June 2018

Residential Air Leakage (Blower Door) Testing for Florida Code Compliance

Infiltration uncontrolled air leakage into buildings is a result of the number and size of cracks and gaps in the building's thermal envelope (its floor, walls, ceilings, windows, and doors) and the natural and mechanical air pressure "driving forces" that the building experiences. Natural driving forces include wind, ~~stack effect" (air motion in buildings related to indoor-to-outdoor temperature difference and height)~~ and atmospherically vented combustion appliances. Mechanical driving forces include fans (such as exhaust and air handler fans), duct leakage, and interior door closure (closing doors restricts airflow between rooms and the main body of the building).

To address the energy and indoor air quality impacts of air leakage in homes, the current Florida Building Code includes a building air leakage testing requirement for new Florida homes and stipulates both a maximum air leakage rate and, at the lower end, an air leakage rate "trigger" at which whole-house mechanical ventilation is required.

As discussed in more detail later in this guide, the air leakage test (or "blower door test") uses a calibrated fan and digital pressure gauge to either pressurize or depressurize a home to a standard test pressure of 50 Pascals ~~with respect to the outside and measure the air leakage flow at that pressure. Standardization of the test procedure allows the air leakage of one home to be compared with that of another, and with the Code maximum of seven air changes per hour at 50 Pascals test pressure, or "7 ACH50."~~

If the tested air leakage of a new home is less than three air changes per hour at 50 Pascals test pressure (3 ACH50), current Florida Code requires whole-house mechanical ventilation be provided for it.

Why is uncontrolled air leakage important?

As its name implies, uncontrolled air leakage is outdoor airflow into buildings that is not planned or intended. While some level of outdoor air is important, too much will increase energy use, and in hot-humid climates like Florida's, introduce a lot of moisture. This air may also be pulled into the building from undesirable locations such as the attic or garage. In more extreme cases, uncontrolled airflow can lead to significant indoor air quality issues. ~~As houses become more airtight, outdoor air is brought in via whole-house mechanical ventilation to decrease indoor pollutant concentrations,~~ but unlike uncontrolled air leakage, mechanical ventilation allows control over how much air is brought in and the location from which it is drawn.

UCF | FSEC Energy Research Center
UNIVERSITY OF CENTRAL FLORIDA

Summary of Comments on BLDG-75-DRAFT_Info_Guide Stewart Comments.pdf

Page: 1

Number: 1 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:55:49 AM

Use code definition: **INFILTRATION.** The uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building FSEC response: We will change to actual code definition for the final version.

Number: 2 Author: AZ Stewart Subject: Cross-Out Date: 7/22/2018 2:32:15 PM

Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 2:32:44 PM

Why even mention Stack effect since it's been said in the Energy TAC many times that Florida has no Stack effect to speak of? FSEC response: Stack effect is included in the 2017 FEC Infiltration definition and while not as great a factor here as in other climates, still does occur in Florida.

Number: 3 Author: AZ Stewart Subject: Cross-Out Date: 7/23/2018 10:38:37 AM FSEC response: We don't see a #3 comment in the guide.

Number: 4 Author: AZ Stewart Subject: Highlight Date: 7/23/2018 10:36:02 AM

Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 12:01:04 PM

Strike This point is still controversial and there are no explicit code provisions for decreasing indoor pollutants. FSEC response: The idea that mechanical ventilation is intended to decrease indoor pollutant or contaminant levels is well established (e.g. see EERE/PNNL ventilation document referenced at end of this guide). The exception provided in Section 403.2 of the 2017 Florida Mechanical Code also acknowledges the relationship between ventilation and contaminant concentration.

Number: 5 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 2:33:26 PM

Break up the run on sentence, it is confusing for people who don't know about air flow FSEC response: We agree this is a relatively long sentence-- we will break up by adding a period after "homes."

Number: 6 Author: AZ Stewart Subject: Cross-Out Date: 7/23/2018 10:37:45 AM

Number: 7 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:57:17 AM

"With respect to" is an important concept for testers and is covered later but to introduce it here just opens up confusion. FSEC response: The beginning of this sentence explains that the the test will be discussed in more detail later, and this is the more in depth document, so it is appropriate to keep as-is.

Number: 8 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:58:06 AM

Comparison of one house to another is non-germane and just offers another bamboozle point. The whole point of a 'standard' is to keep a practice consistent across many types. Therefore it doesn't need to be explained here FSEC response: We think the home comparison language is helpful and it is preferable to keep it as is.

