TECH TIP # 17

HEATING, AIRCONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

One of a series of dealer contractor technical advisories prepared by HARDI wholesalers as a customer service.

A GOOD WAY TO SIZE A HEAT PUMP

An air-to-air heat pump differs from other types of heating units because its Btuh output changes with changes in outdoor temperature. As most of us are aware, a heat pump is a refrigeration device which extracts heat from outdoor air to warm a house. Naturally, as the outdoor air temperature decreases it becomes harder for the heat pump to extract heat from the air, and the unit's capacity falls off. So, while a building's heat loss is increasing, a heat pump's output is decreasing. When we need the most heat, it provides the least heat.

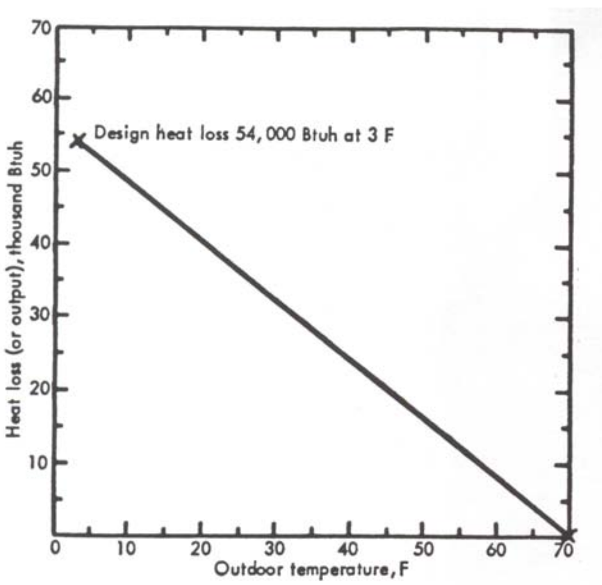
With this changing heat output how do we properly size a heat pump for the job? To start off, a heat pump is usually selected to match the house *cooling* load.

Then the heating capacity is compared to the heat loss of the house, and if any additional heat is needed, supplemental electric resistance heaters can be added. Typically, here's how it's done.

Suppose a house to be considered has a heat loss of 54,000 Btuh at a 3º F design outdoor temperature (comparable to Terre Haute, Indiana or Buffalo, New York). The design cooling load is estimated to be 34,000 Btuh.

Based on the 34,000 Btuh cooling load we would pick a nominal 3 ton heat pump.

Fig. 1



Step 1 GRAPH house heat loss

The first step is to plot the heat loss of the house versus the outdoor temperature on a graph. This can be done simply by drawing a straight line between the design heat loss of 54,000 Btuh at 3º F, and zero heat loss at 70º F --- the assumed indoor conditions. (See Figure 1.)

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Next, the heating performance data, as listed by the manufacturer, are plotted on the same graph. (We show this in Figure 2.)

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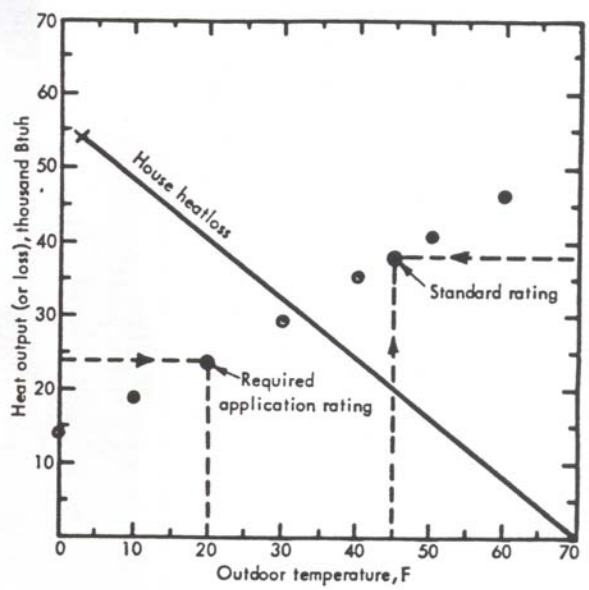
Fig. 2

