ASHRAE in Weatherization

BY THOM KNOLL

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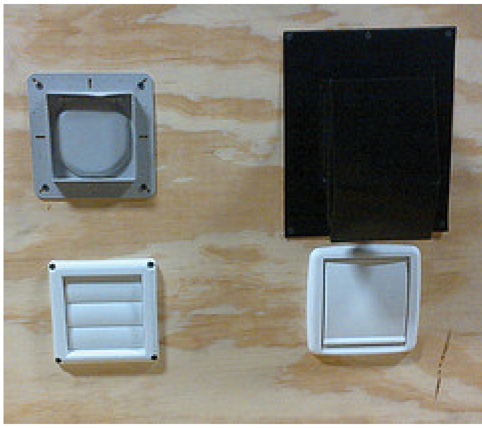
Over the years, the Weatherization Assistance Program (WAP) has gone through a number of significant changes, trying to become more scientific and technical. There has been frequent controversy, however, about how tight a house should be, for fear that indoor air quality (IAQ) will suffer if a house is too tight. These choices are changing again, taking the words “too tight” out of the discussion. Soon it will be possible to tighten a house as much as possible, and still be confident that IAQ will remain acceptable.

DOE has mandated that the low-income weatherization program implement a new ventilation standard—one that will probably require the addition of mechanical ventilation on many weatherized houses. BPI also recently announced that it will be adopting this same standard, effective January 1, 2013. The referenced standard, ASHRAE 62.2-2010, “Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings,” calculates required air movement based on both floor space and number of occupants. The standard also looks at the capacity to remove contaminants (including moisture) from the bath and kitchen and, in existing buildings, recognizes accidental ventilation from infiltration.

Jeremy Morris at WARM Training Center, Detroit, adapts Energy Conservatory’s Exhaust Fan Flow Meter (the black box) to measure range hood flow. (Steve Christensen)

This prop, assembled by DOE-Funded WARM Training Center in Detroit, gives hands-on access to practitioners (auditors and contractors) to help select appropriate equipment for whole-house ventilation, as well as to overcome spot deficits. (Steve Christensen)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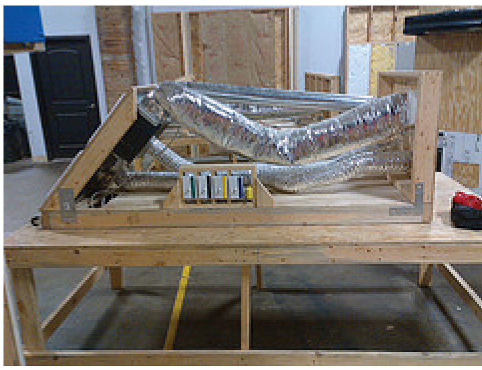
The importance of proper duct installation is obvious when similar equipment is attached to smooth and straight versus poorly installed flex ducts. (Steve Christensen)

First, according to the standard, 1 cubic foot per minute (CFM) of ventilation for every 100 square feet of area is the minimum flow rate for an "occupiable" floor area in low-rise residences. For example, a 1,200 ft2 home must get at least 12 CFM of continuous ventilation (simply slide the decimal two places to the left). Add to that a requirement of 7.5 CFM per resident; the standard assumes two people in the master bedroom and one in each additional bedroom (minimum ventilation for occupants is number of BR + 1). Therefore, a three-bedroom home would need (3 + 1) x 7.5 CFM, or another 30 CFM of ventilation for the occupants. Adding the initial 12 CFM to this 30 gives 42 CFM of continuous whole-house ventilation for this example. However, if more than five people live in a three-bedroom home, the flow rate is based strictly on the number of residents.

Because the bathrooms and kitchen are recognized as sources of poor IAQ, there are specific requirements for each room. Every bath (with a tub or shower) should have an intermittent fan capable of either removing 50 CFM or providing a continuous flow of 20 CFM; there is no mechanical requirement for a room with only a toilet and a sink. The kitchen can have a range hood that removes 100 CFM on demand, or an exhaust fan that provides a continuous flow of 5 ACH for the entire volume of the kitchen. This completes required calculations for new houses, aside from evaluating other obvious sources of pollution (attached garage and combustion appliances, for example) and limits the noise from these fans, measured in sones. Though there is no guarantee, the upside of these rigorous sound requirements is that fairly high-quality fans will be installed.

