Greasing the Skids – Tips for Completing the HVAC Checklists

RESNET Building Performance Conference,
San Diego, CA
February 17h, 2015

Agenda

- Introduction
- How the process is changing for the better
- Into the weeds
- Upcoming resources
- Q&A

Introduction:
Rev. 08 is Great

Introduction

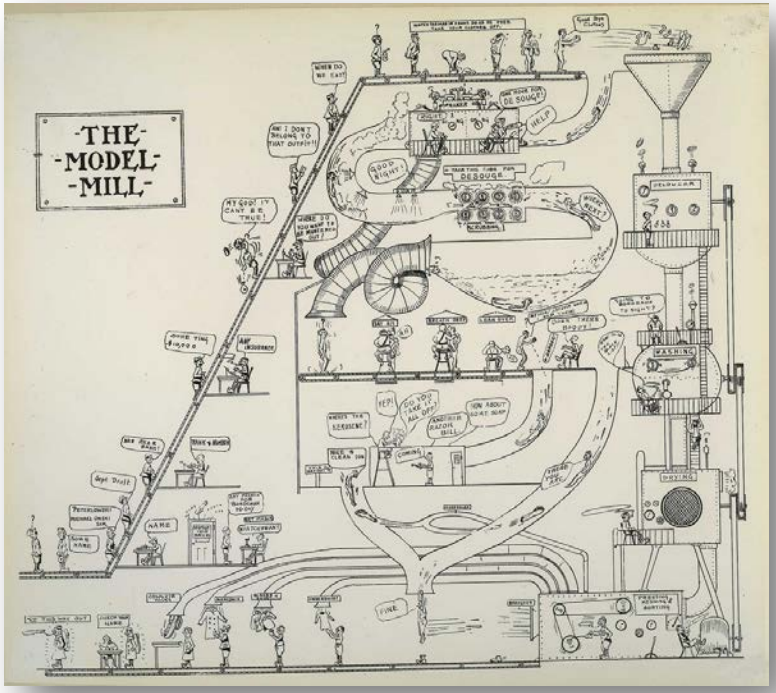
Tips for Completing the HVAC Checklists

#1. Use **REVISION 08**

Introduction

Two Key Goals of Revision 08

Reduce Paperwork



Streamline Certification Process

Introduction

- Revision 08 is based upon feedback from everyone:
  - In this room..
  - At the RESNET conference..
  - At the ACCA conference..
  - At the EEBA conference..
  - At the IBS conference..

Introduction

Introduction

Improperly Installed HVAC Equipment Can Increase Consumption by 30%!

Read it yourself, it's a page-turner!

http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1848.pdf

Introduction

REVISION 08

Introduction

For Raters:

- Reduces all paperwork collection to a one-page report per plan.
- Greatly improves predictability at final inspection.
- Easier than ever to include ENERGY STAR in your offerings.

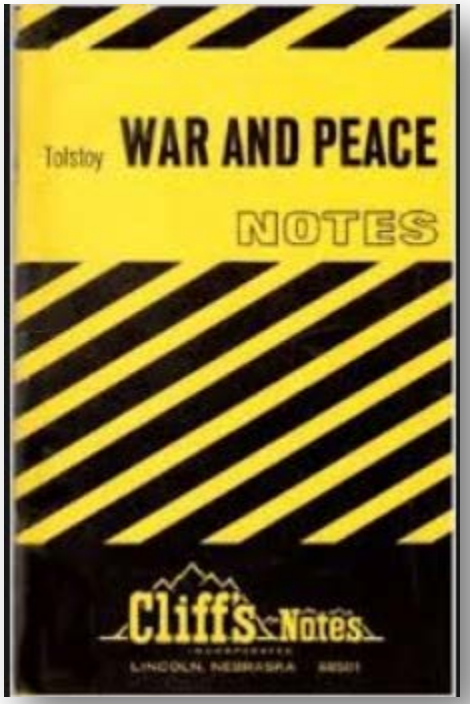
For Builders:

- Estimated to reduce costs by ~$275 from Revision 07.
- Less hassle-factor for them and their trades.
- Continues to help improve performance & reduce cost of HVAC system.

How the Process is Changing for the Better: Rev. 08 is Great!

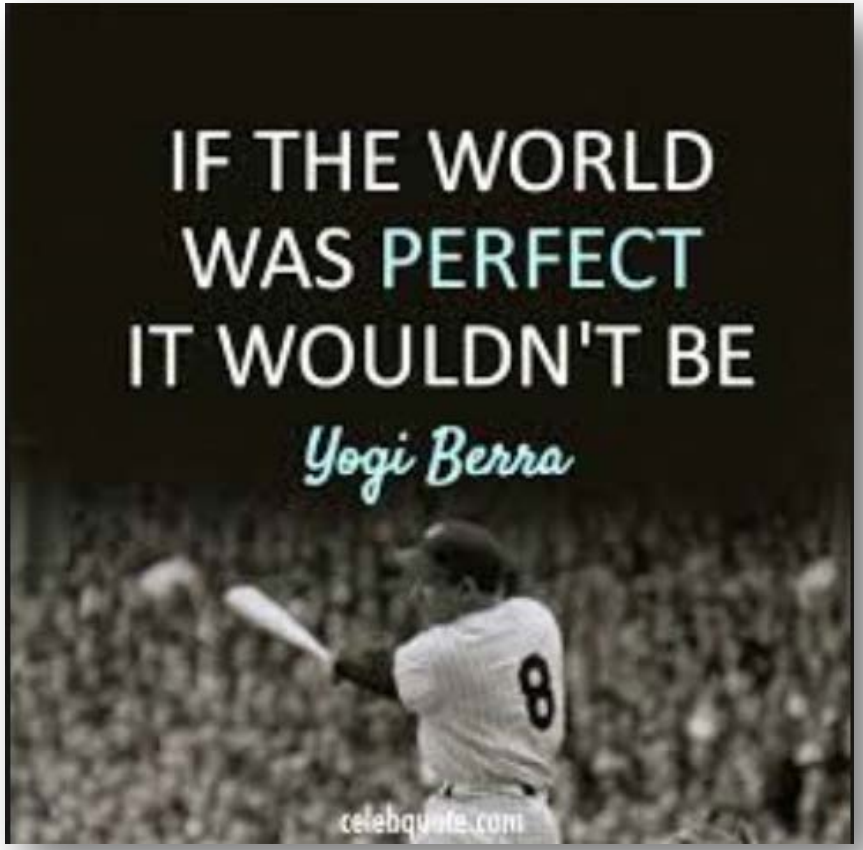
The Evolution of ENERGY STAR

- ENERGY STAR Version 1
  - You should make houses more efficient
- ENERGY STAR Version 2
  - Lets do some diagnostic testing, modeling, and a one page checklist
- ENERGY STAR Version 3
  - Lets expand the checklists to 4 and have everything you need to know about building science packed into 16 pages



