



FLORIDA SOLAR ENERGY CENTER®

Creating Energy Independence

Residential Air Leakage Testing and Mechanical Ventilation Verification

FSEC-CR-2082-18

Final Report

June 15, 2018

Submitted to

Mo Madani

Department of Business and Professional Development
2601 Blair Stone Road
Tallahassee FL 32399

Author

Jeffrey K. Sonne

Copyright ©2018 Florida Solar Energy Center/University of Central Florida
All Rights Reserved.

1679 Clearlake Road
Cocoa, Florida 32922, USA
(321) 638-1000

www.floridaenergycenter.org



A Research Institute of the University of Central Florida

Disclaimer

The Florida Solar Energy Center/University of Central Florida nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the Florida Solar Energy Center/University of Central Florida or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Florida Solar Energy Center/University of Central Florida or any agency thereof.

Table of Contents

EXECUTIVE SUMMARY	2
Research Questions	2
Research Approach	2
Results	2
Recommendations	3
1. INTRODUCTION	4
Background and Code Relevance to Florida	4
Research Questions	4
2. RESEARCH APPROACH	5
Home Recruitment.....	5
Document Review	6
Air Leakage Testing	7
Ventilation System Inspection	7
3. RESULTS	7
Document Review	7
Test House Characteristics.....	9
Air Leakage Testing Results.....	9
Ventilation System Inspection	11
4. DISCUSSION.....	11
Document Review	11
Air Leakage Testing	12
Ventilation System Inspection	12
5. RECOMMENDATIONS	12
ACKNOWLEDGEMENTS	13
REFERENCES	13
APPENDICES	14
Appendix A-- Homeowner Recruiting Postcard	15
Appendix B—Air Leakage Study Web Page	16
Appendix C-- Test Protocol	17

Residential Air Leakage Testing and Mechanical Ventilation Verification

FSEC-CR-2082-18

EXECUTIVE SUMMARY

Research Questions

This project is intended to answer the following four questions regarding residential building air leakage (blower door) testing and whole-house mechanical ventilation requirements as stated in the 2016 Supplement 1 changes to the 5th Edition (2014) Florida Building Code, and now continued in the 6th Edition (2017) Code:

- Is the new requirement to test residential air leakage being followed?
- Who is providing the air leakage testing?
- Are accurate air leakage rate test values being reported?
- Is whole-house mechanical ventilation being installed in applicable cases?

Research Approach

The research was conducted via a document review and field study of 15 single family homes throughout the State of Florida that have been permitted after July 1, 2017, when the residential air leakage testing requirement went into effect. Tasks included:

- Home Recruitment: After identifying eligible homes via building department searches, post cards were mailed to homeowners offering \$150 to allow FSEC to conduct an air leakage (blower door) test in their home and, if applicable, inspect their mechanical ventilation system.
- Document Review: Where available, each home's Energy Code compliance and building air leakage test reports were reviewed to determine the building air leakage rate submitted for compliance, whether the test report shows the leakage rate to be at or below this level, and whether a code-qualified individual performed the test. To augment the study, an additional code compliance and air leakage testing document survey was conducted for 14 jurisdictions from which it was not possible to recruit homes to test.
- Air Leakage Testing: FSEC staff conducted a building air leakage rate (blower door) test for each study home
- Ventilation System Inspection: In applicable cases, FSEC staff inspect the home's mechanical ventilation system and record the system type.

Results

The document review for the 15 tested study homes shows that air leakage forms were available from six of the 10 jurisdictions involved, with forms not being available from three jurisdictions, and the form from one other jurisdiction pending. The average industry tested ACH50 leakage (median 4.0) for the study sample was very close to the average FSEC tested ACH50 (median 4.3), but two of the nine ACH50 values differed by 1.5, and one by 2.0. All industry and FSEC test results are below the code's maximum ACH50 of 7.0. Test forms that were received were shown to have code qualified testers providing the tests.

Based on FSEC testing results, whole-house mechanical ventilation is required in three of the 15 study homes. One of these three homes did not have a ventilation system installed, while one additional home for which the code did not require mechanical ventilation had a system installed.

Recommendations

This document review and field study has a relatively small sample size and as such any conclusions must be treated as non-scientific. Although most the state was canvassed for willing homeowners, the research team did not obtain any households in southeast or northwest Florida. In the homes tested, the code's maximum air leakage rate stipulation was found to be observed, and tester qualification requirements were also being followed. However, since some jurisdictions did not provide completed test forms and three industry ACH50 values differed significantly from FSEC test values, some level of additional spot-checking to further substantiate these results and provide ongoing air leakage related quality assurance may be advisable. There is also some concern from the sample of homes that all jurisdictions are not collecting the required test form.

