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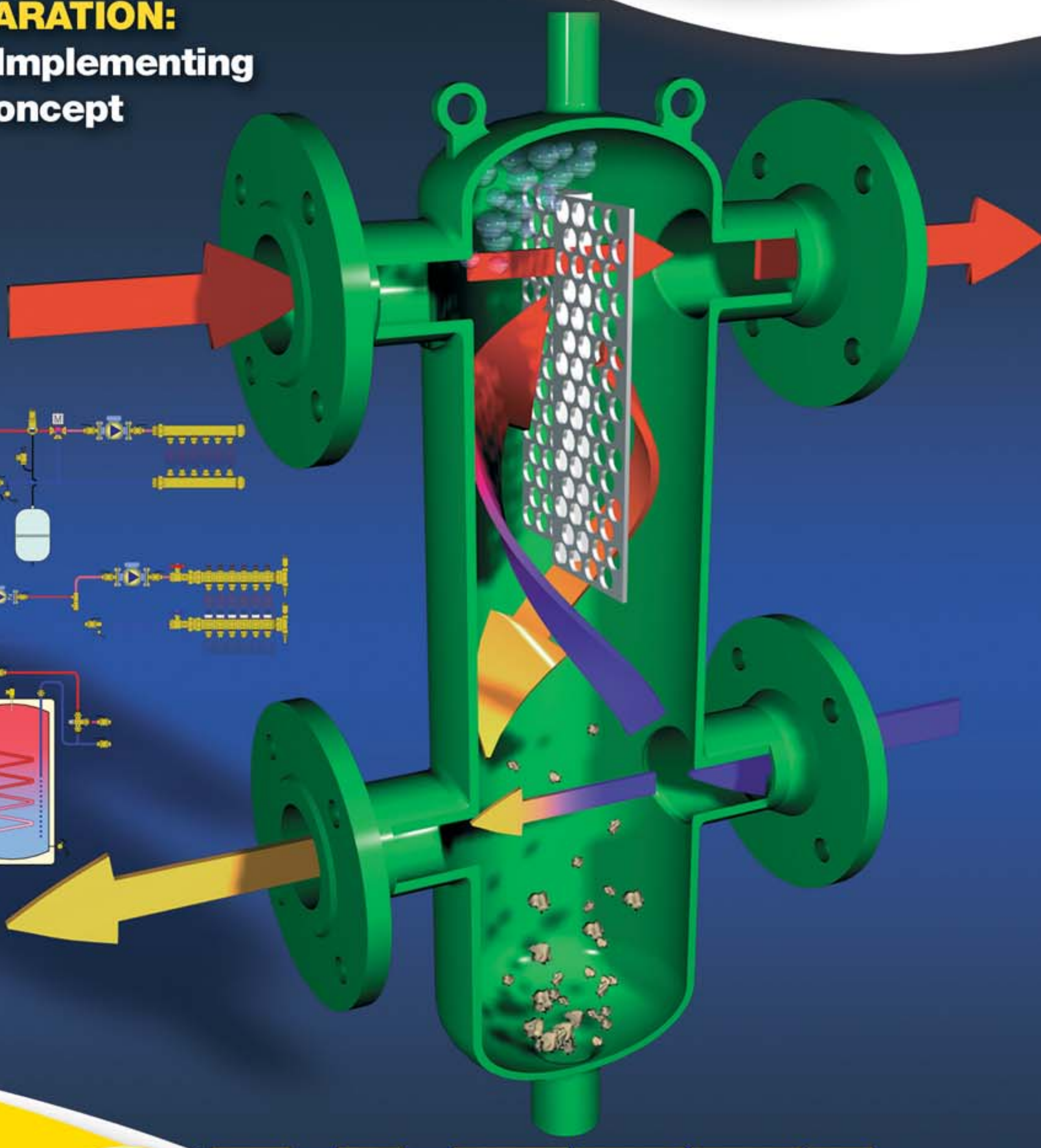
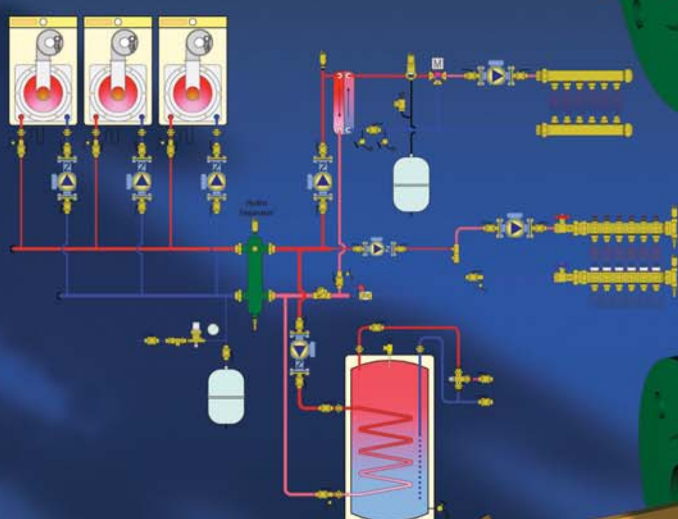
# idronics™

JOURNAL OF DESIGN INNOVATION FOR HYDRONIC PROFESSIONALS

## HYDRAULIC SEPARATION:
## New Methods of Implementing an Established Concept





CALEFFI


A Techinal Journal
from
Caleffi Hydronic Solutions

CALEFFI
Hydronic Solutions

Official release

Dear Professionals,

The world wide corporate initiatives of Caleffi include not only developing and marketing innovative products, but also providing excellent customer service and informative technical documentation as well.

And it is precisely in this context that this new publication *'idronics'* was born, a semi-annual journal planned and developed following the example of what Caleffi has successfully published in Europe. The journal is technically rigorous, but at the same time easy to read and handy to consult. It is written by American engineers for American engineers, designers and installers alike, whose needs are not always the same as their European counterparts.

We would be enormously grateful to anyone offering advice and information so that we can best refine future issues. Your input will help insure our goal of establishing *'idronics'* as a highly useful and anticipated hydronic system design tool in the months and years ahead.

Best regards,

Marco Caleffi
C.E.O. – Caleffi S.p.A.

**CALEFFI NORTH AMERICA, INC**
9850 South 54th Street
Franklin, Wisconsin 53132 USA

TEL: 414.421.1000
FAX: 414.421.2878

E-mail: idronics@caleffi.com
Website: www.caleffi.us



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# Index

# A BRIEF HISTORY OF CALEFFI

Although Caleffi is a relatively new name in the North American HVAC industry, it is a name recognized around the world for quality hydronic products.

Caleffi S.p.A. was founded in 1961 in Gozzano, Italy, by Francesco Caleffi. During the last 45 years, it has grown from a small machine shop into a world wide company now serving markets in 50 countries and generating over $300 million in annual sales. Each year, Caleffi processes over 13,000 tons of brass as well as engineered polymers into hundreds of specialized components, such as valves, air separators, manifold systems and modular heating distribution stations. The majority of these products come from Caleffi's ISO-certified and highly automated manufacturing facilities near Milano, Italy.

A recognized world-class company, Caleffi now serves the ever-expanding hydronic heating market in North America. From a main office/warehouse facility in Milwaukee, Wisconsin, Caleffi North America provides products with the same meticulous attention to detail in design and manufacturing as it makes available to the rest of the world. These products are sold through a growing network of distributors and wholesalers across the U.S. and Canada.

Many Caleffi products are unique in the North American market. These include hydraulic separators (the technical subject addressed in this issue of idronics) as well as Hydro Link distribution stations, auto-resetting valve actuators, pre-adjustable boiler feed valves, and micrometric manifold systems.

However, unique and quality hardware alone doesn't ensure optimal system design and installation. To this end, Caleffi North America is dedicated to continuous education in the area of hydronic technology. The better trained system designers are, the better they can apply Caleffi products as well as other hardware to produce efficient, reliable, and long-lasting hydronic comfort systems. This "high road" approach ensures continued growth of the hydronics market in North America, as well as the rest of the world.


This idronics journal has been created specifically to support this commitment to continuous education of North American hydronic professionals. Each issue will provide detailed technical discussion of the "best practices" available for deploying hydronic technology in the 21st century. You'll find topics and technical depth not typically provided in newsletters and sales brochures.

We hope you enjoy idronics and keep each issue handy for future reference. A PDF file of each issue can be freely downloaded from our web site www.caleffi.us located in the Technical Library area. If you know of others who would enjoy reading idronics, please refer them to this web site where they can download this PDF file.

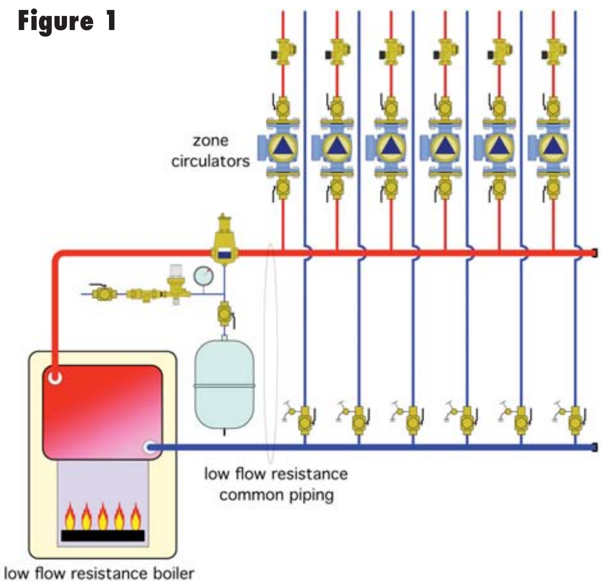
Finally, if you have a particular topic you would like to see addressed in a future issue, please feel free to call or e-mail us at idronics@caleffi.com with your suggestions.

