1 DHW PRODUCTION

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

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

Table 1.1 *Heating temperature limits*

			GAHP A	GAHP-AR	GAHP GS/WS	AY
Heating operation						
Hot water outlet temperature	maximum for heating	°C	65	-	65	-
	maximum	°C	-	60	-	88
Hot water inlet temperature	maximum for heating	°C	55	-	55	-
	maximum	°C	-	50	-	-

These features are reflected in the need to use the "indirect" (non-instantaneous) mode for DHW production, with a buffer tank that has a suitable exchange surface (tank expressly designed for coupling with heat pumps, Paragraph 2 *p. 1*) and adequate capacity in relation to demand.
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.
For the GAHP A and GAHP GS/WS appliances, it is possible to raise the maximum delivery temperature up to 70 °C (maximum return to 60 °C), but halving the thermal input when the temperatures indicated in Table 1.1 *p. 1* are exceeded.
When the power required for DHW is less than 20 kW, it is recommended to provide two independent systems, avoiding the use of GAHP for DHW, as the investment for the DHW buffer tank would not be justified by the savings.

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

DHW production in instantaneous mode is not possible.

Use of ACF60-00 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 ACF60-00 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 regard to the sizing of the exchange coil, the following parameters must be taken into account when coupling it with a GAHP heat pump:

- ► buffer tank temperature between 45 °C and 50 °C
- ► coil inlet temperature between 50 °C and 60 °C
- ► nominal thermal leap 10 °C
- ► water flow within the operating limits of the GAHP, if the buffer tank is installed on the primary

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 figure published by manufacturers should be used with caution, as this figure usually refers to inlet water at 80 °C and a thermal leap of 20 °C, which is not applicable in the case of heat pumps.

3 DHW SERVICE REQUESTS

DHW service requests may be relayed in two different ways:

- ► via RB100/RB200 devices via digital or analogue signals (Section C01.10 for the electrical design and Section C01.11 for the description of the operating logic)
- ► directly to the DDC or CCI panel via Modbus protocol by setting the appropriate registers (Section C1.11) via an external system controller

DHW service requests can be associated with the separation of any separable part of the system, where this has been hydraulically provided for and configured on the relevant control systems.
Temperature control in the DHW tank is performed alternatively with:

- ► two thermostats in the DHW buffer tank, with adjustable differential, connected directly to RB100/RB200
- ► temperature probes in the DHW buffer tank, serving an external controller

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

3.1 DHW TANK WITH THERMOSTATS

If the DHW buffer tank temperature is controlled by thermostats, it will be necessary to provide two separate thermostats with adjustable differentials, appropriately set to the desired temperatures:

- DHW heating service (or DHW service at reduced temperature)
- anti-legionella disinfection service (or DHW service at comfort temperature)

The digital outputs of these thermostats must be connected to the two DHW digital inputs available on the RB100/RB200 devices (Section C1.10), 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 buffer tank temperature is controlled by means of temperature probes, an external electronic controller must be provided, capable of supplying a 0-10 V signal or a voltage-free contact to the DHW analogue/digital input of the RB100/RB200 devices (Section C01.10), setting the relevant configuration both on the RB100/RB200 devices and on the DDC panel.
The external electronic controller will then take care of both the probe reading and the DHW or anti-legionella service activation logic, including the setpoint and any time 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 its poor effectiveness and high energy consumption, remains disinfection by means of thermal shock, which consists of bringing the buffer tank and the distribution and recirculation network to a high temperature (above 55 °C) for at least 1 h.
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 an optimal degree of disinfection (the thermal shock does not operate on system branches where the water is still)
- avoid heavily penalising the efficiency of GAHP appliances

In order to carry out anti-legionella disinfection by means of thermal shock, it may be advisable to have at least one AY or a third-party boiler in the system.

