By Rick Brindamour

Hydraulic Separation:

An affair of hydronic perfection

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The hydraulic separator, or decoupler, is a simple device that permits co-mingling of the primary and secondary circuits while also eliminating problems. It uses a common pipe between the primary and secondary circuits to create a place of low pressure loss where fluid from the circuits can blend and unite, or separate, as the system requires.

Hydraulic separators, also referred to as low-loss hydronic headers, provide a pressure drop between the supply-and-return connections. Ultimately, the body of water between the connections serves as a hydraulic separator between the boiler or heat source and the load circuits.

Their purpose is to connect the secondary circuit to the primary loop, yet in a way that neutralizes any tendency to influence flow in the secondary circuit or vice versa. This is achieved by installing the two Ts of the separator as close together as possible to achieve a zero pressure drop between them. The path of least resistance for the (primary) water is through the separator rather then through the secondary circuit.

With no pressure differential between the connections, there's virtually no tendency for flow to develop in the secondary circuit, even though flow is moving through the primary circuit. So it makes sense that the secondary and primary circuits are said to be "hydraulically separated."

The proportions of a hydraulic separator are important. Most use a 1:3 ratio between the piping connection size and the diameter of the vertical cylinder. This additional volume of water allows the unit to act as a thermal buffer tank.

Hydraulic separators, or low-loss headers, are gaining a significant following with system designers looking for optimal performance from low-temperature, multi-zone hydronic systems.

USING THE *sweet spot*

The function of a hydro separator is critical for the current generation of high head, low-mass condensing boiler installations because it provides a safe-haven for interconnecting multiple circuits with varying flow-rates and head-loss.

A hydro-sep's "sweet spot" is within a piped system when the source of heat is a low-mass boiler, and micro-zoning BTUH loads fall well below minimum firing rates for modulating burners. A hydro-separator offers additional thermal mass to minimize short cycling when micro-zones are calling for comfort. And they can also be an ideal companion when a buffer tank is installed.

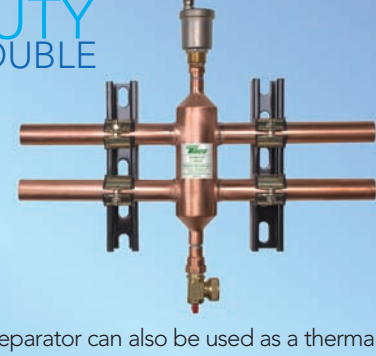
The key challenge, of course, is that low-mass boilers have no place to put large heat inputs. If improperly sized, this can lead to the over-firing of a complete building load and then, as a result, hammering and sizzling – with or without a good bypass.

If the system uses a 300,000 BTUH copper-tube boiler, there better be a safe place to direct 230,000 BTUH. You don't want 70,000 BTUH 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.

With the use of a hydro separator, it is assumed 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 only a few, zones are open.

The essence of this concern is the danger of too much heat being forced into a system that's ill-equipped to handle it. Simply-controlled, 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 the input, or with radiantly-heated slabs that can absorb it.

DOUBLE DUTY DOUBLE

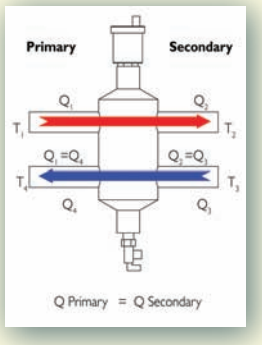


The separator can also be used as a thermal buffer tank. In today's world, HVAC equipment like boilers and chillers is being manufactured with less and less water volume. This is partially to achieve higher efficiencies, but it also tends to reduce manufacturing costs. The downside of this trend is potential short cycling of the equipment.

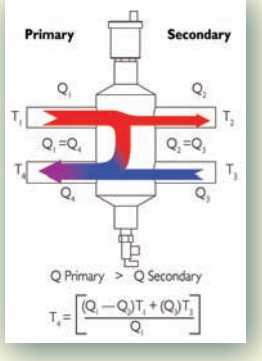
The solution is to install a buffer tank to provide more thermal inertia in the system. A hydraulic separator can be manufactured to provide dual functions, more water volume for thermal buffering, as well as hydraulic separation.

continued on page 40

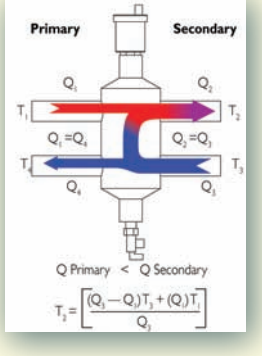
3 combinations of **FLOW** and **TEMPERATURE**



Primary and secondary flow are equal.



Primary flow is more than secondary flow.



Primary flow is less than secondary flow.

DESIGNING THE SYSTEM

Single pipe series primary loops operate at their best when two or more secondary loads operate at different supply temperatures. In a heating system, the basic principle is to connect the higher-temp secondary circuits near the beginning of the primary loop and the lower-temp secondary circuits toward the end.

In a cooling system you would do the opposite, connect the lower temperature secondary circuits at the beginning and the higher temperature circuits at the end. This design can be used to increase the temperature drop along the primary loop, reducing flow rate. An added benefit is that it may also permit a reduction of the size of the primary loop's piping, and circulator(s).

Sensible modifications to this basic design will accommodate any number of secondary circuits, permitting them to operate at similar supply temperatures. The engineering is smart and the time saved with the use of a hydro-separator generally makes up for the unit's cost.

The devices, which come in a range of sizes, are attached to hydronic heating or chilled water systems to permit different heat adjustments for separate, multiple zones when there is only one boiler or chiller. The technology can easily be designed into any type of hydronic circuit, offering a low pressure loss zone where fluids enter and depart freely. This enables both primary and secondary circuits to be hydraulically independent of one another.

The beauty of **buffers**

Modulating boilers can adjust downward to supply small matching loads. However, one- or two-stage burner input can easily exceed indirect water heater-only loads, especially in summer months and staggered zone-opening loads. For installations like these, the use of a buffer tank is recommended, ideally with a coil inside for domestic water, adding valuable mass to the water loop during operation of single or two-stage boilers.

Sufficient water mass permits some additional time for the controls to sense and shut down the burner, then absorb the exchanger's heat.

THE UN-COUPLING

A hydraulic separator's connections have one purpose in life: to decouple all secondary circuits to a common primary. This has been described as the function that "uncouples" the primary and secondary circuits, allowing several circulators the ability to coexist within the same system without interfering with each other.

With primary/secondary piping, the ability to isolate system circuits makes it relatively easy to design sophisticated multi-load systems with little concern about how flow rates and pressure drops will change as various circulators turn on and off. This is a big advantage because, otherwise, circuits compete in a tug-of-war with each other for water pressure within the system.