# HYDRAULIC SEPARATION

## New Hardware Provides Multiple Functions And Simple Installation

An important benefit of hydronic heating is the ability to provide several independently controlled zones within a building. This is often done by supplying and returning each zone circuit from a common header set, as shown in Figure 1.

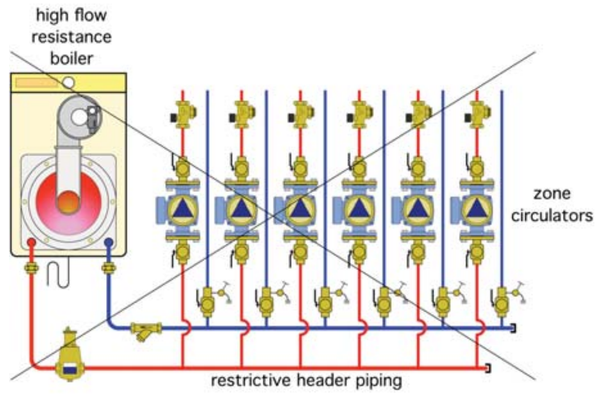
**Figure 1**




This piping arrangement is common in traditional hydronic systems where a heat source with low flow resistance is used (i.e., a cast iron boiler). Such boilers and the larger diameter header piping connecting them to the zone circuits create very little flow resistance, and thus can accommodate relatively high flow rates with minimal interference between the zone circuits. In short, the hydraulic characteristics of these systems seldom create problems.

**Times Have Changed:** Today, many hydronic systems use compact boilers as their heat source. These boilers have much higher flow resistance relative to cast iron boilers. If such a boiler is simply substituted for the low flow resistance boiler shown in Figure 1, problems are likely to develop, most notably interference between simultaneously operating circulators. The schematic in Figure 2 illustrates a situation to avoid.

**Figure 2**




The designer of such a system might assume that each zone circuit develops a flow based on the flow resistance of its piping and the circulator in that circuit. In essence, this thinking treats each zone circuit as if it was a “stand-alone circuit,” unaffected by its neighboring circuits.

This oversimplification ignores the fact that the total flow of all zone circuits must pass through the high-resistance heat source. The latter will act as a flow “bottleneck” and significantly reduce the flow within each zone circuit. The more zone circuits that operate at one time, the worse this bottlenecking effect is. The resulting drop in flow through individual zone circuits may create under-heating, which will likely lead to complaints of inadequate heat delivery in some zones.

**Divide and Conquer:** The solution to this problem is hydraulic separation. In short, it’s the concept of preventing flow in one circuit from interfering with flow in another circuit. When hydraulic separation between circuits is present, the designer can correctly think of each circuit as if it where a stand-alone entity and design it accordingly. This not only simplifies system analysis, it also prevents the previously described flow interference problems.

Figure 3

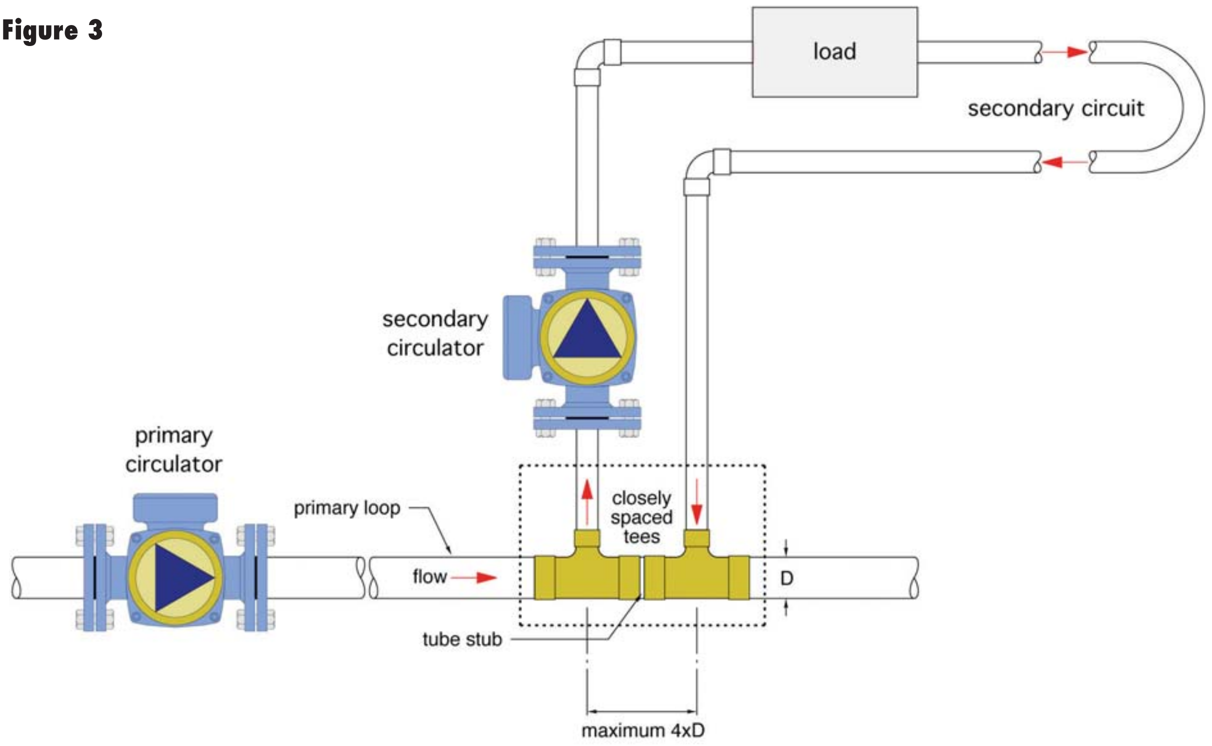
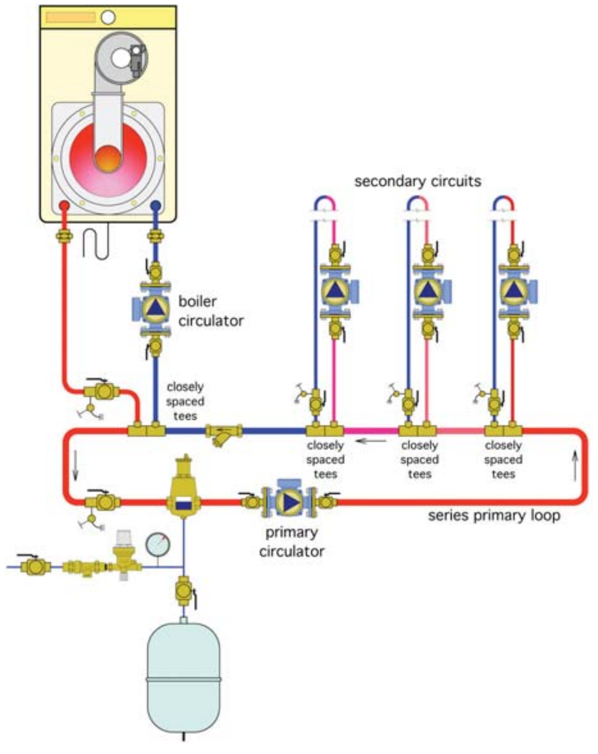



Figure 4

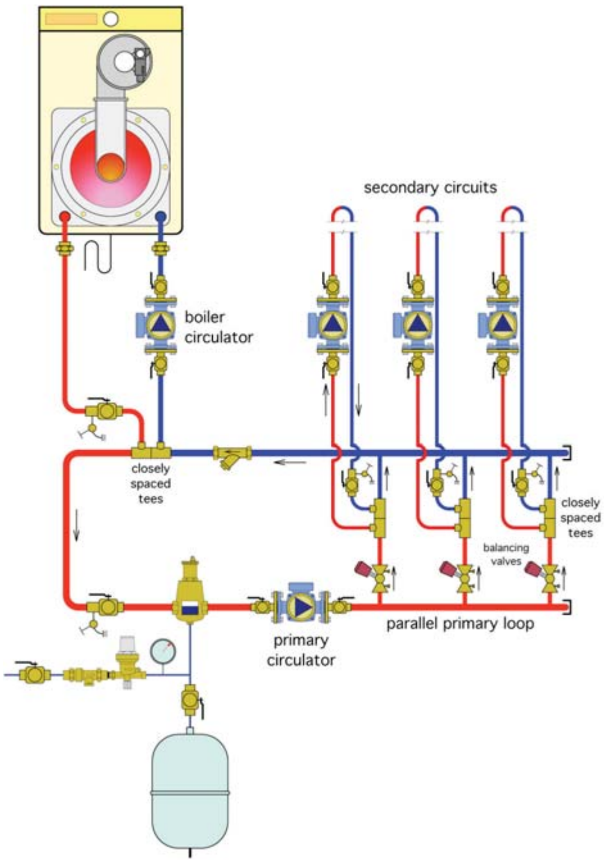



Although the term hydraulic separation is perhaps new to many hydronic system designers in North America, it is not a new discovery in hydronic heating technology. The concept of primary/secondary piping is perhaps the best-known form of hydraulic separation now used in the North American hydronics industry. It is based on the use of two very closely spaced tees, as shown in Figure 3.

Because the tees are very close together, the pressure drop between them due to head loss is almost zero. Hence, the pressure at the side port of each tee is almost exactly the same. Since there is no pressure differential between the tees, there is virtually no tendency for flow to develop in the secondary circuit, even though flow is passing through the tees in the primary circuit. The secondary circuit is therefore said to be "hydraulically separated" from the primary circuit. Flow will develop in the secondary circuit only when the secondary circulator is operating.

This concept can be extended to multiple secondary circuits served by a common primary loop, as shown in Figure 4. Each secondary circuit, including the secondary circuit through the boiler, is joined to the primary circuit using a pair of closely spaced tees to provide hydraulic separation.

