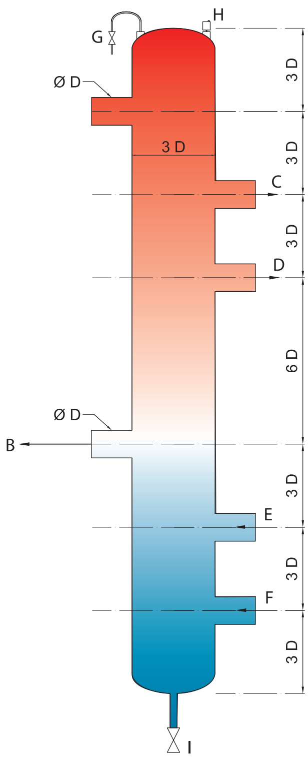
1 HYDRAULIC SEPARATOR

The hydraulic separator is used to make the primary and secondary circuit independent, to prevent interferences and mutual disruptions, especially when the flow rates on the circuits are different.
The separator cannot replace the buffer tank, except where it has an adequate volume (see Paragraph 2 *p. 2*).
The hydraulic separator should have the following features:

- ► Maximum water speed in the separator 0.1 m/s;
- ► Maximum water speed in inlet/outlet 0.9 m/s;
- ► Branch connections for circuits at higher temperature upwards (for heating applications);
- ► In case of several take-off points at the same temperature use a single branch connection and install a distribution manifold.

Sizing must be carried out on the basis of the maximum flow rate between primary and secondary.
For optimal sizing it is recommended to follow the so-called "3 D" rule, shown in Figure 1.1 *p. 1*.
This is based on the diameter D of the hydraulic separator's connections to define the dimensional features and position of the branch connections, based on multiples of the diameter.
Figure 1.1 *p. 1* shows the use for heating applications.
For conditioning applications, the inlet of the primary circuit should be at the bottom, so that natural circulation does not trigger parasitic mixing phenomena.
Similarly, for conditioning applications, branch connections at lower temperature must be at the bottom and those at higher temperature must be at the top.

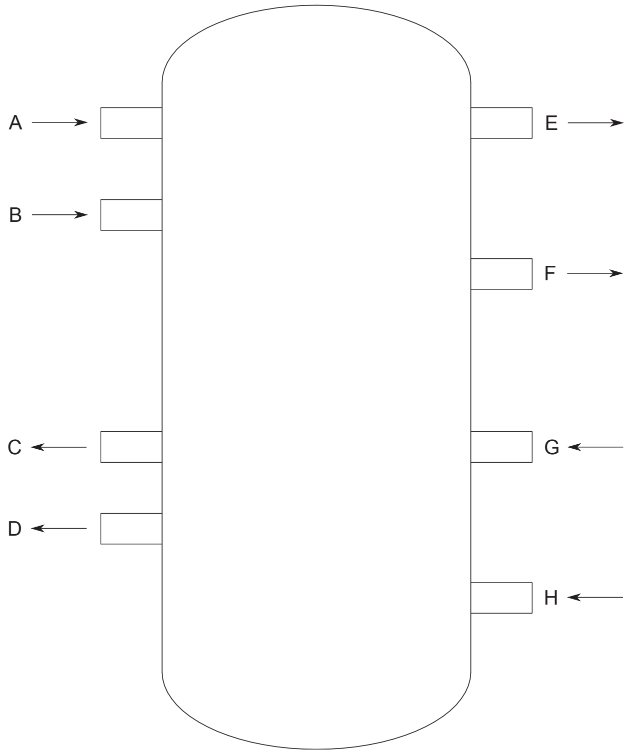
Figure 1.1 *6-connection hydraulic separator*



A Hot primary circuit delivery
B Hot primary circuit return
C High temperature secondary circuit delivery
D Low temperature secondary circuit delivery
E High temperature secondary circuit return
F Low temperature secondary circuit return
G Manual air vent
H Automatic air vent
I Sludge purge

If different types of generators are installed on the primary circuit, connected to the same separator, one should refer to Picture 1.2 *p. 1*, related to heating applications.
Branch connections at higher temperature, on inlet or outlet, must be positioned higher, in order to prevent excessively hot water reaches the heat pumps from the boilers.

Figure 1.2 *8-connection hydraulic separator*



A Boiler primary circuit delivery
B GAHP primary circuit delivery
C Boiler primary circuit return
D GAHP primary circuit return
E High temperature secondary circuit delivery
F Low temperature secondary circuit delivery
G High temperature secondary circuit return
H Low temperature secondary circuit return

2 BUFFER TANK

The buffer tank has the purpose of providing thermal inertia to the system, especially in low load conditions, thus reducing the number of heat generators ON/OFF, particularly significant for the system general efficiency.
In the appropriate plumbing configuration, it may also be used as hydraulic separator (see Paragraph 1 *p. 1*).
The buffer tank may also be used for disposing of thermal and cooling power during unit switching off, in order to prevent the water temperature to rise or drop excessively.

The heating or cooling energy accumulated during normal operation of the system, which also depends on the buffer tank capacity, can only be exploited effectively with a control system which, on the basis of the secondary temperature, switches off the generation system and relevant circulating pumps and chokes the water flow on the secondary circuit, for example by means of mixing valves.