While not the main focus of this study, two cases were seen where the tested ACH50 values were above those submitted on the compliance form at time of permit. Since Performance and Energy Rating Index compliance credit is received for ACH50 values below 7, code official education may be needed to help insure that tested ACH50 values are less than or equal to those submitted.

Since only three tested study homes had ACH50 values less than 3, it is not possible to conclude whether the Code's whole-house mechanical ventilation requirement is being observed. As reported previously (Sonne and Vieira, 2014, Vieira et al. 2016), there is significant ongoing discussion regarding the need for mechanical ventilation as homes become more airtight, so this important issue may warrant additional research.

1. INTRODUCTION

Background and Code Relevance to Florida

Florida HB 535 and the resulting 2016 Supplement 1 to the 5th Edition (2014) Florida Building Code delayed implementation of two residential air leakage and ventilation related Code provisions:

- 1) An Energy Conservation Code Section R402.4.1.2 building air leakage testing requirement and maximum air leakage rate stipulation
- 2) A Residential Code Section R303.4 regarding whole-house mechanical ventilation requirement “triggers.”

Supplement 1 changed the Section R402.4.1.2 maximum building air leakage rate from 5 ACH50 (air changes per hour when tested with a blower door at a pressure of 50 Pascals) to 7 ACH50, and also made changes to the tester qualification requirements:

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 ~~7~~ air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). ~~Where required by the code official,~~ 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*.

[No change to the remaining text]

Supplement 1 also added a new Energy Code section that stipulates that residential blower door testing would not become mandatory before July 1, 2017:

R101.4.9 Blower door testing. The mandatory blower door testing for residential buildings or dwelling units as contained in section R402.4.1.2 of the Florida Building Code, 5th Edition (2014) Energy Conservation, shall not take effect until July 1, 2017, and shall not apply to construction permitted before July 1, 2017.

In addition, Supplement 1 changed the Florida Residential Code’s Section R303.4 whole-house mechanical ventilation requirement “trigger” from less than 5 ACH50 to less than 3 ACH50. So under Supplement 1, the maximum residential building air leakage rate is 7 ACH50, and if below 3 ACH50, whole-house mechanical ventilation is required.

The air leakage testing, maximum air leakage rate, and whole-house mechanical ventilation requirements are now continued in the 6th Edition (2017) Florida Building Code.

Research Questions

This project is intended to answer the following four questions regarding residential building air leakage (blower door) testing and whole-house mechanical ventilation requirements as stated in the 2016 Supplement 1 changes to the 5th Edition (2014) Florida Energy Conservation Code, and now continued in the 6th Edition (2017) Code:

- Is the new requirement to test residential air leakage being followed?
- Who is providing the air leakage testing?
- Are accurate air leakage rate test values being reported?
- Is whole-house mechanical ventilation being installed in applicable cases?

2. RESEARCH APPROACH

This research included a document review and field study of 15 single family homes throughout the State of Florida that have been permitted after July 1, 2017. After Institutional Review Board (IRB) and other approvals were obtained, the main study tasks undertaken included:

- **Home Recruitment:** After identifying eligible homes via building department searches, postcards were mailed to homeowners offering \$150 to allow FSEC to conduct an air leakage (blower door) test in their home and, if applicable, inspect their mechanical ventilation system.
- **Document Review:** Where available, each home's Energy Code compliance and building air leakage test reports were reviewed to determine the building air leakage rate submitted for compliance, whether the test report shows the leakage rate to be at or below this level, and whether a code-qualified individual performed the test. To augment the study, an additional code compliance and air leakage testing document survey was conducted for 14 jurisdictions from which it was not possible to recruit homes to test.
- **Air Leakage Testing:** FSEC staff conducted a building air leakage rate (blower door) test for each study home.
- **Ventilation System Inspection:** In applicable cases, FSEC staff inspected the home's mechanical ventilation system and recorded the system type.

Home Recruitment

A homeowner recruiting postcard (Appendix A) was developed together with a project web page (Appendix B) that provided general project and contact information. The postcard announced the existence of a home air leakage testing study conducted by UCF/FSEC and noted the \$150 incentive for participation. The web page provided additional details about the study and also noted the \$150 participation incentive.

When a homeowner called or emailed that they were interested in the project, staff provided additional information, sent them a homeowner agreement to complete and sign, and worked with them to find a date and time for a test visit.

