1 HYDRAULIC SYSTEM

1.1 DESIGN AND IMPLEMENTATION

The system must be designed and realized in a congruent way with the features and functionality of the single appliance or Link.

Pay particular attention to the variable or constant flow operation of the appliances (Paragraph 1.6 *p. 5*).

For the appropriate system design, the following must be considered:

- the characteristics of individual heating/cooling appliances
- manifold configuration (for Link only) and hydraulic connections
- the presence (or not) of water pumps

The sizing of the hydraulic plumbing and of any water circulation pump must provide the nominal flow required for proper operation of the appliance or Link:

- For individual appliance pressure drop data, please refer to Section B.
- For Link pressure drop data, please refer to Section B10.
- For water pumps data, please refer to Section C01.04.

1.2 PRIMARY AND SECONDARY CIRCUIT

In many cases it is advisable to divide the hydraulic system into two parts, primary and secondary circuit(s), uncoupled by a hydraulic separator, or possibly by a tank that also acts as inertial volume/thermal inertia.
Installation of inertial volume/thermal inertia is recommended if the system has low water content.
For indications on sizing the inertial volume/thermal inertia refer to Paragraph 1.5 *p. 5*.

For further information on the buffer tank and hydraulic separator please refer to Section C01.07.

1.3 DHW CIRCUIT

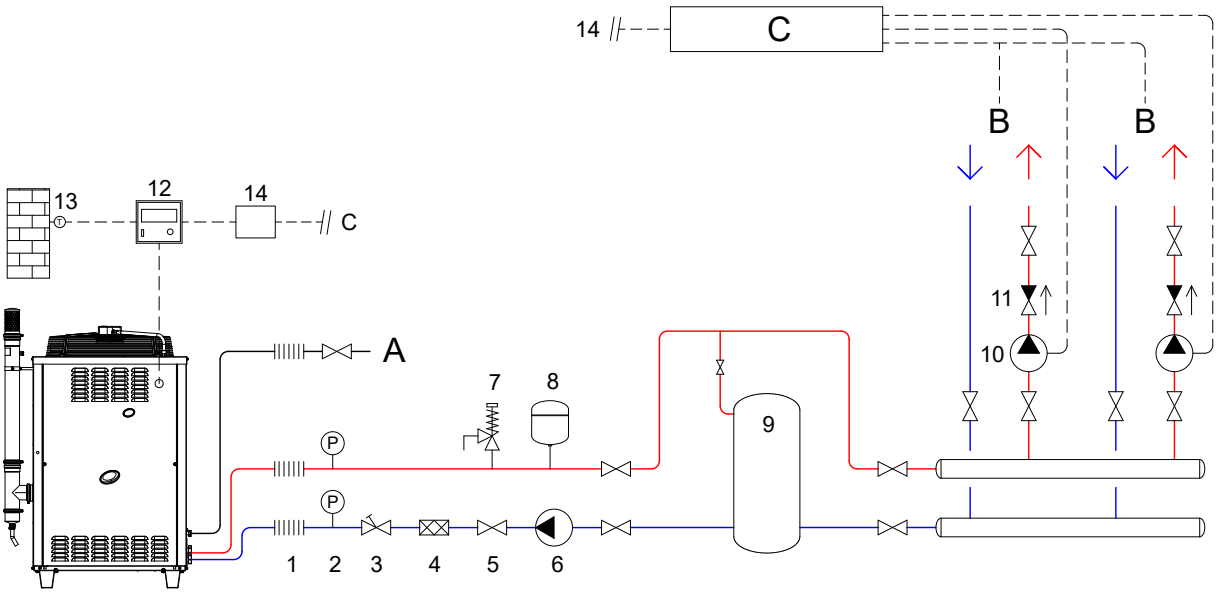
DHW production with Robur appliances can take place via the base DHW circuit or via the separable DHW circuit.
The separable DHW circuit is functional for DHW production using a subset of the generation system, so that the space heating service is not interrupted during DHW production.
Three-way diverting valves must be provided for this purpose (Paragraph 2 *p. 6*) and the pressure drops on this circuit, which typically does not have hydraulic separation as the DHW buffer tanks coil exchangers are fed directly from the primary circuit of the generation system, must be carefully checked.

