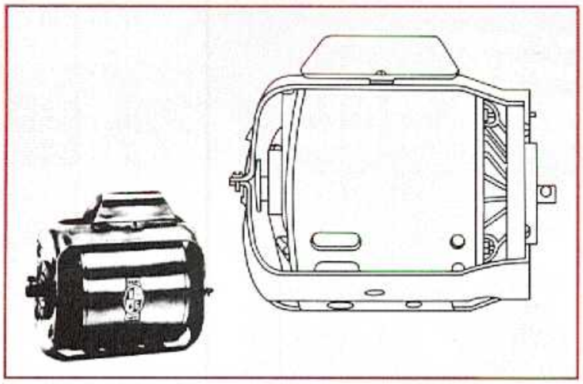
Bell & Gossett

CounterPoint™

Volume 1 Issue 1 ITT Fluid Technology Companies January 1994

It's Not Just A Motor

The heart of a hydronic heating system is the pump, and the prime requisite for the motor of this pump is quiet operation. Many installers have discovered that a proven method of ensuring longer pump life and quieter operation is to specify a motor that is designed and manufactured by the same people who made the pump end.



At ITT Bell & Gossett, we recommend specifying a *Power Pack*, not just a motor selected because it can be made to fit and has enough horsepower. All the features — resilient neoprene motor mounts, oil-lubricated sleeve bearings, laced windings, and wrap-around mounting bracket — become part of the integrated design — maximum reliability with minimum noise. Add to this a top mounted conduit box, pre-stripped electrical connections and tapped holes for mounting to the bearing bracket — features which make installation easy. That's a B&G Power Pack.

So now if someone tells you a motor is a motor is a motor, you'll know there is a difference.

Welcome to CounterPoint

Welcome to CounterPoint!

Your job is to make hydronic and steam systems work — not necessarily to spend a lot of time thinking about how they work. We've created CounterPoint just for you. It's a quick look at the different things you ought to know to save time and reduce callbacks, and a few extras thrown in to make you look really smart. Look for it on the counter of your local Bell & Gossett and McDonnell & Miller wholesaler.

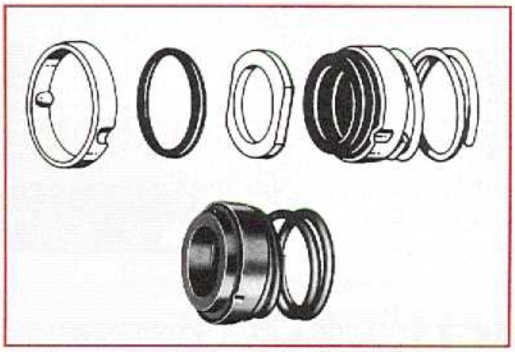
CounterPoint is written just for the contractor or installer—concise, no-nonsense, get to the point quick. We hope you like it. And we always welcome your comments, questions and suggestions.

All Seals Aren't Created Equal

All mechanical seals, those little rings that keep the water inside a circulator, are not created equal. Most pump manufacturers buy a standard ready-made seal assembly from a seal manufacturer. However, these seals can often fail prematurely.

You should be sure that each and every part that makes up a seal assembly — the ceramic and carbon rings, spring, and rubber boot — has been tested and selected as the ideal component for the specific circulator's seal assembly. These may seem like little things, but when they're not done right, they can lead to big headaches.

At ITT Bell & Gossett, our stringent specifications like hardener and material composition are strictly enforced by B&G's Quality Assurance Department to provide the user with the best seal for the Bell & Gossett booster pump. This seal assembly doesn't just fix it; it has been designed and tested to provide maximum reliability.



Mass-manufactured seals from seal manufacturers can't work as well as the originals. At B&G, our replacement seals are the exact same as the originals that come with the pump. So you're assured a perfect fit and long seal life.

The Most Important Air Vent

You know what a problem air can be in a hot-water system. It can be even more of a problem if it's trapped inside a circulator. Air can gather at the back of the impeller and cause the pump to run "dry." And a pump that runs dry is a pump that's going to leak.

This can be a common problem with many circulators. But at ITT Bell & Gossett, engineers developed and patented a special impeller that moves the air out of the circulator, so it can't build up and damage the mechanical seal. And when you add to that the benefits of non-corrosive, molded polypropylene, no one else has anything like it.

This special "air vent" is part of what makes B&G circulators last so long . . . which saves you headaches and callbacks.

Bell & Gossett CounterPoint™

Volume 1 Issue 2 April 1994

How to Run a Hot Water Zone Off a Steam Boiler

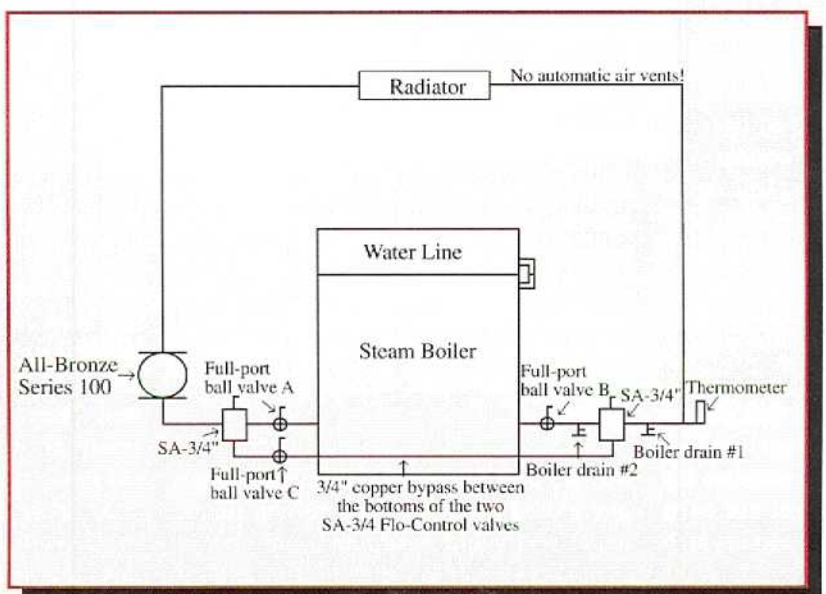
Here's a simple way to add a hot water zone to a steam-heated building without using a heat exchanger. Your new zone can serve an indirect domestic water heater, or a baseboard zone, and that baseboard zone can be nearly thirty feet above the boiler water line!

All you'll need will be an all-bronze Bell & Gossett Series 100 circulator, two B&G SA-3/4 Flo Control valves, an angle thermometer, three full-port 3/4" ball valves, a switching relay, an aquastat and a few feet of 3/4" copper tubing.

Here's how you do it. First, you have to remember that this is an open system. The water above the boiler water line can easily be hotter than 212 degrees when the boiler is steaming. The only thing that keeps the water in a liquid state is the pump's pressure. The trouble is, when the pump shuts off, its pressure vanishes. When that happens, the hot water in the radiator can flash to steam, creating a racket in the radiator and driving the water back down to the boiler.

But that won't be a problem for you because one of our ITT Bell & Gossett representatives came up with a simple trick years ago to solve this problem. They used a bypass line (through the bottom of the two SA-3/4" Flo-Control valves) to blend the cool return water from the zone with the hot supply water from the boiler. The B&G Flo-Control valves also do a great job of preventing gravity circulation into the zone once the thermostat is satisfied.

Pipe it as we've sketched it, and then fill your new zone with a hose attached to Boiler Drain #1. Purge the zone and the bypass piping back to Boiler Drain #2. Make sure you have Ball Valves "A" and "B" closed, but leave Ball Valve "C" open. Now, don't use automatic air vents in your new zone because they can let air *in* as well as out. If air gets into the top of the zone, the water will fall back into the boiler, but if you leave out the vents, the water will stay up in the piping. You know why? Because of atmospheric pressure. It's the same force that keeps water in a straw when you hold your finger over the end and lift it from a glass. We think simple ways are the best, don't you?



Next, steam the boiler and start your all-bronze Series 100. Use your two ball valves ("A" and "C") to blend the water between the boiler and the bypass until you get a 180 degree reading on your thermometer. (Valve "B" is for service only and normally stays open.) Then, take the handles off the ball valves and you're set; you'll never have to touch the system again.

You'll control your new zone by cycling the Series 100 and the burner with a room thermostat (through the switching relay and the aquastat). If you're not making steam for the rest of the house or building, the burner and the circulator will come on at the same time, and the boiler will run up to the aquastat's high limit. If the water is hotter than 180 degrees (as it would be if the steaming cycle had just ended), only the circulator will run to satisfy the hot water zone. Beautifully simple, isn't it.

We recommend you use an all-bronze Series 100 for this service because condensate is usually very acidic and tough on ordinary pumps. The all bronze Series 100 is a workhorse that will last for many years, even on this rough-and-tumble duty. Another plus is that the Series 100 has a much wider opening through its impeller and waterway than, say, our smaller Red Fox circulator. Because of its wide waterway, a Series 100 is *much* less likely to clog with steam-system sediment than other pumps. That translates to happy customers, and no callbacks.

Bell & Gossett CounterPoint™

Volume 1 Issue 3 July 1994

How To Solve Common Zoning Problems

People are getting used to the little water-lubricated circulators that come standard with most "packaged" boilers because of their low cost.

But have you noticed some changes in the way your multi-zoned systems operate when you use these little circulators?

For example, let's say someone installs three electric zone valves on a packaged boiler which came with a little circulator. When any one zone calls, everything is fine. But when two zones are calling, things begin to get a bit noisy.

Both zone valves are open and the little circulator is on. Suddenly one zone valve closes, but it doesn't close quietly. It's accompanied by an annoying water-hammer and the next thing you know, the customer is on the phone asking if his boiler is going to explode.

To understand what's happening here, you have to cut through the marketing chatter and look only at the engineering.

There is a difference between the B&G Series 100 and Taco's 007, B&G's Red Fox, or any other small wet-rotor circulator. And it's a difference that has nothing to do with size and price. It's an engineering difference, one you can see by considering the operating performance curves.

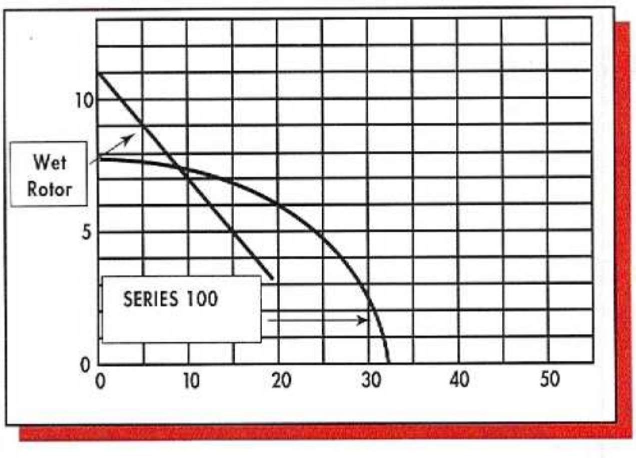
Operating performance curves are the roads on which the circulator must travel when it's operating in a system. They show us that as resistance (Head) increases, flow will decrease. Of course, the opposite also applies: As resistance decreases (in other words, as valves open), flow will increase.

The Series 100 has a very flat curve. That's because it runs at 1750 rpm. It's designed to move a lot of water against a system with low "head" resistance (typically, systems with 3/4", 1" and 1-1/4" piping).

Wet rotors have a steep curve. This is characteristic of all high-speed circulators. This type of circulator will move less water, but at a higher pressure. It can handle, for instance, the higher resistance and lower-flow requirements you'd find in the small tubes of a radiant or solar panel.

See? Different applications require different circulators. It's engineering, pure and simple.

Now let's take a look at the problem mentioned earlier. Why do the zone valves sometimes bang when the little circulator shuts down?



The reason becomes clear if you can imagine the water flowing through the pipes. Two 3/4" zones are open so we have about 8 gpm moving out to the two zones. We can safely say this because a 3/4" copper pipe can handle a maximum of about 4 gpm. That's why baseboard is rated at 4 gpm; it's the most water that can move through a 3/4" pipe without making a whistling, velocity noise.

Knowing this, we can say that wet rotor circulators will be operating at about this point on its performance curve.

The Series 100, as you can see, would also be operating at this same point were it serving this system. However, look at the difference in the curves.

Look at the 20% rise in pressure the little water lubricated circulator must go through to get back to 4 gpm. That rise represents nearly a full pound of circulator pressure. This pressure increase is usually what causes the zone valve to bang as it shuts.

You see, some zone valve manufacturers use a rotating valve disk to close their valve. As the disk swings into the onrushing flow from the high-speed circulator, the velocity across the valve increases.

Then, just before the disk seats, the velocity from the circulator peaks and the valve bangs shut. The bang is caused by the high-pressure water that suddenly has the brakes put on it.

But now look at the Series 100 curve. The difference is apparent; the Series 100 has a "flat" curve. This is characteristic of most 1750-rpm circulators.

Because of the flatness of the curve, the Series 100 can drift back to 4 gpm without creating a rise in pressure. And since the Series 100 doesn't build excessive pressure as the flow needs of the system change, the velocity of the water doesn't increase. That means the zone valve doesn't bang when it closes.

This is something that's rarely mentioned in the marketing of small high-speed circulators. Their steep curves make them fine for single-zone duty, but they pale by comparison to the Series 100 when it comes to systems zoned with several valves.

B&G designed the Series 100 to be able to shed load without a rise in pressure. It was designed for zoned systems, and it will solve the banging zone valve problem once and for all. Try it once. You'll see what we mean.

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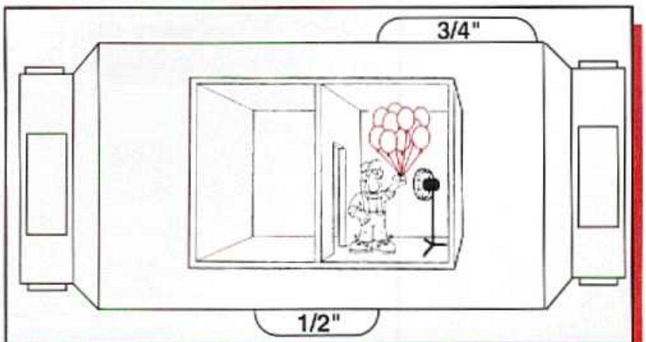
Volume 1 Issue 4 October 1994

The B&G IAS Inline Air Separator ("It Ain't the Same!")

Purging with cold water doesn't do it. Venting the high points of the system won't do it either, and neither will an automatic air vent stuck somewhere in the boiler header. No, to really get rid of system air and all those nuisance call-backs, you need a good air separator.



But where does the air come from in the first place? Good question! It comes into the system with the cold fill water. You can't see it, no matter how hard you look, because it's dissolved in solution — just like sugar in hot coffee. But, unlike sugar, the air in a hydronic system comes flying out of solution as soon as you heat the water. That's why purging with cold water can't possibly get rid of it.

And once it's released, system air whips through the pipes with the pumped water at a pretty good clip. That's why a high-point air vent or an automatic air vent near the boiler can't catch it. It's moving too fast. On most jobs, the air is out of the boiler and up into the system piping in about 1-1/2 seconds. The only way to catch it is to slow that water down.

The boiler room is the best place to get rid of that air. If it gets past you there, it will sound like marbles up in your customer's pipes and radiators. System air also blocks the flow of heat to their rooms and acts as a terrific insulator against heat transfer — which is exactly what you don't want, because that kind of "insulation" raises fuel bills and leads to very unhappy customers.

But a good air separator can get rid of system air once and for all. And if you use one on each of your boiler installations, chances are you'll save yourself a lot of nuisance callbacks and wind up with happy customers who are sure to recommend you to their friends.

The best part is, if you plan things right, you won't have to spend a small fortune on that air separator either. Take a look at the IAS, Inline Air Separator, for instance.

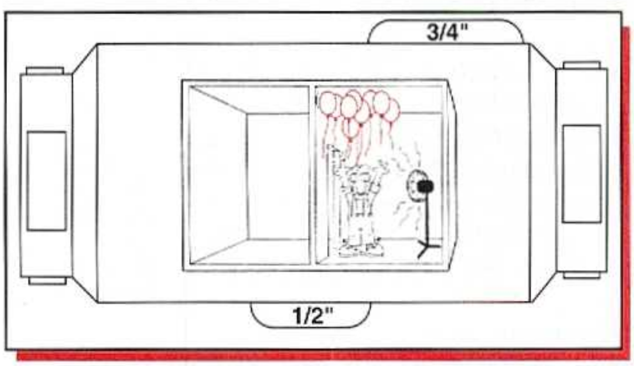
This is a very uncomplicated device that's remarkably effective. The folks at B&G designed the IAS to work on a simple principle — when you slow water down, trapped air rises to the top because it's buoyant. Common sense, right? And once the air reaches the top of the IAS, it can't get out because the orifice traps it.

