In this research project, the U.S. Department of Energy Building America team, Partnership for Advanced Residential Retrofit, developed a method for evaluating safe installation and operation of combustion appliances in homes undergoing energy efficiency upgrades where indoor air is used for combustion and venting. Only appliances installed in the living space or in an area freely communicating with the living space, vented alone, or in tandem with another appliance were considered in this project. The result of this work is captured in a measure guideline that outlines steps for inspectors, auditors, and technicians to follow when working in homes where energy upgrades are being conducted, whether or not air infiltration control is included in the package of measures being applied.

In this case, guidelines are based on language provided in several of the codes to establish minimum requirements for the space using simplified prescriptive measures. In addition, building performance testing procedures are provided by testing agencies. The codes, in combination with the test procedures, offer comprehensive combustion safety coverage to address safety concerns, allowing trained residential energy retrofit inspectors to effectively address combustion safety issues and allow energy retrofits to proceed.

“Following the code guidelines for combustion air and venting is important for the safe operation of gas appliances in high efficiency homes.”

– Ted Williams, American Gas Association

Smoke pen test of draft hood equipped water heater
Category I appliances require air for combustion and dilution of flue gases. A draft hood or draft diverter is provided with some of these appliances to decouple the burner operation from the outdoor weather conditions, primarily wind effects. Adequate air is needed for the burners and the draft hood to ensure good combustion and avoid nuisance outages. Dilution has the added advantage of reducing corrosion in the vent system.

Lessons Learned

Following are steps for evaluating safe installation and operation of combustion appliances in homes undergoing energy efficiency upgrades:

1. Start with a visual inspection of the appliances and vent systems.
2. Identify vent system design or installation flaws and have them addressed.
3. Calculate the required air volume for indoor combustion air using one of several methods provided in the code.
4. Test for adequate draft and high carbon monoxide levels in the flue or in the space.
5. Have a trained technician repair broken or damaged appliance components.
6. Perform remediation or replace unsafe appliances before or during the energy efficiency upgrade.
7. Conduct the upgrade and test the appliances again to ensure safe performance.
8. Perform additional remediation as needed.

Looking Ahead

As houses become tighter through energy upgrades, combustion safety test procedures and recommendations will evolve. Ensure that the latest code requirements are being followed in the field.

Table 13.2(a) Type B Double-Wall Vent

The National Fuel Gas Code provides sizing tables for vent connectors, vertical vents, and masonry chimneys for safe venting of gas appliances. In many cases in the field, the vent connector is not properly sized or an adjustment was made to the vent system, the number and type of appliances, or the appliance location that requires a fresh look at the vent design.

When using indoor air for combustion, the indoor space must meet volume requirements and freely communicate with the indoor environment to provide adequate combustion air.