Commissioning a Solar Thermal Installation

Contents

1. Solar Circuit

Components

- Pipework
- Pipework connections (screw joints, solder/pressfittings, etc.)
- Piping insulation
- Built-in components (CIRCO solar circulation unit, heat meter, de-aerrator etc.)

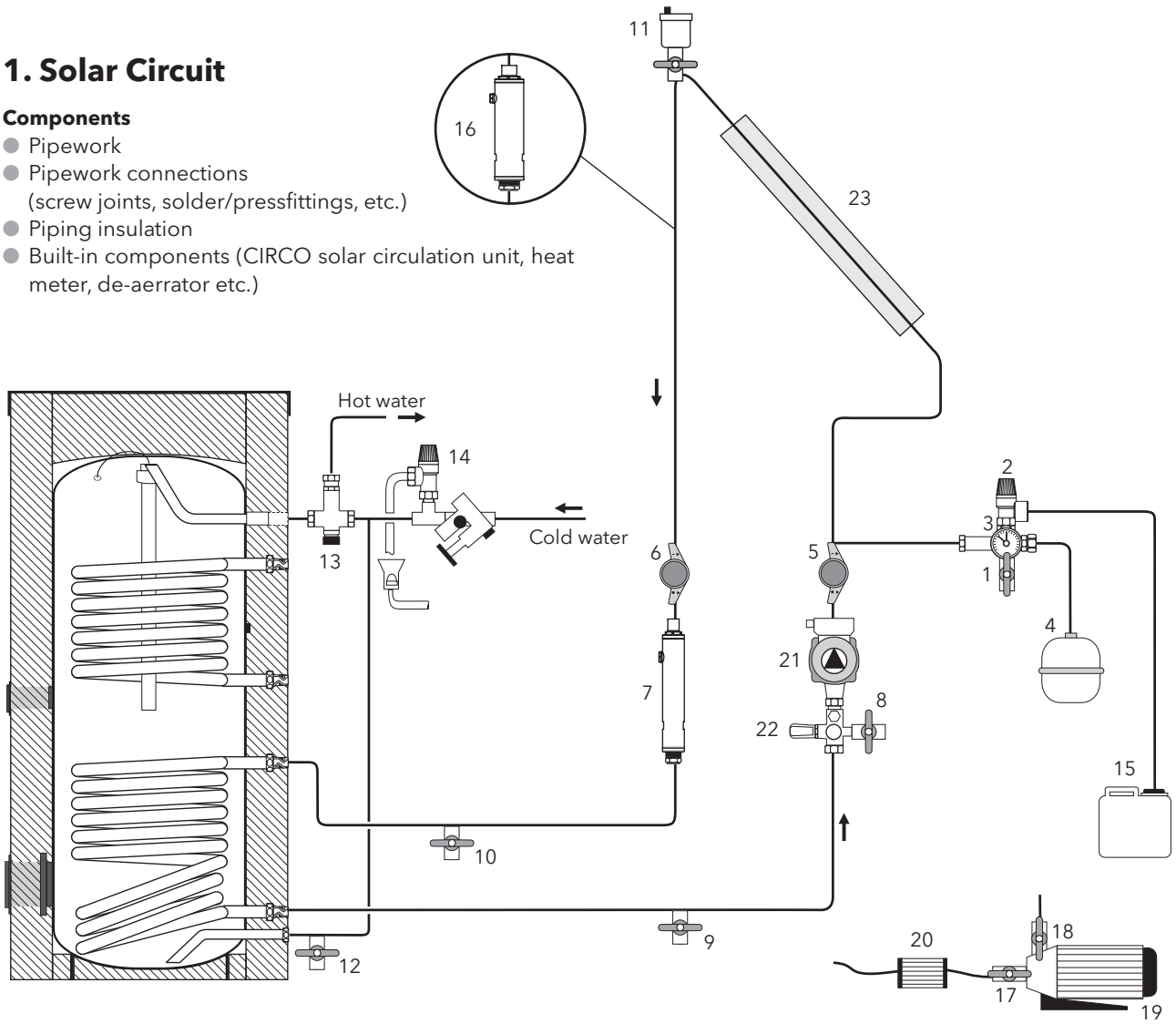

Figure 1 The components of the solar circuit
***1** Filler and drain valve in the CIRCO safety unit **2** Safety valve with exhaust line **3** Pressure gauge **4** Expansion vessel **5** Non-return ball valve in the return flow line **6** Non-return ball valve in supply flow line **7** CIRCO air separator pipe **8** CIRCO flow meter valve **9** solar circuit return flow valve **10** Solar circuit filler and drain valve **11** Automatic air release valve with shut-off valve – if air vent pipe (7) not present or insufficient **12** Drinking water drain valve **13** Thermostatic mixer **14** Safety unit of the cylinder **15** Catchment tank (e.g. empty solar fluid container) **16** Air separator in the supply pipe – if air vent pipe (7) not present **17** Shut-off valve at the suction side of the filling pump **18** Shut-off valve at the pumping side of the filling pump **19** High performance filling pump KS **20** Filter **21** Solar circuit pump **22** Flow meter **23** Collector.*

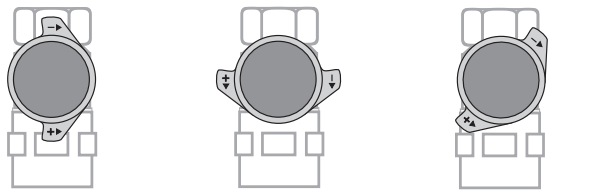

Figure 2 The functions of the non-return valves (5) and (6) in the solar circulation station CIRCO.