Figure 5




The configuration shown in Figure 4 is more precisely called a series primary/secondary system. In this approach, all secondary circuits are arranged in a sequence around the common primary loop.

Although hydraulic separation exists between all circuits, so does an often-undesirable effect — a drop in supply water temperature from one secondary circuit to the next whenever two or more of the secondary circuits are operating simultaneously. Although there are situations in which this temperature drop doesn't present a problem, it does add complications that prudent designers must assess and compensate for.

The piping configuration shown in Figure 5 is known as a parallel primary/secondary system. Here, the primary loop is divided into two or more "crossover bridges." Within each crossover bridge is a pair of closely spaced tees that provide hydraulic isolation between each secondary circuit, as well as the primary loop.

Assuming that piping heat losses are minimal, a parallel primary/secondary system provides the same supply water temperature to each secondary circuit regardless of which secondary circuits are operating. It eliminates the sequential temperature drop effect associated with series primary/secondary circuits.

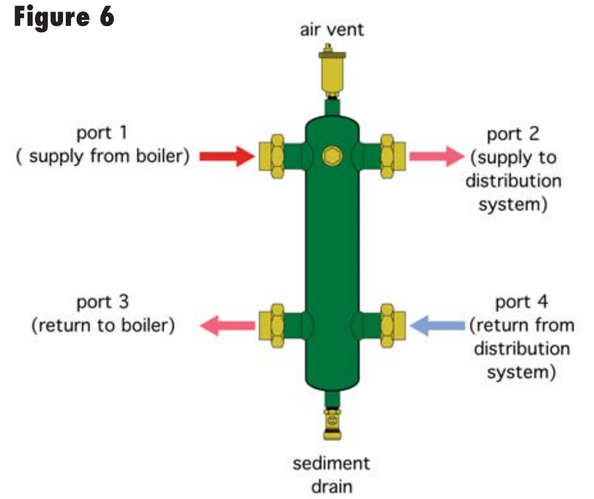
This benefit is achieved at the cost of more complicated and costly piping. Notice that each crossover bridge contains a flow-balancing valve. These valves are needed to set the flow through each crossover bridge in proportion to the thermal load served by the secondary circuit supplied from that bridge. If these valves are not present and properly adjusted, there may be problems, such as inadequate flows through the crossover bridges located farther away from the primary circulator.

Another important consideration is that both series and parallel primary/secondary systems require a primary circulator. This circulator obviously adds to the installed cost of the system. Even more importantly, it adds to the system's operating cost over its entire life. The latter may add up to hundreds, if not thousands, of dollars over a typical system life.

Wouldn't it be nice to achieve the benefits of hydraulic separation and equal supply temperatures to each load circuit without the costs associated with the primary circulator and the complexities of building and adjusting a parallel primary/secondary system? This is possible through use of a specialized component called a hydraulic separator.

Figure 6 shows an illustration of a hydraulic separator.

Figure 6



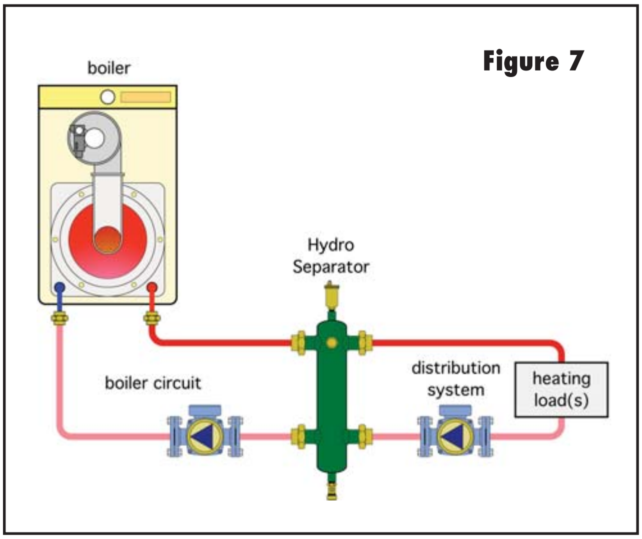



Figure 7 shows where the device is installed in a typical hydronic heating system.

The geometric proportions of a hydraulic separator are important to proper operation. Many hydraulic separators use a 1:3 ratio between the piping connection size and the diameter of the vertical cylinder. This provides proper mixing within the hydraulic separator (when flow in the boiler circuit is different from flow in the distribution circuit). These proportions also ensure a relatively low flow velocity within the vertical cylinder that minimizes pressure drop, allowing air bubbles to rise to the top and dirt particles to settle to the bottom.

A specially designed baffle located near the top of the vertical cylinder in some hydraulic separators also assists with air removal. The perforated surface of this baffle allows air bubbles to coalesce and rise above the flow stream area. The bubbles are then captured in the upper chamber of the separator and ejected through a float-type vent at the top of the unit.

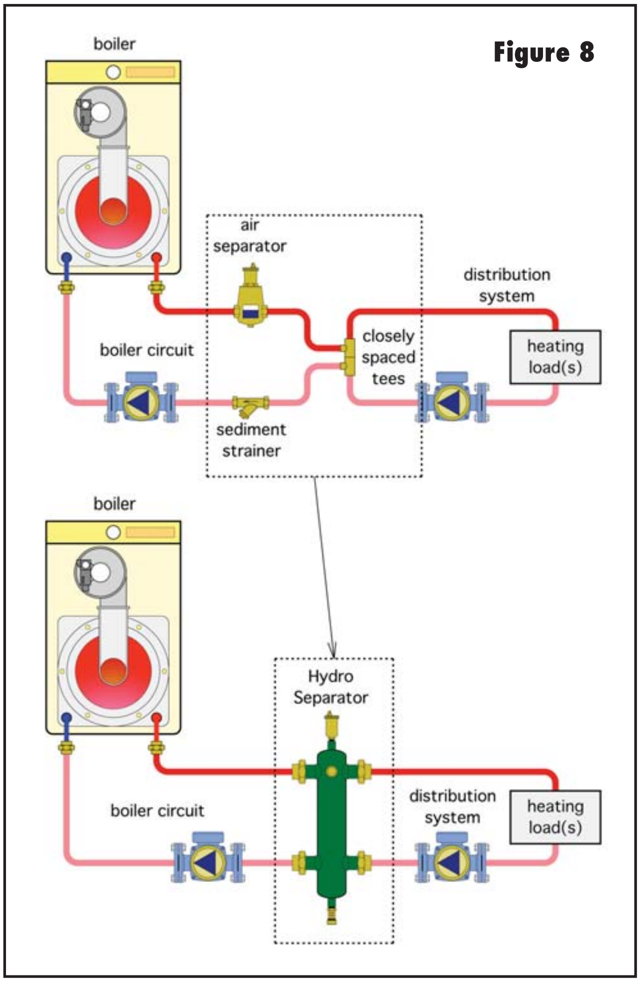
**Multiple Benefits:** As its name implies, a hydraulic separator provides hydraulic separation. It does so using the same physical principles at work in the closely spaced tees of a primary/secondary piping system.

It's also important to recognize that some hydraulic separators provide additional functions, namely air separation and sediment separation. In systems using closely spaced tees for hydraulic separation, these functions require additional components. Such components usually cost more to purchase and install relative to a "multi-functional" hydraulic separator that provides all three functions in one device, as shown in Figure 8. Separate components also require more space for installation and increase system heat loss relative to a single hydraulic separator with an insulated jacket.

**Flow Possibilities:** The temperatures at the two outlet ports of a hydraulic separator (e.g., ports 2 and 3 in Figure 6) depend on the temperatures at the two inlet ports (e.g., ports 1 and 4 in Figure 6) as well as the flow rates in both the boiler circuit and distribution system.

There are three possible cases:

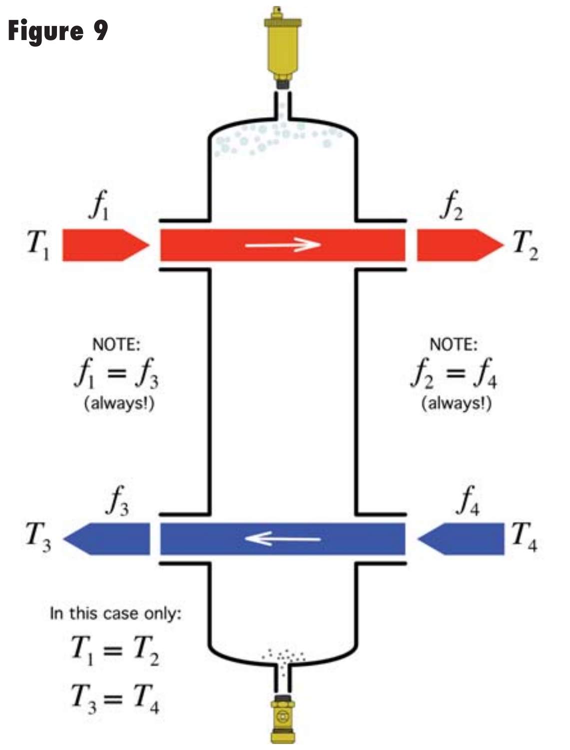
1. Flow in the distribution system is equal to flow in the boiler circuit.
2. Flow in the distribution system is greater than flow in the boiler circuit.
3. Flow in the distribution system is less than flow in the boiler circuit.



We'll examine each case using the basic thermodynamics that govern all mixing situations.

**Case #1.** *Distribution flow equals boiler flow:* In this case, which is typically the exception rather than the norm, the flow and temperature leaving the distribution system outlet port (port 2) of the hydraulic separator is essentially the same as the temperature of the hot water entering the boiler inlet port (port 1), as shown in Figure 9. Very little mixing occurs because the flows are balanced. The hot water entering port 1 remains near the top of the hydraulic separator because of its buoyancy. Most of the air bubbles carried into port 1, or that form within the hydraulic separator, rise to the top of the unit and are ejected through the vent.

