



St. Mary's Janesville Hospital in Janesville, Wis. installed two ClearFire®-C full-condensing boilers as part of their hybrid hydronic system, improving the hospital's operating efficiency.

Selecting the Right Hydronic Boiler Pump

Selecting the right-size pump for a hydronic boiler requires knowledge of the system. The first step is to determine the water flow rate, measured in GPM or gallons per minute. Calculate this by taking the boiler's output, rated in BTUs, and divide it by 500 times the delta T, which is typically 20, but can be 30 or 40 in newer systems. Also, be sure to take into consideration whether the system uses water or glycol. If the system uses glycol for freeze protection, there will be less heat transfer.

After determining the flow rate for the pump, the next step is calculating the head loss or differential pressure. There are differences based on whether a system is open or closed. The following example assumes a closed system, typical for heating boilers.

The head loss calculates the resistance to flow in the system caused by the heat transfer units (typically hot water coils), piping, control valves, miscellaneous valves and fittings. A quick way to estimate head loss is to take the longest run of piping on the longest circuit, flowing away from and back to the boiler. Once the longest run is known, multiply that length (in feet) by .045 to determine pressure loss in feet of head. Using the measurement of feet of head provides more resolution compared to psi. One psi equals 2.31 feet of head.

In addition to piping loss, the pressure loss for the hot water coil, boiler and control valve must be added together to determine total system loss. Control valves typically have a pressure loss of approximately 15 feet of head. The coil pressure loss must be obtained from the manufacturer; however, it is typically between 5 to 15 feet of head. Likewise, each boiler will have a specific pressure drop so it is best to consult the manufacturer. One of the advantages of the Cleaver-Brooks ClearFire® line is its extremely low pressure drop regardless of flow, typically less than 2 feet of head.

Another criterion to consider is system pressure. For the majority of buildings, system pressure is typically 20 to 80 psi. Design pressure of the system will typically be 60 lbs., 125 lbs and upwards to 160 lbs. In high-rise designs, the system pressure can increase, so the casing on the pump must be adequate.

After calculating flow rate, head loss and system pressure, there are several pump designs available:

Circulator pump – A very small inline pump whereby the motor is mounted directly to the impeller. This pump is only applicable for very small GPMs.

Inline pump – This type of pump fits in the piping and takes up minimal space. Typically this type of pump is used on small systems or for the boiler circulating pump.

Vertical inline pump – This is an inline pump with a coupling that allows the motor to be removed from the pump. Pump sizes range from 20 GPM to more than 1,000 GPM. The larger pumps are generally mounted near the floor for better service.

Close-coupled pump – This pump is mounted on a concrete pad on the floor or on a steel base, but there is no coupling between the actual pump and motor. For maintenance and part replacement, the pump and piping have to be disassembled.

Base-mounted pump – This pump features flexible coupling that makes maintenance and part replacement simple. The coupling can be removed, leaving the piping and pump intact.

Pumps can be either a constant flow or variable flow system. Constant flow pumps are not typically allowed for most modern hydronic heating systems due to their higher energy consumption. Variable flow systems are more energy efficient and offer better control and HP savings.

Nearly all manufacturers are designing pumps that have an integral variable speed drive (VSD). In fact, this feature was promoted heavily by manufacturers at the 2014 AHR Expo. These drives have a control system that eliminates the need for a remote sensor. The control system knows where to run based on pump demands and pre-set information, so it is not necessary to put in a sensor to measure pressure. These products are called sensorless pumps and offer several benefits. They are energy-efficient, more reliable and make the pump easier to troubleshoot.

Pumps need a minimum flow. Typically, 20 percent of design flow is required to ensure a pump does not overheat. The VSD can theoretically reduce the pump flow to 0 GPM, but at low flows, the inefficiency of the motor and the bearings start to heat up the water in the pump, which can lead to problems, including damage to the bearings and seals. It is important to remember that a pump always requires a minimum flow, which engineers account for in system design.

Today's hydronic system pumps are generally variable flow. Sometimes on boiler systems, the pumps will be primary-secondary, which means the boiler has a constant speed primary pump, but the secondary distribution is variable speed. Some primary-secondary boiler systems may also incorporate variable speed boiler primary pumping for even greater energy savings.

With Cleaver-Brooks line of ClearFire products and their inherent low-flow tolerant, low-pressure drop design, primary variable flow pumping is the ideal method to maximize efficiency and minimize energy use in a hydronic system. With this design strategy, one attains both electrical energy savings and improved boiler operational efficiency delivering greater energy savings than primary-secondary systems as well as improved temperature control. In addition, there are fewer pumps required resulting in a lower first cost compared to conventional primary-secondary arrangements.

To learn more about hydronic pumps or the ClearFire line of products, contact your local Cleaver-Brooks representative or visit cleaverbrooks.com.