For further information, please refer to Section C01.12.

1.4 WATER FLOW

The GAHP/GA single appliances are always supplied without water pumps, which must be chosen appropriately on the basis of the characteristics of the appliance (possibly from those available in the catalogue as options) and the circuit connected to it.
Figure 1.1 *p. 1* shows an example of plumbing diagram for an individual aerothermal unit.

Figure 1.1 *Plumbing diagram for a single GAHP-AR for heating and cooling*

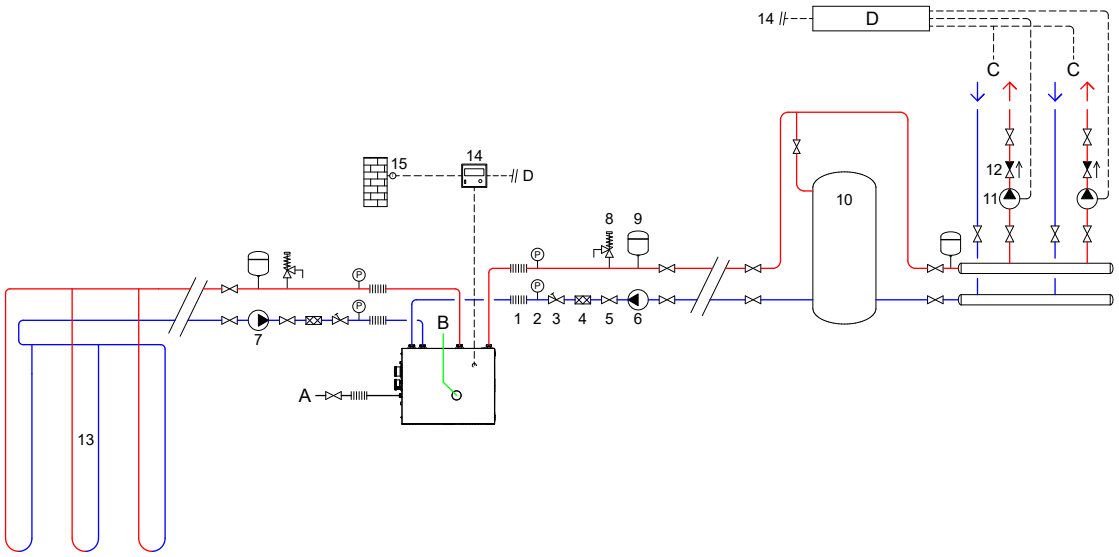


The flow regulation valve must only be used if the pump in the primary circuit is the fixed flow type

A Gas connection
B Heating/Cooling circuit
C Secondary circuit management system
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulation valve
4 Sludge filter
5 Shut-off valve
6 Primary circuit water pump
7 Safety valve
8 Expansion tank
9 Buffer tank (and hydraulic separator)
10 Heating/Cooling circuit water pump
11 Check valve
12 DDC panel
13 Outdoor temperature probe
14 Summer/winter selector switch

Figure 1.2 *p. 2* shows an example of plumbing diagram for an individual GAHP GS HT unit.

