION REQUIREMENTS: ENERGY RECOVERY VENTILATION: EXCEPTIONS

**What are allowable exceptional conditions for waiving ERV requirement?**

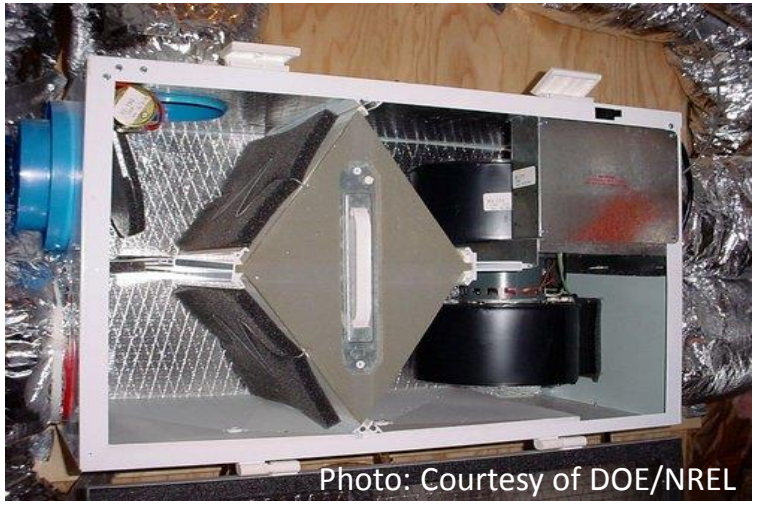


Photo: Courtesy of DOE/NREL

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.

## 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; 2° F

    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



*ERV: C403.2.7, Table C403.2.7 (1) & (2) & Inspection requirements: 1 RCNY§5000-01: IIB4*

# 6. VENTILATION REQUIREMENTS: 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's often very difficult to achieve code compliant performance requirements with these types of energy recovery systems.

# 7. MANDATORY CONTROLS: OVERVIEW

Slides 79 to 85

**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.

# 7. MANDATORY CONTROLS: THERMOSTAT CONTROL 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.

# 7. MANDATORY CONTROLS: 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



*Set point overlap restriction: C403.2.4.1.3*

# 7. MANDATORY CONTROLS: THERMOSTAT CONTROLS – SET POINT RESTRICTIONS

**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 a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch
  - 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.

# 7. MANDATORY CONTROLS:
# 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 at least 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: C403.2.4.2.1, C403.2.4.2.2*

# 7. MANDATORY CONTROLS: OUTSIDE AIR DAMPER REQUIREMENTS AND CONTROLS

**What scenarios require motorized dampers?**

## Motorized Damper Requirements:

- Outdoor Air (OA) supply & exhaust openings and stairway and shaft vents must have motorized dampers with automatic shut-off when system or space not in use or during unoccupied period warm-up and setback operation
- Gravity dampers allowed if building is less than 3 floors or air volume is less than 300 CFM

# 7. MANDATORY CONTROLS: 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: OVERVIEW

Slides 86 to 96

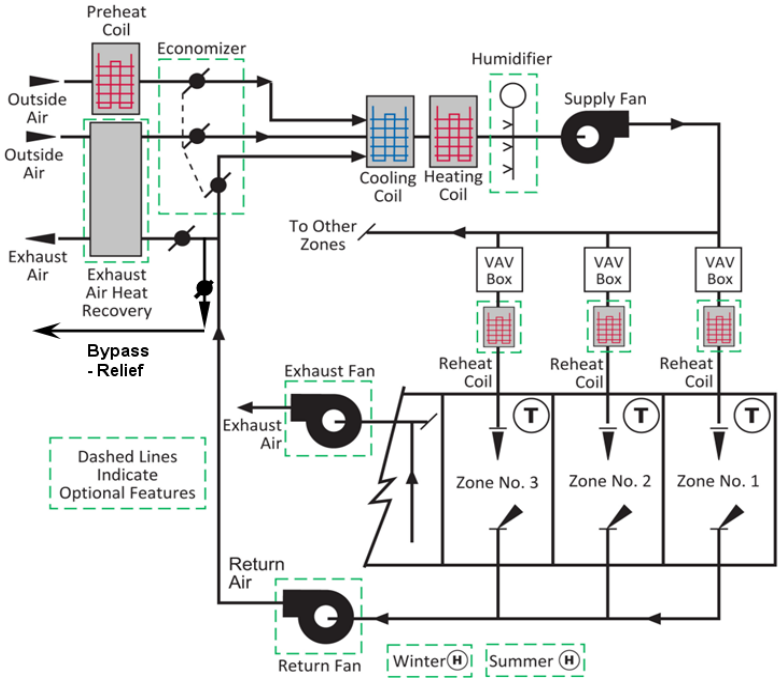
## In this section you will learn about:

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

# 8. DISTRIBUTION SYSTEMS: FAN POWER LIMIT 1

## What is regulated in ventilation system fans?

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




## 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)
    - Hospital, vivarium and laboratory systems that utilize flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable fan power limitation
    - 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



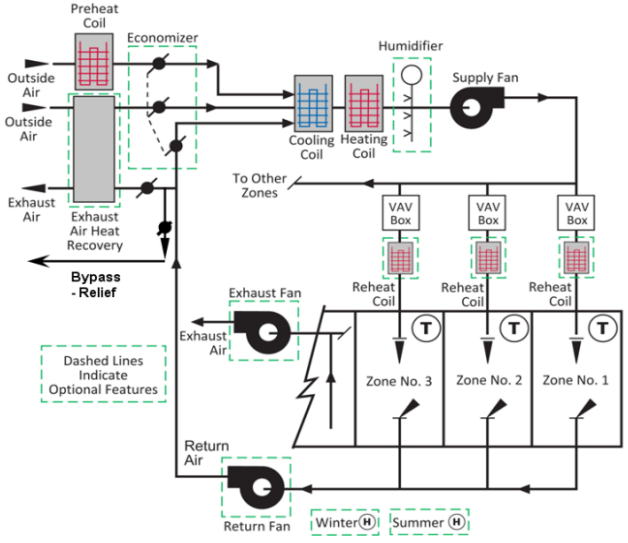
*Fan System power: C403.2.12, Tables C403.2.12.1(1) & (2)*

# 8. DISTRIBUTION SYSTEMS: FAN POWER LIMIT 2

## How is fan sizing or power allowance calculated?

| Table C403.2.12.1 (1) Fan Power Limitation: Pressure Drop Adjustment | | | |
|---|---|---|---|
| | LIMIT | CONSTANT VOLUME | VARIABLE VOLUME |
| Option 1: Fan system motor nameplate hp | Allowable nameplate motor hp | hp ≤ CFMs • 0.0011 | hp ≤ CFMs • 0.0015 |
| Option 2: Fan system bhp | Allowable fan system bhp | bhp ≤ CFMs • 0.00094 + A | bhp ≤ CFMs • 0.0013 + A |

Source: For full table see; NYCECC Tables 403.2.12.1(1) and (2)




## 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

# 8. DISTRIBUTION SYSTEMS: FAN POWER LIMIT 2

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| O… | | | • 0.0013 |

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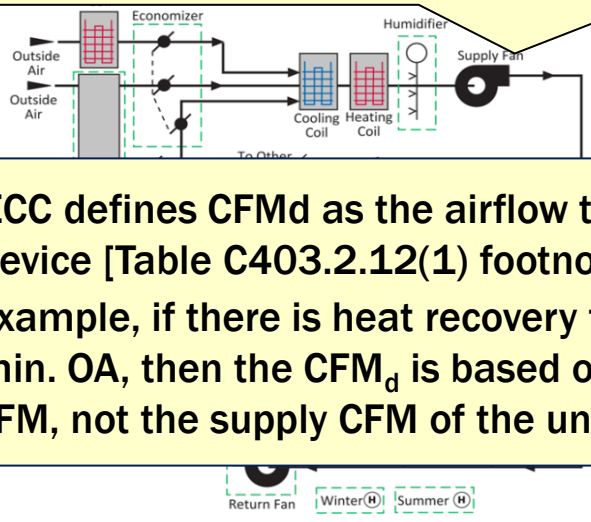
Total Fan Power Limit applies to all fans combined per system:
Supply + Return + Exhaust




NYCECC defines CFMd as the airflow through the device [Table C403.2.12(1) footnote].

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.

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# 8. DISTRIBUTION SYSTEMS: FAN POWER LIMIT 3

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

| Table C403.2.12.1 (2) 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 filtration credit MERV 13 thru 12 | 0.5 in. w.c. |
| Particulate filtration credit MERV 13 thru 12 | 0.9 in. w.c. |
| Particulate filtration credit MERV 16 & greater & electronically enhanced filters | PD @ 2x clean filter at design condition |
| Carbon & other gas-phase air cleaners | PD @ clean filter at design condition |
| Biosafety cabinet | PD @ design condition |
| Energy recovery device, other than coil runaround loop | (2.2 x energy recovery effectiveness) – 0.5 inch w.c. for each airstream |
| Coil runaround loop | 0.6 in w.c. for each airstream |
| Evaporative humidified/ cooler in series with another cooling coil | PD @ design condition |
| Sound attenuation section (fans serving spaces with design background noise goals below NC35) | 0.15 in. w.c. |
| Exhaust system serving fume hoods | 0.35 in. w.c. |
| Laboratory & vivarium exhaust systems in high-rise builings | 0.25 in. w.c./100 ft. of vertical duct exceeding 75 ft. |
| **Deductions** | |
| Systems without central cooling device | -0.6 in. w.c. |
| Systems without central heating device | -0.3 in. w.c. |
| Systems with central electrical resistance heat | -0.2 in. w.c. |

Source: For full table see; NYC Mechanical Code Table 403.3.2.12.1(2)

## Pressure Drop Adjustment:

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

**AND**

## 3 Deductions:

- Option 1: Name Plate HP Limit
  - Systems without central cooling device - 0.6 in. w. c.
  - Systems without central heating device - 0.3 in. w. c
  - Systems with central electric resistance heat - 0.2 in. w.c.

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  - Return/Exhaust airflow control
  - Exhaust treatment
  - Filters MERV 9 & higher
  - Heat Recovery
  - Evaporative humidifier/coolers
  - Sound Attenuation

The credits refer 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.

**AND**

## 3 Deductions:

- Option 1: Name Plate HP Limit
  - Systems without central cooling device - 0.6 in. w. c.
  - Systems without central heating device - 0.3 in. w. c
  - Systems with central electric resistance heat

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

# 8. DISTRIBUTION SYSTEMS: DUCTS & PLENUM CONSTRUCTION

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

| 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

## Insulation Requirements:

- R-6 if located in unconditioned space within the building enclosure
- R-8 if located outside the building
- None if located within conditioned space

## 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 4.0
    - $CL = F / P^{0.65}$
    - F = Measured Leakage Rate in CFM/100 $ft^2$ duct surface
    - P = Static Pressure of test

# 8. DISTRIBUTION SYSTEMS: DUCTS & PLENUM CONSTRUCTION

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

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

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# 8. DISTRIBUTION SYSTEMS: PIPING INSULATION

## What are minimum insulation requirements for pipes?

**TABLE C403.2.10**
**MINIMUM PIPE INSULATION THICKNESS (in inches)[a,c]**

| FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F) | INSULATION CONDUCTIVITY | | NOMINAL PIPE OR TUBE SIZE (inches) | | | | |
|---|---|---|---|---|---|---|---|
| | Conductivity Btu · in./(h · ft$^2$ · °F)[b] | Mean Rating Temperature, °F | < 1 | 1 to < 1$^1/_2$ | 1$^1/_2$ to < 4 | 4 to < 8 | ≥ 8 |
| > 350 | 0.32 – 0.34 | 250 | 4.5 | 5.0 | 5.0 | 5.0 | 5.0 |
| 251 – 350 | 0.29 – 0.32 | 200 | 3.0 | 4.0 | 4.5 | 4.5 | 4.5 |
| 201 – 250 | 0.27 – 0.30 | 150 | 2.5 | 2.5 | 2.5 | 3.0 | 3.0 |
| 141 – 200 | 0.25 – 0.29 | 125 | 1.5 | 1.5 | 2.0 | 2.0 | 2.0 |
| 105 – 140 | 0.21 – 0.28 | 100 | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 |
| 40 – 60 | 0.21 – 0.27 | 75 | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| < 40 | 0.20 – 0.26 | 50 | 0.5 | 1.0 | 1.0 | 1.0 | 1.5 |

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

a. For piping smaller than 1$^1/_2$ inches and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\{(1 + t/r)^{K/k} - 1\}$$

where:

$T$ = minimum insulation thickness,
$r$ = actual outside radius of pipe,
$t$ = insulation thickness listed in the table for applicable fluid temperature and pipe size,
$K$ = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu • in/h • ft$^2$ • °F) and
$k$ = the upper value of the conductivity range listed in the table for the applicable fluid temperature.

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1$^1/_2$ inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25 mm)).

## HVAC System piping to be insulated:

- Insulation thickness based on temperature range and size of pipe
- Exceptions
  - Factory-installed piping with HVAC equipment, fan coils, unit ventilators
  - Piping with fluids between 66° F to 105° F
  - Piping with fluids not heated or cooled using fossil fuels (or electric power)
  - Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter
  - Direct buried piping that conveys fluids at or below 60° F (15° C)

# 8. DISTRIBUTION SYSTEMS: 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 (18.6 kW) and larger
- Exception: Fans with motors of 1 hp or less

## Hydronic System Balancing:

- Individual hydronic heating and cooling coils must have a means for balancing and measuring flow
- Exceptions:
  1. Pumps with pump motors of 5 hp (3.7 kW) or less.
  2. Where throttling results in no greater than 5 percent of the nameplate horsepower draw above that



*Air Systems Balancing: C408.2.2.1; Hydronic systems balancing: C408.2.2.2; Manuals: C408.2.5.2*

# 8. DISTRIBUTION SYSTEMS: HVAC SYSTEM COMPLETION

**What is required for balancing and O&M manuals?** *(continued)*

## 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 (C408.2.5.2 lists a total of 8 items)
  - Air Systems Balancing: C408.2.2.1, Hydronic systems balancing: C408.2.2.2, Manuals: C408.2.5.2



*Air Systems Balancing: C408.2.2.1; Hydronic systems balancing: C408.2.2.2; Manuals: C408.2.5.2*

