The history of primary/secondary pumping

(and how to apply it to today's heating systems)

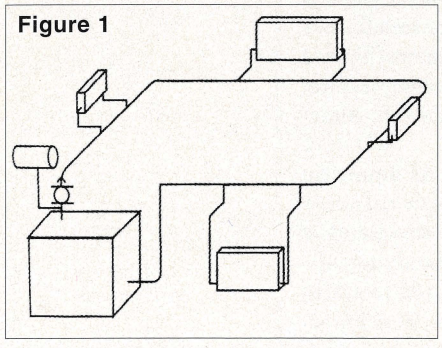
Part 1

by George Carey

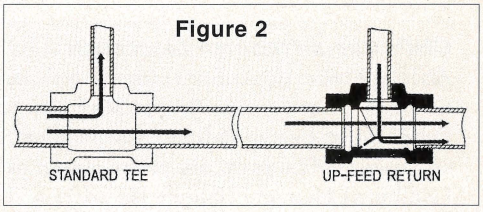
Primary/Secondary pumping...It seems to have become the "catch-phrase" of the hydronics industry over the last few years, and rightly so. Its applications are virtually endless and the benefits of this piping technique have solved many problems over the years. But where did this piping technique come from and WHY is it so useful?

An engineer from Bell & Gossett named Gil Carlson originally developed this piping technique. This is the same Gil Carlson who promoted the concept of "pumping away" from the point of no pressure change; he developed circuit setters to balance multiple circuits and developed a famous engineering tool known as the B&G "System Syzer". He was instrumental in developing and promoting engineering principals and piping techniques as the world of hydronic heating developed.

As the story goes, Gil was called out to the field to troubleshoot a recently installed commercial hydronic system that was not working. It was a large garden-style apartment complex. The system was designed to operate as a "mono-flo" heating system. And as you know, a "mono-flo" system relies on one primary circulator to pump hot water around the heating main. Piped off this main are risers that feed the various pieces of radiation. Now remember, this is not a two-pipe system where there is a separate supply and return main. With a "mono-flo" system, there is only ONE main and each riser's supply and return pipe is connected to this single main. (See Fig.1) When the water is circulated around this main, what is going to cause some of the water to "jump off" and flow into the radiation circuit? That is where the mono-flo fittings come into play. From the outside, a mono-flo fitting looks like an ordinary tee, but on the inside there is a cone-shaped fitting that reduces the opening of the tee. (See fig.2) This reduction causes pressure drop as the water flows along the primary main. And it is this pressure drop that causes a portion of the water to move off the main and into the radiation circuit. On the problem job that Gil was called out to troubleshoot, the water was flowing nice and hot along the main, but was NOT flowing up into the radiation circuits.



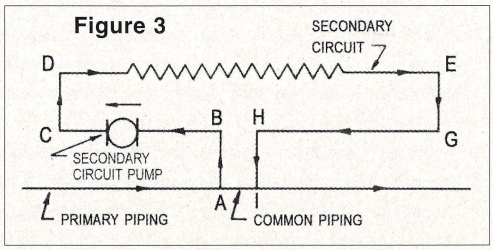
After some investigating, he found out that two different engineering firms were involved in the system design. One was responsible for the boiler room and primary main piping. The other firm was responsible for the distribution piping throughout the buildings. What happened was the primary main piping was significantly oversized and the distribution and radiation piping was undersized. When you put these two mistakes together in a large mono-flo system, the result is NO HEAT throughout the complex!



After much arguing and "finger-pointing", Gil decided to try an idea. His thought was to install a small, in-line booster pump on the supply riser of each building. His idea was to turn on the booster pumps every time the main circulator was running. The booster pumps would be able to overcome the pressure drop of their own risers and radiation circuits, thus establishing the needed flow to heat the buildings. One problem that he had to contend with was the problem of installing all these smaller booster pumps in series with the larger primary pump. To overcome this problem, he came up with the idea of installing a piece of piping that was connected from the supply to return riser. The pipe, which he referred to as the "common pipe", was "common" to both the riser circuit piping and the primary main piping. When all was said and done, the problems went away, the buildings heated as designed and a new and innovative method of pumping multiple circulators was born. By the way, this all took place back in the early 1950s!

The Essence of Primary/Secondary Pumping

When two piping circuits are connected, flow in one circuit will cause flow to occur in the other circuit based upon the pressure drop in the piping common to both circuits. This describes exactly how a mono-flo system is supposed to operate. Flow in the primary main will cause some flow to occur in the mono-flo circuit due to the pressure drop of the mono-flo fittings in the piping common to both circuits. What Gil discovered, some 50 years ago, was if the pressure drop in the piping common to both circuits was eliminated, flow in one



circuit will not necessarily cause flow to occur in the other circuit.