Figure 1.2 *GAHP GS plumbing diagram*

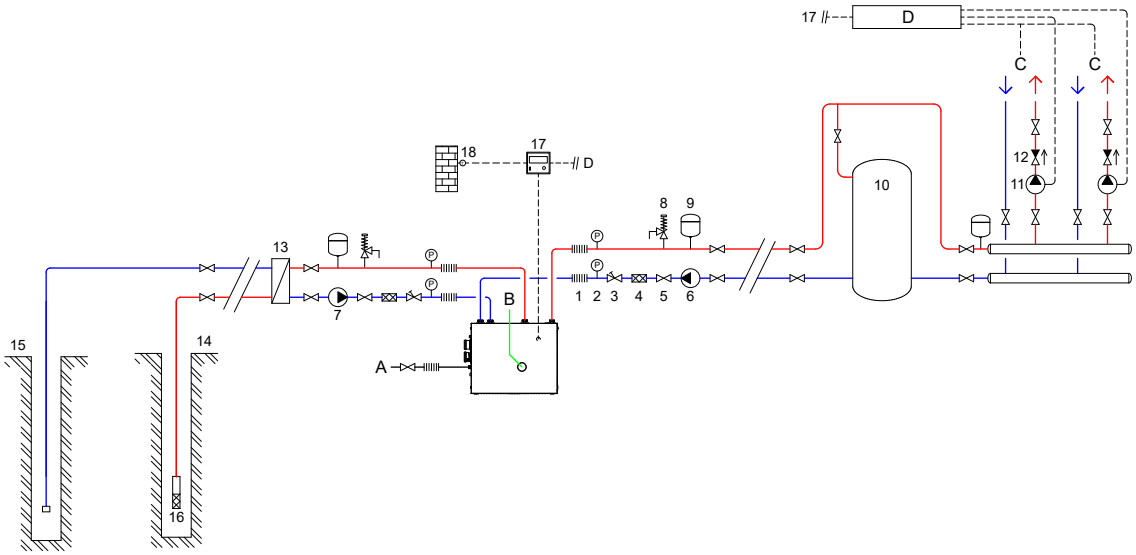


The flow regulation valve must only be used if the pump in the primary circuit is the fixed flow type

A	Gas connection	1	Anti-vibration connection	8	Safety valve
B	Safety valve drain ducting connection (indoor version only)	2	Pressure gauge	9	Expansion tank
C	Heating circuit	3	Flow regulation valve	10	Buffer tank (and hydraulic separator)
D	Secondary circuit management system	4	Sludge filter	11	Heating/Cooling circuit water pump
		5	Shut-off valve	12	Check valve
		6	Primary circuit water pump on system side	13	Geothermal field probes
		7	Primary circuit water pump on renewable source side	14	DDC panel
				15	Outdoor temperature probe

Figure 1.3 *p. 2* shows an example of plumbing diagram for an individual GAHP WS unit.

Figure 1.3 *GAHP WS plumbing diagram*



The flow regulation valve must only be used if the pump in the primary circuit is the fixed flow type

A	Gas connection	2	Pressure gauge	10	Buffer tank (and hydraulic separator)
B	Safety valve drain ducting connection (indoor version only)	3	Flow regulation valve	11	Heating/Cooling circuit water pump
C	Heating circuit	4	Sludge filter	12	Check valve
D	Secondary circuit management system	5	Shut-off valve	13	Heat exchanger
1	Anti-vibration connection	6	Primary circuit water pump on system side	14	Extraction well
		7	Primary circuit water pump on renewable source side	15	Water return well
		8	Safety valve	16	Submersible pump
		9	Expansion tank	17	DDC panel
				18	Outdoor temperature probe

The primary water pump must be mandatorily controlled by the appliance (see Section C01.10 for primary water

pump wiring diagrams).

AY boilers and Gitié 2.0 integrated packages are always equipped with independent water pumps (one for each module) of oversized type.
The Link can be:

- ► already equipped with water pumps for each module (preferred configuration in many applications)

or

- ► without water pumps, in which case it is required to install at least one common water pump, on the primary circuit (this choice should be carefully evaluated, discussing it in advance with Robur technical service)

If there is at least one AY boiler, it is mandatory to provide Link with water pumps for each individual module.

