1 DHW PRODUCTION;

Absorption heat pumps may also be used for DHW production, taking into account their specific features, namely:

1. maximum operative temperatures, summarised in Table 1.1 *p. 1* below;
2. time required to be fully operational.

Table 1.1 *GAHP heating temperature limits*

			GAHP A	GAHP-AR	GAHP GS/WS	AY00-120
Heating mode						
Hot water delivery temperature	maximum for heating	°C	65	-	65	-
	maximum	°C	-	60	-	80
Hot water return temperature	maximum for heating	°C	55	-	55	-
	maximum	°C	-	50	-	70

These specific features are reflected in the need to use the "indirect" mode (non instantaneous) for DHW production, with a buffer tank having appropriate exchange surface (tank expressly designed for being coupled to heat pumps, see Paragraph 2 *p. 1*) and adequate capacity for the requirements.
For correct operation of heat pumps, it is essential for the exchange surface of the tank to be able to develop a thermal gradient of at least 10 °C in any operating condition.
The "DHW" mode may be activated for units GAHP A and GAHP GS/WS which allows the maximum delivery temperature to be raised up to 70°C (return at 60°C), nevertheless halving the thermal input upon exceeding the temperatures indicated in Table 1.1 *p. 1*.
If the power required for DHW is less than 20 kW, it is recommended to arrange for two independent systems, avoiding GAHP use for DHW, since the investment for the DHW buffer tank would not be justified.

The use of compact buffer tanks for high temperature storage should be avoided.

DHW production in instantaneous mode is not possible.

Use of ACF 60-00 HR units for DHW production is only possible in recovery mode. The thermal power is therefore only available in case of simultaneous cooling request. Therefore, the ACF 60-00 HR unit cannot be used as the only DHW source.

The permitted number of annual hot/cold inversions of GAHP-AR units is limited. Therefore, the GAHP-AR unit must not be used to meet DHW requests in summer.

2 DHW TANK SIZING

The DHW buffer tank must be sized on the basis of the DHW need established according to design regulations in force.
With regards to sizing the exchange coil, the following parameters must be considered for coupling to a GAHP heat pump:

- buffer tank temperature between 45°C and 50°C;
- coil inlet temperature between 50°C and 60°C;
- nominal thermal gradient 10°C;
- water flow within the operative limits of GAHP units, if the buffer tank is installed on the primary circuit.

The minimum recommended surfaces according to buffer tank size are summarised in Table 2.1 *p. 1* below.

Table 2.1 *DHW buffer tank minimum coil surface*

Buffer tank capacity (l)	Coil surface (m2)
300	4,0
400	5,0
500	6,0
800	7,0
1000	8,0

The nominal coil exchange capacity data published by manufacturers must be used with much caution, since these data usually refer to inlet water at 80°C and thermal gradient 20°C, not applicable to the case of heat pumps.

3 DHW SERVICE REQUESTS

DHW service requests may be relayed in two different ways:

1. with devices RB100/RB200 through digital or analogue signals (see Section C1.12);
2. directly to DDC Panel or CCI Panel via Modbus protocol, by setting the appropriate adjustments (see Section C1.12) through an external system regulator.

DHW service requests may be associated with separation of any separable system section, according to the set configuration.
Temperature control in the DHW tank is performed alternatively with:

- two thermostats in the DHW tank directly connected to RB100/RB200;
- temperature probes in the DHW tank, serving an external regulator.

The DHW production service always has operating priority over the heating service.

3.1 DHW TANK WITH THERMOSTATS

If the DHW tank temperature is controlled with thermostats, two separate thermostats must be installed, appropriately set on the desired temperatures:

- DHW heating service;
- Legionella disinfection service.

The digital outputs of these thermostats must be connected to the two digital inputs for DHW available on the RB100/RB200 devices (see Section C1.12), setting up the relevant configuration both on the RB100/RB200 devices and on the DDC Panel.

