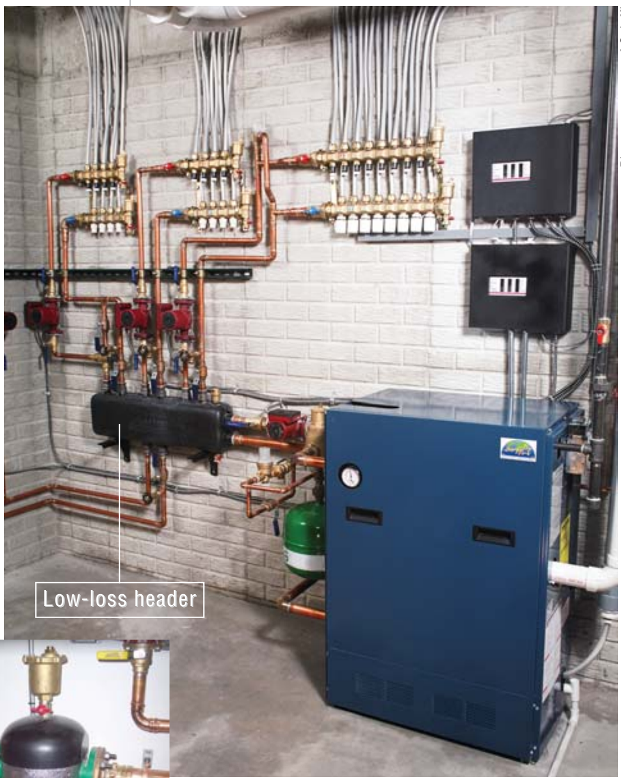
By JOHN VASTYAN

Low-Loss Hydronic Headers

Industry vets weigh in on this alternative to parallel primary loops

The installation of a parallel primary loop is widely regarded as fundamental to the optimal performance of low-temperature, multizone hydronic systems. Gaining traction as an alternative to meticulously constructed parallel primary loops is the low-loss hydronic header, now available in pre-assembled packages.

In this article, several hydronics-industry veterans share their thoughts on low-loss hydronic headers, which can offer a quick, reliable solution for a rather broad range of applications.



Photos courtesy of Caleffi

Off-the-shelf low-loss-header solutions can be accomplished two ways: (1) for light-commercial applications up to about 250 MBH, with closely spaced tees (above) and, (2) for larger systems, with a hydraulic separator (left).

Primary/secondary primer

For a low-loss header to be truly effective, overall system design must be of a primary/secondary (P/S) configuration.

"There's an abundance of engineers, system designers, and installers who want to get in on the primary/secondary-piping game, but few really understand how to make it happen—especially with the larger, more-complex systems, the type we typically see in commercial hydronic systems," Daniel Schlicher, owner of Watertown, Wis.-based DS Design Consultants, a firm specializing in large hydronic- and radiant-heat-system designs, said.

According to John Siegenthaler, PE, president of Utica, N.Y.-based Appropriate Designs, P/S piping has been used in the hydronic heating industry for decades. The closely spaced tees of low-loss hydronic headers—or the closely spaced ports of parallel primary loops—couple each secondary circuit to a common primary, allowing circulators of different pumping to co-exist in the same system without interfering with one another. Each circuit functions singularly, with no real connection to the other circuits.

"You might even say that a circulator in a given circuit of a P/S system doesn't know the other circulators and piping circuits even exist," Siegenthaler said.

With P/S piping, the ability to isolate system circuits makes designing sophisticated multiload systems relatively easy, without concern for how flow rates and pressure drops will change as circulators turn on and off, Siegenthaler said. This is a considerable benefit because, otherwise, circuits would compete with one another for fluid flow, greatly complicating heat distribution.

Dan Foley, president of Alexandria, Va.-based Foley Mechanical, said that when a P/S system is piped in the field, there always is the risk of the "cascade effect," with each successive set of tees "seeing" a lower temperature.

"Yet, with a low-loss header, each supply tapping receives the same temperature," Foley said.

Although P/S piping is best suited to more-complex multiload, multitemperature systems, its applicability can extend to simpler hydronic systems, Siegenthaler said.

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Finessing the design

Series primary loops are best suited to situations in which two or more secondary loads operate with different supply temperatures, Siegenthaler said, adding that the basic principle is to connect the higher-temperature secondary circuits near the beginning of a primary loop to the lower-temperature secondary circuits near the end.