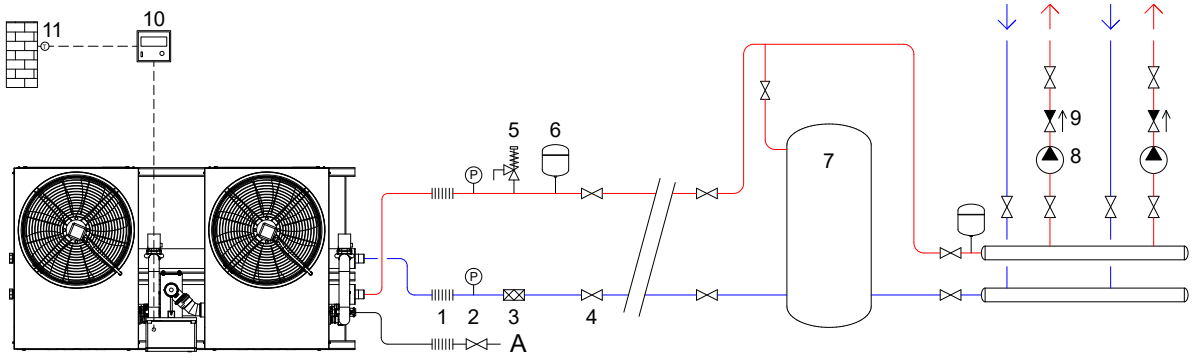
Examples of hydraulic diagrams of Link with independent water pumps are shown in Figure 1.4 *p. 3* and 1.5 *p. 4*.
Examples of hydraulic diagrams of Link without independent water pumps (with common water pump, not supplied with the Link) are shown in Figure 1.6 *p. 4* and 1.7 *p. 5*.

The common circulating pump does not allow the water flow to bypass generators that are temporarily turned off from normal cascade control.

Under partial load conditions, it is not therefore possible to ensure the general setpoint is reached and maintained.
With high delivery setpoint, GAHP/GA appliances may exceed their operating limits to offset the mixing that occurs with inactive units.
The solution with common circulating pump is therefore recommended only if the thermal or cooling load applied is constant in any operating condition.
If systems with Link without independent water pumps are to be designed, a prior check with the Robur technical service is always advisable.

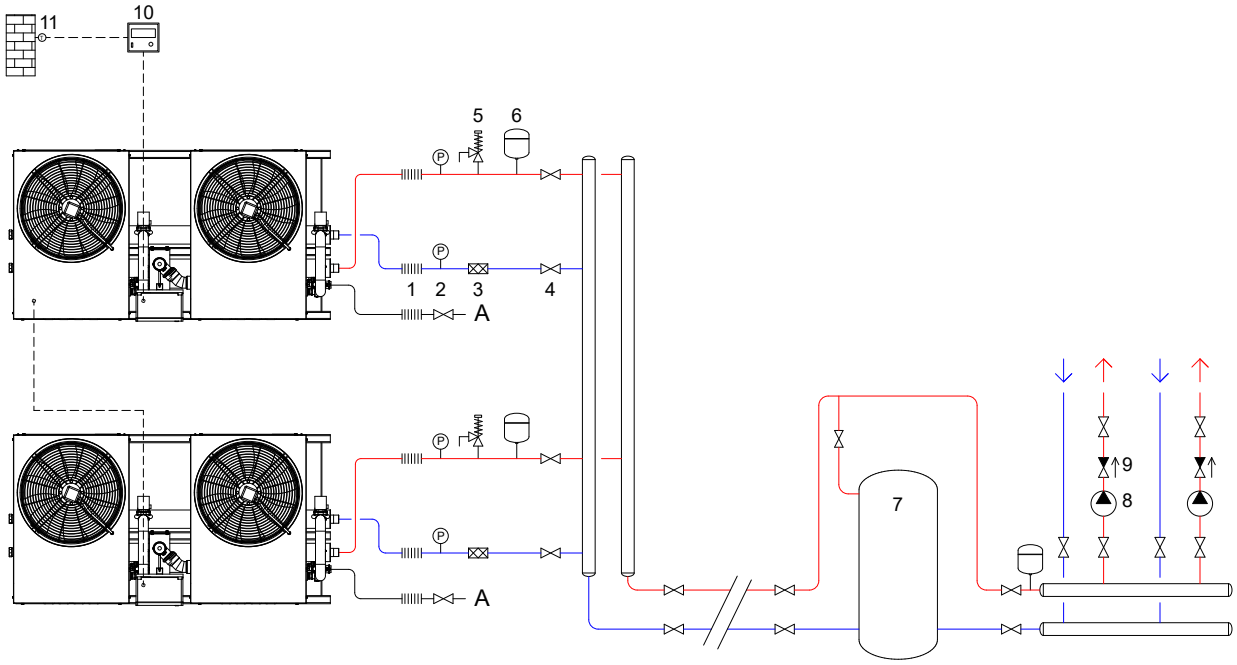
The common primary water pump must mandatorily be controlled by the request on the Link electrical panel (see Section C01.10).