# 9. CASE STUDY EXERCISE: OVERVIEW

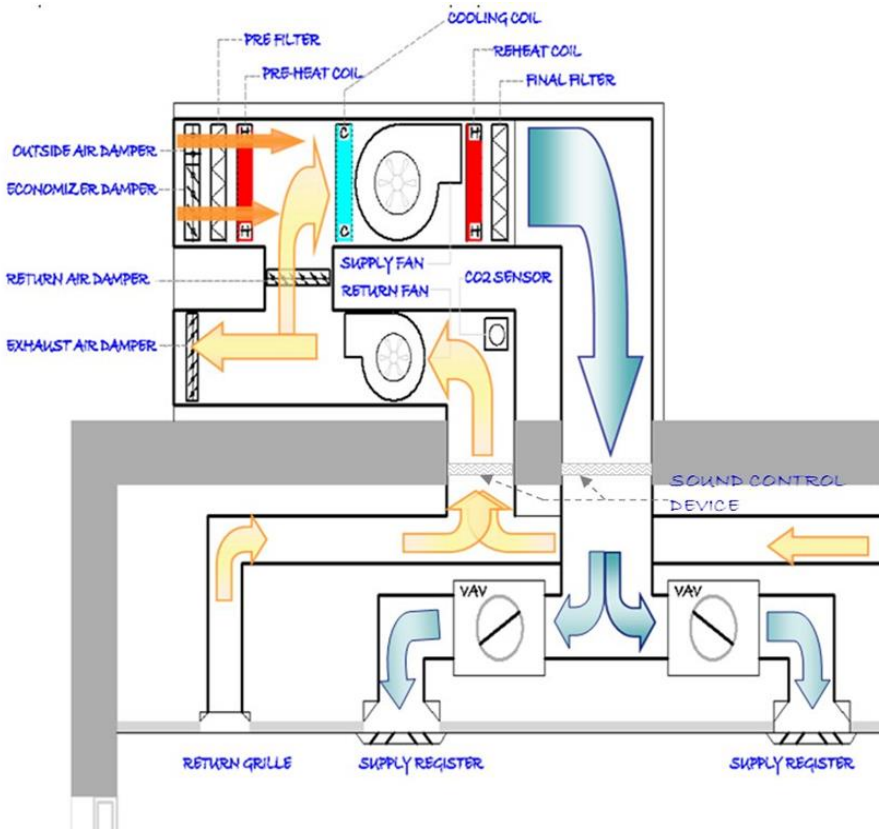
Slides 97 to 105

**In this section you will learn about:**

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

# 9. CASE STUDY EXERCISE: CASE 1 DESCRIPTION

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



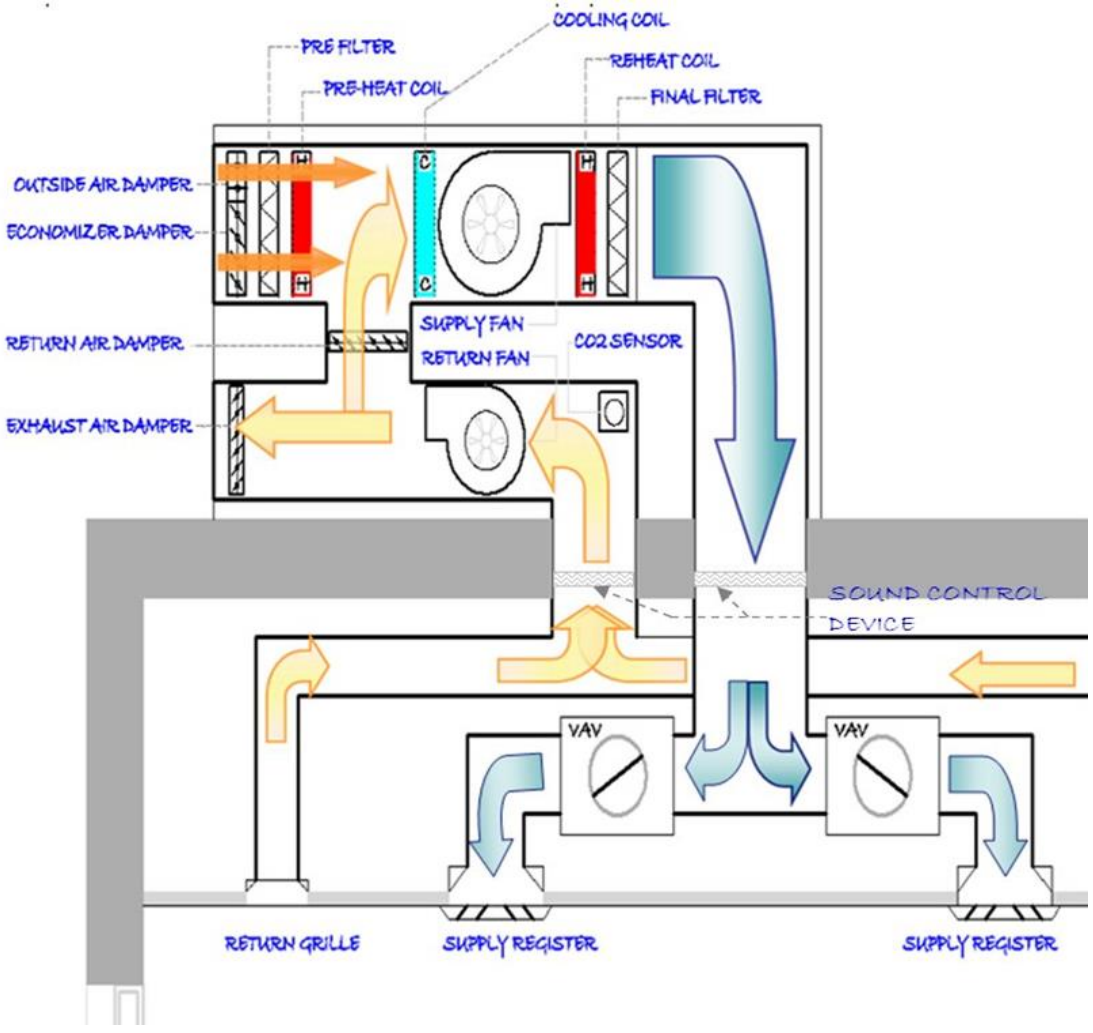

## Proposed System:

- Space Type:
  - 2000 ft$^2$ 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
  - Sound attenuation section is incorporated in the supply & return duct to mitigate supply fan's noise

## What are minimum compliance requirements for this system?

# 9. CASE STUDY EXERCISE: CASE 1 - SOLUTION 1

## Summarize applicable regulated features

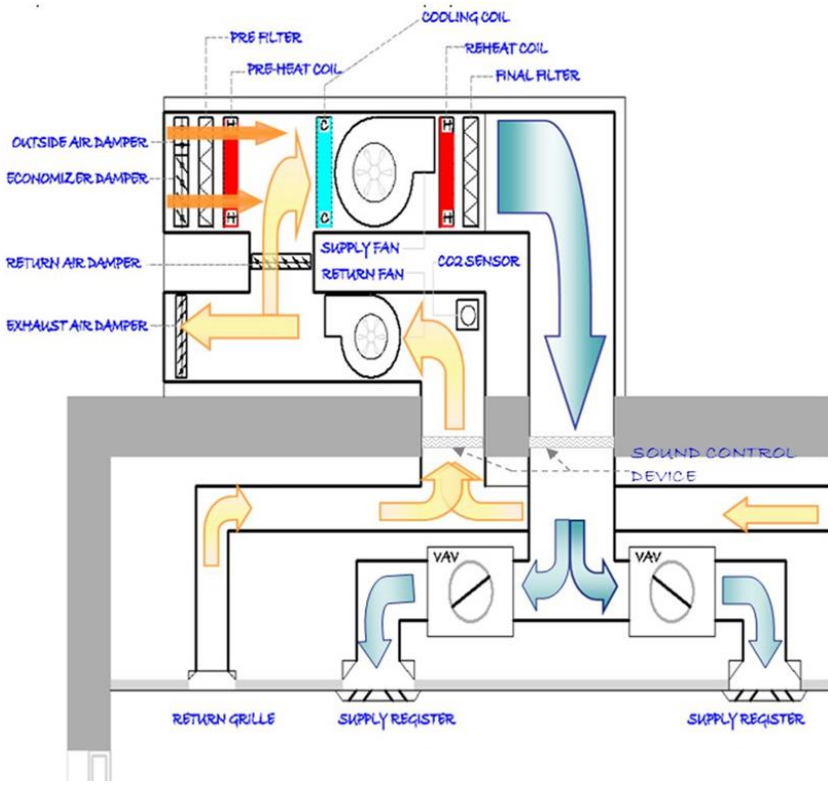



## Key Requirements:

- 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

# 9. CASE STUDY EXERCISE: 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 & IEER: 11.4
  - Hot Gas Bypass: Allowed if the unit has multistep unloading and limited to 50% capacity
- Heating Efficiency
  - 80% $E_t$

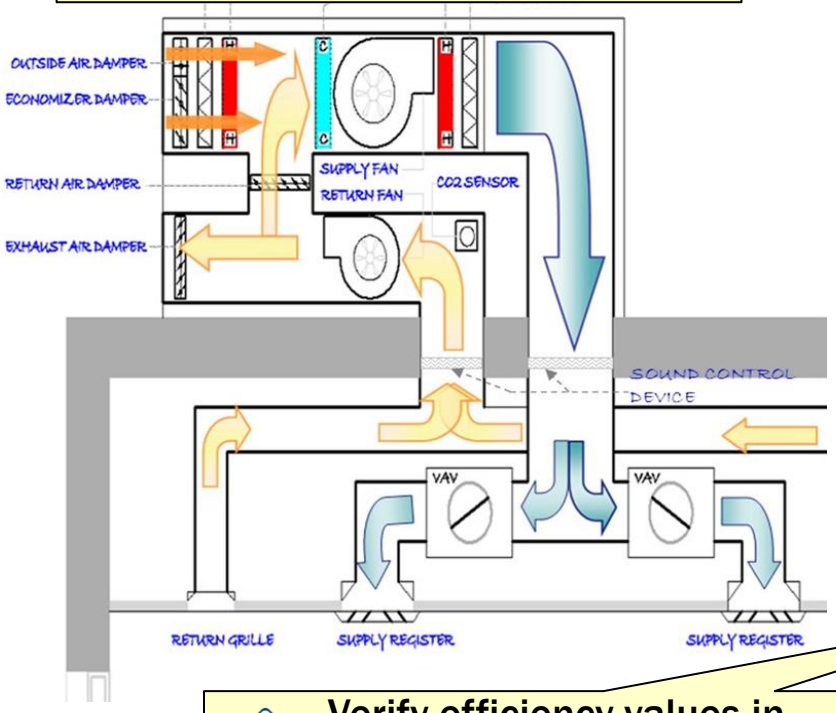


*Calculation of heating and cooling loads:* *C403.2.1*

# 9. CASE STUDY EXERCISE: CASE 1 - SOLUTION 2

## Determine equipment sizing & efficiency requirements

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




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

### Required Equipment Sizing & Efficiency:

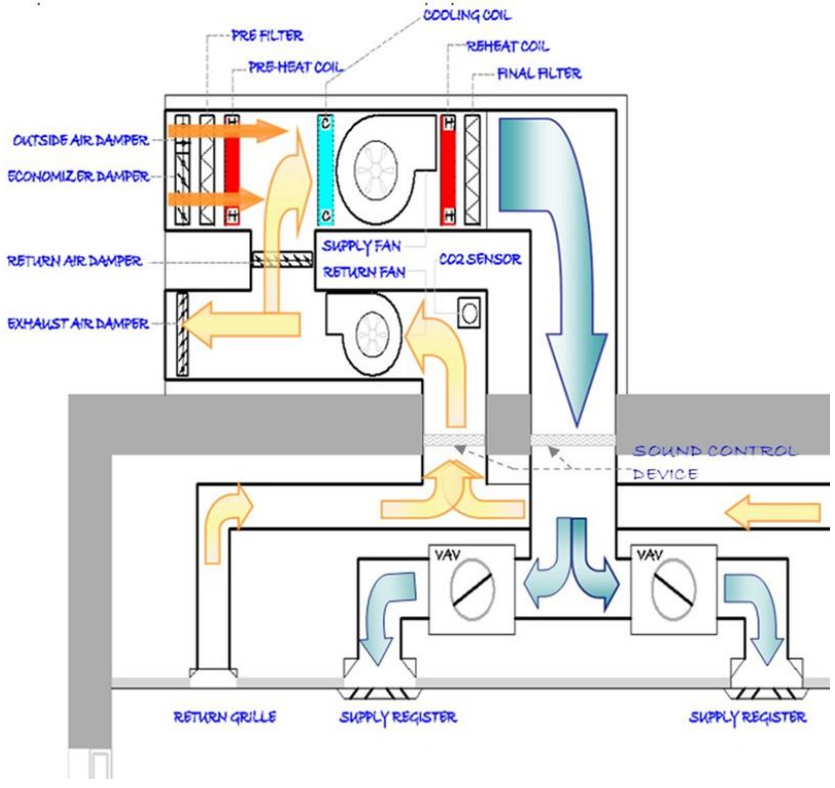
- Load Calculations:
  - Calculation method must follow procedures as prescribed in ASHRAE/ACCA 183 Standard
    - Single equipment, so no exception
    - Load sizing based on 75°F Cooling & 72°F Heating set points
- HVAC Type: Simple
  - Single packaged unit serving one zone
- Cooling Efficiency
  - EER: 9.8 & IEER: 11.4
  - Hot Gas Bypass: Allowed if the unit has multistep unloading and limited to 50% capacity
- Heating Efficiency
  - 80% $E_t$



*Calculation of heating and cooling loads:* *C403.2.1*

# 9. CASE STUDY EXERCISE: 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
    - Single equipment, so no exception
    - Load sizing based on 75°F Cooling & 72°F Heating set points
- **Demand Control Ventilation: Required**
  - Space greater than 500 $ft^2$ AND occupant density is greater than 25 persons/1000 $ft^2$
- **Energy Recovery: Required**
  - Design Outside Air volume – 56.25% @ less than 8,000 hrs/yr – Required since design supply fan airflow > 3500 cfm
- **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

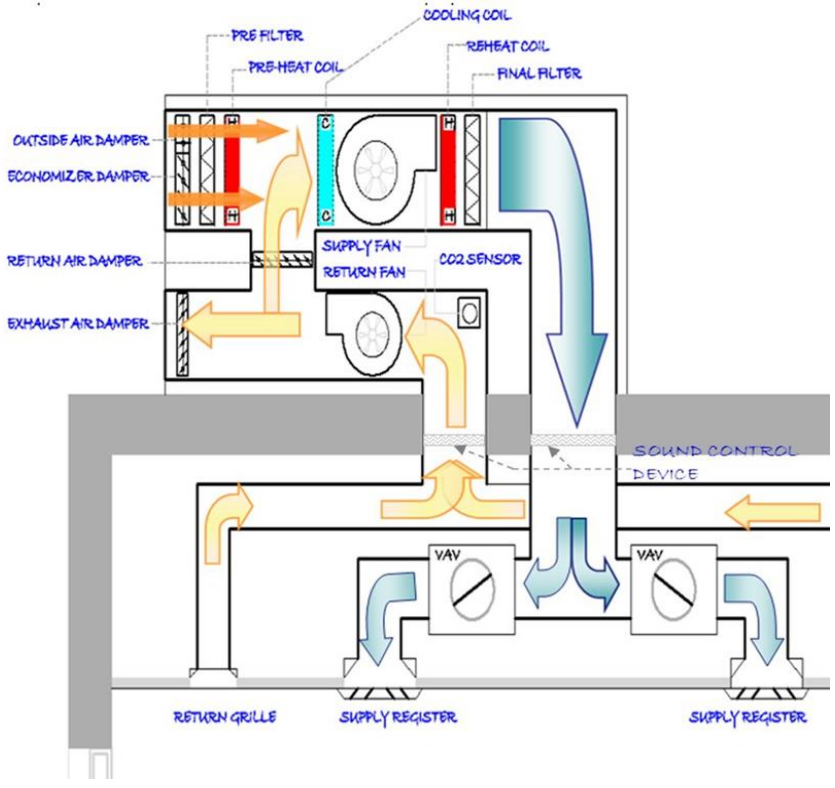


*Demand controlled ventilation: C403.2.6.1*

# 9. CASE STUDY EXERCISE: CASE 1 - SOLUTION 3

## List applicable efficiency features

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

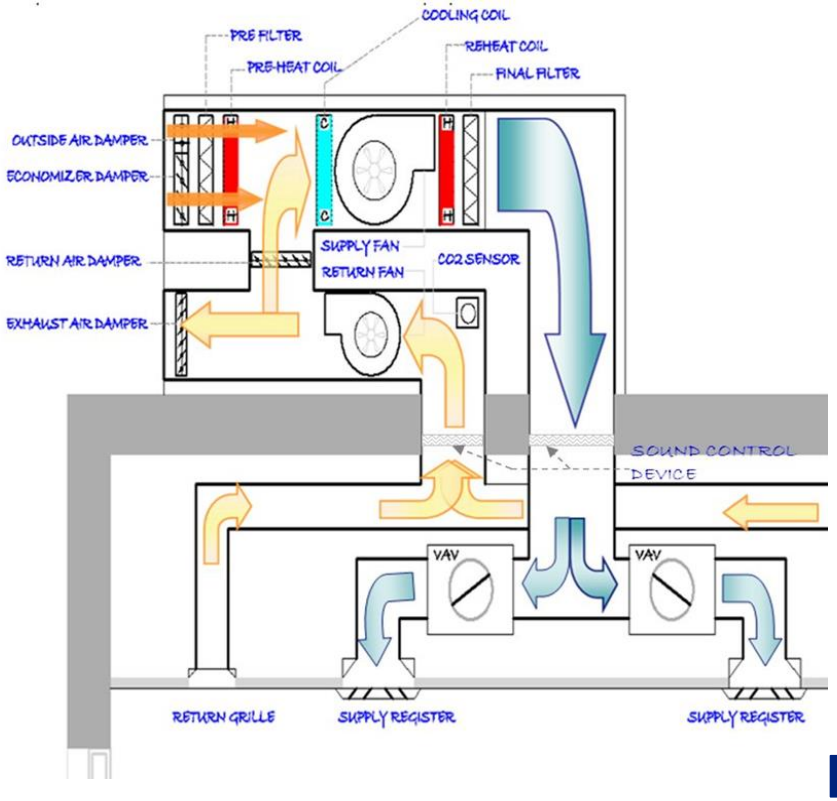



## Efficiency Features & Controls:

- **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
    - Single equipment, so no exception
    - Load sizing based on 75°F Cooling & 72°F Heating set points
- **Demand Control Ventilation: Required**
  - Space greater than 500 $ft^2$ AND occupant density is greater than 25 persons/1000 $ft^2$
- **Energy Recovery: Required**
  - Design Outside Air volume – 56.25% @ less than 8,000 hrs/yr – since design supply fan airflow > 3500 cfm
- **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

# 9. CASE STUDY EXERCISE: CASE 1 - SOLUTION 4

## List applicable efficiency features




## 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 (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 (for all fans)
  - Allowance VAV: (8000 x 0.0013 + 3.29) = 13.69 B

| 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** |

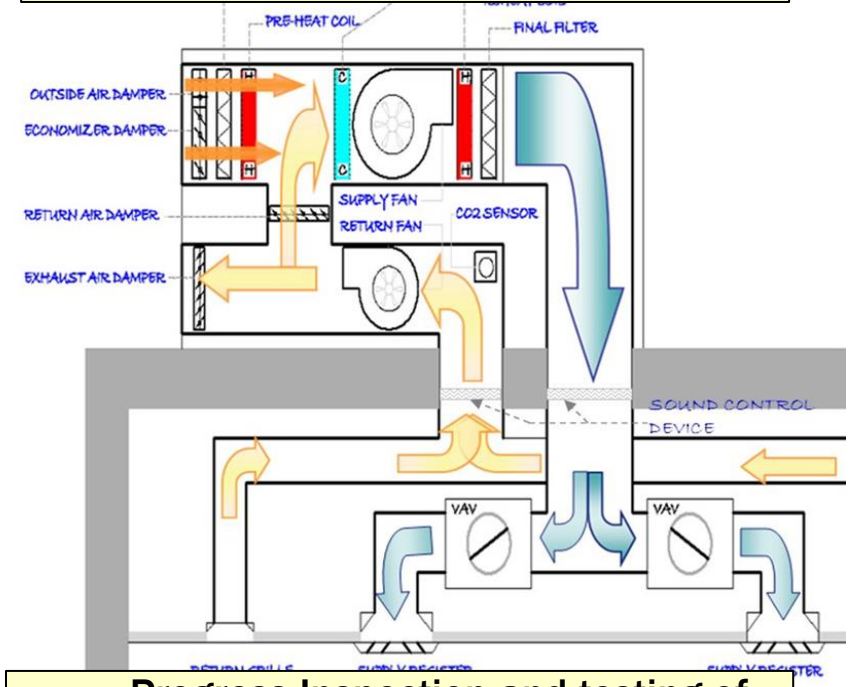
## Duct Pressure Classification:

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

# 9. CASE STUDY EXERCISE: CASE 1 - SOLUTION 4

## List applicable efficiency features

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

## 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 (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 (for all fans)
  - Allowance VAV: (8000 x 0.0013 + 3.29) = 13.69 B

| 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

# 10. SUBMISSIONS & INSPECTIONS

## Slides 106 to 143

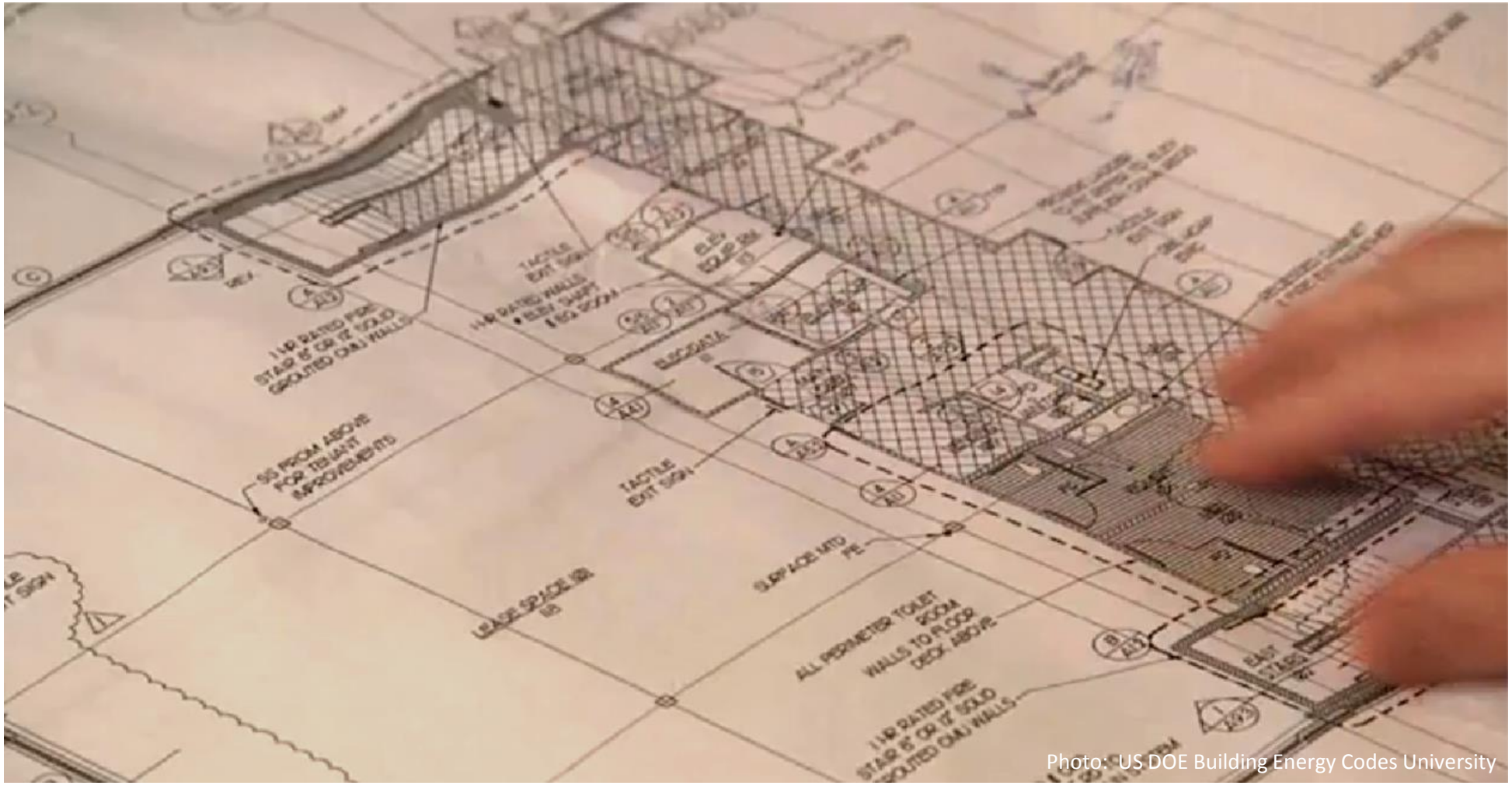


Photo: US DOE Building Energy Codes University

# 10. SUBMISSIONS & INSPECTIONS: LEARNING OBJECTIVES

## In this section you will learn about:

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

# 10. SUBMISSIONS & INSPECTIONS: NYCECC & 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.

# 10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

**What types of Energy Analysis are allowed?**

## Per 1 RCNY §5000-01:

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

# 10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

**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

# 10. SUBMISSIONS & INSPECTIONS: SAMPLE TABULAR ANALYSIS

## Examples of notes for commercial alterations/renovations

| NYCECC Citation | Provision | Item Description | Proposed Design Value | Code Prescriptive Value (ECC) | Code Prescriptive Value (ASHRAE) | Supporting Documentation |
|---|---|---|---|---|---|---|
| Building Mechanical Systems | | Building Mechanical Systems | | | | |
| **C403** | **Mandatory Provisions** | **Mandatory Provisions** | | | | |
| C403.2.1 | Calculation of heating and cooling loads | Load calculations for HVAC systems | Sample text: Design loads shall be are determined in accordance with the procedures described in the ANSI/ASHRAE/ACCA Standard183. | Sample text: Determined in accordance with ANSI/ASHRAE/ACCA Standard 183 HVAC Systems and Equipment Handbook | 6.4.2.1 Determined in accordance with ANSI/ASHRAE/ACCA Standard 183 | Signed and sealed statement from Engineer certifying compliance with Energy Code |
| C403.2.2 | Equipment sizing | HVAC systems sizing based on load calculations | Sample text: Specified equipment sized within load calculation limits | Heating and cooling equipment shall not exceed calculated loads | 6.4.2.1 Determined in accordance with ANSI/ASHRAE/ACCA Standard 183 | Signed and sealed statement from Engineer certifying compliance with Energy Code |
| C403.2.2 | HVAC equipment performance requirements | HVAC Equipment Performance Requirements | | | | |
| Table C403.2.3(1) | Minimum efficiency requirements: electrically operated unitary air conditioners and condensing units | Sample text: Split System 7.5 ton air cooled AC unit, AC-1 | Sample text: 12.0 EER | Sample text: 11.2 EER | Sample text: Table 6.8.1-1. 11.2 EER | Sample text: Split System AC units schedule, drawing M-XXX |
| Table C403.2.3(1) | Minimum efficiency requirements: electrically operated unitary air conditioners and condensing units | Sample text: Through the Wall packaged AC, 1 ton, AC-2 | Sample text: 14.5 SEER | Sample text: 12.0 SEER | Sample text: Table 6.8.1-1. 12.0 SEER. | Sample text: Through the wall AC units schedule, drawing M-XXX |
| Table C403.2.3(2) | Minimum efficiency requirements: electrically operated unitary and applied heat pumps | Sample text: 3 ton air cooled heat pump, single package, HP-1 | Sample text: 14.5 SEER | Sample text: 14.0 SEER | Sample text: Table 6.8.12. 14.0 SEER | Sample text: AC units schedule, drawing M-XXX |

# 10. SUBMISSIONS & INSPECTIONS: SAMPLE TABULAR ANALYSIS

## Examples of notes for commercial alterations/renovations

| NYCECC Citation | Provision | Item Description | Proposed Design Value | Code Prescriptive Value (ECC) | Code Prescriptive Value (ASHRAE) | Supporting Documentation |
|---|---|---|---|---|---|---|
| Building Mechanical Systems | | Building Mechanical Systems | | | | |
| **C403** | **Mandatory Provisions** | **Mandatory Provisions** | | | | |
| C403.2.1 | Calculation of heating and cooling loads | Load calculations for HVAC systems | Sample text: Design loads shall be are determined in accordance with the procedures described in the ANSI/ASHRAE/ACCA Standa | Sample text: Determined in accordance with ANSI/ASHRAE/ACCA Standard 183 HVAC Systems and Equipm | 6.4.2.1 in a ACCA Standard | Signed and sealed statement from Engineer certifying compliance with Energy Code |
| C403.2.2 | Equipment sizing | HVAC systems sizing based on load calculations | Sampl equipr calcula | | dard | Signed and sealed statement from Engineer certifying compliance with Energy Code |
| C403.2.2 | HVAC equipment performance requirements | HVAC Equipment Performance Requirer | | | | |
| Table C403.2.3(1) | Minimum efficiency requirements: electrically operated unitary air conditioners and condensing units | Sample text: Split System 7.5 ton air cooled AC unit, AC-1 | Sample text: 12.0 EER | Sample text: 11.2 EER | Sample text: Table 6.8.1-1. 11.2 EER | Sample text: Split System AC units schedule, drawing M-XXX |
| Table C403.2.3(1) | Minimum efficiency requirements: electrically operated unitary air conditioners and condensing units | Sample text: Through the Wall packaged AC, 1 ton, AC-2 | Sample text: 14.5 SEER | Sample text: 12.0 SEER | Sample text: Table 6.8.1-1. 12.0 SEER. | Sample text: Through the wall AC units schedule, drawing M-XXX |
| Table C403.2.3(2) | Minimum efficiency requirements: electrically operated unitary and applied heat pumps | Sample text: 3 ton air cooled heat pump, single package, HP-1 | Sample text: 14.5 SEER | Sample text: 14.0 SEER | Sample text: Table 6.8.12. 14.0 SEER | Sample text: AC units schedule, drawing M-XXX |

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

# 10. SUBMISSIONS & INSPECTIONS: SAMPLE TABULAR ANALYSIS

## Examples of notes for commercial alterations/renovations *(continued)*

| NYCECC Citation | Provision | Item Description | Proposed Design Value | Code Prescriptive Value (ECC) | Code Prescriptive Value (ASHRAE) | Supporting Documentation |
|---|---|---|---|---|---|---|
| C403.4.4.1 | Single-duct VAV system, terminal devices | Sample text: single duct VAV system in zone XX | Sample text: control sequences provided as required | Terminal devices shall be capable of reducing primary supply air before reheating or recooling takes place | N/A | Sample text: See mechanical plans, M-1XX, M-1XX, M-1XX, mechanical control sequences, drawing M-XXX, and mechanical specifications drawing M-XXX |
| C403.4.4.2 | Dual-duct and mixing VAV systems, terminal devices | Sample text: dual duct mixing VAV system in zone XX | Sample text: control sequences provided as required | Terminal devices shall be capable of reducing air from one duct to a minimum before mixing takes place | N/A | Sample text: See mechanical plans, M-1XX, M-1XX, M-1XX, mechanical control sequences, drawing M-XXX, and mechanical specifications drawing M-XXX |
| C403.4.4.3 | Single-fan dual-duct and mixing VAV systems, economizers | Sample text: dual duct mixing VAV system in zone XX | Sample text: economizer not provided as per requirements | 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 | Sample text: See mechanical plans, M-1XX and mechanical specifications drawing M-XXX |
| **Service Water Heating** | | | | | | |
| **C404** | **Service Water Heating (Mandatory)** | | | | | |
| C404.2, Table C404.2 | Service water-heating equipment performance efficiency | Sample text: Domestic Water Heater, DWH-1,-2 | Sample text: 92% Et, Gas-fired, (2) 500,000 Btu/h | Shall meet efficiency requirements of table C404.2. If capacity is 1 MBH or greater, 90% Et or greater is required in Section C404.2.1 | 7.4.2 Shall meet the criteria listed in Table 7.8. Equipment not listed in Table 7.8 has no minimum requirement. | Sample text: See plumbing schedules, drawing P-XXX |
| C404.6 | Heated-water circulating and temperature maintenance systems | Hot water circulation pumps and heat trace | Sample text: DHW circulation pump controls provided as required | The system return pipe shall be a dedicated return pipe or cold water supply pipe. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy… | 7.4.4 The service hot water heating system shall be designed with controls meeting the requirements in 7.4.4.1 - 7.4.4.4 | Sample text: See plumbing specification drawings, P-XXX |
| C404.4 | Insulation of piping | Sample text: DHW Pipe Insulation | Sample text: 1.5" insulation shall be used on all hot water service piping | Service water piping shall be insulated according to Table C403.2.10 | 7.4.3 Items a through d listed in 7.4.3 shall be insulated to levels shown in Section 6, Table 6.8.3-1 | Sample text: See plumbing schedules, drawing P-XXX |

# 10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

**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 City or ASHRAE-90.1 COMcheck forms are permitted (not IECC)
  - Downloads: https://www.energycodes.gov/

# 10. SUBMISSIONS & INSPECTIONS: SAMPLE COMCHECK

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

Reduced interior lighting power. Requirements are implicitly enforced within interior lighting allowance calculations.

**Mechanical Systems List**

| Quantity | System Type & Description |
|---|---|
| 1 | RTU-1 (Single Zone):<br>Heating: 1 each - Duct Furnace, Gas, Capacity = 400 kBtu/h<br>Proposed Efficiency = 80.00% Ec, Required Efficiency = 80.00% Ec<br>Cooling: 1 each - Single Package DX Unit, Capacity = 382 kBtu/h, Air-Cooled Condenser, Air Economizer<br>Proposed Efficiency = 10.00 EER, Required Efficiency: 9.80 EER + 11.4 IEER<br>Fan System: None |
| 1 | ACCU-1 (Single Zone):<br>VRF, Air Cooled Heat Pump<br>Heating Mode: Capacity = 54 kBtu/h,<br>Proposed Efficiency = 8.70 HSPF, Required Efficiency = 7.70 HSPF<br>Cooling Mode: Capacity = 48 kBtu/h,<br>Proposed Efficiency = 15.80 SEER, Required Efficiency: 13.00 SEER<br>Fan System: None |
| 1 | ACCU-2 (Single Zone):<br>VRF, Air Cooled Heat Pump<br>Heating Mode: Capacity = 135 kBtu/h,<br>Proposed Efficiency = 3.54 COP, Required Efficiency = 3.30 COP<br>Cooling Mode: Capacity = 120 kBtu/h,<br>Proposed Efficiency = 11.90 EER, Required Efficiency: 11.00 EER + 14.6 IEER<br>Fan System: None |
| 1 | ACCU-3 (Single Zone): |

**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.**

# 10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

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

## Option 3: Energy modeling

- Section 11 Energy Cost Budget Method or Appendix G Performance Rating Method of the of Appendix CA (ASHRAE 90.1 -2013 with NYC amendments) 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

# 10. SUBMISSIONS & INSPECTIONS: EN1 – HVAC & SHW INPUT FORMS

NYC Buildings

EN1: Energy Cost Budget Worksheet

Enter information for sections 1, 2 and

Must b

| 1 | Location Information | |
|---|---|---|
| | House No(s) | Stree |
| | Borough | Block |
| | Work on Floor(s) | |

| 2 | Applicant Information | |
|---|---|---|
| | Last Name | |
| | Business Name | |
| | Business Address | |
| | City | State |
| | Email | |

NYC Buildings

EN1: Energy Cost Budget Worksheet

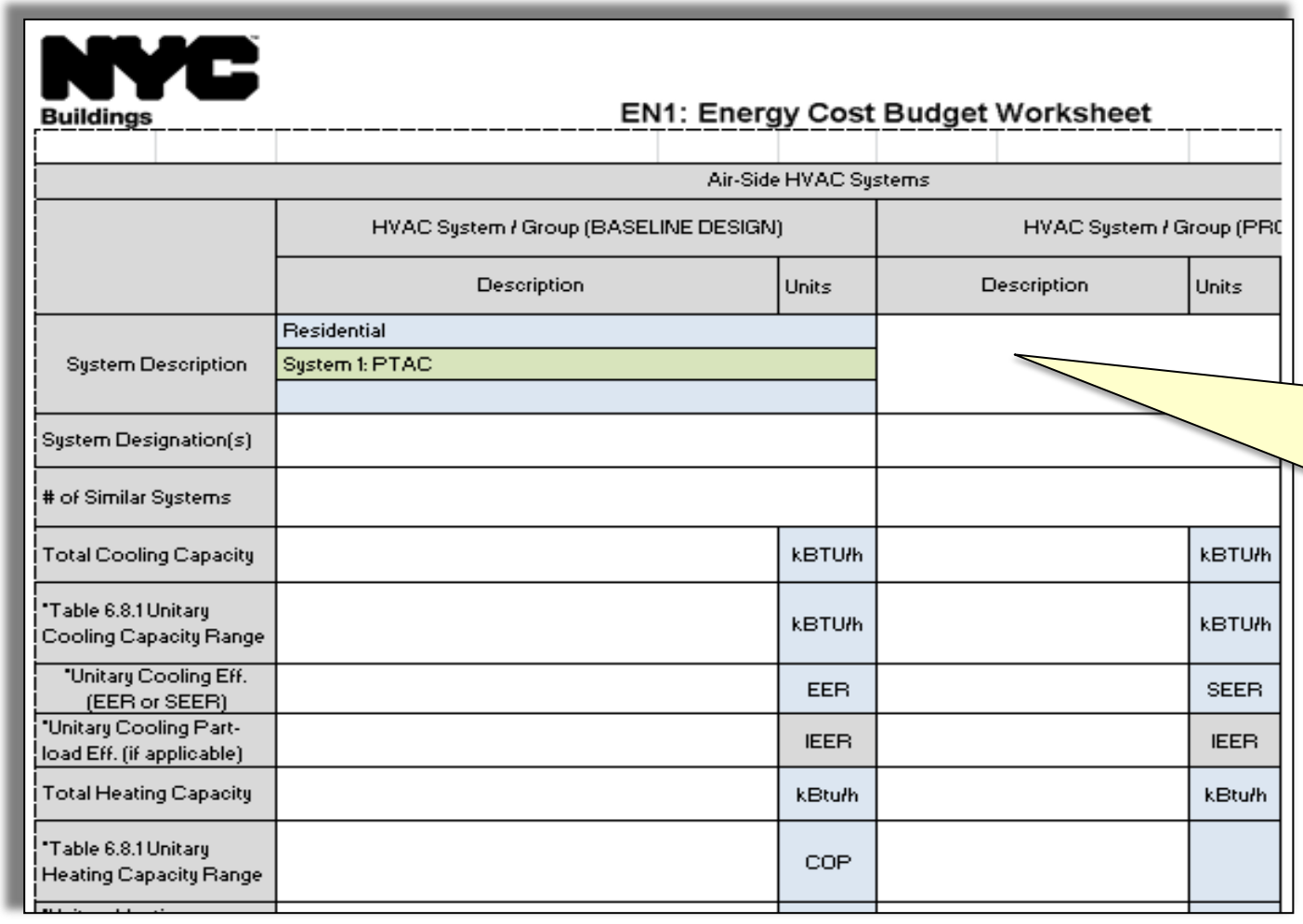
| | HVAC System / Group ( |
|---|---|
| | Description |
| System Description | Residential |
| | System 1: PTAC |
| System Designation(s) | |
| # of Similar Systems | |
| Total Cooling Capacity | |
| *Table 6.8.1 Unitary Cooling Capacity Range | |
| *Unitary Cooling Eff. (EER or SEER) | |
| *Unitary Cooling Part-load Eff. (if applicable) | |

