# Changes to ENERGY STAR for Multifamily New Construction

March 22, 2017


**Look at the documents for today's discussion:**

**www.energystar.gov/mfspec**

# Agenda

- Specification Timeline
- Background
- Overview the 'One Multifamily' framework
  - Goals and concept
- 2017 Changes and Updates
- Proposed Technical Requirements
  - Performance Target
  - Mandatory Measures
  - Verification and Oversight
- Next Steps

# Specification Timeline

First Comment Period

- Webinar mid-November and comments through mid-December

Second Comment Period

- Webinar March 22 and comments through mid-April

Goal:

- Final specification available January 2019
- At least one year transition

# Background

# ENERGY STAR for New Construction MF

Has guidelines that apply to new (or gut rehab):

- Single Family Homes (detached and attached)
- Factory Built Homes (manufactured and modular)
- Low & Mid Rise Multifamily Buildings

} Certified Homes

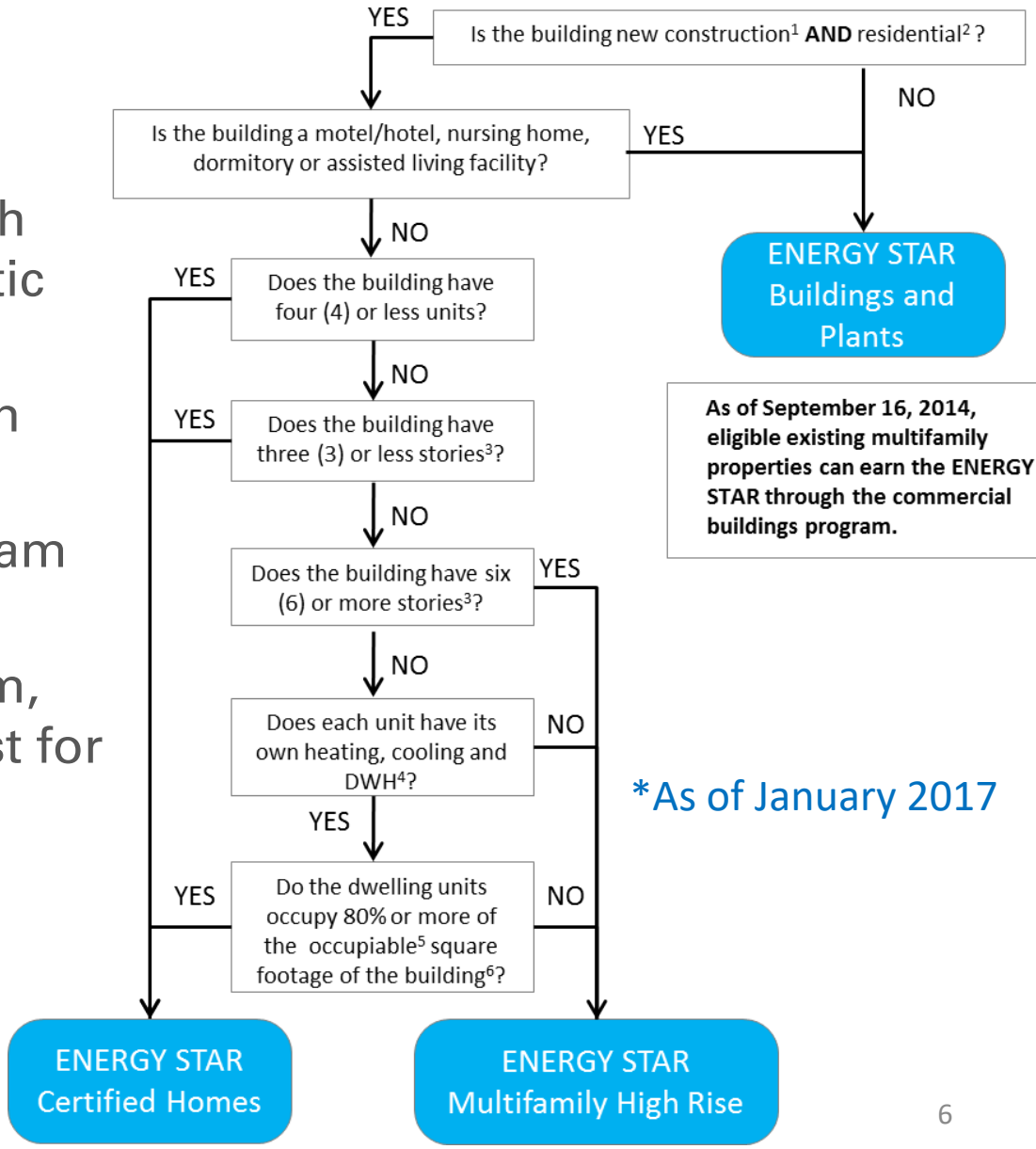
- Mid & High Rise Multifamily Buildings
  - Covers buildings previously ineligible for Certified Homes
  - Launched in June 2011

} MFHR

# Eligibility

Complex, rigid line, with significant programmatic differences causes:

- Confusion/Frustration
- Inconsistency with code/incentive program eligibilities
- Designing to program, instead of what's best for the building
- Requirements not optimized for project




**As of September 16, 2014, eligible existing multifamily properties can earn the ENERGY STAR through the commercial buildings program.**

*As of January 2017

# Goals for the New Concept

- Appropriate eligibility
- Technical requirements are governed by building features
  - Optimized for multifamily
  - Appropriate for variety of building types
- Common areas addressed
- Flexibility for participants and program administrators
- Well-defined verifier requirements
  - Including multifamily training
- Market-based oversight

# Multifamily 2017 Updates

- Feb 2017 Eligibility Update – Still Current Framework
- RESNET Multifamily Sub-Committee
  - Goal: HERS ratings for all multifamily
  - Updated ANSI/RESNET/ICC 301 to apply to all dwelling units (and sleeping units) in any height building and to accommodate MF units/systems better
    - 1st public comment period early March to mid-April
    - Targeting completion by January 2019
    - Earliest Effective date for RESNET: July 1, 2019
    - Possibly referenced in the 2021 IECC
  - ANSI 380 will soon have a specific BD test section for attached units:
    - 1st public comment period ended in January 2018
    - 2nd public comment period coming soon
    - Targeting completion by November 2018

# Multifamily 2017 Updates

- MFHR Review Organizations (MROs)
  Market-based verification for MFHR program
  - Webinar and application release summer 2017
    - Rolling application process
  - MRO's recognized January 2018
    - Home Innovation Research Labs
    - Karpman Consulting
  - All new projects will submit documentation to an MRO

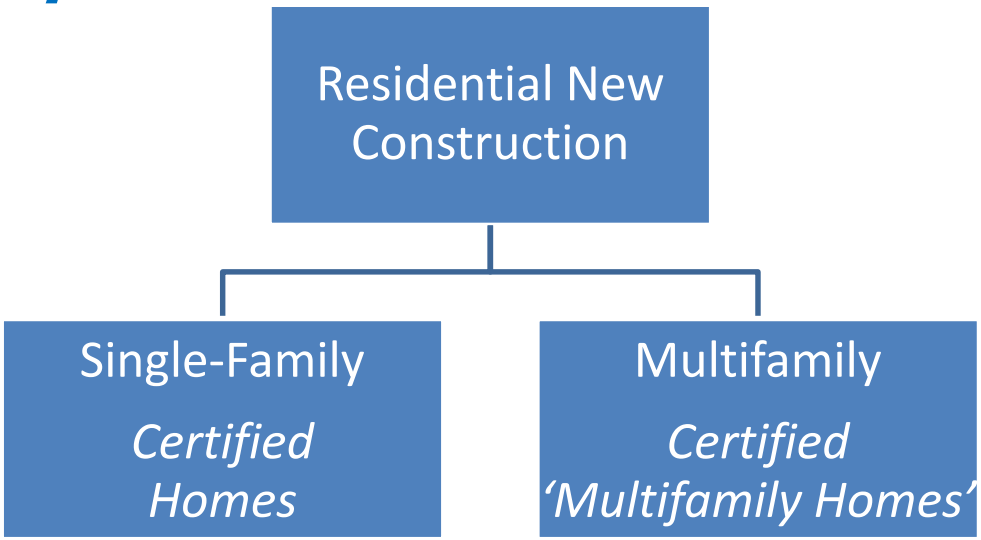
  www.energystar.gov/mfhr/mro

# Multifamily 2017 Updates

- New Multifamily Specification
  - Presented concept 2017 RESNET
  - Webinar on framework and technical requirements Nov 2017
  - Stakeholder feedback Dec 2017
    - Over 20 organizations, over 200 comments
    - Content
      - Mixed
      - Consensus
      - Adjustments

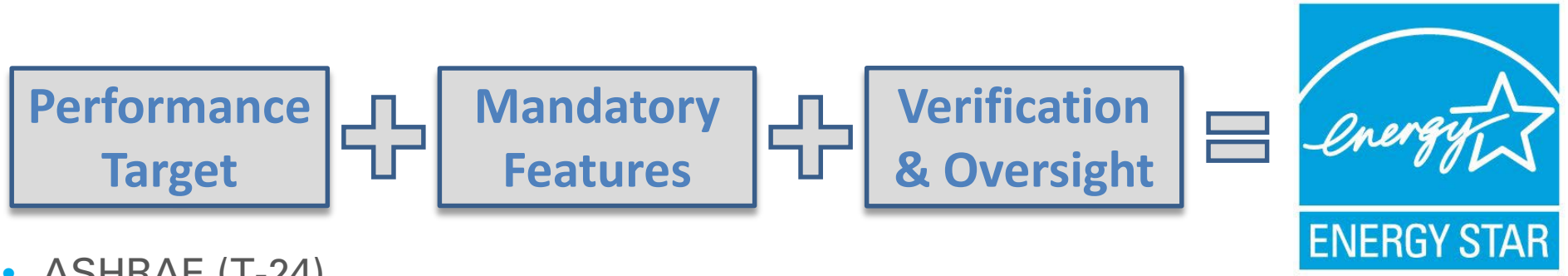
# New Multifamily Framework

# Eligibility




- Delineation between SF and MF
  - Single-Family: Detached housing, two-family dwellings, townhomes
  - Multifamily: All other attached housing
- Consistent specification for multifamily (any height)

# Key Components to Program Requirements

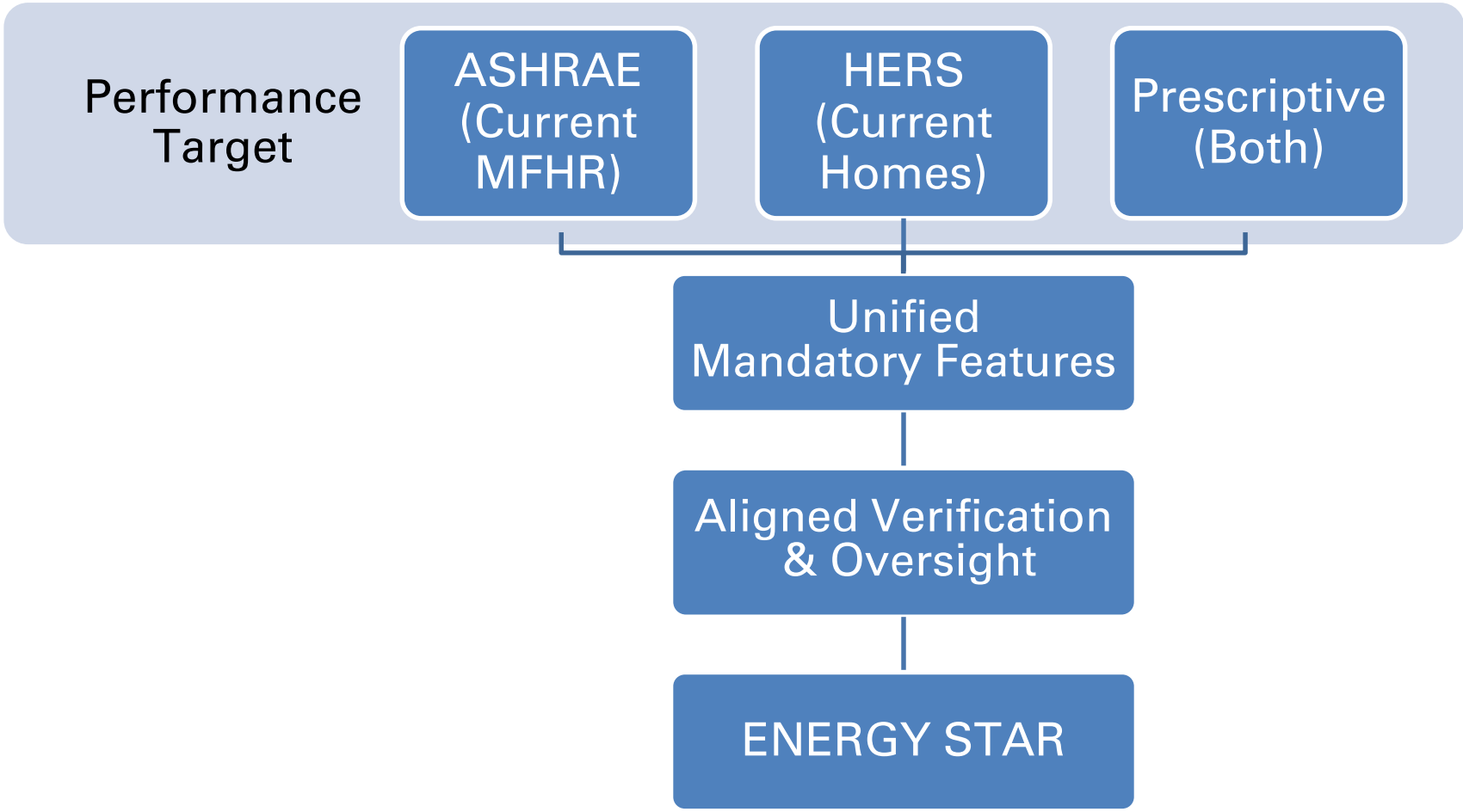



- ASHRAE (T-24) model
- HERS target
- Prescriptive

# New Performance Target Options

| | |
|---|---|
| ASHRAE | • Model residential space (including common areas) to 90.1 using Appendix G and Simulation Guidelines<br>• MFHR business as usual<br>• Low-rise also models to 90.1 Appendix G |
| HERS | • Model units in any height building using HERS<br>• Modified ES Reference Design 'MF Unit'<br>• ANSI 301 for MF calcs in HERS software<br>• Common space prescriptive requirements |
| Prescriptive | • In-unit prescriptive requirements (match modified ES Reference Design 'MF Unit')<br>• Common space prescriptive requirements |

# New Merged Multifamily Requirements Overview



# Eligibility

# Eligibility - Townhomes

- Townhouses: A single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from the foundation to roof and with open space on at least two sides (2015 IBC)
  - Q: What about a configuration where townhouses are adjacent to a vertical structure that contains more than one dwelling unit ("stacked flat")?