The orifice acts like an upside-down dam against the air. The air can't get sucked through by a whirlpool because an orifice simply won't create a whirlpool. As you can see in our illustrations, the balloons being held by the little man represent air bubbles, the two rooms are like the chambers within the IAS, and the door is the orifice. When the balloons (air bubbles) are released, they rise to the top and are trapped by the wall of the orifice even though the water is flowing, as shown by the fan. The air stays at the top because it's buoyant. Since it can't get out of the IAS, it moves to the large 3/4" outlet, where it's either vented to the atmosphere or directed up to a plain steel compression tank.

There are no moving parts in the IAS, nothing to fail or clog with system debris. There's a convenient 1/2" tapping for a diaphragm-type expansion tank in addition to that 3/4" vent tapping. That large tapping, by the way, allows you to use a high-capacity air vent such as B&G's #87 or Hoffman's #79. And if you ever have to replace the air vent, you can do it without having to replace the entire air separator. That's certainly to your customer's advantage, isn't it?

The 3/4" vent tapping gives you something else as well: the option to use an existing, plain steel compression tank. The IAS is the only air separator of its size that lets you do this. All you have to do is run a 3/4" copper line from the IAS up to the existing compression tank.

To keep the steel tank from waterlogging, use a B&G Airtrol Tank Fitting. This simple fitting is the most positive and time-proven way we know of to keep the air from leaving a steel compression tank. Reduce your pipe size from 3/4" to 1/2" when you reach the Airtrol Tank Fitting, and you're done.



Install your IAS in the horizontal boiler header, about 18" downstream of the supply elbow. The hottest water in the system must pass this point, so you'll be able to snag those troublesome bubbles before they have a chance to make it out to the radiators.

It's easy to take charge of system air without spending a lot of money when you use the B&G IAS. It ain't the same. Try one on your next job, and you'll see what we mean.

Bell & Gossett CounterPoint™

Volume 2 Issue 1 January 1995

How A Good Troubleshooter Got Results

(Patrick Linhardt Of Aramac Supply in Cincinnati shared this story with us. We liked it a lot because it shows how a good troubleshooter goes about solving a tricky problem.)

At first, the call sounded like one we hear all the time - not enough heat in a room that had been added onto a house. The service guy told me the radiators were big enough, and that the house had an old gravity hot water system. He asked if I'd stop by to look at it, and I said I would.

When I arrived, the service guy met me in the driveway. He immediately began telling me all about the problem. He explained that someone else had installed a circulator, but that it hadn't helped much with the lack-of-heat problem. I suggested we start in the basement and we headed for the stairs.

The first thing I checked was the piping. I know that pipes have to be large enough to carry the heat from the boiler to the radiators. That's something a lot of guys overlook when they're faced with a problem. Here, however, the piping looked fine. The new fitter had taken great pains to mimic the original fitter's piping techniques. The branch line to the new addition took off from the main at the correct angle. It was the same as the branches that fed the other first-floor radiators. The size was right, and everything else in the basement looked okay.

I talked to the home owner, and she told me most of the house heated well. "It's just the addition," she said. "We've been cold for the past two years. We need some answers, and we need them fast!"

I asked her if the radiators in the addition got warm and she said they did, but the room was still uncomfortably cold. I started to suspect there might not be enough radiation in the new addition.

"What's the heat loss in the addition?" I asked the service guy.

"Seventeen-thousand BTUs," he said.

I checked out the two new radiators. Together, they put out 90 square feet EDR. I divided the heat loss of the new addition (17,000 BTU/hr) by the square foot EDR. Those radiators would have to have 190 degrees flowing through them before they'd heat that space. And since most hydronic systems work with a 20-degree temperature difference from supply to return, the boiler would have to run up to 200 degrees to satisfy the load.

This is a fine point many installers overlook. They think a square foot of radiation puts out 240 BTUs, but that's only true when there's steam in the radiator. The output changes when you circulate hot water. You can see this on the chart.

Radiator Heat Output Varies With Average Water Temperature

Average Temperature	Heat Output per Square Foot EDR
150° F	110 BTU/hr.
155° F	120 BTU/hr.
160° F	130 BTU/hr.
165° F	140 BTU/hr.
170° F	150 BTU/hr.
175° F	160 BTU/hr.
180° F	170 BTU/hr.
185° F	180 BTU/hr.
190° F	190 BTU/hr.
195° F	200 BTU/hr.
200° F	210 BTU/hr.
205° F	220 BTU/hr.
210° F	230 BTU/hr.
215° F	240 BTU/hr.

So how much radiation did we need to add to the addition? Well, a lot depended on the average water temperature flowing through the rest of the house. The home owner told me the rest of the house was comfortable, so we ran a heat loss calculation on the living room and came up with 21,000 BTU/hr. The installed radiation in the living room was 175 square feet EDR. Again, I divided the heat loss by the installed EDR and came up with 120 (21,000 ÷ 175 = 120). That meant the radiators in the living room were providing comfort by putting out 120 BTU/hr. per square foot.

Looking at the chart, I could see this corresponded with an average water temperature of 155 degrees. No wonder they didn't have enough heat in the new addition! The water wasn't hot enough. The original installer had designed this system to run on relatively low-temperature water (165 degrees) because he was using a coal-fired boiler. Low temperature water was the norm in the days of gravity hot water heat.

If we raised the boiler water temperature to satisfy the addition, we would have made the rest of the house uncomfortably warm. We also would have increased the home owner's fuel bills. That's why we decided to add an additional 52 square feet EDR to the addition.

We figured this out by dividing the heat loss of the addition by the heat output we'd expect to get from 155 degree average water temperature (17,000 BTU/hr. heat loss ÷ 120 BTU/hr/square foot = 142 square feet EDR required). We already had 90 square feet installed; the additional 52 would bring us up to 142 square feet EDR, and that's exactly what we needed to bring the addition in line with the rest of the house.

Once we had this figured out, we suggested to the home owner that she put the new addition on its own zone. We explained how this would give control over the system and take her from the 1920s into the 1990s in a hurry. She liked the idea and gave us the go ahead.

I sized a B&G Series 100 for each zone. The 100 provides the large flow/low head characteristic you need for a gravity-conversion job. I added two B&G Flo-Control valves, one for each circulator, to prevent gravity circulation to a heat-satisfied zone. I also had the installer pipe in a bypass to protect the boiler from thermal shock.

The system works beautifully now!

Bell & Gossett CounterPoint™

Volume 2 Issue 2 March 1995

Baseboard Loop Rules of Thumb

The copper-fin baseboard loop is probably the most popular type of residential hydronic heating there is. Contractors love baseboard loops because they're easy to install and usually run trouble-free. There are times, however, when problems can appear, even with a system as simple as this one. The funny thing is, it's usually the simplicity of the system that creates the problems in the first place!

You can avoid problems if you keep a few simple rules of thumb in mind.

Flow is the "train" that carries the heat.

Heat moves on the flow of water like a passenger on a train. The heat gets on in the boiler and off in the radiators. To keep things simple, heating professionals usually work with a 20-degree temperature difference from supply to return. That means that if the water leaves the boiler at, say, 190 degrees on a very cold day, it will return from the radiators at about 170 degrees. That gives you an average water temperature in the baseboard radiation of 180 degrees.

Now, at 180 degrees, each linear foot of copper fin-tube baseboard (1/2" and 3/4" sizes) will give off about 600 BTU/Hr. Let's say you were sizing baseboard for a room with a heat loss of 6,000 BTU/Hr. You'd probably install 10 feet of either 1/2" or 3/4" baseboard. That would keep everyone warm on the coldest day of the year.

There's a rule of thumb that makes flow rate easy to figure. **Divide the boiler's D.O.E. Heating Capacity by 10,000 to get the flow rate at a 20-degree temperature difference**. So, for instance, if you had a boiler with a D.O.E. Heating Capacity rating of 140,000, you'd usually be pumping 14 gpm around the system. From there, you'd decide how much you need to send to each zone.

How Much Flow Will a Pipe Carry?

That's a good question! You have to have the right size pipe if you're going to get the heat to where the people are. With hydronic heat, you have to take care not to oversize your circulators. You can't force water through a too-small pipe. If you try, the water will make a whistling sound as it moves through the house. That's a sure source of callbacks!

Here are the flow rate rules of thumb for common residential pipe sizes. Follow them, and you'll always be okay:

Pipe Size	Flow Rate in GPM	Heat Load in BTU/Hr.
1/2" copper	1-1/2	15,000
3/4" copper	4	40,000
1" copper	8	80,000
1-1/4" copper	14	140,000
1-1/4" steel	17	170,000
1-1/2" copper	22	220,000
1-1/2" steel	25	250,000

Naturally, if you were bringing two, 3/4" lines together, you'd use 1" pipe. Can you see how connecting the two lines into a 3/4" manifold would choke down the flow to both of them? This is a mistake many contractors make with loop systems. Don't let it happen to you.

Notice, too, how a 1-1/4" steel pipe can support 160,000 BTU/Hr. Stop for a minute and think about the size of the supply and return tappings in a boiler with a D.O.E. Heating Capacity of 160,000 BTU/Hr. It's probably 1-1/2", right? Now you know why. We all follow the same rules of thumb.

How Much Baseboard?

If you connect too much fin-tube to a single loop, you may run into problems on a cold day. The water can get too cool to meet the temperature needs of the last rooms on the zone. This is especially true if the people close the doors to the rooms as they probably would with a zone that ran through bedrooms.

If you want to stay out of trouble, follow these rules of thumb:

- **Never feed more than 25 linear feet of active baseboard element with a 1/2" line.**
- **Never feed more than 67 linear feet of active baseboard element with a 3/4" line.**

By "active baseboard element," we mean element that has a full flow of air moving through it. You'll appreciate this rule of thumb if you've ever made the mistake of running, say, 125 feet of 3/4" baseboard off a 3/4" line. Remember how that last bedroom was always too cool when the outdoor temperature plummeted? The water was in the loop too long. It gave up too much of its heat. Follow the rule, and you'll avoid callbacks.

How Long Can the Total Loop Be?

If the loop is too long, the pressure drop will be too high for the circulator to handle. The flow of water will slow and cool down to a point where it can't heat the last rooms on the coldest days. The problem looks just like an air problem, but it's really a flow problem.

To stay out of trouble, follow these rules of thumb:

- **When you're using a Series 100 circulator, keep your total loop under 130 feet.**
- **When you're using an SLC circulator, keep your total loop under 170 feet.**

Here, the "total loop" includes the baseboard radiation, the piping to and from the baseboard radiation, and the boiler itself.

For even more Rules of Thumb, ask your ITT Bell & Gossett representative for a copy of our popular Zoning Made Easy Rules of Thumb card. It's free!

Bell & Gossett

CounterPoint™

Volume 2 Issue 3

June 1995

Monoflo Know-How From B&G

Sixty years ago, long before the invention of baseboard radiation, B&G Monoflo tees made one-pipe hot water heating possible. Today, you can find Monoflo tees by the tens of thousands in American heating systems. They continue to work in their simple way, diverting some hot water from the main, through the radiator and back again. But as simple as they are, Monoflo tees often baffle installers, so we thought we'd take a moment to pass on a few tips your father may not have taught you.

The rings go between the risers.

We put a red ring on one side of each Monoflo tee. That ring should always be between the risers that lead to the radiator. This means that if you're using two Monoflo tees, they'd be facing in opposite directions. If you have a radiator that's not heating as it should, check the position of the tees. If they're facing the wrong way, the radiator won't heat well. And check your circulator, too. It may be in backwards, too.

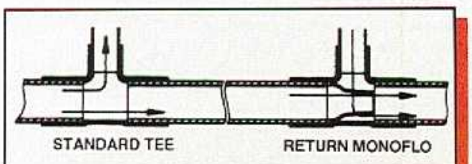
Alternate up and down.

If you have an upfeed and a downfeed radiator next to each other, the Monoflo tees should look like this: First tee (a standard tee) goes to the upfeed radiator. Second tee (a Monoflo) goes to the downfeed radiator. Third tee (a Monoflo) comes from the upfeed radiator. Fourth tee (a Monoflo) comes from the downfeed radiator.

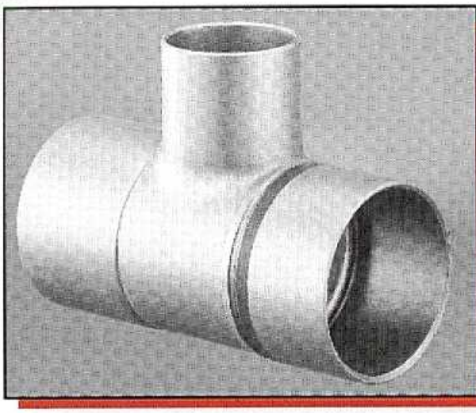
In other words, you alternate the up and down connections. That produces more resistance to flow along the main and nudges more hot water into the radiators.

If you remove a radiator, don't seal the branches.

If you cap the pipes that used to lead to the radiators, all the water will go through the run of the Monoflo tee. That increases the system pressure drop and slows the flow rate to the entire system.



If you remove a radiator, remove the tees as well. Or better yet, just connect the two branches with a short length of copper tubing. That way, the water that used to go to the radiator will still have a place to go.



On downfeed radiation, keep the temperature low to start.

Cold water is heavier than hot water. If you drain a downfeed Monoflo system and you're having a tough time getting it to circulate again, try lowering the water temperature. This brings the density of the hot water in the main closer to the density of the cold water in the radiators and helps to get things moving. It's an old-timer's trick, and it works!

If air is a problem on start-up, raise the static pressure until you've cleared it.

More air will dissolve in water that's under pressure. If you're having a hard time getting rid of air on start-up, try raising the static fill pressure. The higher pressure drives free air into solution and brings it down to your air separator. Once you get the system going, lower the static pressure again. This is important because if you continue to operate at higher pressure, your compression tank may not be large enough for the system. Your relief valve will pop.

Pitch the main and the radiators up in the direction of flow.

This advice goes back to the original installation books of the 1930s. The pitch makes it easier to get rid of air on start-up. Check those pipes. They may have sagged as the years went by, and that can give an installer fits. If you're having problems, always check the pitch.

Use the right amount of tees.

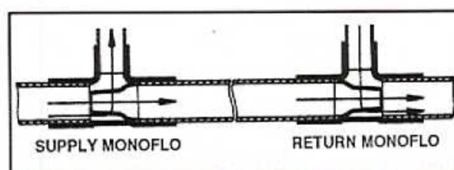
Radiators above the main usually work with one tee, and that tee should be on the return side. Radiators below the main always need two tees, and those tees should be the width of the radiator apart.

And keep in mind these rules apply to convectors and freestanding cast-iron radiators. The folks who invented the Monoflo fittings never imagined you'd be running 50 feet of copper baseboard from two tees piped six inches apart. The long run of baseboard puts too much pressure drop along the branch. The water responds by taking the path of least resistance along the run. The result? A cold radiator. And it looks just like an air problem!

If you have long runs of baseboard, run them as a separate zone.

Put your circulator on the supply, pumping away from the compression tank.

When you pump away from the compression tank, the circulator adds its pressure to the system's static fill pressure. That drives air bubbles into solution and makes it much easier for you get rid of the air that appears when you start the burner. Usually, you'll find you won't have to bleed the radiators when you pump away.



Call your Bell & Gossett representative.

Your local B&G rep can be one of your best tools when you have questions about Monoflo or any other type of hydronic heating system. And they're only a phone call away!

Bell & Gossett CounterPoint™

Volume 2 Issue 4 October 1995

The Ins and Outs of Boiler Bypass Lines

Boiler manufacturers are emphasizing bypass lines nowadays and with good reason. Today's boilers are relatively small. Their heat exchangers are much more efficient than the boilers of yesteryear, and because they are, modern boilers have specific flow rate and temperature needs. Many of them call for a flow-bypass line. It really pays to read the instructions carefully, because if you install this bypass in the wrong place, you'll be inviting trouble.

With that in mind, here's a crash course in the right way to pump a boiler bypass line.

First decide what you want the bypass to do. It can either raise the temperature of water returning to the boiler, or lower the temperature of water heading out to the system. Different systems have different needs.