NYC Buildings

EN1: Energy Cost Bud

| 6g | Service Hot Water Systems | | |
|---|---|---|---|
| Model Input Parameter | Baseline Design | Units | Proposed Des |
| | Multifamily | | |
| System Type & Fuel | | | |
| Input Rating | | kBtu/h | |
| Efficiency | | EF | |
| Storage Volume | | Gal | |
| Storage Temperature | | °F | |
| Peak HW Demand | | GPM | |
| Number of Primary DHW | | # | |

# 10. SUBMISSIONS & INSPECTIONS: EN1 – HVAC & SHW INPUT FORMS



NYC Buildings

EN1: Energy Cost Budget Worksheet

| Air-Side HVAC Systems | | | | |
|---|---|---|---|---|
| | HVAC System / Group (BASELINE DESIGN) | | HVAC System / Group (PRC | |
| | Description | Units | Description | Units |
| System Description | Residential<br>System 1: PTAC | | | |
| System Designation(s) | | | | |
| # of Similar Systems | | | | |
| Total Cooling Capacity | | kBTU/h | | kBTU/h |
| *Table 6.8.1 Unitary Cooling Capacity Range | | kBTU/h | | kBTU/h |
| *Unitary Cooling Eff. (EER or SEER) | | EER | | SEER |
| *Unitary Cooling Part-load Eff. (if applicable) | | IEER | | IEER |
| Total Heating Capacity | | kBtu/h | | kBtu/h |
| *Table 6.8.1 Unitary Heating Capacity Range | | COP | | |

Input information on the HVAC input form should be reflected in the Supporting Documentation to the permit application.

# 10. SUBMISSIONS & INSPECTIONS: 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.

# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

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

## Supporting Documentation for HVAC and SHW:

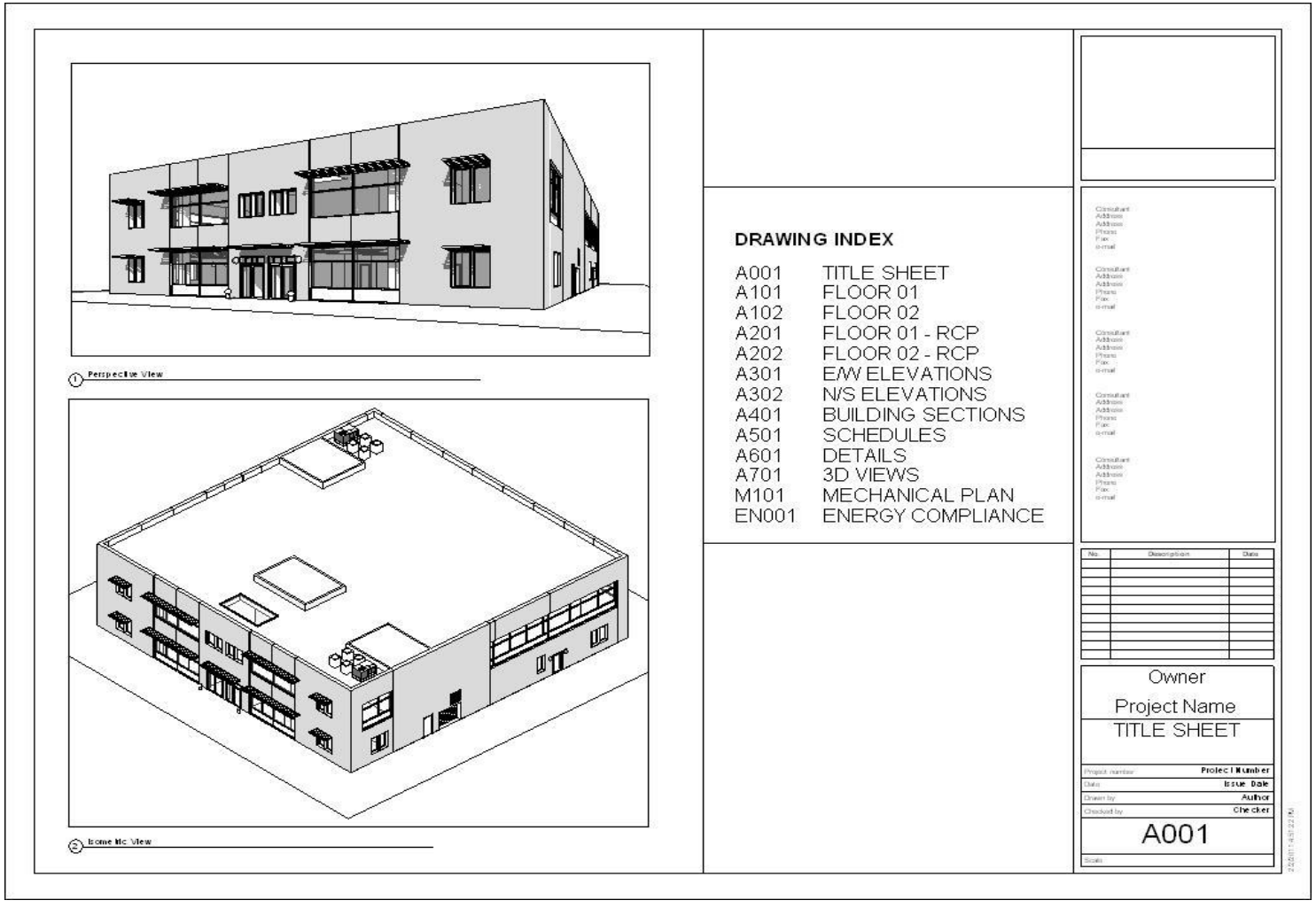
- Floor plans showing:
  - Terminal Units
  - Controls
  - Duct work and piping
  - HVAC equipment
- Mechanical schedules showing:
  - HVAC equipment (terminal units, pumps, fans, energy recovery)
  - Design operating temperatures
  - Performance values (flow rates, efficiencies, net horse power)
- Equipment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



*Supporting Documentation: ECC 103.2, 1 RCNY §5000-01(g)*

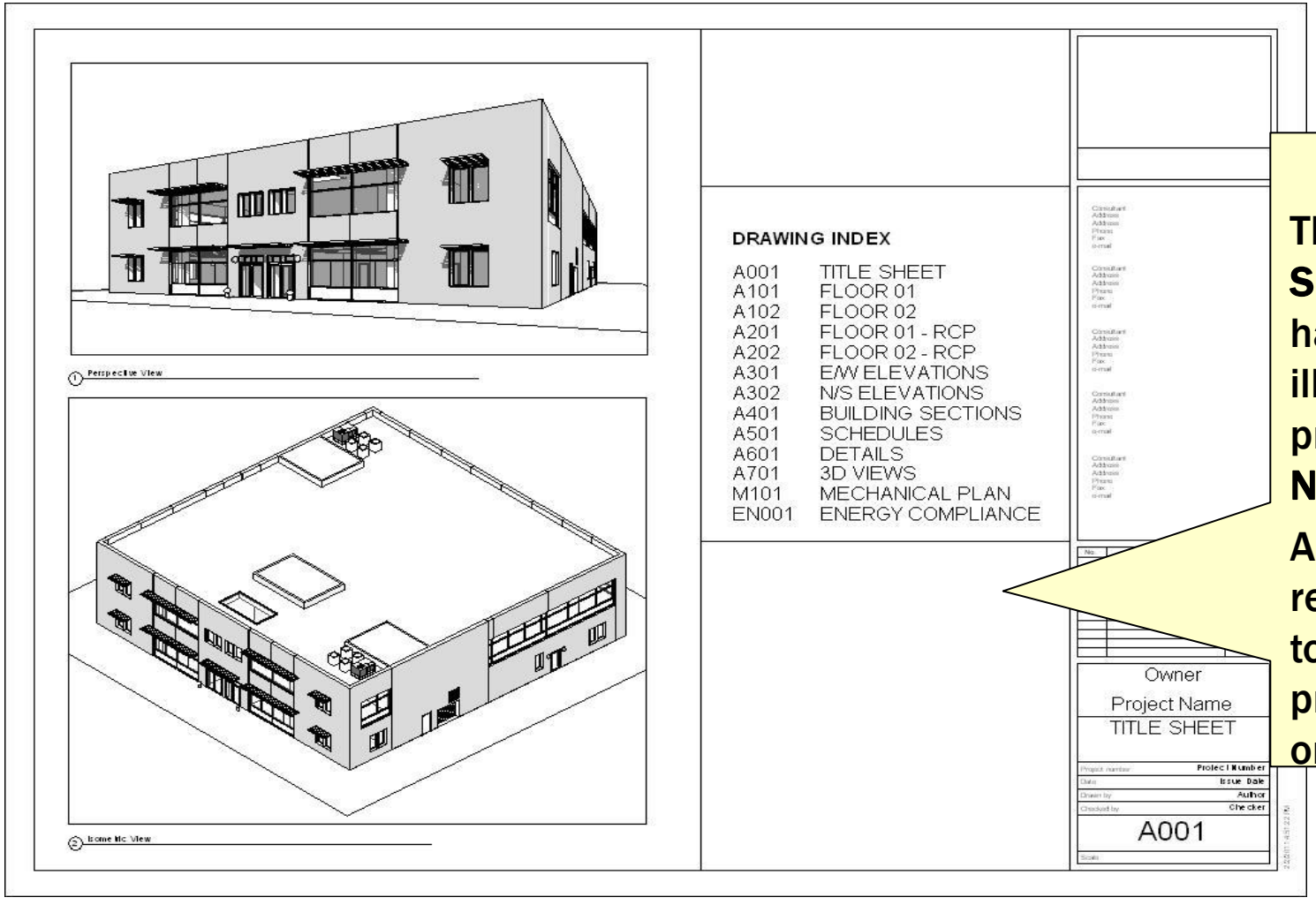
# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building: New Office Facility



# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building: New Office Facility



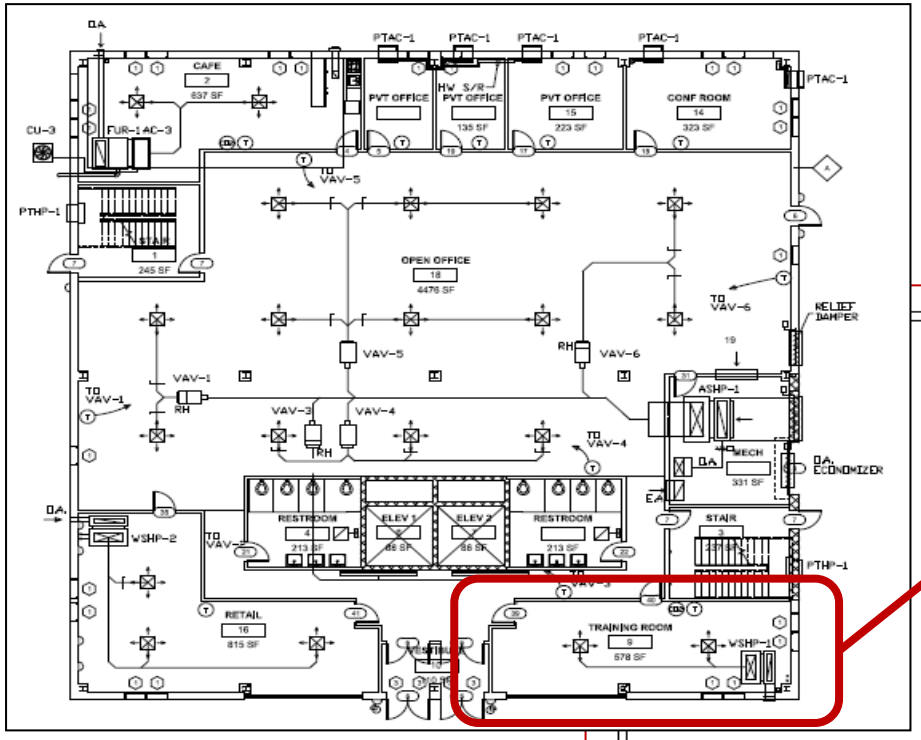

The following **Sample Supporting Documentation** has been developed to illustrate compliance procedures related to **the NYCECC only.**

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

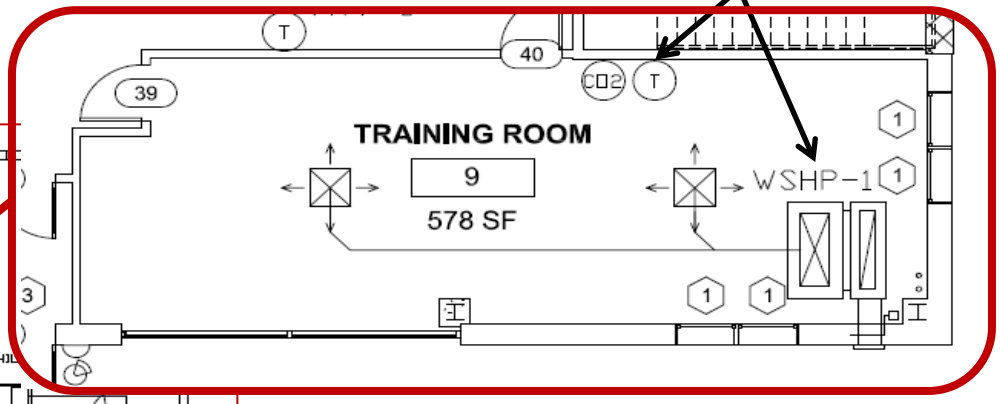
# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

