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Residential Ventilation for Existing Buildings

BY RICK KARG, MEMBER ASHRAE

Of the many ASHRAE standards, none distinguish existing buildings from new buildings as clearly as Standard 62.2, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*. Although Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, allows below-compliance equipment in existing buildings to remain in place, as Standard 62.2 does, the ventilation standard goes further by allowing more generous concessions for existing structures. Since 2010 Standard 62.2 has uniquely recognized the increased cost and challenges of adding mechanical ventilation to existing dwellings. This recognition is arguably responsible for the adoption of Standard 62.2-2010 by its biggest user, the Department of Energy's (DOE) Weatherization Assistance Program (WAP).

Alternative Compliance Path

Since its inception, Standard 62.2 has required local, demand-controlled exhaust ventilation in bathrooms and kitchens, 50 cfm (25 L/s) and 100 cfm (50 L/s), respectively.* The objective of these provisions is to exhaust contaminants from the dwelling at their sources, primarily bathroom moisture (*Photos 1* and *2*) and the byproducts of cooking. Additionally, 62.2 requires whole-building (dilution) ventilation. The airflow rate of this ventilation, which may be exhaust-only, supply-only, or balanced, depends on the size of the dwelling and the number of occupants.

Efforts to include an alternative compliance path for existing buildings in Standard 62.2 began around 2008, after the appointment of new committee members having extensive experience with the WAP† and other retrofit programs. They realized that installing local exhaust fans in bathrooms and kitchens can be expensive or unachievable in existing homes, particularly if the home has more than one bathroom. Many dwellings, especially in regions with older housing stock (the Northeast for example), have cooking ranges located under windows, making installation of a range hood impossible. Existing ducts, support beams, and distance from exterior walls often impede the ducting of bathroom or kitchen exhaust fans to the outdoors.

In June 2009 the Standard 62.2 committee approved "Normative Appendix A—Existing Buildings" to be included in the 2010 version of the standard. This is commonly called the Alternative Compliance Path. Although all subsequent releases of 62.2 have included further recognition and clarification of existing building provisions, the inclusion in 2010 was the most significant.

Compared with normal compliance, the alternative compliance path allows mechanical ventilation installation in existing dwellings at lower cost and with increased flexibility. To do this, the requirement for local ventilation is relaxed from the normal prescriptive exhaust flow rates, as long as the whole-building ventilation airflow rate is increased by one-quarter of the local exhaust fan deficit total.‖ If the room has an

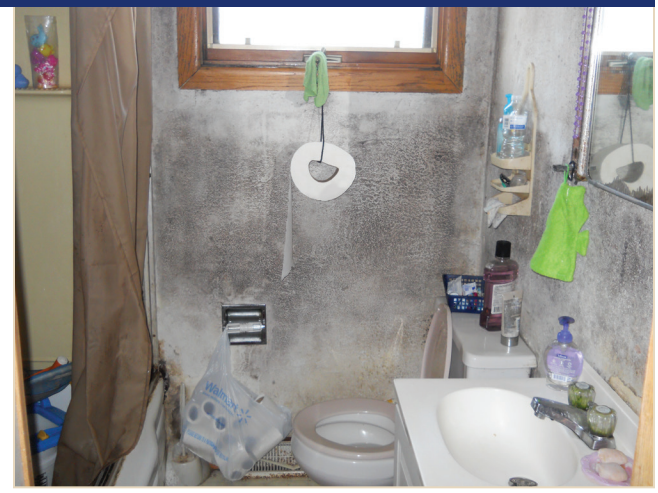
* Standard 62.2 also allows continuously operating local ventilation.

† See "Indoor Air Quality in Residential Energy Retrofits" by Paul Francisco, *ASHRAE Journal,* June 2016, for further discussion of the Weatherization Assistance Program.

‖ The ¼ value is based on the logic that the deficient local ventilation would have operated ¼ of the time, so the whole-building ventilation rate, Q_{fan}, is increased by ¼ of the local ventilation deficit total.