# Eligibility Notes

- HERS reference design based on unit configuration regardless of checklists used
- Inspection checklists are very similar except:
  - Common areas are included in MF
  - Additional requirements for central systems in MF
  - SF does not currently include compartmentalization

# Eligibility Flexibility – Optional

If using these options, all units in the project must use the same checklists

- Alternative 1: Townhomes attached to other multifamily may use multifamily checklists
- Add compartmentalization requirement for all multifamily units to SF checklists, and allow the following:
  - Alternative 2: Buildings with 4 or fewer units may use SF checklists
  - Alternative 3: Buildings 3 stories or less with no central systems and <20% common space may use SF checklists

## Eligibility – Sleeping Units

- Sleeping units are treated equivalent to dwelling units

## Eligibility – Dorms and Assisted Living

- Under review

# Eligibility – Mixed Use

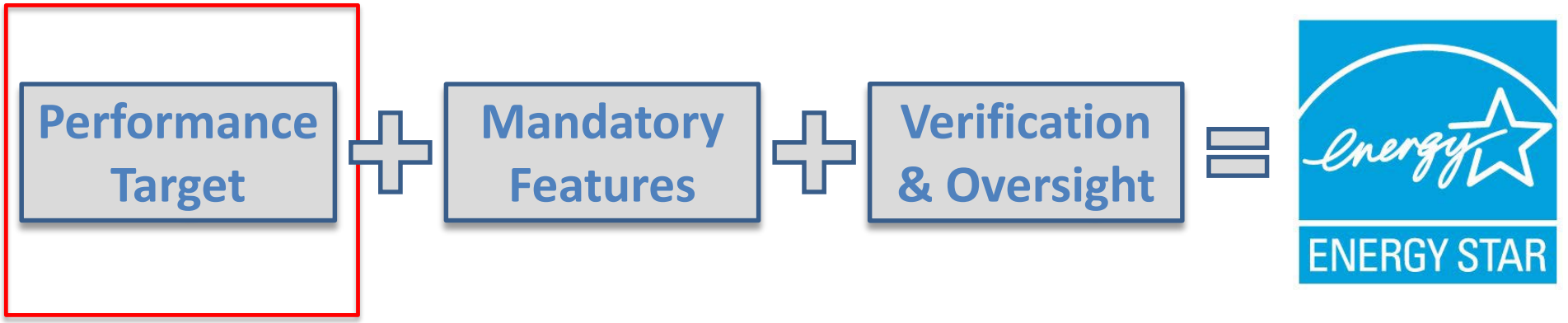
Must be majority residential:

Residential and Common Space must be >50% of the project

'Common space' refers to any spaces on the property that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit.

- Includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, or parking garages used exclusively by residents, building staff, and their guests.
- This also includes offices used by building management, administration or maintenance and all special use areas located on the property to serve and support the residents such as day-care facilities, gyms, dining halls, etc.

# Key Components to Program Requirements



# HERS Target

**Performance Target**

ENERGY STAR MF Reference Design

Versions for both 3.1 and 3.0 states based on Certified Homes Reference Design (generally modeling more stringent)

- Change infiltration level to compartmentalization metric
- Focus on hot water energy
  - Hot water heater efficiency
  - Low-flow fixtures, laundry appliances
- Some modifications, but similar levels for insulation, windows, heating/cooling efficiency
  - Insulation based on commercial code
  - Structural windows based on commercial code
- '3.0' design also updates duct location

# Exhibit 1 – Reference Design 'Multifamily Unit' ~3.1

| Hot Climates (2009 IECC Zones 1,2,3) | Mixed and Cold Climates (2009 IECC Zones 4,5,6,7,8) |
|---|---|
| Cooling Equipment (Where Provided) | |
| • Cooling equipment modeled at the applicable efficiency levels below: | |
| • 15 SEER / 12 EER AC,<br>• Heat pump (See Heating Equipment) | • CZ 4: 15 SEER / 12 EER AC<br>• CZ 5: 14 SEER AC<br>• CZ 6-8: 13 SEER AC<br>• Heat pump (See Heating Equipment) |
| Heating Equipment | |
| • Heating equipment modeled at the applicable efficiency levels below, dependent on fuel and system type: | |
| • Gas furnace, efficiency as follows:<br>• CZ 1-3: 80 AFUE gas furnace,<br>• 80 AFUE oil furnace,<br>• 80 AFUE boiler,<br>• 8.2 HSPF / 15 SEER / 12 EER air-source heat pump with electric or dual-fuel backup | • CZ 4-5: 90 AFUE gas furnace<br>• CZ 6-8: 95 AFUE ENERGY STAR gas furnace,<br>• 85 AFUE ENERGY STAR oil furnace,<br>• 90 AFUE ENERGY STAR gas boiler,<br>• 86 AFUE ENERGY STAR oil boiler,<br>• Heat pump, with efficiency as follows:<br>• CZ 4: 8.5 HSPF / 15 SEER / 12 EER air-source w/ electric or dual-fuel backup,<br>• CZ 5: 9.25 HSPF / 15 SEER / 12 EER air-source w/ electric or dual-fuel backup,<br>• CZ 6: 9.5 HSPF / 15 SEER / 12 EER air-source w/ electric or dual-fuel backup,<br>• CZ 7-8: 3.6 COP / 17.1 EER ground-source w/ electric or dual-fuel backup |

# Exhibit 1 – Reference Design 'Multifamily Unit' ~3.1

## Envelope, Windows, & Doors

- Insulation levels modeled to 2012 IECC levels (Commercial, wood frame) and Grade I installation per RESNET standards.
- Infiltration rates modeled as follows: ≤0.30 CFM50/ft$^2$ of enclosure
- ENERGY STAR windows and doors modeled, as illustrated below:

| | | | | |
|---|---|---|---|---|
| Window U-Value: | 0.40 in CZs 1,2 | 0.30 in CZ 3 | 0.30 in CZ 4 | 0.27 in CZs 5,6,7,8 |
| Window SHGC: | 0.25 in CZs 1,2 | 0.25 in CZ 3 | 0.40 in CZ 4 | Any in CZs 5,6,7,8 |

| | | | | |
|---|---|---|---|---|
| Door U-Value: | Opaque: 0.17 | ≤½ lite: 0.25 | >½ lite: 0.30 | |
| Door SHGC: | Opaque: Any | ≤½ lite: 0.25 | >½ lite: 0.25 in CZs 1,2,3; 0.40 in CZs 4,5,6,7,8 | |

Exception: Class AW windows meet 2015 IgCC commercial window U-Value requirements

## Water Heater

- DHW equipment modeled with the following efficiency levels as applicable:

| | | | | | | |
|---|---|---|---|---|---|---|
| Gas: | | ≤55 Gal = 0.67 EF | | | >55 Gal = 0.77 EF | |
| Electric: | | ≤55 Gal = 0.95 EF | | | >55 Gal = 2.00 EF | |
| Oil: | 30 Gal = 0.63 EF | 40 Gal = 0.61 EF | 50 Gal = 0.59 EF | 60 Gal = 0.57 EF | 70 Gal = 0.55 EF | 80 Gal = 0.53 EF |

## Thermostat & Ductwork

- Programmable thermostat modeled.
- All ducts and air handlers modeled within conditioned space.

## Lighting, Appliances & Plumbing Fixtures

- ENERGY STAR refrigerators, dishwashers, clothes washers, dryers, and ceiling fans modeled.
- ENERGY STAR light bulbs modeled in 90% of RESNET-defined Qualifying Light Fixture Locations.
- WaterSense bathroom faucets, bathroom aerators, and showerheads

# Exhibit 1 – Reference Design 'Multifamily Unit' ~3.0

| Hot Climates (2009 IECC Zones 1,2,3) | Mixed and Cold Climates (2009 IECC Zones 4,5,6,7,8) |
|---|---|
| Cooling Equipment (Where Provided) | |
| • Cooling equipment modeled at the applicable efficiency levels below: | |
| • 14.5 SEER / 12 EER AC,<br>• Heat pump (See Heating Equipment) | • 13 SEER AC<br>• Heat pump (See Heating Equipment) |
| Heating Equipment | |
| • Heating equipment modeled at the applicable efficiency levels below, dependent on fuel and system type: | |
| • Gas furnace, efficiency as follows:<br>• 80 AFUE gas furnace,<br>• 80 AFUE oil furnace,<br>• 80 AFUE boiler,<br>• 8.2 HSPF / 14.5 SEER / 12 EER air-source heat pump with electric or dual-fuel backup | • 90 AFUE gas furnace<br>• 85 AFUE ENERGY STAR oil furnace,<br>• 85 AFUE ENERGY STAR boiler,<br>• Heat pump, with efficiency as follows:<br>• CZ 4: 8.5 HSPF / 14.5 SEER / 12 EER air-source w/ electric or dual-fuel backup,<br>• CZ 5: 9.25 HSPF / 14.5 SEER / 12 EER air-source w/ electric or dual-fuel backup,<br>• CZ 6: 9.5 HSPF / 14.5 SEER / 12 EER air-source w/ electric or dual-fuel backup,<br>• CZ 7-8: 3.5 COP / 16.1 EER ground-source w/ electric or dual-fuel backup |

# Exhibit 1 – Reference Design 'Multifamily Unit' ~3.0

## Envelope, Windows, & Doors

- Insulation levels modeled to 2009 IECC levels (Commercial, wood frame) and Grade I installation per RESNET standards.
- Infiltration rates modeled as follows: ≤0.30 CFM50/ft$^2$ of enclosure
- ENERGY STAR windows and doors modeled, as illustrated below:

| | | | | |
|---|---|---|---|---|
| Window U-Value: | 0.60 in CZs 1,2 | 0.35 in CZ 3 | 0.32 in CZ 4 | 0.30 in CZs 4 C,5,6,7,8 |
| Window SHGC: | 0.27 in CZs 1,2 | 0.30 in CZ 3 | 0.40 in CZ 4 | Any in CZs 4 C,5,6,7,8 |

| | | | |
|---|---|---|---|
| Door U-value: | Opaque: 0.21 | ≤½ lite: 0.27 | >½ lite: 0.32 |
| Door SHGC: | Opaque: Any | ≤½ lite: 0.30 | >½ lite: 0.30 |

Exception: Class AW windows meet 2012 IECC commercial window U-Value requirements

## Water Heater

- DHW equipment modeled with the following efficiency levels as applicable:

| | | | | | | |
|---|---|---|---|---|---|---|
| Gas: | ≤55 Gal = 0.67 EF | | | | >55 Gal = 0.77 EF | |
| Electric: | ≤55 Gal = 0.95 EF | | | | >55 Gal = 2.00 EF | |
| Oil: | 30 Gal = 0.63 EF | 40 Gal = 0.61 EF | 50 Gal = 0.59 EF | 60 Gal = 0.57 EF | 70 Gal = 0.55 EF | 80 Gal = 0.53 EF |

## Thermostat & Ductwork

- Programmable thermostat modeled.
- Ducts for top apartments located in attic, other apartments ducts located in conditioned space. Supply ducts in unconditioned attics modeled with R-8 insulation; all other ducts in unconditioned space modeled with R-6 insulation.
- Duct leakage to outdoors modeled at the greater of ≤ 4 CFM25 per 100 sq. ft. of conditioned floor area or ≤ 40 CFM25.

## Lighting, Appliances & Plumbing Fixtures

- ENERGY STAR refrigerators, dishwashers, clothes washers, dryers, and ceiling fans modeled.
- ENERGY STAR light bulbs modeled in 90% of RESNET-defined Qualifying Light Fixture Locations.
- WaterSense bathroom faucets, bathroom aerators, and showerheads

# HERS Target

**Performance Target**

- In-unit modeling
  - ENERGY STAR Reference Design is **not** required in-unit – this is the benchmark
- Prescriptive common area measures
  - Meet reference design for covered measures
    - HVAC/HW systems shared with included in HERS model for units exempted
  - Meet additional common area measures in prescriptive path (e.g., common area lighting controls)

# Prescriptive Path

**Performance Target**

- Available for all projects
- ENERGY STAR Reference Design specifications is required (in-unit and common areas)
- Additional req'ts beyond ENERGY STAR Reference Design (e.g. in-unit LPD, building level window-to-wall ratio, ventilation cap)

# Reference Design Requirements

| | ASHRAE | HERS | Prescriptive |
|---|---|---|---|
| In-Unit | N/A | N/A | Ref Design |
| Common Space | N/A | Ref Design | Ref Design |

Items are added to Rater checklist in same spot as Minimum Requirements with designation by path

| 2. High-Performance Fenestration |
|---|
| 2.1 Dwelling units: |
| 2.1.1 Prescriptive: Specified fenestration meets or exceeds ENERGY STAR MF Reference Design requirements[5] |
| 2.1.2 HERS and ASHRAE only: Specified fenestration meets or exceeds 2009 IECC residential requirements[5] |

Notes:

- Dwelling units – match reference design precisely (including wood-frame, Group R)
- Common spaces – match reference design generally, but some adjustments (e.g., meet "All Other" insulation not "Group R")

# Reference Design in Rater Checklist: Equipment Efficiency

| System serves: | ASHRAE | HERS | Prescriptive |
|---|---|---|---|
| Dwelling units | N/A | N/A | Ref Design |
| Common space and NOT dwelling units | N/A | Ref Design | Ref Design |

- Efficiency levels not in Ref Design are in Exhibit X of Rater Checklist
- Restriction on electric resistance heating:
  - Not permitted in any dwelling unit (Prescriptive Path)
  - Electric resistance heating specified in common spaces has a total heating capacity ≤ 12 kBtu/h (3.5 kW) per enclosed space and has automatic thermostatic controls (HERS and Prescriptive)

# Prescriptive Path Only Req's Highlights

Not captured in Reference Design (partial list)

- Window-to-wall ratio ≤ 30%
- Dwelling unit overall in-unit lighting power density ≤ 0.75 W/ft$^2$
- Dwelling unit ventilation rate ≤ 150% ASHRAE 62.2-2013 rates
- Shower compartments with multiple fixtures cannot be operated simultaneously OR the average flow rate per shower compartment must not exceed 1.75 gallons per minute

# ASHRAE Target

**Performance Target**

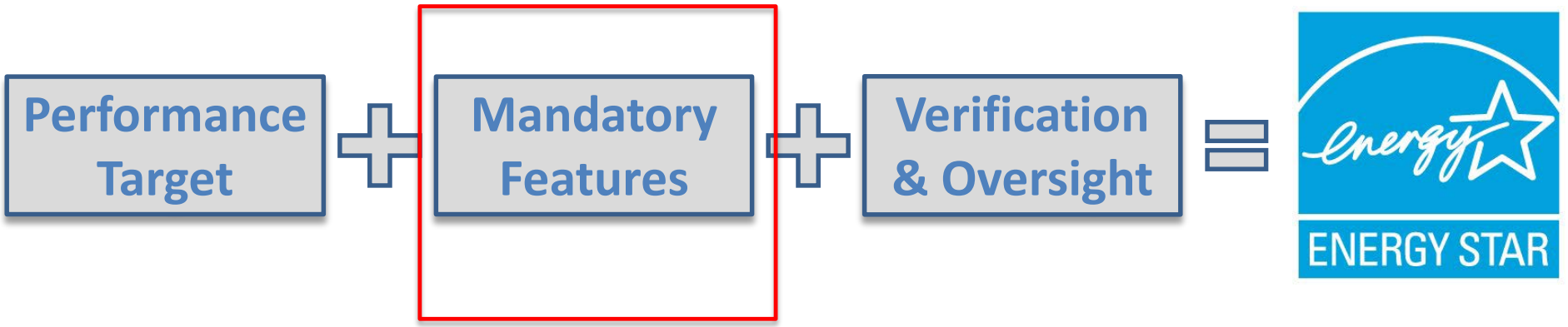
Target

- 15% above ASHRAE 90.1 (the year is based on the state code)
- 10% above Title 24-2016 in California