An initial postcard mailing was made at the end of February to 1,240 addresses gathered from 17 jurisdictions. To allow some time for jurisdictions to comply with the air leakage testing requirement after its July 1st 2017 effective date, postcards weren't sent to homes known to have been permitted before the third week of July. A total of 13 responses were received from this mailing. Despite the effort to avoid homes that were permitted too early, two of the 13 homes could not be included in the study due to an early permit date, and another four respondents did not complete the homeowner agreement.

A second postcard mailing was made in mid-April to 2,640 addresses gathered from a total of 29 jurisdictions (including 14 new jurisdictions). The mailing included some address overlap as some of the homes that postcards were sent to for the first mailing may not have already been occupied at the time of the mailing, and sometimes homeowners respond to a second mailing. An additional 13 responses were received from the second mailing. Of these, two homes could not be included in the study because the permit date was too early¹, and another five respondents either did not respond to subsequent emails or phone calls or did not complete the homeowner agreement.

When it became clear at the end of April that it would likely not be possible to test the full 24 homes required for the project from the responses received at that point, a third postcard mailing was made to 2,500 addresses (including four new jurisdictions and a number of new, later permitted addresses in other jurisdictions). A significant number of the third mailing's addresses had been included in the second mailing, but again due to the timing of the study, it was felt that a number of the homes may not have been occupied yet when the second mailing arrived. However, only six additional responses were received from this third mailing. One additional potential study home was found via FSEC staff contacts.

In the second and third postcard mailings, staff worked to limit the number of homes in any one jurisdiction. A total of 33 homeowner responses have been received, from which 15 homes have been included in the study. These 15 homes represent 10 different jurisdictions and 14 different builders.

Document Review

After a homeowner signed and returned the homeowner agreement FSEC staff searched the appropriate jurisdiction's web site to see if the home's energy code and completed blower door test form were available online. If the forms were not available online, the jurisdiction was emailed to request the code and blower door test forms. The blower door test forms were used to obtain the ACH50 recorded for the homes by the industry tester, and determine if the industry tester was qualified to perform the test per Florida Energy Code Section R402.4.1.2. In cases where the performance (R405) method is used for compliance, using an ACH50 less than 7 provides code credit, so the ACH50 value shown on the energy code form was also recorded for this study.

To augment the study, an additional code compliance and air leakage testing document survey was conducted for 14 jurisdictions from which it was not possible to recruit homes to test. An email or public records request was sent to each of the jurisdictions requesting energy code related forms for several homes permitted in August, September or October 2017 (all with permit applications made after July 1, 2017). If a jurisdiction responded with either the energy code forms or air leakage test forms but not both, a second inquiry was made asking for the remaining form. While it would not be possible to compare the industry tester's ACH50 values for these homes with FSEC test values as FSEC testing was not done, the forms could still be used to gather additional industry ACH50 and tester qualification data.

¹ In both cases the permit issue dates were after July 1, 2017, but the application dates were before July 1, and at least some jurisdictions were interpreting the code's language that mandatory blower door testing ... "shall not apply to construction permitted before July 1, 2017" to mean the permit application date, so these homes were not included in the study.

Air Leakage Testing

Each home visit included measuring conditioned volume, air leakage (blower door) testing and taking photos of relevant areas and equipment per the study’s testing protocol (see Appendix C). The air leakage test itself was performed in accordance with 2016 Supplement 1 to the 5th Edition (2014) Florida Energy Conservation Code Section R402.4.1.2. Figure 1 shows a blower door set-up and ready to test a study home.



Figure 1. Blower door set-up at study home.

Ventilation System Inspection

FSEC staff looked for whole-house mechanical ventilation systems at each study home, and when found (whether the home’s ACH50 was below 3 or not) inspected the system, recorded the system type and took equipment photos.

3. RESULTS

Document Review

Table 1 shows the code and test forms received for each tested study home, the source of the forms and the air leakage tester’s qualification in each case. The “2017 Permit Date” column provides the approximate permit application and issue dates for each study home.

