

# **ENERGY STAR Qualified Homes 2011 Spec Training – Completing HVAC Systems**

**Presented by:  
Dean Gamble, ICF International  
February 23, 2010**



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# Key Concepts Behind the Proposed 2011 Guidelines

# Key Concepts Behind 2011 Guidelines

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- Increased Savings
- Expanded Building Science Checklists
- Variable vs. Fixed HERS Score
- Consideration for House Size

# Key Concept #2: Expanded Building Science Checklists

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- Incorporate key building science principles:
  - Thermal Enclosure System Checklist
  - HVAC System Quality Installation Checklists
  - Water Management System Checklists
- These will ensure that energy savings are achieved without compromising durability or indoor air quality



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# Update on Significant Changes to Second Draft of Guidelines

# Most Significant Changes In 2nd Draft: Timeline

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- Added additional one year transition period during which lack of compliance with the new checklist requirements will not result in disqualification of the home.

# Most Significant Changes In 2nd Draft: HVAC System Quality Install Checklists



- IAQ requirements have been integrated into checklists
- One checklist created for rater and one for HVAC contractor
- Added liability disclaimer
- Better aligned with industry standards
- Added requirement that combustion appliances inside the home's pressure boundary be direct-vented or mechanically vented to outdoors
- Removed the requirement for CO alarms
- The following three requirements have been added:
  - Building cavities shall not be used as supply or returns.
  - Ducts shall not be installed in insulated walls
  - Exhaust fans and duct boots shall be sealed to floor, walls, or ceiling



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# HVAC System Quality Installation Checklists



# Overview



- There are two checklists:
  - One for the HVAC Contractor to complete
  - One for the HERS Rater to complete
- Large majority of checklists are based directly on industry-developed documents:
  - ANSI/ACCA 5 QI-2007
  - ACCA Manuals J, S, & D
  - ASHRAE Standard 62.2-2007

# ANSI/ACCA 5 QI-2007



- HVAC Quality Installation Specification

The cover of the ACCA Standard 5 QI-2007 specification. It features the ACCA logo (Air Conditioning Contractors of America) on the left, the title "ACCA Standard 5" in large white letters on a blue background, and the subtitle "HVAC Quality Installation Specification" below it. Contact information for ACCA is provided on the left side of the cover.

**ACCA**  
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CONTRACTORS OF AMERICA

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STANDARD NUMBER: ANSI/ACCA 5 QI-2007

## ACCA Standard 5

### HVAC Quality Installation Specification

Residential and Commercial Heating,  
Ventilating, and Air Conditioning (HVAC)  
Applications

The Air Conditioning Contractors of America Educational Institute (ACCA-EI) Standards Task Team (STT) develops standards as an American National Standards Institute (ANSI) accredited standards developer (ASD). ACCA develops voluntary standards as outlined in the ACCA Essential Requirements and the ANSI Essential Requirements. ACCA standards are developed by diverse groups of industry volunteers in a climate of openness, consensus building, and lack of dominance (e.g., committee/group/team balance). Essential requirements, standard activities and documentation can be found in the standards portion of the ACCA website at [www.acca.org](http://www.acca.org). Questions, suggestions, and proposed revisions to this standard can be addressed to the attention of the Standards Task Team, ACCA, 2800 Shirlington Road, Suite 300, Arlington, VA 22206.