**Figure 9**

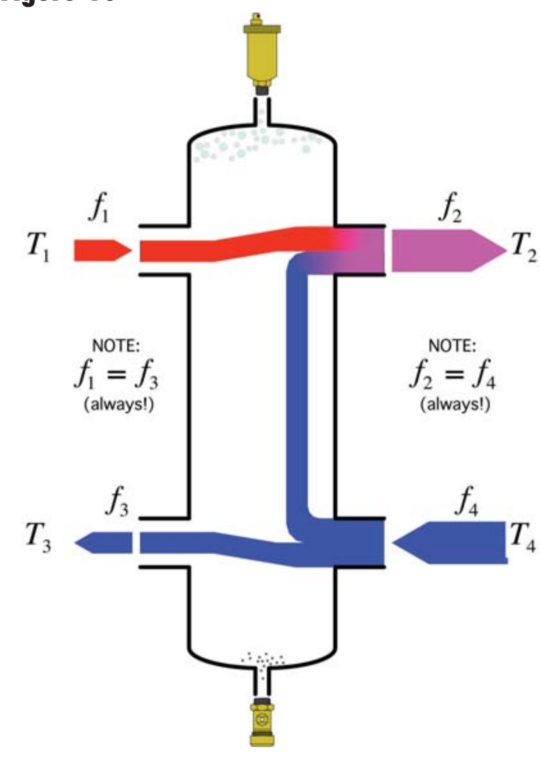



A similar situation exists at the lower ports of the separator. Since the flows are balanced, the outlet temperature returned to the boiler from port 3 equals the temperature returning from the distribution system into port 4. Again, very little mixing takes place within the separator. Dirt particles carried into the separator from port 4 will tend to settle to the bottom of the separator where they can be periodically flushed out through the drain valve.

If a conventional (non-condensing) boiler is used in the system, the designer should verify that the water temperature on the return side of the distribution system is high enough to prevent sustained flue gas condensation within the boiler.

**Case #2.** *Distribution system flow is greater than boiler flow:* Since the flow rates in the boiler circuit and distribution system are not the same, mixing occurs within the hydraulic separator. In this case, a portion of the cooler water returning from the distribution system moves upward through the separator and mixes with the hot water entering from the boiler, as shown in Figure 10.

**Figure 10**




This mixing reduces the water temperature supplied to the distribution system. This is not necessarily a bad thing, but the designer does need to realize it can occur.

Formula 1 can be used to calculate the mixed temperature ($T_2$) supplied to the distribution system under these conditions.

$$T_2 = \left(\frac{(f_4 - f_1)T_4 + (f_1)T_1}{f_4}\right)$$

**Formula 1**

Where:
$f_4$ = flow rate returning from distribution system (gpm)
$f_1$ = flow rate entering from boiler(s) (gpm)
$T_4$ = temperature of fluid returning from distribution system (ºF)
$T_1$ = temperature of fluid entering from boiler (ºF)

Formula 1 is valid for both water and other system fluids, provided all fluid entering and leaving the hydraulic separator is the same. It can also be used with any consistent set of units for flow and temperature.

Here's an example of how to use Formula 1: Suppose a distribution system containing several simultaneously operating circulators is running at 25 gallons per minute of total flow. Water returns from the distribution system at 120ºF and enters port 4 of the hydraulic separator. At the same time, the boiler flow rate is 10 gallons per minute, and the water temperature supplied to port 1 is 160ºF. What is the mixed water temperature leaving port 3 headed for the supply side of the distribution system? Also, what is the water temperature returning to the boiler?

The mixed water temperature is found using Formula 1:

$$T_2 = \left(\frac{(f_4 - f_1)T_4 + (f_1)T_1}{f_4}\right) = \left(\frac{(25-10)120 + (10)160}{25}\right) = 136^\circ F$$

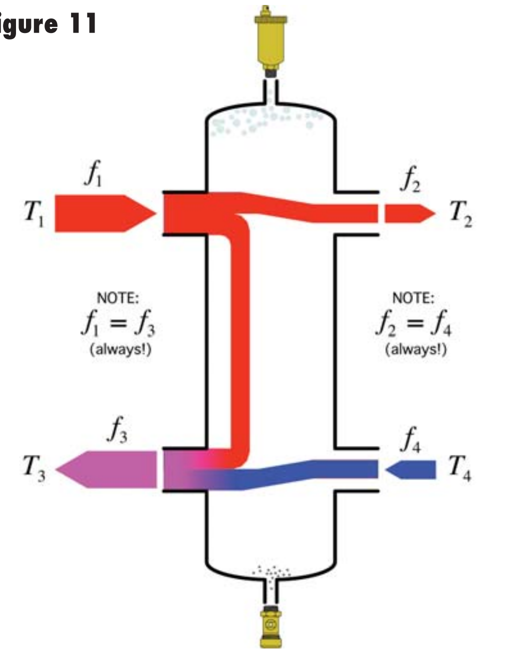
Notice that the water temperature supplied to the distribution system (136ºF) is substantially lower than the water supplied from the boiler (160ºF). This is the result of mixing within the hydraulic separator.

Since no mixing occurs in the bottom portion of the separator, the water temperature returning to the boiler is the same as that returning from the distribution system: 120ºF.

If the boiler firing rate is to be modulated based on the supply temperature to the distribution system, it's imperative that the temperature sensor providing supply temperature information to the modulating controller is located downstream of the distribution system outlet port (port 2) of the hydraulic separator.

**Case #3:** *Distribution system flow is less than boiler flow:* Again, since the flow rates on opposite sides of the hydraulic separator are not equal, mixing will occur inside the separator. In this case, a portion of the hot water entering from the boiler circuit moves downward through the separator and mixes with cool water entering from the distribution system, as shown in Figure 11.

**Figure 11**




This condition occurs when the boiler heat output rate is (temporarily) higher than the current system load. Simply put, heat is being injected into the system faster than the load is removing heat. This produces a relatively fast increase in boiler return temperature. If a modulating boiler is being used, this will lead to a relatively fast decrease in firing rate as the system attempts to achieve thermal equilibrium.

Under this scenario, the temperature returning to the boiler ($T_3$) can be calculated using Formula 2:

$$T_3 = \left(\frac{[f_1 - f_2]T_1 + [f_4]T_4}{f_1}\right)$$

**Formula 2**

Where:

$T_3$ = temperature of fluid returned to the boiler(s) (°F)
$f_1$ = flow rate entering from boiler(s) (gpm)
$f_2$, $f_4$ = flow rate of the distribution system (gpm)
$T_1$ = temperature of fluid entering from boiler(s) (°F)
$T_4$ = temperature of fluid returning from distribution system (°F)

Here's an example: Assume the boiler supply temperature is 170°F, and that boiler flow rate into port 1 of the hydraulic separator is 15 gallons per minute. Water returns from the distribution system and enters port 4 of the hydraulic separator at 100°F and 10 gallons per minute flow rate. What is the water temperature returned to the boiler?

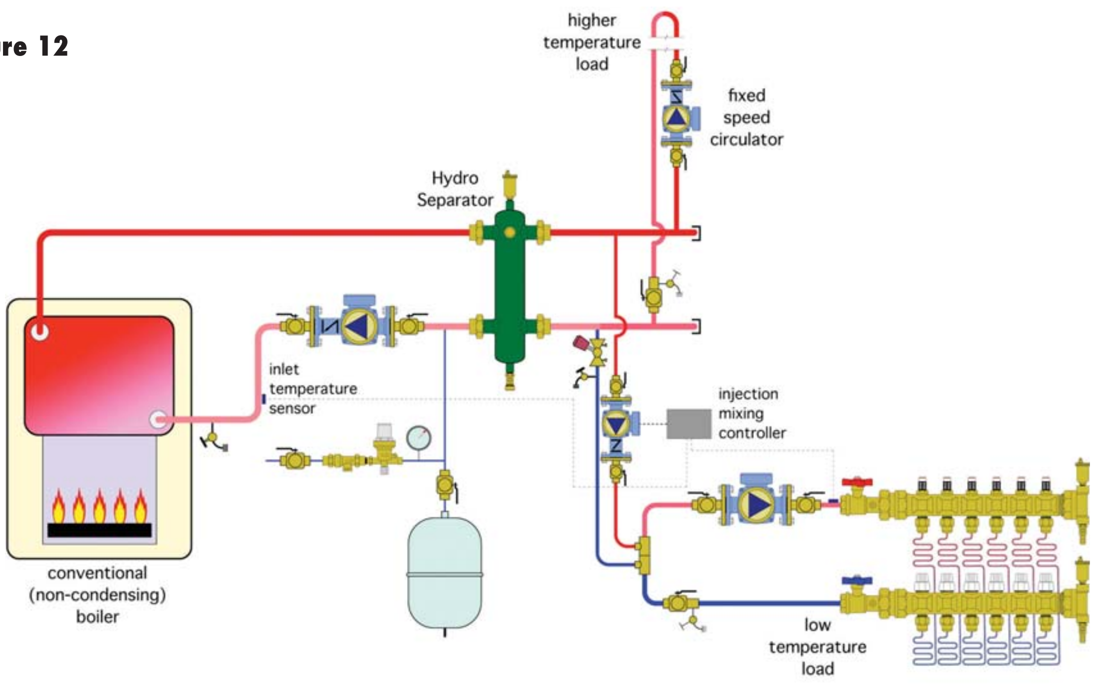
Substituting these operating conditions into Formula 2 yields:

$$T_3 = \left(\frac{[f_1 - f_2]T_1 + [f_4]T_4}{f_1}\right) = \left(\frac{(15-10)170 + (10)100}{15}\right) = 123.3^{\circ}F$$

Notice that the boiler inlet temperature is about 23°F higher than the return temperature of the distribution system. This again is due to mixing within the hydraulic separator.

