

**Questar Gas Company - ThermWise**  
**WHOLE HOUSE AIR SEALING SPECIFICATIONS**

**December 1, 2011**

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## I. GENERAL SPECIFICATIONS

1. These specifications apply to existing residential (retro-fit) whole house air sealing for single family homes. Also applies to existing attached single family homes, that are on their own foundation and have their own roof (i.e., townhomes), in buildings consisting of four or less attached homes. Does not apply to multi-family homes or apartment buildings.
2. Air sealing shall be installed in accordance with these specifications, all applicable State and local codes, and federal regulations. In cases where a federal, state or local code or regulation exceeds the requirements herein, that code or regulation shall apply. If the federal, state or local code or regulation does not exceed the requirements herein, then the requirements contained in this specification shall apply.
3. All work shall be completed in a manner that will provide a safe, permanent, effective, and professional installation.
4. Whole House Mechanical Ventilation Compliance, see Section MV, is required on all projects.. Whole house air sealing includes a pre and post blower door test, and a measurement of building tightness.
5. All homes that have Whole House Air Sealing shall receive:
  - a) *Care for Your Air: A Guide to Indoor Air Quality, EPA*
  - b) *Indoor Air Quality Homeowner Disclosure Form*

## II. GENERAL MATERIAL SPECIFICATIONS

1. Materials used shall meet or exceed applicable local, state and federal codes and regulations. All materials shall be installed in accordance with manufacturer's instructions.
2. All materials shall be resistant to corrosion, degradation from ultraviolet light, and be compatible with other elements and materials (e.g. will not react chemically, etc.) so as to enhance long life expectancy of installed measures.
3. Structural members and building components shall be free of decay and structurally sound before the weatherization measure is installed.
4. Weatherization materials, products and labor shall be warranted by the Installer against failure due to manufacturing and installation defects for a period of at least 1 year from the installation date. The Installer shall provide a written warranty, with the installation date, to the Homeowner or Homeowner Designee. Manufacturers' written warranties may be used by Installers to satisfy a part of this requirement where appropriate.
7. Caulking shall be one of the following materials conforming to the federal specifications listed below or material demonstrating equivalent performance in resiliency and durability. The cartridge or tube containing the caulking material shall be labeled indicating conformance to the applicable federal specification:

- |  |            |
|--|------------|
| a) Silicone Rubber                                     | TT-S-1543A |
| b) Polysulfide or Polyurethane<br>(single component)   | TT-S-230C  |
| c) Polysulfide or Polyurethane<br>(multiple component) | TT-S-227E  |
| d) Acrylic Terpolymer<br>(single component)            | TT-S-230C  |
| e) Butyl Rubber  | TT-S-1657  |
| f) Acrylic Latex                                       | ASTM C834  |

### 8. Installer Record

The Installer of any measure covered by this specification manual shall provide a copy to the utility, and permanently post, an Installer Record, at the furnace, electrical panel or circuit box or other location approved by the homeowner as a record of work performed, containing the following information as applicable:

- a) Residence address.
- b) Installation date.
- c) Name, address and phone number of the Installer.
- d) Any air sealing that was completed, with final whole house leakage test results if applicable. List primary areas or building components that were air sealed. List any special conditions existing during leakage testing.
- e) List and describe any new fans or mechanical ventilation systems installed, including design airflow rate and control strategy.

### **III. General Requirements**

#### **1. Combustion Appliance Exhaust Ventilation Inspection**

- a) Combustion heating and water heating systems shall be visually inspected at accessible locations for readily apparent signs of improper venting and to observe that combustion vent flue terminates outdoors. Visual inspections shall be documented by contractor.
- b) Repairs shall be made prior to project completion to assure that exhaust venting at accessible locations is continuously connected between the appliance and outdoors ending in a code approved vent cap.
- c) Homeowners shall be notified of observed signs of improper venting, damaged venting, corrosion or deterioration of equipment or venting system and encouraged to contact a heating or water heating contractor or fuel utility for further inspection.
- d) Gas clothes dryers shall be vented to outside.
- e) Homes with unvented combustion heating appliances are not eligible.