ENERGY STAR Rev. 07 – The perfect-world scenario

- A builder, an HVAC contractor and a rater walk into a bar…
- Everyone has reviewed ENERGY STAR checklists in advance
- And you'd talk about the design of the house



ENERGY STAR Rev. 07 – The perfect-world scenario

- Final site inspection the HVAC contractor provides:
  - Liquid line pressure
  - Suction line pressure
  - Temperature pressure chart
  - Subcooling or Super Heat
  - Manual D
  - Balancing report
  - Test holes for static pressure test

ENERGY STAR Rev. 07 – The perfect-world scenario

- So in a perfect world, tracking all the ENERGY STAR information felt a little like this:

ENERGY STAR Rev. 08 – The new normal

- A one page report that captures all the design parameters
- All items on report can be verified within the REM/Rate file, or on the temperature look-up website.
- Only needed per system design
- No other paperwork
- No other paperwork
- No other paperwork

ENERGY STAR Rev. 08 – The new normal: Modeling

Rater Plan Review Checklist
ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 08)

Home Address: _____ City: _____ State: _____ Permit Date: _____

1. Partnership Status	Must Correct	Rater [1] Verified	N/A
1.1 Rater has verified that builder is an ENERGY STAR partner.	☐	☐	☐
1.2 HVAC contractor holds credentials necessary to complete the HVAC System QI Contractor Checklist [2] HVAC Contractor Company Name: _____	☐	☐	☐
2. High-Performance Fenestration			
2.1 Fenestration shall meet or exceed 2009 IECC requirements. [3]	☐	☐	☐
3. Quality Insulation			
3.1 Ceiling, wall, floor, and slab insulation levels shall comply with one of the following options:	☐	☐	☐
3.1.1 Meet or exceed 2009 IECC levels [4,5,6] **OR**;			
3.1.2 Achieve ≤ 133% of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, excluding fenestration and per guidance in Footnote 4d, AND home shall achieve ≤ 50% of the infiltration rate in Exhibit 1 of the National Program Requirements [5, 6]			
4. Review of HVAC System Design Report [7]			
4.1 HVAC System Design Report collected for records, with no items left blank.	☐	☐	☐
4.2 Review the following parameters related to system cooling design, selection, and installation from the HVAC System Designer Checklist (Designer Checklist Item # indicated in parenthesis):			
4.2.1 Cooling season and heating season design temperature (2.5) are within the limits defined at energystar.gov/hvacdesigntemps, or an appeal has been submitted to EPA [8]	☐	☐	☐
4.2.2 Loads have been provided for (2.12-2.15) for the orientation of the rated home and the variation in Total Heat Gain across orientations (2.16) is ≤ 15%.	☐	☐	☐
4.2.3 Number of occupants (2.6) equals number of occupants in rated home [9]	☐	☐	☐
4.2.4 Conditioned floor area (2.7) is within ±10% of conditioned floor area of rated home	☐	☐	☐
4.2.5 Window area (2.8) is within ±10% of calculated window area of rated home	☐	☐	☐
4.2.6 Predominant window SHGC (2.9) is within 0.1 of predominant value in rated home [10]	☐	☐	☐
4.2.7 Cooling Sizing % (3.12) is within the Cooling Sizing Limit (3.14) selected by the HVAC designer	☐	☐	☐

Rater Name: _____ Date Checklist Inspected: _____

Rater Signature: _____ Rater Company Name: _____

EPA

ENERGY STAR Rev. 08 – What is on that half page?

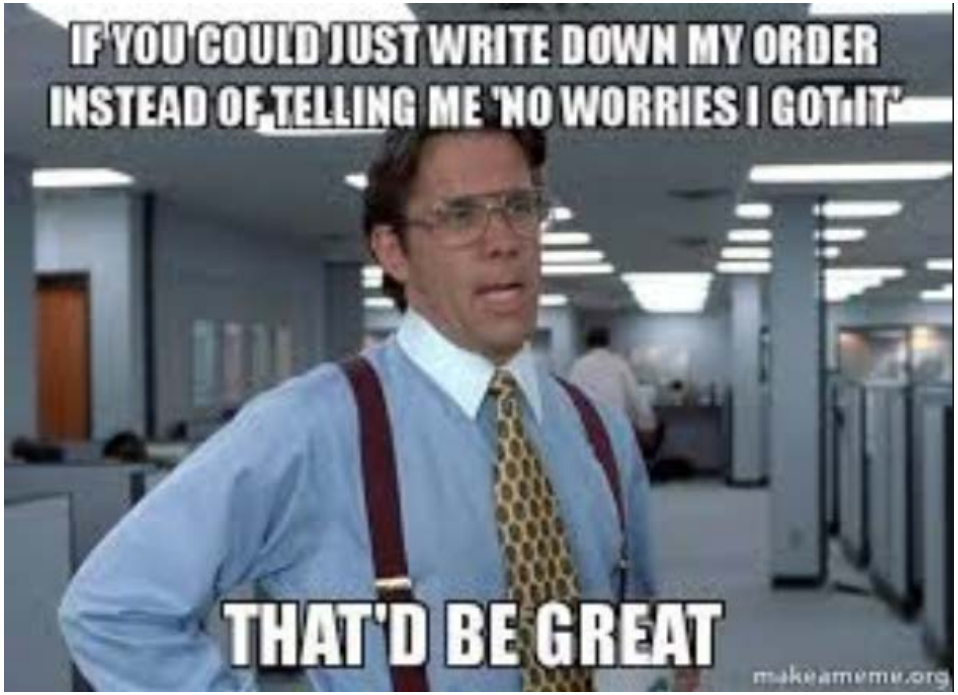
- Cooling season and heating season design temperature (2.5) are within the limits defined by EPA.
- Loads have been provided for the orientation of the rated home and the variation in Total Heat Gain across orientations is ≤ 15%.
- Number of occupants equals number of occupants in rated home .

ENERGY STAR Rev. 08 – What is on that half page?

- Conditioned floor area is within ±10% of conditioned floor area of rated home
- Window area is within ±10% of calculated window area of rated home
- Predominant window SHGC is within 0.1 of predominant value in rated home
- Cooling Sizing % is within the Cooling Sizing Limit selected by the HVAC designer

ENERGY STAR Rev. 08 – What is done in the field?

