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February 8th, 2010 ~ Monday Morning Minutes:

The Bell and Gossett System Syzer and Pump Affinity Laws

Hydronic heating system flow rates and pressure drops are related through a series of AFFINITY LAWS. Let's examine the laws and how to use them in practical day to day applications.

$$\frac{GPM_1}{GPM_2} = \frac{RPM_1}{RPM_2} = \frac{IMP\ DIA_1}{IMP\ DIA_2}$$

This first law tells us if we have a pump operating at design conditions, in a closed hydronic system, and it is flowing "X" GPM; if we cut the speed in half we will cut the flow in half. If we trim the impeller, then the flow will drop in a direct relationship.

$$\left(\frac{GPM_1}{GPM_2}\right)^2 = \frac{HEAD_1}{HEAD_2}$$

The second Affinity Law is a bit more complicated. It says, "The change in pump head or pressure drop in the system varies as the square of the change in GPM flow rate. If the system pump is flowing "X" GPM at "Y" feet of head and we want to double the flow rate; the pump will have to produce 4 times the head. Conversely, if we want to drop the flow rate in half it only takes ¼ of the pump head. Of course, all of this assumes a steady state condition, meaning the control valves are all at design condition or not changing as the flow changes.

Scale 5 on the B&G System Syzer can be a handy tool for using the second Affinity Law. Let's take a look at an example. Assume you have a heat exchanger with a capacity of 100 GPM at a pressure drop of 20 feet. Maybe that 100 GPM was based on an original design of 20°ΔT and you want to see what the pressure drop would be if you went to 40°ΔT with the same BTUH output. We know that BTUH = GPM x ΔT x 500 for water, so if we change from 20°ΔT to 40°ΔT then the GPM goes from 100 GPM to 50 GPM.

Now let's find the new pressure drop using scale 5 of the System Syzer. We could just use the formula above and a calculator, but let's find a quick answer. Take scale 5 and align 100 GPM in the white window with 20 feet in the blue window. Now look at 50 GPM in the white window. Without moving the wheel, we see 5 feet of pressure drop. We obtain a quick answer using the second Affinity Law and the ITT Bell and Gossett System Syzer.

Next week we'll use this tool for a field pumping problem.

If you would like to download the electronic system syzer go to http://www.bellgossett.com/BG-SystemSyzer.asp