ACCA Standards are updated on a five-year cycle. The date following the standard number is the year of approval release by the ACCA-EI Standards Task Team. The latest copy may be purchased from the ACCA online store at [www.acca.org](http://www.acca.org) or ordered from the ACCA bookstore via toll-free telephone at 888.290.2220.  
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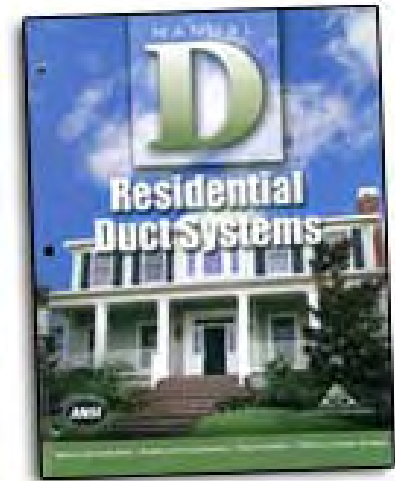
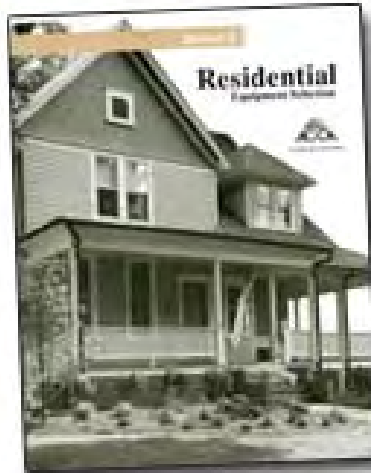
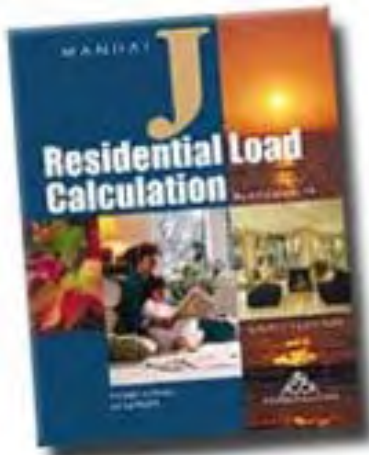
The ANSI logo, featuring the text "ANSI" in a bold, sans-serif font inside a circular border with "American National Standards Institute" around it.

www.ansi.org

# ACCA Manuals



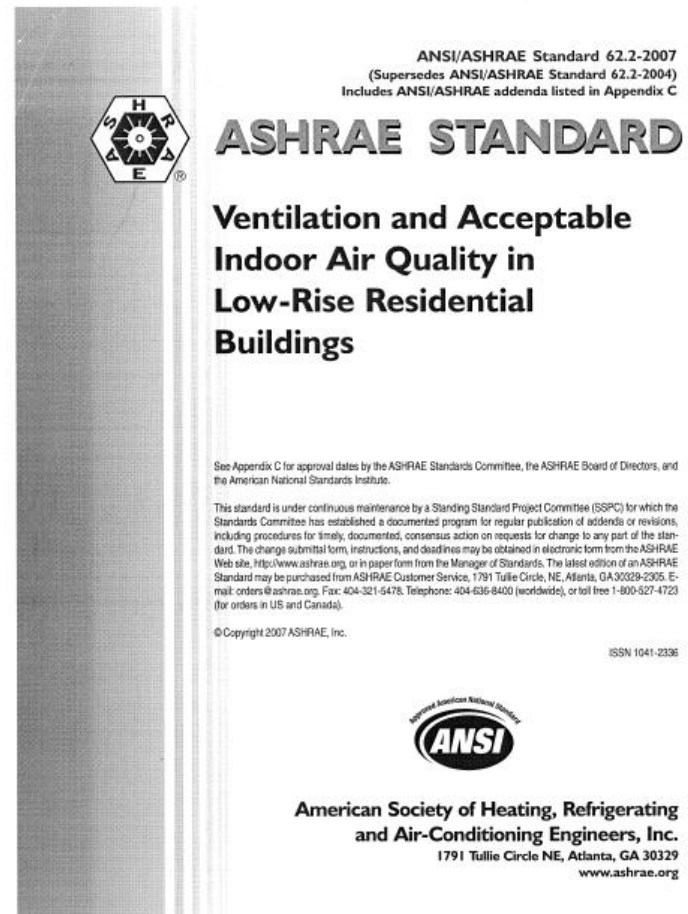
- Manual J – Residential Load Calculation
- Manual S – Residential Equipment Selection
- Manual D – Residential Duct Systems



# ASHRAE 62.2



- Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
- Key Concepts of Indoor Air Quality:
  - Reduce contaminants
  - Exhaust contaminants
  - Dilute contaminants





# Ventilation System Types

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- Exhaust Only Systems
- Supply Only Systems
- Balanced Systems

# Exhaust Only Systems



- Ventilate by exhausting air from the house to the outdoors.
- May be done with an exhaust fan and automatic controls.
- As a result, the house is slightly depressurized and outdoor air is pulled in through the envelope.



# Supply Only Systems



- Ventilate by supplying outdoor air directly to the HVAC system.
- May be done using a duct connected to the outside, along with a motorized damper, and automatic controls.
- As a result, the house is slightly pressurized and some indoor air is forced out through the envelope.

# Supply Only Systems





# Balanced System



- Ventilate by exhausting and supplying equal amounts of air.
- May be done using a dedicated system, either through the wall or whole-home. May be combined with energy/heat recovery devices.
- As a result, the house is neither pressurized or depressurized.