- Making sure the designed HVAC unit matches the installed unit.
- The static pressure test
  - Videos later

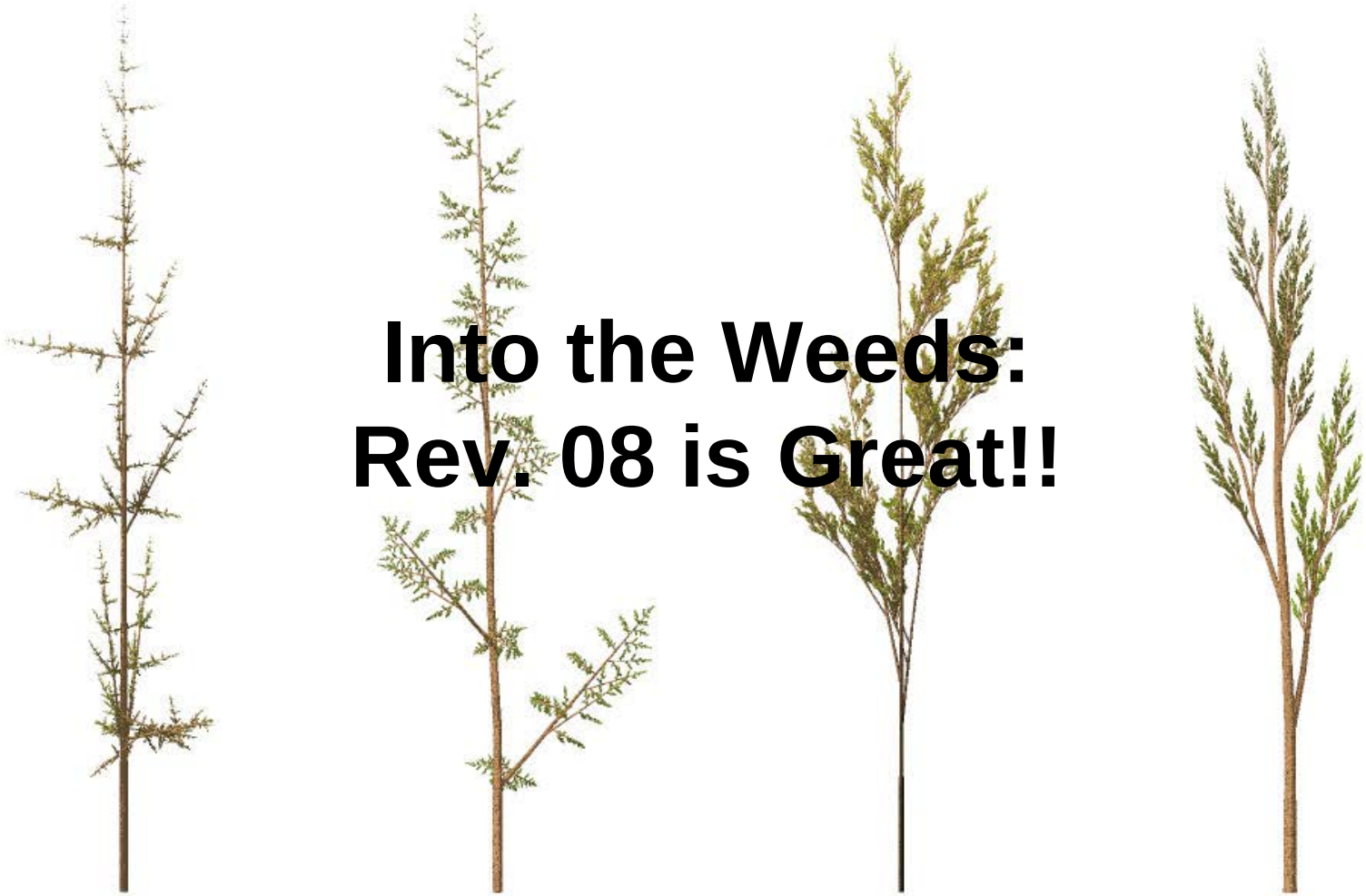


ENERGY STAR Rev. 08 – What is done in the field?

- Ducts
  - Insulated; Sealed; Not kinked; Bedrooms Pressure balanced
- Mechanical Ventilation
  - More videos to show how to test.
- Filters are in place
- Combustion safety verification

ENERGY STAR Rev. 08 – Summary

- Adding value to the HVAC by getting proper design and confirming air is going to the right spot
- No more 50 page reports per house
- Focus now on reducing costs
- No more paperwork fire drills at the end of the process
- Adding value by consulting on new technology that provides healthy home and improved indoor air quality.



Into the Weeds: Rev. 08 is Great!!

ENERGY STAR Rev. 08 – Preview

- Items here are subject to minor change as we finalize Rev 08.
- The purpose is to provide you a more in-depth overview of the changes, as they're currently drafted.

Rev. 07:
Thermal Enclosure System Rater Checklist – Section 1

1. High-Performance Fenestration	Must Correct	Builder Verified [1]	Rater Verified	N/A
1.1 *Prescriptive Path:* Fenestration shall meet or exceed ENERGY STAR requirements [2]	☐	☐	☐	☐
1.2 *Performance Path*: Fenestration shall meet or exceed 2009 IECC requirements [2]	☐	☐	☐	☐

Rev. 08:
Rater Plan Review Checklist – Section 2

2. High-Performance Fenestration		
2.1 Fenestration shall meet or exceed 2009 IECC requirements. [3]	☐	☐

Rev. 08:
Rater Field Checklist – Section 1

1. Fenestration & Insulation				
1.1 Fenestration meets or exceeds performance selected in Item 2.1 of the Rater Design Review Checklist	☐	☐	☐	☐
1.2 Insulation meets or exceeds levels selected in Item 3.1 of the Rater Design Review Checklist	☐	☐	☐	☐
1.3 All insulation achieves RESNET-defined Grade I installation. See Footnote 3 for alternative. [3]	☐	☐	☐	☐

Rev. 07:
Thermal Enclosure System Rater Checklist – Section 2

2. Quality-Installed Insulation				
2.1 Ceiling, wall, floor, and slab insulation levels shall comply with one of the following options:				
2.1.1 Meet or exceed 2009 IECC levels [3,4,5] OR;	☐	☐	☐	☐
2.1.2 Achieve ≤ 133% of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, excluding fenestration and per guidance in Footnote 3d, AND home shall achieve ≤ 50% of the infiltration rate in Exhibit 1 of the National Program Requirements [4,5]	☐	☐	☐	☐
2.2 All ceiling, wall, floor, and slab insulation shall achieve RESNET-defined Grade I installation or, alternatively, Grade II for surfaces that contain a layer of continuous, air impermeable insulation ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8	☐	☐	☐	☐

Rev. 08:
Rater Plan Review Checklist – Section 3

3. Quality Insulation			
3.1 Ceiling, wall, floor, and slab insulation levels shall comply with one of the following options:	☐	☐	☐
3.1.1 Meet or exceed 2009 IECC levels [4,5,6] **OR**;			
3.1.2 Achieve ≤ 133% of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, excluding fenestration and per guidance in Footnote 4d, AND home shall achieve ≤ 50% of the infiltration rate in Exhibit 1 of the National Program Requirements [5, 6]			