#### **2. Carbon Monoxide Detectors**

##### **All Carbon Monoxide Detectors shall:**

- a) Be Underwriters Laboratories Tested and Listed to ANSI/UL 2034-09
- b) Include an electrochemical sensor
- c) Be powered by long-life lithium type battery
- d) Include a digital readout that automatically displays the current CO level detected when an alarm signal is activated
- e) Include a data feature which is activated when the test/reset or memory button is pressed, and the readout shall include the current CO level detected down to 10 parts per million (ppm), the highest level detected down to 10 ppm, and for how long the peak level was detected

##### **Locked Battery Compartment**

- a) Battery shall be factory pre-installed within a compartment which has a separate battery door that is locked closed with a tamper-resistant screw
- b) Battery compartment shall not be accessible without removing alarm from its mounting

#### **Five-Year Warranty**

CO detector manufacturer shall warrant alarm and sensor for minimum 5 years, and shall guarantee that battery provided will power alarm for minimum 5 years without replacement

##### **Installation Requirements**

- a) CO detector shall be installed in all family living units containing a permanently installed combustion appliance.
- b) CO detector installed in accordance to manufacturer installation instructions
- c) Detector shall not be installed within unconditioned space, furnace closet or garage

##### **Occupant Education**

- a) The CO detector shall be tested upon completion of installation, and the occupant shall be instructed how to operate, test and maintain the alarm
- b) The occupant shall be provided with the manufacturer's owner's manual

#### **3. Interior Attic Access Doors**

- a) Weather-stripping shall be permanently attached to create an effective air seal between the attic access frame and the door. Accesses with air leaks that cannot be weather-stripped shall be

repaired or replaced prior to insulating. Ceiling accesses shall be insulated to at least R-30 with batt-type or rigid insulation. Alternatively, R-10 or greater rigid insulation securely attached to the top surface of the access cover is allowed. Insulation must be sealed around the perimeter to the access cover using caulk, adhesive or spray foam. Access cover assembly must be tightly sealed using weather stripping around the entire perimeter.

- b) Batt-type insulation shall be attached to the door with twine. The twine shall be stapled to the edges of the door. Stapling the insulation directly to the door is unacceptable. Fibrous insulation must be covered with a vapor permeable air barrier material.
- c) Attic accesses shall be protected from having loose-fill insulation fall through the opening. The full level of ceiling insulation shall be maintained to the edge of the attic access opening by one of the following methods:
  - I. The opening may be framed with wood or plywood boards. The framing shall be permanently attached and extend at least 4 inches above the final level of insulation. **Cardboard or foam board are not acceptable for attic access damming.**
  - II. A minimum 14-1/2-inch wide insulation batt laid flat, with an R-value equal to that specified for the attic, may be placed tightly around the perimeter of the access opening. This 14-1/2 inches shall be maintained in all outward directions from the access opening, including corners. Scoop out all loose-fill insulation from the edges before laying batts.

#### **4. Pull-Down Stairs**

Pull-down stairs in heated areas shall be weather-stripped and insulated to a minimum of R-10. Insulation and weather-stripping shall be installed to allow easy operation of the stairs. Factory or site-built pull-down stair covers shall have a minimum R-10. New pull-down stair assemblies with a minimum R-5 insulation rating will be permitted provided the insulation is between conditioned space and the attic stair assembly and gaskets or weather-stripping prevent air infiltration.

#### **5. Crawl Space Access Doors**

Weather-stripping shall be permanently attached to create an effective air seal between the crawl space access frame and the door. Access door to be insulated with R-5 or greater rigid insulation securely attached to bottom side of door panel

#### **6. Exterior Attic Access Doors**

Any outside access shall have a door that is constructed for continuous exposure to exterior conditions.

## **IV Air Sealing & Testing**

Whole House Air Sealing includes a pre and post blower door test, and a measurement of building tightness.

### **1. Air Sealing Requirements**

- a) All accessible and applicable items on **AIR SEALING CHECKLIST** shall be sealed.
- b) Whole house air sealing requires compliance with Section V – Mechanical Ventilation.
- c) Air leakage testing, in accordance with Section 4, shall occur immediately prior to the installation of any air leakage control measures. Post-installation testing shall occur immediately following the installation of air leakage control measures.
- d) Pre and post blower door tests will be done by a BPI certified building analyst approved by program, or by a Questar Gas Company energy auditor.
- e) All air sealing work to be performed by contractor approved by program.
- f) Combustion Appliance Zone testing shall be performed in accordance with Section 4.
- g) All locations except the following are considered to be accessible:
  - I. Locations not physically accessible due to building structure or mechanically fastened materials
  - II. Top plates located adjacent to eave line
  - III. Top plates covered by more than ten inches of loose-fill insulation or a combination of loose-fill and batt/blanket insulation totaling R-30 or more.