Table 1. Study Home Energy Code Compliance and Air Leakage Test Forms

Home #	Jurisdiction #	2017 Permit Date Applied / Issued	Form Source	Code Form Acquired? (Compliance Method)	Air Leakage Test Form Acquired?	Tester Qualification
1	1	Mid July / Mid Aug.	Owner*	Yes (R405)	No	Not Available
2	2	Early Aug. / Mid Aug.	Jurisdiction Request	Yes (R405)	Yes	RESNET Field Inspector
3	2	Late Aug. / Late Aug.	Jurisdiction Request	Yes (R405)	Yes	Building Performance Institute
4	3	Mid July / Late July	Online	Yes (R405)	Yes	RESNET Rater
5	4	Late Aug. / Late Sept.	Online	Yes (R405)	Yes	RESNET Rater
6	5	Mid July / Late July	Jurisdiction Request	Yes (R405)	No (Jurisdiction only had code form)	Not Available
7	5	Early June / Late July	Jurisdiction Request	Yes (R405)	No (Jurisdiction only had code form)	Not Available
8	6	Late Aug. / Mid Oct.	Jurisdiction Request	Yes (R405)	Yes	RESNET Rater
9	6	Late July / Mid Aug.	Jurisdiction Request	Yes (R405)	Yes	RESNET Field Inspector
10	7	Pending / Early Aug.	Jurisdiction Request	Pending	Yes	RESNET Field Inspector

11	8	Late July / Early Aug.	Jurisdiction Request	Yes (R405)	Pending	Pending
12	9	Early Aug. / Late Aug.	Jurisdiction Request	Yes (R405)	No (Jurisdiction only had code form)	Not Available
13	10	Late Aug. / Late Sept.	Jurisdiction Request	Pending	Yes	RESNET Rater
14	3	Mid Aug. / Late Aug.	Online	Yes (R405)	Yes	RESNET Rater
15	9	Mid Oct. / Early Nov.	Jurisdiction Request	Pending	No (Jurisdiction does not have)	Not Available

* Jurisdiction was contacted but no forms were received; homeowner was also builder and had own copy of Form R405, but stated the jurisdiction did not require an air leakage test.

A total of 10 jurisdictions are represented by the 15 study homes. Of these 10 jurisdictions, air leakage test forms were not obtained from three, representing five study homes, with the form from one additional jurisdiction pending.

Since a number of jurisdictions interpreted the July 1, 2017 effective date of the air leakage testing requirement to be based on application date, an effort was made to avoid homes with application dates before July 1st. One study home (#7) still had an early June application date though, and an air leakage test form was not received for this home; however, the same jurisdiction also did not provide a test form for a home that had a mid-July permit application date.

The name of the industry tester is provided on the air leakage test form, so the same five study homes from three jurisdictions for which no test form was received also do not have tester information. All study homes for which test forms were obtained had Florida Energy Code Section R402.4.1.2 qualified testers.

As described above, to augment the study, an additional code compliance and air leakage testing document survey was conducted for 14 jurisdictions from which it was not possible to recruit homes to test. Results of this additional document review are provided in Table 2.

Table 2. Energy Code and Air Leakage Test Forms from Jurisdictions with no Tested Study Homes

Jurisdiction #	Number of Home Forms Requested	Code Forms Acquired?	Air Leakage Test Forms Acquired?	Tested Air Leakage Values (ACH50s)	Tester Qualifications
1	2	Yes	Yes	4.8, 4.1	RESNET Field Inspector (2)
2	3	Yes	2 of 3	6.0, 5.5	RESNET Rater (1), RESNET Field Inspector (1)
3	2	Yes	1 of 2	1.9	RESNET Rater
4	4	Yes	Yes	5.6, 4.1, 4.4, 4.9	RESNET Rater (2), RESNET Field Inspector (2)
5*	3	Yes	No	Not Avail.	Not Avail.
6	3	No	Yes	3.1, 4.3, 3.6	RESNET Field Inspector (3)
No forms were received from the remaining eight jurisdictions.					

* Jurisdiction lists Blower Door Test form on a checklist of items required before CO, but did not have a completed form for any of the three homes for which they were requested.

Of the 14 jurisdictions contacted for the additional survey, despite at least two attempts (as needed) to obtain the forms from each jurisdiction over a two week period, only six have responded, with only four providing the requested forms. However, all reported ACH50s are below the Code maximum of 7.0, and a check showed all industry testers to be qualified to provide the air leakage test per Florida Energy Code Section R402.4.1.2.

Test House Characteristics

A total of 15 homes were included in the testing part of this study (Table 3) ranging from 1,405 square feet to 4,130 square feet in size, from northeast to southwest Florida. Twelve of the 15 study homes were single story.

Table 3. Study Home Characteristics

Home #	Location in Florida	Conditioned Area (sq. ft.)	Number of Stories
1	East Central	1,405	1
2	Central	2,562	2
3	Central	2,937	2
4	East Central	2,798	1
5	East Central	1,557	1
6	Northeast	2,806	1
7	Northeast	2,471	1
8	East Central	1,528	1
9	East Central	2,566	1
10	Central	2,391	1
11	West Central	1,943	1
12	West Central	2,358	1
13	Southwest	2,790	2
14	East Central	4,130	1
15	West Central	1,838	1

While homes were sought throughout the state, no responses were received from the southeast, and one response was received from the panhandle, but the owner did not complete the homeowner agreement.