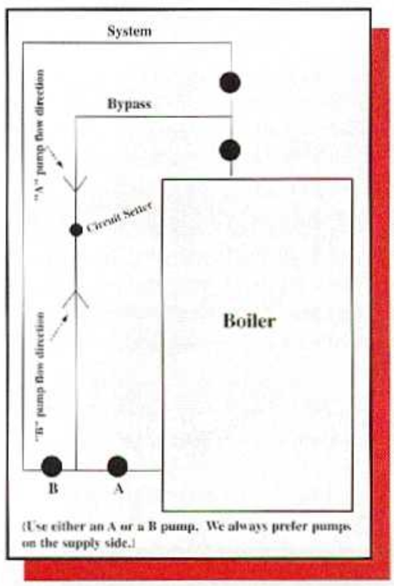
Next, make a sketch of the piping around the boiler. Use the tip of your pencil to trace the water's path as it flows through the boiler and the bypass. Remember, when water enters a tee, it has two ways out. Depending on where you place your Bell & Gossett circulator, the water can flow *either way* through your bypass. And when it comes to system performance, this choice makes a world of difference.

Look at our sketch, for instance. We're showing four possible locations for your B&G circulator. We've marked two of those locations "A," and the other two "B." Naturally, you'll be using *either* the A location or the B location, not both. We're just illustrating that you can have your circulator on the supply side of the system (always our first choice), or on the return. It's your choice

Let's look at the A location. Set up this way, the circulator will take hot water out of the boiler and use it to raise the temperature of the water returning from the system. The water, as you can see, flows from the top of the bypass to the bottom.

Now, whether it's on the supply (our first choice!) or the return side of the boiler, notice how our circulator is on the *boiler* side of the bypass. Make a note of this, and stick it in your wallet: *"A circulator on the boiler side of the bypass will raise the return water temperature."*

Now, why would you want to raise the temperature of the water returning to the boiler? Well, suppose you had a high-volume system and a low-volume boiler. Say, an old gravity system. If the returning water



(Use either an A or a B pump. We always prefer pumps on the supply side.)

was cool (less than 140 degrees for a cast-iron boiler), the flue gases would condense inside the boiler and cause corrosion. There's also the possibility of thermal shock, although this is usually less of a concern than condensation.

Also, without the bypass, the fuel bills will usually be much higher than they should be, because the low-volume boiler will find it difficult to reach high-limit and shut off. Piped this way, the bypass lets you avoid these common problems.

Okay, let's look at the B location for your B&G circulator. In this position, the circulator mixes the cooler return water with the hot boiler water. In other words, it lowers the temperature of the hot water heading out to the system. Notice how the circulator is on the system side of the bypass. Before you put that note away in your wallet, add this to it: *"A circulator on the __system__ side of the bypass lowers the supply water temperature."*

Why would you want to lower the temperature of the water leaving the boiler? Seems like a waste, doesn't it? But it's an inexpensive way to run a radiant heating system, at say 120° while you maintain 180° in the boiler to satisfy a tankless domestic hot water coil. However, we don't recommend using this type of bypass as a "control," because it doesn't respond to temperature. If you had more than one zone, things wouldn't work out well for you.

Nevertheless, you'll find this sketch in most boiler manufacturers' operating manuals, so it's important to be clear on the difference between the two bypass piping arrangements. Imagine what would happen if you were trying to protect a boiler from a potential flue-gas condensation problem, and you misplaced your circulator or your bypass line. You'd have big problems for sure!

Now consider a copper fin-tube boiler. These can accept cooler return-water temperatures (typically 105°), but they're very dependent on the right flow rates across their heat exchangers. If the water moves too slowly across a copper fin-tube boiler, the boiler will shut off on safety.

With copper fin-tube boilers, the circulator always goes on the boiler side of the bypass, whether you're pumping on the supply or the return. And check the manufacturer's instructions, because most of them insist that the bypass line should never be smaller than one inch in diameter.

If you're looking to save a few fittings when your setting up your bypass line around that modern boiler, keep in mind you can use the bottom part of your B&G Flo-Control® valve to send the water back to the boiler. Just enter on the side of the Flo-Control valve, and bypass through the bottom. It works beautifully!

And always use a true balancing valve in the bypass line so you can set the right temperature and/or flow rate. For long life, a B&G Circuit Setter® is your best choice. Ball valve manufacturers caution against using their products as balancing valves. They want their ball valves to be either fully opened or fully closed, not throttled.

If you have any questions, you'll get straight answers from your local B&G representative. These professionals are always ready to help with solid advice and the most reliable products made today.

Bell & Gossett CounterPoint™

Volume 3 Issue 1 January 1996

A Flo-Control Q & A

Q: What does a B&G Flo-Control valve do?

A: It has two jobs. First the Flo-Control valve acts as a check valve, keeping the system flow from short-circuiting into places where it doesn't belong. Second, and just as important, the Flo-Control valve stops hot water from migrating into a zone that's not calling for heat.

Q: Can't I just use a swing check valve to do this?

A: A swing check valve will do the first job (preventing flow from short-circuiting), but it usually can't do the second. The Flo-Control valve has a weighted check. When the water in the boiler is hot, it tries to rise into the system piping. We call this gravity circulation. The Flo-Control valve's weighted check stops gravity circulation before it can create a problem with your customer.

Q: Should I use a B&G Flo-Control valve only on the supply line?

A: If you're using circulators, you need a Flo-Control valve on each supply line, but you might need one on each return line as well. Gravity circulation doesn't need a complete circuit; it can happen in a single pipe. The hot water rises up the pipe as the cold water falls. If a radiator on the return side of your zone overheats, install a B&G Flo-Control valve on the return. That solves the problem just about every time.

Q: Why does a B&G Flo-Control valve have two inlets?

A: So you can use it in a horizontal line, or as an elbow. The Flo-Control valve's model designation, "SA," stands for "straight" and "angle." We make them this way for your piping convenience.

Q: Can I use the "extra" inlet for anything?

A: You can use it as a place to install a boiler-bypass line. You'll need a bypass if you're putting a low-volume boiler in a high-volume system (such as an old gravity hot water system).

The bypass gives you a way of raising the temperature of the returning water; and that helps to keep the flue gasses from condensing. Run the bypass only from the bottom tapping of the Flo-Control valve to the boiler return. If your circulator is on the return, pipe the bypass into the circulator's inlet side.

Use a B&G Circuit Setter valve in the bypass line to balance the flow between the system and the bypass line.

Q: Do I need B&G Flo-Control valves if I have a primary/secondary system?

A: If the secondary circuit is above the primary circuit, it's a good idea to install a Flo-Control valve on both the supply and return lines of the secondary circuit. If the primary circuit is higher than the secondary, you probably won't need the Flo-Control valves—unless the secondary circuit contains a boiler.

Q: If I use zone valves, do I still need B&G Flo-Control valves?

A: Not on the side of the system that has the zone valves, but you may need them on the other side. It all depends on how you run your piping, and how close your boiler is to a radiator that might overheat from gravity circulation. Sometimes you can have gravity circulation and not even notice it! It all depends on where the radiators are.

Q: What is the purpose of the knob on the top of the B&G Flo-Control valve?

A: If you turn the knob counter-clockwise, you'll lift the weighted check off its seat. This will give you gravity circulation, which you may want if the circulator should fail. Once you've repaired the circulator, turn the knob clockwise to reseat the weighted check.

Q: Is there much of a pressure drop across B&G Flo-Control valves?

A: There's just enough to make the Flo-Control valve work effectively. For instance, with three gpm flowing through a three-quarter-inch Flo-Control valve, the pressure drop will be about 2-1/2 feet. For six gpm flowing through a one-inch Flo-Control, the pressure drop will be about 1-1/2 feet. We have charts available that show the pressure drops for all our valves. If you need to know, just call!

Q: What size B&G Flo-Control valve should I use?

A: Usually line size, but you might want to use a larger Flo-Control valve on a volume boiler that comes up to temperature very quickly. Quick-start boilers sometimes produce enough thermal lift to raise the weight of a line-size Flo-Control valve.

Q: Do B&G Flo-Control valves make noise?

A: B&G Flo-Control valves have a patented design that eliminates noise. When the flow from the circulator lifts the weighted check, it also tilts it a bit to the side (that's the idea we patented!). This slight tilt of the weighted check on its stem keeps it from "chattering" as the water flows by. It's a small detail, but it's one of the things that makes the B&G Flo-Control valve so reliable.

(If you have a question about B&G Flo-Control valves, and you didn't find your answer here, call your ITT Bell&Gossett representative. They're the people with the answers to all your hydronic heating needs!)

Bell & Gossett CounterPoint™

Volume 3 Issue 2 April 1996

Even If It's Blue, We'll Still Have Parts For You!

One of our reps told us a story about how he was standing at a wholesaler's counter one day when a contractor walked in. The contractor was carrying an old B&G Series 100 bearing assembly. Since the part was painted that distinctive blue, our guy knew right away that the pump had come from a Weil-McLain "packaged" boiler. Our friends at Weil-McLain paint just about everything on their boilers that special blue.

The contractor set the bearing assembly down on the crowded counter. "I need one of these," he said to the counterman. The counterman picked up the part and slowly looked it over. Our rep silently recited the part number to himself. Eleven eighty-eight forty-four, he thought. That's the most common bearing assembly of all. There are millions of them out there in the field.

But then the counterman set the bearing assembly down and sadly frowned at the contractor. "Sorry," he said, "but we only have the red ones."

The contractor shook his head in disgust, and said, "Nuts! Now I gotta go some place else." He started to walk out, but they caught him in time. Lucky thing!

Don't Be Clueless

The next day, a wholesaler friend called to tell us about a contractor who wanted to buy a replacement B&G pump.

"Which pump is it?" the wholesaler asked.

"I don't know," the contractor answered.

"Well, what can you tell me about it?" the wholesaler asked, trying to pry out a clue that would help him solve the mystery.

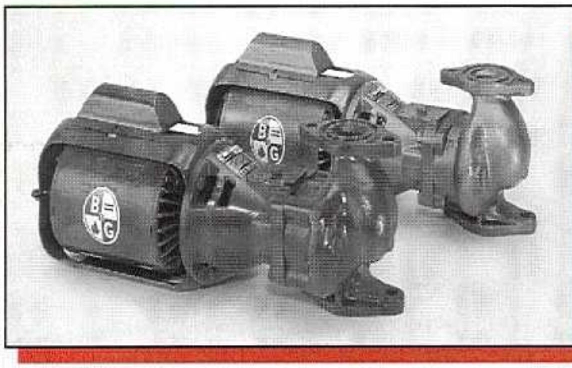
"It's red," the contractor said.

"Hey, that's a start!" the wholesaler said, encouragingly. "Can you tell me anything else about the pump?"

"Yeah," the contractor said, "it's broke."

We know that life in the field can be difficult at times, and that information is often hard to come by. We also know that there are powerful forces out there that cause identification tags to vanish in the night. It's not easy being a contractor, especially when you have to replace an old pump or an old part.

You may not always find enough information, but if you pick up on the right clues, your wholesaler and your B&G rep can almost always figure out what you need.



Even if it's painted some color other than red, the B&G Series 100 remains an industry standard.

Here are the questions they'll ask you.

Is there a nameplate?
This, of course, would make life so simple! Look on that baseplate or the bearing assembly for an ID tag, and write down all the numbers you can find.

Is the pump base-mounted or inline?
So there's no nameplate. Don't worry because centrifugal pumps will always wind up in one of two basic families. Some sit on the floor; others hang in the pipes. Which is it in your case? This is a great place to start, because the answer will narrow the field by half.

What is the motor's horsepower and voltage?
We often punch this information right into the motor. That makes it harder for those forces in the night to remove, so if you can get it for us, it'll help.

Does the pump have a coupler between the bearing assembly and the motor?
Here again we wind up with two families of pumps. Yours has to be in one or the other. Some pumps have couplers; some don't. It's an easy question, and it gets us even closer to that final answer.

Does the coupler have springs?
The larger pumps use couplers without springs. The smaller (usually fractional-horsepower) pumps are the ones that have the spring couplers. We can tell a lot by that coupler, so check it out.

Which way does the motor spin?
Imagine you're sitting on the motor, and holding onto the pipe with both hands. Look down. Does the motor spin clockwise or counterclockwise? By knowing this, we can tell whether you have a booster or a centrifugal pump, and that helps us a lot.

Is the pump oil or grease lubricated?
Again, this information narrows the field. And don't think that just because the pump sits on the floor, it has to be grease-lubricated. We once made a line of base-mounted pumps we called the "Universal." They were big, and they sat on the floor, but they also had oil-lubricated, sleeve bearings. We sold many of these to schools and libraries across the U.S.

Can you read any casting numbers?
These numbers go on at the foundry. They may not make sense to you, but they can help us identify what you're dealing with. And they're very tough to remove!

What size is the inlet and outlet piping?
Look at the flanges, not at the pipe running into and out of the pump. Give us the size of the flanges, and we'll use this with the other information you've provided to really zero in on that pump.

What is the end-to-end dimension from the volute to the back of the motor? And what is the face-to-face dimension between the flanges?
When all else fails, we look to this important information. By knowing the physical size of the pump, we can hunt it down by these two critical dimensions.

So don't worry! When it comes to pumps and parts, we'll *always* be able to figure it out. All you have to do is take a few moments and gather the right clues for us.

And remember, if your bearing assembly is blue, or some color other than that beautiful B&G red, don't give up! Lots of people paint B&G products colors other than our famous B&G red.

Bell & Gossett CounterPoint™

Volume 3 Issue 3 September 1996

Gravity Hot Water - Conversion to Forced Flow

Life may have been simpler before the invention of the circulator, but those old gravity hot water systems of yesteryear sure weren't! Gravity systems had slow response time, no control, plus poor circulation in radiation. The addition of the booster pump increased circulation and provided rapid response and more complete control. But there are still many things you need to consider besides using a booster pump to increase circulation.

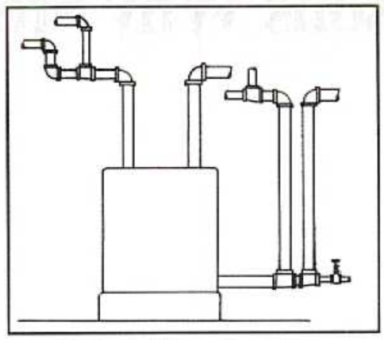
Supply and return - The old gravity system boilers had multiple tappings that were used for multiple circuits direct off the boiler to increase circulation. When you convert to forced flow you want only one supply and one return, so boilers should be cross connected for full use of the boiler and better efficiency, and the piping around the boiler should be reduced to the flow required according to the radiation BTU load. Measurement of the longest circuit will determine the pressure drop of the system - most buildings are either rectangles or squares, so measure the length and width and multiply by 2 to get the approximate length of the longest circuit. The pressure drop and flow will then determine pump size. Note that this method applies to 1- or 2-story residential only.

Orifice plates - In many of the old systems, orifice plates were used to balance the flow between the first and second floor. Because hot water rises and takes the path of least resistance (which would occur in upper floor radiation), a small hole was drilled into these plates to increase the pressure drop of the second floor radiation and create flow in the first floor radiation. In converting to forced flow it may be advisable to reverse the location of the orifice plates from the second floor radiation to the first floor to increase the resistance so flow will occur equally in each piece of radiation.

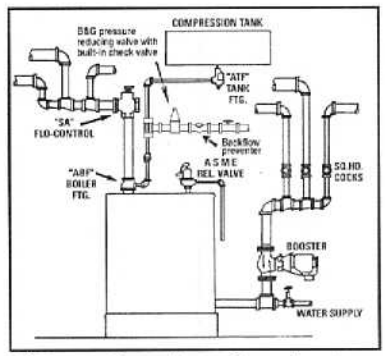
Radiator valves - In old systems with radiator valves, the valves do not have to be changed. These globe type valves can be used to balance each individual radiator, and in multiple circuit systems each circuit should be balanced. It is easy to get short circuiting in older systems because of the larger diameter pipes, and low resistance in some circuits will cause a tremendous flow unbalance causing less heat in some circuits and more than needed in others.

Distribution piping - The existing distribution piping can be used when changes are made at the boiler; however, if the existing boiler is to be used, remember that it holds a great deal of water compared to newer boilers. If a new boiler is to be installed, the piping water volume will be much greater than boiler water volume. To prevent possible water hammer, thermal shock and flue gas condensation in the boiler, it is recommended you install a bypass line that mixes hot supply water with colder water from the system and modulates return water from the system to the boiler.

