U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

TOPIC Brief

Residential Duct Insulation and Sealing Requirements

Studies show that duct air leakage results in major energy losses.

All versions of the International Energy Conservation Code (IECC) require ducts, air handlers, filter boxes, and air cavities used as ducts to be sealed, and reference Chapter 16 of the International Residential Code for details on air sealing. This sealing is required on all ducts and other air distribution components regardless of whether they are located inside or outside the conditioned living space.

For single-family homes and other low-rise residential buildings, the 2009 and 2012 IECC have duct insulation and sealing requirements in Section 403.2. Both codes require insulation on air ducts supplying heated and/or cooled air to the living space. Ducts located outside of conditioned space are required to have a minimum of R-6 insulation with one exception: supply[1] ducts in attics only are required to have R-8.

The 2009 and 2012 IECC have a substantial new requirement that duct systems be pressure tested and that the leakage rate be proven to be at or below allowable limits. An exemption from testing is allowed if all of the ducts and other components are located entirely in the conditioned living space. Testing is not required in the 2006 IECC or older versions of the IECC.

Table 1 shows the leakage rate limits in the 2009 and 2012 IECC. Most requirements are based on total air leakage, which includes leaks from ducts to outside and inside the conditioned space. The 2009 IECC also has a post-construction option for leakage to the outdoors only. The IECC allows this test to occur either at a "rough-in" stage or at the "post-construction" stage. Testing at the post-construction stage is allowed to have higher leakage levels than testing at the rough-in stage in the 2009 IECC in particular. In the IECC, allowable maximum leakage rates are specified at cubic feet per minute per 100 ft^2 of conditioned floor area in the home. This allows larger homes to have a higher allowable leakage rate to account for the fact larger homes will normally have more ducts.

[1] Supply ducts are ducts containing heated or cooled air downstream from the heating system or air conditioner.

Building Energy Codes

Table 1. Allowable Duct Leakage Rates in the 2009 and 2012 IECC (cfm per 100 ft^2 of conditioned floor area)

	2009 IECC	2012 IECC
Post-construction test		
Leakage to outdoors	8	n/a
OR Total leakage	12	4
Rough-in test (total leakage)		
Air handler already installed	6	4
Air handler not installed	4	3

The first step of the leakage test is to temporarily seal the register openings. The entire duct system is then pressurized by using a special portable fan to pump air into the duct system. The airflow through the fan is then measured with the fan set to the specified test pressure of 0.1 inch water gauge (w.g.) (or 25 pascals). This flow rate through the fan is equal to the flow rate of air leaking out of cracks and seams in the duct system. See Further Resources for links to a number of video presentations that demonstrate the testing procedure.

Importance of Testing

Even in newly-constructed buildings, air leakage from ducts can lead to substantial energy losses, particularly when ducts passing through unconditioned spaces leak into these spaces. While energy codes have long required ducts to be sealed, there is ample evidence that ducts in new buildings often have far too much leakage. Visual inspection of duct sealing by code officials is insufficient; testing is the only way to confirm adequate sealing. A 2001 study in Fort Collins, Colorado, tested 80 new homes and discovered that not one of them complied with their code, which relied on visual inspection.[2] Moreover, the average duct leakage in those homes was 75% of total system airflow. Similar tests have been performed in other regions with similar results[2]. BECP estimates that the maximum allowable duct leakage levels specified in the IECC verified by duct testing can reduce heating and cooling costs by an average of 10% or more.

Types of Testing

Duct leakage testing is normally performed using duct pressurization equipment. There are several manufacturers that produce equipment and gauges specifically for this purpose. Duct leakage testing can also be done by whole-building pressurization equipment typically installed in a door opening of the building. For more information on types of duct testing, visit the Green Building Advisor website.

How to Seal Leaks

Duct seams must be fastened using sheet metal screws (or compression straps for flex duct) before being sealed. Mastic is always preferred to any type of tape because of its thoroughness and durability (ironically, basic "duct tape" often performs very poorly for sealing ducts). UL Standard 181 regulates both tape and mastics for air ducts. More precise information on the use of tapes and mastics can be found at the Green Building Advisor Website.[2]

[2] www.greenbuildingadvisor.com/blogs/dept/musings/duct-leakage-testing

Further Resources

For information on why duct testing is important, see PG&E's Tech Brief at www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/rebatesincentives/duct_testing.pdf.

For information on efficient duct systems see the ENERGY STAR® writeup at www.energystar.gov/ia/new_homes/features/DuctSystems_062906.pdf.

For videos on duct testing, see:

- www.youtube.com/watch?v=QZTly-CTQ4o&list=UU9HrA1-VeaEG9Mkc2JSyQtQ&index=2&feature=plcp
- www.youtube.com/watch?v=v6S14yQ1AeY
- www.energycode.com/?page_id=41.

For presentations on duct sealing and testing, see:

- www.ba-pirc.org/presentations/eeba/EEBAProducing.pdf
- www.engr.psu.edu/phrc/Conference/2012%20Conference/Presentations%202012/Housing/Jack%20Wilson%20-%20Duct%20sealing.pdf
- www.rdcboston.com/ResPlus/Images/Document/A1.pdf
- www.southface.org/default-interior/Documents/detverifiertrainingpresentation2.pdf.

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August 2012 PNNL-89964

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