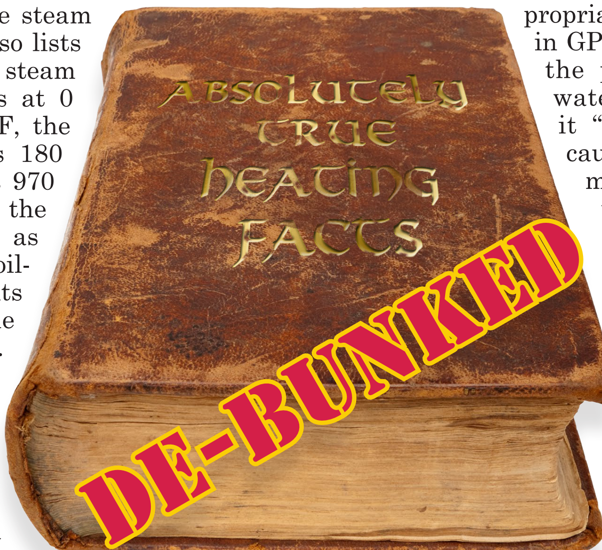
By George R. Carey, Jr.
Vice President, Fluid
Industrial Associates, Inc.
gcarey@fiainc.com

3 Common Heating Myths...De-bunked!

1) High pressure steam moves faster than low pressure steam.

This is a very common misconception in the industry...if you crank up the pressure in the boiler, the steam will move faster because it is under higher pressure. NOT TRUE! High pressure steam is hotter than low pressure but it does not move faster. If you were to look at a "properties of steam" chart, there are several interesting "tidbits" that appear. Things like the temperature of the steam at a corresponding pressure, the amount of sensible and latent BTUs that is contained in the steam at that specific pressure. It also lists the volume of one pound of steam in cubic feet. When steam is at 0 psig, its temperature is 212°F, the amount of sensible BTUs is 180 per lb. and the latent heat is 970 BTUs per lb. (Latent heat is the amount of energy, expressed as BTUs, that is added to the boiling water (212°F) to change its state to a vapor.) The volume of steam at 0 is 27 cubic feet. The temperature of steam at 10 psig is 240°F; the sensible BTUs increase to 208 but the latent BTUs drop to 952! The volume at 10 psi is only 16 cubic feet!



GRAPHIC: MIKE SANGIOVANNI, ICM

To calculate the velocity (how fast the steam is moving), there is a simple formula used in the industry. It is based upon a couple of factors—the BTU/H expressed as lbs. per hr. of condensate, the pipe size and the cubic volume of the steam. If I had a 100,000 BTU/H boiler and it was making steam at 0 psig and the steam main was 2″ its velocity would be 33 feet per second, or approximately 22 mph. If I cranked up the pressuretrol to 10 psig, the steam's new velocity would only be 20 feet per second or approximately 13 mph! Don't get confused into thinking higher pressure steam is going to speed up the delivery of heat to the building!

2) A circulator lifts the water up from the basement to the highest piece of radiation.

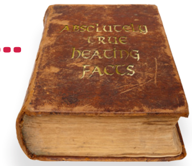
As a manufacturer's representative of circulators, we often get the call from someone in the field asking for a circulator with a high head on it. When asked why they need this "high head," the answer always comes back, "...the circulator is in the basement of a three story apartment building. How will I get the heat from the boiler up to the baseboard on the third floor units?" Again, this is another common misunderstanding; the circulator's only job in a CLOSED LOOP hydronic system is to move heated water from the boiler, out to the terminal units where the water is cooled and then back to the boiler to be re-heated. The circulator has to be able move the appropriate amount of water expressed in GPM (gallons per minute) through the piping network. Now, as the water moves through the piping, it "rubs" against the pipe walls causing frictional resistance. How much resistance is a function of the pipe size and the flow rate. The answer is VERY important for proper delivery of heat out to the space, BUT the answer has NOTHING to do with how tall the building is, only the desired flow rate, the pipe sizes and the total length of pipe in the system. Whether the building is 10′, 30′ or 100′ high, the circulator is NOT responsible for pumping the water "all the way up there." The PRV (pressure reducing valve) is the component that is responsible for making sure the entire system is filled and pressurized. Establish what the distance is from the mechanical room to the highest pipe or radiation in feet. Divide that number by 2.31′ to establish the number in psi (pounds per square inch) and then add 4 psi to that number. This ensures good positive pressure at the highest point in the system.

3) Water can move too fast through baseboard.

I have had conversations with contractors who were convinced the baseboard was "under-performing" because the water was flowing too fast. I guess you could reason that with the water moving so fast, it doesn't have enough time while inside the baseboard to "give

Continued on page 14

3 Common Heating Myths… De-bunked!



Continued from page 12

up" its heat. Fortunately, BTUs aren't that smart! So how does hot water flowing through radiation give off its BTUs? There are three methods that govern heat transfer: thermal radiant, conduction and convection. Without getting too deep, the mode of heat transfer that we want to focus on with a baseboard system is convection. Most are aware of the convective nature of the air surrounding a baseboard element. The hotter, lighter air wants to rise and float into the room while the colder, heavier air wants to drop to the floor and move along towards the baseboard to replace the hotter air that has just floated up. In the process, the hotter air gives up its BTUs to the cooler surroundings. But before this even takes place, there is another convective occurrence that must take place—and that is the hot water (fluid) flowing through the tubing has to give off its heat to the tubing wall. Before the baseboard can emit heat into the space, the heated stream of water must transfer its heat to the baseboard's inner wall by convection.

For this convection to occur, there are three factors to consider: 1) surface contact area; 2) temperature difference between the water and the inside wall of the tubing; 3) the convection coefficient which is calculated based upon the properties of the fluid, the surface area's shape and the velocity of the fluid. I think if you use your mind's eye, you can visualize the following: as the stream of water flows through the baseboard; the outer edge of this stream is in direct contact with the tube's inner wall. This "rubbing" against the wall creates drag, which means the water that is touching the inner wall of the tubing is moving slower than the "core" or inner stream. Because of this, the temperature of this outer layer of water becomes cooler than the inner stream. This drop in temperature impacts the rate of heat transfer—it slows it down. Remember, one of the factors that affect convection is temperature difference! In fact, a good visual is to think of this outer layer as an insulator that impacts the rate of heat transfer from the hotter inner stream of water to the tubing's inner wall. This is especially true when the speed of the water approaches laminar flow instead of turbulent flow. So in effect, the faster the water flows through the tubing, the thinner the outer boundary layer or insulator becomes, thus increasing the rate of heat transfer from the hotter inner "core" water to the tubing's inner wall. You can confirm this by taking a look at any baseboard manufacturer's literature and check out their capacity charts. They typically will publish their BTU output per linear foot based upon two flow rates: 1 gpm and 4 gpm. The BTU output is ALWAYS higher in the 4 gpm column. ICM

If you have any questions or comments, e-mail me at gcarey@fiainc.com or call me at FIA. 1-800-423-7187.