# Balanced System



WHOLE-HOUSE  
BALANCED SYSTEM



THROUGH-THE-WALL  
BALANCED SYSTEM



*Whole-House Ventilation*

# Overview of HVAC Contractor Checklist

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- The HVAC Contractor checklist covers:
  - Whole Building Mechanical Ventilation Design
  - Heating & Cooling System Design
  - Cooling Equipment Selection
  - Heating Equipment Selection
  - In-Field Refrigerant Tests & Calculations
  - In-Field Equipment Electrical Tests
  - In-Field Air Flow Tests
  - System Controls
  - Drain Pan

# Rater Responsibility for HVAC Contractor Checklist

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- EPA requires that the Rater collect the HVAC Contractor checklist and ensure that it is complete
- EPA does not require that the Rater verify that all information on the checklist is accurate.

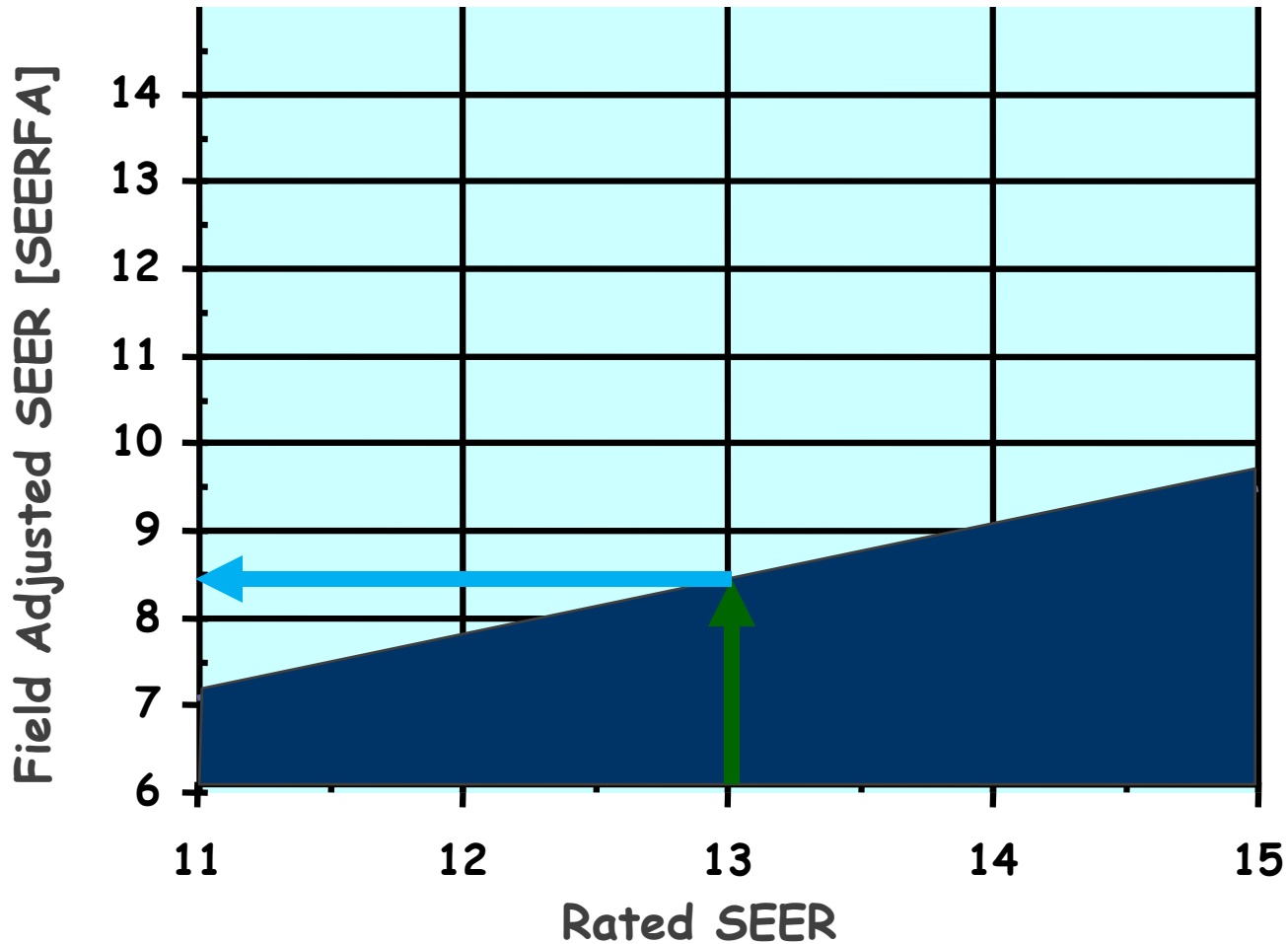
# Why is HVAC System QI Contractor Checklist Important?