Air Leakage Testing Results

Table 4 summarizes the air leakage testing and mechanical ventilation inspection results for each study home. The industry tester qualification is also provided again for reference. Data shown as “Pending” in Table 4 has been requested, but not received from the jurisdiction. Out of 15 homes tested, envelope leakage test reports were obtained for nine, five are not available, and one is pending.

Table 4. Air Leakage Testing and Mechanical Ventilation Inspection Results

Home #	Conditioned Volume (cu. ft.)	Code Form Air Leakage Proposed on Permit (ACH50)	Air Leakage Test Results (ACH50)		Industry Tester Qualification	Mechanical Ventilation	
			Industry	FSEC		Code Required?	Installed?
1	13,525	5.0	Not Avail.*	5.8	Not Avail.	No	No
2	23,616	5.0	3.4	4.9	RESNET Field Inspector	No	No
3	27,116	5.0	6.7	4.7	BPI	No	No
4	27,700	5.0	3.0	2.7	RESNET Rater	Yes**	No
5	14,505	5.0	6.4	6.4	RESNET Rater	No	Yes; RWC***
6	28,341	5.0	Not Avail.	1.9	Not Avail.	Yes	Yes; RWC***
7	22,876	5.0	Not Avail.	4.2	Not Avail.	No	No
8	14,103	5.0	3.3	3.4	RESNET Rater	No	No
9	28,429	7.0	5.0	4.3	RESNET Field Inspector	No	No
10	22,571	Pending	4.0	4.3	RESNET Field Inspector	No	No
11	16,316	5.0	Pending	3.7	Pending	No	No
12	21,929	7.0	Not Avail.	4.8	Not Avail.	No	No
13	25,946	Pending	4.1	4.8	RESNET Rater	No	No
14	49,973	5.0	3.0	1.5	RESNET Rater	Yes [†]	Yes; ERV
15	17,137	Pending	Not Avail.	6.37	Not Avail.	No	No
Avg. (mean)	23,606	5.3	4.3 (for 9 homes)	4.1 (for 9 homes)			
Avg. (median)	22,876	5.0	4.0 (for 9homes)	4.3 (for 9 homes)			

*Not Avail. means an air leakage test form was requested but the jurisdiction either did not reply, or replied that they do not have a test form for the property. In the case of home #7, while the permit issue date is after July 1, 2017, the permit application date was in June. It is not clear why a test form was not available for this property, but as noted above at least some jurisdictions are interpreting the testing requirement to apply if the application date (instead of permit issue date) is July 1st or later. In the case of homes #12 and #15, the jurisdiction responded that they only require test forms for homes permitted with the 2017 Florida Energy Code, starting January 1, 2018.

**Based on industry test results ventilation would not be required, and industry and FSEC ACH50 results are close; possible that additional air tightening was performed after original test.

***RWC = runtime ventilation with control which uses an air duct with motorized damper to bring outside air into the return plenum.

[†] Industry test results were 2.97 ACH50, which if rounded to one decimal place would not require mechanical ventilation. Using FSEC’s ACH50 result of 1.46, this house does require mechanical ventilation.

All code form ACH50 values except two were 5.0. The prevalence of this code form value may be due to EnergyGauge® code compliance software’s default leakage value being set to 5.0 based on the original 2014 Florida Energy Code’s maximum. So although performance code credit is received for leakage values below 7.0, it is not possible to know if this credit was intentionally taken for these projects.

The median industry tested ACH50 for all study homes for which results were obtained is 4.0 vs. 4.3 from FSEC testing of the same homes. Six of the nine industry and FSEC results were very similar, and all industry and FSEC test results are below the code’s maximum ACH50 of 7.0.

Ventilation System Inspection

Based on *industry test results* from the nine available air leakage test forms, none of the study homes would require whole-house mechanical ventilation per the code's 3 ACH50 ventilation trigger. Using *FSEC test results*, three homes (#4, #6 and #14) would require mechanical ventilation. Home #4 does not have whole-house mechanical ventilation, but the industry and FSEC test results are both close to 3 ACH50. For home #6, the jurisdiction stated they did not have an industry test form for this home, but the home still has a runtime ventilation system with control (RWC) installed. Home #14 had an ERV installed. Only one of the other homes (#5) had a whole house mechanical ventilation system.