5 INDICATIVE DHW DIAGRAMS

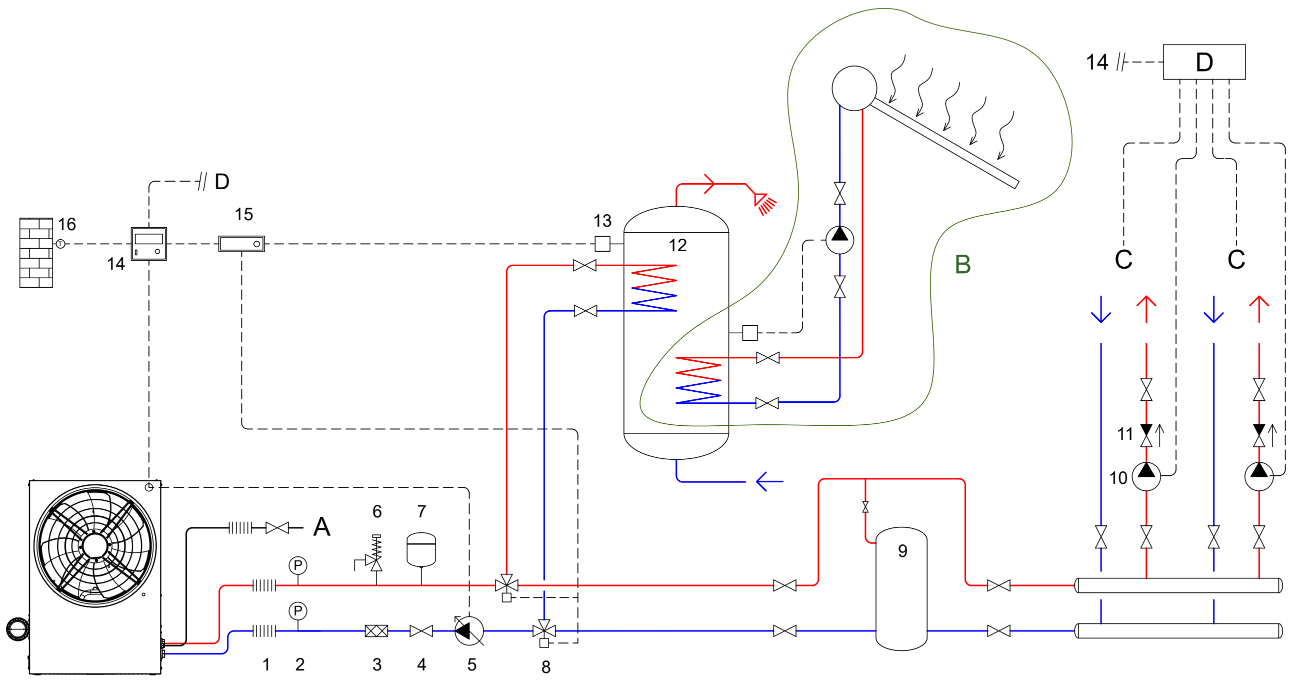
Below are some example diagrams, which are useful to understand the various methods for producing DHW using Robur units.
Below are some definitions (taken from Section A01):

- **Separable DHW system** = part of the primary circuit that can be hydraulically separated from the base system part and operate independently. It can assume two states, depending on the position of the three-way diverter valve:
  - Water plumbing connected to the base system (**included** state): in included state this part of the system integrates the space heating service.
  - 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 for the exclusive production of DHW, hydraulically disconnected permanently from the base system.
- **DHW system** = system intended for DHW production.
- **Base system** = part of the primary circuit comprising all generators, excluding those that can be hydraulically separated from it by means of a suitable three-way valve.

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 thermal integration is useful in the summer season when there are no other heat demands, in order to avoid too short and frequent switching on of the GAHP.
The same schematic diagram is applicable to GAHP GS/WS appliances when used for space heating and DHW production only (provided that the appropriate hydrothermal/geothermal exchange system is in place to supply the renewable thermal energy required to operate the heat pump).