PHOTO 1 A bathroom in a WAP house in Wisconsin. The ceiling fan does not work or is not used. The mold growing on the surfaces is potentially hazardous to the occupants, some of whom are children. This is the kind of problem that Standard 62.2-compliant ventilation, and use, can prevent. PHOTO 2 The same bathroom in Wisconsin. Notice the evidence of hands touching the moldy wall next to the toilet.





Photos courtesy of Tony Francis

"openable" window, the deficit for that room may be reduced by 20 cfm (10 L/s).

For example, assume an existing house has this inventory of existing local exhaust fans:

- Bathroom 1—no fan and openable window;
- Bathroom 2—26 cfm (13 L/s) fan and no openable window; and
- Kitchen—46 cfm (23 L/s) range hood and openable window.

If the ventilation analyst decides not to change any of the existing local ventilation, the deficit is 108 cfm (54 L/s): Bathroom 1 equals a 50 cfm (25 L/s) deficit; Bathroom 2 equals a 24 cfm (12 L/s) deficit; and Kitchen equals a 34 cfm (17 L/s) deficit. One-quarter of this total deficit (27 cfm [14 L/s]) must be added to the dwelling-unit ventilation minimum requirement, Q_{fan}, to compensate for the below-normal-compliance local ventilation. If the whole-building ventilation requirement is calculated to be 50 cfm (25 L/s), it would have to be increased to 77 cfm (39 L/s) if using the alternative compliance approach for this existing home.

On the other hand, if a new exhaust fan were added to Bathroom 1, the total deficit is reduced by 50 cfm (25 L/s), requiring the dwelling-unit ventilation to be increased by only 15 cfm (7 L/s), to 65 cfm (32 L/s).

It is likely that the committee's addition of the alternative compliance path for exiting dwellings was the tipping point for the DOE WAP administrations' adoption of Standard 62.2-2010. DOE issued a national notice in 2011[1] addressing the subject of weatherization health and safety. It stated: "2010 (or most current) ASHRAE 62.2 is required to be met to the fullest extent possible, when performing weatherization activity (must be implemented by Jan. 1, 2012)... Existing fans and blower systems should be updated if not adequate." This DOE requirement made the WAP the largest user of Standard 62.2 as of the beginning of 2012. This continues today.

Additionally, DOE made it clear that:

- Measurement of existing and new fan airflows is required;
- Occupant/owner information and education about the installed ventilation and its use and maintenance is required; and
- WAP field staff must be trained for the proper implementation of Standard 62.2 and its commissioning.

This adoption of Standard 62.2 quickly changed it from a requirement in new dwellings in only two states (Maine and California), to one catapulted to center stage, used by hundreds of field analysts and installers in existing dwellings in every state, every day.

Infiltration

The whole-building ventilation requirement, Q_{tot}, for Standard 62.2 is dependent on the dwelling floor area and the number of occupants, as shown in *Equation 1*.

$$Q_{tot} = 0.03A_{floor} + 7.5\,(N_{bedrooms} + 1) \quad (1)$$

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The number of occupants is usually determined by the number of bedrooms, plus one, assuming two occupants in the master bedroom and one in each additional bedroom. The calculated Q_{tot} value is then required to be supplied by infiltration and mechanical ventilation. Infiltration must be determined by a blower door test of the dwelling and the mathematical provisions of Standard 62.2; the result is the infiltration credit, Q_{inf}. The mechanical ventilation requirement, Q_{fan}, is determined thus:

$$Q_{fan} = Q_{tot} - Q_{inf} \quad (2)$$

Whereas the infiltration credit for new dwellings is limited to two-thirds the value of Q_{tot}, existing dwellings are able to claim the full value of the infiltration credit, allowing a lower Q_{fan} value for a given floor area and number of bedrooms (occupants). The logic here is that existing buildings were often built before the recognition of the importance of envelope tightness, whereas new buildings are not. The Standard 62.2 committee did not want to incentivize the construction of new dwellings having high leakage rates, with the underlying objective of avoiding mechanical ventilation.

