Furnaces in High Performance Homes
Making the Case for Smaller Furnaces

David Butler, info@acrightsize.com

When specifying equipment for high performance homes, I'm often frustrated by the lack of small capacity furnaces. While this is not a new issue in moderate climates, I wonder if manufacturers realize how much worse the situation has become for high performance homes.

In most areas of the country, furnace selection is constrained by cooling airflow requirements. When we beef up the insulation and tighten the building envelope, the impact on the heating load is much greater than on the cooling load. So in a high performance home, the smallest furnace that can handle the cooling airflow necessarily ends up being substantially oversized in terms of heating capacity, even in cold climates. In cooling-dominated climates like Phoenix, Las Vegas and Tucson, it's not unusual to see 90,000 Btuh furnaces and even larger in homes with design heat loads well under 25,000 Btuh. That's just nuts!

Consider what happens if, on a design day, the furnace only operates a third of the time. As soon as the furnace cycles off, the house begins to cool from the outside in. The thermostat is purposely located away from exterior walls and windows, often in a hallway. When the furnace is off, air doesn't circulate. By the time the thermostat senses the call for heat, the temperature in the perimeter zones will have dropped by an uncomfortable margin. During mild days when heating loads are small, minimum runtime logic assures significant overshoot. Either scenario results in occupant discomfort.

These types of comfort issues have been a persistent cause for homeowner complaints over the years. Not surprisingly, buyers of high performance homes have high expectations in terms of comfort. However, a grossly oversized furnace greatly exacerbates the problem. Installing 25% or even 50% excess capacity is probably OK, but oversizing by a factor of two, three, or even more, is going to cause problems.

Manufacturers are quick to recommend their most expensive modulating furnaces to address the sizing issue. Call it irony, but top-of-the-line high-efficiency source equipment is almost never cost-justified in homes with extremely low loads. What's needed are single-stage 80% and 90% models with small burners and increased blower capacity. For example, we need a 25,000 Btuh furnace with a 2-ton blower, a 45,000 Btuh furnace with a 3.5-ton blower, and a 70,000 Btuh furnace with a 5-ton blower. These furnaces should be equipped with high-efficiency ECM motors, sized to deliver their design airflow against at least 0.6 inches ESP on high speed. The only constraint is that the blower must maintain a non-condensing supply temperature on low speed. No one needs or wants 120 degree supply air in a tight, well insulated home.

This is why heat pumps are usually the best choice for high performance homes in moderate and mild climates. Although there's still significant market prejudice against heat pumps, the old argument that they're less comfortable than furnaces is getting flipped on its head in high performance homes. Unfortunately, in some areas such as California, heat pumps are not viable due to extremely high electric rates. Subdivision builders are also quick to point out how they're often forced to install gas furnaces in order to be able to offer other popular gas appliances.

High performance homes are no longer a niche market. Nationally, the number of Energy Star qualified homes will soon surpass the one-million mark through a network of over 5,500 participating builders. In Las Vegas alone, over 78,000 Energy Star homes have been certified. And despite the depressed housing market, Energy Star's new homes program more than doubled its market share in 2008.

A smart furnace manufacturer could capture a significant portion of this market by offering small capacity furnaces with larger blowers.