If the system uses a conventional (non-condensing) boiler, one might consider the boost in boiler return temperature beneficial because it moves the boiler operating condition away from potential flue gas condensation. However, this temperature boost effect can quickly diminish if flow through the distribution system increases (i.e., more load circuits turn on), or if the return temperature of the distribution system drops. *Use of a hydraulic separator alone does not prevent flue gas condensation under all circumstances.* The only way to ensure such protection is to install automatic mixing devices on the load circuits that monitor boiler return temperature and reduce hot water flow when necessary to prevent the boiler from dropping below a predetermined minimum return temperature. This concept is shown in Figure 12. Here, a variable speed injection pump is the mixing device that monitors boiler inlet temperature and reduces hot water flow into the low temperature distribution system when necessary to prevent flue gas condensation within the boiler. Notice that the variable speed injection pump is piped in parallel with the fixed speed circulator serving the higher temperature load circuit. This is possible because of the very low pressure drop through the Hydro Separator, as well as a low pressure drop along the headers on the right side of the Hydro Separator. The mixing needed to boost boiler return temperature occurs within the Hydro Separator rather than the downstream tee in a primary/secondary system. The injection pump and fixed speed circulator both require a check valve to prevent reverse flow.

**Figure 12**



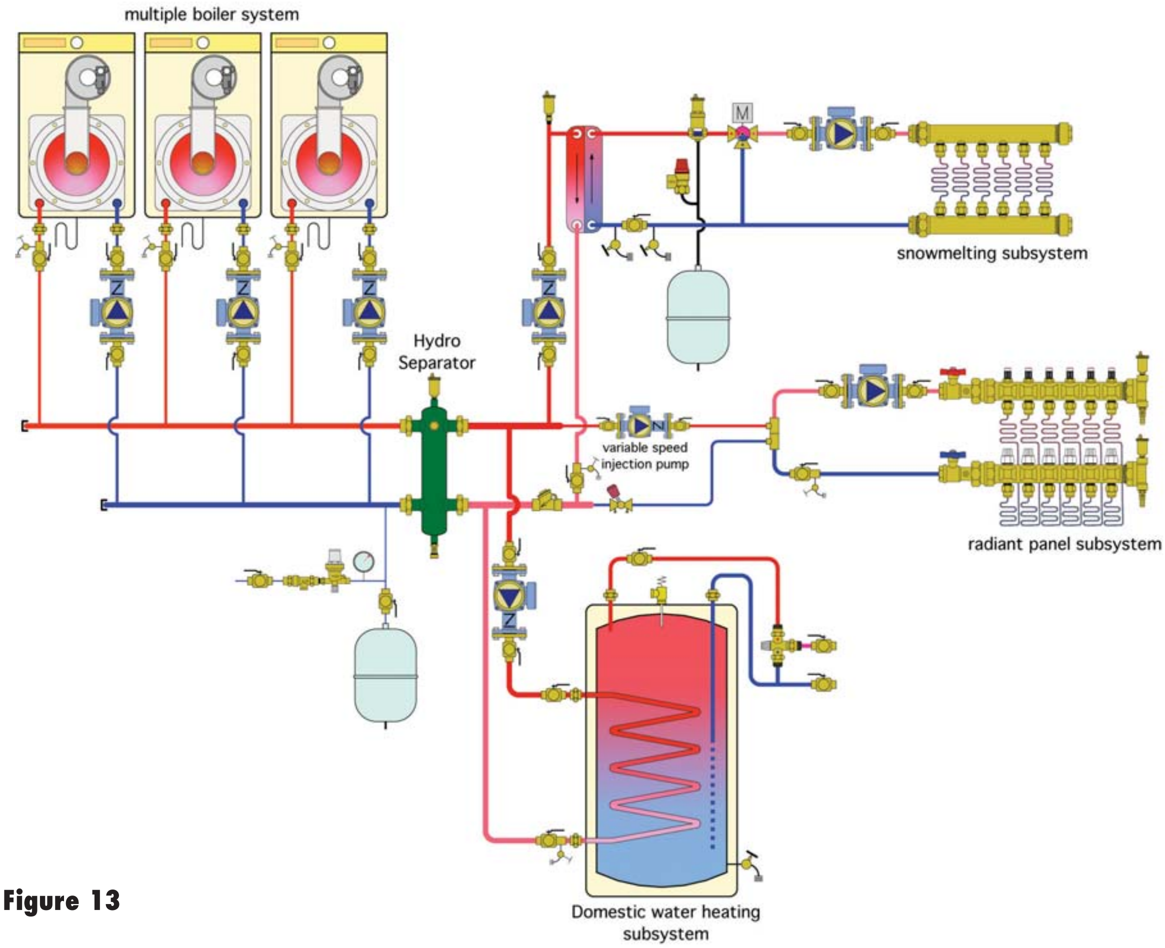



**Figure 13**

**Sizing & Application:** Hydraulic separators must be properly sized to provide proper hydraulic, air, and dirt separation. Excessively high flow rates will impede these functions.

Sizing is straightforward. First, determine the maximum flow rate that will exist in both the boiler circuit and distribution system, then note the greater of these values. Next, look up the pipe connection size of the hydraulic separator needed to handle this maximum flow rate in the table below.

| **Pipe size of hydraulic separator** | 1″ | 1.25″ | 1.5″ | 2″ | 2.5″ | 3″ | 4″ | 6″ |
|---|---|---|---|---|---|---|---|---|
| **Max flow rate (GPM)** | 11 | 18 | 26 | 40 | 80 | 124 | 247 | 485 |

The header piping connecting to the distribution side of the Hydro Separator should be sized for a flow velocity of 4 feet per second or less under maximum flow rate conditions. All header piping should also be kept as short as possible to minimize pressure drop.

Be sure that all load circuits having individual circulators include an appropriate check valve. This is necessary to prevent reverse flow as well as buoyancy-induced heat migration through that circuit when its circulator is off. The internal spring-loaded check valves included with some circulators are acceptable, as are flow-check or spring-loaded check valves mounted on the discharge side of the circulators. A standard swing check valve does not provide protection against forward heat migration and is not an acceptable device for this service.

Hydraulic separators are an ideal way to interface new boilers, especially those with high flow resistance heat exchangers, to existing distribution systems. They eliminate the potential of flow bottlenecks that may arise in systems where the full flow of the distribution system would otherwise be routed through the boiler. Their ability to collect and dispose of sediment also makes them ideal for older systems where sediment is more common. This is especially true in systems that once operated with steam and have since been converted to hot water.

**HydroLink:** The principle of hydraulic separation combined with uniform supply water temperature to distribution circuits is desirable in both large and small hydronic systems.

As already discussed, the Caleffi Hydro Separator is ideal for medium to large systems. Currently available models can handle flow rates up to 485 gpm with piping sizes ranging from 1 to 6 inches.

For smaller systems, Caleffi also offers the HydroLink, as shown in Figure 14.

This product provides a chamber to hydraulically separate the boiler circuit from the distribution circuits. It also provides a self-contained manifold station that supplies up to four independently controlled load circuits with the same supply temperature. These features and their equivalent piping are shown in Figure 15.