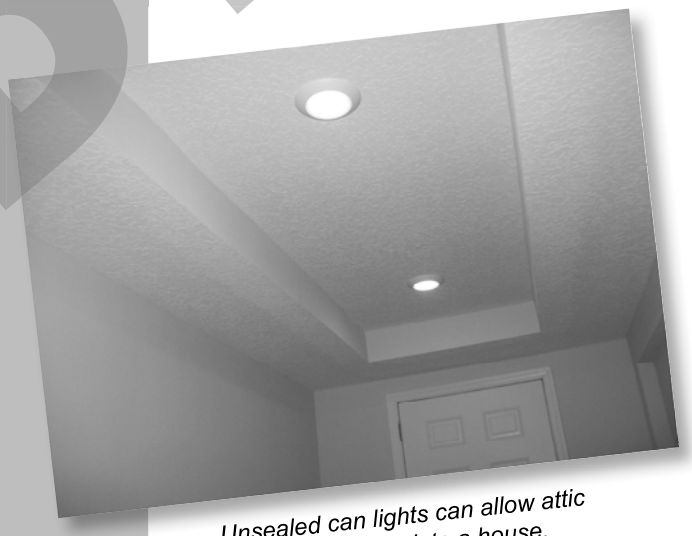
Number: 9 Author: AZ Stewart Subject: Cross-Out Date: 7/23/2018 10:38:05 AM

Class: A legacy term under the Building Energy Efficiency Rating System as maintained by the Department of Community Affairs according to FS 553.990-999. In the accompanying Rule, a number of rater 'classes' were established. A Class 3 was certified to evaluate the energy efficiency of residential buildings from plans, while a Class 2 added on-site inspections to the Class 3 skill set. Only Class 1 were certified to conduct all aspects of residential energy evaluation including blower door and duct testing. Therefore while all system participants were called "raters", the system limited certification activities of Class 2 and 3 raters since the Class scope did not include testing.

APPROVED
Approval by the code official as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

BLOWER DOOR
A powerful fan that mounts into the frame of an exterior door and pulls air out of a building, lowering the air pressure inside the building with respect to the outside; the higher outside air pressure then causes air to flow in through all unsealed cracks and gaps.

BUILDING THERMAL ENVELOPE
The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.



Unsealed can lights can allow attic air to infiltrate into a house.

ENERGY AUDITOR
A trained and certified professional who conducts energy evaluations of an existing building and uses tools to identify the building's current energy usage and the condition of the building and equipment.

ENERGY RATER
An individual certified by a building energy-efficiency rating system to perform building energy-efficiency ratings for the building type and in the rating class for which the rater is certified.

INFILTRATION
The uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building caused by pressure differences across these elements due to factors such as wind, inside and outside temperature differences (stack effect), and imbalance between supply and exhaust air systems.

OUTDOOR (OUTSIDE) AIR
Air that is outside the building envelope or is taken from outside the building that has not been previously circulated through the building.

VENTILATION
The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

WHOLE HOUSE MECHANICAL VENTILATION SYSTEM
An exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates.

All definitions from Chapter 1 of the residential provisions of the Florida Building Code, Energy Conservation except Blower Door adapted from energy.gov Blower Door Tests article and Energy Auditor and Energy Rater from 553.993(5) or (7), *Florida Statutes*.

Number: 1 Author: AZ Stewart Subject: Text Box Date: 7/25/2018 11:59:36 AM

Class: A legacy term under the Building Energy Efficiency Rating System as maintained by the Department of Community Affairs according to FS 553.990-999. In the accompanying Rule, a number of rater 'classes' were established. A Class 3 was certified to evaluate the energy efficiency of residential buildings from plans, while a Class 2 added on-site inspections to the Class 3 skill set. Only Class 1 were certified to conduct all aspects of residential energy evaluation including blower door and duct testing. Therefore while all system participants were called "raters", the system limited certification activities of Class 2 and 3 raters since the Class scope did not include testing.

Number: 2 Author: AZ Stewart Subject: Highlight Date: 7/25/2018 11:12:51 AM

Number: 3 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:14:45 AM

Both system and class should be defined to provide a complete understanding to the reader. The system definition is found at FS 553.993(3) FSEC response (to comments 1-4): We have used the actual FS 553.993 language here; any additions could lead to complaints by others.

Number: 4 Author: AZ Stewart Subject: Highlight Date: 7/25/2018 11:12:46 AM

Number: 5 Author: AZ Stewart Subject: Sticky Note Date: 7/23/2018 10:34:34 AM

use Code definition:The uncontrolled inward air leakage through cracks and crevices in any building element and around windows and doors of a building FSEC response: We do not understand this comment-- we have already used the full, word-for-word 2017 FEC definition of Infiltration in the original guide (commenter has not included the full definition here).

Number: 6 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 2:41:49 PM

why is statute and code quoted sometimes and not others? FSEC response: All definitions are from the 2017 FEC or FS 553.993 except Blower Door which is not defined in the code.

Number: 7 Author: AZ Stewart Subject: Sticky Note Date: 7/23/2018 10:35:09 AM

Use code definition:
VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

FSEC response: Same as for Infiltration comment above-- we do not understand this comment-- we have already used the full, word-for-word 2017 FEC definition of Ventilation in the original guide.

Number: 8 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:30:50 AM

Two definitions (infiltration and ventilation) do not reference the code. They should changed to match the code FSEC response: We again do not understand this comment; both the Infiltration and Ventilation definitions used in the guide are word-for-word from the 2017 FEC.

