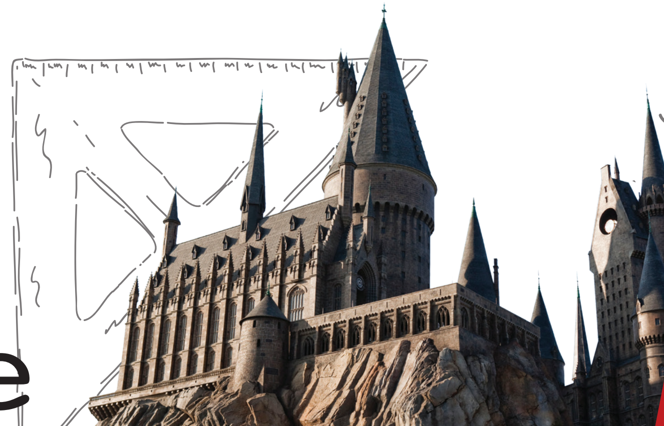
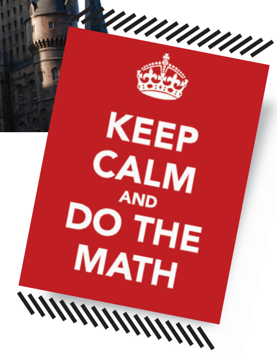
By John Barba



The "Magic" of Math



How Delta-T variable speed pumping works

On an initial call for heat, the circulator will run at full speed for a certain amount of time to establish a temperature difference. It will continue until it establishes that 20-degree temperature difference between the supply and return.

In a 70,000 BTUH sample system, if all zones were calling at design temperature, the load would be 70,000 BTUH. In order to deliver the 70,000 BTUH and maintain that 20° Delta-T, the circulator would have to provide 7 gpm, presuming your heat loss is dead-on accurate (which it rarely is, but this is an example).

BECAUSE THE MATH SAYS SO.

As zone valves close, common sense says the actual BTUH load of the system will be lower. Since the system is taking less "heat" out of the fluid, the return sensor will pick up an increase in the return water temperature as the system's Delta-T starts to shrink. The logic written into the circulator control takes over and slows the circulator down in order to restore that 20° ∆T.

WHEN ZONE VALVES OPEN, IT DOES THE OPPOSITE.

The same thing happens when the outdoor temperature changes. When it's colder out, the system takes more energy out of the fluid. To maintain the 20° ∆T, the circulator will have to go faster. When it's warmer out, it's the opposite.

Math is a really cool thing. And it helps make sense of this crazy thing we call hydronics, but there's no such thing as "magic" in hydronics.

There are no magic boilers, controls or circulators that know what to do. If someone can't explain to you exactly how a Delta-P or a Delta-T variable speed circulator works, and why, without using the word magic, or some derivative thereof, they either went to hydronics school at Hogwarts or they don't really know.

As Einstein once said, if you can't explain it simply, then you don't understand it well enough.

So let's talk about what Delta-T and Delta-P variable speed circulators are, how they work, why they work, and a little about the applications that each is best suited to.

The P Side of CIRCULATORS

Much like Delta-T circulators, Delta-P models also work on a differential, but rather than varying its speed based on changing temperatures, it counts on pressure differentials in a system, and was designed for TRV applications.

The "trigger" that tells a Delta-P circulator to speed up or slow down is resistance against the impeller. When there's enough heat in a room a TRV will start to close, placing more resistance against the impeller. The circulator senses that, and slows down.

So far, so good, right?

But again, common sense tells us there's more than one radiator in a system, and more than one TRV. While one is closing, another may be opening, and another may be holding steady. What's a Delta-P circulator to do?

Same thing as Delta-T: react to the overall system-wide changes in pressure differential.

It varies its speed based on overall system pressure differential. That's all it knows.

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Meeting up at the
Delta-T

It's a very simple concept. When you design a hydronic system, you always calculate flow rate around a Delta-T, or temperature drop, between the supply and return. This little factoid is found in the age-old Universal Hydronics Formula, which states that:

$$\text{GPM} = \text{BTUH} \div (\Delta T \times 500)$$

• BTUH is the heating load you're trying to satisfy at a given point in time.
• ΔT is the designed-for fluid temperature drop as it goes round the system.
• 500 is a constant when using 100% water. Glycol changes things, but that's a story for another time.

We tend to use a 20°F ΔT when designing residential hydronics here in North America. If we know the heating load, and we know the Delta-T we're designing for, finding the required flow rate is simple math:

$$\text{GPM} = 70{,}000 \div (20 \times 500)$$
$$\text{GPM} = 70{,}000 \div 10{,}000$$
$$\text{GPM} = 7$$

PICKING THE RIGHT PIECE

The installer/designer is the brains of this operation. If he selects a Delta-T variable speed circulator, he'll need to do three things, none of which are very difficult, but all of which are essential.

1. Make sure the circulator can handle the maximum flow and head requirements. If it's not big enough, it's not big enough.
2. Make sure the circulator is programmed for the "designed-for" Delta-T. Some Delta-T circulators are factory set for a 20°F ΔT, but it's generally easy to change if necessary, based on the application.
3. Install the supply and return temperature sensors in the appropriate locations.

So this says in order to deliver 70,000 BTUH to this structure at a 20°F ΔT, I'll need a flow rate of 7 gpm. That's the real magic right there!

Knowing the flow rate, I can now calculate the head loss as best I can through the rest of the system. When I know the flow and head requirements, I can go about selecting a circulator that will deliver that flow and overcome that head loss.

Now please note, there's not a circulator in the world that can be thrown blindly into a random application with the assumption that it will "figure it out." No machine can – nor should – replace your experience and knowledge when it comes to accurately selecting a circulator.

Machines aren't ready to take over the world just yet.

SHIELDS UP!

All of the real or self-proclaimed industry experts out there have an "angle."

No matter whose comments you're seeing on message boards, whose webinars you're watching or whose columns you're reading, keep your BS shields up.

Usually the most bombastic, snarky, long-winded or big-word-loaded responses are coming from someone who has something to gain.

And you get I work for Taco, right? That's my angle and I urge you to filter accordingly. Use your own smarts and rely on what makes sense and what is logical to you. And don't believe in "magic."

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