All accessible and applicable items on **AIR SEALING CHECKLIST** shall be addressed.

**AIR SEALING CHECKLIST**

Attic		
	<b>Item</b>	<b>Sealing requirements between conditioned and unconditioned space/exterior</b>
	Attic hatch/door	Weather-stripping permanently attached to create an effective air seal between the attic access frame and hatch/door
	Pull down stair cover	Gasket or weather-stripping permanently attached between frame and door or air-tight cover installed between stairs and attic
	Duct penetrations	Foam/caulk or other air-tight seal around perimeter of duct boots between the boot and the subfloor
	Chases	Foam/caulk/rigid material sealed to attic floor/wall; use fire rated materials at chimneys and flues
	Recessed cans	Foam/caulk or other air-tight seal between fixture and ceiling or install air-tight drywall, sheet metal, or other non-combustible assembly; maintain 3" space between non-IC rated fixtures and insulation ; Do not insulate above non-IC rated fixtures
	Bath fans	Foam/caulk or other air-tight seal around fixture perimeter
	Bath fans with heat source	Fire rated materials shall be used. Foam /caulk/ rigid sheet if opening larger than 1 inch
	Electrical penetrations	Foam/caulk or other air-tight seal around perimeter of electrical junction box
	Plumbing penetrations	Penetrations sealed
	Top plates	Accessible drywall to top plate connections, wood to wood seams, other wall penetrations sealed with foam/caulk
	Drop soffits	Rigid material covering attic floor opening and sealed with foam/caulk
Kneewall doors	Weather-stripping permanently attached to create an effective air seal between the attic access frame and hatch/door. Install latch or handle if necessary	

	Kneewall transition (under floor paths)	Rigid material between joists; Foam/caulk perimeter of each rim joist
	Kneewall bottom plates	Floor/floor plate connection sealed with foam/caulk
	Open wall cavities	Rigid material sealed to attic floor/wall
Crawl Space/Unconditioned Basement	<b>Item</b>	<b>Sealing requirements between conditioned and unconditioned space/exterior</b>
	Crawlspace hatch/door	Weather-stripping permanently attached to create an effective air seal between the crawl space access frame and hatch/door
	Chases	Foam/caulk/rigid moisture resistant material sealed to ceiling/wall; use fire rated materials at chimneys and flues
	Duct penetrations	Foam/caulk or other air-tight seal around perimeter of duct boots between the boot and the subfloor
	Plumbing penetration	Penetrations sealed; Rigid moisture resistant material sealed to crawl space/basement ceiling if opening larger than 1 inch
	Electrical penetrations	Foam, caulking; Rigid material sealed to crawl space/basement ceiling if opening larger than 1 inch
	Other open cavities	Rigid material sealed to ceiling
Conditioned Basement	<b>Item</b>	<b>Sealing requirements between conditioned and unconditioned space/exterior</b>
	Sill plate/stem wall	Sill plate to stem wall connection sealed with foam/caulk
	Rim joists	Rigid material between joists; Foam/caulk perimeter of each rim joist



Walls Separating Conditioned Space From Exterior/Unconditioned Space	Item	Sealing requirements between conditioned and unconditioned space/exterior
	Plumbing penetrations	Foam /caulk/rigid moisture resistant material if opening larger than 1 inch
	Doors	Weather-stripping and door sweep/air-tight threshold permanently attached to create an effective air seal between interior and exterior/unconditioned space
	Other unintentional opening	Sealed with appropriate material if accessible
	Electrical boxes (optional)	Seal box to drywall
	Baseboards (optional)	
	Door & window trim (optional)	
	Window weather-stripping (optional)	

## 2. Sealing Floor Penetrations

Air sealing shall not prohibit drainage or maintenance of plumbing system.