4. DISCUSSION

Document Review

The document review for the 15 tested study homes summarized in Table 1 above shows that air leakage forms were available from six of the 10 jurisdictions involved, with forms not being available from three jurisdictions, and the form from the one other jurisdiction pending. Test forms that were received were shown to have code qualified testers providing the tests.

As described and summarized above, to augment the study, an additional review of blower door test forms from 14 jurisdictions that did not have any homeowner participation in this study was also conducted (see results summary Table 2 above). The median industry reported ACH50 for these homes was 4.4. While these industry ACH50 values could not be corroborated by FSEC air leakage tests, since there was relatively good overall agreement between industry and FSEC ACH50 values for homes that could be tested, it is reasonable to expect that the ACH50 values reported for at least a majority of these additional review homes would be accurate. However, based on the low jurisdiction response rate (only 6 of 14) combined with the fact that three of the test home jurisdictions did not have test forms for their homes, **it is not clear what percent of jurisdictions are actually requiring documentation of blower door testing.**

In visiting building department web sites for this study, a number of jurisdictions were found to have online notices regarding the air leakage testing requirement (Figure 2) and/or their own downloadable air leakage test forms.

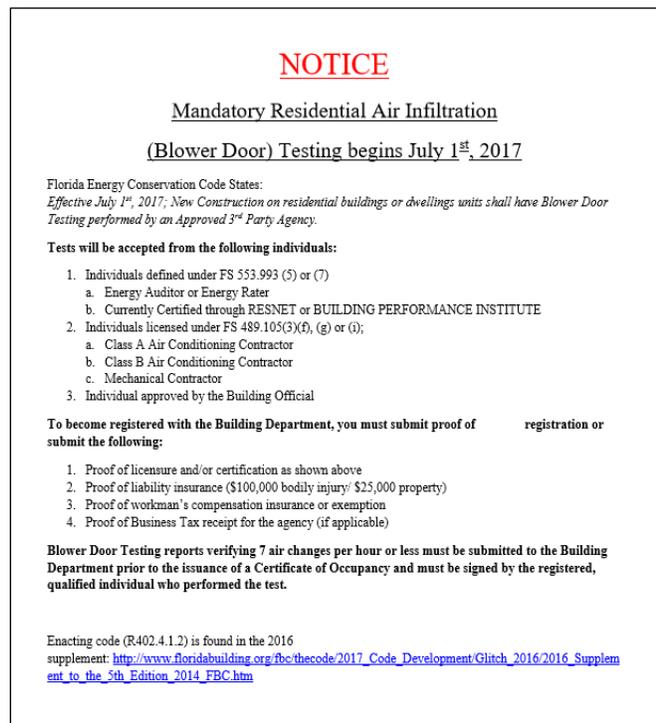


Figure 2. Sample mandatory blower door testing notice.

Air Leakage Testing

The average industry tested ACH50 for the study sample was very close to the average FSEC tested ACH50, but two of nine ACH50 values differed by 1.5, and one by 2.0. No homes were tested by either industry or FSEC that were over the code's maximum allowable 7 ACH50. While the study sample size was limited, these results suggest that a majority of testers are likely providing accurate test results, but there may be some room for improvement, and homes are also largely under the code's 7 ACH50 leakage maximum.

While not the main focus of this study, comparing the air leakage values used for code calculations with tested air leakage values (Table 4 columns 3 and 4) shows two homes (#1 and #5) to have tested ACH50 values above those submitted at time of permit. Performance and Energy Rating Index compliance credit is received for ACH50 values below 7 so code official education may be needed to help insure that the tested ACH50 values are less than or equal to the R405 and R406 submitted code form values.

Ventilation System Inspection

Based on FSEC testing results, one of the study homes that did not have whole-house mechanical ventilation installed is required to have it. However, since only two of the study homes are required to have whole-house mechanical ventilation by code, the sample size is too small to conclude whether the whole-house mechanical ventilation requirement is generally being observed.

5. RECOMMENDATIONS

Supplement 1 to the 5th Edition (2014) Florida Building Code and subsequent 6th Edition (2017) Florida Building Code residential air leakage testing and mechanical ventilation requirements stipulate that, with two 2017 Code exceptions, all new Florida residential projects must have:

- 1) A tested air leakage rate not exceeding 7 ACH50
- 2) The air leakage test conducted by a code qualified individual
- 3) Whole-house mechanical ventilation provided if the tested ACH50 is less than 3.