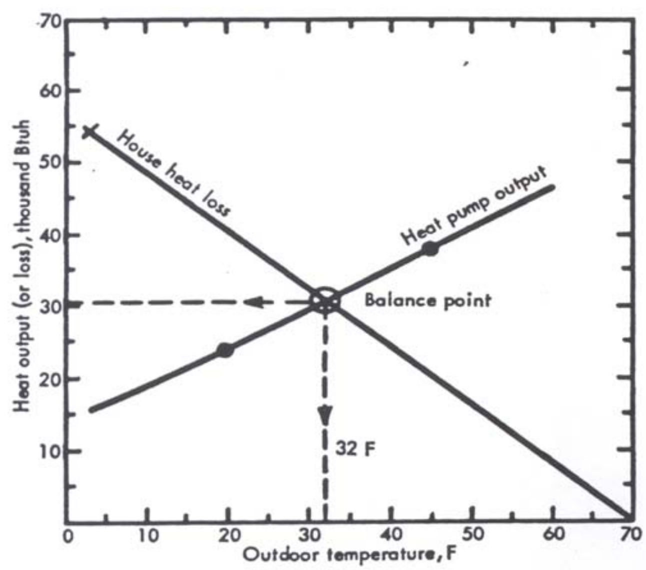


Step 2 PLOT heat pump output

After the performance data has been plotted, the points should be connected by a smooth curve. Where this heat pump curve intersects the house heat loss curve is called the ***balance point***. At this point the heat pump's capacity just matches the heating requirements of the house.

Figure 3 shows that for our example, the balance point occurs at 32º F when the heat loss and output each equal 30,500 Btuh. This means, below an outdoor temperature of 32º F, our heat pump will not have sufficient capacity to offset the heat loss of the home. At this point supplemental heat will be needed.

Fig. 3

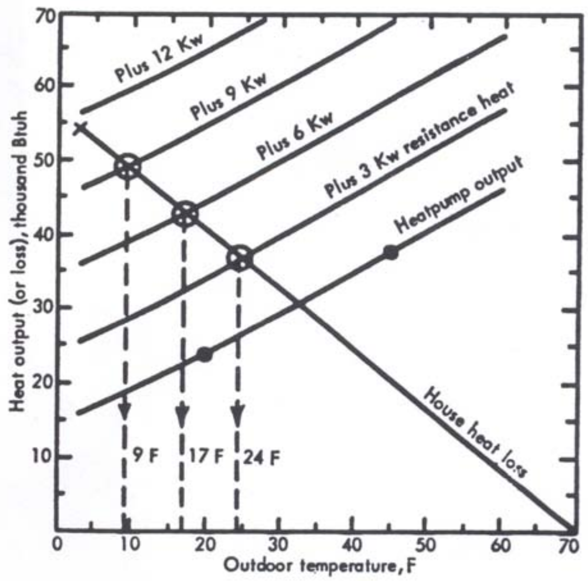


Step 3 FIND the balance point

The final step is to find out how much electric resistance heat is needed, and also at what outdoor temperatures (new balance points) succeeding stages must be energized.

Figure 4 shows curves of heat pump output with the addition of resistance heat -- in our case, in 3 kilowatt increments. Each of these new curves intersects the house heat loss curve at a different outdoor temperature forming completely new balance points each time. For instance: with 3 kilowatts of supplemental heat added to the heat pump output, the balance point occurs at 24º F instead of 32 degrees; with 6 kilowatts added, at 17º F; etc.

Fig. 4



Step 4 DETERMINE auxiliary heat needed.

In this particular example, 12 kilowatts (40,956 Btuh) of supplemental heat must be added to satisfy the design heat loss of the house. However, very often supplemental heat sufficient in itself to satisfy the total heat loss must be added because heat pumps are usually shut off at low ambient temperatures due to their inefficiency. (Usual cut off point is somewhere between 15 and 0º F.)

All this may seem like a lot of trouble, and the first time a specific heat pump is chosen, the construction of the sizing chart will, no doubt, be a bit time consuming. But, it can be used over again on a new job. All that has to be changed is the house heat loss curve -- just draw in the appropriate one and pick off the balance points. Of course, you must have a graph for each model of heat pump that you handle.

Also, in actual practice, the outdoor thermostats used to activate the supplemental heaters are set 2 to 5 degrees higher than the values indicated on the graph. The reason is to provide some reserve capacity to offset a higher heat loss, say, due to strong winds blowing just when we are near a balance point temperature.