3.2 DHW TANK WITH TEMPERATURE PROBES

If the DHW tank temperature is controlled with temperature probes, an external electronic regulator must be installed able to provide a 0-10 V signal or a voltage free contact for request to the DHW analogue/digital input of RB100/RB200 devices (see Section C1.12), setting up the relevant configuration both on the RB100/RB200 devices and on the DDC Panel.
The external electronic regulator therefore deals with reading the probes as well as with the switching-on logic of DHW or Legionella services, including the set-point and any schedule.

4 LEGIONELLA DISINFECTION

The Legionella disinfection obligation complies with the regulations in force.
Legionella disinfection may be performed with a number of methods, either physical or chemical.
The most widely used method, despite less than optimal effectiveness and high energy consumption, is disinfection through thermal shock, which consists in raising the temperature (above 55°C) for at least 1 h in the heat buffer tank and distribution and recirculation circuit.
It is recommended to assure Legionella disinfection with methods other than thermal shock (such as chemical methods, UV lamps or adding ozone) in order to:

- achieve optimal disinfection (in fact the thermal shock is not effective on the system branches where water is standing);
- avoid excessively undermining the efficiency of GAHP units.

In order to perform Legionella disinfection through thermal shock it may be advisable to install at least one AY 00-120 boiler or a third party boiler in the system.

5 INDICATIVE DHW DIAGRAMS

Below are some example diagrams, which are useful to understand the various methods for producing DHW using Robur units.
It is useful to look at some definitions from the glossary (see Section A):

- **Separable DHW system** part of a primary circuit that is able to have two states by means of diverter valves:

1. water plumbing connected to the base system (“included” state); in included state this part of the system integrates the space heating service;
2. disconnected from the base system (“separate” state); in the separate state this part of the system is designated for DHW production, regardless of the service supplied by the base system.

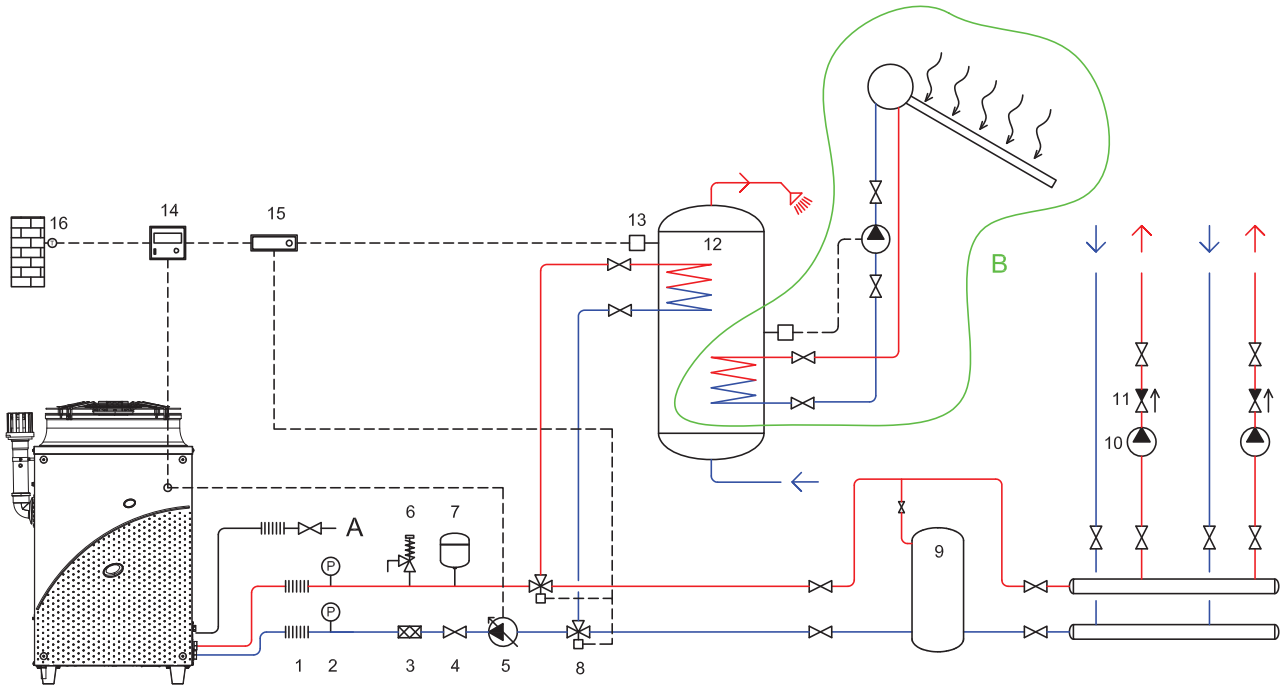
- **Separate DHW system** part of the primary circuit exclusively for DHW production, the plumbing of which is permanently disconnected from the base system.
- **DHW system** a system only intended for domestic hot water production.
- **Base system** part of the primary circuit on which generator's plumbing is permanently connected.