Existing Buildings

As before, there are requirements both for whole-building (continuous) ventilation and for local exhaust in existing buildings. The calculation for whole-house ventilation in a previously occupied building, such as a weatherization house, is the same as that described above. In addition, there are means to accommodate inadequate local ventilation in existing buildings, and recognition (and credit) for infiltration. Rather than install each required local ventilator, whole-house flow can be increased in proportion to a calculated deficit, but also can potentially be reduced based on how leaky this leaves the house.

The local, or spot, airflow deficit calculation starts with the required intermittent flows of 50 CFM for each bath, and 100 CFM for the kitchen. Actual flow from any existing fans can be measured (or calculated, with a compliant duct size and length based on specified flow at 0.25 inches of water gauge), and then subtracted from the requirement. One operable window can further reduce a deficit by 20 CFM per room. The remaining deficit, after existing fans and windows are recognized, is divided by 4, and the result is added to the whole-house ventilation flow rate requirement as additional continuous flow.

As an example, a house with one bath that has a window and a vent fan with flow measured at 20 CFM has a calculated deficit of 10 (as 50 - [20 + 20]). The kitchen, with two windows and a range hood with measured flow of 125 CFM, has no deficit (100 - (20 + 125) = -45). Note that no room deficit can exceed zero and provide a credit. Summing the bath (10) and kitchen (0) deficits, and dividing by 4 yields 2.5 CFM, to be added to the whole-house ventilation flow rate for the building.

By contrast, in a house with a window in the kitchen but not in the bath and no existing fans in either room, the additional flow would be 32.5 CFM:

- Kitchen: 100 – (20 + 0) = 80.
- Bath: 50 – (0 + 0) = 50.
- Overall: (80 + 50)/4 = 32.5.

Based on the initial 1,200 ft^2 example, the total ventilation flow required would be 42 + 32.5, or 74.5 CFM continuously. By optimizing equipment selection—say, by installing a range hood meeting the required 100 CFM intermittent flow— the continuous flow could be reduced by 20 CFM to 54.5 CFM.

Infiltration Credit and Its Cost

A postweatherization blower door value can be used to recognize the contribution of unintentional ventilation to IAQ. ASHRAE Standard 136 is referenced in Standard 62.2, so the blower door value at the reference standard of 50 pascals (CFM_{50}) is converted, based on building height and local weather factor, to an estimated natural value in CFM. An allowance based on 2 CFM per 100 square feet of occupiable floor area is deducted from the blower door result and then cut in half. The resulting flow rate can then be deducted from the continuous whole-house ventilation rate.

For a 2,000 ft^2 single-story house in Chicago for which measured infiltration is 1,550 CFM_{50}, the ASHRAE 136 calculation would equal 73.2 CFM (1,550 x height factor 1 x weather factor 0.93 x constant 0.0508). The 2 CFM per 100 square feet yields 40 CFM, so the infiltration credit equals 16.6 CFM (half of 73.2 – 40).

This infiltration credit clearly increases as house tightness decreases. So too, however, do the heating bills. When infiltration is increased to 2,550 CFM_{50} (infiltration credit of 40 CFM), the cost of heating the ventilation air removed by the fan will decrease by an estimated $450, but the cost of heating the infiltration air will increase by approximately $900. This two-to-one relationship continues until infiltration credit eliminates the need for mechanical ventilation (but heating bills will become the homeowner's biggest concern).

Since the object of weatherization is to reduce energy costs for low-income households, it is important not only to look at the cost to the program of installing equipment, but also to calculate the lost opportunity if maximal infiltration reduction isn't delivered at every opportunity. It should be a no-brainer to embrace the idea of tightening the house as much as possible, and to provide high-quality equipment to operate the home efficiently and economically.

Thom Knoll recently retired from the Kalamazoo County Community Action Agency, where he ran weatherization and housing programs for 14 years, including a successful American Recovery and Reinvestment Act project. Based in Michigan, he is now consulting and training.

learn more

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For more information, and to read the standard, visit **www.ASHRAE.org** or go to their bookstore to purchase the Standard 62.2-2010, the Standard 62.2-2010 Users Manual, and Guideline 10-2011: "Interactions Affecting the Achievement of Acceptable Indoor Environments" at**www.techstreet.com/ashrae/ashraegate.html**.

To learn about the WAP Technical Assistance Center (WAPTAC), visit**www.WAPTAC.org**. Useful articles on this web site include the "Weatherization Guidance Memo" (under the Rules and Guidance tab), "Health and Safety Guidance" (also under the Rules and Guidance tab), and "WAP Standardized Curricula: ASHRAE 62.2" (under Training Resources).

WARM Training Center is located at 4835 Michigan Ave., Detroit MI 48210. Call 313-894-1030 or visit**www.WARMTraining.org**.

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