Figure 5.1 *Plumbing diagram for a single GAHP A for heating and base DHW*

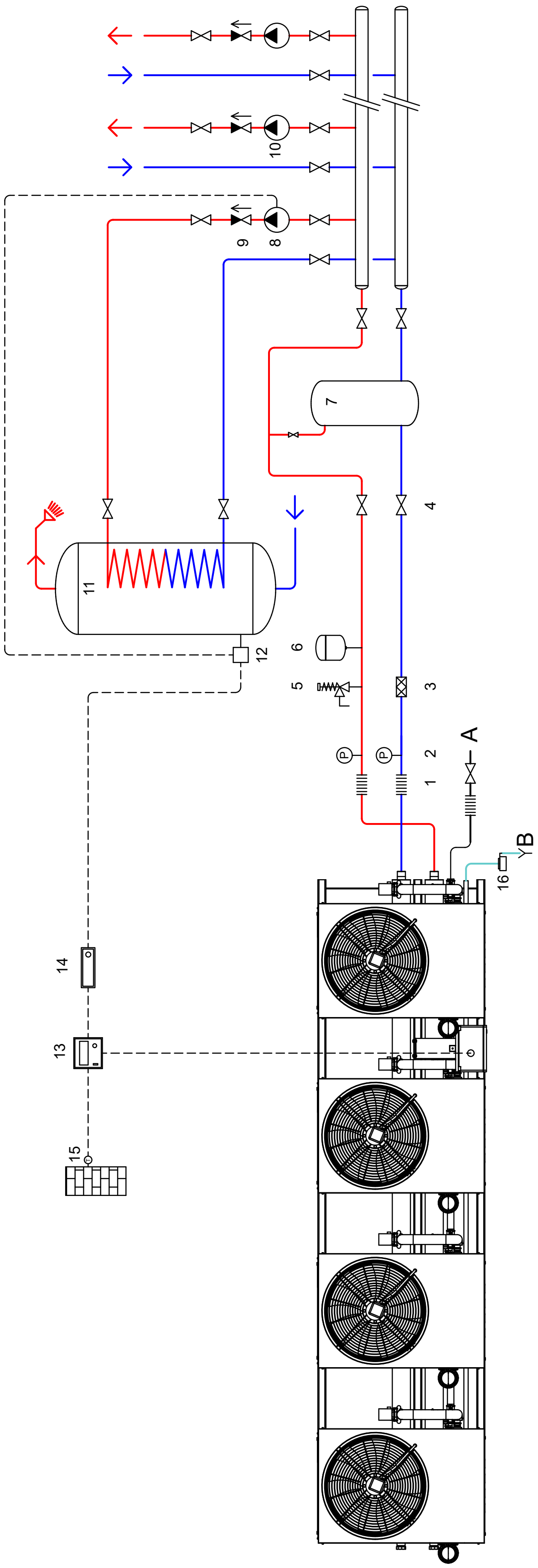


A	Gas connection	4	Shut-off valve	12	DHW buffer tank
B	Solar thermal integration (not supplied)	5	Primary circuit water pump (variable flow)	13	Thermostat with adjustable differential for DHW
C	Heating circuit	6	Safety valve	14	DDC panel
D	Secondary circuit management system	7	Expansion tank	15	RB100 device
System components:		8	3-way diverter valves for DHW	16	Outdoor temperature probe
1	Anti-vibration connection	9	Buffer tank (and hydraulic separator)		
2	Pressure gauge	10	Heating circuit water pump		
3	Sludge filter	11	Check valve		

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.
It is important to point out that in this type of system, with DHW service provided by means of a delivery from the delivery manifold, the manifold itself must always be kept heated in order to meet any DHW demands.
Alternatively, the same thermostat that activates the DHW request must also activate the heating request, so as to switch on the generation system (which will need time to heat up the system's water mass so that the delivery feeding the buffer tank can be fed with water at a sufficient temperature).
The direct connection between the DHW thermostat (detail 12 in Figure 5.2 *p. 4*) and the delivery pump 8 only makes sense if the delivery manifold is actually kept heated at all times. If this is not the case, a system (differential thermostat) should be provided to prevent the start-up of the delivery pump 8 if the temperature difference between the manifold temperature and the temperature in the DHW buffer tank is insufficient for proper heat exchange.
The same schematic diagram is applicable to GAHP GS/WS appliances when used for space heating and DHW production only (provided that the appropriate hydrothermal/geothermal exchange system is in place to supply the renewable thermal energy required to operate the heat pump).

Figure 5.2 *Multi GAHP base DHW*



A Gas connection
B Condensate drain
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Sludge filter
4 Shut-off valve
5 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 buffer tank
12 Thermostat with adjustable differential for DHW
13 DDC panel
14 RB100 device
15 Outdoor temperature probe
16 Condensate neutralizer

Notes:

- Pump 8 of the DHW circuit must only turn on when the heating system is on

5.3 SEPARABLE DHW

The diagram in Figure 5.3 *p. 5* shows the case of an heating/cooling/DHW system with a Link consisting of 2 reversible GAHP-AR S heat pumps and 2 AY 50 boilers that are both connected to the rear manifold pair.

Pay attention to the appropriate neutralisation and drainage of condensate in accordance with the applicable standards.

On the separable DHW circuit, there is no safety valve as this is already present inside the AY boiler and also acts on this circuit branch.

DHW production is assured by:

- ► to a preheating delivery from the secondary manifold
- ► to boiler separation

Preheating spillage must only be turned on if:

- ► the temperature in the manifold is suitable for proper heat exchange in the DHW buffer tank
- ► the system is active in heating mode

The winter preheating must be designed to work with a thermal leap greater than 10 °C, so as not to risk excessive heating of the inlet to GAHP, which would result in switching them off due to exceeded operational limit.