This document review and field study has a relatively small sample size and as such any conclusions must be treated as non-scientific. Although most the state was canvassed for willing homeowners, the research team did not obtain any households in southeast or northwest Florida. In the homes tested, the code's maximum air leakage rate stipulation was found to be observed, and tester qualification requirements were also being followed. However, since some jurisdictions did not provide completed test forms and three industry ACH50 values differed significantly from FSEC test values, some level of additional spot-checking to further substantiate these results and provide ongoing air leakage related quality assurance may be advisable. There is also some concern that all jurisdictions are not collecting the required test form.

While not the main focus of this study, two cases were seen where the tested ACH50 values were above those submitted at time of permit. Since Performance and Energy Rating Index compliance credit is received for ACH50 values below 7, code official education may be needed to help insure that the tested ACH50 values are less than or equal to those submitted.

Since only three tested study homes had ACH50 values less than 3, it is not possible to conclude whether the Code's whole-house mechanical ventilation requirement is being followed. As reported previously (Sonne and Vieira, 2014, Vieira et al. 2016), there is significant ongoing discussion regarding the need for mechanical ventilation as homes become more airtight, so this important issue may warrant additional research.

ACKNOWLEDGEMENTS

The author would like to thank the Florida Building Commission and Mo Madani of the Florida Department of Business and Professional Regulation for supporting this work. The author also appreciates the very helpful assistance provided by FSEC staff members Donard Metzger, Ken Blackwell, Wanda Dutton, and Robin Vieira.

REFERENCES

2016 Supplement (Code Fixes) to the 5th Edition (2014) Florida Building Code as per HB 535 and SB 1602. (2016). Florida Building Commission. Accessed May 2018: http://www.floridabuilding.org/fbc/thecode/2017_Code_Development/Glitch_2016/2016_Supplement_to_the_5th_Edition_2014_FBC.htm

Florida Building Code, Energy Conservation, 6th Edition (2017). (2017). Country Club Hills, IL: International Code Council, Inc. Accessed May 2018: <https://codes.iccsafe.org/public/document/FEC2017>

Florida House of Representatives, CS/CS/CS/HB 535, 2016. Accessed May 2018: <https://www.flsenate.gov/Session/Bill/2016/535/?Tab=BillText>

Sonne, J. and R. Vieira. (2014). *A Review of Home Airtightness and Ventilation Approaches for Florida Building Commission Research.* FSEC-CR-1977-14, Florida Solar Energy Center, Cocoa, FL, June 15, 2014. Accessed May 2018: https://securedb.fsec.ucf.edu/pub/pub_show_detail?v_pub_id=4673

Vieira, R. et al. (2016). *Evaluating the Economic Impacts of the Legislatively Delayed Provisions of the 5th Edition (2014) Florida Building Code (Final Report).* FSEC-CR-2024-16, Florida Solar Energy Center, Cocoa, FL, May 1, 2016. Accessed May 2018: https://securedb.fsec.ucf.edu/pub/pub_show_detail?v_pub_id=4744

APPENDICES

Appendix A-- Homeowner Recruiting Postcard

Appendix B—Air Leakage Study Web Page

Appendix C—Test Protocol

Appendix A-- Homeowner Recruiting Postcard



UNIVERSITY OF
CENTRAL FLORIDA

Florida Solar Energy Center® (FSEC®)
1679 Clearlake Road
Cocoa, FL 32922-5703
<http://www.fsec.ucf.edu>

HOMEOWNERS:

Participate in a home energy research study conducted by FSEC® at the University of Central Florida and earn \$150!

Participation involves allowing FSEC to test your home's air tightness and, if applicable, inspect your whole-house mechanical ventilation system.

For more information,
call 321-638-1430 or visit
www.fsec.ucf.edu/go/airleakstudy

Don't Miss Out!



UNIVERSITY OF
CENTRAL FLORIDA

BLD0-71

Appendix B—Air Leakage Study Web Page

Media Center | Employee Directory | Publications

FLORIDA SOLAR ENERGY CENTER
Creating Energy Independence



RESEARCH

CONSUMER | EDUCATION | **RESEARCH** | TESTING & CERTIFICATION

Home > Research > Buildings > Air Leak Study

WANTED:

Florida homeowners to participate in a home air tightness testing and ventilation inspection study conducted by the Florida Solar Energy Center (FSEC), a research institute of the [University of Central Florida](#).

What is this study about?

FSEC is conducting a study funded by the [Florida Department of Business and Professional Regulation](#) to learn about compliance with new home air leakage testing and mechanical ventilation requirements.

What does participating involve?