Rev. 08:
Rater Field Checklist – Section 1

1. Fenestration & Insulation				
1.1 Fenestration meets or exceeds performance selected in Item 2.1 of the Rater Design Review Checklist	☐	☐	☐	☐
1.2 Insulation meets or exceeds levels selected in Item 3.1 of the Rater Design Review Checklist	☐	☐	☐	☐
1.3 All insulation achieves RESNET-defined Grade I installation. See Footnote 3 for alternative. [3]	☐	☐	☐	☐

Rev. 07:
Thermal Enclosure System Rater Checklist – Section 3

3. Fully-Aligned Air Barriers [6]				
At each insulated location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows: • At interior or exterior surface of ceilings in Climate Zones 1-3; at interior surface of ceilings in Climate Zones 4-8. Also, include barrier at interior edge of attic eave in all climate zones using a wind baffle that extends to the full height of the insulation. Include a baffle in every bay or a tabbed baffle in each bay with a soffit vent that will also prevent wind washing of insulation in adjacent bays • At exterior surface of walls in all climate zones; and also at interior surface of walls for Climate Zones 4-8 [7] • At interior surface of floors in all climate zones, including supports to ensure permanent contact and blocking at exposed edge [8,9]				
3.1 Walls [10]				
3.1.1 Walls behind showers and tubs	☐	☐	☐	☐
3.1.2 Walls behind fireplaces	☐	☐	☐	☐
3.1.3 Attic knee walls [11]	☐	☐	☐	☐
3.1.4 Skylight shaft walls	☐	☐	☐	☐
3.1.5 Wall adjoining porch roof	☐	☐	☐	☐
3.1.6 Staircase walls	☐	☐	☐	☐
3.1.7 Double walls	☐	☐	☐	☐
3.1.8 Garage rim / band joist adjoining conditioned space	☐	☐	☐	☐
3.1.9 All other exterior walls	☐	☐	☐	☐
3.2 Floors				
3.2.1 Floor above garage	☐	☐	☐	☐
3.2.2 Cantilevered floor	☐	☐	☐	☐
3.2.3 Floor above unconditioned basement or unconditioned crawlspace	☐	☐	☐	☐
3.3 Ceilings [10]				
3.3.1 Dropped ceiling / soffit below unconditioned attic	☐	☐	☐	☐
3.3.2 All other ceilings	☐	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 2

2. Fully-Aligned Air Barriers [4]				
At each insulated location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows: • At interior or exterior surface of ceilings in Climate Zones 1-3; at interior surface of ceilings in Climate Zones 4-8. Also, include barrier at interior edge of attic eave in all climate zones using a wind baffle that extends to the full height of the insulation. Include a baffle in every bay or a tabbed baffle in each bay with a soffit vent that will also prevent wind washing of insulation in adjacent bays [5] • At exterior surface of walls in all climate zones; and also at interior surface of walls for Climate Zones 4-8 [5, 6] • At interior surface of floors in all climate zones, including supports to ensure permanent contact and blocking at exposed edge [7, 8]				
2.1 Walls: Walls behind showers, tubs, staircases, and fireplaces	☐	☐	☐	☐
2.2 Walls: Attic knee walls and skylight shaft walls [9]	☐	☐	☐	☐
2.3 Walls: Wall adjoining porch roof	☐	☐	☐	☐
2.4 Walls: Garage rim / band joist adjoining conditioned space	☐	☐	☐	☐
2.5 Walls: Double-walls and all other exterior walls	☐	☐	☐	☐
2.6 Floors: Floor above garage, floor above unconditioned basement or crawlspace, or cantilevered floor	☐	☐	☐	☐
2.7 Ceilings: Dropped ceiling / soffit below unconditioned attic, and all other ceilings	☐	☐	☐	☐

Rev. 07:
Thermal Enclosure System Rater Checklist – Section 4

4. Reduced Thermal Bridging				
4.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade I insulation extends to the inside face of the exterior wall below at these levels: CZ 1-5: ≥ R-21; CZ 6-8: ≥ R-30 [12]	☐	☐	☐	☐
4.2 For slabs on grade in CZ 4 and higher, 100% of slab edge insulated to ≥ R-5 at the depth specified by the 2009 IECC and aligned with thermal boundary of the walls [4,5]	☐	☐	☐	☐
4.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8	☐	☐	☐	☐
4.4 Reduced thermal bridging at above-grade walls separating conditioned from unconditioned space (rim / band joists exempted) using one of the following options: [13]				
4.4.1 Continuous rigid insulation, insulated siding, or combination of the two; ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8 [14,15,16], **OR**;	☐	☐	☐	☐
4.4.2 Structural Insulated Panels (SIPs) [14], **OR**;	☐	☐	☐	☐
4.4.3 Insulated Concrete Forms (ICFs) [14], **OR**;	☐	☐	☐	☐
4.4.4 Double-wall framing [14,17], **OR**;	☐	☐	☐	☐
4.4.5 Advanced framing, including all of the items below:				
4.4.5a All corners insulated ≥ R-6 to edge [18], **AND**;	☐	☐	☐	☐
4.4.5b All 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) [19], **AND**;	☐	☐	☐	☐
4.4.5c Framing limited at all windows & doors to one pair of king studs, plus one pair of jack studs per window opening to support the header and sill [20], **AND**;	☐	☐	☐	☐
4.4.5d All interior / exterior wall intersections insulated to the same R-value as the rest of the exterior wall [21], **AND**;	☐	☐	☐	☐
4.4.5e Minimum stud spacing of 16 in. o.c. for 2x4 framing in all Climate Zones and, in Climate Zones 5 through 8, 24 in. o.c. for 2x6 framing [22]	☐	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 3

3. Reduced Thermal Bridging				
3.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade I insulation extends to the inside face of the exterior wall below at these levels: CZ 1-5: ≥ R-21; CZ 6-8: ≥ R-30 [10]	☐	☐	☐	☐
3.2 For slabs on grade in CZ 4 and higher, 100% of slab edge insulated to ≥ R-5 at the depth specified by the 2009 IECC and aligned with thermal boundary of the walls [11, 12]	☐	☐	☐	☐
3.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8	☐	☐	☐	☐
3.4 One of the following options used at above-grade walls separating conditioned from unconditioned space (rim / band joists exempted): [13]				
3.4.1 Continuous rigid insulation, insulated siding, or combination of the two; ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8 [14, 15,16], OR;	☐	☐	☐	☐
3.4.2 Structural Insulated Panels OR; Insulated Concrete Forms OR; Double-wall framing [14,17]	☐	☐	☐	☐
3.4.3 Advanced framing, including all of the Items below:				
3.4.3a Corners insulated ≥ R-6 to edge [18], **AND**;	☐	☐	☐	☐
3.4.3b 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) [19], **AND**;	☐	☐	☐	☐
3.4.3c Framing limited at all windows & doors to one pair of king studs, plus one pair of jack studs per window opening to support the header and sill. [20], **AND**;	☐	☐	☐	☐
3.4.3d Interior / exterior wall intersections insulated to same R-value as rest of exterior wall. [21],**AND**;	☐	☐	☐	☐
3.4.3e Minimum stud spacing of 16 in. o.c. for 2x4 framing in all Climate Zones and, in Climate Zones 5 through 8, 24 in. o.c. for 2x6 framing. [22]	☐	☐	☐	☐