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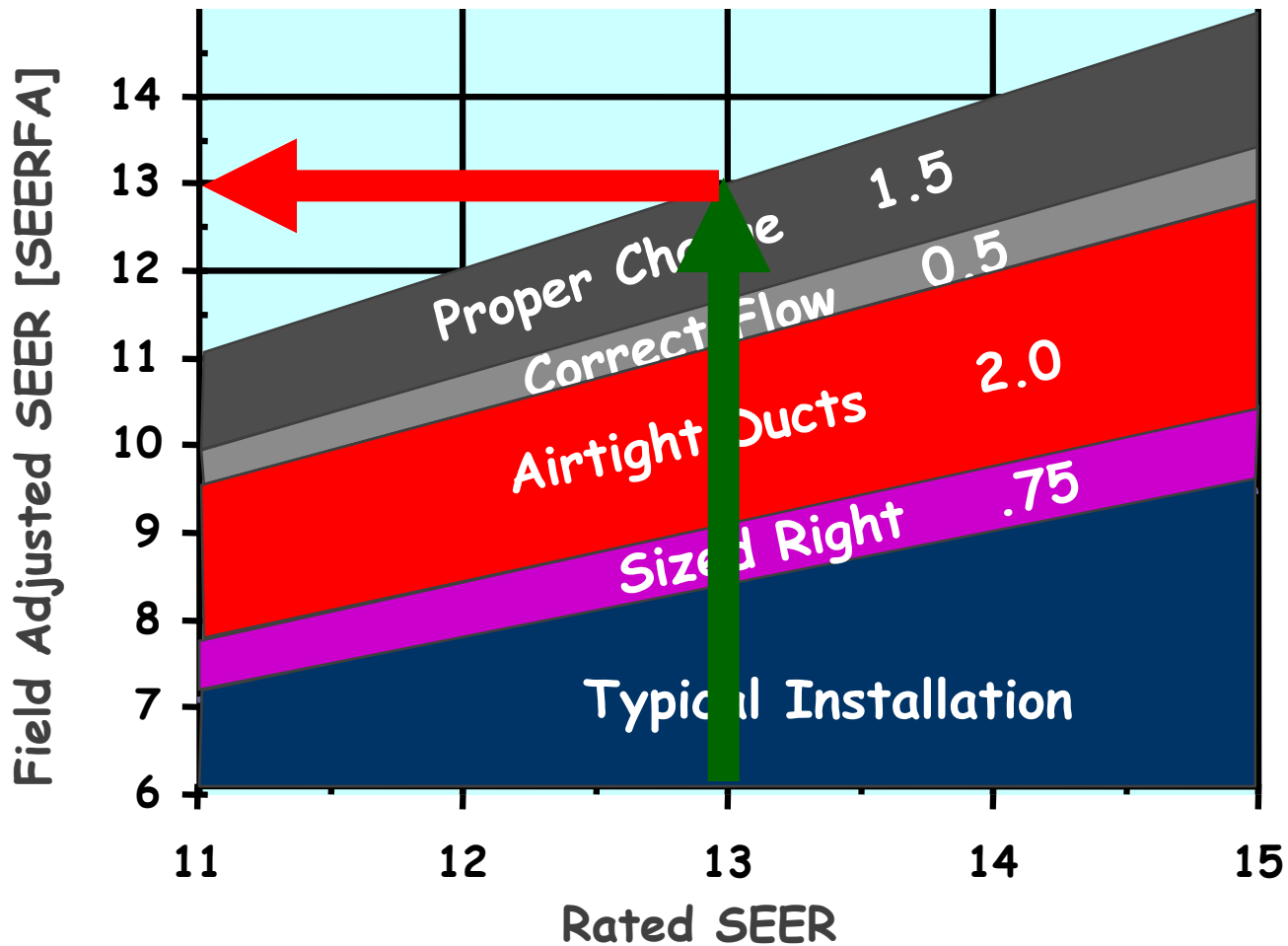


- It helps to ensure that HVAC systems are designed and installed to operate as expected

# Illustration of Typical Install



# Illustration of Quality Install



Courtesy of Advanced Energy Corp.