The solar circuit must always be composed of material appropriate to the temperature and pressure as well as the heat transfer medium (propylene glycol).

Pipework and connections

- Hard or soft copper piping.
- Twinflex TVA stainless steel corrugated tube (figure 4).
- Hard soldering, pressfittings with approved sealing material, soft soldering with Sn Cu3.
- You should use a suitable sealant e.g. hemp and a pipe sealing compound. Teflon tape is not suitable.

Insulating material

- Temperature resistant EPDM insulation hose.
- Mineral wool cover for dry areas (figure 5).
- Outside insulation must be protected against UV radiation (e.g. metal cladding).

Figure 3 Pipe assembly kit for the solar circuit.

Figure 4 Twinflex TVA – quick assembly piping system.

Figure 5 Mineral wool insulation.

Components for the solar circuit

- Automatic air release valve (figure 6) with a temperature resistant shut-off valve (max. 200 °C). This is not necessary when a deaerator and an efficient filling pump is being used.
- Air separator e.g. Wagner LA 180 for vertical installation in pipes (no picture).
- An air vent pipe (figure 7), which is integrated in the CIRCO solar circuit unit. Layout may differ depending on the model.

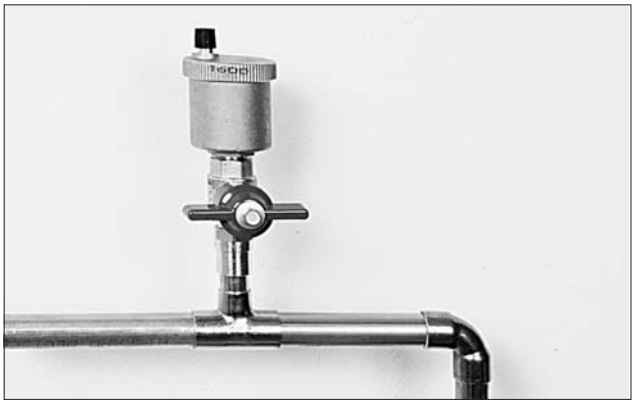

Figure 6 Automatic air release valve with possibility to shut off.

Figure 7 Air vent pipe.