**Figure 14**

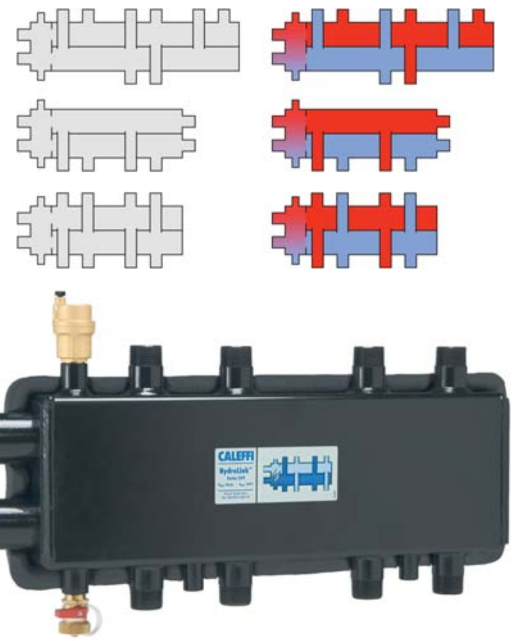



**Figure 15**

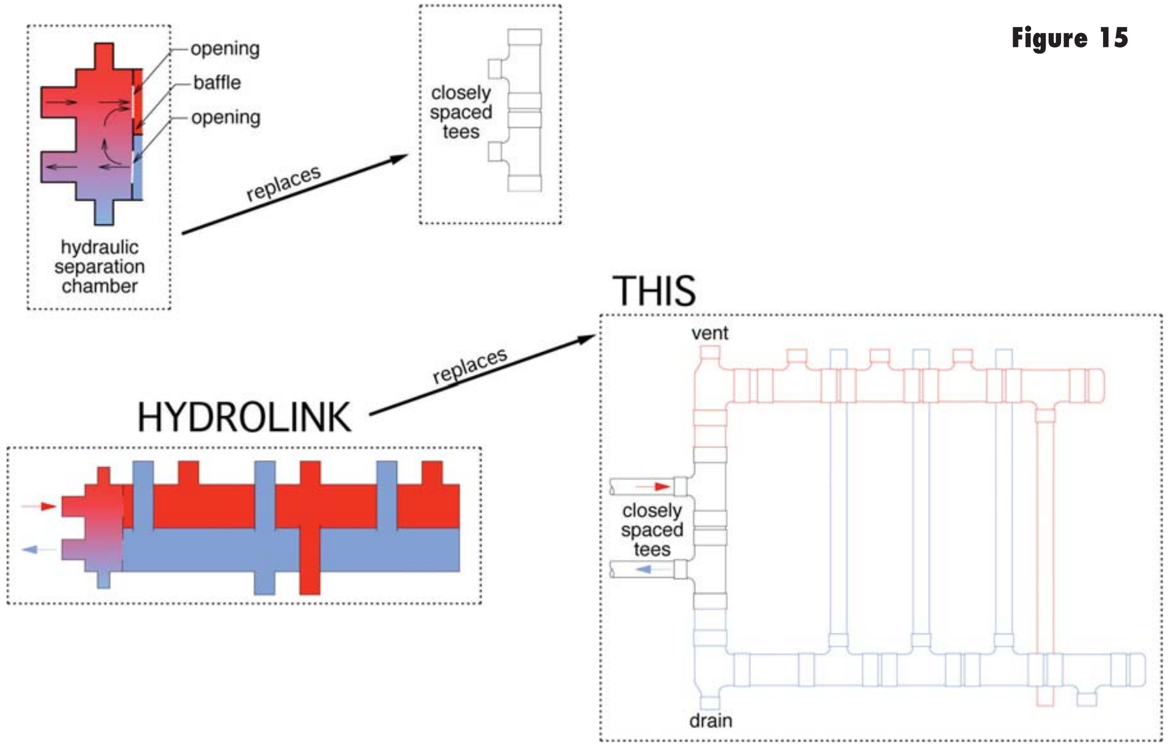
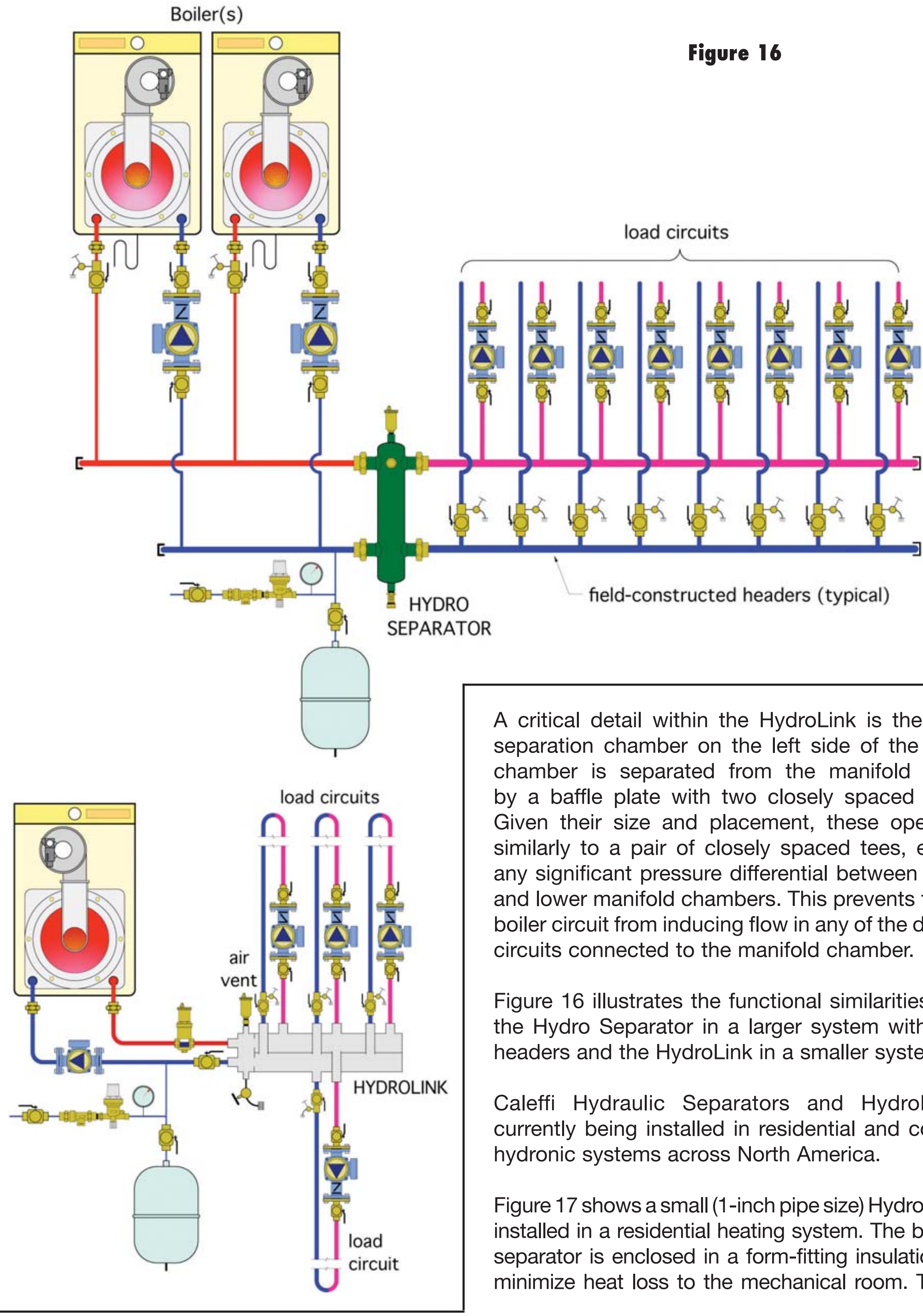


Figure 16




A critical detail within the HydroLink is the hydraulic separation chamber on the left side of the unit. This chamber is separated from the manifold chambers by a baffle plate with two closely spaced openings. Given their size and placement, these openings act similarly to a pair of closely spaced tees, eliminating any significant pressure differential between the upper and lower manifold chambers. This prevents flow in the boiler circuit from inducing flow in any of the distribution circuits connected to the manifold chamber.

Figure 16 illustrates the functional similarities between the Hydro Separator in a larger system with site-built headers and the HydroLink in a smaller system.

Caleffi Hydraulic Separators and HydroLinks are currently being installed in residential and commercial hydronic systems across North America.

Figure 17 shows a small (1-inch pipe size) Hydro Separator installed in a residential heating system. The body of the separator is enclosed in a form-fitting insulation shell to minimize heat loss to the mechanical room. This Hydro

**Figure 17**

**Figure 18**

**Figure 19**

Separator is installed between a modulating boiler and the space-heating distribution system containing several zone circulators.

Figure 18 shows a 4-inch Hydro Separator installed in a larger commercial system where it provides the link between a multiple boiler system and several independently controlled distribution circuits.

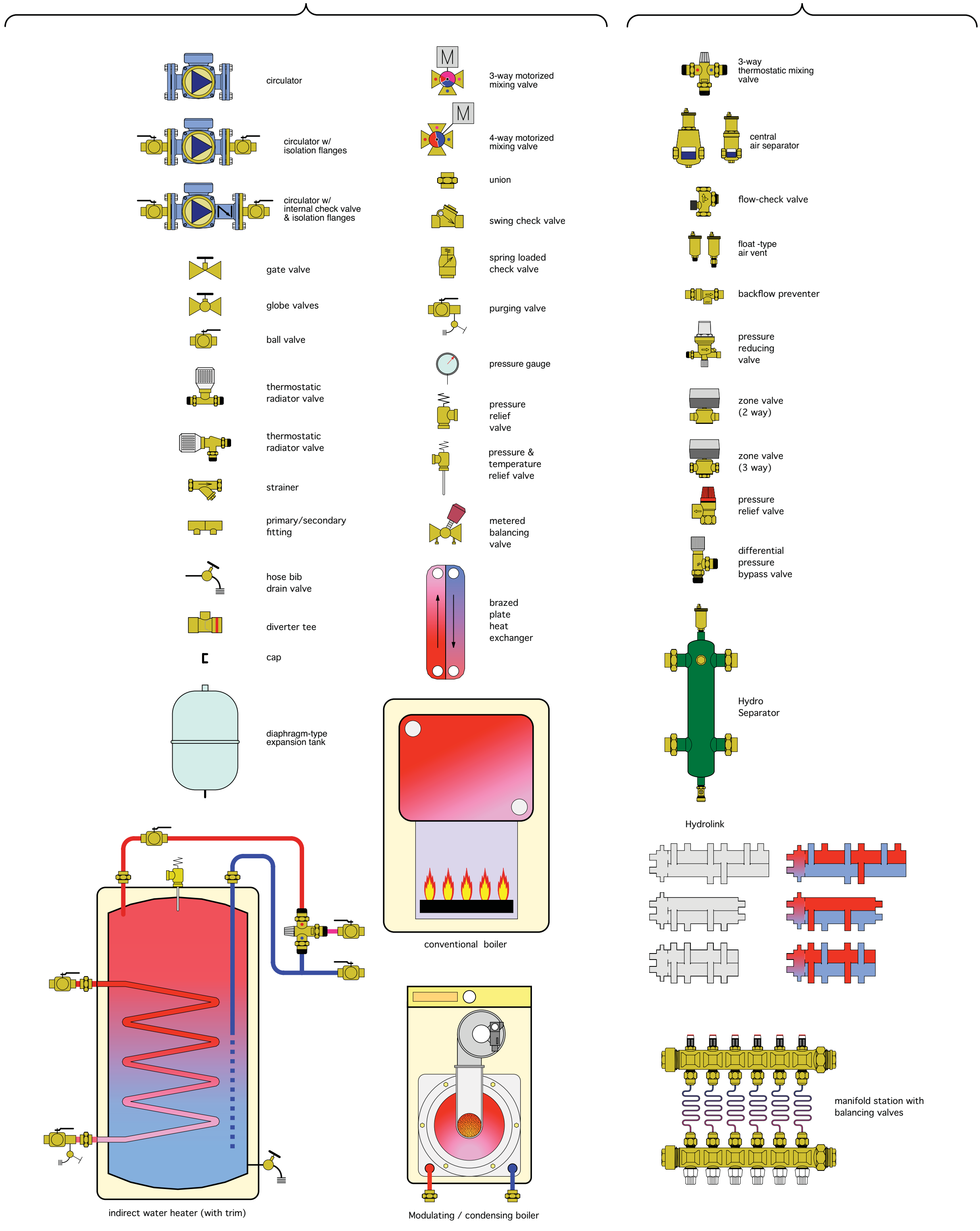
Figure 19 shows a four-circuit HydroLink installed in a residential heating system. Like the Hydro Separator in Figure 17, this HydroLink is fitted with a form-fitting insulation jacket to minimize heat loss. In this system, it provides hydraulic separation between the high-performance boiler and several independently controlled heating distribution zones, each with its own circulator.

