

Residential Distribution System Leakage

2008 California Building Energy Efficiency Standards

Low Leakage Air Handlers

and

Low Leakage Ducts in Conditioned Spaces

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Purpose

The purpose of this proposal is to specify new compliance credits for higher efficiency central heating and cooling systems when air handler leakage is lowered by using factory sealed air handlers and when duct leakage to outside conditions is lowered by using duct systems that are located within conditioned space. Both of these credits require verification by a HERS rater and are linked to other existing HERS verified features.

Overview

Description	This proposal has two parts: 1. Introduce a new credit for low leakage air handlers. This credit may be taken when factory sealed air handlers are installed in conjunction with verified duct leakage. Factory sealed air handlers must be certified by the manufacturer to the Commission as meeting the reduced air handler leakage criteria and must be verified by the HERS rater. The credit is calculated by either reducing the duct air leakage rates from 8% to 6%, or by specifying and verifying the actual duct air leakage rates. 2. Introduce a new credit for low leakage ducts in conditioned space. This credit may be taken when ducts meet the existing criteria for verified ducts in conditioned space and the duct leakage to outside is verified to be less than 25 cfm when measured in accordance with ACM Section RC4.3.3. The credit is calculated by reducing the total duct air leakage rates from 8% to 0%.
Type of Change	Compliance credit requiring new and/or revised HERS verification procedures. The Standards, ACM, Residential Manual and compliance forms will need to be revised to cover these new credits. ACMs will need a minor change to allow for the specified levels of distribution system leakage required to implement these credits. Additionally, this proposal requires that air handlers meeting the factory sealed criteria be certified to the Commission in order to qualify for the credit.
Energy Benefits	As credits, this proposal does not directly change the stringency of the standards. However, the credits proposed here allow builders an additional path to improving the energy efficiency of their homes.
Non-Energy Benefits	Gives air handler manufacturers a way to distinguish better, less leaky air handlers in the marketplace.
Environmental Impact	n/a
Technology Measures	n/a

Performance Verification	Both measures proposed require HERS verification and are linked to existing HERS verified features.
Cost Effectiveness	Credits are not subject to meeting cost effectiveness criteria.
Analysis Tools	Can be modeled with minor modification to existing software tools.
Relationship to Other Measures	Builds upon exiting procedures for field verification and diagnostic testing of air distribution systems as described in ACM Appendix RC.

Methodology

Low Leakage Air Handlers

Reducing air handler leakage is known to be an important factor in improving distribution systems. Raters regularly report that leaky air handlers are one of the reasons that distribution systems fail to meet the established duct sealing criteria.

The 2004 Florida Building Code includes a credit for factory sealed air handlers as follows:

13-610.2.A.2.1 Factory-sealed air-handling unit credit.

A factory-sealed air-handling unit credit multiplier of 0.95 may be used if the unit has been tested and certified by the manufacturer to have achieved a 2 percent or less leakage rate at 1-inch water gauge when all air inlets, air outlets and condensate drain port(s), when present, are sealed at an air pressure of 1-inch water gauge with no greater than 2-percent design cubic foot per minute discharge.

Discussions with knowledgeable sources in Florida suggest that this credit is infrequently used for compliance with the Florida code, but is in increasing use for above code programs like Energy Star homes. Air handler units meeting the Florida criteria are available, although there is no listing published at this time. There is no national standard at this time defining reduced leakage air handlers, although there are indications that ASHRAE is beginning to work on such a standard.

In order to foster a marketplace that rewards low leakage air handlers, this proposal recommends that the Commission add a credit for factory sealed air handlers that meet the same technical criteria as the Florida code, but that must be certified to the Commission and subject to verification.

The starting point for credit for low leakage air handlers comes from the current ACM rules that require the total measured duct leakage to be less than 6% of total fan flow, but then uses 8% of total fan flow for the ACM calculations. Part of the reason for this conservative calculation is the concern over seal failure over time. It is believed that factory sealed air handlers are likely to retain their low leakage rates better over time than field sealed air handlers. Two methods are suggested here for credits for low leakage air handlers. The first uses the standard duct sealing test to

establish a leakage of not more than 6%, but then 6% is used in the ACM calculations. The second allows the user to specify the total leakage to be used in the calculations and that must be verified by the installer and rater. This allows credit for sealing the ducts further than the current 6% leakage threshold.