Rev. 07:
Thermal Enclosure System Rater Checklist – Section 5

5. Air Sealing	Must Correct	Builder Verified [1]	Rater Verified	N/A
5.1 Penetrations to unconditioned space fully sealed with solid blocking or flashing as needed and gaps sealed with caulk or foam				
5.1.1 Duct / flue shaft	☐	☐	☐	☐
5.1.2 Plumbing / piping	☐	☐	☐	☐
5.1.3 Electrical wiring	☐	☐	☐	☐
5.1.4 Bathroom and kitchen exhaust fans	☐	☐	☐	☐
5.1.5 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and fully gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to ≥ R-10 in CZ 4 and higher to minimize condensation potential.	☐	☐	☐	☐
5.1.6 Light tubes adjacent to unconditioned space include lens separating unconditioned and conditioned space and are fully gasketed [23]	☐	☐	☐	☐
5.2 Cracks in the building envelope fully sealed				
5.2.1 All above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor with caulk, foam, or equivalent material. Foam gasket also placed beneath above-grade sill plate if resting atop concrete or masonry and adjacent to conditioned space [24, 25]	☐	☐	☐	☐
5.2.2 At top of walls adjoining unconditioned spaces, continuous top plates or sealed blocking using caulk, foam, or equivalent material	☐	☐	☐	☐
5.2.3 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.	☐	☐	☐	☐
5.2.4 Rough opening around windows & exterior doors sealed with caulk or foam [26]	☐	☐	☐	☐
5.2.5 Marriage joints between modular home modules at all exterior boundary conditions fully sealed with gasket and foam	☐	☐	☐	☐
5.2.6 All seams between Structural Insulated Panels (SIPs) foamed and / or taped per manufacturer's instructions	☐	☐	☐	☐
5.2.7 In multifamily buildings, the gap between the common wall (e.g. the drywall shaft wall) and the structural framing between units fully sealed at all exterior boundaries	☐	☐	☐	☐
5.3 Other openings				
5.3.1 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air-tight with weatherstripping or equivalent gasket	☐	☐	☐	☐
5.3.2 Attic access panels and drop-down stairs equipped with a durable ≥ R-10 insulated cover that is gasketed (i.e., not caulked) to produce continuous air seal when occupant is not accessing the attic [27]	☐	☐	☐	☐
5.3.3 Whole-house fans equipped with a durable ≥ R-10 insulated cover that is gasketed and either installed on the house side or mechanically operated [27]	☐	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 4

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 and higher.	☐	☐	☐	☐
4.3 Light tubes include lens separating unconditioned and conditioned space and are gasketed. [23]	☐	☐	☐	☐
4.4 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[24,25]	☐	☐	☐	☐
4.5 Continuous top plate or blocking at top of walls adjoining unconditioned space, and sealed	☐	☐	☐	☐
4.6 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.	☐	☐	☐	☐
4.7 Rough opening around windows & exterior doors sealed [26]	☐	☐	☐	☐
4.8 All seams between Structural Insulated Panels sealed per manufacturer's instructions	☐	☐	☐	☐
4.9 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	☐	☐	☐	☐
4.10 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air-tight with weatherstripping or equivalent gasket	☐	☐	☐	☐
4.11 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 [27]	☐	☐	☐	☐

Rev. 07:
HVAC System QI Rater Checklist – Section 1

1. Review of HVAC System Quality Installation Contractor Checklist [2]	Must Correct	Rater Verified	N/A
1.1 HVAC System Quality Installation Contractor Checklist completed in its entirety and collected for records, along with documentation on ventilation system (1.3), full load calculations (2.18), and AHRI certificate (3.13).	☐	☐	☐
1.2 Review the following parameters related to system cooling design, selection, and installation from the HVAC Contractor Checklist (Contractor Checklist Item # indicated in parenthesis): [3]			
1.2.1 Outdoor design temperatures (2.4) are equal to the 1% and 99% ACCA Manual J design temperatures for contractor-designated design location [4]	☐	☐	☐
1.2.2 Home orientation (2.5) matches orientation of rated home	☐	☐	☐
1.2.3 Number of occupants (2.6) equals number of occupants in rated home [5]	☐	☐	☐
1.2.4 Conditioned floor area (2.7) is within ±10% of conditioned floor area of rated home	☐	☐	☐
1.2.5 Window area (2.8) is within ±10% of calculated window area of rated home	☐	☐	☐
1.2.6 Predominant window SHGC (2.9) is within 0.1 of predominant value in rated home [6]	☐	☐	☐
1.2.7 Listed latent cooling capacity (3.8) exceeds design latent heat gain (2.12)	☐	☐	☐
1.2.8 Listed sensible cooling capacity (3.9) exceeds design sensible heat gain (2.13)	☐	☐	☐
1.2.9 Listed total cooling capacity (3.10) is 95-115% (or 95-125% for Heat Pumps in Climate Zones 4-8) of design total heat gain (2.14), or next nominal size [7]	☐	☐	☐
1.2.10 HVAC manufacturer and model numbers on installed equipment, Contractor Checklist (3.1, 3.2, 5.1), and AHRI certificate or OEM catalog data all match [8]	☐	☐	☐
1.2.11 Using reported liquid line (6.3) or suction line (6.5) pressure, corresponding temperature (as determined using pressure / temperature chart for refrigerant type) matches reported condenser (7.1) or evaporator (7.5) saturation temperature (± 3 degrees) [9]	☐	☐	☐
1.2.12 Calculated subcooling (7.1 minus 6.4) value is within ±3 °F of the reported target temperature (7.3) or calculated superheat (6.6 minus 7.5) value is within ±5 °F of the reported target temperature (7.7). [9]	☐	☐	☐
1.3 Rater-verified supply & return duct static pressure ≤ 110% of contractor values (9.3, 9.4)	☐	☐	☐
1.4 Contractor-prepared balancing report indicating the room name and design airflow for each supply and return register collected by Rater for records. In addition, final individual room airflows measured and documented on balancing report through one of the following options:			
1.4.1 Measured and documented by contractor (10.1.1), OR;	☐	☐	☐
1.4.2 Measured by Rater using Section 804.2 of the Mortgage Industry National HERS Standard, documented by Rater, & verified by Rater to be within the greater of ± 20% or 25 CFM of design airflow (10.1.2)	☐	☐	☐
1.5 HVAC contractor holds credentials necessary to complete the HVAC System QI Contractor Checklist [10]	☐	☐	☐