This arrangement, Dave Yates, owner of York, Pa.-based F.W. Behler Inc., said, tends to increase the temperature drop along the primary loop, reducing flow rate. An added benefit is that it may permit a reduction in the size of the primary loop's piping and circulator(s). Sensible modifications of this basic design will accommodate any number of secondary circuits, permitting them to operate at similar supply temperatures.

Out-of-the-box solution

Combining a hydraulic separator and distribution manifold, low-loss headers typically are attached to a hydronic-heating or chilled-water system, permitting different heat adjustments for multiple separate zones when there is only one boiler or chiller.

Low-loss-header configurations typically are compact and easily can be designed into any type of hydronic circuit. The primary operating principle is this: When a system does not contain a means of hydraulic separation between loops with separately sized circulators, the possibility of a tug of war between the circulators is created, which could lead to unexpected flow problems.

The key function of a low-loss header is to provide a low-pressure-loss zone enabling both primary and secondary circuits to be hydraulically independent of one another. This is critical to the new generation of high-flow-resistant, low-mass condensing-boiler installations because the point of lowest pressure drop is moved from the boiler to the header's low-pressure chamber. The closely spaced tees of the distribution manifold connect the secondary circuit to the primary

Photo courtesy of Caleffi/Grundfos

Bob Rohr of Show Me Radiant Heat connects circulators to a low-loss header.

loop internally so that flow in the primary loop has little or no influence on flow in the secondary circuit, preventing pump conflict and the thorny dilemma of having different loop delta-Ps.

"Because the openings in the primary chamber are so close together, there is almost no pressure difference between them, and so the pressure differential across the internal headers is close to zero," Roger Michaud, national sales manager for hydronic-systems supplier Caleffi, said. "The pressure increase created by a given zone circulator is almost entirely depleted by the time the flow returns back to the distribution manifold. This arrangement prevents interference between the boiler circulator and whatever zone circulators are operating. It's easy for system designers or installers to think that isolating the primary loop is the only thing that needs to be done."

Bob Rohr, owner of Rogersville, Mo.-based Show Me Radiant Heat, said: "There's no question copper pipe and fittings can be used to build low-loss headers, but a manufactured low-loss header greatly simplifies the process, reduces labor