Figure 1.4 *Example of hydraulic system diagram for connection of 1 RTCR, version with circulating pumps*



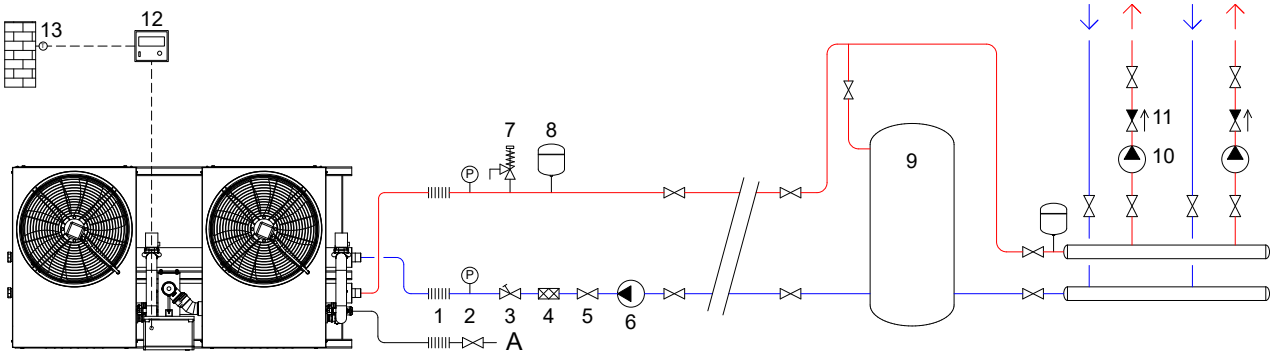
A	Gas connection	4	Shut-off valve	8	Heating/Cooling circuit water pump
1	Anti-vibration connections	5	Safety valve	9	Check valve
2	Pressure gauge	6	Expansion tank	10	DDC panel
3	Sludge filter	7	Buffer tank (and hydraulic separator)	11	Outdoor temperature probe

Figure 1.5 *Example of hydraulic system diagram for connection of 2 RTCR, version with circulating pumps*



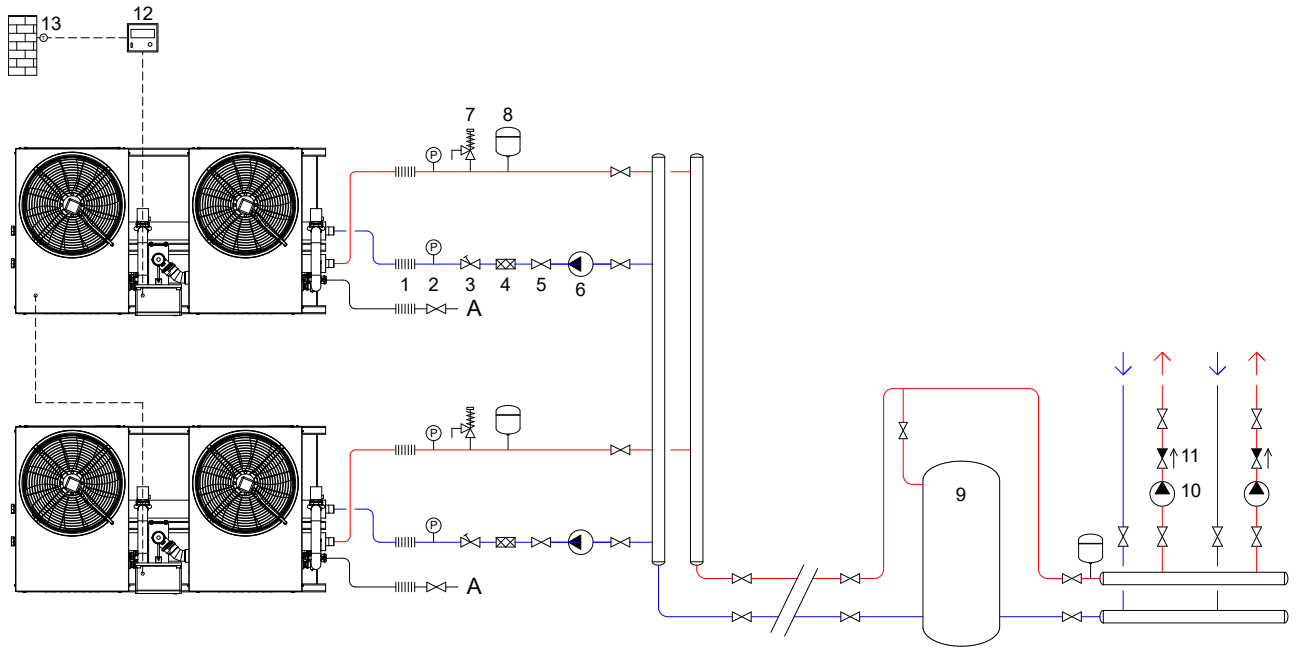
A	Gas connection	4	Shut-off valve	8	Heating/Cooling circuit water pump
1	Anti-vibration connection	5	Safety valve	9	Check valve
2	Pressure gauge	6	Expansion tank	10	DDC panel
3	Sludge filter	7	Buffer tank (and hydraulic separator)	11	Outdoor temperature probe

