HSPF/SEER Temperature Data: Another Source of Inflated Rated Efficiencies

Similar to the automobile miles per gallon rating procedure, the test method for heat pump efficiency inflates the rated values above actual performance. Heat pumps operate more efficiently when the temperature is mild. Since the ratings are "average" or seasonal, higher rating values will result if efficiency is computed using a large number of hours when the temperature is mild. Typically homeowners set thermostats lower in the winter because heavier clothing is worn and to save energy. They will raise this temperature several degrees in the summer to save energy and to remain comfortable in lighter clothing. This will create a band of outdoor temperatures when the heat pump will not operate. Logically, this also corresponds to mild outdoor conditions when heat pumps are most efficient.

Close examination of the temperature data used to determine Heating Seasonal Performance Factor (HSPF) and Seasonal Energy Efficiency Ratio (SEER) reveals that the assumption is that the homeowner will set the thermostat **5ºF higher** in the winter than in the summer. The figures below represent graphs that plot building heating load (left axis) and cooling load (right axis) with respect to the outdoor air temperature. In Figure 1 the heating load is 25,000 Btu/h at 12ºF and it decreases to a point of no-load at 50ºF. The outdoor temperature of 50ºF represents the point where the heat loss from inside the building balances the internal heat generated by occupants and equipment. Thermostats are typically set to have a 5ºF to 15ºF dead band that represents the temperature swing occupants will allow before requiring cooling. In this case cooling is required above an outdoor temperature 60ºF, indicating building heat loss is less than internal heat generation. As outdoor temperature rises, cooling load increases. An example point is shown for 90ºF where the cooling load is 16,000 Btu/h.

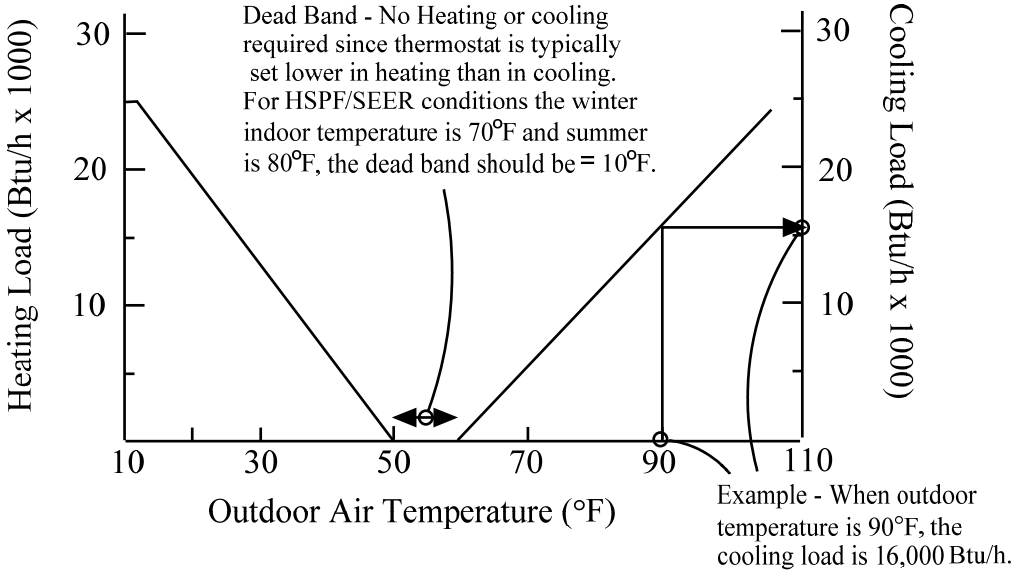

Figure 1 – Traditional Heating and Cooling Load Plots with Outdoor Temperature

The temperature "bin" data used for the computation of HSPF and SEER does not reflect this traditional format. Since the data used in ARI Standard 210/240 includes values in the 62ºF bin (temperatures between 60 and 64ºF), the 67ºF bin (temperatures between 65 and 69ºF) is the no-load point for heating. However, the data used for cooling includes values in the 67ºF bin which indicates the 62ºF bin is the no-load point for cooling. Since the indoor temperatures for the ARI Standard are 70ºF for heating and 80ºF for cooling, a 10ºF dead band or gap in the temperature data should be present. However, there is actually an overlap in the resulting load lines and shown in Figure 2.

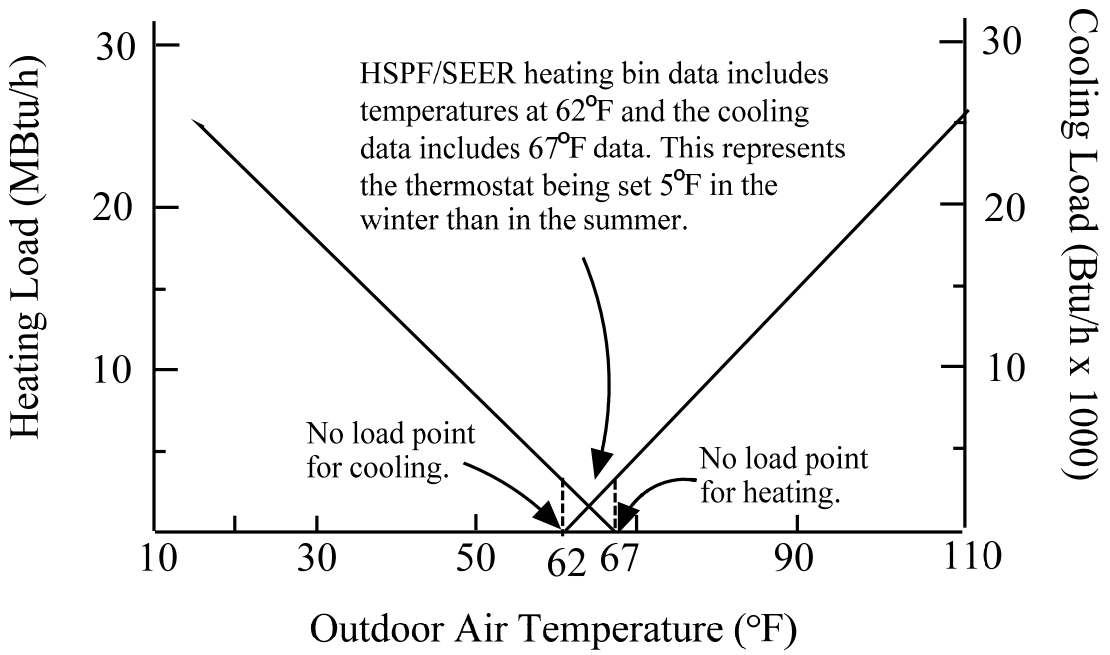

Figure 2 – Heating and Cooling Load vs. Outdoor Temperature for HSPF/SEER Test Procedure

In a more realistic test procedure the no-load point in heating should be 10ºF lower than the no-load temperature in cooling. For example, if the cooling load line shown in Figure 2 were shifted to the right so the no-load point is 67ºF, the no-load point for heating would be 57ºF. This would mean that a realistic cooling SEER would not include performance data for 67ºF since it is the no-load point. The HSPF computation would not include performance data for 57ºF or 62ºF since a heat pump in a "real" building would not be operating.