Pressurization - Older gravity systems are open to the atmosphere and cannot be pressurized, so an open expansion tank was used to take up the expansion of water as it was heated in the system (maximum operating temperature was 180 degrees). If the old system is changed to a closed system, you must put in a compression tank (a closed tank) to take up the expansion and pressure of the water as it is heated.



Typical old gravity system.



Converted gravity to forced system.

Air control - In a forced flow installation, an air control system would have to be installed to control the air in the system once it is closed. An air separator and a standard or pressurized tank could be used.

Relief valves - Gravity systems did not have a relief valve on the boiler. Don't forget that closing the system requires a safety relief valve rated at the maximum boiler operating pressure and gross BTU output load of the boiler.

Flow control - Valves are needed to prevent gravity flow and if they are not used, you will get flow in the system whether or not the pump is on. Old systems operated on gravity flow, and without flow control, will be subject to overheating or loss of control.

Thermostats - In older systems, the boiler maintained a set temperature all the time with an aquastat controlling the burner. In new systems, a two-stage thermostat can activate the boiler and pump to control the system. For greater energy savings, the boiler doesn't have to be kept at a constant temperature, but it should only be called into operation when needed.

Some final reminders - Before raising water temperature, know that the boiler is rated at a certain capacity per hour, and that raising the water temperature does not increase the output of the boiler (it will increase the output of the radiation if the boiler has the capability).

If you're changing the type of radiation in any part of the building, put it on a separate zone. Convector baseboard and free-standing radiation have different characteristics of heat transfer and capacity: convector baseboard heats up fast and cools down rapidly, while old radiation with more water and a greater metal mass heats up slowly and holds heat longer.

There are many factors which must be considered in conversion jobs, and common sense should be applied with good judgment in designing a conversion from gravity to forced flow. When you have questions about gravity hot water, or any hydronic system (old or new!) you'll find the answers at your Bell & Gossett representative's. They're there to help, so give them a call!

Bell & Gossett CounterPoint™

Volume 3 Issue 4 December 1996

New Solution to an Age-Old Problem

B&G HYDRO-FLO® module

Ask any heating man what is the most common cause of hydronic heating problems, and he'll tell you air! Air can be the source of all kinds of problems including unbalanced heating zones due to air binding. It is a great insulator, reducing the heat output of baseboard zones, which in turn creates higher fuel bills for your customer. It can also damage pump seals and bearing assemblies. But the most common complaint of air in hydronic systems is the gurgling, "waterfall"-like noises that result in a service call to your customer.

Did you ever think about where this air comes from or why it always seems to make its way into the bedroom zones? Well, it comes in with the cold make-up water used to fill the system. You can't see this air because it is dissolved in the cold water (like sugar in coffee!). But as soon as this cold water is heated by the boiler, the air comes out of solution in the form of air bubbles. You see, hot water can't hold as much air in solution as cold water. If these air bubbles aren't caught right at the boiler, the circulator will send them flying out to the piping system at a speed of 4-5 feet per second. This explains why, when you place float vents throughout the system, they do nothing to solve the problem. The air just whips past these vents as if they weren't even installed.

The answer is to install a good air separator right near the outlet side of the boiler to catch these "bubbles."

Typically, the traditional "airscoop" has been installed incorrectly, which only adds to the problem. On most of these jobs, you end up going back and purging the air out of the system. Of course the water used to purge the system is cold and holding a large amount of air in solution. Once heated, the air again comes out of solution in the form of bubbles and makes its way out to the system. Eventually you'll get the call complaining about the "air problem" again and you'll go back to purge it out! This is like a dog chasing his tail!

There's Got to be a Better Way!

Bell & Gossett recently introduced a concept on how to effectively pipe residential hydronic boilers. It is called the **HYDRO-FLO®** module, and it provides a cost-effective method to assure the system will operate free of air-related problems, while providing a quiet, efficient hydronic system. The HYDRO-FLO module reduces the contractor's installation time and the components can be easily serviced!

The Hydro-Flo Module

The heart of the HYDRO-FLO module consists of B&G's EAS which is our new **enhanced air separator**. This device uses a coalescing medium which acts like "thousands of little fingers" snatching the air bubbles out of the water as it flows through the unit. In addition, they surround the coalescing medium with a diffuser plate. This plate spreads the water across a greater percentage of these "fingers," increasing their effectiveness.

From an installer's perspective, what's unique about this unit is its inlets and one outlet (like our SA Flo Control valves.) This means you can pipe the EAS right into the vertical supply riser coming up out of your boiler. The air separator is so effective, no minimum pipe diameters are required to install it. On the outlet connection you should install your system/zoning circulators and Flo-Control valves or system circulator and zone valves. Instead of plugging the horizontal inlet port, you can locate the diaphragm compression tank, a pressure reducing valve and a pressure gauge, all installed on a conventional piping cross.

Easy to Install, Easy to Service!

By simply installing a boiler drain in a tee fitting on the supply riser out of the boiler, and service valves on each zone, you can **POWER PURGE™** individual zones from this one drain and hose connection. Don't forget to locate the boiler drain below the EAS and the supply riser's service valve. Now when it comes time to service any of the hydronic components, simply close each zone's service valve and the supply riser's valve, and you have access to all the components without draining down the system!

If you need more information or have any questions about **HYDRO-FLO®**, contact your local Bell & Gossett representative.

Compliments of:

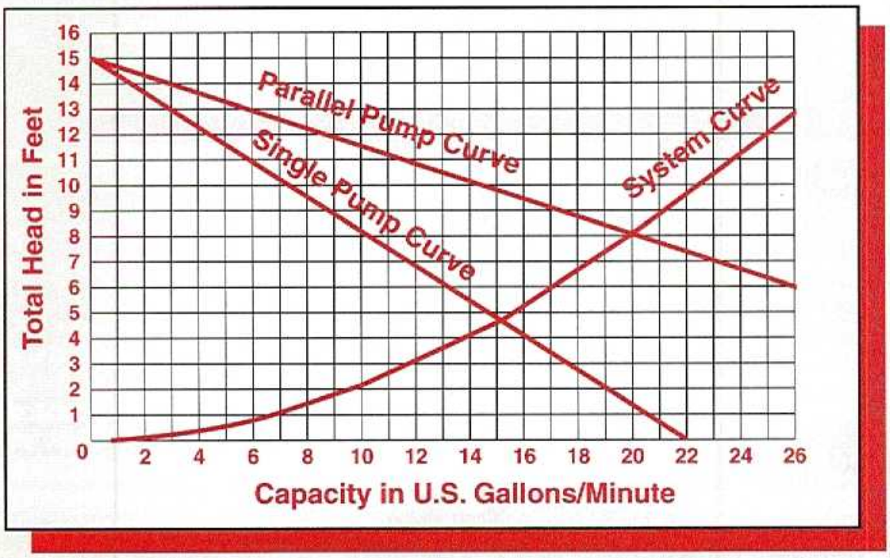
Bell & Gossett CounterPoint™

Volume 4 Issue 1 May 1997

The Benefits of Parallel Pumping are "Unparalleled"!

The benefits of parallel pumping seem to be known only in the engineering community. For some reason our industry thinks that parallel pumping is only for large flow rate applications such as chilled water distribution systems. This is unfortunate because there are many benefits to be realized by the "smaller" applications.

In fact, once you understand parallel pumping and how to apply it properly, you will find that you don't need to use bigger in-line or base-mounted pumps as often because two smaller pumps in parallel will handle the job just as well. Also, if you get stuck in a jam and your supply house doesn't have that one big pump you need to do the job, by applying parallel pumping you will be able to use two smaller stock pumps.



When two pumps are better than one

Parallel pumping involves installing two circulating pumps in a piping system in parallel with each other. When selected properly, each circulator will pump half of the total required flow rate at the design head loss. This means that each pump is capable of pumping half of the gallons per minute needed at the total designed pressure drop for an application.

For example, if you had a system with a heat loss of 200,000 Btu/h and you calculated the flow rate based upon a design temperature drop of 20°F, you would need to pump 20 gpm. And for argument's sake, let's say that at this flow rate, the system has a total pressure drop of 8'. At this point you have several choices:

1) you can select one pump that is capable of meeting the design conditions,

2) you can also pick one additional pump as 100% stand-by, or

3) you can pick two smaller pumps in parallel to meet the condition.

If you decide to use two smaller pumps in parallel, you could choose two B&G NRF-22 pumps. Each NRF-22 is capable of pumping 10 gpm at 8'. When they are both piped into the system and turned on, they will provide a total flow rate of 20 gpm at 8' of head.

System Curves and Pump Curves

To really appreciate parallel pumping and all its benefits, we have to consider system curves and pump curves. A pump curve is the path that a pump has to operate on. In graph form, it tells us the performance of a pump in gallons per minute flow rate versus the head in feet. The curve is designed by the manufacturer and is based on the horsepower, the diameter of the impeller and the shape of its volute (the wet end of the pump that contains the impeller). No matter what the conditions of a system, the pump has to operate somewhere on this curve.

System curves, on the other hand, represent the flow-head relationships that exist for particular installations. For any given system, once a design condition is calculated, you can establish other flow-head conditions by using scale #5 on B&G's System Syzer. This scale states that "head will change as the square of the change in flow." For example, if you had a system pumping 5 gpm at 4' head loss and wanted to increase the flow rate to 10 gpm, the head loss would increase to 16' head. Using scale #5 from the System Syzer, you can plot a system curve that is specific to a given system. We need to know this information so we can determine the flow rate when only one of the pumps is operating.

What happens when one of the pumps shuts off?

One major benefit of parallel pumping is the high degree of standby capacity provided by single pump operation. When one pump is out of operation, the other pump continues to pump water through the system. But the flow rate isn't cut in half just because only one pump is operating. Remember, the pump has to operate at the intersection of its pump curve with the already determined system curve. In our design example of 20 gpm at 8', we can build a system curve based on these points: (7 gpm-1'), (10 gpm-2'), (15 gpm-4.5'), (22 gpm-9.5').

If you look at the NRF-22 pump curve above, you'll see that when one pump is in operation it crosses our system curve at about 15 gpm at 4.5' of head. (Note that when one pump operates, it moves more gpm than when both are working!) In this example, the flow is 75% of design, which can handle most loads.

For more information on parallel pumping, ask your local B&G Representative for help. He has the answers to all your hydronic heating questions. And don't forget to ask him for a copy of B&G's manual on Parallel & Series Pump Application (TEH-1065).

Bell & Gossett CounterPoint™

Volume 4 Issue 2 http://fhs.ittind.com October 1997

Primary-Secondary Pumping "Rules of Thumb"

Primary-secondary pumping has been around since 1954. Most of the applications for this pumping technique, pioneered by Bell & Gossett, have been in large commercial systems such as chilled water campus systems, dual temperature change-over systems, and freeze protection for make-up air systems.

In recent years though, there has been renewed interest in this technique for smaller, light commercial - and even residential - applications. In fact, multiple hot water boiler applications, when installed correctly, must use primary-secondary pumping.

Radiant in-floor heating has become very popular too. To meet the design water temperatures of radiant systems, the mixing of some cooler return water with some hot water from a cast iron boiler must take place, and the most effective method for accomplishing this is through primary-secondary pumping. Most residential cast iron boiler manufacturers have limitations on the water temperature maintained in their boiler, but, when using these boilers with radiant heating systems, primary-secondary pumping is an effective way to raise the return water's temperature.

In the late '70s and early '80s, commercial buildings such as apartments and smaller schools incorporated a method of reset through the use of a 3-way motorized valve. Based upon outdoor temperatures, the valve would reposition itself to deliver just the right amount of heat to satisfy the building's heat loss. However, the problem with a lot of these installations was that there was no means provided for measuring the return temperature of the water entering the boiler. Under certain conditions, a tremendous amount of cool water would enter the boiler, causing thermal shock and possibly cracking boiler sections. However, a simple boiler loop pump, piped using primary-secondary methods, would prevent this problem.

Primary-secondary pumping is simple in theory as well as operation. It is based on a simple fact: *when two circuits are interconnected, flow in one will not cause flow in the other if the pressure drop in the piping common to both is eliminated.*

RULES OF THUMB

#1 THE COMMON PIPE

The key to all primary-secondary applications is the use of a common pipe which interconnects the primary and secondary circuits. The length of this pipe should be kept very short in order to keep the pressure drop very low, and the supply and return tees to the secondary circuit should be a maximum of four pipe diameters apart. By keeping the pressure drop very low, water that is flowing in the primary loop will not flow into the secondary circuit until its circulator turns on.

#2 THE SECONDARY CIRCULATOR

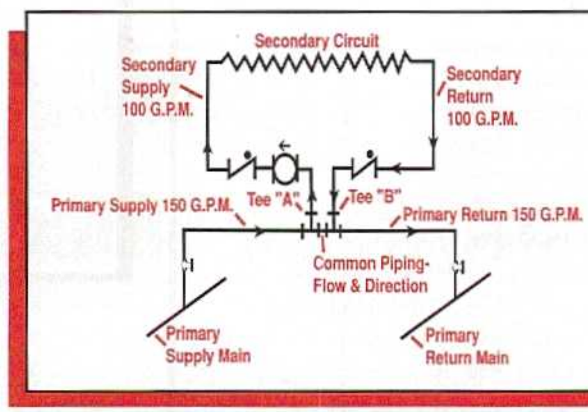
A separate circulator is installed in the secondary circuit to establish flow. This circulator is sized to move the flow rate and to overcome the pressure drop of its circuit only. The circulator should be located so it is pumping away from the "common piping" and discharging into the secondary circuit. This causes an increase in pressure in the secondary circuit rather than a reduction in pressure which would occur if the pump were located on the return pumping towards the common pipe.

#3 THE LAW OF THE TEE

This rule determines the flow rate and direction of flow that occurs in common piping. It is based on the relationship of the primary and secondary flow rates, and there are three possibilities to evaluate:

1) Primary flow more than secondary
2) Primary flow equal to secondary
3) Primary flow less than secondary

This rule of thumb is best described by a simple statement: *flow into a tee must equal flow away from the tee.*



#4 FLO-CONTROL VALVES

Flo-Control valves are recommended to prevent any flow into the secondary circuit induced by either the slightest pressure drop that may exist on the common pipe or by gravity heads. Because gravity flow can occur within a single pipe, two Flo-Control valves are best, one on the supply and one on the return. However, if the secondary circuit's return is underslung, only one valve is needed.

For more detailed information on primary-secondary pumping, contact your local B&G representative. They are well "primed" on this and many other hydronic subjects. Ask for B&G's bulletin TEH-775 Primary-Secondary Pumping Application Manual.

Bell & Gossett CounterPoint™

Volume 5 Issue 1 http://fhs.ittind.com February 1998

The Shocking Facts About Sudden Thermal Changes

When a modern hot water boiler experiences thermal shock, the cause is often ignored and written off as defective material or workmanship. But there is always a reason why a boiler (cast iron, steel fire tube or steel water tube) becomes thermally shocked.

"Boiler Thermal Shock" can be loosely defined as sudden thermal changes that occur within the boiler causing rapid and uneven contractions of the boiler's cast iron or steel material. An example is placing a cold glass under hot water—the glass cracks because of the extreme temperature change. In thermally shocked boilers, the fractures or cracks occur where the temperature difference is greatest—usually in the back of the boiler near the nipple joints or the furnace area where the cold water enters. Surfaces exposed to cold water are contracting while surfaces exposed to fire are expanding.

Causes of Boiler Thermal Shock

Several conditions can contribute to boiler stressing and eventual boiler shock. All involve introducing excessively low temperature water, or cool temperature water at high flow rates, into the hot boiler:

- ✔ Returning water at too low a temperature
- ✔ Cool return water at too great a flow
- ✔ Firing the boiler and heating up water before system circulator is turned on
- ✔ Moving the burner into high fire with boiler water at too low a temperature

Influence of System Designs

■ Systems incorporating night setback and/or weekend shutdown are designed to save energy, but turning down or shutting off the building's temperature causes problems when all the zone valves and pumps come back on delivering room temperature water to a hot boiler.

■ Dual temperature changeover systems can experience boiler problems when the system tries to change over from a cooling demand to heating. The piping system and terminal units are filled with 50-60°F water and the boiler may contain 180°F water.