Modeling methodology/documentation

- 90.1-2007, 2010 and 2013 can model using Appendix G from ASHRAE 90.1-2016
  - New Simulation Guidelines and Performance Path Calc. released Dec 2017
- 90.1-2007 and 90.1-2010 can also model using Appendix G from respective standards
- Low-rise projects follow Simulation Guidelines, but have wood-framed baseline
- New – Projects cannot model using ASHRAE 90.1-2013 Appendix G (must use 2016)

# Key Components to Program Requirements



# Checklist Item/Prerequisite Summary

**Mandatory Features**

- Developed by evaluating requirements from ESCH and ESMFHR and combining/adjusting as appropriate (both more and less stringent)
- Include requirements related to central heating, cooling, ventilation, and hot water systems
- Include requirements from MFHR that focus on reducing hot water energy use
- Include requirements in common areas

# Envelope

# Analyzing ESCH/MFHR Envelope Requirements

## Certified Homes

1. Change minimum insulation levels to Commercial table
2. Adjust air sealing details
   - Optional on design review checklist
   - Remove some less-relevant details from field checklist
3. Add compartmentalization metric
4. Adjust Reduced Thermal Bridging req't: limit advanced framing option; CZ 3-8, cont. ext. insulation or SIP/ICF
5. Update slab edge requirements/exemptions for MF; specify garage podium insulation requirement
6. Allow Class AW performance windows to meet commercial code U-value
7. Requirements apply to common areas

## MFHR

1. Add minimum insulation level requirements (2009 IECC Commercial)
2. Adjust air-sealing and air-barrier design review and field inspection requirements to align with ESCH checklist items
3. Keep compartmentalization metric
4. Adjust continuous insulation req't including wood-frame, or SIP/ICF, and allow limited advanced framing
5. Add slab edge requirements/ exemptions including garage podium insulation requirement
6. Adjust minimum window requirement to meet 2009 IECC U-value and SHGC
7. Requirements continue to apply to common areas

# Envelope

- Insulation: Reference 2009 IECC Commercial
- Heated garages and garage plenum insulation
- Reduced Thermal Bridging:
  - Continuous exterior insulation OR
  - SIPs, ICFs, or Double-wall framing OR
  - Limited advanced framing details (not allowed for all projects)
- Slab-On-Grade and Elevated Slab insulation requirements
- Air Sealing/Air Barrier
  - Require in-unit compartmentalization: ≤0.30 CFM50/ft2 of enclosure
  - Specific air sealing details for in-field verification
  - Complete, fully aligned air barrier
- Windows: Reference 2009 IECC Residential
- Measures required for common areas

# Minimum Insulation Levels

Specified ceiling, wall, floor, and slab insulation levels meets or exceeds 2009 IECC Commercial levels for apartments and common areas

- Meet Table 502.2(1) (R-Value); OR
- Meet Table 502.1.2 (U-Value); OR
- Total UA alternative

Notes:

Prescriptive Path must meet MF Ref design levels in units

Prescriptive and HERS Path must meet MF Ref design levels in common areas, BUT for 'All Other' category and for the building's framing type

# Minimum Insulation Levels

| 3. High-Performance Insulation |
|---|
| 3.1 Dwelling unit: |
| 3.1.1: Prescriptive: Specified ceiling[6], wall[7], floor, and slab-on-grade insulation levels meet or exceed ENERGY STAR MF Reference Design requirements for "Group R"[8, 9, 10] |
| 3.1.2: HERS and ASHRAE only: Specified ceiling[6], wall[7], floor, and slab-on-grade insulation levels meet or exceed values from the "Group R" column in the 2009 IECC Commercial chapter[8, 9, 10] |
| 3.2 Common space: |
| 3.2.1 HERS and Prescriptive: Specified ceiling[6], wall[7], floor, and slab-on-grade insulation levels meet or exceed ENERGY STAR MF Reference Design requirements for 'All other'[8, 9, 10] |
| 3.2.2 ASHRAE only: Specified ceiling[6], wall[7], floor, and slab-on-grade insulation levels meet or exceed the values from the 2009 IECC Commercial chapter'[8, 9, 10] |

## Rater Design Checklist

| | ASHRAE | HERS | Prescriptive |
|---|---|---|---|
| In-Unit | Minimum:<br>2009 IECC Group R | Minimum:<br>2009 IECC Group R | Ref Design: (Wood-frame)<br>3.0: 2009 IECC Group R<br>3.1: 2012 IECC Group R |
| Common Space | Minimum:<br>2009 IECC 'All Other' | Ref Design:<br>3.0: 2009 IECC 'All Other'<br>3.1: 2012 IECC 'All Other' | Ref Design:<br>3.0: 2009 IECC 'All Other'<br>3.1: 2012 IECC 'All Other' |

# Insulation: Heated Plenums and Garages

- Plenums and Garages:
  - Insulate top - 'ceiling' or floor above
  - Insulate walls
- Plenums:
  - Plenum 'wall' must be an air barrier
  - Insulate plenum 'floor' to R-13
    - Floor can be suspended ceiling tiles (or other non-air barrier)
- ASHRAE projects can choose to not insulate, but regardless, heating energy must be modeled in both baseline and proposed

# Heated Plenums and Garages

| | |
|---|---|
| 1.5 Heated plenums in unconditioned space or ambient conditions must meet the following requirements[8] | |
| 1.5.1 Plenum walls are an air barrier and insulated to ≥ R-5ci in CZ 5-6; ≥ R-7.5ci in CZ 7; ≥ R-9.5ci in CZ 8, **AND;** | ☐ |
| 1.5.2 Plenum ceiling insulation meets or exceeds the R-value for mass floors from the "All other" column of Table 502.2(1) of 2009 IECC, **AND;** | ☐ |
| 1.5.3 Plenum floors must have at least R-13 insulation[9] | ☐ |
| 1.6: Garages with space heating must meet the following requirements[8] | |
| 1.6.1 Insulation on above grade walls and walls on the first story below grade ≥ R-5ci in CZ 5-6; ≥ R-7.5ci in CZ 7; ≥ R-9.5ci in C | ☐ |
| 1.6.2 Garage ceiling insulation meets or exceeds the R-value for mass floors from the "All other" column of Table 502.2(1) of 2009 IECC. | ☐ |

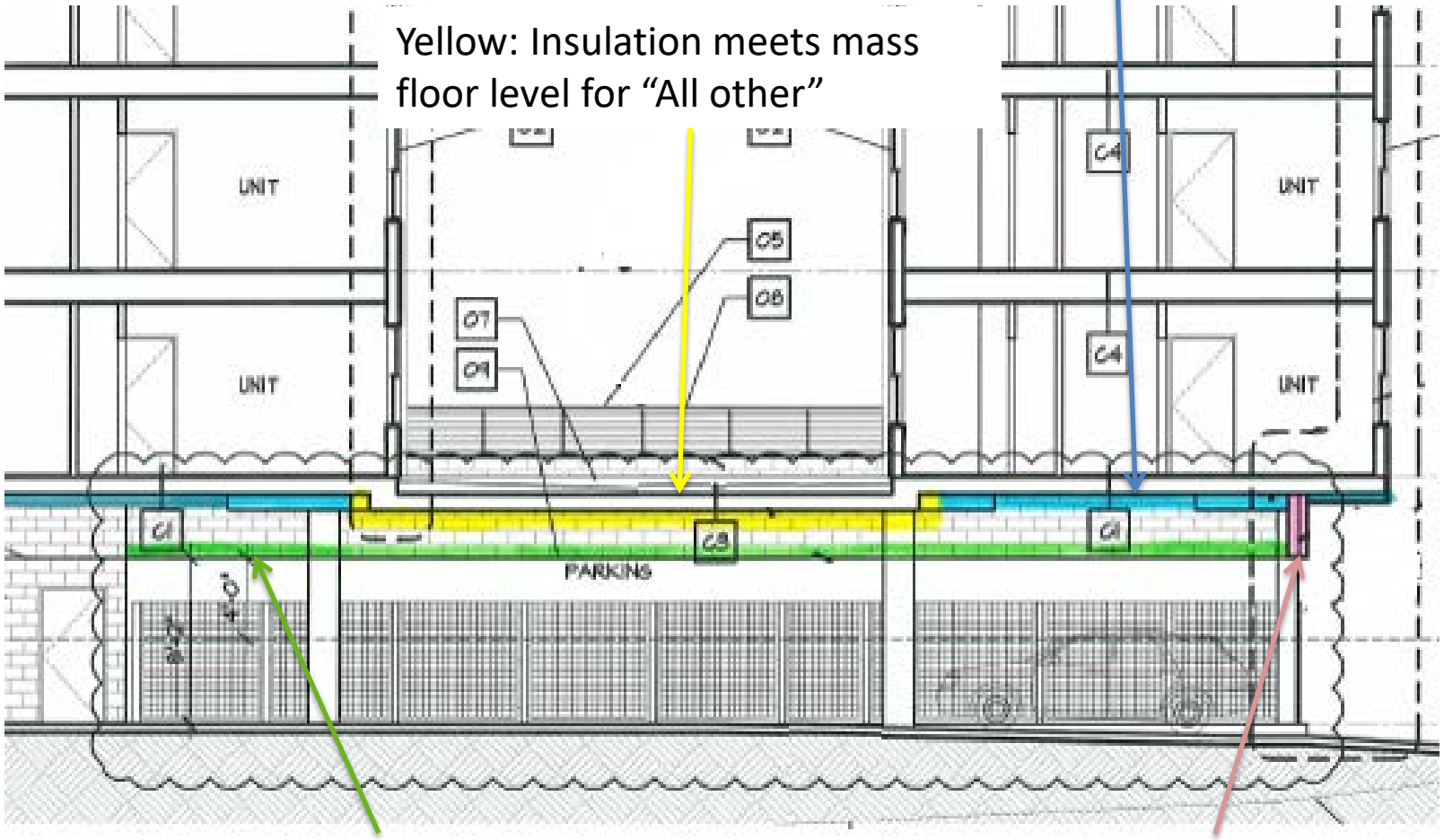
**Rater Field Checklist**

*Note: 1.5.2 already required unless ceiling is not attached to apartment or common areas*

# Heated Plenum Detail

Blue: Insulation meets mass floor level

Yellow: Insulation meets mass floor level for "All other"




Green: R-13 insulation (air barrier not required)

Pink: Insulation meets above grade wall level

# Heated Plenums and Garages

| | |
|---|---|
| 1.5 Heated plenums in unconditioned space or ambient conditions must meet the following requirements[8] | |
| 1.5.1 Plenum walls are an air barrier and insulated to ≥ R-5ci in CZ 5-6; ≥ R-7.5ci in CZ 7; ≥ R-9.5ci in CZ 8, **AND;** | ☐ |
| 1.5.2 Plenum ceiling insulation meets or exceeds the R-value for mass floors from the "All other" column of Table 502.2(1) of 2009 IECC, **AND;** | ☐ |
| 1.5.3 Plenum floors must have at least R-13 insulation[9] | ☐ |
| 1.6: Garages with space heating must meet the following requirements[8] | |
| 1.6.1 Insulation on above grade walls and walls on the first story below grade ≥ R-5ci in CZ 5-6; ≥ R-7.5ci in CZ 7; ≥ R-9.5ci in CZ 8, **AND;** | ☐ |
| 1.6.2 Garage ceiling insulation meets or exceeds the R-value for mass floors from the "All other" column of Table 502.2(1) of 2009 IECC. | ☐ |

**Rater Field Checklist**

*Note: 1.6.2 already required unless ceiling is not attached to apartment or common areas*

# Reduced Thermal Bridging

At apartment and common area above-grade walls separating conditioned from unconditioned space, use one of the following options:

1. Continuous insulation, insulated siding, or combination of the two is ≥ R-3 for CZ 1-4 and ≥ R-5 for CZ 5-8

**OR**

2. Select an advanced assembly option: Structural Insulated Panels; Insulated Concrete Forms; Double-wall framing

**OR** (Only for wood-framed projects ≤ 3 stories OR in CZ 1-3)

3. Complete the following 'advanced framing' details*:

- Corners insulated ≥ R-6 to edge, AND
- Headers above windows & doors insulated ≥ R-3 for 2x4 framing and ≥ R-5 for all other, AND
- Interior/exterior wall intersections insulated to same R-value as rest of exterior wall

# Reduced Thermal Bridging

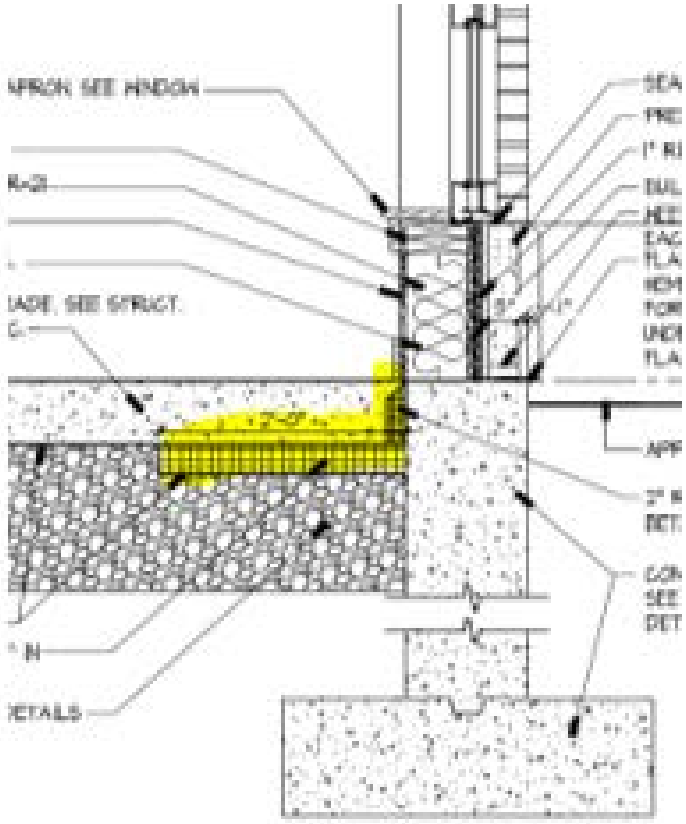
| | |
|---|---|
| 2.6 At above-grade walls separating conditioned from unconditioned space, one of the following options used: [15] | |
| 2.6.1 Continuous exterior rigid insulation, insulated siding, or combination of the two is: ≥ R-3 in CZ 1-4; ≥ R-5 in CZ 5-8 [16, 17, 18], **OR**; | ☐ |
| 2.6.2 Structural Insulated Panels **OR**; Insulated Concrete Forms **OR**; Double-wall framing **OR**; [16,19] | ☐ |
| 2.6.3 Option for CZ 1-3 OR buildings ≤3 stories: 'advanced framing' details including all of the Items below: [20] | |
| 2.6.3a Corners insulated ≥ R-6 to edge [21], **AND**; | ☐ |
| 2.6.3b Headers above windows & doors insulated ≥ R-3 for 2x4 framing or equivalent cavity width, and ≥ R-5 for all other assemblies (e.g., with 2x6 framing) [22], **AND**; | ☐ |
| 2.6.3c Interior / exterior wall intersections insulated to same R-value as rest of exterior wall. [23] | ☐ |