# HVAC Contractor Checklist

## Sec 1: Whole Bldg Ventilation Design

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- 1.1 Ventilation system designed to meet ASHRAE 62.2-2007 requirements
- 1.2 Documentation attached with ventilation system type, location and design rate
- 1.3 If present, continuously-operating ventilation and exhaust fans designed to automatically operate during all occupiable hours
- 1.4 If present, intermittently-operating whole-house ventilation system designed to automatically operate at least once per day and at least 10% of the time per 24 hour period



# HVAC Contractor Checklist

## Sec 2: Heat & Cool System Design



- Design the heating & cooling system in accordance with ACCA Manual J, D, & S, or equivalent
- Must include key parameters from analysis, such as:
  - Design Sensible, Latent, and Total Heat Gain
  - Design Heat Loss
  - Design Sensible Heat Ratio
  - Design Airflow
  - Design Duct Static Pressure

# HVAC Contractor Checklist

## Sec 3-5: Heat & Cool System Selection

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- Select heating and cooling equipment that aligns with the design in Section 2
- Must include key parameters of selected equipment, such as:
  - Equipment Manufacturer, Model, & Serial #
  - Listed Efficiency
  - AHRI Reference #, as Applicable
  - Fan Speed Type, as Applicable
  - Refrigerant & Metering Device Type, as Applicable
  - Selected Latent, Sensible, & Total Capacity, as Applicable
  - Selected Sensible Heat Ratio, as Applicable

# HVAC Contractor Checklist

## Sec 6-7: Refrigerant Tests & Calcs

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- In-field measurement of refrigerant parameters
- Calculations to ensure alignment with expected performance
- Must include key parameters of refrigerant, such as:
  - Outdoor Ambient Temperature & Temp at Evaporator
  - Liquid Line Pressure and Temperature
  - Suction Line Pressure and Temperature
  - Saturation Temperatures
  - Subcool & Superheat Temperatures & Deviation

# HVAC Contractor Checklist

## Sec 8: Electrical Measurements

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- In-field measurement of key electrical parameters
- Must include amps, volts, and watts of:
  - Evaporator / Air Handler Fan
  - Condensor Fan
  - Compressor

# HVAC Contractor Checklist

## Sec 9-10: Air Flow Tests & Balancing

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- In-field measurement of air flow and balancing
- Must include key parameters of air flow, such as:
  - Air Flow at Evaporator
  - Supply & Return Static Pressure
  - Measurement Method Used
  - Confirmation that Room Airflows are Aligned with Design

# HVAC Contractor Checklist

## Sec 11: System Controls

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- Confirmation that operating and safety controls meet OEM requirements

# HVAC Contractor Checklist

## Sec 12: Drain Pans

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- Confirmation that corrosion-resistant drain pan, properly sloped to drainage system, is installed

# Overview of HERS Rater Checklist



- The HERS Rater checklist covers:
  - Collection of completed HVAC Contractor checklist
  - Duct Quality Installation, Insulation, and Leakage
  - Whole-Building Delivered Ventilation
  - Ventilation Controls, Inlets, & Sources
  - Local Mechanical Exhaust
  - Ventilation & Exhaust Fan Ratings
  - Combustion & Non-Combustion Pollutants
  - Filtration



# HERS Rater Checklist

## Sec 1: Review of Contractor Checklist

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1.1 HVAC System Contractor checklist completed in its entirety