Specifically, the proposal is to establish a Verified Low Leakage Air Handler credit as follows:

1. Add the following definition: Low Leakage Air Handler. A factory sealed air handler unit tested by the manufacturer and certified to the Commission to have achieved a 2 percent or less leakage rate at 1-inch water gauge when all air inlets, air outlets and condensate drain port(s), when present, are sealed at an air pressure of 1-inch water gauge with no greater than 2-percent of design cubic foot per minute discharge.
2. The credit for low leakage air handlers requires HERS verification that a certified low leakage air handler is installed and must be used in combination with the existing credit for verified duct leakage. If the option to specify the duct leakage is used, the installer and rater shall also verify that the duct leakage as a percentage of fan flow is equal to or lower than the specified leakage. The air handler must be installed before diagnostic duct leakage is measured either by the installer or the HERS rater therefore the methods of Section RC.4.3.2.2 *For Ducts with Air Handling Unit Not Yet Installed* shall not be used with this credit.
3. The ACM credit is calculated by reducing the duct air leakage factors (a_s and a_r) either by:
 - a. Lowering the duct air leakage factors by 2% of total fan flow by adding a row to Table R4-13 of the Residential ACM that specifies $a_s = a_r = 0.97$; or
 - b. Having the user specify the duct leakage as a percentage of fan flow. The ACM will then assume that one-half of the total is supply and one-half is return leakage and will set $a_s = a_r = (1 - \text{target duct leakage} / 2)$.

Low Leakage Ducts in Conditioned Spaces

For many years the standards have recognized that placing the ducts within conditioned space can provide significant energy savings. The current ACM rules separate the conduction losses and the air leakage losses for ducts located in conditioned space. When ducts meet the criteria for verified ducts in conditioned space, the conduction losses are set to zero, but duct leakage remains at the same levels as ducts not in conditioned space with all leakage assumed to be to outside conditions. In situations where the distribution system is completely within conditioned space or where there is very limited leakage to the outside, the assumption that all leakage is to outside conditions is very conservative.

In order to more properly credit distribution systems that have ducts in conditioned space and limited leakage to outside conditions, this proposal recommends that the Commission add a credit for low leakage ducts in conditioned space by utilizing the methods already described in Appendix RC of the ACM manual, Section RC.4.3.3. This section, *Duct Leakage to Outside from Fan*

Pressurization of Ducts describes a method to measure duct leakage to outdoors using a blower door. As the measurement process not exact, a threshold of 25 cfm is recommended as the target for low leakage ducts.

Specifically, the proposal is to establish a Verified Low Leakage Ducts in Conditioned Space in as follows:

1. Add the following definition: Low Leakage Ducts. A duct system that has air leakage to outside conditions equal to or less than 25 cfm when measured in accordance with Section RC.4.3.3, steps 1 through 9.
2. The credit for low leakage ducts requires HERS verification and must be used in combination with the existing credit for verified ducts in conditioned space.
3. The ACM credit is calculated by reducing the duct air leakage factors (a_s and a_r) to 0% of total fan flow by adding a row to Table R4-13 of the Residential ACM that specifies $a_s = a_r = 1.00$.

Analysis and Results

See Methodolgy.

Recommendations

See Methodolgy.

Material for Compliance Manuals

Not developed at this time.

Bibliography and Other Research

1. *Florida Building Code 2004, Chapter 13, Florida Energy Efficiency for New Construction*. Links available at www.floridabuilding.org.
2. *Residential Alternative Calculation Method (ACM) Approval Manual*.
3. Discussions with Philip Fairey and Danny Parker of the Florida Solar Energy Center.
4. Discussions with Arlene Stewart, Florida Home Energy Rater.

Appendices

None