Monday, July 25, 2016

Part Load Efficiency Value (Part 5): BTUH Load Output vs. Percent Flow Tolerance

The last four segments of the R. L. Deppmann Monday Morning Minutes introduced the valuable PLEV tool from Bell and Gossett. The part load efficiency value (PLEV) for pumps is based on flow rate while the IPLV for chillers is based on load. This final segment on PLEV will look at the difference.

Gil Carlson from Bell and Gossett provided much of the basic knowledge in the B&G Engineering Design manual. Gil spent a great deal of time discussing balancing of hydronic systems and flow tolerance. How much BTUH can you get if the flow rate is less than design? Can we use the Bell and Gossett PLEV for load calculations?

Flow Tolerance for Hydronic Heating Systems

The figure below shows a typical heating coil output based on percentage of the coil manufacturer's recommended coil velocity. Clearly in heating systems, we can get a large percentage of the heat transfer at a lower flow rate. The graph assumes a constant supply temperature. If your design is using temperature reset, there is less tolerance to reduced flow. The actual velocity through the coil, and even the type of terminal unit, all affect the flow tolerance in hydronic heating systems. Since most heating systems have a temperature reset along with modulating two-way valves, percentage of flow rate will approximate percentage of load.
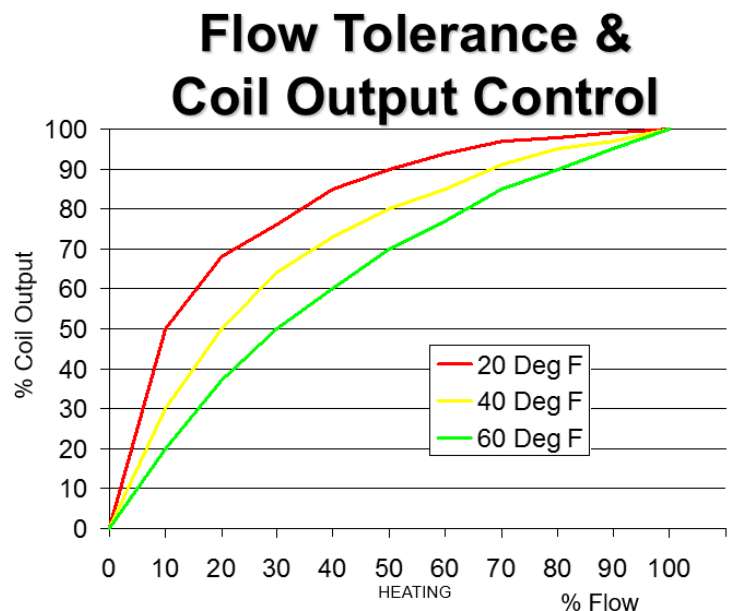
Flow Tolerance for Hydronic Chilled Water Systems

Chilled water systems require enough flow rate to meet both sensible and latent loads. The chart below is from ASHRAE 2015 Applications, chapter 38, and shows flow tolerance for this particular coil at 45°F supply and 10°F ΔT. Note that although there is 90% of the total heat transfer at 80% of the design flow rate, there is only 70% of the latent heat transfer.

Percent of flow rate is a good approximation of load when looking at chilled water coils.

B&G created the PLEV for engineers to evaluate pump efficiency over a range of operating points. Obviously, the pump selection program does not differentiate between heating and chilled water and does not require the user to enter the type of terminal units and temperatures. PLEV is simple to see and use with minimal input and we recommend its use when comparing variable speed variable flow pump selections in HVAC applications.