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De Minimis

In mid-2014 another change was made to Standard 62.2 distinguishing existing and new dwelling treatment; it is often informally referred to as the "*de minimis*." It states: "For existing buildings, if Q_{fan}** is less than or equal to 15 cfm (7 L/s), then dwelling-unit [whole-building] ventilation is not required."

Because existing buildings are usually much leakier than new buildings, even after air sealing, the required minimum whole-building ventilation rates are often quite low. Applying the full extent of the standard would likely require significant cost and effort for little change in outdoor fresh air delivery to a dwelling. This *de minimis* results in fewer existing dwellings with mechanical dwelling-unit ventilation, but thousands of dollars are saved by avoiding the installation of marginally effective ventilation systems.

Double-Duty Fans

Although Standard 62.2 is silent regarding the use of a single fan for both local exhaust *and* whole-building ventilation, it is often done in the field, especially in existing dwellings. The objective is usually to reduce compliance costs by installing one exhaust fan rather than two or more. The provisions of 62.2 state all fans providing local ventilation in bathrooms and kitchens must be *exhaust* fans, extracting contaminants and moisture at the source. If exhaust whole-building ventilation is appropriate for a dwelling, one fan can satisfy local and whole-building requirements; it is all a matter of fan control.

My house exemplifies the use of a double-duty fan. Built in 1787, it has hidden secrets, including many heavy beams. Installing ducts is challenging or impossible. For local ventilation, I have a Standard 62.2-compliant range hood and a high quality exhaust fan in each of the two bathrooms. Because of the difficulty of installing a separate whole-building fan, the fan in my centrally located bathroom also serves as a whole-building exhaust fan.††

** Q_{fan} is the minimum requirement for whole-building mechanical ventilation (see *Equation 2*).

†† My house is located in the mountains of Maine where it can get very cold. Exhaust whole-building ventilation generally works better in cold climates than in warm climates.

This high quality, low wattage exhaust fan operates continuously to provide whole-building ventilation in compliance with Standard 62.2: 40 cfm (20 L/s). An occupancy sensor at the center of the ceiling fan grille kicks the airflow rate up to 80 cfm (40 L/s) upon detection of movement and holds this rate until 30 minutes after movement stops. The same double-duty function can be performed with a number of kitchen range hoods available today.

Double-duty exhaust fans are used in most WAP installations as a means of keeping costs down while providing 62.2-compliant ventilation. Although Standard 62.2 does not address this practice, the efforts of WAPs have refined the installation and control of this cost-saving ventilation.

What Have We Learned?

Standard 62.2-2003, the first version of ASHRAE's residential ventilation standard, made no distinction between new and existing dwellings; all requirements addressed both. Starting with Standard 62.2-2010, the special needs of existing dwellings were recognized with the inclusion of the alternative compliance path, a full infiltration credit, and the *de minimis* for whole-building ventilation. Along with the increased use of double-duty exhaust fans, these provisions significantly increased compliance with Standard 62.2, while lowering the installed cost of ventilation. It is likely this has been accomplished without sacrificing the health of the occupants.

Based on data from DOE for the WAP from 2012, the year DOE first required the use of Standard 62.2, through 2015, over 424,000 existing dwellings have been appraised for ventilation, most having mechanical ventilation installed as a health and safety measure.[2] Without the Standard 62.2 committee's recognition of the unique needs of existing dwellings, DOE arguably would not have adopted the use of the standard, and the vast majority of these dwellings would not be served by mechanical ventilation. Based on this DOE data, it is likely that over one million people have been positively affected by the Standard 62.2 committee's efforts to recognize the needs of existing dwellings. Not bad.

References

1. DOE. 2011. "Weatherization Program Notice 11-6." U.S. Department of Energy. http://tinyurl.com/h6hbo79.

2. Personal communication between Rick Karg and Josh Olsen, Weatherization Assistance Program, U.S. Department of Energy. 2016. ■

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