Rev. 08:
Rater Plan Review Checklist – Sections 1 & 4

1. Partnership Status	Must Correct	Rater [1] Verified	N/A
1.1 Rater has verified that builder is an ENERGY STAR partner.	☐	☐	☐
1.2 HVAC contractor holds credentials necessary to complete the HVAC System QI Contractor Checklist [2] HVAC Contractor Company Name: _____	☐	☐	☐
4. Review of HVAC System Design Report [7]			
4.1 HVAC System Design Report collected for records, with no items left blank.	☐	☐	☐
4.2 Review the following parameters related to system cooling design, selection, and installation from the HVAC System Designer Checklist (Designer Checklist Item # indicated in parenthesis):			
4.2.1 Cooling season and heating season design temperature (2.5) are within the limits defined at energystar.gov/hvacdesigntemps, or an appeal has been submitted to EPA [8]	☐	☐	☐
4.2.2 Loads have been provided for (2.12-2.15) for the orientation of the rated home and the variation in Total Heat Gain across orientations (2.16) is ≤ 15%.	☐	☐	☐
4.2.3 Number of occupants (2.6) equals number of occupants in rated home [9]	☐	☐	☐
4.2.4 Conditioned floor area (2.7) is within ±10% of conditioned floor area of rated home	☐	☐	☐
4.2.5 Window area (2.8) is within ±10% of calculated window area of rated home	☐	☐	☐
4.2.6 Predominant window SHGC (2.9) is within 0.1 of predominant value in rated home [10]	☐	☐	☐
4.2.7 Cooling Sizing % (3.12) is within the Cooling Sizing Limit (3.14) selected by the HVAC designer	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 5

5. HVAC System Equipment [30]			
5.1 HVAC manufacturer & model number on installed equipment matches either of the following (check box): [31] ☐ HVAC System Design Report (3.2, 3.3, 5.1) ☐ Written approval received from designer	☐	☐	☐
5.2 External static pressure measured by Rater at contractor-provided test locations and documented here: [32] Return-Side External Static Pressure: ____ IWC Supply-Side External Static Pressure: ____ IWC	☐	☐	☐

Rev. 07:
HVAC System QI Rater Checklist – Section 2, 3, 4

2. Duct Quality Installation - *Applies to All Heating, Cooling, Ventilation, Exhaust, and Pressure Balancing Ducts* [11]			
2.1 Connections and routing of ductwork completed without kinks or sharp bends. [12]	☐	☐	☐
2.2 No excessive coiled or looped flexible ductwork. [13]	☐	☐	☐
2.3 Flexible ducts in unconditioned space not installed in cavities smaller than outer duct diameter; in conditioned space not installed in cavities smaller than inner duct diameter	☐	☐	☐
2.4 Flexible ducts supported at intervals as recommended by mfr. but at a distance ≤ 5 ft.	☐	☐	☐
2.5 Building cavities not used as supply or return ducts unless they meet Items 3.2, 3.3, 4.1, and 4.2 of this Checklist.	☐	☐	☐
2.6 HVAC ducts, cavities used as ducts, and combustion inlets and outlets may pass perpendicularly through exterior walls but shall not be run within exterior walls unless at least R-6 continuous insulation is provided on exterior side of the cavity, along with an interior and exterior air barrier where required by the Thermal Enclosure System Rater Checklist.	☐	☐	☐
2.7 Quantity & location of supply and return duct terminals match contractor balancing report. [11]	☐	☐	☐
2.8 Bedrooms pressure-balanced using any combination of transfer grills, jump ducts, dedicated return ducts, and / or undercut doors to either: a) provide 1 sq. in. of free area opening per 1 CFM of supply air, as reported on the contractor-provided balancing report; or b) achieve a Rater-measured pressure differential ≤ 3 Pa with respect to the main body of the house when all bedroom doors are closed and all air handlers are operating. [11,14]	☐	☐	☐
3. Duct Insulation - *Applies to All Heating, Cooling, Supply Ventilation, and Pressure Balancing Ducts* [15]			
3.1 All connections to trunk ducts in unconditioned space are insulated.	☐	☐	☐
3.2 *Prescriptive Path*: Supply ducts in unconditioned attic have insulation ≥ R-8. *Performance Path*: Supply ducts in unconditioned attic have insulation ≥ R-6.	☐	☐	☐
3.3 All other supply ducts and all return ducts in unconditioned space have insulation ≥ R-6.	☐	☐	☐
4. Duct Leakage - *Applies to All Heating, Cooling, and Balanced Ventilation Ducts*	**Must Correct**	**Rater Verified**	**N/A**
4.1 Total Rater-measured duct leakage meets one of the following two options: [16]			
4.1.1 Rough-in: ≤ 4 CFM25 per 100 sq. ft. of CFA with air handler and all ductwork, building cavities used as ductwork, & duct boots installed. In addition, all duct bo[illegible]ealed to finished surface, Rater-verified at final. [17]	☐	☐	☐
4.1.2 Final: ≤ 8 CFM25 per 100 sq. ft. of CFA with the air han[illegible]nd all ductwork, building cavities used as ductwork, duct boots, & register grilles atop the finished [illegible]ce (e.g., drywall, flooring) installed. [18]	☐	☐	☐
4.2 Rater-measured duct leakage to outdoors ≤ 4 CFM25 per 100 [illegible]ft. of conditioned floor area. [16,19]	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 6

6. Duct Quality Installation - *Applies to Heating, Cooling, Ventilation, Exhaust, & Pressure Balancing Ducts, Unless Noted in Footnote*			
6.1 Ductwork installed without kinks, sharp bends, compressions, or excessive coiled flexible ductwork. [33, 34]	☐	☐	☐
6.2 Bedrooms pressure-balanced using any combination of transfer grills, jump ducts, dedicated return ducts, and / or undercut doors to achieve a Rater-measured pressure differential ≤ 3 Pa with respect to the main body of the house when all bedroom doors are closed and all air handlers are operating.[35,36]	☐	☐	☐
6.3 All supply and return ducts, including connections to trunk ducts in unconditioned space are insulated to ≥ R-6. [37,38]	☐	☐	☐
6.4 Total Rater-measured duct leakage meets one of the following two options: [39,40]			
6.4.1 Rough-in: ≤ 4 CFM25 per 100 sq. ft. of CFA with air handler and all ductwork, building cavities used as ductwork, & duct boots installed. In addition, all duct boots sealed to finished surface, Rater-verified at final. [41]	☐	☐	☐
6.4.2 Final: ≤ 8 CFM25 per 100 sq. ft. of CFA with the air handler and all ductwork, building cavities used as ductwork, duct boots, & register grilles atop the finished surface (e.g., drywall, flooring) installed. [42]	☐	☐	☐
6.5 Rater-measured duct leakage to outdoors ≤ 4 CFM25 per 100 sq. ft. of conditioned floor area. [40,43]	☐	☐	☐

