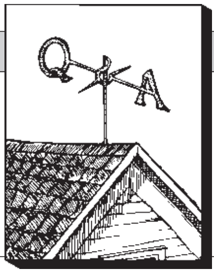

What Capacity Heating System?

by Henry Spies

Q. *I have been trying to design a heating system, and I am getting nothing but confused. Apparently the furnace should be sized according to the total calculated heat loss. However, the bonnet temperature is supposed to be about 165 F or so, and the temperature rise through the furnace about 100 F—as if that were possible with the blower furnished.*

Two contractors have agreed that a satisfactory system can be achieved only by ignoring the published theory and putting in a blower with a circulation capacity of about five air changes per hour and enough input capacity to give a minimum temperature rise of 55 F. What does *work?*

A. As an example, let us assume that you are talking about a small or super-insulated house with a design heat loss of 30,000 Btu per hour. This also assumes a reasonable infiltration rate, such as one air change per hour. Therefore, the register heat delivery must be at least 30,000 Btu per hour.

Heat is lost through the ducts between the bonnet and the warm-air registers. A 25-percent heat loss is commonly assumed for a house of average size (about 1,200 square feet). This means that the minimum bonnet capacity should be about 40,000 Btu per hour to account for the heat loss. In hydronic systems (but not in forced-air systems), an extra 10 percent is added for pick-up.

For a temperature rise of 100 F, the required fan capacity would be only 370 cubic feet per minute (c.f.m.). Fans seldom are installed at this low a capacity, since a slight error in calculating the duct resistance could cause lower delivery volume, which would result in register air temperatures above 165 F (and which is not desirable).

Many furnace systems are designed on the basis of year-round operation. In the summer, the flow of cooling air will be based on the probable cooling requirement of the house. For example, if the cooling load is estimated to require a two-ton (24,000 Btu per hour) compressor, the required air flow would be two times 400 c.f.m., or 800 c.f.m. As a general rule, the 400-c.f.m.-per-ton air flow is the minimum you would need to avoid coil freezing.

If we assume that the furnace with a capacity of 40,000 Btu per hour would be matched with a 24,000-Btu-per-hour cooling coil, the packaged furnace unit would be equipped with an 800-c.f.m. fan.

If the packaged unit is equipped with a single-speed fan, which is common, then the same 800 c.f.m. would be delivered in winter. With a bonnet capacity of 40,000 Btu per hour, this means that the winter temperature rise would be only 50 F rather than the 100 F first assumed.

If a two-speed fan is used, the air flow in winter can be reduced so that the delivered air temperature will be higher. In terms of combustion efficiency, the 800-c.f.m. air flow would provide for more efficient heat transfer during the winter cycle than the barely sufficient 400 c.f.m. The higher cost of operating the fan would be offset by a much-improved heat transfer, with lower fuel costs.

While some installers argue that some magic number—such as five air changes per hour—is necessary, this is hard to justify. A good baseboard hot-water system provides excellent comfort conditions with convective air movement equal to less than two air changes per hour.

We strongly urge the installer to set the fan switch inside the casing to turn on at a bonnet temperature of 110 F. This should provide almost continuous fan operation when the weather reaches freezing or below.

Designing for Snow Loads

Q. *We are building an air-tight, super-insulated house with about R-70 in the ceiling and wood shingles on a 6/12 roof. Even here in southern Vermont, substantial snow loads can accumulate, and they can be increased even more by rainfall absorbed by the snow, providing potential live loads in excess of 100 pounds per square foot (p.s.f.). Trusses designed for a live load of more than 60 p.s.f are inordinately expensive. Other than shoveling the roof, do you have any suggestions?*

A. I think you may be overestimating the problem. A live load of 60 p.s.f. is equal to about 11 ½ inches of water—the equivalent of about nine feet of snow—and that is unlikely even if the snow is waterlogged. According to the ANSI standard, the maximum snow load ever observed in Burlington, Vt., is 43 p.s.f., so a design load of 60 p.s.f. should be sufficiently safe.

Wet Waferboard

Q. *Used as a subfloor, how do some of the new products, such as waferboard or oriented strandboard, react to the almost inevitable wetting from rains before the roof is on, etc.? Are they better than plywood in this respect?*

A. Unfortunately, the waferboard and oriented strandboard are even more susceptible to moisture damage than CDX plywood. When wet, the swelling of the edges can be expected to be 20 to 30 percent more than the swelling of plywood. Of course, they do not delaminate as such, but the edge swelling is just as much of a problem.

The spacing between sheets is just as important as with pine plywood. If the sheet increases in length due to moisture absorption and there is no space between the ends of the sheets, it will buckle up from the floor joists, pulling the nails as it comes. If the manufacturers of the material would only make the sheets 95 7/8 inches long, the spacing would be automatic and solve a lot of problems. ■

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