It is recommended to provide a system (differential thermostat) to prevent the start-up of the delivery pump 9 if the temperature difference between the manifold temperature and the temperature in the DHW buffer tank is insufficient for proper heat exchange.

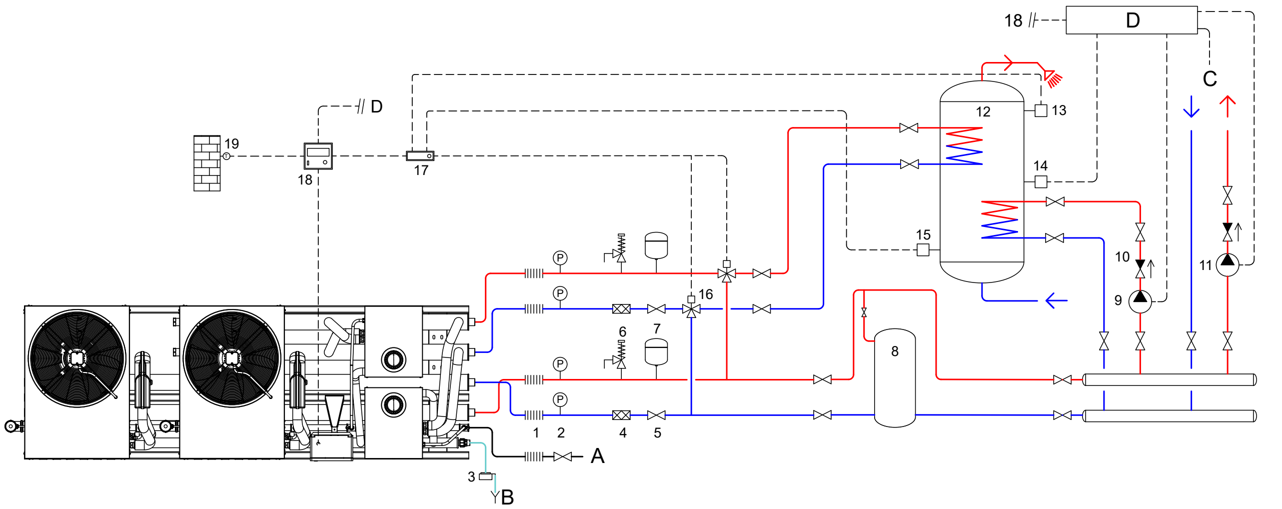
If there is a separable DHW request from thermostat 13, the boilers will be activated with the DHW service setpoint (set on the DDC panel or RB100 device) and the diverter valves 16 will be switched.

The diagram also supports anti-legionella thermal disinfection, also by activating a separable DHW request from thermostat 15, with a dedicated setpoint (set on the DDC panel or RB100), with a dedicated schedule on the DDC panel.

If the DHW requirement and the heating power are high, one may decide to use a separate preheating tank.

The same schematic diagram is more generally applicable to all systems in which there is at least one boiler (Robur or third-party, for the latter case, see Section C01.11) on the separable circuit.

Figure 5.3 *Plumbing diagram for separable DHW*



A Gas connection
B Condensate drain
C Heating/Cooling circuit
D Secondary circuit management system
System components:
1 Anti-vibration connection
2 Pressure gauge
3 Condensate neutralizer
4 Sludge filter
5 Shut-off valve
6 Safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW winter preheating water pump
10 Check valve
11 Heating/Cooling circuit water pump
12 DHW buffer tank
13 Thermostat with adjustable differential for DHW
14 Thermostat with adjustable differential for DHW preheating
15 Thermostat with adjustable differential for Legionella function
16 3-way diverter valves for DHW
17 RB100 device
18 DDC panel
19 Outdoor temperature probe

Notes:

- Pump 9 of DHW preheating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the preheating coil
- DHW preheating pump 9 must be turned off in summer

5.4 SEPARABLE DHW WITH HEAT RECOVERY

The diagram in Figure 5.4 *p. 7* shows the case of an heating/cooling/DHW system with a Link consisting of 2 reversible GAHP-AR S heat pumps, 2 ACF60-00 HR chiller-heaters with heat recovery, a AY 50 boiler connected to the main heating circuit and a AY 100 boiler with its own independent connections.
DHW production is assured by:

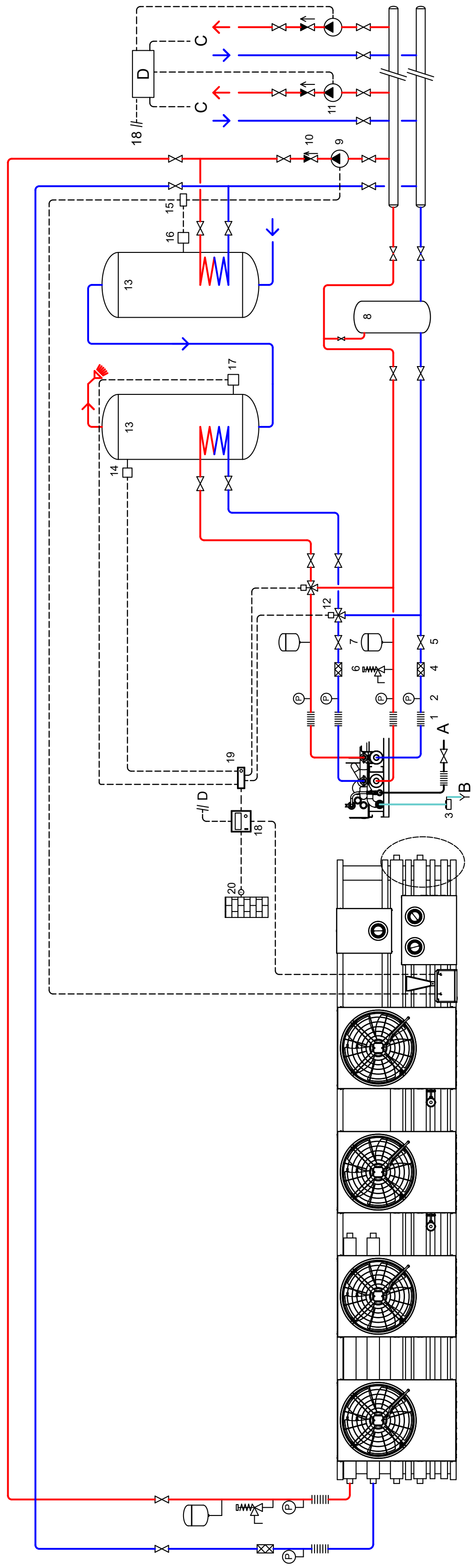
- to a preheating delivery from the secondary manifold
- to the preheating from the recovery of ACF60-00 HR freely available during summer cooling
- to AY 100 boiler separation

Preheating spillage must only be turned on if:

- the temperature in the manifold is suitable for proper heat exchange in the DHW buffer tank
- the system is active in heating mode

Manual switching of selector switch 15 when switching from heating to cooling will activate the request to the heat recovery exchanger via thermostat 16 and thus carry out preheating with free heat from the heat recovery.
The winter preheating must be designed to work with a thermal leap greater than 10 °C, so as not to risk excessive heating of the inlet to GAHP, which would result in switching them off due to exceeded operational limit.
If there is a separable DHW request from thermostat 14, the AY 100 boiler will be activated with the set DHW service setpoint (on the DDC panel or RB100 device) and the diverter valves 12 will be switched.
The diagram also supports anti-legionella thermal disinfection, also by activating a separable DHW request from thermostat 17, with a dedicated setpoint (set on the DDC panel or RB100), with a dedicated schedule on the DDC panel.
The same schematic diagram is more generally applicable to all systems in which there is at least one boiler (Robur or third-party, for the latter case, see Section C01.11) on the separable circuit and a ACF60-00 HR chiller-heater.

Figure 5.4 *Plumbing diagram for separable DHW with heat recovery*



A Gas connection
B Condensate drain
C Heating/Cooling circuit
D Secondary circuit management system

System components:

1 Anti-vibration connection
2 Pressure gauge
3 Condensate neutralizer
4 Sludge filter
5 Shut-off valve
6 Safety valve
7 Expansion tank
8 Buffer tank (and hydraulic separator)
9 DHW winter preheating water pump
10 Check valve
11 Heating/Cooling circuit water pump
12 3-way diverter valves for DHW
13 DHW buffer tank
14 Thermostat with adjustable differential for DHW
15 Summer/winter selector switch
16 Thermostat with adjustable differential for DHW preheating
17 Thermostat with adjustable differential for Legionella function
18 DDC panel
19 RB100 device
20 Outdoor temperature probe

Notes:

- Pump 9 of DHW preheating must only turn on if the temperature difference between manifold and buffer tank is sufficient for correct heat exchange on the preheating coil
- DHW preheating pump 9 must be turned off in summer
- The summer/winter selector switch 15 will enable thermostat 16 to activate the heat recovery exchanger request to ACF60-00 HR chiller-heaters in summer.