Participation involves allowing us to test your home's air leakage and, if applicable, inspect the ventilation system. The entire visit should take less than three hours.

Why should I sign up?

Testing your home's air leakage would allow us to confirm if your home's air leakage is within new Florida code requirements. We'll inform you of the test results and you'll also receive a \$150 participation incentive.

Does my home qualify for the study?

If you received this postcard we believe your home qualifies for the study:



Home air leakage test in progress. (N. Waters)

HOMEOWNERS:

Participate in a home energy research study conducted by FSEC* at the University of Central Florida and earn \$150!

Participation involves allowing FSEC to test your home's air tightness and, if applicable, inspect your whole-house mechanical ventilation system.

For more information, call 321-638-1430 or visit www.fsec.ucf.edu/airleakstudy

Don't Miss Out!



If you haven't received the postcard, you may still qualify for the study if you have a single family Florida home that was permitted to be built after July 1, 2017.

To find out more or sign up for the study, contact Wanda Dutton at 321-638-1430 or e-mail at wanda@fsec.ucf.edu.

[Privacy Policy](#) | [Terms and Conditions](#) | [Legal Notices](#)

© 2007-2014 University of Central Florida. The Florida Solar Energy Center (FSEC) is a research institute of the University of Central Florida. For more information about FSEC, please [contact us](#) or [learn more about us](#). Find us on [Facebook](#)



Appendix C-- Test Protocol

DBPR AIR LEAKAGE TEST VERIFICATION STUDY TESTING PROTOCOL

Address _____

Test Date _____

AIR LEAKAGE RATE (BLOWER DOOR) TESTING

House Characteristics and Test Prep

- Confirm with homeowner(s) that no changes have been made to house since CO that might affect air leakage. Done Notes: _____
- Inform owner test will increase natural outdoor air exchange rate for a few minutes. Done
- Number of stories or split-level: 1 2 Split
- Conditioned floor area and volume measured / confirmed?
- Fireplace? Y / N Type (atm. vented wood, sealed gas) : _____
- Number of recessed can lights: _____ Notes: _____
- Unvented attic? Y / N
- Examine / take picture of thermostat Notes: _____

Testing

- Prep:
 - Exterior doors and windows closed; interior doors open
 - Fireplace not hot, damper closed, and no cold ashes or cold ashes covered Done N/A
 - If sealed attic, hatch to attic opened for test?
 - AC / heat off (all systems)
 - All vented combustion appliances incl. water heater and dryer safed? Done N/A
 - Bath, kitchen and whole-house ventilation fans off
 - Whole-house vent system sealed-off (if accessible) N/A
- Perform air leakage test and record results
 - Verified BD ring used and that it matches DG700 input BEFORE and AFTER readings?
- Record any testing problems or observations _____

- After test:
 - If atmospherically vented combustion equipment “safed”, returned to as-found N/A
 - If unvented attic and hatch opened for test, closed after test N/A
 - Fireplace damper returned to as-found and any newspaper cover removed N/A
 - AC / heat and whole-house vent fan () returned to as-found setting
 - If whole-house vent system sealed, unsealed after test N/A

WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM INSPECTION

- Whole-house ventilation system present? Y / N (If not, disregard related entries below.)
- Record ventilation system make and model _____
- Record ventilation system type (e.g. exhaust only, supply only, supply and exhaust w/ or w/o ERV, HRV) _____
- Record and photograph ventilation system component location(s) _____

 - Photos taken
- Record how the ventilation system is controlled (e.g. remote control, wall panel) _____

- Determine if air flow balancing damper is present and note setting (approx. % open)
 Damper Present? Y / N Can determine setting? Y / N Approx. % open _____
- Record vent system interior duct diameter or cross sectional area _____
- Note type and thickness of vent duct system insulation if any.
- Record ventilation system operational status / control setting (on, off, disconnected, deactivated, timer setting, ventilation rate setting, etc.) _____

- Record and photograph ventilation system filter location and condition _____

- Filter photo(s) taken
- Record any ventilation system issues discovered and likely reasons for them (e.g. missing insulation, potential pollution sources near air intake, poorly installed or disconnected ducts, inoperable damper, unbalanced HRV or ERV) _____

- Is there evidence of occupant adjustments to the system or flow rates _____

- Other observations / notes _____

- VENTILATION SYSTEM FILTERS AND SETTINGS LEFT AS INITIALLY FOUND DONE

BEFORE LEAVING

- Took exterior and other applicable photos
- Gave homeowner gift card and received signed receipt
- Double checked appliances and that all equipment gathered
- Left business card with homeowner