That is the basis for Primary/Secondary Pumping; the pressure drop in the common pipe has to be designed for a minimum amount of resistance. By keeping the pressure drop very low, you have hydraulically isolated one loop from the other. Therefore, each loop's circulator can operate as if the other circulator does not exist. The benefit of this is you can have different size circulators co-exist without pumping problems. You can isolate flow through the off circuits by simply turning off that particular circuit's pump. You can prevent heat from traveling into off circuits (boilers, radiation zones, etc...). The spacing of the supply and return tees for each secondary circuit is critical. By keeping the tees close together (maximum 3-4 pipe diameters apart), the pressure drop between the tees is almost negligible. (See fig.3) Therefore, as the primary pump is circulating water along the main, the water will not flow through the secondary circuit if its circulator is off. You have successfully isolated one circuit from the other.

Law of the Tee

Gil use to say that to fully understand primary/secondary pumping, you had to understand the concept of "the law of the tee". (See fig.4) What he was referring to is what happens in the common piping. The flow rate and the direction of the flow rate that occurs in the common pipe needs to be discussed. Because we have hydraulically isolated one circuit from the other, we can have different flow rates occurring in each circuit. These different flow rates will meet in the common piping. What occurs there can be very interesting. The flow in the primary piping can be greater than the flow in the secondary circuit, the flow rates can be equal and the secondary flow rate may be greater than the primary.

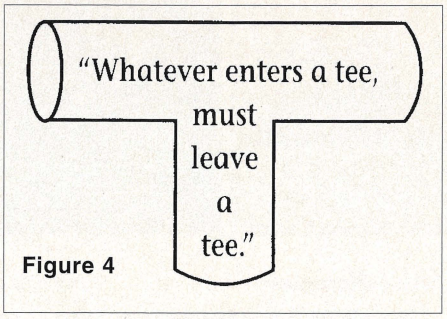


Figure 4

What is the significance of all this? Well, with different flow rates coming together in this "common pipe", mixing of water temperatures is going to occur. And depending upon the flow rates of the primary circuit versus the secondary's flow rate, you can mix down supply water temperatures that are going to the secondary circuit. You can elevate the return water's temperature going back to the primary main. The possibilities are endless, and that is one of the reasons why a system designed with primary/secondary pumping can achieve what other more traditional systems cannot.

In the next issue, we will describe how to apply this piping technique to today's heating systems. If you have any comments or questions, please call me at 1-800-423-7187 or email me at gcarey@fiainc.com. ❑

Oilheating's Cover Photo Contest!

Are you an avid photographer? Here is your chance to see your best work on the cover of a national magazine! ***Oilheating Journal*** is asking its readers to send in their best oilheat-related photo for consideration as a cover image on an upcoming issue of the magazine. And there'll be more than one winner! Get a frameable blowup of your winning cover image, share copies with friends and family, and best of all, see your name in print!

There are a few rules, though:

1. Photos must be related to oilheating. For this first contest, we are not looking for installation or in-the-home photos. We're looking for the best delivery shots, or trucks-on-the road. Snowy scenes or fall foliage are definite pluses. We'd love to see dramatic images of trucks delivering oil in city or country settings, day or night, preferably in cold weather. Other possibilities: the loading rack or bulk storage.

2. **This is important:** the photos must be vertical, to fit our cover, or able to be cropped in a vertical manner. While we use horizontal images from time to time, we always like a full bleed cover.

3. Quality: Unfortunately, the advent of digital photography has been the source of many poor quality images. It's not that the photos themselves are bad—they might be quite striking—but people tend to shoot digital photos at low resolution. They look fine for 4x6-inch inkjet prints, or on the web, but they do not reproduce well at all. If you can, shoot conventional film. If you can't, set your camera to the highest quality setting it can produce. Pixellated images are not a plus. As always, the bigger the image or negative, usually the better the reproduction.

4. Finally, keep it clean! That is, clean trucks, uniforms, facilities, etc. We want to convey the image of oilheat as a clean, modern fuel.

Get guidelines automatically:
Send an e-mail with the words PHOTO CONTEST in the subject line of your e-mail and we'll automatically return the message with the list of guidelines!

Oilheating will select two or three photos for use on our covers during the coming year, and runners-up will see some of their images inside the magazine as well.

For the full guidelines and additional information, see the box at left. . You will need the guidelines for submission.

Good luck!

Send all entries to Oilheating Journal, Photo Contest, 3621 Hill Rd., Parsippany, NJ 07054, or electronically to editor@oilheating.com