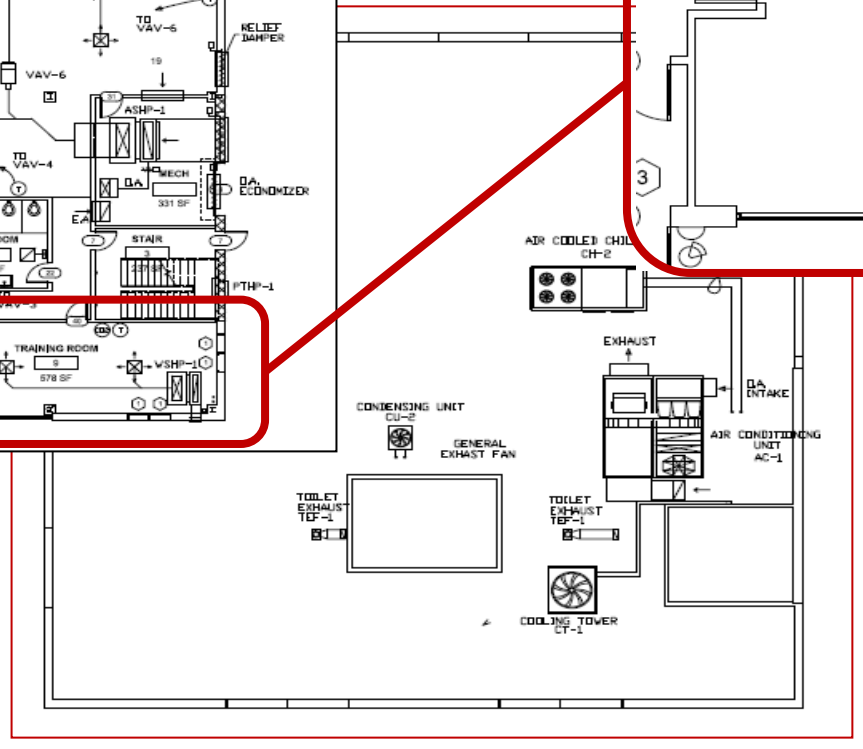
## Sample Building

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




1st FLOOR PLAN

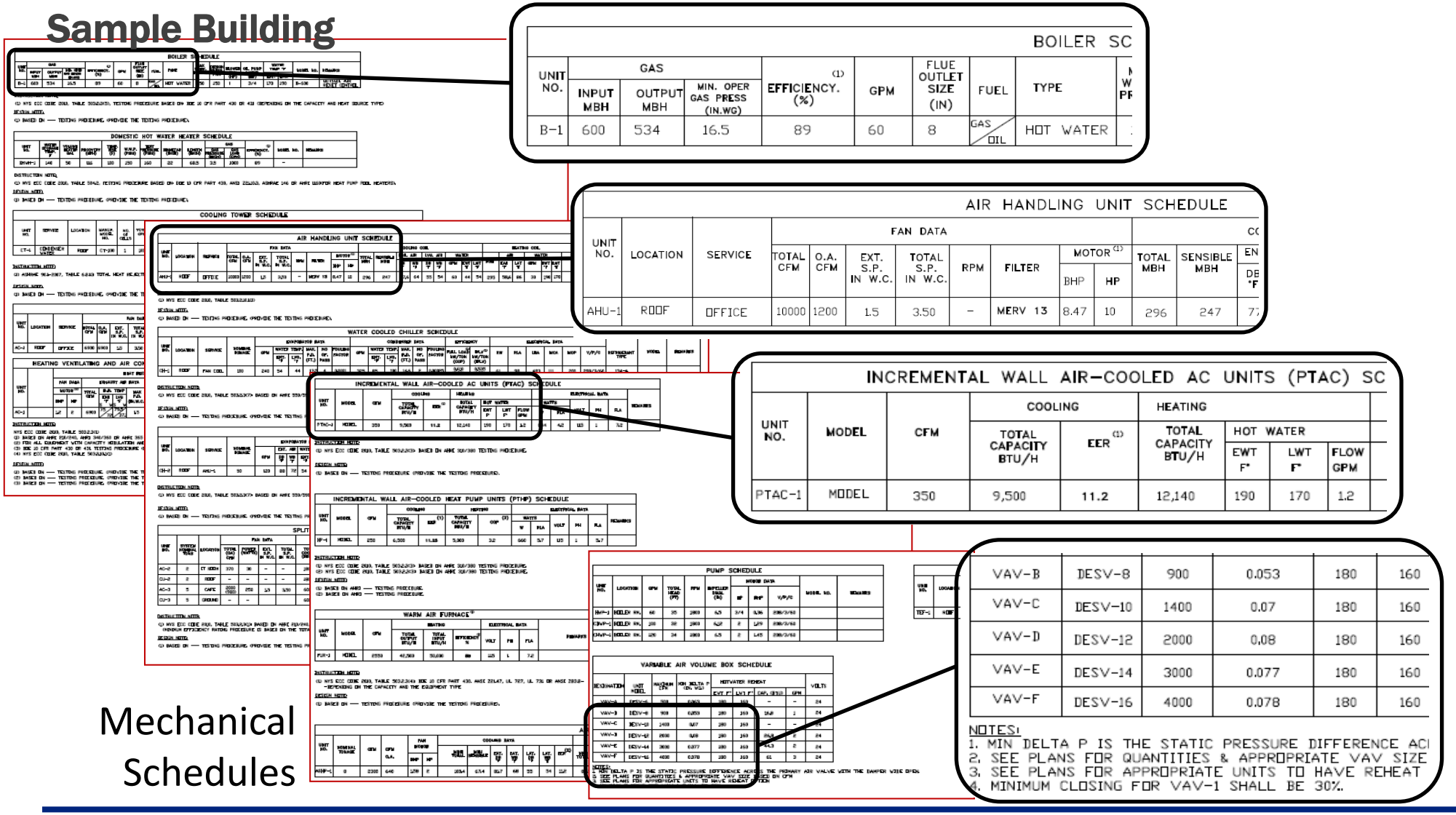



ROOF PLAN

# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building



BOILER SC

| UNIT NO. | GAS | | | EFFICIENCY. (%) (1) | GPM | FLUE OUTLET SIZE (IN) | FUEL | TYPE |
|---|---|---|---|---|---|---|---|---|
| | 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 | | | DE °F |
| AHU-1 | ROOF | OFFICE | 10000 | 1200 | 1.5 | 3.50 | – | MERV 13 | 8.47 | 10 | 296 | 247 | 7 |

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 |

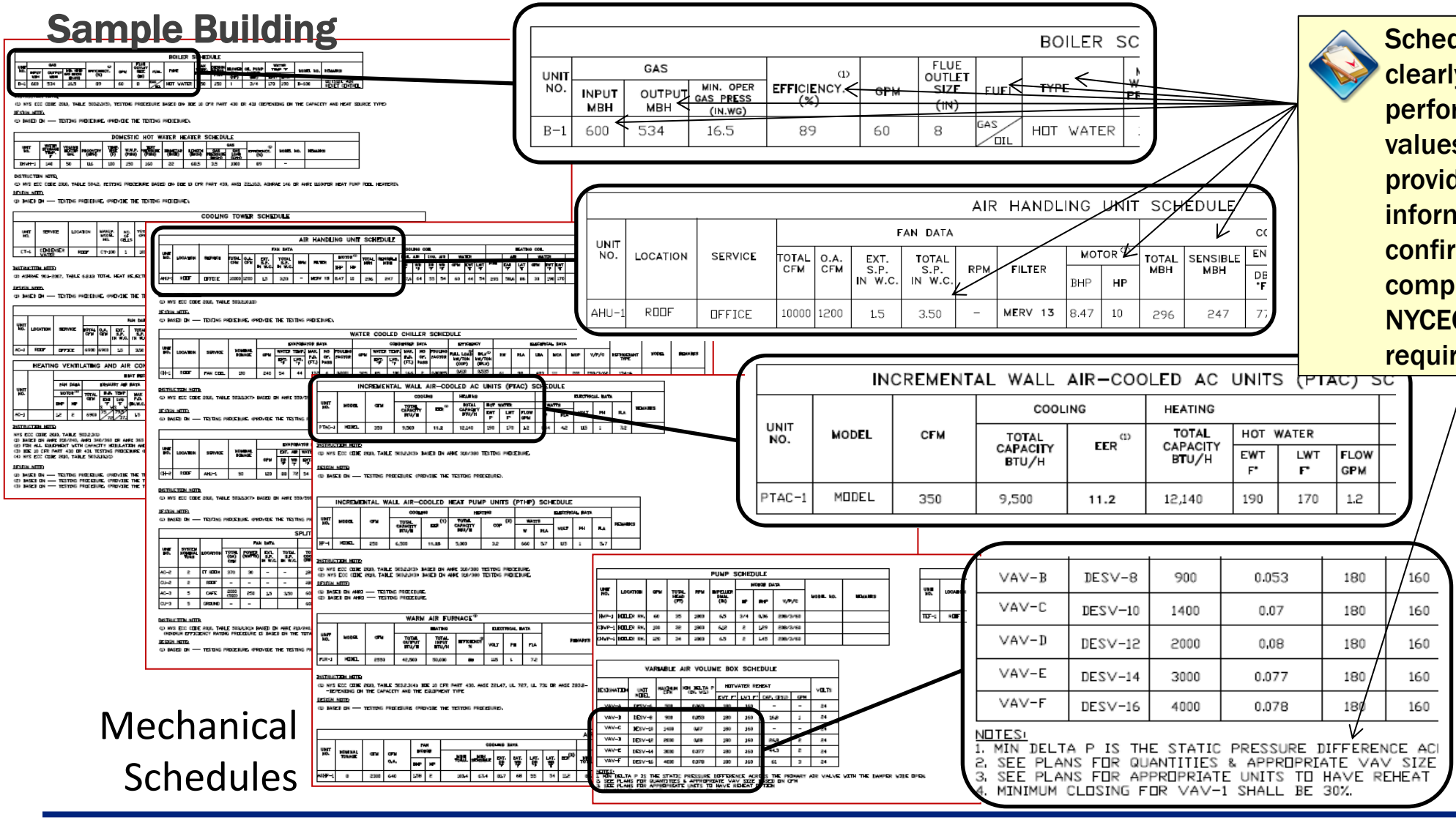
| | | | | | |
|---|---|---|---|---|---|
| VAV-B | DESV-8 | 900 | 0.053 | 180 | 160 |
| VAV-C | DESV-10 | 1400 | 0.07 | 180 | 160 |
| VAV-D | DESV-12 | 2000 | 0.08 | 180 | 160 |
| VAV-E | DESV-14 | 3000 | 0.077 | 180 | 160 |
| VAV-F | DESV-16 | 4000 | 0.078 | 180 | 160 |

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

# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building



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 | TYPE |
|---|---|---|---|---|---|---|---|---|
| B-1 | 600 | 534 | 16.5 | 89 | 60 | 8 | GAS / OIL | 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 | CC 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 (PTAC) SC

| 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 |

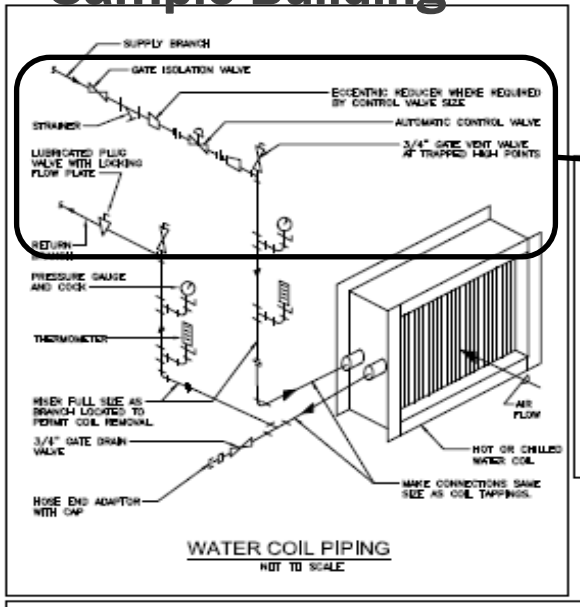
| | | | | | |
|---|---|---|---|---|---|
| VAV-B | DESV-8 | 900 | 0.053 | 180 | 160 |
| VAV-C | DESV-10 | 1400 | 0.07 | 180 | 160 |
| VAV-D | DESV-12 | 2000 | 0.08 | 180 | 160 |
| VAV-E | DESV-14 | 3000 | 0.077 | 180 | 160 |
| VAV-F | DESV-16 | 4000 | 0.078 | 180 | 160 |

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%.

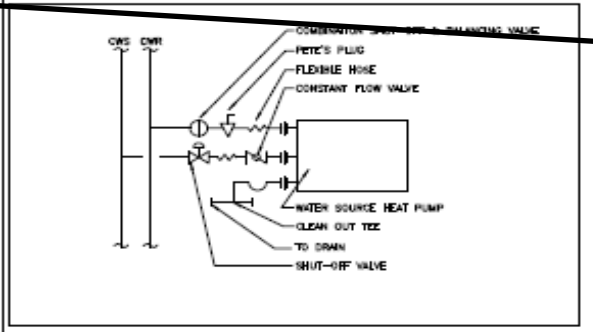
Mechanical Schedules

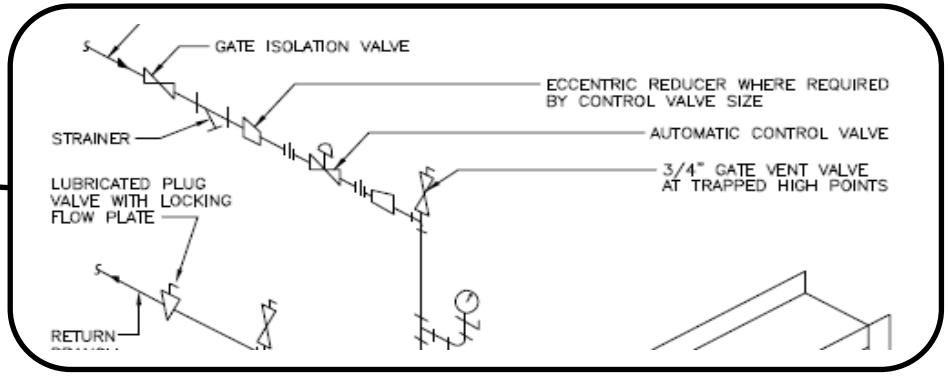
# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

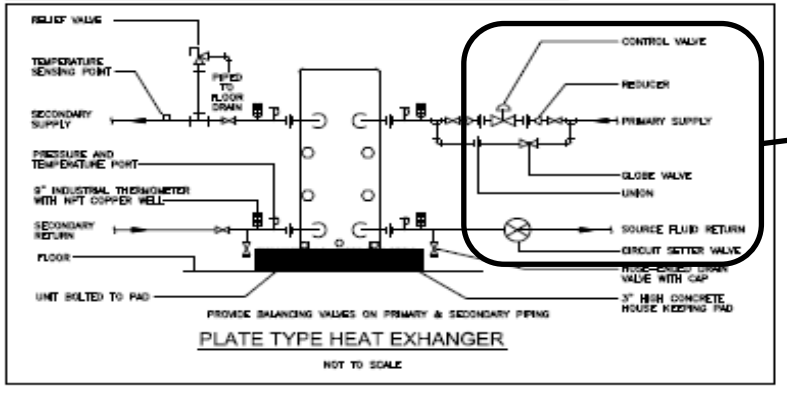
## Sample Building

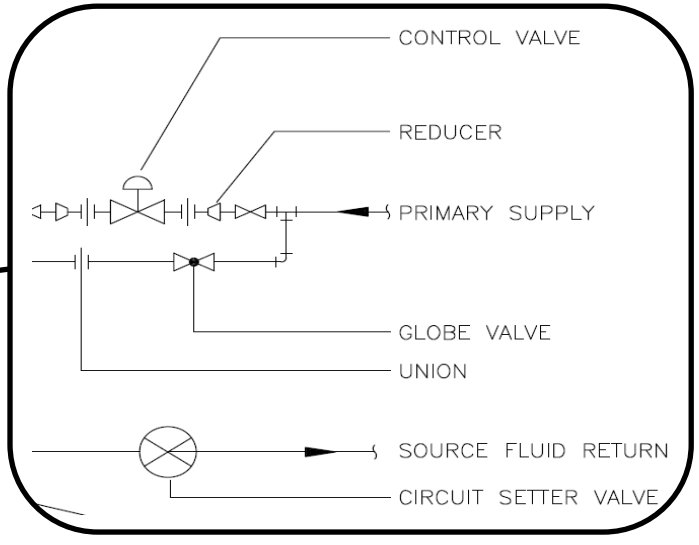



## Mechanical Details



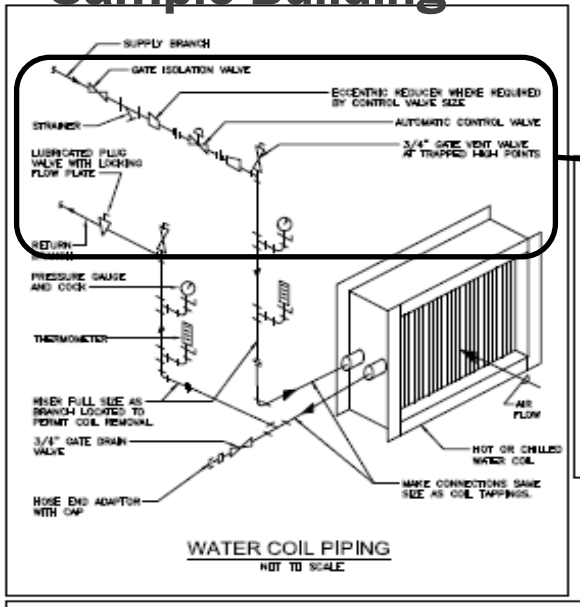



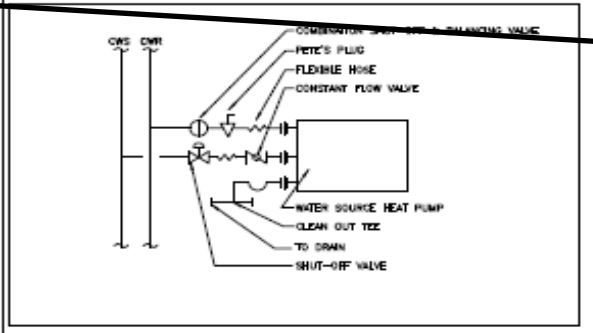
# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building

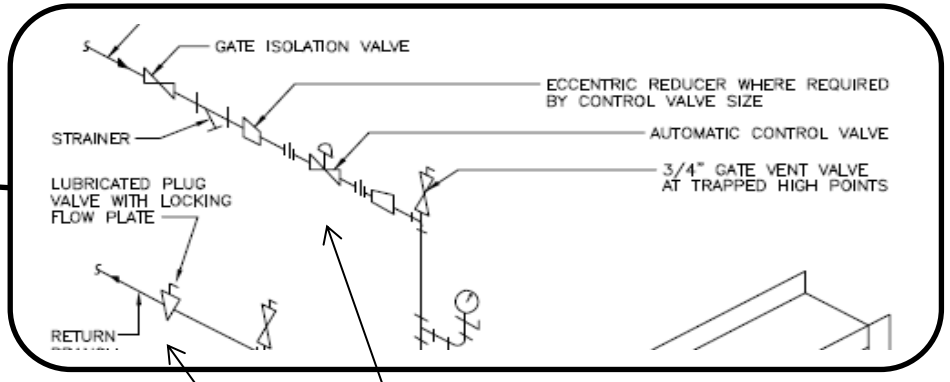



WATER COIL PIPING
NOT TO SCALE

## Mechanical Details




WATER SOURCE HEAT PUMP PIPING
NOT TO SCALE



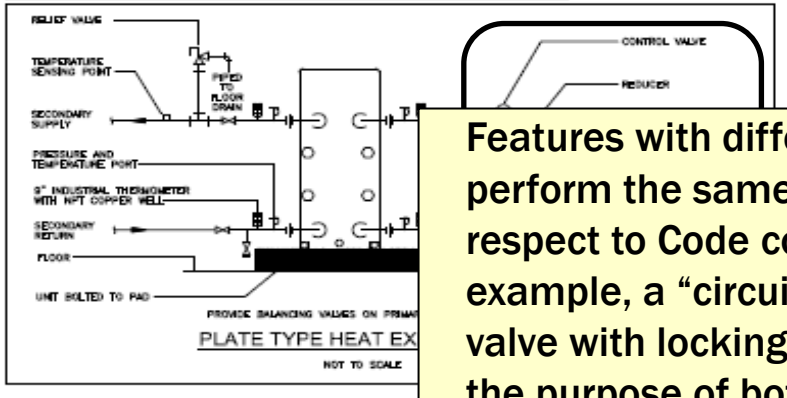
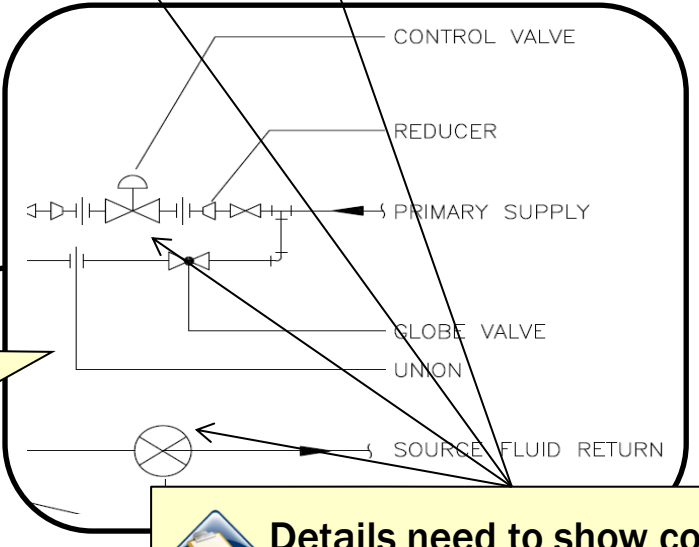




PLATE TYPE HEAT EX
NOT TO SCALE




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.

# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building

**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 WITH 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 FA... ...LS, 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 <=65 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 AHRI 440 RATING) AND UNIT VENTILATORS (WITH AHRI 840 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 1.5 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 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 TO COMFORT CONDITIONING SYSTEMS INCLUDE CONTROLS THAT AUTOMATICALLY RESET SUPPLY WATER TEMPERATURES BY REPRESENTATIVE BUILDING LOADS OR 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 PRE-OCCUPANCY 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**

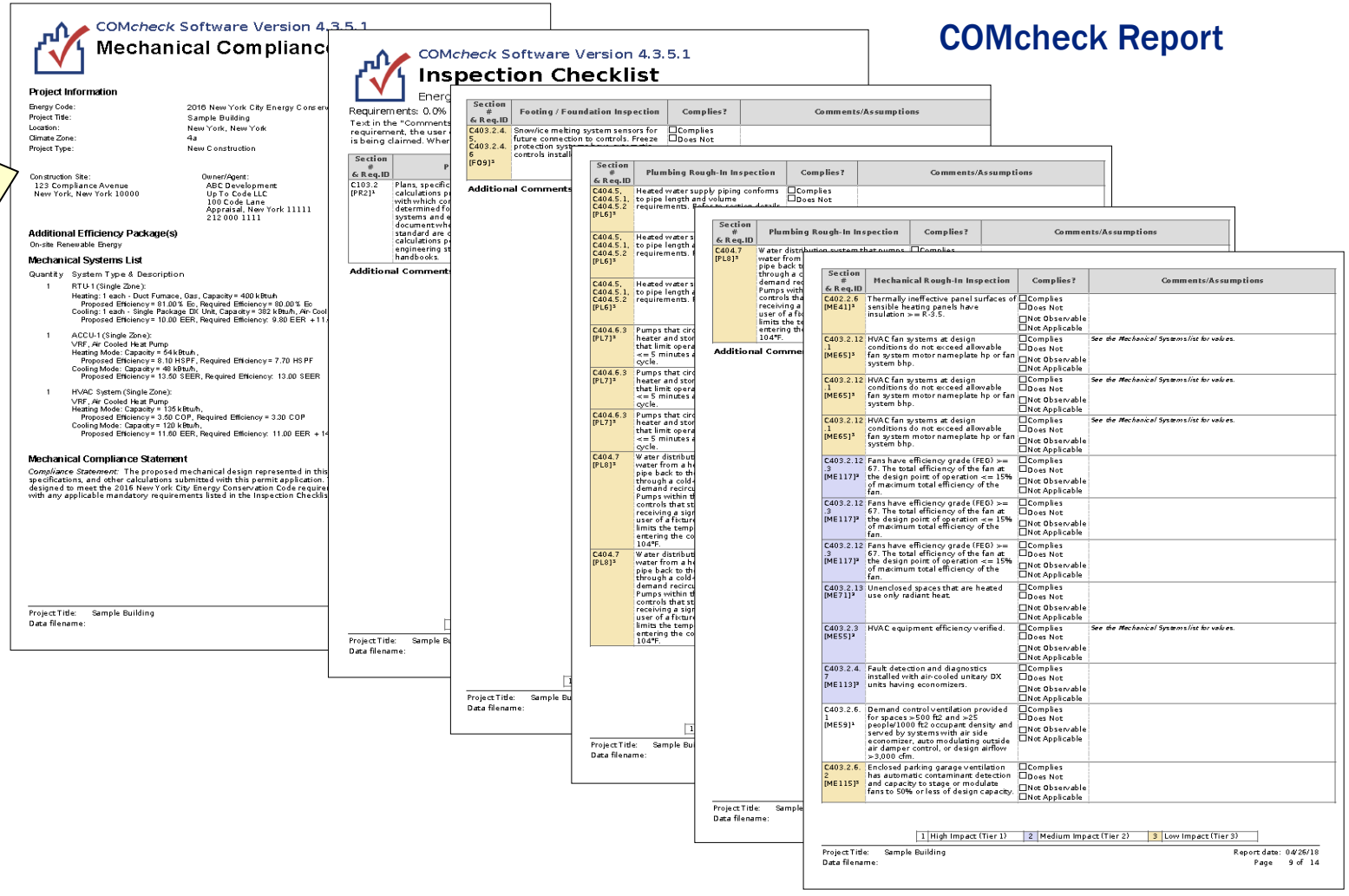
**Notes shall contain Code requirements not shown elsewhere in documents. Note number and drawings should be indexed/referenced to Code citation in the Energy Analysis.**

# 10. SUBMISSIONS & INSPECTIONS: SUPPORTING DOCUMENTATION

## Sample Building

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. Include <u>all</u> pages of the report.

COMcheck Report



# 10. SUBMISSIONS & INSPECTIONS: PROGRESS INSPECTIONS

## Sample List

| | Inspection/Test | Periodic (minimum) | Reference Standard (See ECC Chapter C6) or Other Criteria | ECC 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 | C402.2.7; BC 2111; MC Chapters 7, 8, 9; FGC Chapter 6 |
| IIB2 | **Shutoff dampers:** 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 | C403.2.4.3; ASHRAE 90.1 – 6.4.3.4 |
| IIB3 | **HVAC-R and service water heating equipment:** Equipment sizing, efficiencies, pipe sizing 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; ASHRAE 183, ASHRAE HVAC Systems and Equipment Handbook | C403.2, C404.2, C404.5, C404.9, C406.2, ASHRAE 90.1 – 6.3, 6.4.1, 6.4.2, 6.4.5, 6.4.6, 6.5.11, 6.8, 7.4, 7.8 |
| IIB4 | **HVAC-R 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, Off-hour, Zones, Freeze protection/Snow- and ice-melt system, Ventilation System and Fan Controls, Energy recovery systems, Kitchen/lab exhaust systems, Fan systems serving single and multiple zones, Outdoor heating systems, HVAC control in hotel/motel guest rooms, Air/Water Economizers & controls, Hydronic systems, Heat rejection systems, Hot gas bypass limitation, Refrigeration systems, Door switches, Computer room systems, Service water heating systems, Pool heater and time switches. | 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 | C403.2, C404.3, C403.4, C403.5, C404.6, C404.7, C404.9; ASHRAE 90.1 – 6.3, 6.4, 6.5, 6.6, 7.4.4, 7.4.5 |
| IIB5 | **HVAC-R 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 | C403.2.9, C403.2.10, C404.4; MC 603.9; ASHRAE 90.1 – 6.3, 6.4.4, 6.8.2, 6.8.3; 7.4.3 |



*TR8:* http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
*1 RCNY §5000-01:* http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

# 10. SUBMISSIONS & INSPECTIONS: PROGRESS INSPECTIONS

## Sample List

| | Inspection/Test | Periodic (minimum) | Reference Standard (See ECC Chapter C6) or Other Criteria | ECC 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 | C402.2.7; BC 2111; MC Chapters 7, 8, 9; FGC Chapter 6 |
| IIB2 | **Shutoff dampers:** 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 | C403.2.4.3; ASHRAE 90.1 – 6.4.3.4 |
| IIB3 | **HVAC-R and service water heating equipment:** Equipment sizing, efficiencies, pipe sizing 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; ASHRAE 183, ASHRAE HVAC Systems and Equipment Handbook | C403.2, C404.2, C404.5, C404.9, C406.2, ASHRAE 90.1 – 6.3, 6.4.1, 6.4.2, 6.4.5, 6.4.6, 6.5.11, 6.8, 7.4, 7.8 |
| IIB4 | **HVAC-R 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, Off-hour, Zones, Free… …w- and ice-melt system, Ventilation System and Fan Controls, Energy recovery syst… Fan systems serving single and multiple zo… rooms, Air/Water Economizers & controls, … limitation, Refrigeration systems, Door swi… Pool heater and time switches. | After installation and prior to final electrical and construction inspection, except that for controls with seasonally | Approved construction documents, including control system narratives; | C403.2, C404.3, C403.4, C403.5, C404.6, C404.7, …1 |
| IIB5 | **HVAC-R insulation and sealing:** Installed d… proper insulation placement and values. Jo… ductwork shall be visually inspected for pro… | | | …0, …; …, …; 7.4.3 |

**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.**



*TR8:* http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
*1 RCNY §5000-01:* http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

# 10. SUBMISSIONS & INSPECTIONS: PROGRESS INSPECTIONS

## What are the applicable progress inspections for HVAC & SHW?

| Inspection / Test (As indicated on the TR8) | Frequency |
|---|---|
| **Fireplaces (IIB1)**<br>Provisions of combustion air and tight-fitting fireplace doors shall be **verified by visual inspection**. | Prior to final construction inspection |
| **Shutoff dampers (IIB2)**<br>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.<br><br>**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-R and service water heating equipment (IIB3)**<br>Equipment sizing, efficiencies, pipe sizing 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**.<br><br>Pool heaters and covers shall be verified by visual inspection. | Prior to final plumbing and construction inspection |



*TR8:*
http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
*1 RCNY §5000-01:*
http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

# 10. SUBMISSIONS & INSPECTIONS: PROGRESS INSPECTIONS

## What are the applicable progress inspections for HVAC & SHW?

| Inspection / Test (As indicated on the TR8) | | Frequency |
|---|---|---|
| **HVAC-R and service water heating system controls (IIB4)** | | 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 |
| **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<br>▪ Off-hour<br>▪ Zones<br>▪ Freeze protection/Snow- and ice-melt system<br>▪ Ventilation System and Fan Controls<br>▪ Energy recovery systems<br>▪ Kitchen/lab exhaust systems<br>▪ Fan systems serving single and multiple zones<br>▪ Outdoor heating systems<br>▪ HVAC control in hotel/motel guest rooms<br>▪ Air/Water Economizers & controls<br>▪ Hydronic systems<br>▪ Heat rejection systems<br>▪ Hot gas bypass limitation<br>▪ Refrigeration systems<br>▪ Door switches<br>▪ Computer room systems<br>▪ Service water heating systems<br>▪ Pool heater and time switches | **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.<br><br>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.<br><br>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. | |



*TR8:* http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
*1 RCNY §5000-01:* http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

# 10. SUBMISSIONS & INSPECTIONS: PROGRESS INSPECTIONS

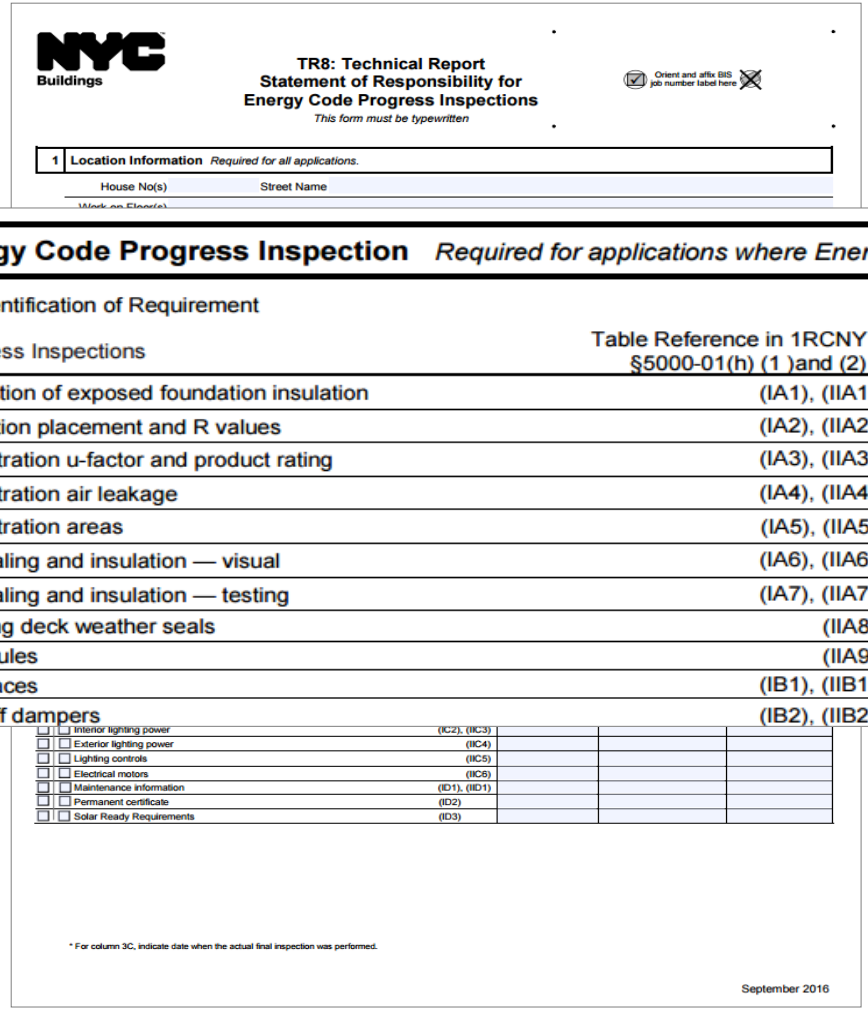
## What are the applicable progress inspections for HVAC & SHW?

| Inspection / Test (As indicated on the TR8) | Frequency |
|---|---|
| **HVAC-R insulation and sealing (IIB5)**<br><br>Installed duct and piping insulation shall be **visually inspected to verify proper insulation placement and values**.<br><br>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 |
| **Duct leakage testing (IIB6)**<br><br>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 ECC C403.2.9.1.3 or ASHRAE 90.1 6.4.4.2.2, **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 |



*TR8:* http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
*1 RCNY §5000-01 :* http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT



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

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

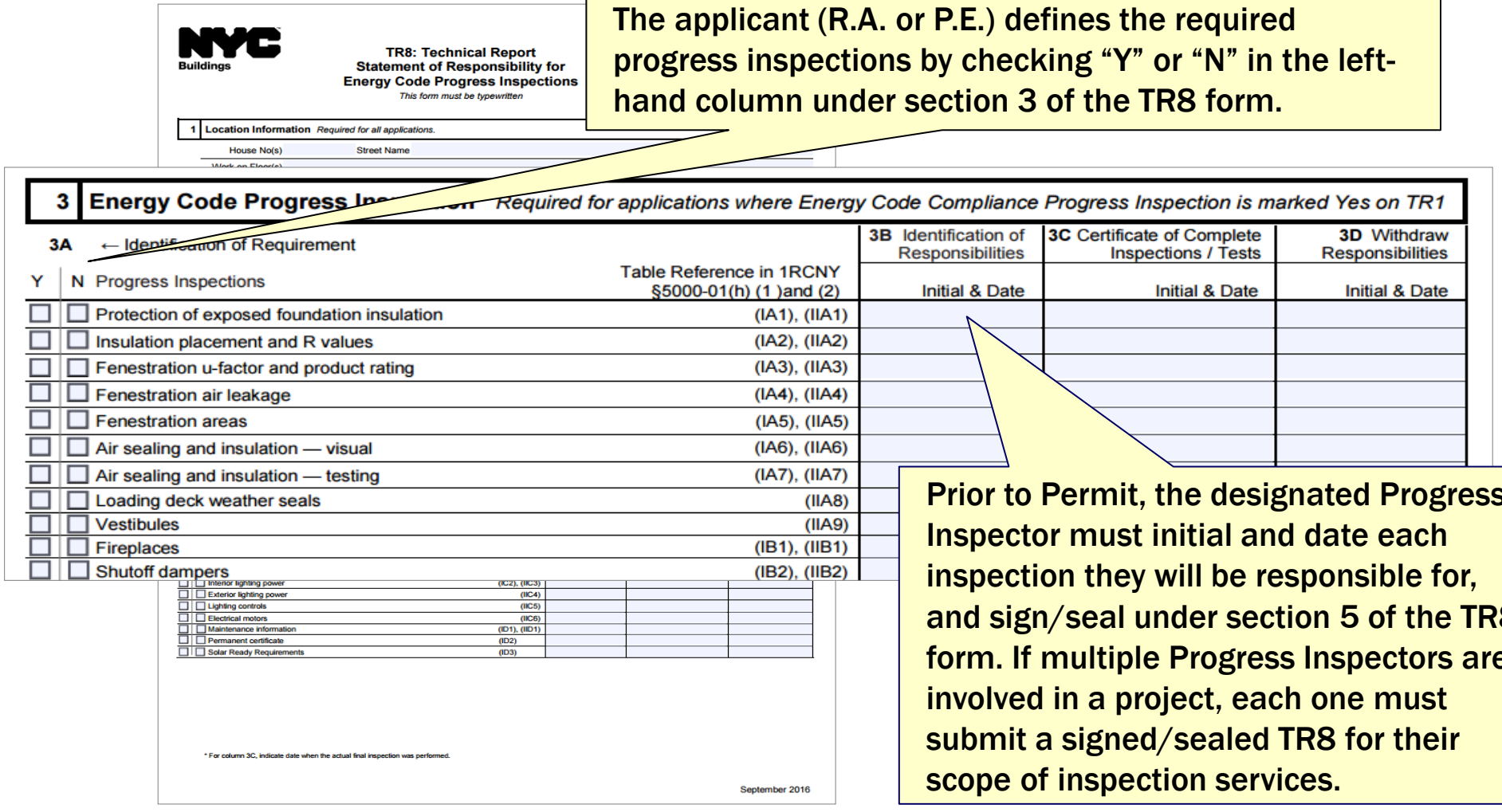
| 3A ← Identification of Requirement | | | 3B Identification of Responsibilities | 3C Certificate of Complete Inspections / Tests | 3D Withdraw Responsibilities |
|---|---|---|---|---|---|
| Y | N | Progress Inspections | Table Reference in 1RCNY §5000-01(h) (1 )and (2) | Initial & Date | Initial & Date | Initial & Date |
| ☐ | ☐ | Protection of exposed foundation insulation | (IA1), (IIA1) | | | |
| ☐ | ☐ | Insulation placement and R values | (IA2), (IIA2) | | | |
| ☐ | ☐ | Fenestration u-factor and product rating | (IA3), (IIA3) | | | |
| ☐ | ☐ | Fenestration air leakage | (IA4), (IIA4) | | | |
| ☐ | ☐ | Fenestration areas | (IA5), (IIA5) | | | |
| ☐ | ☐ | Air sealing and insulation — visual | (IA6), (IIA6) | | | |
| ☐ | ☐ | Air sealing and insulation — testing | (IA7), (IIA7) | | | |
| ☐ | ☐ | Loading deck weather seals | (IIA8) | | | |
| ☐ | ☐ | Vestibules | (IIA9) | | | |
| ☐ | ☐ | Fireplaces | (IB1), (IIB1) | | | |
| ☐ | ☐ | Shutoff dampers | (IB2), (IIB2) | | | |
| ☐ | ☐ | Interior lighting power | (IC2), (IIC3) | | | |
| ☐ | ☐ | Exterior lighting power | (IIC4) | | | |
| ☐ | ☐ | Lighting controls | (IIC5) | | | |
| ☐ | ☐ | Electrical motors | (IIC6) | | | |
| ☐ | ☐ | Maintenance information | (ID1), (IID1) | | | |
| ☐ | ☐ | Permanent certificate | (ID2) | | | |
| ☐ | ☐ | Solar Ready Requirements | (ID3) | | | |

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT

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



NYC Buildings

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

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

House No(s) Street Name

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

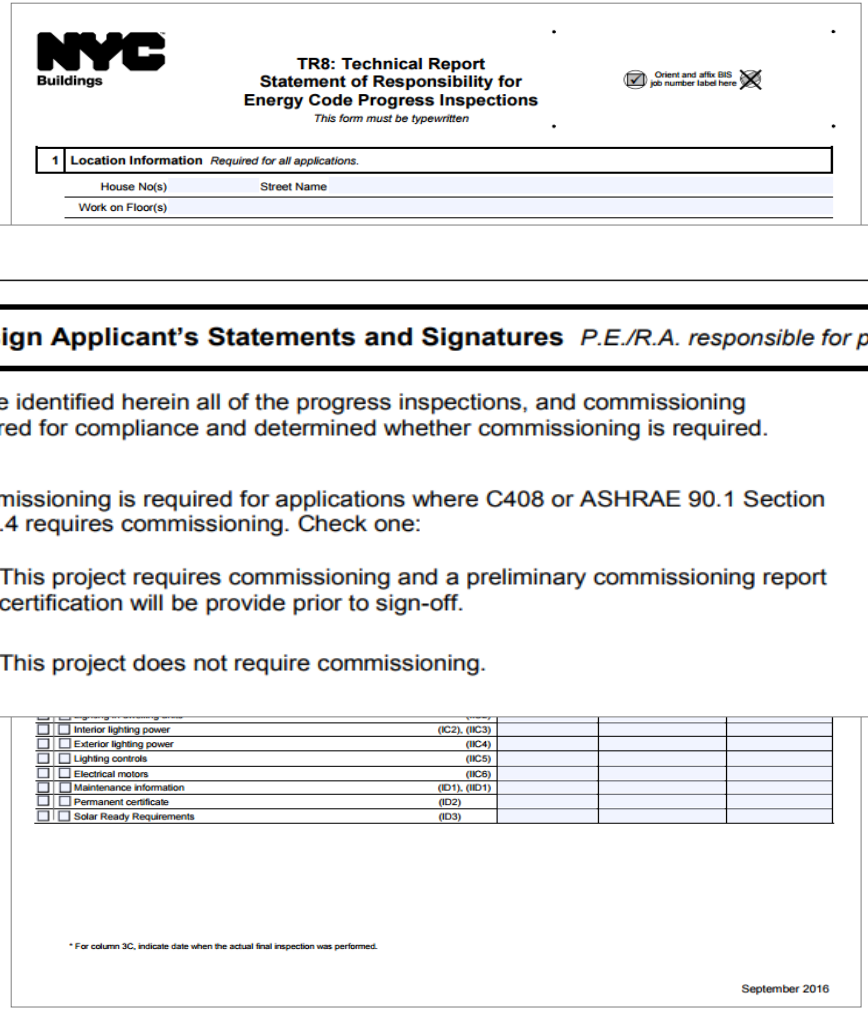
| 3A ← Identification of Requirement | | | 3B Identification of Responsibilities | 3C Certificate of Complete Inspections / Tests | 3D Withdraw Responsibilities |
|---|---|---|---|---|---|
| Y | N | Progress Inspections | Table Reference in 1RCNY §5000-01(h) (1 )and (2) | Initial & Date | Initial & Date | Initial & Date |
| ☐ | ☐ | Protection of exposed foundation insulation | (IA1), (IIA1) | | | |
| ☐ | ☐ | Insulation placement and R values | (IA2), (IIA2) | | | |
| ☐ | ☐ | Fenestration u-factor and product rating | (IA3), (IIA3) | | | |
| ☐ | ☐ | Fenestration air leakage | (IA4), (IIA4) | | | |
| ☐ | ☐ | Fenestration areas | (IA5), (IIA5) | | | |
| ☐ | ☐ | Air sealing and insulation — visual | (IA6), (IIA6) | | | |
| ☐ | ☐ | Air sealing and insulation — testing | (IA7), (IIA7) | | | |
| ☐ | ☐ | Loading deck weather seals | (IIA8) | | | |
| ☐ | ☐ | Vestibules | (IIA9) | | | |
| ☐ | ☐ | Fireplaces | (IB1), (IIB1) | | | |
| ☐ | ☐ | Shutoff dampers | (IB2), (IIB2) | | | |
| ☐ | ☐ | Interior lighting power | (IC2), (IIC3) | | | |
| ☐ | ☐ | Exterior lighting power | (IIC4) | | | |
| ☐ | ☐ | Lighting controls | (IIC5) | | | |
| ☐ | ☐ | Electrical motors | (IIC6) | | | |
| ☐ | ☐ | Maintenance information | (ID1), (IID1) | | | |
| ☐ | ☐ | Permanent certificate | (ID2) | | | |
| ☐ | ☐ | Solar Ready Requirements | (ID3) | | | |

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

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.

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT



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.*

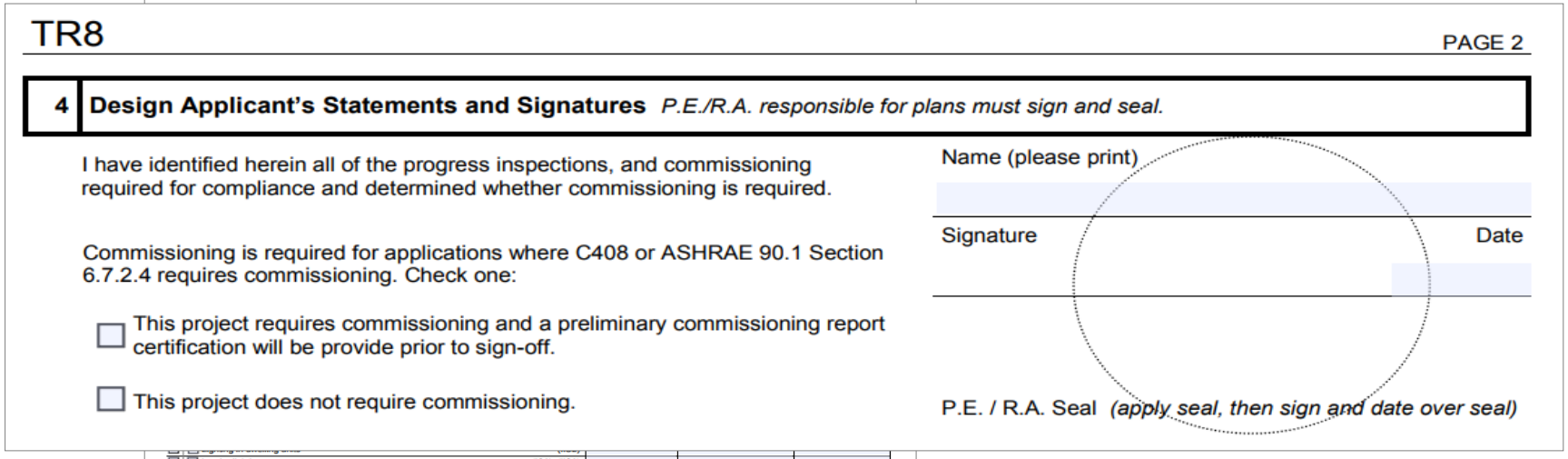
House No(s) Street Name

Work on Floor(s)

| | | | | |
|---|---|---|---|---|
| Interior lighting power | (IC2), (IIC3) | | | |
| Exterior lighting power | (IIC4) | | | |
| Lighting controls | (IIC5) | | | |
| Electrical motors | (IIC6) | | | |
| Maintenance information | (ID1), (IID1) | | | |
| Permanent certificate | (ID2) | | | |
| Solar Ready Requirements | (ID3) | | | |

* For column 3C, indicate date when the actual final inspection was performed.

September 2016



TR8

PAGE 2

**4 Design Applicant's Statements and Signatures** *P.E./R.A. responsible for plans must sign and seal.*

I have identified herein all of the progress inspections, and commissioning required for compliance and determined whether commissioning is required.

Commissioning is required for applications where C408 or ASHRAE 90.1 Section 6.7.2.4 requires commissioning. Check one:

☐ This project requires commissioning and a preliminary commissioning report certification will be provide prior to sign-off.

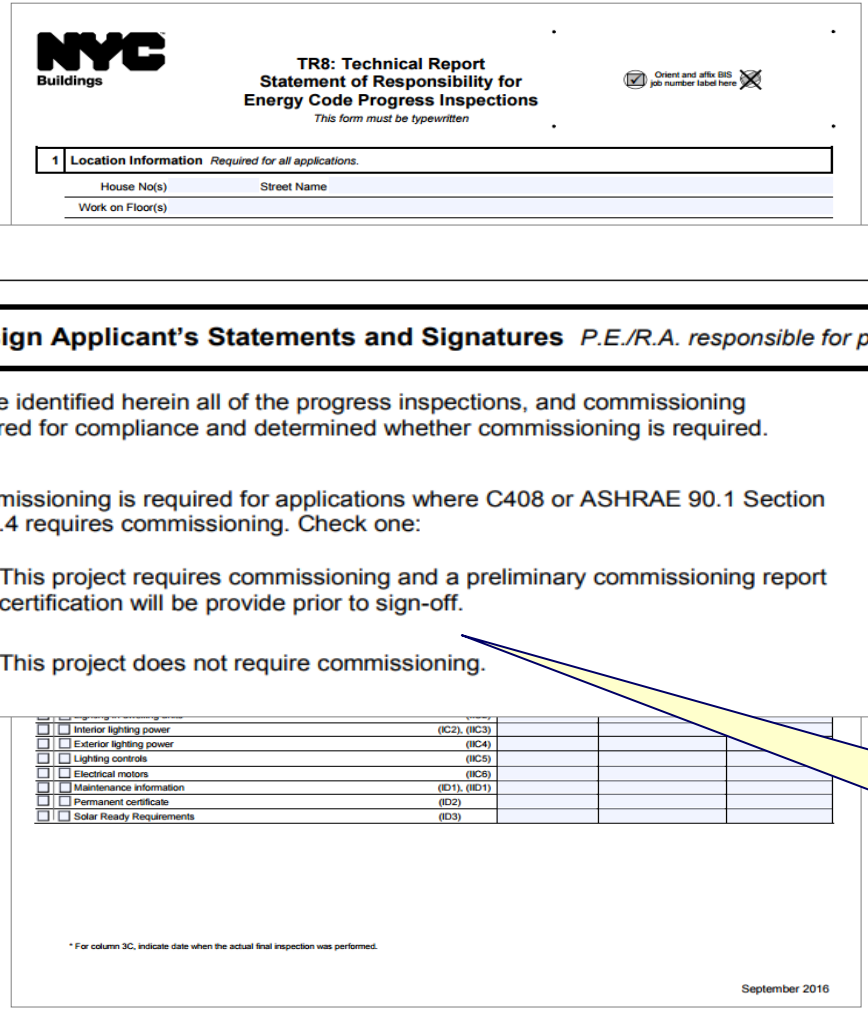
☐ This project does not require commissioning.

Name (please print)

Signature Date

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

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT



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)

TR8 PAGE 2

**4 Design Applicant's Statements and Signatures** *P.E./R.A. responsible for plans must sign and seal.*

I have identified herein all of the progress inspections, and commissioning required for compliance and determined whether commissioning is required.

Commissioning is required for applications where C408 or ASHRAE 90.1 Section 6.7.2.4 requires commissioning. Check one:

☐ This project requires commissioning and a preliminary commissioning report certification will be provide prior to sign-off.

☐ This project does not require commissioning.