Figure 1.6 *Example of hydraulic system diagram for connection of 1 RTCR, version without circulating pumps*



A	Gas connection	5	Shut-off valve	10	Heating/Cooling circuit water pump
1	Anti-vibration connection	6	Primary circuit water pump	11	Check valve
2	Pressure gauge	7	Safety valve	12	DDC panel
3	Flow regulation valve	8	Expansion tank	13	Outdoor temperature probe
4	Sludge filter	9	Buffer tank (and hydraulic separator)		

Figure 1.7 *Example of hydraulic system diagram for connection of 2 RTCR, version without circulating pumps*



1	Anti-vibration connection	6	Primary circuit water pump	11	Check valve
2	Pressure gauge	7	Safety valve	12	DDC panel
3	Flow regulation valve	8	Expansion tank	13	Outdoor temperature probe
4	Sludge filter	9	Buffer tank (and hydraulic separator)	A	Gas connection
5	Shut-off valve	10	Heating/Cooling circuit water pump		

1.5 PRIMARY CIRCUIT WATER CONTENT

A minimum volume of water in the primary circuit equal to at least 70 litres for each GAHP/GA module must be provided, both on the heating/cooling circuit and on the renewable source circuit (only for systems with GAHP GS/WS), in order to absorb the energy (thermal or cooling) supplied by the unit during the switch-off phase.
In order to provide thermal inertia to the system, especially under low load conditions, and optimise performance accordingly, a larger volume of water can be provided, as detailed in Section C01.07.

1.6 CONSTANT OT VARIABLE WATER FLOW

Units GAHP A and GAHP GS/WS are able to operate with constant or variable water flow (only on the hot side) regardless of operative mode, ON/OFF or modulating.

All other single units may only work with constant water flow.
Link equipped with independent water pumps operate at variable flow, as only the water pumps of the actually active modules are switched on.
On the other hand, Link without independent water pumps operate at constant flow (even if the common water pump serving the Link is a modulating one, as it is not possible to intercept the water flow arriving at each module of the Link, excluding modules not currently in operation).

1.7 HYDRAULIC CONNECTIONS

1.7.1 Hydraulic connections

1.7.1.1 Single GAHP/GA/AY

The hydraulic connections of the individual appliances are summarised in Table 1.1 *p. 5* below:

Table 1.1 *Appliance hydraulic connections*

Appliance	Hydraulic connections	Condensate drain connection	Boiler safety valve drain connections
GAHP/GA	1 1/4" F	outside 25 mm, inside 21 mm (only on GAHP A and GAHP GS/WS)	-
Gitié 2.0	1 1/4" F	outside 25 mm, inside 21 mm (only on GAHP A) outside 25 mm, inside 21 mm (separated for AY)	outside 20 mm, inside 14 mm
AY 35/AY 50	1 1/4" F	outside 25 mm, inside 21 mm	outside 20 mm, inside 14 mm
AY 100	1 1/2" F	outside 25 mm, inside 21 mm	outside 20 mm, inside 14 mm

Connect the outlet of the boiler safety valve to a suitable drain. The manufacturer is not liable for any damage caused by the opening of the safety valve in the event of system overpressure.