Florida Building Code Testing Requirements

The 6th Edition (2017) Florida Building Code air leakage testing requirements are specified in Section R402.4.1.2 of the residential Energy Conservation volume. This code section stipulates maximum leakage rates, how the test is to be conducted, who can conduct the testing, reporting requirements, and at what point in construction the test can be performed:

"The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding seven air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380 and reported at a pressure of 0.2 inch w.g. (50 pascals). Testing shall be conducted by either individuals as defined in Section 553.993(5) or (7), Florida Statutes, or individuals licensed as set forth in Section 489.105(3)(f), (g) or (i) or an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope…"

Note that the maximum air leakage rate allowed in Florida (Climate Zones 1 and 2) is up to 7 air changes per hour at a pressure of 0.2 inch w.g., or 50 pascals (also written as "7 ACH50").

Per the Florida Statutes referenced in Section R402.4.1.2 above, individuals qualified to provide air leakage testing include energy auditors, energy raters, Class A or B air-conditioning contractors and mechanical contractors, plus approved third parties. For the purposes of this code section, an approved third party is an individual approved by a code official to perform air leakage testing not affiliated with the building design or construction.

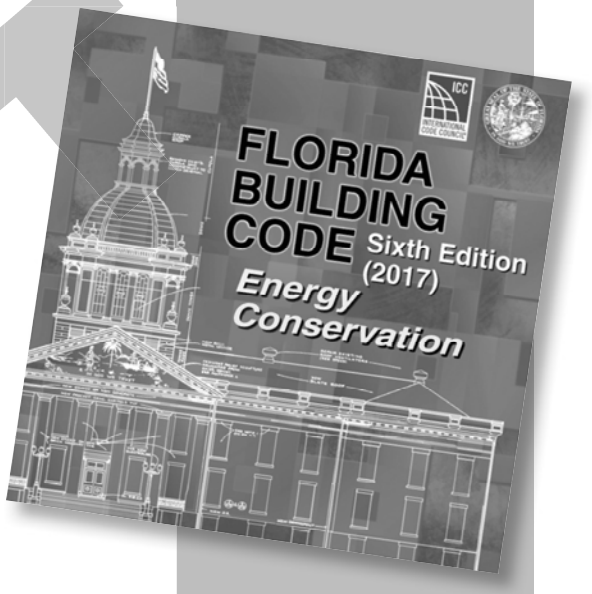
wo testing exceptions are provided:

es that dwelling units of R-2 Occupancies and multiple attached single family dwellings are permitted to comply with Section C402.5 of the commercial provisions of the Florida Energy Code. Section C402.5 allows thermal envelope leakage compliance via either a list of prescriptive requirements or through air leakage testing.

- Section R402.4.1.2 lies the testing requirement for additions, alterations, renovations or repairs to an existing home's building thermal envelope if the new construction is less than 85 percent of the thermal envelope.

As homes become more airtight, whole-house ventilation systems are installed to mechanically exchange indoor air with outdoor air. The 6th Edition (2017) Florida Building Code, Residential volume requires whole-house mechanical ventilation when the air infiltration (leakage) rate in a home under standard test conditions is less than 3 (ACH50 < 3). Section R303.4 states:

"Where the air infiltration rate of a dwelling unit is less than 3.00 air changes per hour where tested with a blower door at a pressure of 0.2 inch w.c (50 Pa) in accordance with Section R402.4.1.2 of the Florida Building Code, Energy Conservation, the dwelling unit shall be provided with whole-house mechanical ventilation in accordance with Section M1507.3."



Who can perform a blower door test?

Per the Florida Statutes referenced in Section R402.4.1.2, individuals qualified to provide air leakage testing include energy auditors, energy raters, Class A or B air-conditioning contractors and mechanical contractors, plus approved third parties. For the purposes of this code section, an approved third party is an individual approved by a code official to perform air leakage testing not affiliated with the building design or construction.

Page: 3

Number: 1 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 2:47:58 PM

exempts FSEC response: We will change to "exempts" for the final version.

Number: 2 Author: AZ Stewart Subject: Cross-Out Date: 7/22/2018 2:48:04 PM

Number: 3 Author: AZ Stewart Subject: Highlight Date: 7/22/2018 2:49:00 PM

Number: 4 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 2:48:54 PM

use this language in the shorter document instead of comment about indoor pollutants

Number: 5 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 12:02:48 PM

putting these concepts in two columns of unequal width adds to the difficulty in understanding the concepts. Just repeating the code section in subsequent paragraphs doesn't help with further understanding FSEC response: The final version will be edited to remove redundant text.

Number: 6 Author: lehma Subject: Highlight Date: 7/19/2018 3:37:21 PM FSEC response: As stated in the Fact Sheet comment response, "not affiliated with the building design or construction" as added here by the commenter is not included in 2017 FEC R402.4.1.2, but is included in Chapter 1 Section R103.3 regarding examination of documents and R104.4 regarding approved inspection agencies. An authoritative decision whether to include this additional text would be needed.

Number: 7 Author: lehma Subject: Highlight Date: 7/19/2018 3:34:43 PM FSEC response: Same as for comment #6 above.

Understanding the test process

Pressure Measurement

The natural and mechanical air pressure driving forces that buildings experience are typically measured by digital pressure gauges in Pascals. Pascals are very small units of pressure—one Pascal (or Pa) is equal to 0.004 inches of water column or 0.000145 pounds per square inch (PSI); A sheet of notebook paper exerts about one Pascal of pressure.