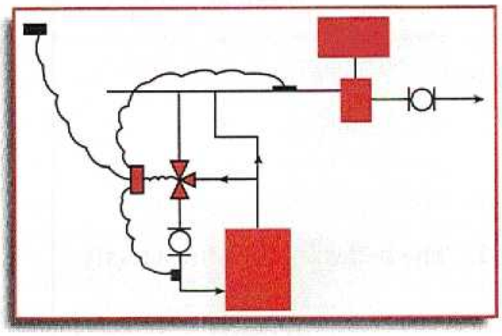
■ Heat pump loop systems typically require some form of supplementary heat to maintain supply water loop temperatures when the outdoor temperature approaches design conditions. Boilers are the common source for this additional heat, but design loop temperatures are as low as 70-85°F, while most commercial cast iron boilers don't operate below 140-150°F.

■ Heating systems that have boilers maintaining temperature without flow are susceptible to thermal shock by sudden changes in flow due to pump operation.

■ The most common cause of thermal shock is a system that incorporates outdoor reset with 3-way valves while the boiler maintains temperature. The boiler is at 180°F, but based on outdoor temperature, the system may require only 100°F. The return temperature can be as low as 90°F, which can cause a 90°F differential across the boiler. (Remember the cold glass and hot water!) Most cast iron boiler manufacturers would like to see no more than a 40-50°F temperature difference between the boiler's return temperature and leaving temperature.

Preventing Thermal Shock

Waterside thermal shock can be prevented by controlling the load imposed on the boiler. Boiler load is a function of flow rate and temperature difference, and one of the most effective methods is to create a boiler loop separate from the system and pump it with its own circulator. Since the flow rate is constant, the temperature difference across the boiler becomes the measurement of the boiler's load, and if the boiler is maintaining temperature, the return water's temperature will determine the boiler load.



3-Way Valve in Boiler Loop

Control against "boiler shock" involves control of the incoming cold water flow rate so that the boiler's temperature is changed slowly. By installing the 3-way valve in the boiler loop, the outdoor reset can control the amount of hot water that is introduced into the system based upon a reset schedule. More importantly, the reset controller can measure the return temperature entering the boiler. If water temperature becomes too low for the boiler manufacturer's recommendations, the 3-way valve will close off the system loop. Hot water from the boiler will then be pumped right back into the return, raising the water temperature entering the boiler. The 3-way valve and controller will float back and forth, resetting the supply water to the system while protecting the boiler from cold water.

The best method for interconnecting this boiler loop with the system loop is through primary/secondary pumping techniques. By keeping the supply and return tees close together, the pressure drop in the common piping is kept to a minimum. This allows different size pumps to co-exist in the system without affecting each other as well as preventing ghost flows from occurring from one loop into the other.

For more information on this or any hydronic subject, contact your local Bell & Gossett representative. They can help soothe your shock, so give them a call.

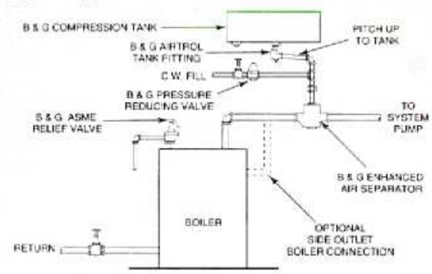
Bell & Gossett CounterPoint™

Volume 5 Issue 2 http://fhs.ittind.com November 1998

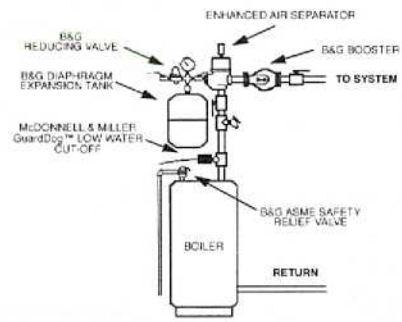
Proper Air Management in a Hydronic System

Whether you are troubleshooting an old forced hot water system or installing a new one, you must consider air that will be present in the system. The two basic types of air management in hydronic systems are air control and air elimination. When installed properly, both are effective at preventing air problems.

Typical Applications



Model EAS with Conventional Compression Tank



Model EAS with Pressurized Expansion Tank

Air Control

The air control method has been around for more than 40 years and has proven quite successful. It uses a standard steel tank in which the air and water actually touch. The air inside the tank acts like a spring pushing down on the water to keep the system pressurized. The air cushion in the tank is compressed by the heated water that expands into the steel tank. The compressing of the air in the tank causes the system pressure to increase, but through proper sizing methods, the pressure increase won't reach the relief valve's setting. Without this cushion of air, the pressure in the system will rise rapidly when the water is heated, causing the relief valve to dump water onto the floor. Therefore, for this system to work properly, it is important that a cushion of air be maintained in the compression tank.

Unfortunately, one of the characteristics of this system is that the water and air "see" each other inside the compression tank. We know that water can absorb air into solution, the hotter the water and the lower the pressure, the more air will come out of solution in the form of bubbles; as the water temperature cools down or the pressure increases, the water will be able to absorb more air. On the next firing cycle, if the air that comes out of solution isn't directed back into the compression tank—and is instead vented out of the system—the tank will start to lose its cushion. Then it is only a matter of time before the tank becomes waterlogged.

For an air control system to work properly, it is important to use some type of air separating device that "catches" the air when it comes out of solution and then immediately directs it back up into the steel compression tank. Do not use automatic vents in an air control system. They will do a good job of venting air out of the system that really belongs back in the expansion tank. Also, don't forget to install a device known as an Airtrol Tank Fitting (ATF). It does a great job of preventing the cooler, "air-filled" water from sliding out of the tank in gravity flow. Finally, make sure the line connecting the tank to the air separator is pitched up towards the tank without any pockets or places where the air can get trapped.

Air Elimination

The air elimination method has also proved to be quite effective. This method uses a diaphragm or bladder-style expansion tank instead of a standard steel tank. The tank is pre-charged with air on one side of the membrane that separates the system water from the air. Any air that is released from the water needs to be vented out of the system through automatic air vents. This tank style also gives you a lot of flexibility regarding installations. When a standard steel tank is used, it is necessary to locate the tank somewhere above the air separator so that the separated air can flow by bouyancy back into the tank; however the diaphragm tank can be located anywhere because it already has a charge of air in the tank.

The air pressure in the tank must be precharged to the same pressure as the system's fill pressure. When the tank is under-charged, cold system water will enter the tank even before the boiler has heated up the water. The result is an undersized tank causing the relief valve to discharge water onto the floor. When checking an existing tank's air charge, make sure you isolate the tank from the system. If you don't, you will just read the pressure of the system at the point where the tank is connected.

An effective air separator, such as the B&G EAS (see illustrations above), is also very important for successful air elimination; the difference is that now all of the separated air must be vented out through a high capacity automatic vent.

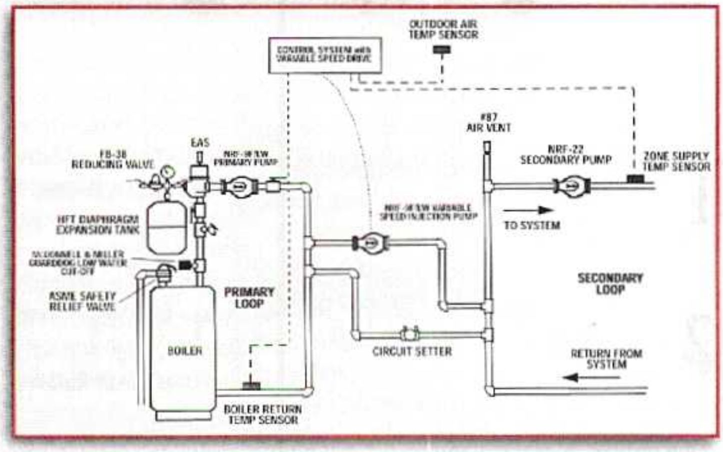
Both methods of air management have proven to be quite successful, but they must be installed properly to work. If you have any questions regarding air management in hydronic systems, contact your local Bell & Gossett representative. They are well trained in all aspects of hydronics. Ask for a copy of B&G's training manual TEH-1196, Air Management.

Bell & Gossett CounterPoint™

Volume 6 Issue 1 www.bellgossett.com May 1999

All Mixed Up

Questions & Answers on Mixing Methods Used in Hydronic Heating



Primary/secondary variable speed injection pumping for radiant floor panel systems.

What is Mixing? Mixing is when a portion of return water from the system is "mixed" with a portion of hot water from the boiler to supply a specific water temperature that is lower than the boiler temperature but warmer than the return temperature.

What methods are used for mixing? There are two basic mixing methods: mixing valves which consist of three-way and four-way valves, and injection mixing which uses either two-way valves or injection pumps.

What is the difference between each method? A three-way mixing valve has three ports and a four-way valve has four ports. Mixing blends cooler return water into one of the valve's ports with hot water that is entering another port. The two temperatures blend and exit the supply port. With a four-way valve, any of the return water that isn't used to mix with the hot water is returned back to the boiler. Injection mixing injects bursts of hot water into a constantly circulating loop. A two-way valve opens and closes, or a pump's speed is changed, to introduce the right amount of heat.

Why would someone use mixing in a hydronic system? Three major uses, for:

- Radiant heating that requires lower water temperatures than most boilers can produce without experiencing flue gas condensation.
- Outdoor reset. By matching the supply water temperature to the load on the building, the heating system will operate more efficiently. Unfortunately, the required water temperatures are lower than most boilers are designed to handle.
- Hydronic systems that incorporate different types of heat emitters such as in-floor heating, panel radiation, cast-iron radiation and hydro-air coils. Each type requires a different supply temperature but all receive their water from the same boiler.

What happens if I use only one pump with my mixing device? There will be only one mixing point. This will control the supply water temperature for that particular zone, but not the temperature of the water returning to the boiler. Also, the flow rate through the boiler will vary, decreasing the boiler's efficiency.

Why should I use two pumps? Using two pumps, with a mixing device, establishes two mixing points. This protects the boiler by controlling the temperature of the returning water. The second pump also provides constant flow through the boiler, improving the boiler's efficiency.

How should I pipe the mixing device and the two pumps? Use primary/secondary pumping so the two pumps will not operate in series with each other. Another benefit of primary/secondary pumping: you can efficiently size the mixing device.

Why should I be concerned with the temperature of the water returning to the boiler? If you are using a non-condensing style boiler, it is important that the flue gases released from the combustion process be vented out of the boiler. When the water in the boiler is at a temperature below the dewpoint of the flue gases, these gases will condense back to water inside the boiler. The results can be very damaging. Boiler thermal shock is another reason for controlling the return temperature.

What is flue gas condensation? During combustion of the fuel, many by-products are formed including carbon dioxide, sulphur compounds and water vapor. Low return water temperatures will cause the compounds to condense, forming corrosive liquids in the boiler stack and heat exchangers. The amount of damage that will occur depends on the design and materials of construction used in the boiler, as well as the specific compounds in the flue gas. Always check with the boiler manufacturer to find the minimum recommended return water temperature.

When using a mixing device, how do I calculate the flow rates to achieve the desired mixed temperature? The answer can be found in this example:

Radiant zone load = 50,000 Btu/h designed at 20° temperature drop.

Design radiant zone flow rate = 5gpm

Radiant design supply temperature = 120°F (based upon 20°F temp. drop, return temp. of 100°F)

Boiler loop supply temperature = 180°F

The design temperature difference between the two loops is 80°F so...

$$\frac{50{,}000}{80°F \times 500} = 1.25 \text{ gpm}$$

This is the amount of 180°F boiler water needed to "mix" with 3.75 gpm of 100°F return water from the radiant zone to supply 5 gpm of 120°F water.

For answers to any hydronic heating question, contact your Bell & Gossett representative.

Bell & Gossett CounterPoint™

Volume 6 Issue 2 www.bellgossett.com November 1999

Trimming the Pump Impeller Can Cut Costs

Determining Flow and Head

The pump is installed and running, but how do you know if it is operating at its design point? There is a simple way to check. Knowing that a pump will provide a certain flow at a given head, we can determine the point at which the pump is operating. To determine the head, a few gage readings will be necessary. Take one reading from the suction of the pump and one from the discharge after the system is balanced and with all the control valves wide open. The difference between the two gage readings will give you the head that the pump is providing. Remember to convert your gage readings to feet of head. Knowing the head and the impeller size, you can determine the flow of the pump.

Now that we have the flow and head of the pump, let's see how close we are to the design point. Most often, the head will be less than what we expected, and the flow will be more. Why does this happen? There are many reasons, but it does no good to blame anyone. Let's just fix the problem.

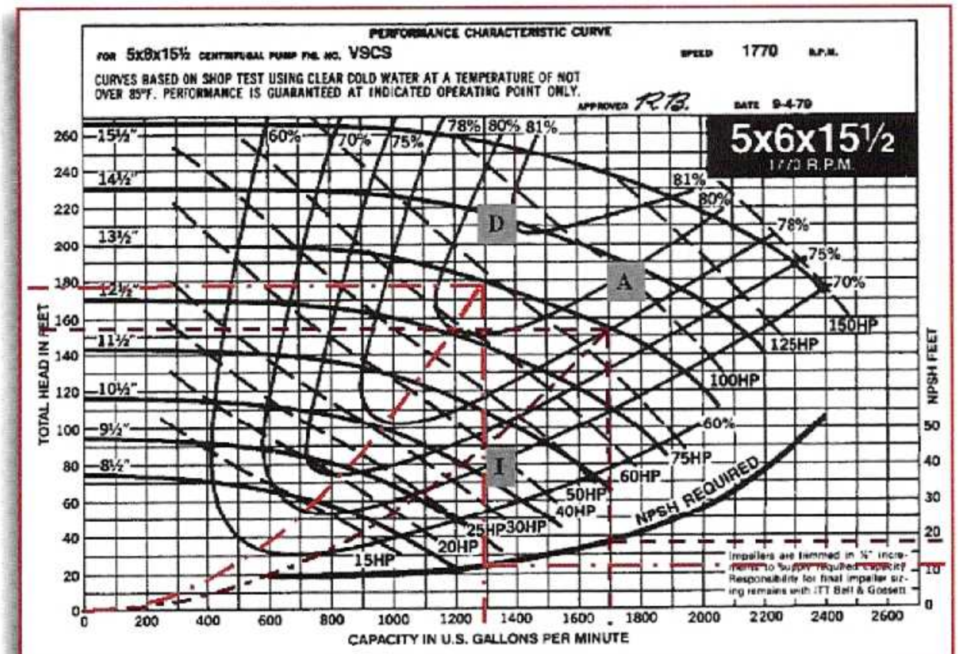
Solutions

Trimming the impeller is one of best solutions. Before we can trim the impeller, we need to determine where the pump is operating. In the pump curve above, let's call point "D" the design point, and draw the system curve that corresponds with that design point. Point "A" is where we actually are, which we determined from our gage readings. Along with that is our actual system curve. Remember that we are concerned with the actual system curve. This shows us how our system operates, not how it was designed. Operational and design points are often completely different.

We would like to be on the unmodified actual system curve, but where on that curve? If our load has not changed and our heat transfer is the same, we want to be at our design flow. That is "I," the ideal point.

Trimming the Impeller

But how do we get there? Although it's off our impeller curve, we can trim our impeller down to the right size. In this particular case, our ideal impeller size falls between 10-1/2" and 11-1/2 (actually about 11"). Fortunately, trimming an impeller is not too difficult or expensive, and in fact it pays for itself very quickly. Notice from the figure that when we trim our impeller we lose some pump efficiency, but we're more concerned about the cost of operating our pump and that cost has dropped tremendously. In this case we have dropped from 85Hp to 40 Hp—that's a lot. Even if your electric rates are low and you don't operate all year long, there is still the potential for great energy savings.



Pump performance curve.

Consider the Savings

Looking at the pump curve you can determine the horsepower savings between the different operating points, and if you know kilowatt-hour costs you can figure your savings. Once you get the cost savings per year for trimming the impeller, a simple payback period can be determined to see if trimming is economically feasible. Payback periods of less than a year are not uncommon.

This example shows how adding a small safety factor can lead to a large energy cost penalty. It also shows why it's not a good idea to install a larger impeller for some higher demand in the future, and in the interim close down on the discharge valve. It is better to wait and buy a new impeller when the increased need arrives in the future.

An impeller cannot be trimmed indefinitely. The further you trim the impeller, the lower its efficiency becomes. Plus, you are now getting near the hub of the impeller eye. It is best not to trim the impeller any smaller than the minimum size impeller that the manufacturer shows on his pump curve.