**Rater Field Checklist**

# Slab-on-Grade Insulation

For slabs on grade in CZ 4-8, 100% of slab edge insulated to ≥ R-5 at the depth specified by the 2009 IECC and aligned with the thermal boundary of the walls

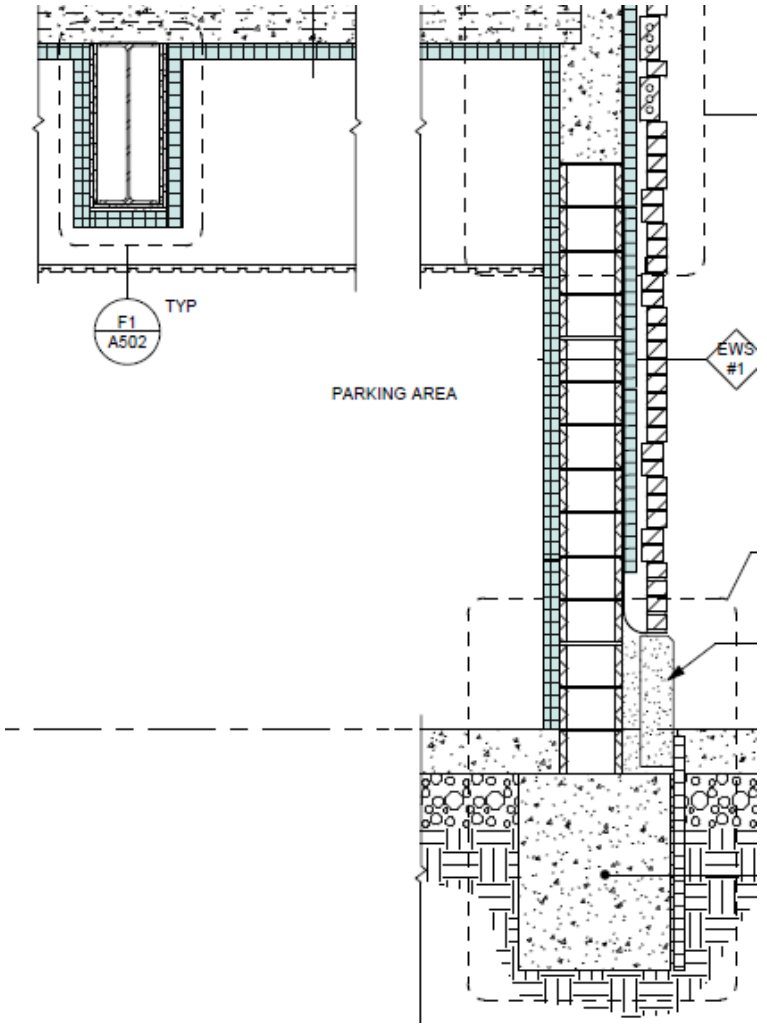
- Required for apartments & common areas
- Required when floor surface less than 24" below grade; and must extend to top of slab
- Required where slab-on-grade transitions from conditioned to unconditioned space (ie. patio)



# Elevated Slab Edge Insulation

For elevated slabs in CZ4 - 8 (such as balconies or garage podiums with apartments or common areas above),

- The elevated slab edge must be insulated **to R-5** (for podium, this means the full height of the wall);
- Floor insulation installed on top or below the podium slab. If installed below the slab:
  - Where insulation below the slab is interrupted by walls or columns, insulation must be installed vertically to maintain a continuous thermal boundary **or those uninsulated areas are part of a modified UA calculation**



# Elevated Slab Edge Insulation

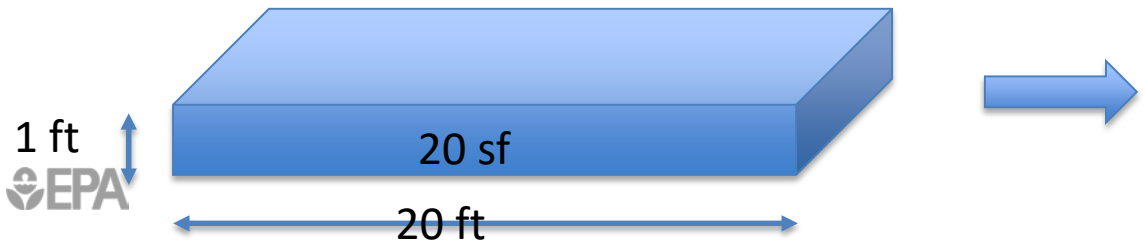
| 2. Reduced Thermal Bridging |
|---|
| 2.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade I insulation extends to the inside face of the exterior wall below and is ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8 [10] |
| 2.2 For slabs on grade in CZ 4-8, 100% of slab edge insulated to ≥ R-5 at the depth specified by Table 502.2(1) of the 2009 IECC and aligned with the thermal boundary of the walls [11, 12] |
| 2.3 For elevated concrete slabs in CZ 4-8 (i.e., podiums and projected balconies, but not intermediate slab floor edges) 100% of the slab edge insulated to ≥ R-5. For podiums, insulation must be installed for the full height of the podium wall. See footnote 13 for balcony alternative [13] |
| 2.4. For elevated concrete slabs in CZ 4-8 (i.e. podiums), floor insulation meets the U-factor specified in Table 502.1.2 of the 2009 IECC for Group R when dwelling units are above the slab, and for 'All Other' when common space is above the slab [14] |
| 2.5 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8 |

13. For projected balconies, install a minimum of R-5 slab edge insulation to provide a thermal break between conditioned space and the unconditioned projected balcony slab. Alternatively, a UA calculation for the wall assembly that accounts for this uninsulated projected slab must be performed to demonstrate compliance with Item 1.2. For the purpose of this UA calculation, the area of the wall that is uninsulated due to the projected balcony is required to be calculated as 400% of that actual area. For example, for a projected balcony that is 20 feet wide, and has a thickness of 1 foot, the area to be used in the UA calculation is 80 $ft^2$ instead of 20 $ft^2$. The distance the balcony projects from the building is not used in this calculation.

14. Whether insulating from above or below the slab, thermal breaks must be accounted for when determining compliance with floor U-factors. Where structural columns cause a discontinuity in the installed floor insulation, the UA calculation for the floor assembly must account for this uninsulated area of the floor. For the purpose of this UA calculation, the area of the floor that is uninsulated due to the structural columns is required to be calculated as 400% of that actual area. For example, for a 4'x4' column, the area to be used in the UA calculation is 64 $ft^2$ instead of 16 $ft^2$. The height of the column is not used in this calculation. Alternatively, if the structural column is insulated for a minimum of 4 vertical feet, the modification to the UA calculation is not required, and the U-value of the column insulation shall be associated with the uninsulated area of the floor due to the column.

# Modified UA Calculation (Balcony)

- Option A: Install the R-5 thermal break
- Option B: Don't install it, but account for the uninsulated slab edge thermal impact, by increasing its area in the UA calculation (using a multiplier of 4)
  - For example, for a balcony that is 20 feet wide, and has a thickness (height) of 1 foot, the area is 20 $ft^2$. The area to be used in the UA calculation is instead increased to 80 $ft^2$. The resulting UA must be used for compliance with the wall insulation requirements.
  - The horizontal distance the balcony projects from the building is not used in this calculation.



# Modified UA Calculation (Podium)

- Whether above or below the slab, thermal breaks must be accounted for when determining compliance with floor U-factors.
- Where installed floor insulation isn't continuous(e.g., at columns), the UA calculation for the floor assembly must account for the thermal impact of the uninsulated column, by increasing its 'area' in the UA calculation (using a multiplier of 4).
- For example, for a 4'x4' column, the area to be used in the UA calculation is 64 $ft^2$ instead of 16 $ft^2$.
- The height of the column is not used in this calculation.
- Alternatively, if the structural column is insulated vertically for a minimum of 4 ft, the modification to the area used in the UA calculation is <u>not</u> required. The U-value of the column insulation shall be associated with the uninsulated area of the floor occupied by the column.

# Air Sealing / Air Barrier / Compartmentalization

- Design Review:
  - Applies to apartments and common spaces
  - Check if field items are noted in construction docs
  - Recommended, not required
- Field Verification:
  - Check exterior air barriers align with insulation
  - Air-Sealing:
    - Apartments: 6 items to visually check & mandatory blower door test (≤0.30cfm50/ft2)
    - Common area: same 6 items to visually check, but no test

# Air Sealing

| 4. Air Sealing (Unless otherwise noted below, "sealed" indicates the use of caulk, foam, or equivalent material) | | | | |
|---|---|---|---|---|
| 4.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed | ☐ | ☐ | ☐ | - |
| 4.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to ≥ R-10 in CZ 4-8. | ☐ | ☐ | ☐ | ☐ |
| 4.3 Above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor. Gasket also placed beneath above-grade sill plate if resting atop concrete / masonry & adjacent to cond. space | ☐ | ☐ | ☐ | ☐ |
| 4.4 Continuous top plate or blocking is at top of walls adjoining unconditioned space, and sealed | ☐ | ☐ | ☐ | ☐ |
| 4.5 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above. | ☐ | ☐ | ☐ | ☐ |
| 4.6 Rough opening around windows & exterior doors sealed [27] | ☐ | ☐ | ☐ | - |
| 4.7 Walls that separate attached garages from occupiable space sealed and, also, an air barrier installed and sealed at floor cavities aligned with these walls | ☐ | ☐ | ☐ | ☐ |
| 4.8 In multifamily buildings, the gap between the common wall (e.g. the drywall shaft wall) and the structural framing between units sealed at all exterior boundaries | ☐ | ☐ | ☐ | ☐ |
| 4.9 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air-tight with weatherstripping or equivalent gasket | ☐ | ☐ | ☐ | ☐ |
| 4.10 Attic access panels, drop-down stairs, & whole-house fans equipped with durable ≥ R-10 cover that is gasketed (i.e., not caulked). Fan covers either installed on house side or mechanically operated. [28] | ☐ | ☐ | ☐ | ☐ |

Add doors to the corridor

Effective for homes permitted [29] starting 07/01/2016 Revised 09/15/2015 Page 3 of 9

**Certified Homes Rater**
**Field Checklist**

# Air Sealing - Field Checklist

| 4. Air Sealing (Unless otherwise noted below, "sealed" indicates the use of caulk, foam, or equivalent material) | | |
|---|---|---|
| 4.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed | ☐ | ☐ |
| 4.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to ≥ R-10 in CZ 4-8. | ☐ | ☐ |
| 4.3 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above. | ☐ | ☐ |
| 4.4 Rough opening around windows & exterior doors sealed [31] | ☐ | ☐ |
| 4.5 Assemblies that separate attached garages from occupiable space sealed and, also, an air barrier installed, sealed, and aligned with these assemblies | ☐ | ☐ |
| 4.6 Doors adjacent to unconditioned space, (e.g., attics, garages, basements) ambient conditions, or a unit entrance to a corridor made substantially air-tight with doorsweep and weatherstripping or equivalent gasket | ☐ | ☐ |
| 4.7 Rater-measured compartmentalization is no greater than 0.30 CFM50 per square feet of dwelling unit enclosure area, following procedures in ANSI 380 | ☐ | ☐ |

**Rater Field Checklist**

# Air Sealing / Air Barrier / Thermal Bridging: Optional on Design Checklist

| 5. Construction Document Review – Recommended, not required |
|---|
| 5.1 Exterior Air Sealing: Review construction documents to verify that air-sealing details are represented which, at a minimum, demonstrate compliance with field checklist items in Section 4 of the Rater Field Checklist. |
| 5.1.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed |
| 5.1.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to ≥ R-10 in CZ 4-8 |
| 5.1.3 Above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor. Gasket also placed beneath above-grade sill plate if resting atop concrete / masonry & adjacent to cond. Space [17] |
| 5.1.4 Continuous top plate or blocking is at top of walls adjoining unconditioned space, and sealed |
| 5.1.5 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above |
| 5.1.6 Rough opening around windows & exterior doors sealed[19] |
| 5.1.7 Assemblies that separate attached garages from occupiable space sealed and, also, an air barrier installed, sealed, and aligned with these assemblies |
| 5.1.8 The gap between the common wall (e.g. the drywall shaft wall) and the structural framing between units sealed at all exterior boundaries |
| 5.1.9 Doors adjacent to unconditioned space (e.g., attics, garages, basements), ambient conditions, or a unit entrance to a corridor, made substantially air-tight with doorsweep and weatherstripping or equivalent gasket |
| 5.1.10 Attic access panels, drop-down stairs, & whole-house fans equipped with durable ≥ R-10 cover that is gasketed (i.e., not caulked). Fan covers either installed on unit side or mechanically operated. [20] |
| 5.2 Compartmentalization |
| 5.2.1 Review construction documents to verify that air-sealing details[21] are represented such that air exchange between the dwelling unit and outside as well as the dwelling unit and other adjacent spaces is minimized and will result in compartmentalization less than or equal to 0.30 CFM50 per square feet of dwelling unit enclosure area, following procedures in ANSI 380. |
| 5.2.2 Seal all spaces 5.1.1-5.1.10 on adiabatic unit enclosure assemblies |
| 5.3 Verify that thermal bridging details are in compliance with checklist items in Section 2 of the Rater Field Checklist |
| 5.4 Verify that air barrier details are in compliance with field checklist items in Section 3 of the Rater Field Checklist |

**Rater Design Checklist**

# Air Barriers - Field Checklist

| **3. Fully-Aligned Air Barriers** [24] At each insulated location below, a complete air barrier is provided that is fully aligned as follows: | | | | |
|---|---|---|---|---|
| Ceilings: At interior or exterior horizontal surface of ceiling insulation in Climate Zones 1-3; at interior horizontal surface of ceiling insulation in Climate Zones 4-8. Also, at exterior vertical surface of ceiling insulation in all climate zones (e.g., using a wind baffle that extends to the full height of the insulation in every bay or a tabbed baffle in each bay with a soffit vent that prevents wind washing in adjacent bays).[25] | | | | |
| 3.1 Dropped ceilings / soffits below unconditioned attics, chase / dead space, and all other ceilings | ☐ | ☐ | ☐ | ☐ |
| 3.2 Top-plate blocking at parapet walls and other walls extending to unconditioned space | ☐ | ☐ | ☐ | ☐ |
| Walls: At exterior vertical surface of wall insulation in all climate zones; also at interior vertical surface of wall insulation in Climate Zones 4-8 [26] | | | | |
| 3.3 Walls behind showers, tubs, staircases, and fireplaces | ☐ | ☐ | ☐ | ☐ |
| 3.4 Architectural bump-outs, dead space, and all other exterior walls | ☐ | ☐ | ☐ | - |
| Floors: At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surface including supports to ensure alignment. See Footnotes 10 & 11 for alternatives. [27, 28, 29] | | | | |
| 3.5 Floors above garages, floors above unconditioned basements or crawlspaces, and cantilevered floors | ☐ | ☐ | ☐ | ☐ |
| 3.6 All other floors adjoining unconditioned space (e.g., rim / band joists at exterior wall or at porch roof) | ☐ | ☐ | ☐ | ☐ |