Building pressure measurements are made and recorded as pressure differentials— the pressure difference between one location, room or zone and another.

Digital gauges are used to make the pressure measurements. Figure 2 shows an example of these gauges. There are two sets of pressure taps at the bottom of the gauge. The two taps on the left side, or channel, of this meter can make one differential pressure measurement and the two taps on the right channel of the meter can make another measurement (so the meter can make two separate differential pressure measurements at once). Tubes attached to the taps allow measurements to be made in various spaces or areas while the gauge can remain in a convenient location.

Blower door set up for an air leakage test.

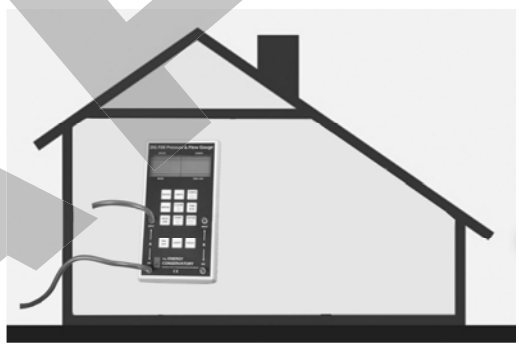


Figure 1. Measuring pressure of house main body with reference to (WRT) outside.

In the example in Figure 1, the end of the red tube is in the main body of the house while the end of the green tube is outdoors. In this case, the pressure differential between the house main body and the outdoors is being measured—or in other words—the pressure of the main body with reference to (or "WRT") the outside is being measured.

Think of it as if comparing one wall to another. When you subtract the height of one wall from another, we call the result the difference - or differential. You can't have a difference with only one number. That's why all pressure measurements are one space "with respect to" another space.

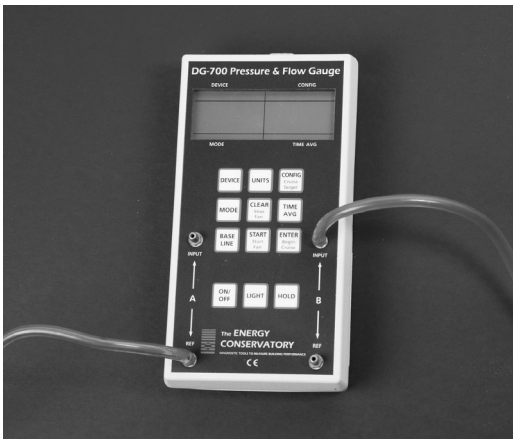
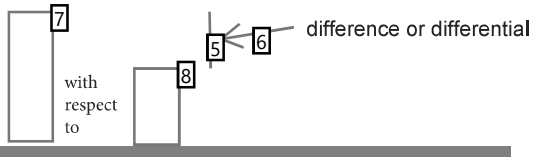


Figure 2. The Energy Conservatory DG-700 Pressure and Flow Gauge



Page: 4

Number: 1 Author: AZ Stewart Subject: Cross-Out Date: 7/23/2018 10:42:02 AM

Number: 2 Author: AZ Stewart Subject: Sticky Note Date: 7/23/2018 10:44:42 AM

Pressure measurement as a title doesn't give an uninformed reader enough reason to continue. The section is really about the test procedure FSEC response: We will change the section title to "Understanding the Test Process" in the final version.

Number: 3 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 2:54:35 PM

All pictures only include equipment from a single manufacturer. It should also include other examples lest it appear that there is an endorsement FSEC response: We will change out some images in the final version to provide some manufacturer balance.

Number: 4 Author: AZ Stewart Subject: Highlight Date: 7/22/2018 3:08:47 PM

Author: AZ Stewart Subject: Sticky Note Date: 7/23/2018 10:48:18 AM

add suggested language to give readers an understanding of what a differential is. It's tough when you don't deal with math every day to understand what a differential is - but people do know what a 'difference' is. FSEC response: Adding an additional concept here may confuse some, and we think the section already adequately discusses the concept without the additional text (we even already include the term "difference" near the top of the page to help bridge the concepts).

Number: 5 Author: AZ Stewart Subject: Line Date: 7/22/2018 3:09:28 PM

Number: 6 Author: AZ Stewart Subject: Line Date: 7/22/2018 3:09:17 PM FSEC response: See response to comment #4 above which also applies to drawing items 5-8.

Number: 7 Author: AZ Stewart Subject: Rectangle Date: 7/22/2018 3:10:24 PM

Number: 8 Author: AZ Stewart Subject: Rectangle Date: 7/22/2018 3:09:07 PM

Blower Door Components

Air leakage tests are performed using a blower door, which includes the following components:

- Digital gauge
- Calibrated variable speed fan
- Adjustable frame and curtain
- Fan speed controller with cable
- Tubing

When a qualified tester is setting-up a blower door, first the blower door frame is adjusted to fit into an exterior doorway. The frame is then removed from the doorway, the curtain is placed over the frame, and the frame and curtain combination is secured into the doorway with locking cams. The fan is then mounted into an opening in the curtain and secured to a frame crossbar with a Velcro strap, and the fan speed controller is plugged into the fan. Each calibrated fan has a pressure sensor (Figure 4) to measure the pressure at the fan with reference to the house (or where the air entering the fan is coming from). This "flow pressure" measurement is used to calculate the airflow through the fan. The fan pressure sensors require a minimum pressure to make accurate readings, so fan manufacturers provide the fans with sets of rings (Figure 5) that can be used to increase the pressure at the fan at lower flow rates. Conversely, rings can be removed to allow more airflow through the fan.