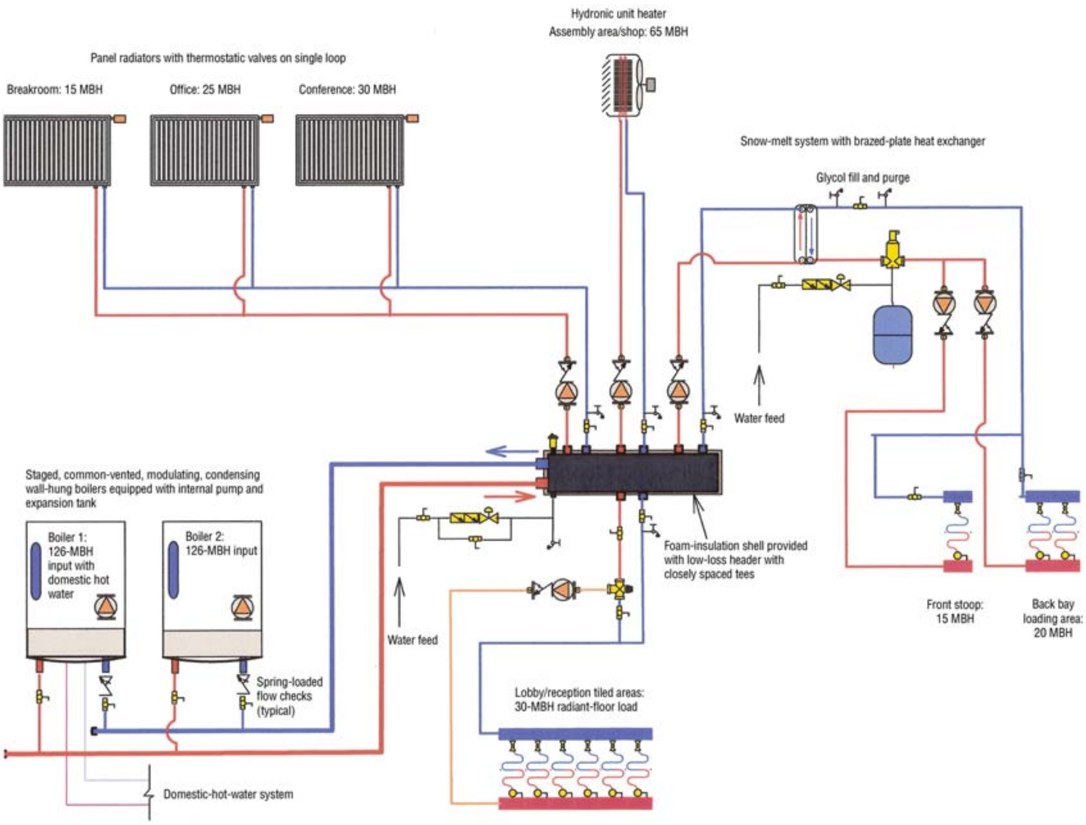

FIGURE 1. Multiple-load, light-commercial design using a low-loss header. An additional circulator is not needed because the boiler has an internal circulator. Previously, one boiler was installed chiefly for domestic-water needs. Once the whole-building remodel was under way, the system quickly grew beyond its ability to provide heat.

cost and time, and, most importantly, gets it done correctly."

"If you talk to engineers and installers about hydronic systems, as I do on a regular basis, you'll soon

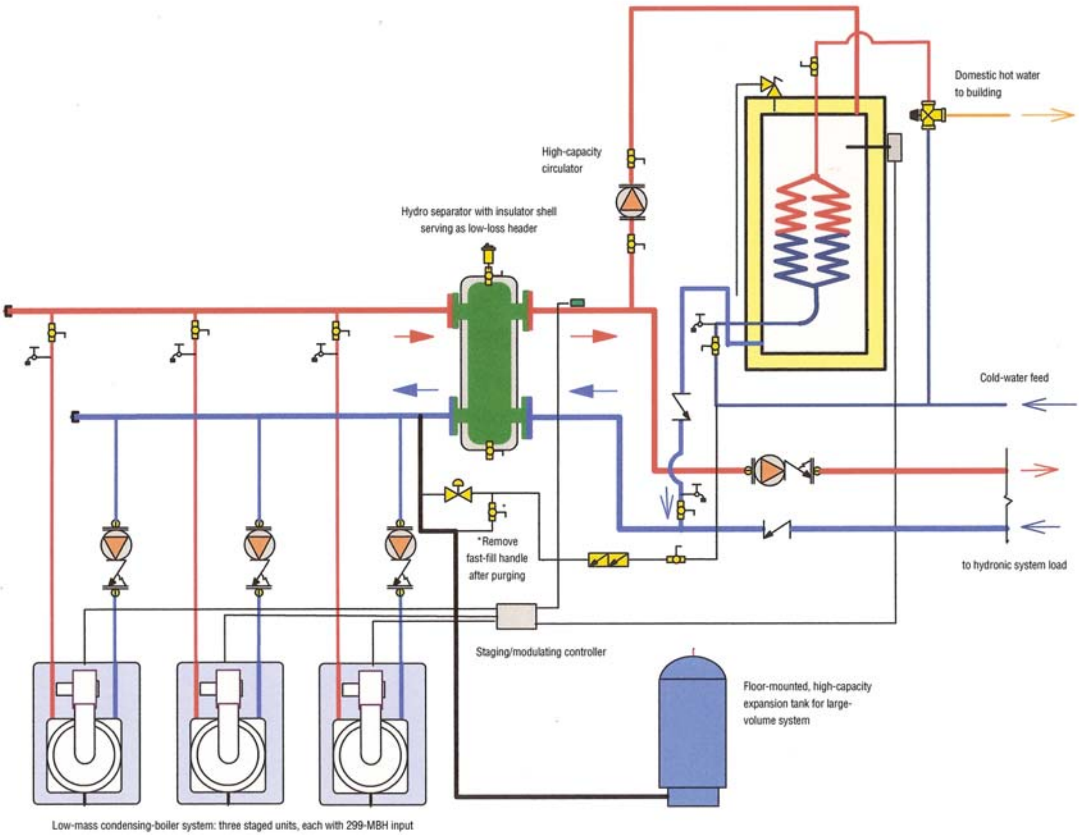

FIGURE 2. Here, a hydraulic separator serves as a high-volume, low-loss header for a three-boiler, 600-MBH system that includes an indirect-fired water heater, which becomes the domestic buffer tank.

learn about plenty of 'missed' P/S and header attempts," Schlicher added. "It's not as easy as soldering pipe to build the proper header or P/S loop. You need to know how to go about it. And, modern high-head condensing boilers pretty much dictate the need for these."