**Summary:** Hydraulic separation, when properly executed, allows multiple, independently controlled circulators to coexist in a system without interference. When accomplished in the form of a Hydro Separator or HydroLink, the additional benefits of uniform supply temperature, air separation and dirt separation are also achieved. These devices eliminate the need for a primary loop circulator, which reduces system installation and operating cost. With suitable vapor-retardant insulation shells, the Hydro Separator or HydroLink devices can also provide these benefits in chilled water as well as hot water systems. They are truly a modern way of achieving a synergy of function and simplicity of installation.

# APPENDIX of Schematic Symbols

## GENERIC COMPONENTS

## CALEFFI COMPONENTS



# Hydro Separator

## series 548

### Function

This device consists of several different functional components, each of which meets specific requirements, typical of the circuits used in heating and air-conditioning systems.

- **Hydronic separator**
  To keep connected hydronic circuits totally independent from each other.
- **Dirt remover**
  To permit the separation and collection of any impurities present in the circuits. Provided with a valved connection with discharge piping.
- **Automatic air vent valve**
  For automatic venting of any air contained in the circuits.
  Provided with a valved connection for maintenance purposes.

### Product range

Series 548 Sweat hydronic separator with insulation ______ sizes 1” and 1 1/4” sweat union
Series 548 NPT F hydronic separator with insulation ______ sizes 1”, 1 1/4” and 1 1/2” NPT F union
Series 548 Flanged hydronic separator with insulation ______ sizes 2”, 2 1/2”, 3“, 4”, 5“ & 6” ANSI Flange

### Technical specification

| series >> | 548 sweat and threaded | 548 flanged |
|---|---|---|
| **Materials** | | |
| Separator body: | Epoxy resin painted steel | Epoxy resin painted steel |
| Air vent body: | Brass | Brass |
| Shut-off and drain valve body: | Brass | Brass, chrome plated |
| Air vent seal: | EPDM | VITON |
| Air vent float: | PP | Stainless steel |
| Performance | | |
| Max. operating pressure: | 150 psi (10 bar) | 150 psi (10 bar) |
| Temperature range: | 32-230°F (0÷110°C) | 32-230°F (0÷110°C) |
| Medium: | Water, non hazardous glycol solutions | Water, non hazardous glycol solutions |
| Max. percentage glycol: | 50% | 50% |
| **Connections** | | |
| Separator: | 1” & 1 1/4“ sweat & NPT and 1 1/2” NPT union | 2", 2 1/2", 3",4", 5” & 6” with flanged ANSI 150 CLASS |
| Front (thermometer pocket): | 1/2” F | - |
| Air vent relief: | - | 3/8” F |
| Drain valve: | hose connector | 1 1/4” F |

**Technical specification of insulation for threaded and sweat versions**

- Material: double density closed cell expanded PEX
- Thickness: 3/4” (20 mm)
- Density: - internal part: 2 lb/ft (30 kg/m³)
  - external part: 3 lb/ft (50 kg/m³)
- Thermal conductivity (ISO 2581): 32ºF (0°C): 9 BTU/in (0.038 W/m·K)
  -40ºF (-40°C): 11 BTU/in (0.045 W/m·K)
- Coefficient of resistance to the diffusion of vapour (DIN 52615): > 1.300
- Temperature range: 32-212ºF (0-100ºC)
- Reaction to fire (DIN 4102): class B2

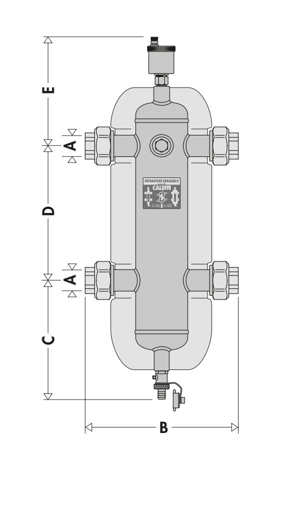
**Technical specification of insulation for flanged versions up to 4”**

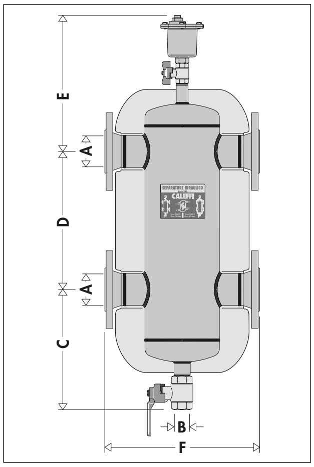
Internal part
- Material: rigid closed cell expanded polyurethane foam
- Thickness: 2 3/8” (60 mm)
- Density: 3 lb/ft (45 kg/m³)
- Thermal conductivity (ISO 2581): 6 BTU/in (0.023 W/m·K)
- Temperature range: 32-220 °F (0–105°C)

External cover
- Material: embossed aluminium
- Thickness: 7.0-mil (0.7 mm)
- Reaction to fire (DIN 4102): class 1

Head covers
- Heat moulded material: PS

**Dimensions**




| Code | A | B | C | D | E | Weight (lb) |
|---|---|---|---|---|---|---|
| **548**006A/96A | 1" | 8 7/8" | 7" | 6 5/8" | 8" | 7.5 |
| **548**007A/97A | 1 1/4" | 9 3/4" | 8" | 9 1/2" | 9" | 8.3 |
| **548**008A | 1 1/2" | 11 1/8" | 9" | 10 1/4" | 9" | 12.5 |

| Code | A | B | C | D | E | F | Weight (lb) |
|---|---|---|---|---|---|---|---|
| **548**052A | 2" | 1 1/4" | 13" | 13" | 15" | 14" | 73 |
| **548**062A | 2 1/2" | 1 1/4" | 13" | 13" | 15" | 14" | 79 |
| **548**082A | 3" | 1 1/4" | 15" | 18" | 17" | 18" | 108 |
| **548**102A | 4" | 1 1/4" | 15" | 18" | 17" | 18" | 117 |
| **548**120A* | 5" | 1 1/4" | 15" | 22" | 19" | 25" | 220 |
| **548**150A* | 6" | 1 1/4" | 15" | 22" | 19" | 25" | 231 |

| Size | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" | 5" | 6" |
|---|---|---|---|---|---|---|---|---|---|
| Volume (gal) | 0.5 | 0.7 | 1.3 | 4 | 4 | 8 | 8 | 22.5 | 23.2 |

** without insulation*

**Operating principle**

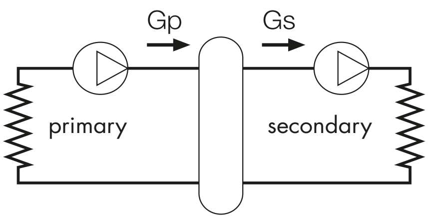
When a single system contains a primary production circuit, with its own pump, and a secondary user circuit, with one or more distribution pumps, operating conditions may arise in the system whereby the pumps interact, creating abnormal variations in circuit flow rates and pressures.

The hydraulic separator creates a zone with a low pressure loss, which enables the primary and secondary circuits connected to it to be hydraulically independent of each other; the flow in one circuit does not create a flow in the other if the pressure loss in the common section is negligible.

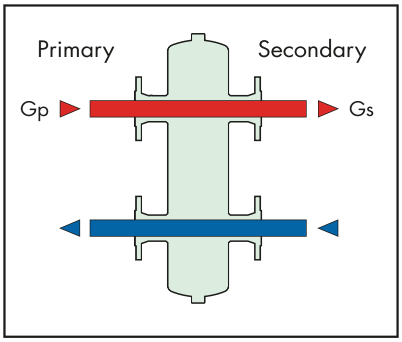
In this case, the flow rate in the respective circuits depends exclusively on the flow rate characteristics of the pumps, preventing reciprocal influence caused by connection in series.
Therefore, using a device with these characteristics means that the flow in the secondary circuit only circulates when the relevant pump is on, permitting the system to meet the specific load requirements at that time.

When the secondary pump is off, there is no circulation in the secondary circuit; the whole flow rate produced by the primary pump is by-passed through the separator.

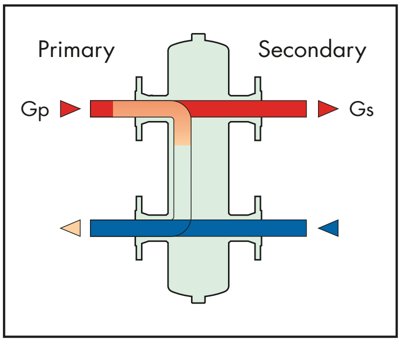
With the hydraulic separator, it is thus possible to have a production circuit with a constant flow rate and a distribution circuit with a variable flow rate; these operating conditions are typical of modern heating and air-conditioning systems.