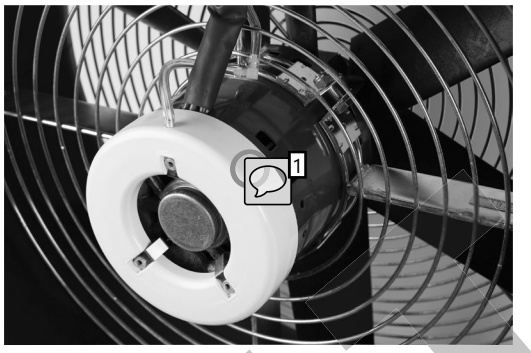


Figure 4. Pressure sensor.

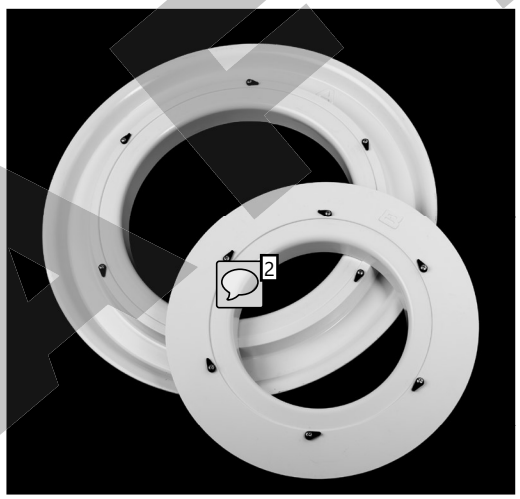


Figure 5. Rings are installed on the fan to increase or decrease airflow, thereby adjusting the flow pressure.

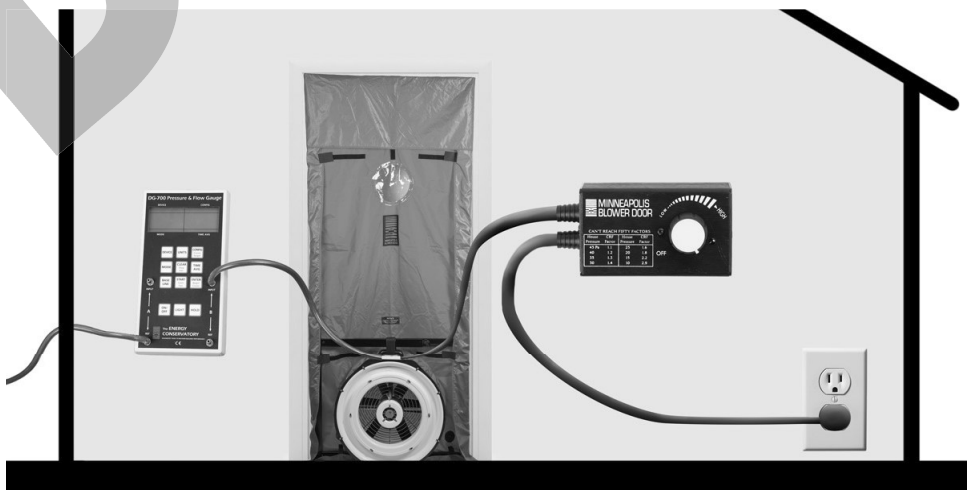


Figure 6. How blower door components are connected.

Page: 5

Number: 1 Author: AZ Stewart Subject: Sticky Note Date: 7/23/2018 11:12:55 AM

while its interesting to know there is a pressure sensor, there really isn't a connection to 'Why' that FSEC response: The reason for showing and discussing the fan sensor is discussed in the text ("...to measure the pressure at the fan...") and the section goes on to discuss how the fan pressure is used to provide airflow.

Number: 2 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 3:19:14 PM

This space is far better used for a explaning the concept of 1 cfm in = 1 cfm out FSEC response: As noted in our response to comment #1 above, we think there is good reason to keep the fan sensor image and discussion.

Number: 3 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:41:05 AM

While interesting, I think it's more important how testers use two sides of the gauge for two different measurements. They use the first side to set the pressure as dictated by the code/standard. Then they take the pressure reading from the fan which is equal to the total aggregate hole size in the building. This is where a visual of 1 cfm in = 1 cfm out should be placed. Without it, taking the flow pressure of the fan doesn't make a lot of sense, because the fan isn't a part of the building. It's easy for an uninformed reader to say so who cares about the fan? FSEC response: Fan rings are an obvious part of the blower door and important to how they operate, so it is fitting to discuss them. We also think the guide makes it very clear that the fan is an important part of the blower door test in general.