## 3. Air Leakage Testing Protocol

- a) All windows and doors shall be properly closed, including pass-through wood-box doors and pet doors. All interior doors shall be left open.
- b) Ventilation openings:  
All exhaust fan openings, vent openings, and intake-air vents with backdraft dampers (e.g., dryer vents and kitchen, bathroom, utility room, whole-house, range vents, etc.) shall NOT be sealed.
- c) Exterior vent openings without backdraft dampers (e.g., some continuous ventilation systems) shall be temporarily sealed for the test. Heat recovery ventilator supply openings shall be sealed. Heat recovery ventilator exhaust openings should have backdraft dampers and shall not be sealed.
- d) When measuring house leakage to determine overall leakage and Mechanical Ventilation, supply and return registers shall be open.
- e) Combustion appliances:  
All flue dampers, fireplace doors, and wood burning stove doors shall be closed, but NOT sealed. In conditions of gas logs in solid-fuel-burning fireplaces, the permanently blocked open dampers shall NOT be closed nor sealed.
- f) Equipment Set-up:  
The blower door and digital manometer equipment shall be set-up using the manufacturer instructions for depressurization to 50 Pa.
- g) Quantifying Air Leakage Reduction:  
Air leakage reduction is determined by the difference between pre-and post-measure  $efmCFM50$ . The post-measure  $efmCFM50$  is also used to determine if mechanical ventilation is required. See section V.

#### 4. Combustion Appliance Safety Testing

- a) In homes with one or more combustion appliances for the purpose of space heating or water heating, combustion safety testing shall be performed both before and after air sealing.
- b) A combustion appliance is any appliance that burns fuel, such as natural gas, propane, oil, or wood. This includes furnaces, boilers, water heaters, wood stoves, and fireplaces (in case of wood stoves and fireplaces normally used for space heating, safety tests may be limited to worst-case CAZ depressurization test, with depressurization limit of -5 Pa).
- c) The following tests are required at minimum, with test procedures and action levels as specified in *Building Performance Institute Technical Standards for the Building Analyst Professional* (BPI Standards):
  - Carbon monoxide test of undiluted flue gas.
  - Ambient carbon monoxide test of CAZ.
  - Spillage test.
  - Draft test.
  - Worst-case CAZ depressurization test.
  - Gas supply line leak test.

Note: The BPI Standards sections 'Health and Safety' and 'Combustion Safety and Carbon Monoxide Protection' are included within these specifications by reference.

## V Mechanical Ventilation

### 1. General Mechanical Ventilation Requirements

All homes that have whole house air sealing performed shall receive:

*Care for Your Air: A Guide to Indoor Air Quality, EPA*

*Indoor Air Quality Homeowner Disclosure Form*

Whole House Mechanical Ventilation Compliance is required for homes where Whole House Air Sealing is performed.

### 2. Spot Ventilation

#### **Bath & Kitchen Fans**

- a) All exhaust fans shall be vented to the exterior of the structure, with ducts mechanically fastened and air-sealed to the termination or the vent.
- b) Any newly installed exhaust fan ducts must be sized according to Exhaust Fan Prescriptive Duct Sizing requirements and installed in meeting following requirements:
  - a. Exhaust ducts in unconditioned space shall be insulated to a minimum of R-4.
  - b. Exhaust fan ducts shall not sag, and shall be as straight as possible to maximize effective air flow, and have no more than two 90-degree turns, or equivalent.
  - c. Exhaust ducts shall be securely attached at each joint and to the fan housing using mechanical fasteners, such as sheet metal screws or a securely tightened metal clamp. Fasteners shall not interfere with damper operation.
  - d. Exhaust duct shall be sheet metal or HVAC flex-duct and insulated to a minimum of R-4. Vinyl coil duct is not allowed.
- c) Existing vent ducts may remain if they are free of holes and kinks and are in otherwise good condition, provided they are vented to the exterior, free of gaps, and sealed to prevent exhaust air from entering back into the attic.

#### **Kitchen Fans**

- a) Non-recirculation kitchen range exhaust fans ducts shall be vented to the exterior of the structure, with ducts mechanically fastened and air-sealed to approved metal termination. Venting kitchen fans to existing plastic ducts and plastic roof vents is not allowed
- b) Any newly installed kitchen exhaust fan ducts must be sized according to Exhaust Fan Prescriptive Duct Sizing requirements.
- c) Kitchen range exhaust fans vented through the ceiling shall be connected to a duct made of 28-gauge galvanized steel, stainless steel, aluminum, or copper (IMC 505.1) which is substantially airtight throughout and which terminates directly to the outside through an approved metal termination. Backdraft dampers are recommended. Existing installations that substantially meet these requirements are acceptable.

