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Break The Tie! Preso Ellipse Flow Meters for HVAC Hydronic Mains

Monday Morning Minutes | by Norm Hall, September 17, 2018

The balance contractor often has a tough job when completing the flow balance of an HVAC hydronic heating or cooling system. Today's engineering documents tend to show little more than a balance device at each terminal unit. The balance valve may be a manual balance and flow measurement valve which includes a flow meter, an automatic flow limiting balance device, or a pressure independent PICV flow limiting device. The contractor is faced with a determination of flow rate based on information at the terminal units and a pump readout at design flow rates. Rarely do they match! Why don't you break the tie!

The Issue: Read Out of Terminal Balance Valves

In past R. L. Deppmann Monday Morning Minutes, as linked above, I mentioned the pros and cons of various balancing strategies and devices used. The manual valves are also flow measurement devices if specified that way. Today's world of hydronic design often has direct return systems with higher head pumps. The balance valves near the pumps have a large pressure drop while the valves at the end of the loop should have little pressure drop. Without branch balance valves, the balancing contractor is faced with a proportional balance where flow rates can change significantly as the balance is performed.

The goal of the contractor is to get the flow rates as close as possible to the design flow rate while staying within the specified flow tolerance. Most times the manual balance valve does not have proper lengths of straight pipe or may be piped in such a manner that the readout ports are not accessible. Another challenge is the building addition where the balance contract is for the terminal units in the addition but there is no money awarded for re-balance in the existing system.

In the case of automatic flow limiting or pressure independent balance valves (PICV), they can read the valve but they have to trust the correct cartridge is in the valve since there no flow measurement.

The contractor does the best they can but this is not an exact science. They end up with a total flow rate of the devices provided.

The Issue: Read Out of the Pumps

In my 40+ years in the industry representing Bell & Gossett, I have grown very comfortable with the continuous accuracy of their pump curves. B&G does a great job of maintaining tolerances during manufacture that leads to a consistent product that performs per the pump curve.

Other manufacturers do not maintain the same quality of manufacture. Their pump curves may be accurate in a very tight band unless you ask for test certified curves. Even then, the test may be done at one point on the curve, the design point.

My point is that I trust the flow measurement I read out on a B&G pump but do not trust the readings of other brands. When the balance contractor reads out the pump to determine the flow rate, they use the published pump curves. This may or may not match the summation of the terminal balance.

Often times there may be air in the system which causes the pump readings to indicate a false flow reading. Flat pump curves are a plus in closed hydronic systems but sometimes the pump curve is too flat for an accurate readout. The readings of pumps under these conditions may or may not match the summation of the terminal balance.

What the contractor needs is a third measurement to assist in determining the true state of the flow rate in the system.

The Solution: A Design that “Breaks the Tie” - The Main Flow Meter

What the balance contractor needs is something to compare the two numbers to. One number is the total of the terminal units flow rates and the other is the pump flow readout. The contractor can determine which is correct and what has to be done to complete a proper balance if they have another flow measurement.

I'll stop now and say we really are not breaking the tie. We are creating a tie! We have two numbers that are too far apart to be comfortable with and the third number will



help the contractor to adjust where needed before signing the balance report.

The engineer should, at a minimum, provide a flow measuring annular device in the return pipe for each pumping system. The flow measuring devices we represent for this service is the Badger Meter Preso DP flow sensors. DP sensors, for most pipe sizes, are installed in an insert weld fitting in the pipe so installation costs are minimal.

We recommend the Preso “Ellipse” Elliptical flow element for pipe sizes 2-1/2” and over. The ellipse has an uncalibrated accuracy of $\pm 3/4\%$ and a 17:1 turndown ratio. Below 2”, the flow meter would be soldered in and you might as well use a combination balance and flow measurement device such as the B&G Circuit Setter or Griswold Quickset.

Preso does make a less expensive round flow element which is the Badger Meter Preso BIN flow element. It is a few dollars less but its accuracy is $\pm 3\%$. More important is the turndown which is significantly less than the BAR Ellipse. The ASHRAE 90.1 Energy Standard tends to have lower velocities in larger pipes so the high turndown is a preferred product. In addition, if you have two pumps in parallel, the larger turndown will assure a higher accuracy when reading each pump individually.

Why Install the Preso Ellipse on the Return Line to Pumps?

When I do see a flow element at the pump, it is often shown on the supply piping from the pumps or on the discharge pipe from the pump. The pump discharge is the most turbulent place in the entire system. In addition, it is not uncommon for the pump header to be fairly short before splitting off or entering another piece of equipment.

The return line has the least pressure and usually the straightest runs of pipe. If you specify hardware to remove the flow meter under pressure, also called hot tap or wet tap, the return line will have less pressure during operation and therefore less potential for a problem due to pressure.

Why not just use the Temperature Control Flow Meter (if there is one)?

Why not use the Badger M2000 magnetic meter or a Badger Dynasonic transit time flow meter shown on the temperature controls details? This is a possibility but the timing and ownership is almost always off. The balance contractor is normally out doing the balance long before the controls system has been commissioned and adjusted. In addition, often

times the control contractor does not work for the piping contractor and concerns about touching something that is owned by someone else may be an issue.

Is There a Value Beyond the Initial Balance?

The proper balance of the hydronic system is important enough that using the Preso Ellipse for each large set of pumps is a great return on the investment. There are other potential advantages. If the HVAC system is not heating or cooling properly, it is a time saver to quickly eliminate the hydronic side as the cause. The contractor can read out the Preso Ellipse to verify flow through the system. It can also be used to dial down the speed and identify the maximum speed for setting the variable speed drive per ASHRAE 90.1 standards. If there is an addition or change to the system years down the road, the Preso Ellipse can verify what the system flow rate is at the time of the design. This will help determine if there is room to add capacity without changing the pumps.

We can add, if specified, a simple wall mounted gauge that reads in GPM for the owners use. It is a quick verification of those more expensive meters in temperature controls. Finally, it is a quick check for the engineer to eliminate flow questions if there are concerns that pop up later in the project.



What do Balance Contractors Have to Say?

Mike Giles of the Michigan Environmental balancing Bureau states, “There have been many, many occasions, on various jobs, where that “third device” would have answered the question of, “Which reading do I believe?” Considering all of the other variables that could skew the reliability of the aggregate individual readings, it is always nice to have one final cross-check of the system total, as it relates the pump readings, the chiller pressure drop readings (where applicable) and the aggregate system total. This can be even more important with systems that employ diversity because the pumps and boilers are not sized to handle the total of all connected devices.”

Simple to Detail and Specify

We recommend drawings show a flow meter on the return pipe to each set of pumps. This can be on the pump detail or the one line schematic. For Deppmann customers, owners, and engineers; you can call R. L. Deppmann or fill out this quick inquiry and we will get you the wording for section 230519 of your specifications. If you are outside of our territory we will get you in touch with Badger factory personnel to help you out.

There is every reason to start adding this inexpensive tool to help commission and troubleshoot the system.