5.1 SINGLE GAHP BASE DHW

The diagram shown in Figure 5.1 *p. 3* illustrates the case of a single GAHP A with solar integration in a system for space heating and DHW production only.

Solar integration is useful in the summer if there are no other thermal requirements, in order to avoid the GAHP being turned on too often and too briefly.
The same broad diagram is applicable to GAHP GS/WS units if used for space heating and DHW production only.

Figure 5.1 *Single GAHP A heating and DHW base plumbing diagram*

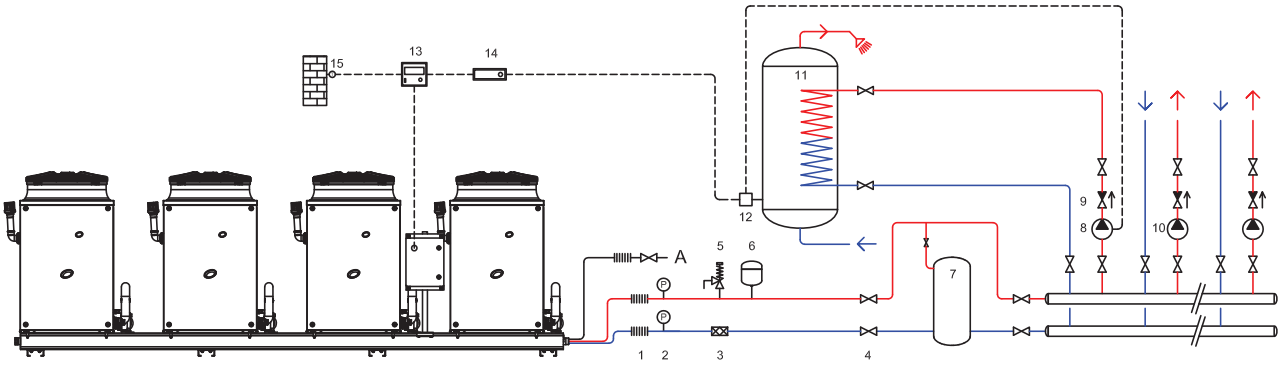


A Gas connection
B Solar heating integration (not supplied)
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Water filter
4 Shut-off valve
5 Primary circuit water pump (variable flow)
6 3 bar safety valve
7 Expansion tank
8 3-way diverter valves for DHW
9 Buffer tank (and hydraulic separator)
10 Heating circuit water pump
11 Check valve
12 DHW accumulation tank
13 Thermostat with adjustable differential for DHW
14 DDC panel
15 RB100 device
16 External temperature probe (for weather curve)

5.2 MULTI GAHP BASE DHW

The diagram shown in Figure 5.2 *p. 4* illustrates the case of a system with several GAHP A in a medium/high power system for space heating and DHW production only.
One should point out that in this type of system the heating service must always be kept on in order to meet any DHW requests.
Alternatively, the same thermostat that turns on the DHW request must also turn on the heating request, in order to switch on the generation system.
The same broad diagram is applicable to GAHP GS/WS units if used for space heating and DHW production only.