There may be times when waiting for the impeller to be trimmed is not possible—for example, when shutting down the system that the pump is supplying would be impossible or too costly. In that case you may want to order an additional impeller and run the process until the new impeller can be installed. Lastly, remember to re-balance the impeller after trimming.

For answers to any pump questions, contact your Bell & Gossett representative. They have the answers to all of your questions.

Bell & Gossett CounterPoint™

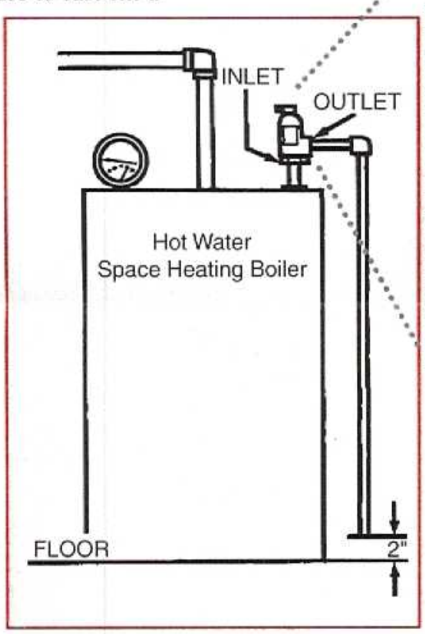
Volume 7 Issue 1 www.bellgossett.com April 2000

Top Ten Reasons Why Relief Valves Discharge

1 Waterlogged Steel Compression Tank. There are some heating systems that still use the older steel compression tanks to absorb the water that expands when heated. If for some reason the tank loses its volume of air, it will be replaced with an equal amount of water. Unfortunately, water isn't compressible so when the boiler fires up, the expanding water tries to enter the tank and causes an immediate increase in pressure which causes the relief valve to discharge this excessive pressure build up.

2 Pressure Reducing Valve is Left Opened or Fails Open. Most systems today use a pressure-reducing valve to fill and pressurize the system. If scale or minerals build up on its seat, it may fail in the open position. Also, most of these valves have a manual bypass feature to fast-fill a system. If the bypass valve is accidentally left open it will expose the system to street pressure, which normally exceeds the boiler's pressure relief valve rating.

3 Diaphragm Tank Loses Its Air Charge. The air cushion in this type of tank is separated from the system by a membrane. Unfortunately, the membrane is permeable which allows a small portion of the air to enter the system where it is vented out. As this occurs, the PRV notices a drop in system pressure and rightfully adds water to maintain the appropriate system pressure. Of course the diaphragm tank is slowly losing its cushion of air and finally one day, when the boiler heats up the water, the relief valve discharges onto the floor.



Protection of Hot Water Space Heating Boilers

4 Undersized Expansion Tank. These tanks, whether the "old" steel or the diaphragm style, have to be sized correctly to do their job. If someone installs an undersized tank, the volume of the water in the system will be too great for the tank to handle. This will cause an immediate rise in pressure and the relief valve will open.

5 Undercharged Diaphragm Tank. It is very important to size the tank correctly and be sure that the pre-charge of air in the tank matches the system's fill pressure. If the air charge doesn't, then cold water will be allowed to enter the tank before the boiler even heats the water. This will have the same effect as an undersized tank.

6 Tankless Coil. A tankless coil located inside the boiler produces domestic hot water. Eventually these coils can develop leaks from corrosion and aggressive water. Once this happens, the boiler and its relief valve are exposed to the pressure of the cold water line. Normally this pressure exceeds the valve's rating and the relief valve opens.

7 Faulty Aquastat. A faulty aquastat will allow the boiler water to reach excessive temperatures. This causes the water to expand beyond the recommended range of tank sizing guides and the result is a rise in pressure beyond the relief valve's capacity, causing it to open.

8 The System's Static Fill Pressure Requirements Approach the Boilers Relief Valve Setting. With this condition, every time the boiler fires, the relief valve will open. It is very important that when selecting a boiler for applications in tall buildings the maximum pressure allowed by the boiler manufacturer must be greater than that required by the system's fill pressure.

9 Improper Location of the Expansion Tank and System Pump. If the expansion tank and high head system pump are installed on the return, the pump's pressure differential will be added to the system's fill pressure. These two pressures, when added together, may exceed the relief valve's setting.

10 Systems that Incorporate High Head Pumps and Pressure Differential Valves. In the Spring and Fall, when most of the zone valves in the system are closed, the pressure differential valve opens to prevent the circulator from building up excessive head pressure. Unfortunately this pump head is now directed toward the boiler and relief valve. If this head pressure combined with the system's static pressure exceeds the relief valve's pressure, it will open.

These are some of the more common (and not so common) situations that can cause a relief valve to discharge. For expert help with questions or problems you may have with any hydronic system, contact your local Bell & Gossett representative.

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CounterPoint™

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Five Good Reasons to Pump Away!

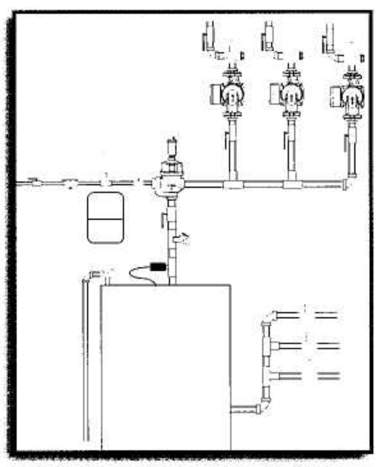
A variety of options are available when deciding how to pump water through a system. However, pumping away is the best choice. There are numerous compelling reasons to "pump away," including improving system performance, and reducing contractor callbacks.

1) When you pump away from the compression tank (steel or diaphragm), the circulator's pressure differential is added to the system's static fill pressure. Whenever the circulator is located so that it is pumping away from "the point of no pressure change," the pressure is increased throughout the entire piping system. This improves the operation of any high vents that may be present in the system. It also prevents any high temperature water from flashing into steam.

2) When you pump away, you drive any air bubbles that are out in the system back into solution. Air (which consists of oxygen, nitrogen and hydrogen) has to follow the basic gas laws. One of those laws states that the more you compress a gas, the more a liquid will be able to absorb it. By increasing the system's pressure with the circulator, any air bubbles exposed to this pressure increase will be driven back into the water. The water will then carry the air back to the boiler water where it will be heated, and the air will be released from the water for efficient separation by an air separator. The airless system will operate much quieter as well. The sloshing and gurgling noises that awake many homeowners will be gone.

3) When you pump away, the circulator's pressure differential will not affect the boiler's relief valve setting or the pressure reducing valve setting. By locating the circulator on the supply, pumping away from the compression tank, its pressure differential will be absorbed by the system and not directed at the relief valve. The pressure-reducing valve should be piped into the line that connects the compression tank to the system. Piped in this manner, the circulator will not be able to "trick" the PRV with any inaccurate system pressures.

4) When you pump away, you prevent the pump from experiencing cavitation and other pumping problems. By locating the circulator so that it pumps away from "the point of no pressure change" (PNPC), the pressure on the suction side of the circulator will not change. If the pressure drop between the PNPC and the pump is small, pressure will remain at whatever the system fill pressure is at the circulator. This helps prevent the water from flashing into vapor inside the circulator's volute. Once the water flashes, very unstable pump operation, mechanical seal failures, and eventually, bearing problems occur.



Typical three-zone system.

5) When you pump away, you will save yourself time, money and expensive callbacks. By installing circulators on the supply, air will no longer be a problem. Any air bubbles out in the system will be driven into solution and brought back to the boiler room. You will not have to bleed the individual radiators. In addition, the system will operate quieter, transfer heat more efficiently, lower energy costs, and make your customers happy while reducing wasteful callbacks!

Now that you know the reasons for—and benefits of—pumping away from the supply, you may be interested in knowing why it is called "the point of no pressure change."

Because:

- Air in a compression tank (steel or diaphragm) has to follow the basic gas laws; a change in air pressure must be accompanied by a change in air volume. (To change the pressure, you must squeeze or expand the gas.)
- A change in the air volume in the tank must be accompanied by a change of water volume within the tank. (The only ways to change air volume are to add/remove water from the tank, or to expand/contract the water by heating/cooling it.)
- A change of water volume within the tank must be accompanied by a change of water volume in the system. (The only ways to change the water volume in the tank is to add water to the system, drain water out of the system, or let it expand/contract with changes in temperature.)
- Since water is incompressible, pump operation cannot increase or decrease system water volume. (Simply turning on the pump does not change the water volume in the system.)

Therefore:

- Pump operation cannot change tank pressure!
- Since tank pressures cannot change due to pump operation, the junction of the compression tank with the system must be a point of no pressure change regardless of whether or not the pump operates!

If you have any hydronic system questions or problems, contact your local Bell & Gossett representative or "Ask Red" on our web site at www.bellgossett.com.

Bell & Gossett CounterPoint™

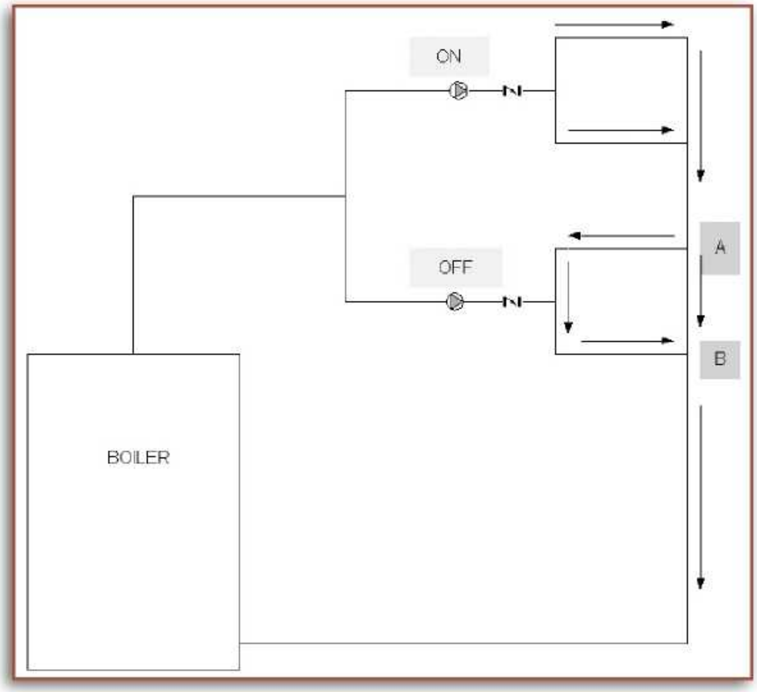
Volume 9 Issue 1 www.bellgossett.com June 2002

Dealing with "Ghost Flows" Can be Scary

A "ghost flow" delivers heat to a terminal unit when there isn't supposed to be any flow at all – even when the room thermostat is satisfied. To learn why this happens, read on.

Ghost flows can occur in a hydronic heating system when a pressure differential exists across an open circuit, allowing water to flow where it doesn't belong. Here's an example of a complaint about overheating:

A heating contractor had replaced a boiler over the summer for a new customer. The contractor did not spend a lot of time looking at the entire piping system – he saw just the piping in the boiler room. He pulled out the old boiler, installed the new one and attached the existing piping in the same manner as it had been piped originally.



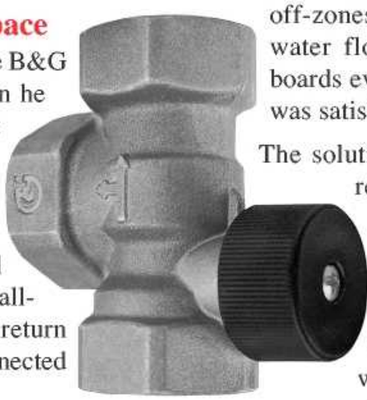
When the heating season came, the homeowner called to complain that several zones were overheating. The heating contractor sent one of his service technicians over to the house. He checked to make sure the flow-control valves were working. He made sure that each thermostat was wired properly to its respective relay and circulator. Everything appeared to be in good working order. Next, the technician went upstairs and checked the room temperatures compared to the thermostat settings of the zones that were overheating. He found that each overheating room's thermostat was set at 60˚F, but the room temperature was actually 75-76˚F. At this point, the service technician called in the local Bell & Gossett Representative to look at the job. After several questions and discussions, the homeowner admitted that "maybe" the same problem had existed with the old boiler. He explained that when the new boiler was installed, he assumed that he was getting a new heating system!

A clue in the crawl space

Here is a sketch of what the B&G Representative found when he inspected the basement looking for clues:

The system had eight heating zones, each with its own circulator. Several of these zones split into smaller, sub-circuits, and each return from these sub-circuits connected into the common return manifold. What was interesting about this particular system - and what made it more difficult to troubleshoot – was that the main return manifold that picked up all the sub-circuit returns was in the crawl space between the first floor ceiling and the second floor. All you could see in the boiler room was the supply manifold with all the zone pumps and flow-control valves, their individual take-offs, and the return main that came down through the ceiling and back to the boiler. Looking at the sketch, you can see that when one zone is calling for heat, the water that enters the return main manifold has access to flow in the return of an off zone.

Note the two returns (A and B) from one of the overheating zones. When the water flows along the return main and reaches point A, it asks itself, "which way do I go"? The answer depends upon the difference in pressure between points A & B. Because there is a difference in pressure between these two points, some water has to flow up the return, moving backwards through the off zone and back down to point B. This is what caused the overheating to occur. The off-zones constantly had some water flowing through the baseboards even though the thermostat was satisfied.



Hydrotrol™ Flow Control Valve

The solution is to combine all the returns from each zone pump together before entering the return main. But in this case, with all the piping concealed in the first floor ceiling, it was necessary to install small spring flow control valves (Hydrotrol™) on the returns of each baseboard circuit. After this was done, the ghost flows disappeared.

Remember, if you have any hydronic questions or problems, who ya gonna call? Your local Bell & Gossett Ghostbuster. They have solutions to all of your hot water heating problems.

Bell & Gossett CounterPoint™

Volume 9 Issue 2 www.bellgossett.com November 2002

The importance of pressure differential in a hydronic system

We've all heard the expressions, "Water takes the path of least resistance", and,"Water is lazy, it goes where it wants". And if you've been in the heating business for any length of time, you've probably experienced these expressions in the field when you go out on a "No Heat" call.

On such calls, you find that the thermostat is calling for heat, and the circulator is running, but there is no heat coming out of certain radiators or pieces of baseboard. You check for air in the system, but only water comes out of the vent so you know it cannot be an air problem. Why, then, do we keep bleeding the radiation when the real problem is that there is **not enough** water flowing into the radiation? If there isn't enough pressure differential (delta P) across the radiation circuit, the water "short circuits" through the closer circuits or zones.

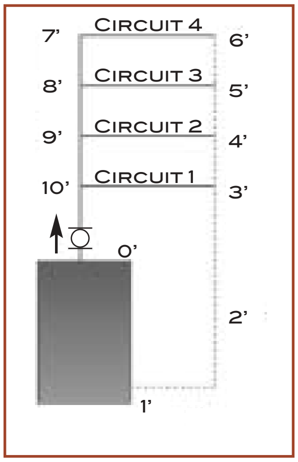


Figure 1
Pressure differentials.

In Figure 1, note the boiler, circulator and four circuits. The numbers on the piping circuit represent the pressure that the circulator can develop at each point. In this example, the circulator can develop ten feet of pressure differential. Note that as the water moves throughout the piping, the pressure is lowered until it reaches the suction side of the circulator where it equals zero. Also, note that as the water moves farther away from the circulator, the pressure differential across each circuit becomes less and less. And since a difference in pressure is what causes flow to occur, you can see why the farthest circuit or zone might create a "No Heat" call on a very cold day. There is a difference in pressure across the farthest circuit which means that water is flowing there. The problem is that **not enough** flow is moving through that circuit. On a cold day, all of the Btu's will "jump off" the baseboard in the first couple of feet, leaving cool water to flow through the rest of the circuit.

Why does it "short circuit"? Look at Figure 1 again and notice the pressure differential for the first zone. It has 10' of head pressure on the supply and 3' on the return side of the zone. That means there is a pressure differential of 7', and this 7' differential will cause a certain amount of flow to take place in that zone. Now look at the farthest zone which has 7' of head pressure on the supply and 6' on the return side, so only 1' of pressure differential exists across this zone.

A difference in pressure is what causes water to flow in a closed-loop system. If there is no pressure differential, the fluid simply can't move. For water to flow, there must be a difference in pressure between the inlet and outlet of a coil, a radiator, or a piece of baseboard. And – everything being equal - the greater the pressure differential, the greater the flow rate .