**Rater Field Checklist**

# Windows / Skylights / Doors

- Minimum meet 2009 IECC Residential U-Value and SHGC

  Exception: Performance windows (Class AW) and windows in the common space meet commercial

**Rater Design Checklist – Footnote 5**

| | Dwelling Unit – not "Class AW"* | Dwelling unit windows that are classified as "Class AW"* | Common Space |
|---|---|---|---|
| HERS | 2009 IECC Table 402.1.1 | 2009 IECC Table 502.3 | ENERGY STAR MF Reference Design – for Class AW |
| ASHRAE | 2009 IECC Table 402.1.1 | 2009 IECC Table 502.3 | 2009 IECC Table 502.3 |
| Prescriptive | ENERGY STAR MF Reference Design | ENERGY STAR MF Reference Design – for Class AW | ENERGY STAR MF Reference Design – for Class AW |

- Exemptions:
  - Up to 5% or 50 sq ft (whichever is larger) of combined window and door area from the entire building is exempted

# New Sections on Rater Checklist

# Lighting – Common Area and Exterior

Controls

- Bi-level controls or occupancy sensors (incl. stairs/halls but exempts lobbies)
  - ASHRAE path only: excludes 24-hour spaces
- Photo sensors controls on exterior

Interior Lighting Power Density

- Do not exceed ASHRAE 90.1-2007 space-by-space lighting power density, OR
- Do not exceed 1 W/ft$^2$ for all common area overall, OR
- ASHRAE only option: Do not exceed ASHRAE 90.1-2007 by more than 20%

Parking garage/lots do not exceed ASHRAE 90.1-2007 by more than 20%

Efficiency (HERS/Prescriptive Only)

- Match reference design (i.e., 90% ENERGY STAR)
- ANSI 301 Tier I or Tier II lighting permitted instead of ENERGY STAR certified lighting

# Lighting Rater Inspections

## Rater Field Checklist

| 12. Lighting | Must Correct | LP Verified[35] | Rater Verified [4] | N/A [5] |
|---|---|---|---|---|
| 12.1 Common Space Occupancy Controls: Meet one of the following: | | | | |
| 12.2.1: HERS and Prescriptive: Automatic bi-level controls or occupancy sensors in all common spaces and garages, except the building lobby and where automatic shutoff would endanger the safety of occupants, must have occupancy sensors or automatic bi-level lighting controls; **OR** | ☐ | ☐ | ☐ | ☐ |
| 12.2.2: ASHRAE path only: All common spaces and garages, except those intended for 24-hour operation or where automatic shutoff would endanger the safety of occupants, must have occupancy sensors or automatic bi-level lighting controls | ☐ | ☐ | ☐ | ☐ |
| 12.2 Common Space Lighting Power Density Maximum: Meet one of the following[61]: | | | | |
| 12.2.1 HERS and Prescriptive: Specified lighting power for common spaces must not exceed ASHRAE 90.1-2007 space by space lighting power density allowances; **OR** | ☐ | ☐ | ☐ | ☐ |
| 12.2.2 HERS and Prescriptive: Total combined specified lighting power density must not exceed 1 W/ft$^2$; **OR** | ☐ | ☐ | ☐ | ☐ |
| 12.2.3 ASHRAE path only: Specified lighting power for common spaces must not exceed ASHRAE 90.1-2007 space by space lighting power density allowances by more than 20% | ☐ | ☐ | ☐ | ☐ |
| 12.3 Parking garages and parking lots do not exceed the ASHRAE 90.1-2007 parking lighting power density allowances by more than 20% | ☐ | ☐ | ☐ | ☐ |
| 12.4 Exterior lighting controls: Fixtures must include automatic switching on timers or photocell controls except fixtures intended for 24-hour operation, required for security, or located on dwelling unit balconies | ☐ | ☐ | ☐ | ☐ |
| 12.5 HERS Path: All exterior and common space lighting fixtures meet the efficiency requirements in the ENERGY STAR MF Reference Design, except fixtures located on dwelling unit balconies | ☐ | - | ☐ | ☐ |
| 12.6 Prescriptive Path: Lighting in dwelling units and common spaces meet the efficiency requirements in the ENERGY STAR Reference Design[62] | ☐ | - | ☐ | ☐ |
| 12.7 Prescriptive Path: Dwelling unit overall in-unit lighting power density ≤ 0.75 W/ft$^2$. When calculating overall lighting power density, use 1.1 W/ft$^2$ where lighting is not installed [61] | ☐ | - | ☐ | ☐ |

# Licensed Professional Verify Rater Items

| Must Correct | LP Verified[35] | Rater Verified [4] | N/A [5] |
|---|---|---|---|

- Similar to Builder Verified:
- At the discretion of the Rater, a Licensed Professional (LP), a Registered Architect or Professional Engineer, may verify up to ten items combined from
  - Sections 5 (HVAC Controls and Hydronic Distribution)
  - Section 11 and12 (DHW and Lighting)

*Looking for feedback on this number and these sections. (Increase/Decrease number, Add/Remove sections/Items)*

Note:

- When exercised, the LP's responsibility will be formally acknowledged by the LP signing off on the checklist for the item(s) that they verified.
- However, if a quality assurance review indicates that Items have not been successfully completed, the Rater will be responsible for facilitating corrective action.

# Senior Housing Lighting Allowances

Footnote 61:

- Senior housing projects can use allowances for 'facilities for the visually impaired' in ASHRAE 90.1-2016 Appendix G Table G3.7 for spaces used primarily by building residents.
  - For example, 1.15 W/SF lighting power allowance may be used for the corridors in the baseline.
- To qualify for the increased allowance, the project must be designed to comply with the light levels in ANSI/IES RP-28 and must provide housing for seniors and/or people with special visual needs.
- Prescriptive Path dwelling unit overall in-unit lighting power density is permitted to be ≤ 1.3 W/SF, using 1.65 W/SF where lighting is not installed.

**Rater Field Checklist**

# Appliances, Plumbing Fixtures, Ceiling Fans

| 13. Appliances, Ceiling Fans, and Plumbing Fixtures |
|---|
| 13.1 Prescriptive Path: Specified appliances, ceiling fans, and plumbing fixtures in dwelling units and common spaces meet the criteria in the ENERGY STAR MF Reference Design[63] |
| 13.2 HERS Path: Specified appliances, ceiling fans, and plumbing fixtures in common areas, and not included in the HERS model, meet the criteria in the ENERGY STAR MF Reference Design[63] |
| 13.3 Prescriptive Path: Shower compartments with multiple fixtures cannot be operated simultaneously OR the average flow rate per shower compartment must not exceed 1.75 gallons per minute, as rated at 80 psi. |

| | ASHRAE | HERS | Prescriptive |
|---|---|---|---|
| In-Unit | N/A | N/A | Ref Design |
| Common Space (except if included in HERS model) | N/A | Ref Design | Ref Design |

Notes:

- Appliances that are not eligible for ENERGY STAR certification (e.g., commercial dryers) are exempted

# Energy Monitoring

- Purpose: To facilitate benchmarking later (and earning the existing buildings ENERGY STAR certification)
- Only required for projects with at least 50 units

| 14. Whole Building Energy Consumption Data Acquisition | |
|---|---|
| 14.1 For buildings with ≥50 units, an energy monitor, data acquisition system, or utility-owned energy meter is installed that can collect building-level data representing total monthly building energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, etc.)[64] | ☐ |

**Rater Field Checklist**

Footnote 64: As an alternative, projects may submit to EPA for approval their strategy for collecting annual building-level data, such as an agreement with the utility companies to provide the aggregated building-level data or evidence that securing signed utility data release forms will be a mandatory component of all lease agreements.

# HVAC, Distribution, & HW

# HVAC/HW & Distribution

- Equipment controls & hydronic distribution
  - Thermostat, balancing valves, pipe insulation
- Total duct leakage performance threshold (in-unit)
  - lower threshold for non-ducted returns
- Central exhaust duct leakage performance threshold
- Ducts installed well and insulated in unconditioned space
- Bedrooms pressure-balanced (150 CFM, 5 Pa)
- More restrictions on Combustion Appliances inside the pressure boundary

# HVAC Design Report

HVAC Designer to provide one report that documents HVAC design, that includes all HVAC systems in the building:

- Documents load calc inputs just for dwelling unit systems
- Load calcs done at unit-level and Manual D not required
- ASHRAE 62.1 and 62.2 ventilation rates documented
- Cooling & Heating Equipment Selection
  - Over-sizing limits apply just to split AC/HP & furnaces
- New! Items from Rater Field appear on HVAC Design Report
  - Equipment Controls & Hydronic Distribution
  - Duct Quality Installation
    - Dwelling Unit (leakage test, insulation, etc)
    - Common Area & Central Exhaust Leakage Test

# Dwelling Unit Design Loads

| 3. Heating & Cooling Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces)** [19] | | | | | | | | |
| 3.1 Loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013/2017 ASHRAE Fundamentals ☐ Other per AHJ [20] | | | | | | | | |
| 3.2 Check one box only to indicate whether the Dwelling Unit Loads is unit-specific or represents the design of more than one unit: [2]<br>☐ Unit-specific design. ☐ Group design[21]. ____ total groups for this project, representing ____ units.<br>☐ Worst-case design. (If the top floor unit with the greatest CFA and window area results in total heat gain <18 kBtuh, it may represent all other units, if cooling system selected for all is single-speed & <20 kBtuh or two-speed/variable-speed & <25 kBtuh. | | | | | | | | |
| 3.3 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling ☐ | | | | | | | | |
| 3.4 Outdoor design temperatures used in loads: (See Footnote 12 and energystar.gov/hvacdesigntemps) [22]<br>County & State selected: _____ Cooling season: _____°F Heating season: _____°F | | | | | | | | |
| **Unit plan for which Loads were calculated:** | **"Unit A"** | **"Unit B"** | **"Unit C"** | **"Unit D"** | **"Unit E"** | **"Unit F"** | **"Unit G"** | **"Unit H"** |
| Location of Unit: top, mid, bottom, corner, interior | | | | | | | | |
| 3.5 Number of occupants used in loads: [23] | | | | | | | | |
| 3.6 Total occupant gains (Btuh)[2]: | | | | | | | | |
| 3.7 Conditioned floor area used in loads: | | | | | | | | |
| 3.8 Window area used in loads: | | | | | | | | |
| 3.9 Predominant window SHGC used in loads:[24] | | | | | | | | |
| 3.10 Infiltration (ACH/ACH50) used in loads:[25] | | | | | | | | |
| 3.11 Mechanical ventilation (CFM) used in loads: | | | | | | | | |
| 3.12 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): | | | | | | | | |
| 3.13 Sensible Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.14 Latent Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.15 Total Heat Gain at Design Conditions (kBtuh) | | | | | | | | |
| 3.16 Total Heat Loss at Design Conditions (kBtuh) | | | | | | | | |
| **Common Space Heating & Cooling Loads** | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| **Building Heating & Cooling Loads** (only required when shared systems such as central boilers or chillers are specified) | | | | | | | | |
| Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |

**HVAC Design Report**

# Dwelling Unit Design Loads

| 3. Heating & Cooling Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces)** [19] | | | | | | | | |
| 3.1 Loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013/2017 ASHRAE Fundamentals ☐ Other per AHJ [20] | | | | | | | | |
| 3.2 Check one box only to indicate whether the Dwelling Unit Loads is unit-specific or represents the design of more than one unit: [2]<br>☐ Unit-specific design. ☐ Group design[21]. ____ total groups for this project, representing ____ units.<br>☐ Worst-case design. (If the top floor unit with the greatest CFA and window area results in total heat gain <18 kBtuh, it may represent all other units, if cooling system selected for all is single-speed & <20 kBtuh or two-speed/variable-speed & <25 kBtuh. | | | | | | | | |
| 3.3 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling ☐ | | | | | | | | |
| 3.4 Outdoor design temperatures used in loads: (See Footnote 12 and energystar.gov/hvacdesigntemps) [22]<br>County & State selected: _____ Cooling season: _____°F Heating season: _____°F | | | | | | | | |
| **Unit plan for which Loads were calculated:** | **"Unit A"** | **"Unit B"** | **"Unit C"** | **"Unit D"** | **"Unit E"** | **"Unit F"** | **"Unit G"** | **"Unit H"** |
| Location of Unit: top, mid, bottom, corner, interior | | | | | | | | |
| 3.5 Number of occupants used in loads: [23] | | | | | | | | |
| 3.6 Total occupant gains (Btuh)[2]: | | | | | | | | |
| 3.7 Conditioned floor area used in loads: | | | | | | | | |
| 3.8 Window area used in loads: | | | | | | | | |
| 3.9 Predominant window SHGC used in loads:[24] | | | | | | | | |
| 3.10 Infiltration (ACH/ACH50) used in loads:[25] | | | | | | | | |
| 3.11 Mechanical ventilation (CFM) used in loads: | | | | | | | | |
| 3.12 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): | | | | | | | | |
| 3.13 Sensible Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.14 Latent Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.15 Total Heat Gain at Design Conditions (kBtuh) | | | | | | | | |
| 3.16 Total Heat Loss at Design Conditions (kBtuh) | | | | | | | | |
| **Common Space Heating & Cooling Loads** | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| **Building Heating & Cooling Loads** (only required when shared systems such as central boilers or chillers are specified) | | | | | | | | |
| Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |

**HVAC Design Report**

# Dwelling Unit Design Loads

| 3. Heating & Cooling Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces)** [19] | | | | | | | | |
| 3.1 Loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013/2017 ASHRAE Fundamentals ☐ Other per AHJ [20] | | | | | | | | |
| 3.2 Check one box only to indicate whether the Dwelling Unit Loads is unit-specific or represents the design of more than one unit: [2]<br>☐ Unit-specific design. ☐ Group design[21]. ____ total groups for this project, representing ____ units.<br>☐ Worst-case design. (If the top floor unit with the greatest CFA and window area results in total heat gain <18 kBtuh, it may represent all other units, if cooling system selected for all is single-speed & <20 kBtuh or two-speed/variable-speed & <25 kBtuh. | | | | | | | | |
| 3.3 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling | | | | | | | | ☐ |
| 3.4 Outdoor design temperatures used in loads: (See Footnote 12 and energystar.gov/hvacdesigntemps) [22]<br>County & State selected: _____ Cooling season: _____°F Heating season: _____°F | | | | | | | | |
| **Unit plan for which Loads were calculated:** | **"Unit A"** | **"Unit B"** | **"Unit C"** | **"Unit D"** | **"Unit E"** | **"Unit F"** | **"Unit G"** | **"Unit H"** |
| Location of Unit: top, mid, bottom, corner, interior | | | | | | | | |
| 3.5 Number of occupants used in loads: [23] | | | | | | | | |
| 3.6 Total occupant gains (Btuh)[2]: | | | | | | | | |
| 3.7 Conditioned floor area used in loads: | | | | | | | | |
| 3.8 Window area used in loads: | | | | | | | | |
| 3.9 Predominant window SHGC used in loads:[24] | | | | | | | | |
| 3.10 Infiltration (ACH/ACH50) used in loads:[25] | | | | | | | | |
| 3.11 Mechanical ventilation (CFM) used in loads: | | | | | | | | |
| 3.12 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): | | | | | | | | |
| 3.13 Sensible Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.14 Latent Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.15 Total Heat Gain at Design Conditions (kBtuh) | | | | | | | | |
| 3.16 Total Heat Loss at Design Conditions (kBtuh) | | | | | | | | |
| **Common Space Heating & Cooling Loads** | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| **Building Heating & Cooling Loads** (only required when shared systems such as central boilers or chillers are specified) | | | | | | | | |
| Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |

**HVAC Design Report**

# Rater Design Review of HVAC Design Report

| 4. Review of HVAC Design Report [11] | | |
|---|---|---|
| 4.1 HVAC Design Report collected for records, with no Items left blank | ☐ | ☐ |
| 4.2 HVAC Design Report reviewed by Rater for the following parameters (HVAC Design Report Item # indicated in parenthesis): | | |
| 4.2.1 Prescriptive Path: Dwelling Unit Mechanical Ventilation (2.6) is <150% of ASHRAE 62.2-2013 requirements[12] | ☐ | ☐ |
| 4.2.2 HERS and Prescriptive Path: Common space Ventilation is <150% of ASHRAE 62.1-2013 (2.2) | ☐ | ☐ |
| 4.2.3 HVAC design includes access and means (2.3) to measure the dwelling-unit mechanical ventilation airflow rate | ☐ | ☐ |
| 4.2.4 Cooling season and heating season outdoor design temperatures used in loads (3.4) are within the limits defined at energystar.gov/hvacdesigntemps for the State and County where the building will be built, or the designer has provided an allowance from EPA to use alternative values [13] | ☐ | ☐ |
| 4.2.5 Number of occupants used in loads (3.5) is within ± 2 of the dwelling unit to be certified and occupant gains (3.6) do not exceed 645 Btuh per occupant [14] | ☐ | ☐ |
| 4.2.6 Conditioned floor area used in loads (3.7) is between zero and 300 sq. ft. larger than the dwelling unit to be certified | ☐ | ☐ |
| 4.2.7 Window area used in loads (3.8) is between zero and 60 sq. ft. larger than the dwelling unit to be certified | ☐ | ☐ |
| 4.2.8 Predominant window SHGC used in loads (3.9) is within 0.1 of predominant value in the dwelling unit to be certified [15] | ☐ | ☐ |
| 4.2.9 Mechanical ventilation used in loads (3.11) is the same as the ventilation design (2.6) for the given unit plan | ☐ | ☐ |
| 4.2.10 Non-occupant internal gains (3.12) are less than 3,600 Btuh | ☐ | ☐ |
| 4.2.11 Sensible & total heat gain are documented (3.13, 3.15) for the orientation of the dwelling unit to be certified [16] | ☐ | ☐ |
| 4.2.12 Cooling sizing % (4.16) is within the cooling sizing limit (4.17) selected by the HVAC designer | ☐ | ☐ |

**Rater Design Checklist**

# Common Area Design Loads

| 3. Heating & Cooling Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces)** [19] | | | | | | | | |
| 3.1 Loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013/2017 ASHRAE Fundamentals ☐ Other per AHJ [20] | | | | | | | | |
| 3.2 Check one box only to indicate whether the Dwelling Unit Loads is unit-specific or represents the design of more than one unit: [2]<br>☐ Unit/space specific design. ☐ Group design[21]. ____ total groups for this project, representing ____ units.<br>☐ Worst-case design. (If the top floor unit with the greatest CFA and window area results in total heat gain <18 kBtuh, it may represent all other units, if cooling system selected for all is single-speed & <20 kBtuh or two-speed/variable-speed & <25 kBtuh. | | | | | | | | |
| 3.3 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling | | | | | | | | ☐ |
| 3.4 Outdoor design temperatures used in loads: (See Footnote 12 and energystar.gov/hvacdesigntemps) [22]<br>County & State selected: _____ Cooling season: _____°F Heating season: _____°F | | | | | | | | |
| **Unit plan for which Loads were calculated:** | **Unit A** | **Unit B** | **Unit C** | **Unit D** | **Unit E** | **Unit F** | **Unit G** | **Unit H** |
| Location of Unit: top, mid, bottom, corner, interior | | | | | | | | |
| 3.5 Number of occupants used in loads: [23] | | | | | | | | |
| 3.6 Total occupant gains (Btuh)[2]: | | | | | | | | |
| 3.7 Conditioned floor area used in loads: | | | | | | | | |
| 3.8 Window area used in loads: | | | | | | | | |
| 3.9 Predominant window SHGC used in loads:[24] | | | | | | | | |
| 3.10 Infiltration (ACH/ACH50) used in loads:[25] | | | | | | | | |
| 3.11 Mechanical ventilation (CFM) used in loads: | | | | | | | | |
| 3.12 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): | | | | | | | | |
| 3.13 Sensible Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.14 Latent Heat Gain At Design Conditions (kBtuh) | | | | | | | | |
| 3.15 Total Heat Gain at Design Conditions (kBtuh) | | | | | | | | |
| 3.16 Total Heat Loss at Design Conditions (kBtuh) | | | | | | | | |
| **Common Area Heating & Cooling Loads** | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| Common Space Name: _____ Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |
| **Building Heating & Cooling Loads** (only required when shared systems such as central boilers or chillers are specified) | | | | | | | | |
| Design Conditions: Cooling Load: _____(kBtuh) Heating Load: _____(kBtuh) | | | | | | | | |

**HVAC Design Report**

# Heating Equipment & Furnace Sizing Limit

| **Heating Equipment** (Complete all applicable items; otherwise check "N/A") | | | | | | | |
|---|---|---|---|---|---|---|---|
| Heating Equipment ID | "FC-1" | "FC-2" | "FC-3" | "Boiler-1" | "Boiler-2" | "WLHP-1" | "WLHP-2" |
| 4.20 Electric equipment type: PTHP, WLHP, GSHP, ASHP, VRF, Boiler, Furnace, Electric Baseboard | | | | | | | |
| 4.21 Gas Equipment type: HW PTAC/fan coil, Gas-Fired PTAC, Boiler, Furnace | | | | | | | |
| 4.22 Area/Space that system serves: | | | | | | | |
| 4.23 Manufacturer & model: | | | | | | | |
| 4.24 Listed efficiency: | | | | | | | |
| 4.25 Equipment output capacity: | | | | | | | |
| 4.26 Air-source heat pump output capacity (17°F): | | | | | | | |
| 4.27 Type of Venting: Natural Draft, Mechanically Drafted, Direct Vent[32] | | | | | | | |
| 4.28 Furnace heating sizing % = Total capacity (Item 4.25) divided by total heat loss (Item 3.16) | | | | | | | |
| 4.29 Meets furnace sizing limit (A, B, C, or NA) | | | | | | | |
| "A": For low-load spaces (≤ 10 kBtuh), furnace output capacity is ≤ 40 kBtuh. | | | | | | | |
| "B": When Used for Heating Only | "C": When Paired With Cooling | | | | | | |
| 100 – 400% | Recommended: 100 – 140% Allowed: 100 – 400% | | | | | | |

**HVAC Design Report**

# Combustion Appliances

- Furnaces, boilers, and water heaters located within the building's pressure boundary are mechanically drafted or direct-vented.
  - Does not apply to rooftop  make-up air units
  - Does apply to systems in closets in the corridor
  - May not apply to mechanical closets on balconies
- Fireplaces located within the building's pressure boundary are direct vented.
- No unvented combustion appliances other than cooking ranges or ovens are permitted inside the building's pressure boundary.

# Filtration

- Only required for in-unit forced air ducted systems
  - i.e., not for mini-splits, common area systems or systems serving more than one unit
- MERV 6 or higher filter
- Must be accessible to either the occupant or building owner
- Filter access panel includes gasket or comparable sealing mechanism to prevent bypass
- All return air and mechanically supplied outdoor air passes through the filter PRIOR to conditioning

# HVAC Equipment, Controls, Hydronic Dist.

- Rater must compare installed equipment (manufacturer and model) to Design Report, for in-unit, common and central systems
- All apartments must have a thermostat (5.6)
- Central Hydronic distribution requirements:
  - Control valve installed (5.10)
  - Pressure independent balancing valve installed (5.11)
  - Pipe insulation meets code level (5.12)
  - Pump motors NEMA Premium (5.13)
- Stair and elevator shaft vents need motorized dampers (5.7)
- Freeze protection & ice/snow-melt systems require temperature-based controls to limit use (5.8/5.9)

# Equipment Controls & Hydronic Requirements

## HVAC Design Report

| Equipment Controls | |
|---|---|
| 4.30 All equipment controls below have been reviewed and included where applicable, in the HVAC Design | ☐ |
| 4.31 All heating and cooling systems serving a dwelling unit shall have thermostatic controls within the dwelling unit which are not located on exterior walls | |
| 4.32 Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems | |
| 4.33 Freeze protection systems, such as heat tracing of piping and heat exchangers, including self-regulating heat tracing, and garage/plenum heaters shall include automatic controls capable of shutting off the systems wh tracing is specified, a minimum of R-3 pipe insulation is also required | |
| 4.34 Snow- and ice-melting systems shall include automatic controls capable 50°F and no precipitation is falling, and an automatic or manual control that wi the potential for snow or ice accumulation is negligible | |
| **Hydronic Distribution** | |
| 4.35 All hydronic distribution requirements below have been reviewed and incl | |
| 4.36 All terminal heating and cooling distribution equipment must be separatec distribution pump, so that heated or cooled fluid is not delivered to the dwelling thermostat | |
| 4.37 Terminal units must be equipped with pressure independent balancing va | |
| 4.38 Piping of a heating or cooling system shall be thermally insulated in acc documents must account for piping total thickness including required insulatio specify that the piping must be inspected before access is covered up | |
| 4.39 For circulating pumps serving hydronic heating or cooling systems with t exceed efficiency standards for NEMA Premium™ motors. If 5 horse-power o | |

## Rater Field Checklist

| Equipment Controls |
|---|
| 5.6 All heating and cooling systems serving a dwellin unit which are not located on exterior walls |
| 5.6.1 Prescriptive Path: Dwelling unit thermostats are programmable |
| 5.7 Stair and elevator shaft vents equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke |
| 5.8 Freeze protection systems, such as heat tracing of piping and heat exchangers, including self-regulating heat tracing, and garage/plenum heaters include automatic controls capable of shutting off |
| 5.8.1 Where heat tracing is specified, a minimum of R-3 pipe insulation is also required |
| 5.9 Snow- and ice-melting systems include automatic controls capable of shutting off the systems when the pavement temperature is above 50°F and no precipitation is falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F so that the potential for snow or ice accumulation is negligible |
| **Hydronic Distribution** |
| 5.10 For hydronic distribution systems, all terminal heating and cooling distribution equipment are separated from the riser or distribution loop by a control valve or terminal distribution pump, so that heated or cooled fluid is not delivered to the dwelling unit distribution equipment when there is no call from the thermostat |
| 5.11 Terminal units in hydronic distribution systems are equipped with pressure independent balancing valves or pressure independent control valves |
| 5.12 Piping of a heating or cooling system is insulated in accordance with ASHRAE 90.1-2007, Table 6.8.3, including where passing through planks or any other penetrations |
| 5.13 For circulating pumps serving hydronic heating or cooling systems with three-phase motors, 1 horse-power or larger, motors meet or exceed efficiency standards for NEMA Premium™ motors. If 5 horse-power or larger, also specified with variable frequency drives |

# Ducts

- Quality Installation: no bends/compression, etc
- R-6 insulation for ducts in unconditioned spaces
- Total Duct Leakage Test for Apartment systems:
  - Either 80 CFM25 or up to 8 CFM25/100 $ft^2$
  - Non-ducted returns: <5 Pa between closet and living space; 60 CFM25 or up to 6 CFM25/100 $ft^2$
- NO Duct Leakage to "Outside" test!
- NO Duct Leakage test if <10ft supply AND isn't required for ANSI 301 (under review based on 301 development)
- No Duct Leakage test in common area forced air systems (no test, just inspection)

# Ducts (cont'd)

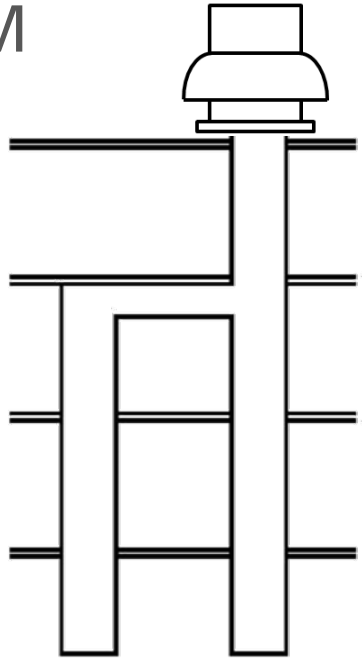
Pressure Balancing

- Test bedrooms with a design airflow ≥ 150 CFM for pressure-balancing (< 5 Pa) using any combination of transfer grills, jump ducts, dedicated return ducts, and / or undercut doors

# Ducts (cont'd)

Central exhaust duct leakage test

- Prior to drywall, 25% of exhaust fan CFM
- At final, 30% of exhaust fan CFM
  - Footnote limits over-sizing of fan



# Dwelling-Unit Ventilation & Exhaust Rates

- Dwelling-Unit Mechanical Ventilation rate (Meet 62.2-2010)
  - Measure within 15% of designed rate
- Local Mechanical Exhaust (Meet 62.2-2010)
  - 20 CFM continuous/50 CFM intermittent in bathrooms
  - 5 ACH/100 CFM in kitchens (vented to exterior)
- Prescriptive Path: Max outdoor air rate is 150% of ASHRAE 62.1-2013

# Kitchen Exhaust Ventilation Alternative

New Policy Record from Dec 2017:

Homes are permitted to use a continuous kitchen exhaust rate of 25 CFM per 2009 IRC Table M1507.3, if they are either

a) PHIUS+ or PHI certified, or

b) Meet all of the following:

- Provide both whole-house ventilation and local mechanical kitchen exhaust using a balanced system, and;
- Have a Rater-verified whole-building infiltration rate ≤ 0.05 CFM50 per sq. ft. of Enclosure Area, and;
- Have a Rater-verified dwelling unit compartmentalization rate ≤ 0.30 CFM50 per sq. ft. of Enclosure Area if multiple dwelling units are present in the building.

# Common Area Ventilation Rates & Fans

- Minimum outdoor air rate (Meet 62.1-2010)
  - Measure within 15% of designed rate
  - OA dampers must be motorized if not 24/7
- Minimum Exhaust rates (Meet 62.1-2010)
  - E.g., trash rooms, janitor closets, public restrooms, community room kitchens, garages
- Garage Exhaust Fans must have CO/NO2 sensors
- HERS/Prescriptive: Max outdoor air rate is 150% of ASHRAE 62.1-2013

# Dwelling & Common Area OA Ventilation

## *DRAFT* HVAC Design Report [1]
## ENERGY STAR Multifamily New Construction Version 1.0 / 1.1

*Note: This is a draft of a work in progress for the purposes of stakeholder feedback. There may be errors with formatting, numbering, etc.*

**HVAC Designer Responsibilities:**

- Complete one HVAC Design Report for each building/project, which includes system design for all unique unit plans and common spaces[1]. Visit www.energystar.gov/newhomeshvacdesign and see Footnote 2 for more information. [2]
- Obtain efficiency features (e.g., window performance, insulation levels, and infiltration rate) from the builder, architect, or Rater.
- Provide the completed HVAC Design Report to the Rater and the person/company completing the HVAC Functional Testing Checklist.