# HERS Rater Checklist

## Sec 2: Duct Quality Installation

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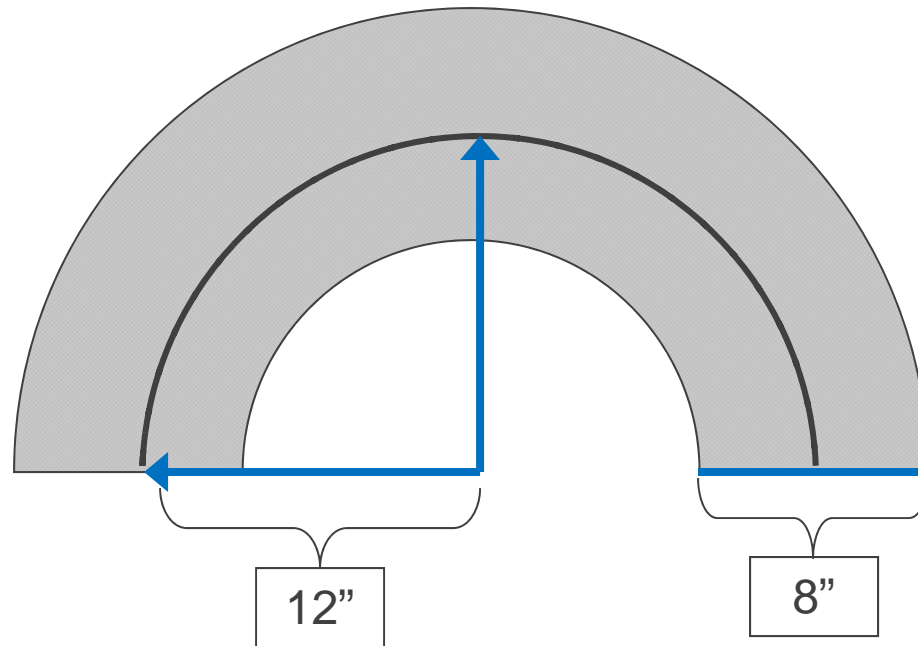
- 2.1 Ductwork completed w/o kinks or sharp bends
- 2.2 No excessive coiled or looped flexible ductwork
- 2.3 Flexible ducts shall not be installed in cavities smaller than the duct diameter.
- 2.4 Flexible ducts supported at intervals as recommended by manufacturer but at a distance  $\leq 5$  ft. and with sag of  $\leq 0.5$  in. per ft. of spacing between supports
- 2.5 Building cavities not used as supply or returns
- 2.6 Ducts not installed in insulated walls
- 2.7 Bedrooms pressure-balanced such that 1 sq. in. of opening is provided per 1 CFM of measured supply air using transfer grills and/or jump ducts. Alternately, dedicated return ducts may be used to meet this requirement.