So how do we solve this imbalance problem? In the design stage, it can be beneficial to install reverse-return systems (see Figure 2). With these types of systems, when the radiation is the same throughout, the reverse-return piping provides equal pressure drop throughout the entire piping system. This equal pressure drop ensures adequate flow to all the radiation units. Of course, there is a bit more piping involved, but the lack of service calls will make it well worth installing.

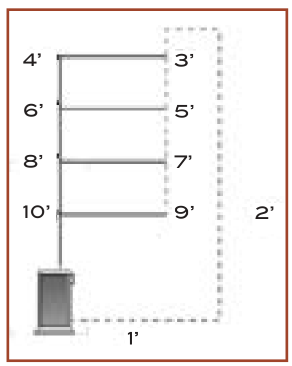


Figure 2
Reverse-return system.

If you come across an existing system that is experiencing the problems described here, you should install Bell & Gossett Circuit Setter balancing valves on the return side of each circuit. By setting the Circuit Setters to the appropriate setting, the pressure drop in each circuit will be the same. With equal pressure drops in each circuit, there is no "path of least resistance", and so there will be adequate flow in each circuit.

Whenever you find yourself troubleshooting a hydronic system, consider pressure differential and the role it plays in a successful heating system. And remember, high pressure **always** goes to low pressure.

Circuit Setter® calibrated valve balances hydronic system flow rates.

If you have any hydronic questions or problems, contact your local Bell & Gossett representative. They have solutions to all of your hot water heating problems.

Bell & Gossett CounterPoint™

Volume 10 Issue 1 www.bellgossett.com September 2003

Frequently Asked Questions

Following are just a few of the many frequently asked questions posted on the Bell & Gossett website.

Q How do you properly lubricate a B&G Series 100 booster? The B&G maintenance manual says to add 1/2-teaspoon of oil at the beginning of the heating season. How much oil should I use in order not to over-oil the booster bearings? How about the motor?

A First, the instruction manual refers to 1/2-teaspoon at the initial installation. For ongoing maintenance purposes in a typical residential hydronic heating application, the Series 100 should get about 6-8 drops in the bearing assembly and 3-4 drops in each of the motor ports twice a year. If the pump is being used for continuous duty or if it is in a really hot equipment room, you will want to oil more often...every couple of months.

For illustrated instructions on "How To Oil Your Series 100 Pump," visit the B&G website.

Q What is the formula to figure how much pressure is required to circulate water in a multi-story building?

A In a closed loop hydronic heating system, the pump does not need to "lift" the water. The pump only needs to overcome the friction losses associated with being circulated through the pipe and throughout the radiation. The required pump head (pressure that the pump must overcome to get circulation) is dependent upon the system piping. The following is a general "Rule of Thumb" that contractors have been using for years.

Pump Head:
1) Measure the longest run of pipe in feet (out and back)
2) Add 50% to this
3) Multiply this by 0.04
4) That's the pump head

Flow Rate (gpm):
Divide the boiler Btu rating by 10,000 to get the required flow rate (gpm)

Example:
Longest pipe run is 20 feet up to the second floor + 60 feet around the upstairs loop (through radiation) + 20 feet back to the boiler in the basement.

1) longest pipe run = 20 + 60 + 20 = 100 feet
2) add 50% = 100 + 50 = 150 feet
3) 150 feet X 0.04 = 6 feet
4) Required pump head = 6 feet

Boiler Rating is 120,000 Btu/h
1) 120,000 / 10,000 = 12 gpm
2) Flow rate = 12 gpm

Looking at the pump curves for residential pumps, we see that a B&G Series 100 Booster will meet this requirement. Keep in mind that this is a guideline for residential systems, not an exact science. Contact your local B&G Representative for further information.

Q I am installing a residential hydronic system that is using conventional copper fin baseboard with seven independent zones covering about 5000 Sq. Ft of space. I would like to know the benefits/drawbacks of zoning with individual circulators versus valves. To use circulators would appear to be the more involved method and more costly due to relays, controls, flow valves etc. It would seem like using circulators might give you a more consistent flow rate through any given zone at any one time. My intention is to not use a primary loop because I am using a boiler that has a built in loop and valve to protect against low return temperature. In a system with many zones like this, where some zones may be too short to give the 20 deg. temp drop between supply and return, does this present any type of problem to the system?

A You're right in observing that zone pumps require some extra components, but that method offers a lot of advantages in your project. With seven valves operating against a single pump, there's a real possibility of high velocity noise if only one zone were calling for heat and all the rest were closed. Zone pumps would avoid that situation. Also, don't ignore the primary-secondary method just because you already have a primary loop to protect the boiler. Just think of extending the idea into three loops: the boiler, the distribution, and the zone loops. Larger systems have used this idea successfully for years. Your local B&G Representative knows this stuff inside and out. Give them a call for additional help, or visit our website.

B&G Series 100® Booster

To view more FAQs, go to www.bellgossett.com, click on "Knowledge Base", and then enter a key word in the search box.

Bell & Gossett CounterPoint™

Volume 10 Issue 2 www.bellgossett.com December 2003

Protecting Small Hydronic Systems in the Winter

In the fall and winter, we get many questions about protecting small residential heating systems. They seem to cluster around two topics:

- Adding antifreeze to provide corrosion and freeze protection
- Laying up the system before an extended winter vacation

Antifreeze

People ask if automotive antifreeze can be used in their heating system to provide protection against freezing and minimize corrosion in the piping system. It seems to make sense, because that's what these products do in an automobile engine. But the answer here is pretty clear: don't put them in a hydronic system. Those products are designed to protect an engine cooling system, so they have additives that are not necessarily friendly to hydronic pumps and seals. Along with freeze protection, you would get a load of problems.

If you must use antifreeze, make sure it's designed for hydronic systems, that it has the proper concentration of inhibitors, and that it's well mixed before you put it in the system. That brings up another issue. Small systems are filled with water through a pressure-reducing valve from the city water supply. City water pressure usually is high enough to fill the system and establish a little extra pressure at the top to prevent boiling and allow venting. To fill a small system with antifreeze solution, you would need a mixing tank and pump, but people don't have access to that equipment. It might be a great idea to add antifreeze to a larger hydronic system, because coils can freeze if they are exposed to cold ventilating air. But in a large building with a large system, there are maintenance people and equipment to do it right.

We routinely see small systems that have been in operation for decades with very little corrosion, simply because there's little loss of water.

Most small systems don't need antifreeze and additives for corrosion protection, anyway. Unlike a larger system, for which renovations, system changes, and maintenance actions are probable, a small system rarely, if ever, is opened up and drained. A system that is tight - as it should be - does not require any significant amount of make-up water. That means the oxygen in the system is rapidly "locked up" in forming metallic oxides, and the system as a whole becomes very non-aggressive. In short, corrosion stops. We routinely see small systems that have been in operation for decades with very little corrosion, simply because there's little loss of water. So there is no need to add new water, with its load of dissolved oxygen.

Vacation

As cold weather approaches, a lot of people pack up and leave for warmer places, which brings up the other issue: What should we do with the heating system before leaving? Draining the heating system means exposing it to oxygen and renewing the corrosion process. Unless the system is completely dry, you can expect pockets of rusty water to work on the piping the whole time you're gone. Refilling the system with fresh, oxygenated water when you return just starts the process all over again. If you drain the heating system, you also have to worry about everything that could be damaged by low temperatures during the absence.

Given those drawbacks, most people simply set the thermostat down a bit and let the system maintain a high enough temperature to avoid damage. There are a few things you should double check:

- Inspect the burner system to ensure safe, efficient operation while you're gone.
- Make sure the system has an adequate fuel source.
- Make sure the boiler relief valve is not clogged or plugged and that it is positioned to discharge toward a floor drain.
- Look at the system pressure gauge to see whether the compression tank is maintaining the system pressure within an acceptable range as the system temperature swings from minimum to maximum. Undersized tanks, waterlogged tanks, or those with broken diaphragms can cause the pressure to rise too high, causing the relief valve to discharge.
- Think about adding low-water fuel cut-off protection to your boiler system. This will shut down the burner in the event of a serious loss of water.
- Shut the valve between the city water supply and the pressure-reducing valve to minimize water damage in case the system does start to leak.
- Lubricate the pump, if necessary.

If you have any hydronic system questions, contact your local Bell & Gossett Representative. They have solutions to all of your hydronic system problems.

For more helpful information, visit our website at www.bellgossett.com.

Bell & Gossett® CounterPoint™

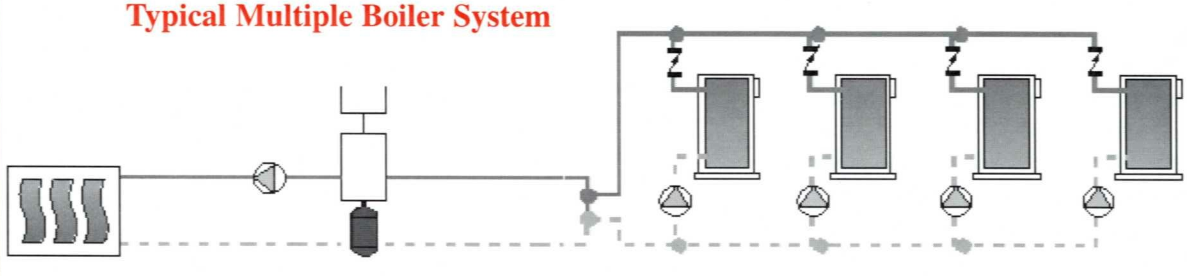
Volume 11 Issue 1 www.bellgossett.com June 2004

Why Multiple Boilers Make $ense

Whether you are faced with replacing an old, large hot water boiler, or when designing a new hydronic heating system, you must decide whether to install one large hot water boiler or multiple smaller boilers. Although most systems are designed around one large boiler, when you think about how most heating systems operate, multiple smaller boilers can make a lot of sense.

First, you want to perform a heat loss calculation. By establishing the true load on the building, the replacement boiler or boilers will not be oversized. However, the conditions we use to establish the heat loss of the building are assumed to be at *design* conditions, which means the coldest day of the year. If you want this capability, then you need to size the boiler or boilers for this maximum load. If not, there are other considerations.

Typical Multiple Boiler System



The pitfalls of over-sizing

Remember that the typical design conditions exist for less than 5% of the heating season. If you choose to use one large boiler, it will be oversized for 95% of the heating season. Oversized boilers generally do not operate very efficiently because of frequent off/on cycling. Boiler manufacturers provide efficiency ratings that indicate how efficiently their boilers use a therm of gas or a gallon of oil. When testing for these efficiencies, the boiler is running at full capacity in a "steady state". However, in the "real world", the boiler rarely operates at a steady state, and therefore it never realizes its rated efficiency.

With multiple smaller boilers, when the load on the building is light, only one of the boilers may be required to heat the space. This smaller boiler will operate for a long "run cycle", increasing its operating efficiency while the other boilers remain "off," keeping the building owner happy because he is not wasting fuel.

Primary/secondary pumping

When using multiple boilers to achieve all the potential efficiency gains, you must prevent water from flowing through the "off" boilers. The reason: whenever you have hot water flowing through an off boiler, the boiler becomes a radiator, wasting energy in the process.

There are several methods available to prevent this unwanted flow from occurring through the off boilers, but the best method is to pipe them by using the technique called primary/secondary pumping whereby each boiler has its own circulator which is sized just for the flow rate and pressure drop of its boiler.

The boilers are piped into a manifold, which is connected to the primary loop through a set of closely-spaced tees. Piped this way, the primary loop circulator will not create flow through any of the boilers. The circulator on the individual boiler will cause the only flow that occurs.

Owner benefits

A multiple boiler system gives the building owner these features and benefits:

Built-in redundancy. Because design conditions typically exist for only 3-5% of the heating season, if one of the smaller, multiple boilers goes down, the remaining boilers will meet the building's heating load.

Off-the-shelf high efficiency boilers can be used to satisfy the heat load in light commercial applications. The boiler plant operates at higher efficiencies and replacement parts are easily accessible.

Smaller packaged residential boilers may be used in some commercial buildings, instead of constructing the boiler in place using commercial sections.

Large domestic hot water loads in commercial and large residential applications can be met with multiple boilers. The staging control will fire the appropriate number of boilers to satisfy both the heating and domestic load and then shut them off as the domestic load is satisfied.

Summer operation efficiencies can be realized in some commercial applications where the only load is domestic hot water. Here, a staging control will fire only the appropriate number of boilers to satisfy the domestic water load, no matter how heavy or light.

If you have any questions or need help designing that next multiple boiler job, call your local Bell & Gossett Representative. They are more than willing to help!

Bell & Gossett® CounterPoint™

Volume 12 Issue 1 www.bellgossett.com January 2005

How A Good Troubleshooter Got Results

A true story...

At first, the call sounded like one we hear all the time - not enough heat in a room that had been added onto a house. The service guy told me the radiators were big enough, and that the house had an old gravity hot water system. He asked if I'd stop by to look at it, and I said I would.

When I arrived, the service guy met me in the driveway. He immediately began telling me all about the problem. He explained that someone else had installed a circulator, but that it hadn't helped much with the lack-of-heat problem. I suggested we start in the basement and we headed for the stairs.

The first thing I checked was the piping. I know that pipes have to be large enough to carry the heat from the boiler to the radiators. That's something a lot of guys overlook when they're faced with a problem. Here, however, the piping looked fine. The new fitter had taken great pains to mimic the original fitter's piping techniques. The branch line to the new addition took off from the main at the correct angle. It was the same as the branches that fed the other first-floor radiators. The size was right, and everything else in the basement looked okay.

I talked to the home owner, and she told me most of the house heated well. "It's just the addition," she said. "We've been cold for the past two years. We need some answers, and we need them fast!"

I asked her if the radiators in the addition got warm and she said they did, but the room was still uncomfortably cold. I started to suspect there might not be enough radiation in the new addition.

"What's the heat loss in the addition?" I asked the service guy.

"Seventeen-thousand BTUs," he said.

I checked out the two new radiators.

Together, they put out 90 square feet EDR. I divided the heat loss of the new addition (17,000 BTU/hr) by the square foot EDR. Those radiators would have to have 190 degrees flowing through them before they'd heat that space. And since most hydronic systems work with a 20-degree temperature difference from supply to return, the boiler would have to run up to 200 degrees to satisfy the load.

Radiator Heat Output Varies With Average Water Temperature

Average Temperature	Heat Output per Square Foot EDR
150° F	110 BTU/hr.
155° F	120 BTU/hr.
160° F	130 BTU/hr.
165° F	140 BTU/hr.
170° F	150 BTU/hr.
175° F	160 BTU/hr.
180° F	170 BTU/hr.
185° F	180 BTU/hr.
190° F	190 BTU/hr.
195° F	200 BTU/hr.
200° F	210 BTU/hr.
205° F	220 BTU/hr.
210° F	230 BTU/hr.
215° F	240 BTU/hr

This is a fine point many installers overlook. They think a square foot of radiation puts out 240 BTUs, but that's only true when there's steam in the radiator. The output changes when you circulate hot water. You can see this on the chart.

So how much radiation did we need to add to the addition? Well, a lot depended on the average water temperature flowing through the rest of the house. The home owner told me the rest of the house was comfortable, so we ran a heat loss calculation on the living room and came up with 21,000 BTU/hr. The installed radiation in the living room was 175 square feet EDR. Again, I divided the heat loss by the installed EDR and came up with 120 (21,000 ÷ 175 = 120). That meant the radiators in the living room were providing comfort by putting out 120 BTU/hr. per square foot.

Looking at the chart, I could see this corresponded with an average water temperature of 155 degrees. No wonder they didn't have enough heat in the new addition! The water wasn't hot enough. The original installer had designed this system to run on relatively low-temperature water (165 degrees) because he was using a coal-fired boiler. Low temperature water was the norm in the days of gravity hot water heat.

If we raised the boiler water temperature to satisfy the addition, we would have made the rest of the house uncomfortably warm. We also would have increased the home owner's fuel bills. That's why we decided to add an additional 52 square feet EDR to the addition.

We figured this out by dividing the heat loss of the addition by the heat output we'd expect to get from 155 degree average water temperature (17,000 BTU/hr. heat loss ÷ 120 BTU/hr/square foot = 142 square feet EDR required). We already had 90 square feet installed; the additional 52 would bring us up to 142 square feet EDR, and that's exactly what we needed to bring the addition in line with the rest of the house.