Testing and Results Reporting

A blower door test can be performed at any time, but for Florida Code compliance, it is conducted just before the Certificate of Occupancy (CO) is issued after all piping, wiring and other penetrations of the building thermal envelope have been sealed. When conducting a blower door test, a qualified tester first prepares the house by:

- Closing all exterior doors and windows
- Opening all interior doors
- Turning off the heating and cooling system(s)
- Turning off all fans that supply air to the house or exhaust air from it
- "Safe-ing" all atmospherically vented combustion appliances by adjusting thermostats so they do not come on during the test.
- If there is a fireplace, making sure there are no hot ashes (if hot ashes, test cannot be conducted), closing the fireplace doors and/or dampers and either vacuuming cold loose ashes or covering them with newspaper.

WARNING!

Due to the potential for combustion and other health and safety issues, blower door testing should only be conducted by trained, qualified individuals.

Either a single- or multi-point blower door test can be conducted. A single point test only measures leakage at one house pressure (house With Reference To outside) of approximately 50 Pascals, while a multi-point test measures leakage over a range of house pressures (from approximately 15 Pascals to 55 Pascals). A single point test is quicker, but analysis of multi-point test results will provide additional leakage characteristic information (e.g. whether the leakage is from a larger number of smaller, thinner cracks and gaps, or smaller number of larger openings). Either test will provide adequate air leakage measurements for code compliance purposes.

In each single-point test, the tester will first take indoor and outdoor temperature measurements and baseline house WRT outside pressure readings with the blower door fan off and sealed, which are all used to increase the accuracy of the test results. The tester then conducts the blower door test and records the house pressure, fan ring used for the test and fan pressure. ~~Entering the fan ring and fan pressure measurement together with temperature and baseline pressure readings and house altitude into software included onboard the digital gauge or other testing software provides the corrected fan airflow rate in cubic feet per minute (CFM50).~~ Example single-point test data is provided in Table 1.

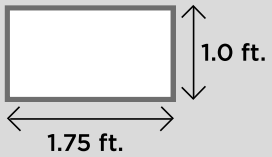
House Pressure (Pa)	Ring (Open, A, or B)	Fan Pressure (Pa)	Corrected Fan Flow (cfm)
50.2	A	96.3	1,940

Table 1. Example single-point blower door test data.

The CFM50 value and conditioned volume of the house can then be used to calculate air changes per hour at 50 Pascals (ACH50):

$$ACH50 = \frac{CFM50 \times 60}{\text{Conditioned Volume}}$$

The CFM50 leakage value is proportional to the number and size of cracks and gaps in the building's thermal envelope and can provide an estimate of the combined area of the holes in the envelope. This equivalent hole size is approximated, in square inches, by multiplying the CFM50 result by a 0.13 conversion factor. So the estimated equivalent hole size of the example house is 1,940 x 0.13 = 252.2 square inches, or 1.75 square feet.



Page: 6

Number: 1 Author: AZ Stewart Subject: Cross-Out Date: 7/22/2018 3:19:55 PM

Number: 2 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 12:03:40 PM

Strike the word Just because the code allows any time when the penetrations are sealed. This is a significant range of time over the build. The test window shouldn't be artificially restricted FSEC response: "We will remove "just" for the final version.

Number: 3 Author: AZ Stewart Subject: Cross-Out Date: 7/25/2018 11:45:11 AM

Number: 4 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:46:20 AM

There is no current code requirement to have a computer to run this test. This is unnecessary expense. Raters were taught years ago how to fill out this table without a computer. The fan flow is a function of information from the manufacturer of the equipment, which MAY be on an app or computer program FSEC response: We will not refer to software in the final version.

Number: 5 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:48:53 AM

This concept needs a visual better what this calculation means in conjunction with 1 cfm in = 1 cfm out FSEC response: We think making the one connection here between leakage values and hole size is helpful as-is; adding another concept may be confusing.

Number: 6 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:47:51 AM

Temperature readings were not part of the ICC 380 -2016 standard as adopted with the FBC. it is a continuous maintenance standard, to which a number of modifications were added, including taking temperature. FSEC response: This section will be modified in the final document to refer to ANSI/ RESNET/ICC 380 without discussing details.