Figure 5.2 *Multi GAHP base DHW*



A Gas connection
Notes:
- Pump 8 of the DHW circuit must only turn on when the heating system is on

System components:
1 Anti-vibration connection
2 Pressure gauge
3 Water filter
4 Shut-off valve
5 3 bar safety valve
6 Expansion tank
7 Buffer tank (and hydraulic separator)
8 DHW circuit water pump
9 Check valve
10 Heating circuit water pump
11 DHW accumulation tank
12 Thermostat with adjustable differential for DHW
13 DDC panel
14 RB100 device
15 External temperature probe (for weather curve)

5.3 SEPARABLE DHW

The diagram shown in Figure 5.3 *p. 5* illustrates the case of a system for conditioning and DHW production with a preassembled group consisting of GAHP-AR and AY00-120 units.
DHW production is assured by:

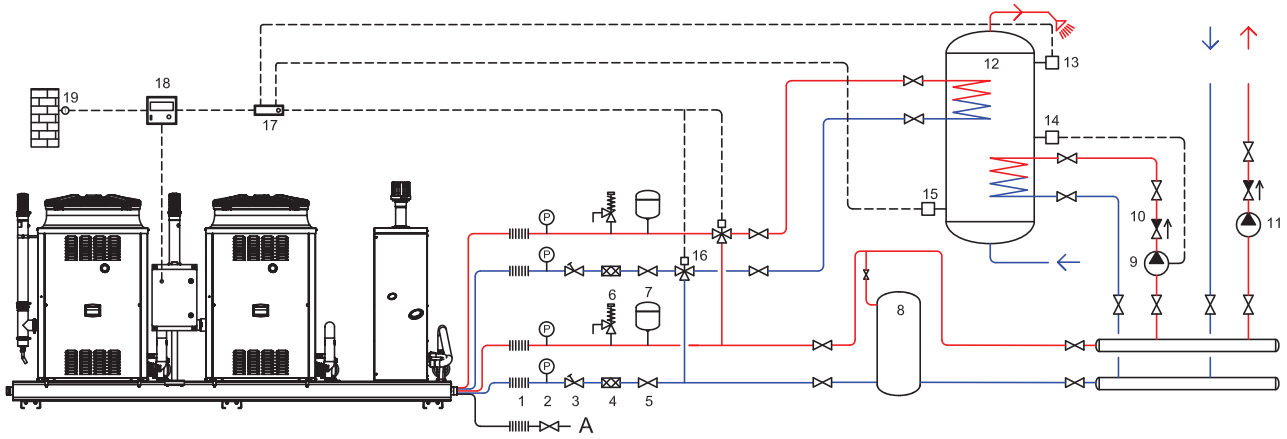
- ► preheating spillage from the secondary manifold;
- ► boiler separation.

Preheating spillage must only be turned on if:

- ► the temperature in the manifold is suitable for correct heat exchange in the DHW tank;
- ► the system is active in heating.

Preheating must be designed in order to operate with the same nominal thermal gradient intended for the GAHP units, i.e. 10 °C, in order not to risk excessive return heating to the GAHP units which would result in turning them off due to limit thermostating.
If there is a separable DHW request from thermostat 13 the boiler is turned on and separation valves 16 are switched.
The diagram shown also supports thermal Legionella disinfection, also by turning on a separable DHW request by thermostat 15.
If the DHW requirement and the heating power are high, one may decide to use a separate pre-heating tank.
The same broad diagram is more generally applicable to all systems including at least one boiler (Robur or third party, for the latter case see Section C1.12) on the separable circuit.

Figure 5.3 *Separable DHW plumbing diagram*



A Gas connection
Notes:
- Pump 9 of DHW pre-heating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the pre-heating coil
- Pump 9 for DHW pre-heating must be turned off in summer

System components:
1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 3 bar safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW winter pre-heating water pump
10 Check valve
11 Conditioning circuit water pump
12 DHW accumulation tank
13 Thermostat with adjustable differential for DHW
14 Thermostat with adjustable differential for DHW pre-heating
15 Thermostat with adjustable differential for Legionella function
16 3-way diverter valves for DHW
17 RB100 device
18 DDC panel
19 External temperature probe (for weather curve)