Once we had this figured out, we suggested to the home owner that she put the new addition on its own zone. We explained how this would give control over the system and take her from the 1920s into the 21st century in a hurry. She liked the idea and gave us the go ahead.

I sized a B&G Series 100 for each zone. The 100 provides the large flow/low head characteristic you need for a gravity conversion job. I added two B&G Flo-Control valves, one for each circulator, to prevent gravity circulation to a heat satisfied zone. I also had the installer pipe in a bypass to protect the boiler from thermal shock.

The system works beautifully now!

For answers to your hydronic questions, contact your local Bell & Gossett representative.

Bell & Gossett® CounterPoint™

Volume 12 Issue 2 www.bellgossett.com October 2005

System Syzer® - The Installer's Best Friend

Have you ever wondered if the pipe you are using in that hydronic heating system is the right size for a specific flow rate or how you calculate the GPM for that heat loss? You can use math formulas that were established years ago, or look up charts relating to flow rate in gallons per minute and pressure drop based upon pipe sizes... or you can use Bell & Gossett's System Syzer calculator.

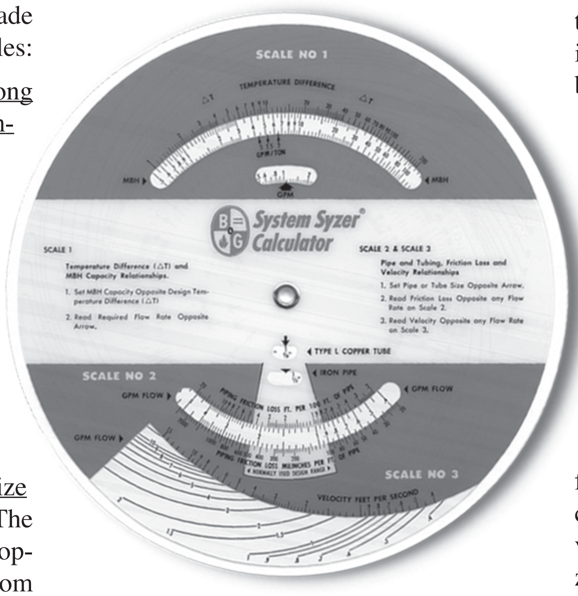
The System Syzer was developed by Bell & Gossett to provide an easier way to get the information needed to design or troubleshoot hot water heating systems. The two-sided wheel (shown at right) is made of durable plastic and features five scales:

Scale #1 shows the relationship among flow rate in GPM, BTU load and temperature difference. If you know two of the three, the wheel can give you the third instantly. For example, if you know the BTU load and the desired temperature drop, by looking at the small window on Scale #1, the necessary flow rate in GPM is shown. Scale #1 is very useful because it helps you establish GPM (the required flow rate) easily.

Scale #2 is used to select the proper size pipe to handle your GPM flow rate. The scale lists two types of pipe: type L copper and schedule 40 iron in sizes from 3/8" to 3", and gives the friction loss in feet of head per 100' as well as in millinches. Scale #2 can also be very helpful when you are in a boiler room trying to select a new pump. If the tags from the boiler and original pump are missing, you can use the existing main hot water pipe as a guide. Based on its size, look on Scale #2 and determine the maximum or minimum flow that that particular pipe can handle.

Scale #3 confirms the proper pipe selection from scale #2 by checking the velocity of the water. Though subtle, there is a difference between friction loss in head energy versus the velocity in feet per second of the water moving through a given pipe size. Scale #3 makes sure that the pipe you select will not be noisy due to the water moving too fast. The last thing a homeowner wants to hear when the thermostat calls for heat is a whistling noise as the water screams through the baseboard piping. When you select a certain size pipe to handle the GPM, always glance down at Scale #3 to be sure it falls within industry standards.

Scale #4 tells you the total pressure drop for a particular loop, zone or even the total system. From Scale #2, you selected a certain size pipe and the scale listed out the unit pressure drop per 100' of piping. When using Scale #4, you plug in this unit pressure drop per 100' figure against the total length of piping and read the total pressure drop. This is helpful information when selecting a circulator.



Scale #5 is the most useful scale because it is based on the fact that the head loss in a hydronic system will vary approximately as the square of the change in flow rate. Scale #5:

- Determines unknown pressure drops.
- Establishes system curves.
- Selects control valves based upon their Cv ratings.

Sometimes circulators are purchased based on the "inventory method", that is, whatever is available! When this happens, the circulator may be a little too large or a little too small. By using Scale #5, you can build a system curve right on the pump curve, determining exactly where the circulator will operate. Obviously if the circulator is too large, it will be pumping more GPM than required which might be acceptable as long as the increased flow rate does not exceed the pipe's maximum velocity. If the circulator is too small, it will be pumping fewer GPM than required, but this isn't necessarily bad, as long as the increased temperature drop does not reduce the output of the radiation.

Scale #5 can be used to select control valves based upon their Cv ratings, a valve coefficient that states the necessary amount of flow in GPM that must flow through the valve's seat opening to cause a 1 pound pressure drop across the valve. For example, a residential 3/4" zone valve has a Cv rating of 3.5. This means when 3.5 GPM of water passes through the valve, the valve will cause a 1 pound pressure drop, and it will use up one pound of energy head. Another way of expressing this: one pound of pressure drop is equal to 2.31' of head loss. So if the zone valve has a Cv rating of 3.5 and you pump 3.5 GPM through the valve, the valve itself will create 2.3' of head loss.

To obtain your own System Syzer calculator, contact your Bell & Gossett Representative. An electronic version of System Syzer may be downloaded from the B&G website at www.bellgossett.com

ITT

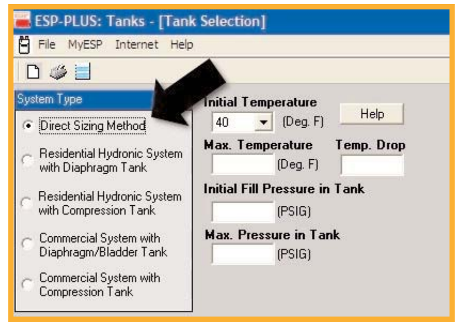
CounterPoint™

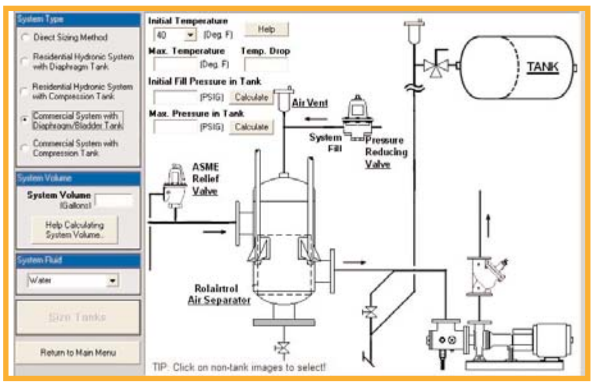
VOLUME 13 ISSUE 1 S U M M E R 2 0 0 7

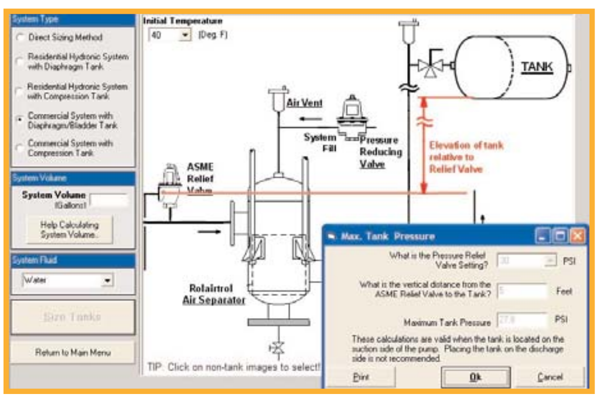
Helpful HVAC design information from ITT Residential & Commercial Water

Expansion Tank Selection Tips

When we redesigned Bell & Gossett's ESP-PLUS® tank selection program a few years ago, we sought comments from users about the program. The feedback came back in two camps. One group wanted a simpler program where the engineer could just enter the basic sizing parameters like other manufacturers' programs. The other group wanted even more design help than offered in the existing ESP-PLUS program. Our solution? Offer both.







Direct Sizing Method

If the engineer knows the tank sizing parameters, he or she can enter them using the direct sizing method. Users who need more guidance in calculating the parameters can choose one of several methods that match their system type. In ESP-PLUS, each system type shows a sample system schematic to help the user answer questions that will lead to a proper tank size.

Each of the tank sizing parameters has a help option that guides the user. In addition to tank sizing, you can size any of the hydronic equipment by clicking on that item in the schematic. ESP-PLUS gives you the ability to spec out the entire system including the tank, pressure reducing valve, pressure relief valve, air separator and the new tank purge valve.

Enhancements to ESP-PLUS CAD Library

ITT has announced the addition of a comprehensive new CAD library to its popular Bell & Gossett ESP-PLUS online pump selection program. The program now includes 3-dimensional drawings and other new, important features that allow engineers to:

- Download 2D and 3D files in several file formats, or directly insert into leading CAD systems like Inventor, Pro-Engineer, Solid Works, Mechanical Desktop, Catia and Solid Edge.
- Preview the drawings through a 3D viewer.
- Access a much larger number of drawings including the new VSX line of split-case centrifugal pumps, Series 80-SC and Series 60 close-coupled in-line pumps.

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ITT

CounterPoint™

VOLUME 13 ISSUE 1 SUMMER 2007

Helpful HVAC design information from ITT Residential & Commercial Water

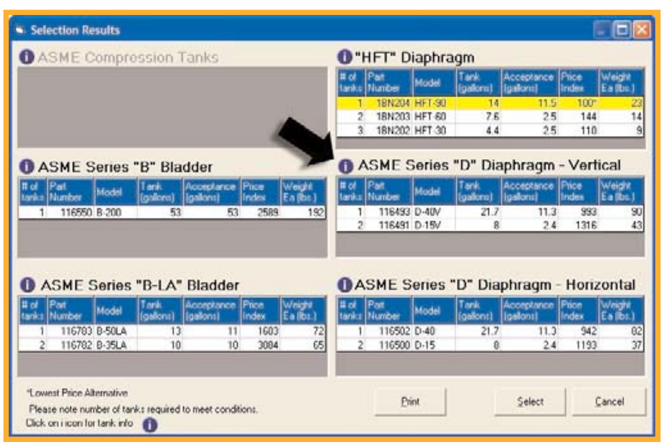
Expansion Tank Selection Tips

(continued)

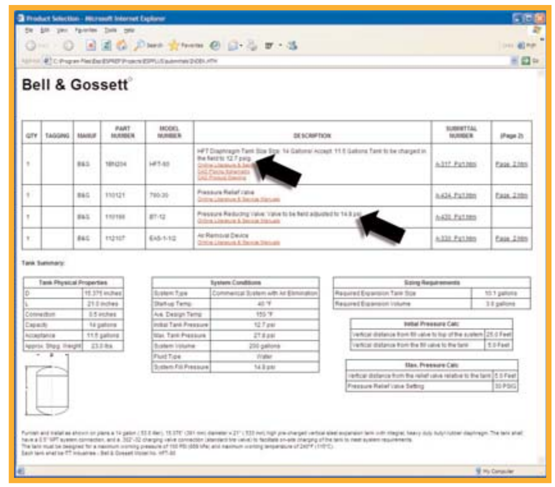
Estimating System Volume

If the user doesn't know the total system volume – a required input for tank sizing – ESP-PLUS offers two methods for estimating the total: Component and Chiller Size. The component method works by entering the water volume for different system components. ESP-PLUS includes calculators to help. As an example, for pipe, a calculator allows you to enter the total length of each of the different pipe diameters.

After the user clicks on the 'Size Tanks' button, ESP-PLUS will display all the possible tank selections and show their cost ranking. Information screens are available to describe the features of each of the different tank types.



When sizing a new diaphragm or bladder type expansion tank to replace an old compression tank, use the ESP-PLUS program to simplify the process. Just input all of the requisite information – system size, pressure, etc., and ESP-PLUS will help make the selection. And, once you install the new tank, make sure you properly dispose of the old compression tank.



A final report is available that shows each of the components for the air control system. The report includes the proper field settings for tank and fill valve pressures and links to product information and CAD drawings.

ESP-PLUS is available online at www.bellgossett.com and also from ITT. For more information please contact your ITT HVAC Representative or visit www.bellgossett.com

Proper Disposal of Tanks

Tank installations, removals, and reinstallations should be conducted by a trained professional and in accordance with the accompanying installation manual. When replacing a tank, air pressure must be relieved to 0 psig prior to disassembly to eliminate any safety hazards. Failure to follow these instructions may cause personal injury and/or property damage. Contact a local commercial or industrial waste disposal company or a metal recycling company to properly dispose of replaced tank.

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Helpful HVAC design information from ITT Residential & Commercial Water

WHY INSTALL A "WEATHER-RESPONSIVE" CONTROL SYSTEM?

"How can I lower my fuel bill?" You are probably getting used to hearing that question! Homeowners everywhere are asking the same question, and it's a golden opportunity for you to talk to homeowners about their heating system. One of the easiest options you can offer any customer with a hot water heating system is to install a "weather responsive" control. Simply turning down the temperature of the water in the boiler - even to a minimum of 140°F - will provide on average…10-15% fuel savings.

Consider the way we size boilers for our heating systems: we pick the boiler based on the design conditions for the coldest day of the year, and we are trying to keep the customers warm by maintaining 70°F inside their homes while the outside temperature may be as low as 0°F or even colder. However, when the outdoor temperature is not at design conditions, our boilers and radiation are in effect oversized, and for most of the heating season the heating load conditions are 50%-60% of design conditions. So here we are…sizing, selling and installing systems that are oversized for 95% of the season. This is where "temperature-responsive" controls provide an opportunity to sell a better job, provide more comfort and cost savings to the customer.

Outdoor reset is accomplished when you increase or decrease the water temperature going out to the system according to the outdoor temperature. The system incorporates an outdoor sensor to inform the control of the outdoor temperature since this temperature has the greatest impact on the building's heating load. When you reduce the supply water temperature, you reduce the Btu/h output of the heating terminal unit, ie, the baseboard. This is because you are changing the difference between the air temperature surrounding the baseboard and the water temperature inside the baseboard. By lowering the supply water temperature, you can input the right amount of heat, offsetting the heat loss of the building. A lower water temperature will also create a more comfortable environment for the homeowner because the wide temperature swings that normally occur will be eliminated.

TYPICAL HEATING SYSTEMS

A typical heating system uses a thermostat, which sends a signal to the boiler and a circulator. The circulator turns on and sends 180°F water out to the baseboard zone, and this happens whether it is 10°F or 50°F outside. Most of the time, the 180°F water heats up the zone quickly, and the thermostat - sensing this temperature rise - shuts off the circulator. However, the heat loss from the building has not stopped. It continues as long as the outdoor temperature is below the desired indoor temperature. Therefore, the system continues to cycle on and off, becoming too cold and then too warm.

The Bell & Gossett ZoneTrol™ II Zone Pump Controller is a technologically advanced device that can be equipped with integrated weather - responsive controls to optimize a hydronic heating system.

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(continued)

The reset solution

With reset, however, when you change the temperature of the water to match the load, the circulators and/or zone valves stay on for longer periods. This keeps the radiation warm all the time instead of cycling on and off. This more constant supply of cooler, comfortable water also eliminates the creaking and groaning noises usually heard in systems that cycle 180°F water into a zone. Plus, the room temperature will not override due to the excessive water temperatures. Another benefit of resetting a hydronic system is fuel savings. By lowering the water temperature in the boiler and piping system, the stand-by losses and stack losses are minimized.

The concept of changing the water temperature to match the load of the heating system is very logical and has been around for quite some time. Recently however, control technology has advanced considerably, providing some reasonably priced yet very effective residential and commercial hydronic controls.

Flue gas condensation

You should be aware of flue gas condensation. If the temperature of the boiler water is allowed to operate below the dew point of the flue gases, they will condense back into liquid, possibly corroding the boiler, its breaching and flue pipe. The boiler will also experience plugged flue gas passageways between its sections. To prevent this problem from occurring, most boiler-reset controls have a minimum supply temperature setting that is adjustable and can be set to satisfy any boiler manufacturer's minimum water temperature requirements.

If you have any hydronic questions, contact your local Bell & Gossett Representative. They have solutions for all your hot water heating problems.

The Bell & Gossett NRF Circulator is used in residential and light commercial heating systems. The NRF 3-speed model allows the pump to cover a wide range of hydraulic capabilities.