**1. Designer Overview**

1.1 Designer name: _____ Designer company: _____ Date: _____

1.2 Select which party you are providing these design services to: ☐ Builder/Developer ☐ Architect/MEP/LP ☐ Credentialed HVAC contractor

1.3 Name of company you are providing these design services to (if different than Item 1.1): _____

| 2a. Dwelling-Unit & Common Space Mechanical Ventilation Design [3, 4] | | | | | | Designer Verified |
|---|---|---|---|---|---|---|
| **Airflow:** | | | | | | |
| 2.1 Dwelling Unit Ventilation airflow design rate & run-time meet the requirements of Section 4 of ASHRAE 62.2[5]-☐ 2010 ☐ 2013 | | | | | | ☐ |
| 2.2 Common Space outdoor airflow design rate meet the requirements of Section 6 of ASHRAE 62.1[6]-☐ 2010 ☐ 2013, without exceeding 2013 rates by more than 50% | | | | | | ☐ |
| 2.3 Access points to measure airflow rate are provided and accessible by the Rater | | | | | | ☐ |
| Unit/space for which ventilation rates were calculated: | Ex: "Unit A" | "Unit B" | "Unit C" | "Corridor" | "Lobby" | "Laundry" |
| 2.4 # of bedrooms or occupants or square footage: | | | | | | |
| 2.5 Ventilation airflow rate required by ASHRAE: | | | | | | |
| 2.6 Ventilation airflow rate designed: | | | | | | |
| 2.6.1 If applicable, run-time per cycle (minutes): | | | | | | |
| 2.6.2 If applicable, cycle time (minutes): | | | | | | |
| **System Type & Controls:** | | | | | | |
| Ventilation System ID | Ex. "TF-1" | "TF-2" | "RTU-1" | "RTU-2" | "ERV-1" | |
| 2.7 Specified system type: (e.g., supply, exhaust, balanced, ERV, HRV) | | | | | | |
| 2.8 Specified system type: (e.g., in-unit, central) | | | | | | |
| 2.9 Manufacturer: | | | | | | |
| 2.10 Model Number: | | | | | | |

# Rater Reviews Design Report, Tests in Field

| 4. Review of HVAC Design Report [11] | |
|---|---|
| 4.1 HVAC Design Report collected for records, with no Items left blank | ☐ |
| 4.2 HVAC Design Report reviewed by Rater for the following parameters (HVAC Design Report Item # indicated in parenthesis): | |
| 4.2.1 Prescriptive Path: Dwelling Unit Mechanical Ventilation (2.6) is <150% of ASHRAE 62.2-2013 requirements[12] | ☐ |
| 4.2.2 HERS and Prescriptive Path: Common space Ventilation is <150% of ASHRAE 62.1-2013 (2.2) | ☐ |
| 4.2.3 HVAC design includes access and means (2.3) to measure the dwelling-unit mechanical ventilation airflow rate | ☐ |

**Rater Design Checklist**

Feedback: Who should be checking this math? The Rater? The HVAC Designer? Both?

| 7. Dwelling-Unit & Common Space Mechanical Ventilation System | |
|---|---|
| 7.1 Rater-measured ventilation rate is within either ± 15 CFM or ±15% of design values (2.6) [44] | ☐ |

**Rater Field Checklist**

# Dwelling Unit Local Exhaust

**2b. Dwelling-Unit Local Mechanical Exhaust Design –** System(s) are installed that mechanically exhaust air from each dwelling unit kitchen and bathroom directly to the outdoors or to ventilation risers and meet one of the following[11]. ☐

| Location | | Continuous Rate | Intermittent Rate[12] | Exhaust Fan Type |
|---|---|---|---|---|
| Kitchen | Airflow | ≥ 5 ACH, based on kitchen volume[13, 14,15] | ≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume [13, 14, 15, 16] | ☐ In-unit fan<br>☐ Central/shared fan |
| | Sound | Recommended if in-unit: ≤ 1 sone | Recommended if in-unit: ≤ 3 sones | |
| Bathroom | Airflow | ≥ 20 CFM | ≥ 50 CFM | ☐ In-unit fan<br>☐ Central/shared fan |
| | Sound | Required if in-unit: ≤ 2 sone | Recommended if in-unit: ≤ 3 sones | |

**2c. Common Space Minimum Exhaust Rates –** System(s) are installed that mechanically exhaust air from each common space, as required by ASHRAE 62.1-2010 or 2 ☐

**HVAC Design Report**

| Location | ASHRAE 62.1 Rate | | E 62.1 Rate | Design Rate |
|---|---|---|---|---|
| Janitor Room | 1 cfm/ft² | | Common space kitchen[17] | 50 cfm / 100 cfm |
| Trash/Recycling Room | 1 cfm/ft² | | Common space bathroom[18] | 50 cfm per toilet/urinal |
| Parking Garage | 0.75 cfm/ft² | ☐ Garage exhaust fan controls include CO and NO2 sensors | | |

**8. Local Mechanical Exhaust**

**Dwelling Unit Mechanical exhaust -** In each dwelling unit kitchen and bathroom, a system is installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow and manufacturer-rated sound level standards: [44, 49]

| Location | | Continuous Rate | Intermittent Rate [50] | | | |
|---|---|---|---|---|---|---|
| 8.1 Kitchen | Airflow | ≥ 5 ACH, based on kitchen volume [51, 52] | ≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume [51, 52, 53] | ☐ | ☐ | - |
| | Sound | Recommended: ≤ 1 sone | Recommended: ≤ 3 sones | | | |
| 8.2 Bathroom | Airflow | ≥ 20 CFM | ≥ 50 CFM | ☐ | ☐ | - |
| | Sound | Required: ≤ 2 sone | Recommended: ≤ 3 sones | | | |

**Common Space Mechanical Exhaust**

**Rater Field Checklist**

| | | | |
|---|---|---|---|
| 8.3 Measured ventilation rate is within either ± 15 CFM or ± | ☐ | ☐ | ☐ |
| 8.4 Parking garage exhaust ventilation system is equipped with controls that sense CO and NO2 | ☐ | ☐ | ☐ |

# Common Area Local Exhaust

**2b. Dwelling-Unit Local Mechanical Exhaust Design –** System(s) are installed that mechanically exhaust air from each dwelling unit kitchen and bathroom directly to the outdoors or to ventilation risers and meet one of the following[11]. ☐

| Location | | Continuous Rate | Intermittent Rate[12] | Exhaust Fan Type |
|---|---|---|---|---|
| Kitchen | Airflow | ≥ 5 ACH, based on kit[illegible] | ≥ 100 CFM and, if not integrated with range, also [13, 14, 15, 16] | ☐ In-unit fan<br>☐ Central/shared fan |
| | Sound | Recommended if in-un | s | |
| Bathroom | Airflow | ≥ 20 CFM | ≥ 50 CFM | ☐ In-unit fan<br>☐ Central/shared fan |
| | Sound | Required if in-unit: ≤ 2 sone | Recommended if in-unit: ≤ 3 sones | |

HVAC Design Report

**2c. Common Space Minimum Exhaust Rates –** System(s) are installed that mechanically exhaust air from each common space, as required by ASHRAE 62.1-2010 or 2013. ☐

| Location | ASHRAE 62.1 Rate | Design Rate | Location | ASHRAE 62.1 Rate | Design Rate |
|---|---|---|---|---|---|
| Janitor Room | 1 cfm/ft² | | Common space kitchen[17] | 50 cfm / 100 cfm | |
| Trash/Recycling Room | 1 cfm/ft² | | Common space bathroom[18] | 50 cfm per toilet/urinal | |
| Parking Garage | 0.75 cfm/ft² | | ☐ Garage exhaust fan controls include CO and NO2 sensors | | |

**8. Local Mechanical Exhaust**

**Dwelling Unit Mechanical exhaust -** In each dwelling unit kitchen and bathroom, a system is installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow and manufacturer-rated sound level standards: [44, 49]

| Location | | Continuous Rate | Intermittent Rate [50] | | | |
|---|---|---|---|---|---|---|
| 8.1 Kitchen | Airflow | ≥ 5 ACH, based on kitchen | d with range, volume [51, 52, 53] | ☐ | ☐ | - |
| | Sound | Recommended: [illegible] | | | | |
| 8.2 Bathroom | Airflow | ≥ 20 CFM | ≥ 50 CFM | ☐ | ☐ | - |
| | Sound | Required: ≤ 2 sone | Recommended: ≤ 3 sones | | | |

Rater Field Checklist

| Common Space Mechanical Exhaust | | | |
|---|---|---|---|
| 8.3 Measured ventilation rate is within either ± 15 CFM or ±15% of design values (2c)[44] | ☐ | ☐ | ☐ |
| 8.4 Parking garage exhaust ventilation system is equipped with controls that sense CO and NO2 | ☐ | ☐ | ☐ |

# Ventilation System/Fan Requirements

| 7. Dwelling-Unit & Common Space Mechanical Ventilation System | |
|---|---|
| 7.1 Rater-measured ventilation rate is within either ± 15 CFM or ±15% of design values (2.6) [44] | ☐ |
| 7.2 No outdoor air intakes connected to return side of the dwelling unit HVAC system, unless controls are installed to operate intermittently & automatically based on a timer and to restrict intake when not in use (e.g., motorized damper) | ☐ |
| 7.3 If located in the dwelling unit, system fan rated ≤ 3 sones if intermittent and ≤ 2 sone if continuous, or exempted[45] | ☐ |
| 7.4 If system utilizes the dwelling unit HVAC fan, then the specified fan type is ECM / ICM (4.10), or the controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling | ☐ |
| 7.5 In-unit bathroom fans or in-line fans are ENERGY STAR certified if used as part of the dwelling-unit mechanical ventilation system [46] | ☐ |
| 7.6 If central exhaust fans, ≤ 1 HP, are specified as part of the dwelling-unit mechanical ventilation system, then they are direct-drive, ECM, with variable speed controllers. If greater than 1 HP, they are specified with NEMA Premium Motors | ☐ |
| 7.7 Air inlet location (Complete if ventilation air inlet location was specified (2.21, 2.22); otherwise check "N/A"): [47, 48] | - |
| 7.7.1 Inlet pulls ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit | ☐ |
| 7.7.2 Inlet is ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and ≥ 3 ft. distance from sources exiting the roof | ☐ |

**Rater Field Checklist**

# Air Inlet Locations

| 7. Dwelling-Unit & Common Space Mechanical Ventilation System | |
|---|---|
| 7.1 Rater-measured ventilation rate is within either ± 15 CFM or ±15% of design values (2.6) [44] | ☐ |
| 7.2 No outdoor air intakes connected to return side of the dwelling unit HVAC system, unless controls are installed to operate intermittently & automatically based on a timer and to restrict intake when not in use (e.g., motorized damper) | ☐ |
| 7.3 If located in the dwelling unit, system fan rated ≤ 3 sones if intermittent and ≤ 2 sone if continuous, or exempted[45] | ☐ |
| 7.4 If system utilizes the dwelling unit HVAC fan, then the specified fan type is ECM / ICM (4.10), or the controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling | ☐ |
| 7.5 In-unit bathroom fans or in-line fans are ENERGY STAR certified if used as part of the dwelling-unit mechanical ventilation system [46] | ☐ |
| 7.6 If central exhaust fans, ≤ 1 HP, are specified as part of the dwelling-unit mechanical ventilation system, then they are direct-drive, ECM, with variable speed controllers. If greater than 1 HP, they are specified with NEMA Premium Motors | ☐ |
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| 7.7.1 Inlet pulls ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit | ☐ |
| 7.7.2 Inlet is ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and ≥ 3 ft. distance from sources exiting the roof | ☐ |

**Rater Field Checklist**

# DHW Rater Inspections

- HERS/Prescriptive Efficiency
- Rater verified inspections and 'functional testing'
  - Heat trap
  - Pipe insulation
  - Hot water temperature measurement

| 11. Domestic Hot Water | |
|---|---|
| 11.1 Prescriptive Path: Hot water equipment rated in EF or UEF meet the efficiency levels specified in the ENERGY STAR MF Reference Design. Boilers providing hot water are ≥85% Et.[59] | ☐ |
| 11.2 HERS: Hot water equipment rated in EF or UEF serving common spaces but not dwelling units nor shared laundry meet the efficiency levels specified in the ENERGY STAR MF Reference Design. Boilers providing hot water are ≥85% Et. [59] | ☐ |
| 11.3 For in-unit storage water heaters, AHRI Certificate confirms the presence of a heat trap | ☐ |
| 11.4 DHW piping[60] is insulated with a minimum of R-3 | ☐ |
| 11.5 Rater-measured temperatures at faucets and showerheads do not exceed 125°F | ☐ |

**Rater Field Checklist**

# HVAC Functional Testing Checklist

- **Who**: Functional Testing Agent ("FT Agent")
  - HVAC Credentialed Contractor, Licensed Professional (registered architect/PE), OEM representative, Rater (?) commissioning professionals (CCP, CBCP, BCxP, CPMP)
  - Checklist must be collected if not completed entirely by an HVAC credentialed contractor
- **What**: All systems (boilers, chillers, cooling towers, PTAC/PTHPs, furnaces, mini-split heat pumps, etc) will require some level of functional testing whether in-unit, common, or central, such as:
  - Basic installation checks
  - Functional testing of systems, controls, sensors, thermostats
  - Testing for proper refrigerant charge, fan flow & power, static pressure (e.g. split AC/furnace like in ESCH; also multi-splits)

# HVAC Functional Testing Checklist

| **1. Functional Testing Overview** | | |
|---|---|---|
| 1.1 Company performing Functional Testing _____ Contractor/LP name_____ Date_____ | | |
| 1.2 If applicable, Organization that your company is credentialed with: ☐ ACCA ☐ Advanced Energy | | |
| 1.3 Builder/developer client name: _____ | | |
| 1.4 Project address: _____ City: _____ State: _____ Zip code: _____ | | |
| 1.5 HVAC Design Report corresponding to this project has been collected from designer or builder. ☐ | | |
| **2. Refrigerant Charge -** Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is ≤ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section.[3] This section must be completed for split air conditioners, unitary air conditioners, air-source heat pumps, and water-source (i.e., geothermal or water-loop) heat pumps up to 65 kBtuh with forced-air distribution systems (i.e., ducts > 0 ft), whether serving dwelling units or other common spaces in the building. All other permutations of refrigerant-based systems such as mini-split / multi-split systems are exempt from this section. | **"FT Agent" Verified** | **N/A** |

| |
|---|
| **3. Indoor HVAC Fan Airflow -** This section must be completed for split air conditioners, unitary air conditioners, air-source heat pumps (including multi-splits), and water-source (i.e., geothermal or water-loop) heat pumps up to 65 kBtuh with forced-air distribution systems (i.e., ducts) and to furnaces up to 225 kBtuh with forced-air distribution systems (i.e., ducts > 0 ft), whether serving dwelling units or other common spaces in the building. Mini-splits are exempt, however multi-split systems such as central VRF systems, where indoor HVAC fans with forced-air distribution are connected to a shared outdoor unit that exceeds 65 kBtuh, are not exempt. |