Failing this type of control system, the buffer tank is unable to prevent the units from switching off, regardless of the buffer tank size, as soon as the set-point temperature is reached, without being able to store energy hence running the risk of triggering a high number of switching ON/OFF especially in the event of low load.
For more information on control systems Robur see Section C1.12.

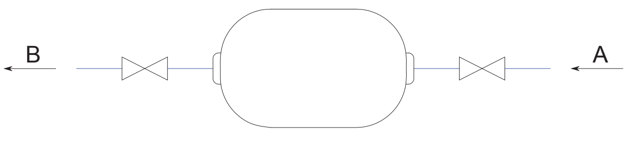
Buffer tanks are divided into:
- in line (2 connections) (see Paragraph 2.1 *p. 2*);
- with hydraulic separation (3 or 4 connections) (see Paragraph 2.2 *p. 2*).

It is required to assure a minimum water volume in the primary circuit equal to <u>at least 70 litres for each intended</u> GAHP module, GA ACF or AY00-120, both on the conditioning and renewable source circuit (only for systems with GAHP GS/WS), in order to absorb the energy (heating or cooling) delivered by the unit in the switch-off stage.
The recommended dimensions for optimising efficiency by reducing the number of ON/OFF switching are however greater:
- Single unit: 300÷500 litres;
- Multiple units: from 500 to 1000 litres in total.

2.1 IN LINE BUFFER TANK

The in line buffer tank, or 2-connection buffer tank, only has the purpose of storing the heating and/or cooling energy.
It must be installed on return to the units, preferably before the circulation pumps.
Figure 2.1 *p. 2* schematically shows an in line buffer tank with 2 connections.

Figure 2.1 *2-connection inertial buffer tank*



A Distribution circuit return (or hydraulic separator)
B Circulation pumps return (or unit Robur)

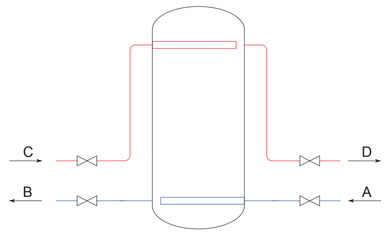
2.2 BUFFER TANK WITH HYDRAULIC SEPARATION

The buffer tank with hydraulic separation performs both functions of thermal buffer tank and hydraulic separator.
There are two types:
- 4 connections;
- 3 connections.

2.2.1 4 connections

The 4-connection buffer tank represents the most typical case of buffer tank with hydraulic separation functions.
Figure 2.2 *p. 2* shows an example of 4-connection buffer tank installation.

Figure 2.2 *4-connection inertial buffer tank*



A Secondary circuit return
B Primary circuit return
C Primary circuit delivery
D Secondary circuit delivery

One should ensure the selected buffer tank includes certain measures to reduce mixing the water flows inside the tank, consequently altering the temperatures and undermining comfort and efficiency:
- correct sizing (especially the relationship between height and diameter);
- installation of anti-mixing devices.

The main types of anti-mixing devices are:
- anti-mixing baffles (see Figure 2.3 *p. 2*);
- conveying pipes (see Figure 2.4 *p. 2*);
- diffuser pipes (see Figure 2.5 *p. 3*);

Figure 2.3 *Tank with dividing baffles*

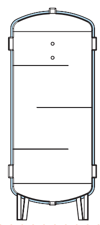


Figure 2.4 *Tank with conveying pipes*

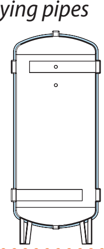
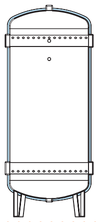


Figure 2.5 *Tank with diffuser pipes*



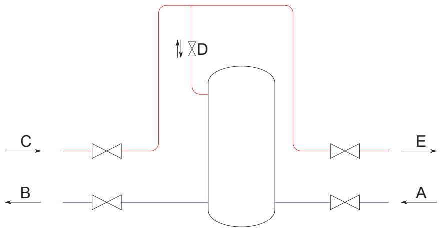
2.2.2 3 connections

The 3-connection buffer tank is actually identical to the more popular 4-connection one, except for the water connection.
A pipe section is installed, indicated by D in Figure 2.6 *p. 3*, featuring minimal pressure drop, where water may flow in both directions.
The water flow is:

- on buffer tank inlet if the primary circuit flow rate is higher than the secondary circuit;
- on buffer tank outlet if the primary circuit flow rate is lower than the secondary circuit.

For the buffer tank to also act as hydraulic separator, it is essential not to close the shut-off valve fitted on pipe D, which must only be closed for maintenance operations on the tank.

Figure 2.6 *3-connection inertial buffer tank*



A Secondary circuit return
B Primary circuit return
C Primary circuit delivery
D Pipe performing hydraulic separation, with shut-off valve
E Secondary circuit delivery

The significant advantage of this configuration, compared to the more popular 4-connection one, lies in the fact that when there are balanced flow rates the water flow is directly transferred from primary to secondary circuit, without mixing inside the buffer tank.
This is particularly useful in high temperature systems, where it is important to reduce temperature drops in order not to undermine the energy efficiency of heat pumps.
This configuration is also possible in cooling, provided the C, D, E sections are positioned at the bottom to better exploit thermal stratification.

2.3 BUFFER TANKS FOR CHILLED WATER

If the buffer tank (of any type) must be used also for chilled water, one should ensure it has specific surface treatments to prevent condensate formation leading to buffer tank decay in a short time.