Harold Kestenholz, who trained thousands of installers during his many years as an instructor with the Hydronics Institute, said that while, "A low-loss-header layout is great for commercial buildings over 300,000 Btuh, … for some smaller or simpler applications, it's overkill."

"There simply isn't enough complicated water flow in some systems to install a low-loss header," Kestenholz explained. "All that some systems require is a header to be made up of a foot of 1-in. copper with two tees.

"A successful installation," Kestenholz continued, "will happen when the supply and return piping near the boiler differ by about 20 F on a thermometer. This will be the same whether the boiler is or is not condensing."

Siegenthaler agreed: "I see where Harold is coming from. For example, he says a simple three-zone system with three pumped zone circuits all operating at the same temperature and supplied by a boiler with low flow resistance can operate just fine if coupled with a properly sized header system. Could it operate with a low-loss header? Yes, but an additional circulator would be needed (Figure 1). This would also be true for a site-built primary/secondary system. The additional circulator does add to installation and operating cost, and our industry seems to have developed a habit of using lots of circulators that at some times are not necessary. I'm trying to get them to discern when P/S is necessary vs. when it could be done with more conventional header piping. Both methods definitely have their place."

When used with high-mass cast-iron or steel boilers, zero-balance manifolds save time and eliminate unexpected problems, Kestenholz said, adding he also favors their use with low-mass boilers.

"My concern, chiefly with low-mass boilers," Kestenholz said, "is that the burner input be controlled to prevent overheating when only some zones are open. Here, the installer could create additional 'mass' in the primary or bypass loop to absorb heat when only a few zones are open."

The key challenge, of course, is that low-mass boilers do not have a place to put large heat inputs. If a boiler is sized improperly, this could lead to the overfiring of a building load and, as a result, hammering and sizzling—with or without a good bypass.

"If you have a 300,000-Btuh copper-tube boiler, you'd better have some place to safely direct 230,000 Btus *right now*," Kestenholz said. "You don't want 70,000 Btus going into an indirect water heater with all the other zones shut off in the summer, unless you have some means to anticipate tube overheating *right now*. A zero-balance header assumes in its design that there will be multi zones, so only part of the input will be necessary. It's also assumed that the installer understands the need to pipe the system to handle part loads when only one or few zones are open.

"There's no question," Kestenholz continued, "that low-loss headers are a useful and helpful device. I just wish there'd be a better way to tell newbies coming into the industry to make sure that users of zero-balance manifolds design their systems so that burner input doesn't exceed terminal-unit output. That's been a constant problem, one that even professional education hasn't solved. Just using one of these devices provides easy—hopefully, pump-away—manifolding, air elimination, and expansion-tank fitting ... while making unexpected flows a thing of the past."

At the root of Kestenholz's concern is the danger of too much heat being forced into a system that is ill-equipped to handle it. Kestenholz said simply controlled (non-modulating) low-mass boilers work well when applied to large masses, such as wide-open, single-zone systems with sufficient baseboard or panel radiation to emit heat or radiant slabs that can absorb heat.

Modulating boilers can adjust downward to supply small matching loads. However, one- or two-stage burner input easily can exceed summer indirect-water-heater-only loads and staggered zone-opening loads. For installations such as these (Figure 2), Kestenholz recommends a buffer tank, perhaps an indirect-fired water heater, to make domestic water, adding valuable mass to the water loop during operation of single- or two-stage boilers with only a few open zones (Figure 2).

"Sufficient water mass permits some time for the controls to sense and shut down the burner, then absorb the exchanger heat without having the water exceed safe boiler temperatures or pressure," Kestenholz said. "Manifolds can be built to use the tank in the same manner as preassembled units, but the (manufactured units) get it done so much more effectively when mounted in such a way that all the boiler water also passes through the tank, as in a bypass or primary loop."

Conclusion

Although a low-loss header is not the answer for every job, its applicability is rather broad. According to Mark Eatherton of Denver-based Advanced Hydronics Inc., it is easy to take a wrong turn when assembling a P/S layout—one small mistake can cause a substantial problem or at least create a situation in which system efficiency is reduced. Out of the box, however, a low-loss header can offer a quick, reliable solution.

About the Author

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