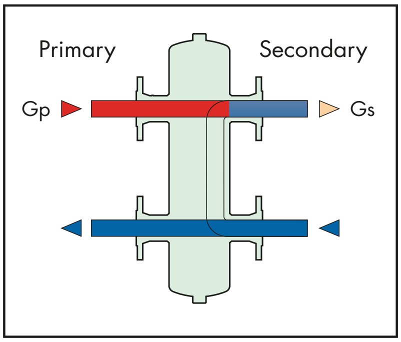

Three possible hydraulic balance situations are shown below.




**G**primary **=** **G**secondary




**G**primary **>** **G**secondary




**G**primary **<** **G**secondary

# Hydronic separator-manifold HydroLink™
## series 559

### Function

The Hydrolink, a new device combining a hydronic separator and distribution manifold, is used in heating and air-conditioning systems to allow different heat adjustments of the various rooms when there is only one boiler or chiller.
The various configurations are compact, and can be easily fitted in any kind of hydronic circuit, with the advantages of ease of installation and a saving of useful living space.

**Patent application No. MI2001A001270**

### Product range

Code 559022A External 2+2 separator-manifold. Complete with support brackets and pre-formed insulation ______ Size 1 1/4"; branches 1"
Code 559031A External 3+1 separator-manifold. Complete with support brackets and pre-formed insulation ______ Size 1 1/4"; branches 1"
Code 559021A Built-in 2+1 separator-manifold. Complete with pre-formed insulation ______ Size 1"; branches 1"

### Technical characteristics

**Body**

Material: - Body: Painted steel

Medium: Water and non-hazardous glycol solutions
Max percentage of glycole: 50%

Max. working pressure: 90 psi (6 bar)
Temperature range: 32 to 230°F (0 ÷ 110°C)

| | | | |
|---|---|---|---|
| Connections: | - main: | 3+1 and 2+2: | 1 1/4" F NPT |
| | | 2+1: | 1" F NPT |
| | - branches: | 3+1 and 2+2: | 1" M NPT |
| | | 2+1 (bottom): | 1" M NPT |
| | | 2+1 (side): | 1" F NPT |
| | - air vent valve: | 3+1, 2+2 and 2+1: | 1/2" F straight |
| | - drain cock: | 3+1, 2+2 and 2+1: | 1/2" F straight |
| Center distances: | - main: | 3+1 and 2+2: | 3 1/8" (80 mm) |
| | | 2+1: | 2 3/8" (60 mm) |
| | - branches: | 3+1 and 2+2: | 3 1/2" (90 mm) |
| | | 2+1: | 3 1/2" (90 mm) |

**Insulation**

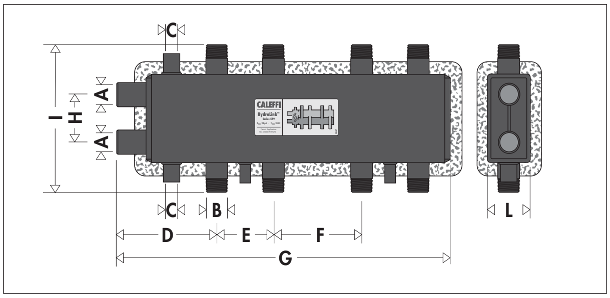
Material: Closed-cell expanded PEX
Thickness: 3/4" (20 mm)
Density: - inner part: 2 lb/ft$^3$ (30 kg/m$^3$)
- outer part: 3 lb/ft$^3$ (50 kg/m$^3$)
Thermal conductivity: - at 32°F (0°C): 0.26 BTU/in (.038 W/mK)
- at 100°F (40°C): 0.31 BTU/in (.045 W/mK)
Vapor resistance coefficient (DIN 52615): > 1.300
Temperature range: 32 to 212°F (0÷100°C)
Fire resistance (DIN 4102): Class 1 (Class B2)

### Flow Characteristics

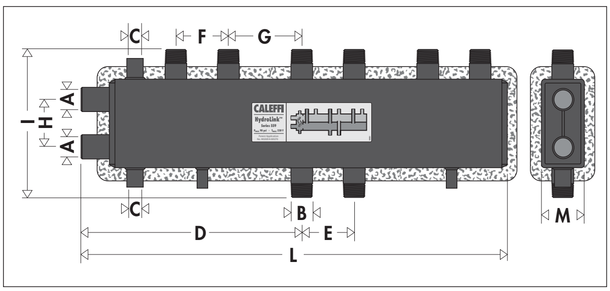
Maximum recommended flow rates at connections:

| Branches | Primary | Secondary (total) |
|---|---|---|
| 2+1 | 9 gpm (2.0 m$^3$/h) | 22 gpm (5 m$^3$/h) |
| 2+2 | 11 gpm (2.5 m$^3$/h) | 26 gpm (6 m$^3$/h) |
| 3+1 | 11 gpm (2.5 m$^3$/h) | 26 gpm (6 m$^3$/h) |

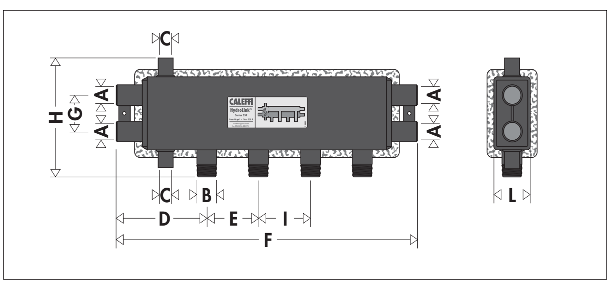
## Dimensions




| Code | A | B | C | D | E | F | G | H | I | L | Weight (lb) | Volume (gal) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **559**022A | 1 1/4" | 1" | 1/2" | 6 5/16" | 3 9/16" | 5 1/2" | 20 7/8" | 3 1/8" | 9 7/8" | 3 1/8" | 29 | 1,8 |




| Code | A | B | C | D | E / F | G | H | I | L | M | Weight (lb) | Volume (gal) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **559**031A | 1 1/4" | 1" | 1/2" | 15 3/8" | 3 9/16" | 5 1/2" | 3 1/8" | 9 7/8" | 29 15/16" | 3 1/8" | 39 | 2,6 |

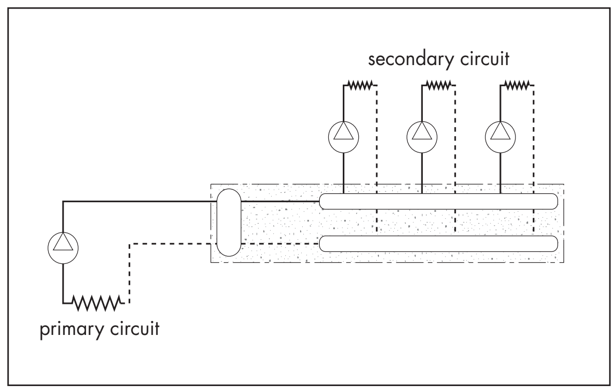


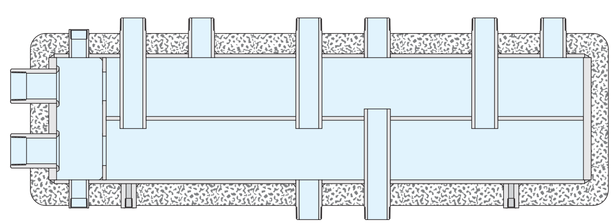

| Code | A | B | C | D | E | F | H | I | L | Weight (lb) | Volume (gal) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **559**021A | 1" | 1" | 1/2" | 6 1/8" | 3 9/16" | 20 1/2" | 7 11/16" | 3 9/16" | 2 3/8" | 16 | 1 |

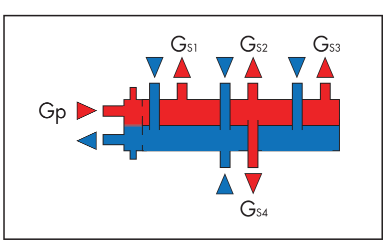
## Operating principle

When a single system contains a primary generating circuit, with its own pump, and a secondary user circuit, with one or more distribution pumps, operating conditions may arise in the system where the pumps interact, creating abnormal variations in flow rates and pressures in the circuits.
In the HydroLink there is a low pressure loss zone, which enables the primary and secondary circuits connected to it to be hydraulically independent of each other; **the flow in one circuit does not create a flow in the other if the pressure loss in the common section is negligible.**
In this case, the flow rates passing through the respective circuits depend exclusively on the flow characteristics of the pumps, preventing reciprocal influence due to connection in series.
Downstream of the hydronic separation zone are the flow and return manifolds to which the various secondary distribution circuits can be connected.

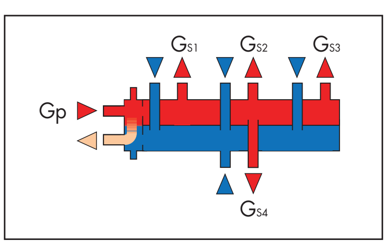
Three possible hydronic balance situations are shown below as examples.



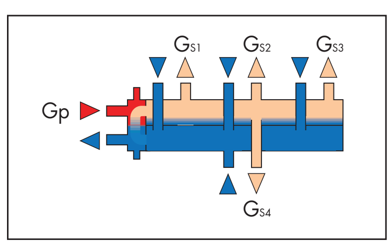






**G**primary = **G**secondary (Gs1+Gs2+Gs3+Gs4)




**G**primary > **G**secondary (Gs1+Gs2+Gs3+Gs4)




**G**primary < **G**secondary (Gs1+Gs2+Gs3+Gs4)


CALEFFI S.p.A. Corporate Headquarters - ITALY


CALEFFI North America Inc. - Milwaukee WI

www.caleffi.us

## Caleffi North America, Inc.

9850 South 54th Street / Milwaukee, WI 53132
Tel: 414.421.1000 / Fax: 414.421.2878
idronics@caleffi.com / www.caleffi.us

CALEFFI SOLUTIONS MADE IN ITALY

CALEFFI
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