#### **Downdraft Exhaust Fans**

Downdraft exhaust ducts may have one 90-degree turn, shall exit through the foundation or exterior wall, be sealed (with no visible gaps) to a vent cap designed for kitchen exhaust. Unless otherwise

allowed by local code, downdraft exhaust ducts shall comply with material requirements for Kitchen Fans.

### **Dryer Exhaust**

Dryer exhaust ducts shall be vented to the exterior of the structure, sealed to prevent exhaust air from entering the building, shall have a back-draft damper, and shall terminate in a code-approved vent cap.

New dryer ducts shall be rigid metal and shall be securely connected with mechanical fasteners and permanently supported. Exhaust systems shall comply with local code and manufacturer specifications, be as straight as practical, sloped downward to allow condensate drain, and shall not exceed 25 feet. To prevent blockage with lint, new dryer vent ducts shall not be connected with screws. A metal clamp or UL-rated foil tape may be used to secure dryer duct connections.

### **Exhaust System Makeup Air**

Exhaust systems capable of exhausting in excess of 450 CFM shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system. Exceptions: When there are no atmospherically vented or solid-fuel burning combustion appliances within pressure boundary of house, or for whole-house ventilation fans designed for summer house cooling with windows opened.

## Exhaust Fan Prescriptive Duct Sizing

Use table below to size new exhaust fan ducts correctly.

Duct Type	HVAC Flex Duct				Smooth Hard Duct			
Fan Rating in CFM	50	80	100	125	50	80	100	125
Duct Diameter	Maximum Duct Length in Feet							
3"	not allowed	not allowed	not allowed	not allowed	5	not allowed	not allowed	not allowed
4"	70	3	not allowed	not allowed	105	35	5	not allowed
5"	unlimited	70	35	20	unlimited	135	85	55
6"	unlimited	unlimited	125	95	unlimited	unlimited	unlimited	145
7"	unlimited	unlimited	unlimited	unlimited	unlimited	unlimited	unlimited	unlimited
<b>Table assumes no elbows. Deduct 15 ft of allowable duct length for each elbow.</b>								

Table adapted from ASHRAE Standard 62.2 (2010), page 6, Table 5.3.

### 3. Whole-House Mechanical Ventilation

- As part of air sealing as a program measure, whole-house mechanical ventilation systems shall exist or be installed and shall provide airflow rates as calculated by the Whole House Ventilation Calculator.
- Ventilation provided by the whole-house mechanical ventilation system shall provide air flow calculated by the Whole House Ventilation Calculator. Air flow rates shall be tested by the contractor and not based on the rated air flow rate of the fan.
- The whole-house mechanical ventilation system shall run automatically either continuously or intermittently on a timer.
- Whole house mechanical ventilation is not required if Whole House Ventilation Calculator shows required whole-house fan measured flow rate of zero cfm.
- Note: These mechanical ventilation procedures are to be used in lieu of procedures contained in the section 'Building Airflow' of the \BPI Standards.

### Exhaust Fans

Exhaust fans installed for whole house mechanical ventilation purposes shall be ENERGY STAR compliant, have a sone level of 1 or less, and be rated for continuous operation.

### Heat Recovery Ventilation

Energy or Heat Recovery Ventilators installed for whole-house mechanical ventilation purposes shall be certified and listed in the Home Ventilating Institute directory, shall be ENERGY STAR compliant and

rated for continuous operation. Any ducts installed as part of a Heat Recovery Ventilation system shall be sealed and insulated as required by code for heating/cooling ducts.

### **Bathroom Fans as Whole-House Fans**

Bathroom exhaust fans may be used to provide whole house ventilation as well as bathroom spot ventilation provided all of the following conditions are met:

- a) A minimum 1" clearance under the bathroom door to provide for a clear air pathway to the rest of the house when the bathroom door is closed. Or an alternative equivalent means of providing a clear air pathway is installed.
- b) The fan shall have both automatic and manual controls.
- c) The fan is set to run automatically either continuously or intermittently on a timer.
- d) There is a manual control switch for spot-ventilation purposes.
- e) All conditions of Spot Ventilation requirements must be met.

### **Fresh Air Inlets**

Air inlets that are part of the ventilation system shall be located a minimum of 10 feet from known sources of contamination such as stack, vent, exhaust hood, or vehicle exhaust. The intake shall be placed so that entering air is not obstructed by snow, plantings, or other material. Inlets shall have rodent/insect screens with mesh not larger than 1/2 inch.