1.7.1.2 Link

The exact configuration of the hydraulic connections depends on the composition of the Link. Please refer to the datasheet of the specific Link or the information in Section B10.
The following Table 1.2 *p. 6* shows the dimensions of the hydraulic and condensate drain connections.

Table 1.2 *Hydraulic connections diameters*

Cold/hot water connections	2" M
Condensate drain connection	1" F
Connection of a single AY on the separate circuit	1 1/4" F for AY 35 and AY 50 1 1/2" F for AY 100
Connection of more AY on the separate circuit	2" M
Recovery circuit connection	2" M
AY safety valve drain	external Ø 20 mm, internal Ø 14 mm

The hydraulic connections are only provided on the right-hand side of the Link, as is any condensate drain.

Connect the outlet of each safety valve of any boiler on the Link to a suitable drain. The manufacturer is not liable for any damage caused by the opening of the safety valve in the event of system overpressure.

1.7.2 Hydraulic pipes, materials and features

Use pipes for heating/cooling installations, protected from weathering, insulated for thermal losses, with vapour barrier to prevent condensation.

1.7.3 Minimum components of primary plumbing circuit

Always provide, near the appliance:

- on water piping, both outlet and inlet
  - 2 antivibration joints on water fittings
  - 2 pressure gauges
  - 2 isolation ball valves
- on the inlet water piping
  - 1 separator filter
  - 1 flow regulation valve, if the water pump is with constant flow (only for Link without water pumps)
  - 1 water pump, towards the appliance (only for Link without water pumps)
- on the water outlet pipe (in the absence of AY boilers on the same pipe pair)
  - 1 safety valve (3 bar)
  - 1 expansion tank

Safety valve and expansion tank must be installed before any isolation valves, so that they cannot be excluded from the system.

For GAHP WS units with open circuit it is always mandatory to use a heat exchanger on the renewable source side

See Paragraph 1.4 *p. 1* and Section C01.13 for example hydraulic diagrams.

2 SPECIFICATIONS OF DIVERTER VALVES

Table 2.1 *p. 6* shows the minimum and maximum flow rate to be assured to Robur units in all operating conditions, hence also during the switching stage of any diverter valves installed on the system.
These flow rates are valid both for DHW separation valves and for hot/cold switching valves.
The valve (hence its kvs indicating pressure drops) must consequently be selected in connection with the required flow rates, so that the indicated flow rate range is complied with even in the switching stage.

Table 2.1 *Diverter valves water flow*

			GAHP GS/WS		GAHP A	AY			GA ACF		GAHP-AR
			GAHP WS	GAHP GS HT		AY 35	AY 50	AY 100		ACF60-00 LB	
Heating operation											
Heating water flow	minimum	l/h	1400		1400	1200	1500	1500	-	-	2500
	maximum	l/h	4000		4000	-	-	-	-	-	3500
Cooling mode											
Cold water flow	minimum	l/h	-	-	-	-	-	-	2500	2300	2500
	maximum	l/h	-	-	-	-	-	-	3500	2900	3500
Renewable source operating conditions											
Renewable source water flow rate	minimum	l/h	2300	-	-	-	-	-	-	-	-
	maximum	l/h	4700	-	-	-	-	-	-	-	-
Renewable source water flow rate (with 25% glycol)	minimum	l/h	-	2000	-	-	-	-	-	-	-
	maximum	l/h	-	4000	-	-	-	-	-	-	-

3 DEFROSTING WATER DRAINAGE

Defrosting

In winter, frost may form on the finned coil of aerothermal heat pumps (GAHP A/GAHP-AR) and the appliance automatically performs defrosting cycles.

3.1 COLLECTION BASIN AND DRAINAGE SYSTEM

Provide for a collection basin or containment rim and a discharge system of the defrosting water, to avoid overflowing, freezing and damage.