5.4 SEPARABLE DHW WITH HEAT RECOVERY

The diagram shown in Figure 5.4 *p. 6* illustrates the case of a system for conditioning and DHW production with a preassembled group consisting of GAHP-AR and ACF 60-00 HR units, with heat recovery and AY00-120.
DHW production is assured by:

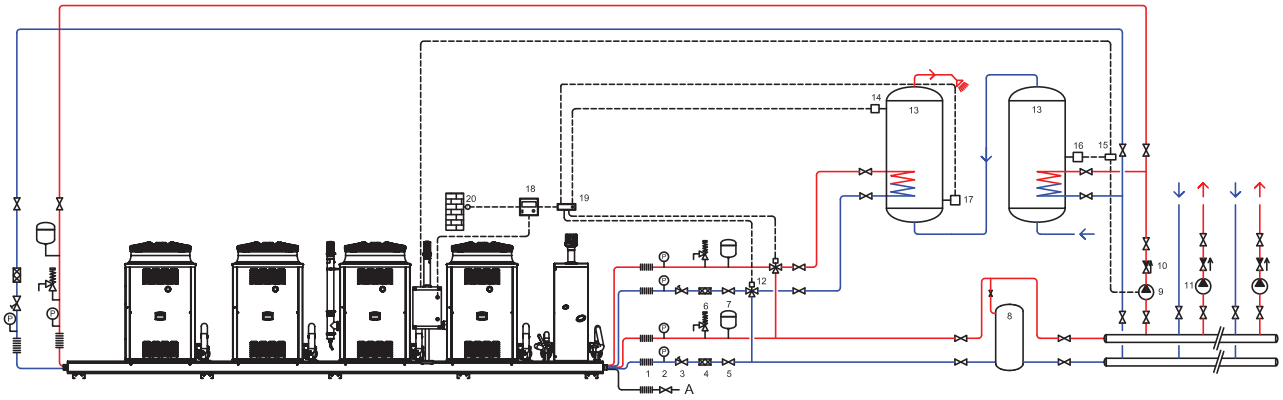
- ► preheating spillage from the secondary manifold;
- ► preheating from ACF 60-00 HR recovery freely available during summer conditioning;
- ► boiler separation.

Preheating spillage must only be turned on if:

- ► the temperature in the manifold is suitable for correct heat exchange in the DHW tank;
- ► the system is active in heating.

Manually switching selector 15 from heating to conditioning turns on the request to the heat recovery exchanger through thermostat 16, thus performing preheating with the free heat from thermal recovery.
Winter-time pre-heating must be designed in order to operate with the same nominal thermal gradient intended for the GAHP units, i.e. 10 °C, in order not to risk excessive return heating to the GAHP units which would result in turning them off due to limit thermostating.
If there is a separable DHW request from thermostat 14 the boiler is turned on and separation valves 12 are switched.
The diagram shown also supports thermal Legionella disinfection, also by turning on a separable DHW request by thermostat 17.
The same broad diagram is more generally applicable to all systems including at least one boiler (Robur or third party, for the latter case see Section C1.12) on the separable circuit and a chiller ACF 60-00 HR.

Figure 5.4 *Separable DHW plumbing diagram with heat recovery*



A Gas connection

Notes:

- Pump 9 of DHW pre-heating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the pre-heating coil
- Pump 9 for DHW pre-heating must be turned off in summer
- Selector 15 allows thermostat 16 tu turn on the heat recovery exchanger request of chillers ACF 60-00 HR in the summer

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Flow regulator valve
4 Water filter
5 Shut-off valve
6 3 bar safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW pre-heating water pump
10 Check valve
11 Conditioning circuit water pump
12 3-way diverter valves for DHW
13 DHW accumulation tank
14 Thermostat with adjustable differential for DHW
15 Summer/winter selector
16 Thermostat with adjustable differential for DHW pre-heating
17 Thermostat with adjustable differential for Legionella function
18 DDC panel
19 RB100 device
20 External temperature probe (for weather curve)