# HERS Rater Checklist

## Sec 2: Duct Quality Installation



### 2.1 Ductwork completed w/o kinks or sharp bends



# HERS Rater Checklist

## Sec 2: Duct Quality Installation



2.3 Flexible ducts shall not be installed in cavities smaller than the duct diameter

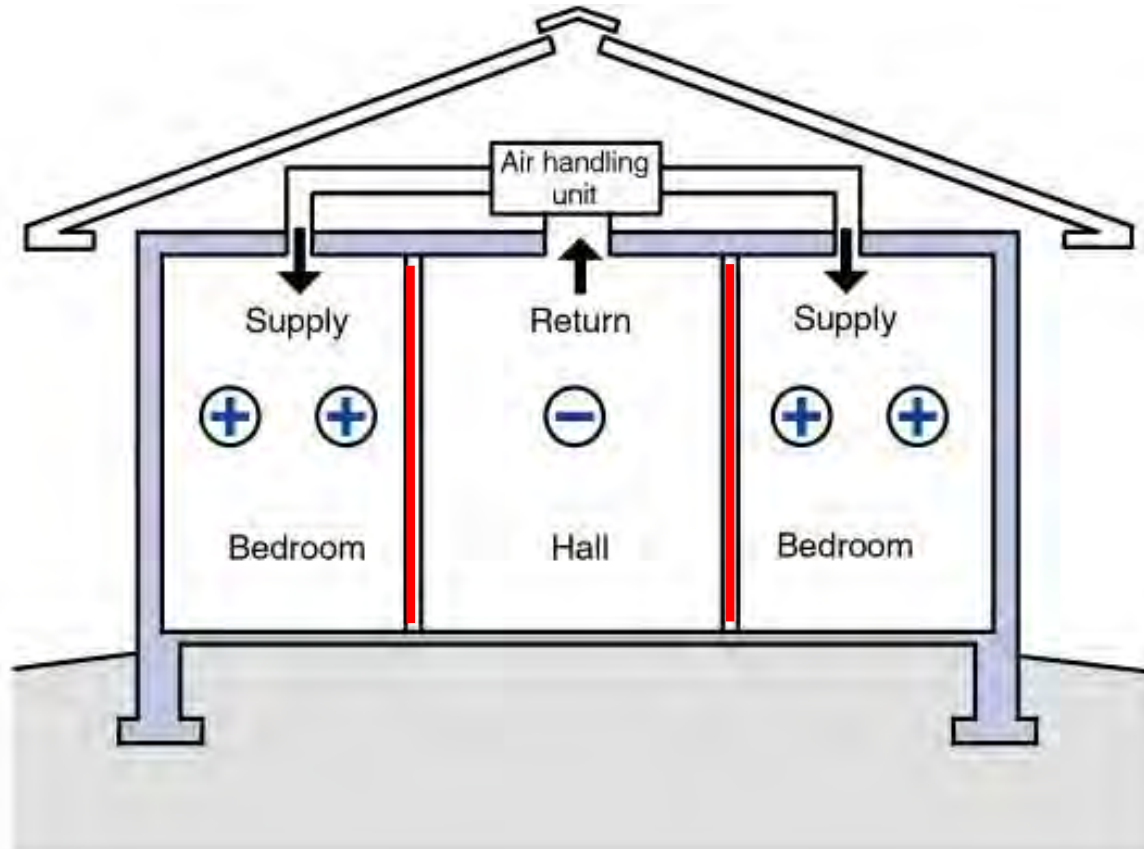


# HERS Rater Checklist

## Sec 2: Duct Quality Installation



### 2.7 Bedrooms pressure-balanced



*Pressure Balancing Problem*

# HERS Rater Checklist

## Sec 2: Duct Quality Installation



### 2.7 Bedrooms pressure-balanced



TRANSFER GRILLE



JUMP DUCT

*Pressure Balancing Solutions*

# HERS Rater Checklist

## Sec 3: Duct Insulation



**3.1** All connections to trunk ducts in unconditioned space insulated

**3.2** Prescriptive Path:

- Supply ducts in unconditioned attic have insulation  $\geq$  R-8

Performance Path:

- Supply ducts in unconditioned attic have insulation  $\geq$  R-6

**3.3** All other supply ducts and all return ducts in unconditioned space have insulation  $\geq$  R-6

# HERS Rater Checklist

## Sec 4: Duct Leakage

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- 4.1 Total measured duct leakage  $\leq$  6 CFM25 per 100 sq. ft. of conditioned floor area
- 4.2 Measured duct leakage to outdoors  $\leq$  4 CFM25 per 100 sq. ft. of conditioned floor area
- 4.3 Duct boots are sealed to floor, wall, or ceiling using caulk, foam or mastic



# HERS Rater Checklist

## Sec 5: Whole-Bldg Ventilation

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- 5.1 Measured ventilation rate is within 100-120% of HVAC contractor design values
- 5.2 In Warm-Humid climates, measured net exhaust flow is < 7.5 CFM per 100 sq. ft.
- 5.3 In very cold climates (i.e., CZ 7-8), measured net supply flow is < 7.5 CFM per 100 sq. ft.

# HERS Rater Checklist

## Sec 6: Ventilation Controls

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- 6.1 Continuously-operating ventilation and exhaust fans include readily accessible override controls
- 6.2 Controls labeled, unless function is obvious (e.g., bathroom exhaust fan)

# HERS Rater Checklist

## Sec 7: Air Inlets & Vent Sources



- 7.1 Air inlets located  $\geq$  10 ft. from contamination sources such as stack, vent, exhaust hood, or vehicle exhaust
- 7.2 Air inlets  $\geq$  2 ft. above grade in Climate Zones 1-3 or  $\geq$  4 ft. above grade in Climate Zones 4-8 and not obstructed by snow, plantings, or other material at time of inspection
- 7.3 Air inlets provided with mesh rodent / insect screen with mesh  $\leq$  0.5 in.
- 7.4 Ventilation air comes directly from outdoors and not from adjacent dwelling units, garages, unconditioned crawlspaces, or attics

# HERS Rater Checklist

## Sec 8: Local Mechanical Exhaust

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- 8.1 For each kitchen, a system is installed that exhausts directly to the outdoors and meets either a 5 ACH continuous or > 100 CFM intermittent flow rate
- 8.2 For each bathroom, a system is installed that exhausts directly to the outdoors and meets either a > 20 CFM continuous or > 50 CFM intermittent flow rate
- 8.3 If fans share common exhaust duct, back-draft dampers installed
- 8.4 Common exhaust duct not shared by fans in separate dwellings
- 8.5 Clothes dryers exhaust vented directly to outdoors

# HERS Rater Checklist

## Sec 9: Vent & Exhaust Fan Ratings

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- 9.1 Intermittent exhaust fans ENERGY STAR qualified; unless rated flow rate  $> 400$  CFM
- 9.2 Continuous exhaust fans ENERGY STAR qualified & rated at  $\leq 1$  sone
- 9.3 Intermittent supply fans rated at  $\leq 3$  sone, unless rated flow rate  $> 400$  CFM
- 9.4 Continuous supply fans rated at  $\leq 1$  sone