Rev. 07:
HVAC System QI Rater Checklist – Section 5, 6, 7, & 9

5. Whole-Building Delivered Ventilation			
5.1 Rater-measured ventilation rate is within 100-120% of HVAC contractor design value (2.11). [20]	☐	☐	☐
6. Controls			
6.1 Air flow is produced when central HVAC fan is energized (set thermostat to "fan").	☐	☐	☐
6.2 Cool air flow is produced when the cooling cycle is energized (set thermostat to "cool"). [21,22]	☐	☐	☐
6.3 Heated air flow is produced when the heating cycle is energized (set thermostat to "heat"). [21]	☐	☐	☐
6.4 Continuously-operating ventilation & exhaust fans include readily accessible override controls.	☐	☐	☐
6.5 Function of ventilation controls is obvious (e.g., bathroom exhaust fan) or, if not, controls have been labeled.	☐	☐	☐
7. Ventilation Air Inlets & Ventilation Source			
7.1 All ventilation air inlets located ≥10 ft. of stretched-string distance from known contamination sources such as stack, vent, exhaust hood, or vehicle exhaust. Exception: ventilation air inlets in the wall ≥ 3 ft. from dryer exhausts and contamination sources exiting through the roof. [23]	☐	☐	☐
7.2 Ventilation air inlets ≥ 2 ft. above grade or roof deck in Climate Zones 1-3 or ≥ 4 ft. above grade or roof deck in Climate Zones 4-8 and not obstructed by snow, plantings, condensing units or other material at time of inspection.[24]	☐	☐	☐
7.3 Ventilation air inlets provided with rodent / insect screen with ≤ 0.5 inch mesh. [25]	☐	☐	☐
7.4 Ventilation air comes directly from outdoors, not from adjacent dwelling units, garages, crawlspaces, or attics.	☐	☐	☐
9. Ventilation & Exhaust Fan Ratings (Exemptions for Kitchen, HVAC, and Remote-Mounted Fans) [33]			
9.1 Intermittent supply and exhaust fans rated at ≤ 3 sones by mfr. when producing no less than the minimum airflow rate required by Section 8 of this Checklist, unless rated flow ≥ 400 CFM.	☐	☐	☐
9.2 Continuous supply & exhaust fans rated at ≤ 1 sone by mfr. when producing no less than the minimum airflow required by Section 8 of this Checklist.	☐	☐	☐
9.3 Bathroom fans used as part of a whole-house mechanical ventilation system shall be ENERGY STAR certified; unless rated flow rate ≥ 500 CFM.	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 7

7. Whole-Building Mechanical Ventilation System			
7.1 Rater-measured ventilation rate is within 100-120% of HVAC contractor design value (1.1). [44]	☐	☐	☐
7.2 A readily-accessible ventilation override control has been installed and has also been labeled if its function is not obvious (e.g., a label is required for a standalone wall switch).	☐	☐	☐
7.3 If the system specifies an intake duct to the return side of the HVAC system, then the specified controls are designed to operate intermittently and automatically based on a timer and to restrict outdoor air intake when not in use (e.g., motorized damper).	☐	☐	☐
7.4 The fan of the specified system shall not exceed ≥ 3 sones for intermittent systems and ≥ 1 sone for continuous systems (exceptions for HVAC and remote-mounted fans).[45]	☐	☐	☐
7.5 Bathroom fans used as part of a whole-house mechanical ventilation system shall be ENERGY STAR certified; unless rated flow rate ≥ 500 CFM.	☐	☐	☐
7.6 If ventilation air inlet is specified, it shall meet the following requirements: [46, 47]			☐
7.6.1 Inlet does not pull ventilation air from within an attic, crawlspace, garage or adjacent dwelling unit.	☐	☐	☐
7.6.2 Inlet is ≥3 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust hood, or vehicle exhaust) exiting the roof and ≥10 ft. from known contamination sources not exiting the roof.	☐	☐	☐

Rev. 07:
HVAC System QI Rater Checklist – Section 8 & 9

8. Local Mechanical Exhaust					
In each kitchen and bathroom, a system shall be installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow standards: [20,26,27]					
Location	**Continuous Rate**	**Intermittent Rate** [28]			
8.1 Kitchen	≥ 5 ACH, based on kitchen volume [29,30]	≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume [29,30,31]	☐	☐	☐
8.2 Bathroom	≥ 20 CFM	≥ 50 CFM	☐	☐	☐
8.3 If fans share common exhaust duct, back-draft dampers installed.			☐	☐	☐
8.4 Common exhaust duct not shared by fans in separate dwellings. [32]			☐	☐	☐
8.5 Clothes dryers vented directly to outdoors, except for ventless dryers equipped with a condensate drain.			☐	☐	☐
9. Ventilation & Exhaust Fan Ratings (Exemptions for Kitchen, HVAC, and Remote-Mounted Fans) [33]					
9.1 Intermittent supply and exhaust fans rated at ≤ 3 sones by mfr. when producing no less than the minimum airflow rate required by Section 8 of this Checklist, unless rated flow ≥ 400 CFM.			☐	☐	☐
9.2 Continuous supply & exhaust fans rated at ≤ 1 sone by mfr. when producing no less than the minimum airflow required by Section 8 of this Checklist.			☐	☐	☐
9.3 Bathroom fans used as part of a whole-house mechanical ventilation system shall be ENERGY STAR certified; unless rated flow rate ≥ 500 CFM.			☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 8

8. Local Mechanical Exhaust						
In each kitchen and bathroom, a system shall be installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow and manufacturer-rated sound level standards: [44,48,49]						
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 [52,52,53]	☐	☐	☐
	Sound	Recommended: ≤ 1 sone	Recommended: ≤ 3 sones			
8.2 Bathroom	Airflow	≥ 20 CFM	≥ 50 CFM	☐	☐	☐
	Sound	Required: ≤ 1 sone	Recommended: ≤ 3 sones			

Rev. 07:
HVAC System QI Rater Checklist – Section 10

10. Combustion Appliances			
10.1 Furnaces, boilers, and water heaters located within the home's pressure boundary are mechanically drafted or direct-vented. As an exception, naturally drafted equipment is allowed in Climate Zones 1-3. For naturally drafted furnaces, boilers, and water heaters, the Rater has followed RESNET or BPI combustion safety test procedures and met the selected standard's limits for depressurization, spillage, draft pressure, and CO concentration in ambient air, as well as a CO concentration in the flue of ≤ 25 ppm. [34,35,36]	☐	☐	☐
10.2 For fireplaces that are not mechanically drafted or direct-vented to outdoors, total net rated exhaust flow of the two largest exhaust fans (excluding summer cooling fans) is ≤ 15 CFM per 100 sq. ft. of occupiable space when at full capacity or the Rater has verified that the pressure differential is ≤ -5 Pa using BPI's or RESNET's worst-case depressurization test procedure. [26,36,37,38]	☐	☐	☐
10.3 If unvented combustion appliances other than cooking ranges or ovens are located inside the home's pressure boundary, the Rater has operated the appliance for at least 10 minutes and verified that the ambient CO level does not exceed 35 ppm. [39]	☐	☐	☐