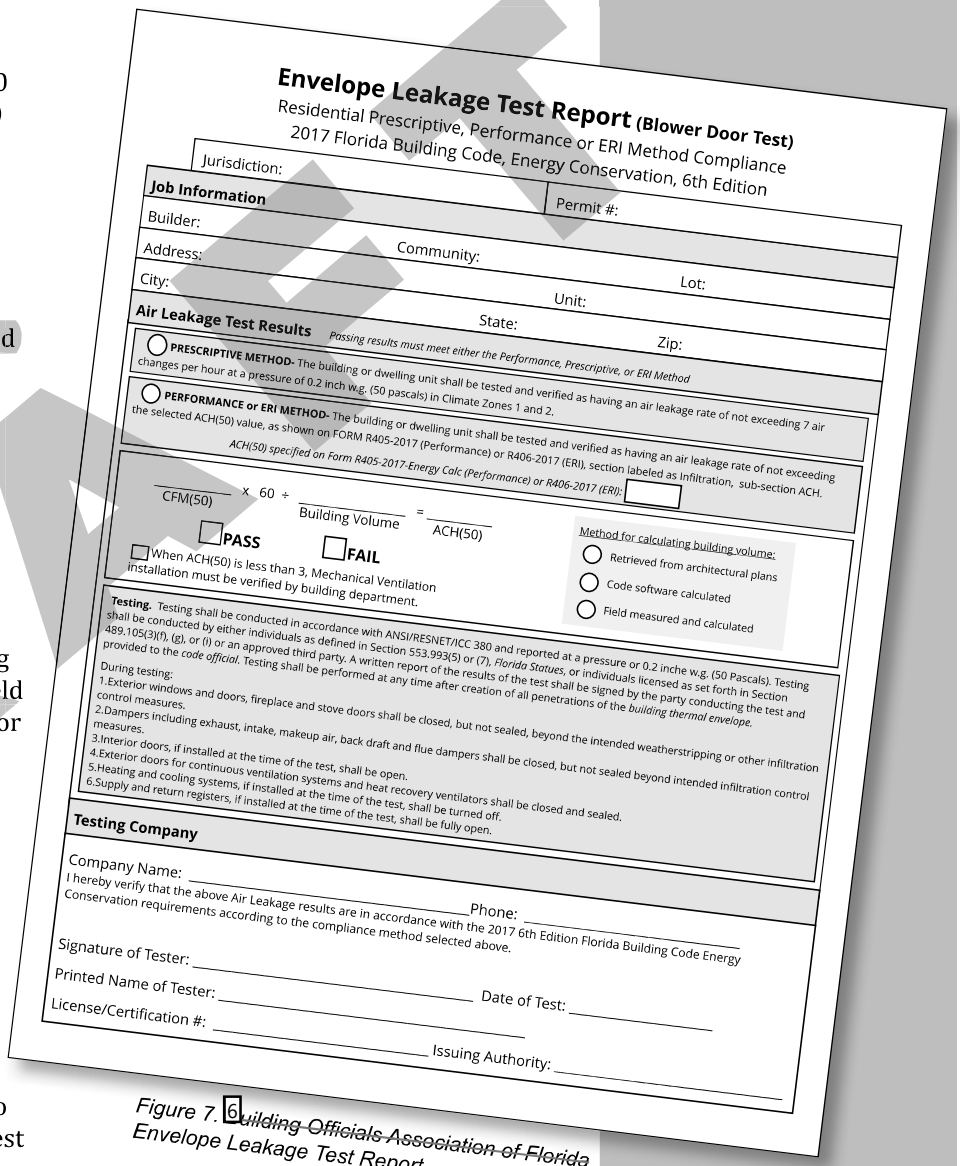
The units for CFM50 are cubic feet per minute, which is multiplied by 60 to convert minutes to hours and divided by the house volume in cubic feet to convert cubit feet to air changes. Given a conditioned house volume of 18,600 cubic feet, the ACH50 for the test results above is 1,940 x 60 / 18,600 = 6.26.

Test results are reported on a form that includes space to record the home's CFM50 measurement, conditioned volume, ACH50 value and Pass/Fail status, and an area for the tester to provide their name, company, qualification and signature. A blank Building Officials Association of Florida (BOAF) approved Envelope Leakage Test Report form (Figure 7) is available from BOAF (see Additional Resources below) and through Florida Energy Code calculation software products. Some Florida building departments require their own version of the form.

You may notice that the BOAF test form shown provides a place to indicate whether the house is complying with the Florida Energy Conservation Code via the Prescriptive, Performance or Energy Rating Index (ERI) method, and also includes a field to enter the ACH50 from the Performance or ERI compliance form[1].

For the Performance and ERI compliance methods, using an ACH50 value lower than the code maximum of 7 for the code compliance calculation will help a house pass the code. But since code credit is received for ACH50 values less than 7, if a lower value is entered for compliance, the blower door test must show that the house's leakage is at or below that lower value (rather than 7). By providing fields to indicate the ACH50 used for compliance, test forms provide project-specific air leakage verification guidance.

For example, if the proposed air leakage was originally entered on the compliance form as 5 ACH50 for the example home, then it would fail because 6.26 ACH50 exceeds 5 ACH50. If the builder had proposed 7 ACH50 on the compliance form then the 6.26 ACH50 home would pass.



Envelope Leakage Test Report (Blower Door Test)

Residential Prescriptive, Performance or ERI Method Compliance
2017 Florida Building Code, Energy Conservation, 6th Edition

Jurisdiction: Permit #:

Job Information

Builder: Community: Lot:

Address: Unit:

City: State: Zip:

Air Leakage Test Results *Passing results must meet either the Performance, Prescriptive, or ERI Method*

○ **PRESCRIPTIVE METHOD-** The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 7 air changes per hour at a pressure of 0.2 inch w.g. (50 pascals) in Climate Zones 1 and 2.

○ **PERFORMANCE or ERI METHOD-** The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding the selected ACH(50) value, as shown on FORM R405-2017 (Performance) or R406-2017 (ERI), section labeled as Infiltration, sub-section ACH.

ACH(50) specified on Form R405-2017-Energy Calc (Performance) or R406-2017 (ERI): ☐

CFM(50) x 60 ÷ Building Volume = ACH(50)

☐ **PASS** ☐ **FAIL**

☐ When ACH(50) is less than 3, Mechanical Ventilation installation must be verified by building department.