# HERS Rater Checklist

## Sec 10: Pollutants

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- 10.1 All combustion appliances located within the home's pressure boundary shall be mechanically drafted or direct-vented to outdoors
- 10.2 If solid-fuel burning appliances are located inside the home's pressure boundary, total net rated exhaust flow of two largest exhaust fans (excluding summer cooling fans) is  $< 15$  CFM per 100 sq. ft. of occupiable space when at full capacity
- 10.3 Air-handler and return ducts not located within the garage
- 10.4 Doors to garage gasketed or made substantially airtight

# HERS Rater Checklist

## Sec 11: Filtration

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- 11.1 MERV 6 or better filter installed in ducted mechanical systems
- 11.2 Filter located so that return and ventilation air pass filter prior to conditioning
- 11.3 Filter accessible for maintenance by owner
- 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

# Scenario #1

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- Single-family home with garage
- In Massachusetts
- Gas space heat and water heat, located inside pressure boundary
- Intermittent exhaust ventilation system
- Gas fireplace without dedicated outdoor air



# HERS Rater Checklist

## Sec 1: Review of Contractor Checklist

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- 1.1 HVAC System Contractor checklist completed in its entirety

# HERS Rater Checklist

## Sec 2: Duct Quality Installation

---



- 2.1 Ductwork completed w/o kinks or sharp bends
- 2.2 No excessive coiled or looped flexible ductwork
- 2.3 Flexible ducts shall not be installed in cavities smaller than the duct diameter.
- 2.4 Flexible ducts supported at intervals as recommended by manufacturer but at a distance  $\leq 5$  ft. and with sag of  $\leq 0.5$  in. per ft. of spacing between supports
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# HERS Rater Checklist

## Sec 3: Duct Insulation



**3.1** All connections to trunk ducts in unconditioned space insulated

**3.2** Prescriptive Path:

- Supply ducts in unconditioned attic have insulation  $\geq$  R-8

Performance Path:

- Supply ducts in unconditioned attic have insulation  $\geq$  R-6

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# HERS Rater Checklist

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- 4.1 Total measured duct leakage  $\leq$  6 CFM25 per 100 sq. ft. of conditioned floor area
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- 5.1 Measured ventilation rate is within 100-120% of HVAC contractor design values
- 5.2 In Warm-Humid climates, measured net exhaust flow is < 7.5 CFM per 100 sq. ft.
- 5.3 In very cold climates (i.e., CZ 7-8), measured net supply flow is < 7.5 CFM per 100 sq. ft.

# HERS Rater Checklist

## Sec 6: Ventilation Controls

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- 6.1 Continuously-operating ventilation and exhaust fans include readily accessible override controls
- 6.2 Controls labeled, unless function is obvious (e.g., bathroom exhaust fan)

# HERS Rater Checklist

## Sec 7: Air Inlets & Vent Sources



- 7.1 Air inlets located  $\geq$  10 ft. from contamination sources such as stack, vent, exhaust hood, or vehicle exhaust
- 7.2 Air inlets  $\geq$  2 ft. above grade in Climate Zones 1-3 or  $\geq$  4 ft. above grade in Climate Zones 4-8 and not obstructed by snow, plantings, or other material at time of inspection
- 7.3 Air inlets provided with mesh rodent / insect screen with mesh  $\leq$  0.5 in.
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- 10.1 All combustion appliances located within the home's pressure boundary shall be mechanically drafted or direct-vented to outdoors
- 10.2 If solid-fuel burning appliances are located inside the home's pressure boundary, total net rated exhaust flow of two largest exhaust fans (excluding summer cooling fans) is < 15 CFM per 100 sq. ft. of occupiable space when at full capacity
- 10.3 Air-handler and return ducts not located within the garage
- 10.4 Doors to garage gasketed or made substantially airtight

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## Sec 11: Filtration

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- 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

# Scenario #2

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- Single-family home without garage
- In Texas
- Gas space heat and water heat, located outside pressure boundary
- Intermittent supply ventilation system
- No fireplace

# HERS Rater Checklist

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1.1 HVAC System Contractor checklist completed in its entirety

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# Next Steps On Guidelines

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- EPA is evaluating stakeholder feedback from second comment period, which ended December 16<sup>th</sup>
- EPA hopes to finalize guidelines by end of 1<sup>st</sup> quarter 2010





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# Q & A