Rev. 08:
Rater Field Checklist – Section 10

10. Combustion Appliances			
10.1 Furnaces, boilers, and water heaters located within the home's pressure boundary are mechanically drafted or direct-vented. As an exception, naturally drafted equipment is allowed in Climate Zones 1-3 if the Rater has followed the combustion safety test procedures in Section 805 of RESNET's standards. [57,58,59]	☐	☐	☐
10.2 Fireplaces are mechanically drafted or direct-vented to outdoors. See Footnote 60 for alternatives. [48,59,60, 61,62]	☐	☐	☐
10.3 If unvented combustion appliances other than cooking ranges or ovens are located inside the home's pressure boundary, the Rater has operated the appliance for at least 10 minutes and verified that the ambient CO level does not exceed 35 ppm. [63]	☐	☐	☐

Rater Name: _____ Rater Pre-Drywall Inspection Date: _____ Rater Initials: _____

Rater Name: _____ Rater Final Inspection Date: _____ Rater Initials: _____

Builder Employee: Builder Inspection Date: ___ Builder Initials: _____

Rev. 07:
HVAC System QI Rater Checklist – Section 11

11. Filtration			
11.1 At least one MERV 6 or higher filter installed in each ducted mechanical system. [40]	☐	☐	☐
11.2 All return air and mechanically supplied outdoor air pass through filter prior to conditioning.	☐	☐	☐
11.3 Filter located and installed so as to facilitate access and regular service by the owner. [41]	☐	☐	☐
11.4 Filter access panel includes gasket or comparable sealing mechanism and fits snugly against the exposed edge of filter when closed to prevent bypass. [42]	☐	☐	☐
Rater Name: _____ Date Checklist Inspected: _____ Rater Signature: _____ Rater Company Name: _____			

Rev. 08:
Rater Field Checklist – Section 9

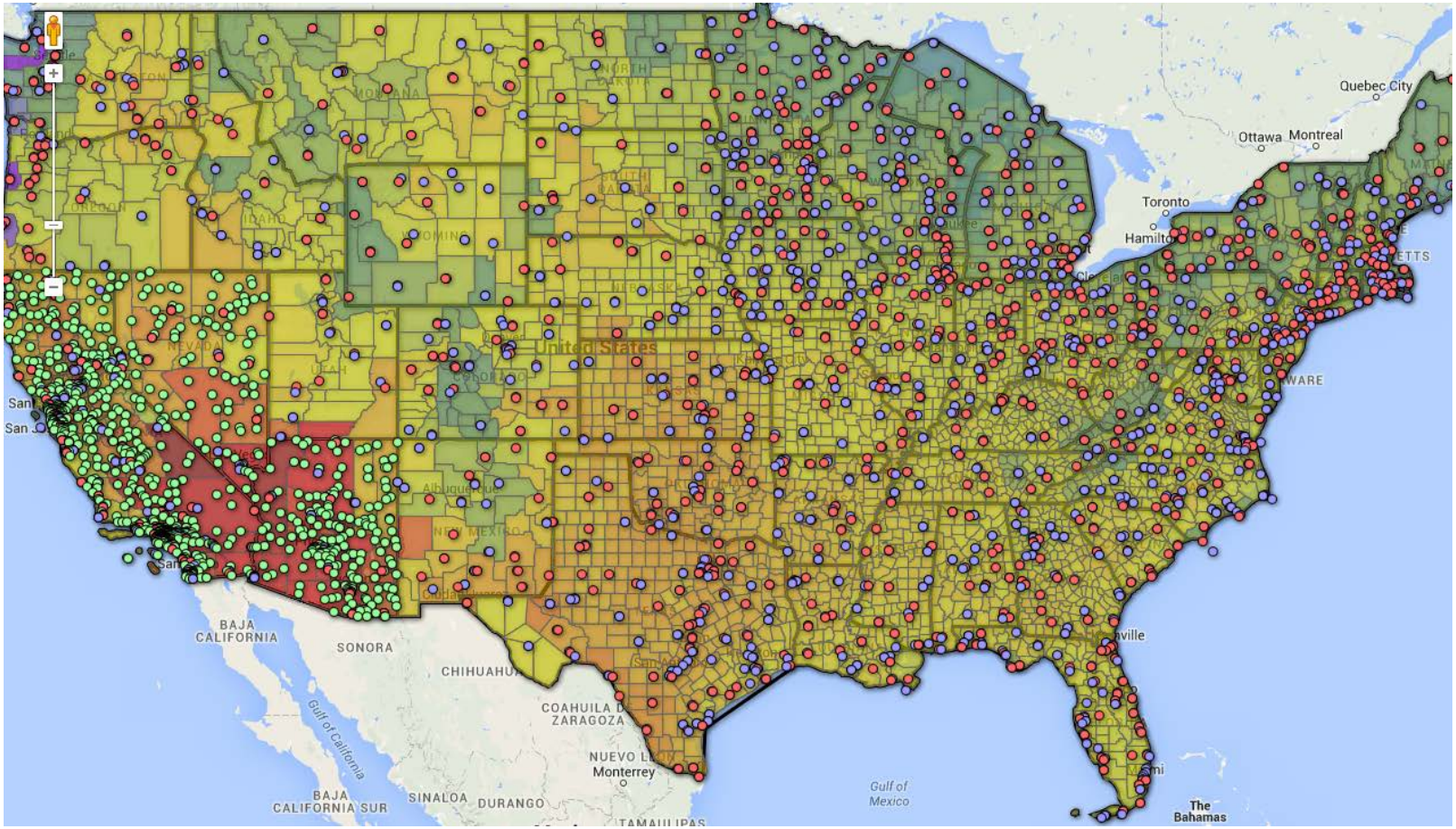
9. Filtration			
9.1 At least one MERV 6 or higher filter installed in each ducted mechanical system. [54]	☐	☐	☐
9.2 Filter located and installed so as to facilitate access and regular service by the owner. [55]	☐	☐	☐
9.3 Filter access panel includes gasket or comparable sealing mechanism and fits snugly against the exposed edge of filter when closed to prevent bypass. [56]	☐	☐	☐

New & Upcoming Resources

EPA

New & upcoming resources coming to help you succeed

1. County-level design temperature limits



New & upcoming resources coming to help you succeed

2. Short informative videos about measuring ventilation airflow

New & upcoming resources coming to help you succeed

3. Short informative videos about measuring HVAC fan airflow

ENERGY STAR Certified Homes

Web:
Main: www.energystar.gov/newhomespartners
Technical: www.energystar.gov/newhomesguidelines
Training: www.energystar.gov/newhomestraining
HVAC: www.energystar.gov/newhomesHVAC

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Social Media:

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