Method for calculating building volume:
○ Retrieved from architectural plans
○ Code software calculated
○ Field measured and calculated

Testing. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380 and reported at a pressure or 0.2 inche w.g. (50 Pascals). Testing shall be conducted by either individuals as defined in Section 553.993(5) or (7), *Florida Statues*, or individuals licensed as set forth in Section 489.105(3)(f), (g), or (i) or an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:
1.Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2.Dampers including exhaust, intake, makeup air, back draft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3.Interior doors, if installed at the time of the test, shall be open.
4.Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5.Heating and cooling systems, if installed at the time of the test, shall be turned off.
6.Supply and return registers, if installed at the time of the test, shall be fully open.

Testing Company

Company Name: Phone:

I hereby verify that the above Air Leakage results are in accordance with the 2017 6th Edition Florida Building Code Energy Conservation requirements according to the compliance method selected above.

Signature of Tester: Date of Test:

Printed Name of Tester:

License/Certification #: Issuing Authority:

Figure 7. Building Officials Association of Florida Envelope Leakage Test Report.

[1] Residential Chapter 4 of the Florida Energy Conservation Code provides three compliance options: Prescriptive (Sections R401 – R404), Performance (Section R405 and mandatory sections of Sections R401 - R404) or Energy Rating Index (Section R406 and mandatory sections of Section R401 – R404).

Page: 7

Number: 1 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 3:26:03 PM
somehow, this should be on the same page as the rest of the information

Number: 2 Author: AZ Stewart Subject: Highlight Date: 7/25/2018 11:52:22 AM

Number: 3 Author: AZ Stewart Subject: Highlight Date: 7/22/2018 3:26:43 PM

Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 12:04:10 PM
This is incorrect and needs to be rewritten. **R101.5.1 Compliance materials.** The Florida Building Commission shall approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code. Since two computer softwares were approved by the FBC under R101.5.1 included this form, it meets the criteria for approval and is no longer a BOAF form. Ideally, it should be posted on the Energy TAC site for all to use without purchase of the software. FSEC Response: We will refer to commission approved software instead of BOAF in the final version.

Number: 4 Author: AZ Stewart Subject: Cross-Out Date: 7/25/2018 11:53:20 AM FSEC response: We will refer to commission approved software instead of BOAF in the final version.

Number: 5 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 3:27:28 PM
See comments from the other document draft FSEC response (same as for Fact Sheet): We are not saying the tester is responsible for making sure code has been met here; we are just providing an illustration for the previous paragraph. Whether AHJs want the tester to check this or not, based on research, having a tested ACH50 at or below the value entered for performance or ERI compliance is an important code concept and should be discussed here.

Number: 6 Author: AZ Stewart Subject: Cross-Out Date: 7/25/2018 11:53:45 AM FSEC response: BOAF deleted in the final version.

Mechanical Ventilation

As previously discussed, if a house's ACH50 is less than 3, Florida Code requires whole-house mechanical ventilation to be provided. Florida Code also stipulates minimum and maximum ventilation rates. Minimum ventilation rates based on conditioned floor area and number of bedrooms are provided in Section M1507 of the Florida Residential Code[2], and maximum rates are provided in Section R403 of the Florida Energy Conservation Code[3].

For further reading, a whole-house ventilation overview, including system type options and hot-humid climate considerations is provided in the U.S. Department of Energy Building Technologies Office's Whole-Building Delivered Ventilation article referenced in the Additional Resources section of this guide.

Additional Resources

6th Edition (2017) Florida Building Code

- Energy Conservation Volume: https://codes.iccsafe.org/public/document/FEC2017
- Residential Volume: https://codes.iccsafe.org/public/document/FRC2017

Test Equipment Manuals and Guides

- Retrotec: https://retrotec.com/manuals-guides
- The Energy Conservatory: https://support.energyconservatory.com/hc/en-us/categories/200031985-Manuals-and-Guides

Test Forms

- The Building Officials Association of Florida approved building air leakage test forms available at: http://boaf.net/page/EnvLeakageTest

Testing Standard

- The ANSI/RESNET/ICC 380 Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems referenced in Section R402.4.1.2 of the Florida Energy Conservation Code is available at: https://codes.iccsafe.org/public/chapter/content/7325/

Whole-House Mechanical Ventilation

- Whole-Building Delivered Ventilation: https://basc.pnnl.gov/resource-guides/whole-building-delivered-ventilation#quicktabs-guides=0.

[2] See Section M1507.3.3 Mechanical ventilation rate

[3] See Section R403.6.2 Ventilation air

This publication was created by the FSEC Energy Research Center at the University of Central Florida.

Page: 8

Number: 1 Author: AZ Stewart Subject: Sticky Note Date: 7/22/2018 3:28:22 PM

there is plenty of space here, why not include that code section? FSEC response: While we think it is valuable to touch on mechanical ventilation, ventilation is not the main focus of the guide and getting into actual rates would require too much additional space and discussion. A for further reading overview of mechanical ventilation is also provided via the referenced and linked DOE document.

Number: 2 Author: AZ Stewart Subject: Sticky Note Date: 7/25/2018 11:55:19 AM

the form should really be part of the Energy TAC webpage