Name (please print)

Signature Date

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

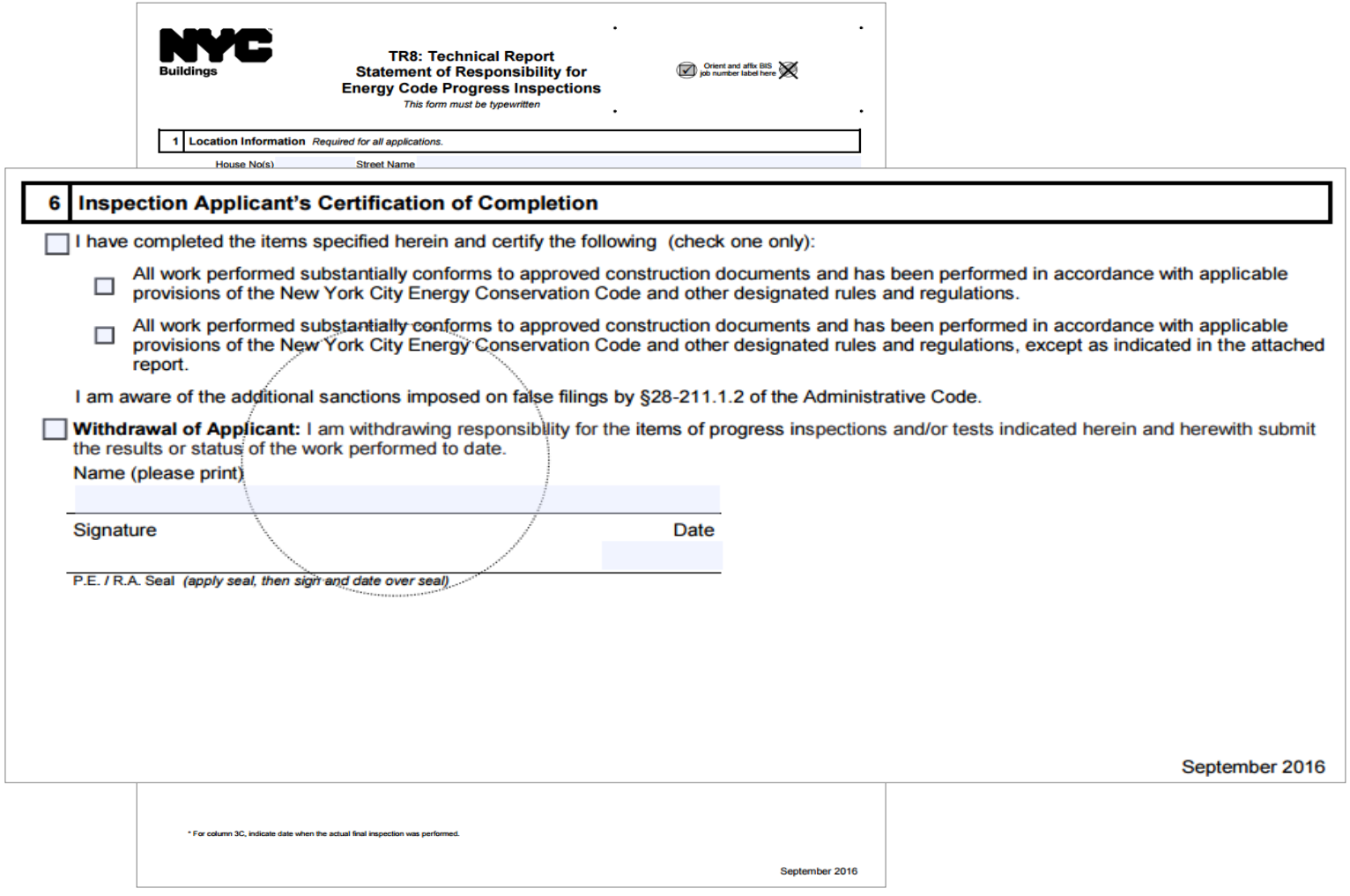
| | | | | |
|---|---|---|---|---|
| Interior lighting power | (IC2), (IIC3) | | | |
| Exterior lighting power | (IIC4) | | | |
| Lighting controls | (IIC5) | | | |
| Electrical motors | (IIC6) | | | |
| Maintenance information | (ID1), (IID1) | | | |
| Permanent certificate | (ID2) | | | |
| Solar Ready Requirements | (ID3) | | | |

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

**The design applicant must indicate whether commissioning is required or not.**

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT



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

**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

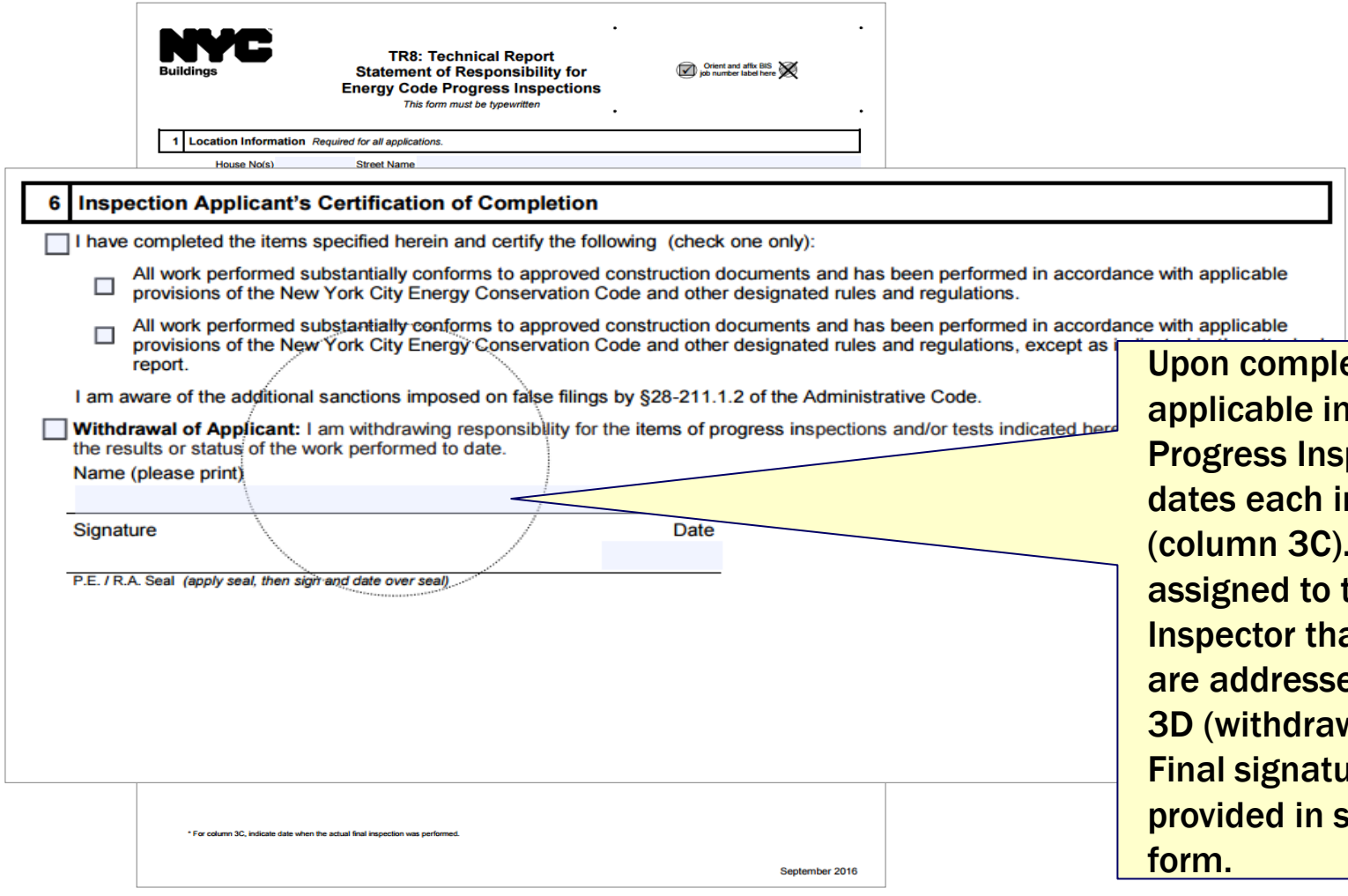
P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

September 2016

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT



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

**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
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 here
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)*

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

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 addressed through column 3D (withdraw responsibilities). Final signatures and seals are provided in section 6 of the TR8 form.

# 10. SUBMISSIONS & INSPECTIONS: TR8 REPORT

## Progress Inspections – Back-up

VSD Controller

CO2 Sensor & Thermostat

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

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

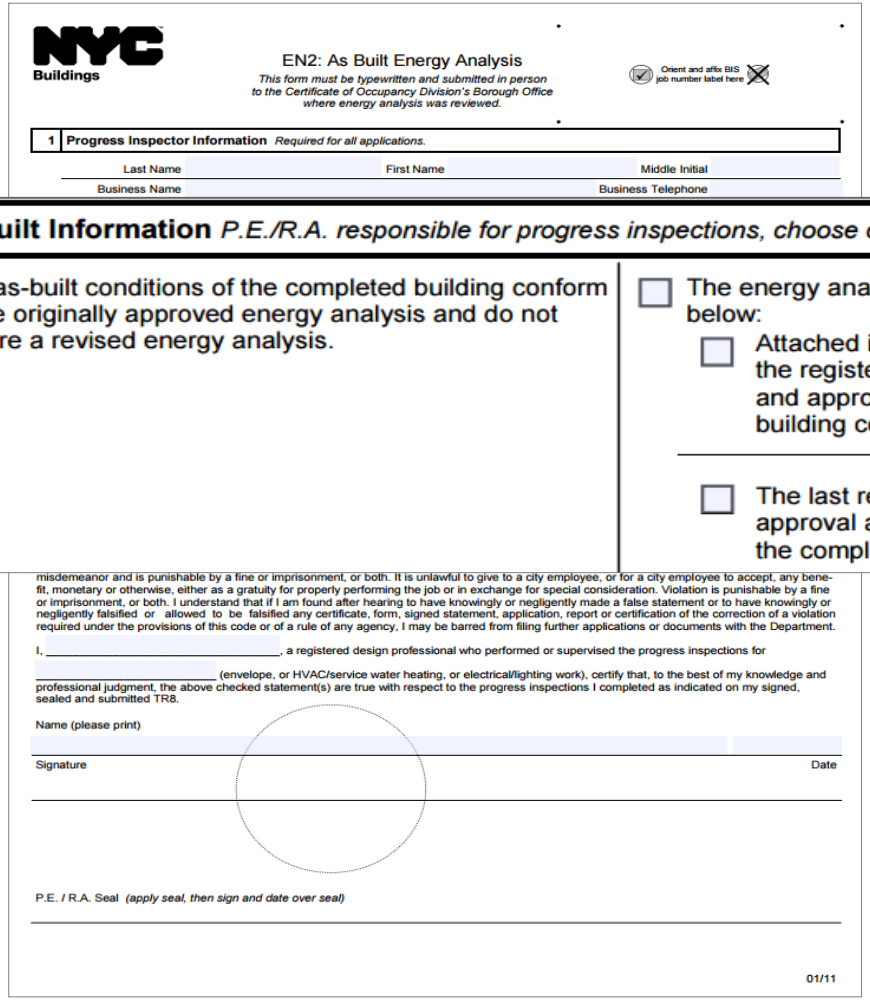
## Per NYC Administrative Code § 28-116.2.3:

- 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

# 10. SUBMISSIONS & INSPECTIONS: EN2 FORM



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

**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.

misdemeanor and is punishable by a fine or imprisonment, or both. It is unlawful to give to a city employee, or for a city employee to accept, any benefit, monetary or otherwise, either as a gratuity for properly performing the job or in exchange for special consideration. Violation is punishable by a fine or imprisonment, or both. I understand that if I am found after hearing to have knowingly or negligently made a false statement or to have knowingly or negligently falsified or allowed to be falsified any certificate, form, signed statement, application, report or certification of the correction of a violation required under the provisions of this code or of a rule of any agency, I may be barred from filing further applications or documents with the Department.

I, _____, a registered design professional who performed or supervised the progress inspections for _____ (envelope, or HVAC/service water heating, or electrical/lighting work), certify that, to the best of my knowledge and professional judgment, the above checked statement(s) are true with respect to the progress inspections I completed as indicated on my signed, sealed and submitted TR8.

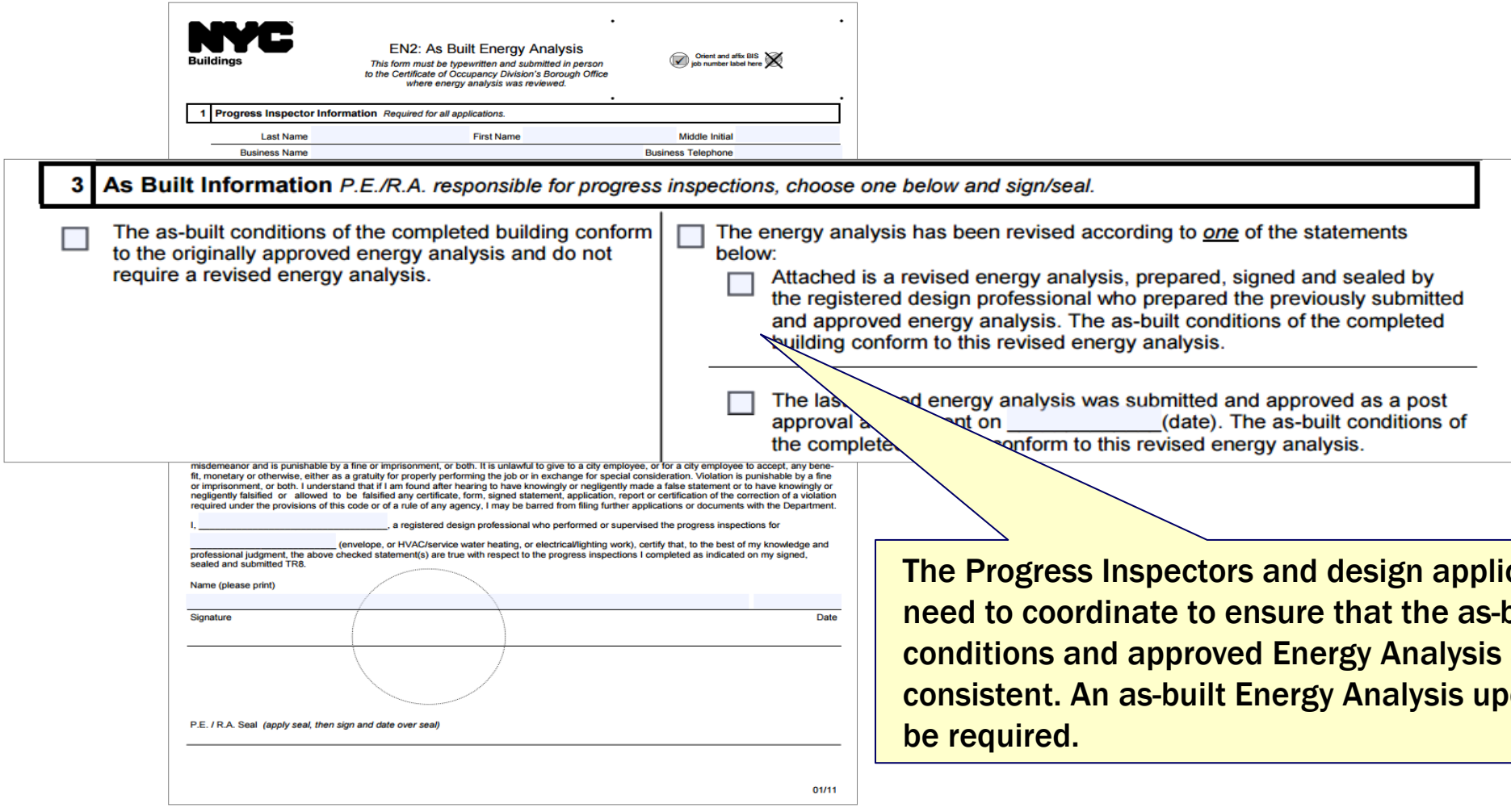
Name (please print)

Signature | Date

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

01/11

# 10. SUBMISSIONS & INSPECTIONS: EN2 FORM



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

**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.

misdemeanor and is punishable by a fine or imprisonment, or both. It is unlawful to give to a city employee, or for a city employee to accept, any benefit, monetary or otherwise, either as a gratuity for properly performing the job or in exchange for special consideration. Violation is punishable by a fine or imprisonment, or both. I understand that if I am found after hearing to have knowingly or negligently made a false statement or to have knowingly or negligently falsified or allowed to be falsified any certificate, form, signed statement, application, report or certification of the correction of a violation required under the provisions of this code or of a rule of any agency, I may be barred from filing further applications or documents with the Department.

I, _____, a registered design professional who performed or supervised the progress inspections for _____ (envelope, or HVAC/service water heating, or electrical/lighting work), certify that, to the best of my knowledge and professional judgment, the above checked statement(s) are true with respect to the progress inspections I completed as indicated on my signed, 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.**

# 11. RESOURCES

## Slides 144 to 149

# 11. RESOURCES: OVERVIEW

**In this section you will learn about:**

- Resources and links;
- DOB assistance; and
- Image/Photo Credits & Copyrights.

# 11. RESOURCES: RESOURCES & LINKS

**The resources below have been referenced in this module**

| Resource | Link |
|---|---|
| 2016 NYCECC | http://www1.nyc.gov/site/buildings/codes/2016-energy-conservation-code.page |
| Local Law 91 of 2016 | http://www1.nyc.gov/assets/buildings/local_laws/ll91of2016.pdf |
| Local Law 125 of 2016 | http://www1.nyc.gov/assets/buildings/local_laws/ll125of2016.pdf |
| Code Notes | http://www1.nyc.gov/site/buildings/codes/list-code-notes.page |
| NYCECC FAQ | http://www1.nyc.gov/site/buildings/codes/nycecc-faq.page |
| 1 RCNY § 5000-01 | http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf |
| 1 RCNY § 101-07 | http://www1.nyc.gov/assets/buildings/rules/1_RCNY_101-07.pdf |

# 11. RESOURCES: RESOURCES & LINKS

**The resources below have been referenced in this module *(continued)***

| Resource | Link |
|---|---|
| Buildings Bulletins | http://www1.nyc.gov/site/buildings/codes/building-bulletins/page |
| EN1, EN2, and TR8 Forms | http://www1.nyc.gov/site/buildings/codes/energy-code-forms.page |
| REScheck/COMcheck | https://www.energycodes.gov/ |
| One City: Built to Last | http://www.nyc.gov/html/builttolast/pages/home/home.shtml |
| New York City Construction Codes | https://www1.nyc.gov/site/buildings/codes/nyc-code.page |
| Energy Code: Supporting Documents How To Guide | https://www1.nyc.gov/assets/buildings/pdf/h2g_all.pdf |

# 11. RESOURCES: DOB ASSISTANCE

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

**EnergyCode@buildings.nyc.gov**

# 11. RESOURCES

## IMAGES/PHOTO CREDITS & COPYRIGHTS

| Company or Individual | Slide Numbers |
|---|---|
| NYC Department of Buildings | 27, 34, 51, 52, 53, 76, 80, 141, 144 |
| US DOE Building Energy Codes University | 106 |
| DOE/ NREL | 77, 92, 93 |
| | |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