# HVAC Functional Testing Checklist (Terminal)

| **5. Functional Testing: Indoor/Terminal Units -** This section must be completed for all heating and cooling equipment located within dwelling units or common spaces, except where specifically noted. | **Rater Verified** | **"FT Agent" Verified** | **N/A** |
|---|---|---|---|
| 5.1 Installation Checks | | | |
| 5.1.1 Zone thermostat (or remote zone temperature sensor) in dwelling units installed in design location, within the zone being served, and not on an exterior wall | ☐ | ☐ | ☐ |
| 5.1.2 Where specified by design, external condensate pump installed and condensate drain pan pitches to the drain | ☐ | ☐ | ☐ |
| 5.2 Functional Testing | | | |
| 5.2.1 Zone temperature displayed on thermostat or sensor is within 2°F of measured zone temperature | ☐ | ☐ | ☐ |
| 5.2.2 System turns on when there is a call for heat and heating is provided. Measured discharge air temperature ___ °F. System turns off when the heating setpoint has been met. | ☐ | ☐ | ☐ |
| 5.2.3 System turns on when there is a call for cooling and cooling is provided. Measured discharge air temperature ___ °F System turns off when the heating setpoint has been met. | ☐ | ☐ | ☐ |
| 5.2.4 For WLHP's, measure and record the inlet and outlet temperatures on the condenser water at the terminal unit. Inlet ___ °F Outlet ___ °F | ☐ | ☐ | ☐ |
| 5.2.5 Where OA dampers are installed, the damper closes when there is no call for ventilation or when fan is off | ☐ | ☐ | ☐ |
| 5.2.6 If more than one system provides heating or cooling to the same space, controls prevent simultaneous heating and cooling. | ☐ | ☐ | ☐ |

# HVAC Functional Testing Checklist (VRF)

| **6. VRF Outdoor Unit-** This section must be completed for all VRF outdoor units serving dwelling units or common spaces. | **"FT Agent" Verified** | **N/A** |
|---|---|---|
| 6.1 Installation Checks | | |
| 6.1.1 Pressure testing on refrigerant piping has been completed for this system (indicate exact test in/test out pressure (psig)/time (hours)): _____/____/____ | ☐ | ☐ |
| 6.1.2 Vacuum testing has been completed (indicate exact test in/test out pressure (microns)/time (hours)): _____/____/____ | ☐ | ☐ |
| 6.1.3 Refrigerant line lengths have been field measured | ☐ | ☐ |
| 6.1.4 Indicate required additional charge amount (lbs): | _____ | ☐ |
| 6.2 Functional Testing | | |
| 6.2.1 In cooling mode, condenser fan is ON and heat is being rejected by condenser | ☐ | ☐ |
| 6.2.2 In heating mode, condenser fan is ON and heat is being absorbed by condenser | ☐ | ☐ |
| 6.2.3 Using the central maintenance tool or controller, none of the condenser modules or connected indoor units are showing an alarm | ☐ | ☐ |
| 6.2.4 Using maintenance tool, the manufacturer's representative confirmed refrigerant charge test per manufacturer's guidelines | ☐ | ☐ |

# HVAC Functional Testing Checklist (Boilers)

| **7. Central Boilers** - This section must be completed for all central boilers serving dwelling units or common spaces. | **"FT Agent" Verified** | **N/A** |
|---|---|---|
| 7.1 Installation Checks | | |
| 7.1.1 Boiler piping and all components are free from leaks | ☐ | ☐ |
| 7.1.2 Boiler relief valves and discharge piping do not show signs of weeping or leakage | ☐ | ☐ |
| 7.1.3 No signs of blockage, leakage, or deterioration in the fresh air intake or flue gas vent piping | ☐ | ☐ |
| 7.1.4 Temperature, pressure gauges, air eliminator, expansion tank, check valves and all other piping components installed as specified by HVAC Designer | ☐ | ☐ |
| 7.1.5 Boiler Supply/Header temperature sensor and, where applicable, outdoor air temperature sensor, are located as specified by HVAC Designer. | ☐ | ☐ |
| 7.1.6 Indicate boiler header/supply setpoint type: ☐ Fixed ☐ Seasonal ☐ Outdoor temperature reset ☐ Indoor temperature reset ☐ Other:_____ | ☐ | ☐ |
| 7.1.7 Where outdoor temperature reset schedule is applicable, indicate reset schedule (e.g. 180F Supply @ 10F outdoor, 120F supply @55F outdoor) _____ @ _____ , _____ @ _____ | ☐ | ☐ |
| 7.1.8 Where Warm Weather Shut Down (WWSD) is applicable, list temperature (NA if boilers and system pumps also serve DHW) | _____°F | ☐ |
| 7.2 Functional Testing: Boilers - If outdoor ambient temperature is ≧ 85°F, how to comply with items 7.2.5 [illegible] | | |
| 7.2.1 Measure the combustion gas efficiency at high fire and low fi[illegible] | | |

# HVAC Functional Testing Checklist (Boilers)

| | | |
|---|---|---|
| 7.2 Functional Testing: Boilers - If outdoor ambient temperature is ≥ 85°F, how to comply with items 7.2.5, 7.2.7 and 7.2.8 is under review. | | |
| 7.2.1 Measure the combustion gas efficiency at high fire and low fire for one of the boilers. Note which one and record information. _____% ☐ high fire ☐ low fire | ☐ | ☐ |
| 7.2.2 Boiler combustion air intake dampers open/close with boiler operation | ☐ | ☐ |
| 7.2.3 If each boiler has its own dedicated boiler circulator pump, it operates only when the respective boiler is firing (Circulator may run for 60 seconds before or 90 seconds after the boiler fires.) | ☐ | ☐ |
| 7.2.4 When there is a call for heating, the boiler(s) are enabled according to their design sequence of operation. | ☐ | ☐ |
| 7.2.5 If multiple boilers are supposed to fire at the same time according to the Engineer of Record's Sequence, all boilers operate with a large enough heating demand. | ☐ | ☐ |
| 7.2.6 Boiler(s) modulate/step down to the minimum firing rate before shutting off. | ☐ | ☐ |
| 7.2.7 Boiler(s) do not short cycle (i.e. the minimum on time is 5 minutes and the minimum off time is 5 minutes) | ☐ | ☐ |
| 7.2.8 Condensing Boiler: Boiler return temperature is appropriate for condensing. Measured temp: _____°F | ☐ | ☐ |
| 7.2.9 Boiler Header/supply Sensor is reading within 3°F of measured boiler header temperature | | |
| 7.3: Functional Testing: Heating System Pumps | | |
| [illegible] heating system pumps (i.e. the pumps which | | |

# HVAC Functional Testing Checklist (Boilers)

| 7.3: Functional Testing: Heating System Pumps | | |
|---|---|---|
| 7.3.1 Where heating system pumps (i.e. the pumps which are responsible for moving the water through the terminal units) are equipped with a VFD which is responding to a pressure sensor within the system or a sensorless pumping system, indicate which one. VFD+Sensor ☐ Sensorless ☐ | ☐ | ☐ |
| 7.3.2 If a variable speed pumping system is installed, the VFD increases and decreases pump speed in response to changes in the system. | ☐ | ☐ |
| 7.3.3 If a variable speed pumping system is installed, system prevents "dead-heading". (May be tested under real or simulated low flow conditions.)<br>Select the method of water flow bypass: ☐Minimum Flow Bypass Valve ☐ 3 way valves on specific terminal units ☐Other | ☐ | ☐ |
| 7.3.4 Pumps are off when outside air temperature is above WWSD (N/A if pumps serve DHW as well as heating) | ☐ | ☐ |

# HVAC Functional Testing Checklist (CTs)

| |
|---|
| **8. Cooling Towers -** This section must be completed for all cooling towers serving dwelling units or common spaces. |
| 8.1 Installation Checks |
| 8.1.1 Cooling Tower piping and all components are free from leaks |
| 8.1.2 Temperature gauges, check valves, tower bypass valve and all other piping components installed as specified by HVAC Designer. |
| 8.1.3 Condenser Water Supply setpoint type: ☐ Fixed ☐Outdoor temperature reset ☐Seasonal/based on free cooling |
| 8.1.4 All control sensors (condenser water supply temperature, outdoor air humidity, etc) are located as specified by HVAC Designer |
| 8.2: Functional Testing: Tower Fans - If cooling tower is used seasonally and has been drained, how to comply with this Sectio |
| 8.2.1 Tower fan(s) do not short cycle (i.e., the minimum on time is 5 minutes and the minimum off time is 5 minutes) |
| 8.2.2 Cooling Tower fan(s) do not run unless associated cooling tower pump(s) are running |
| 8.2.3 If installed, basin heater is not enabled when the basin water temperature is at or above the setpoint |
| 8.2.4 Condenser Water Supply Sensor is reading within 3°F of measured temperature |
| 8.3: Functional Testing: Cooling Tower Pumps |
| 8.3.1 Cooling tower pumps are disabled when there is no call for heat rejection (N/A if tower pumps are set to run year round). |

# HVAC Functional Testing Checklist (Chillers)

| |
|---|
| **9. Chillers** - This section must be completed for all chillers serving dwelling units or common spaces. |
| 9.1 Installation Checks |
| 9.1.1 Chiller piping and all components are free from leaks |
| 9.1.2 If multiple chillers, water flow is balanced across chillers using (indicate which one):<br>☐ Balancing valves ☐ Reverse return piping ☐ Individual boiler pumps ☐ Other: _____ |
| 9.1.3 Temperature, pressure gauges, air eliminator, expansion tank, check valves and all other piping components installed as specified by HVAC Designer. |
| 9.1.4 Chilled Water Supply temperature sensor (and outdoor air temperature sensor where applicable) are located as specified by HVAC Designer. |
| 9.2 Functional Testing: Chillers - If outdoor ambient temperature is ≤ 55°F, how to comply with items 9.2.1, 9.2.2, and 9.2.3 is un |
| 9.2.1 When there is a call for cooling, chillers are operating and maintaining chilled water setpoint. |
| 9.2.2 If multiple chillers are supposed to operate at the same time according to the Engineer of Record's Sequence, all chillers operate with a large enough cooling demand. |
| 9.2.3 Chiller(s) do not short cycle (i.e. the minimum on time is 5 minutes and the minimum off time is 5 minutes) |
| 9.2.4 Chilled Water Supply Sensor is reading within 3°F of measured chiller temperature |
| 9.3: Functional Testing: Chilled Water System Pumps |
| 9.3.1 Where Chilled Water System pumps (i.e. the pumps which are responsible for moving the chilled water through the terminal units) are equipped with a VFD, which is responding to a pressure sensor within the system or a sensorless VFD system, indicate which one. VFD+Sensor ☐ Sensorless ☐ |
| 9.3.2 If a variable speed pumping system is installed, confirm that the VFD increases and decreases pump speed in response to changes in the system. |
| 9.3.3 If a variable speed pumping system is installed, system ... low flow conditions.) |

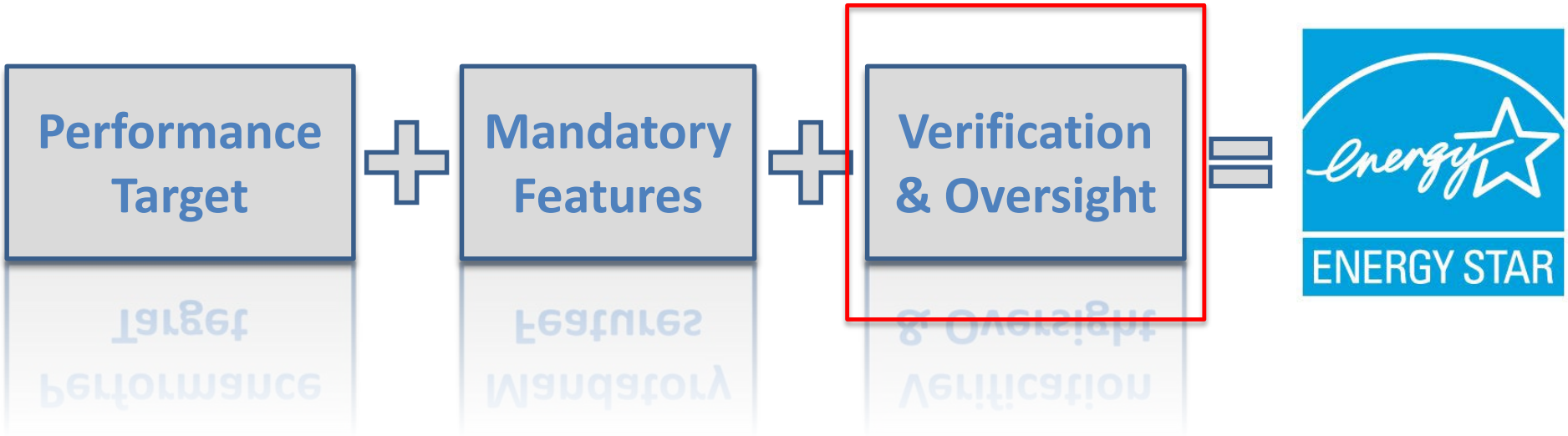
# Water Management

- Keep the Water Management System Builder Requirements and make very minor adjustments for multifamily
- Required for apartment and common area spaces

Planned Adjustment(s):

- Applicability of foundation requirements for below grade garages (feedback requested)

# Key Components of the Multifamily Program



# Verifiers and Oversight Organizations

**Verification and Oversight**

- Different "Multifamily Oversight Organizations" for different pathways
- Verifier requirements and oversight will be specified
  - Performance Testing
  - Visual Inspections
  - Modeling
  - HVAC Functional Testing

# HERS Path Verification/Oversight

- "VOO" Verification Oversight Organization (RESNET)
- Modeling performed by certified HERS Rater
  - ENERGY STAR Rater Training
- Verification performed by certified HERS Rater or Rating Field Inspector
- Provider performs QA on Rater according to RESNET Standards
- RESNET performs oversight on Provider

# ASHRAE/T-24 and Prescriptive Path Verification/Oversight

- New Oversight Organization(s) similar to MFHR Review Organizations (MROs)
  - EPA to release amended Application
- Model (ASHRAE/T-24 Path Only)
  - ENERGY STAR Training required for modeler
  - Under review: ASHRAE modeling training required for modeler
  - QA required for model (i.e. model review) by Oversight Org
- Inspections/Tests performed by a 'Rater'
  - ENERGY STAR Training required
  - Oversight Org provides QA
  - HERS Rater/RFI can be the Rater, but Oversight Org. can allow other qualifications with EPA approval

# Next Steps

- Feedback period through April 20th

# Feedback Format

- Send to mfhr@energystar.gov in an attachment
  - Include your name and organization at the top
- Where possible, specify the specific checklist and/or item that you are responding to
- Make sure to:
  - Include positive feedback (if you like what we have proposed let us know)
  - Include proposed changes (if you want something to change)

  Send clarifying questions separately

# Next Steps

Late Spring/Summer

- Review stakeholder feedback and respond to comments with additional outreach as needed
- Set-up systems and requirements for partnership, MRO's, software, training, reporting, labeling etc.
- Finalize program documentation

Goal:

- Specification available January 2019
  - Note: some options may not be available when first released
- At least one year transition time (depends on release of RESNET standard)

# Q&A

mfhr@energystar.gov

www.energystar.gov/mfspec (more info available here!)

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