2. Commissioning

- Check that the admission pressure of the expansion vessel is correct (see chapter 2.6).
- Please note: High radiation may provoke vapour inside the collector. High temperatures in the solar circuit (collector temperature > 60 °C) may cause scalding.
  It is therefore dangerous to fill the solar circuit with solar fluid under these conditions. In case of high solar radiation please cover the collector and wait until it cools down before you begin to work

2.1 Flushing the Solar Circuit

- Flat plate collectors: flush with water.
- Flushing direction: from the collector to the tank.
- Do not use the filling pump when dry.
- Use filter (20).

Procedure

- Open valves **(1)** and **(8)**.
- Set ball valve **(6)** to 45°.
- Set ball valve **(5)** to horizontal.
- Close ball valve **(11)**.
- Turn on the pump.

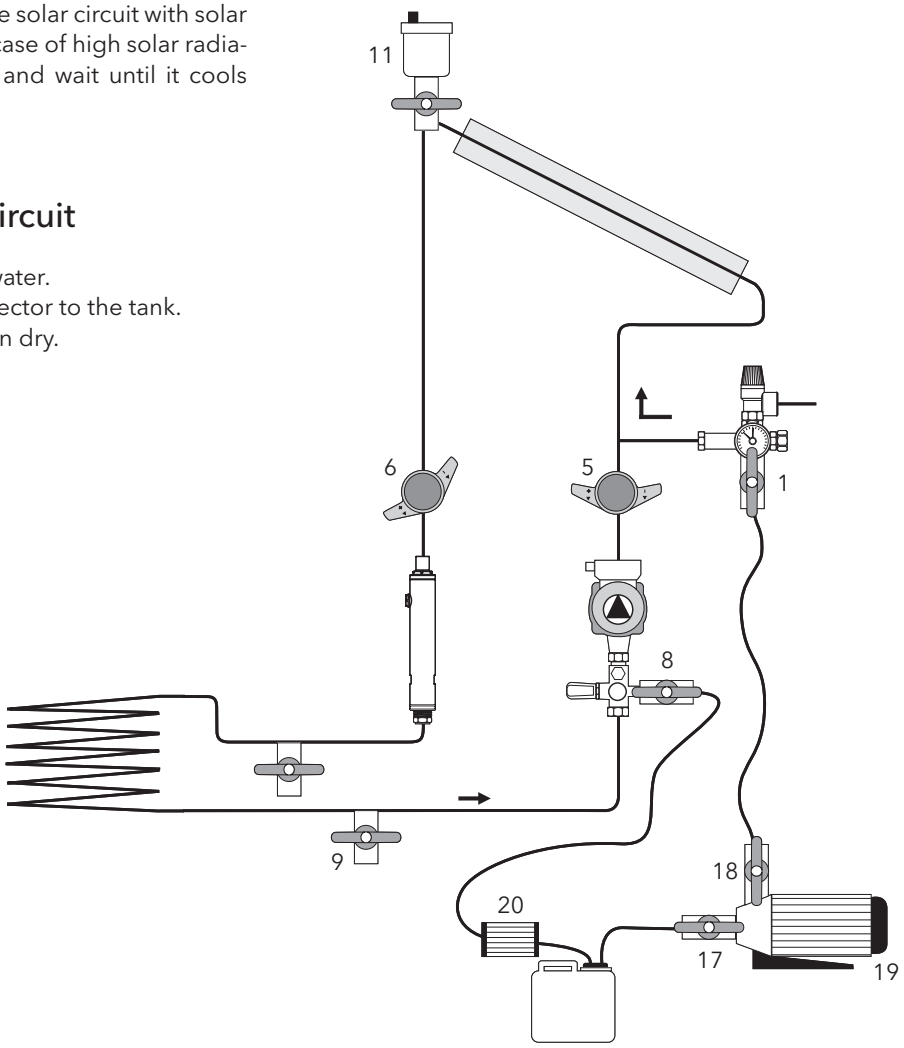

Figure 8 Flushing the solar circuit.

Figure 9 KS filling pump.

Tip:

- Use a Wagner KS high performance filling pump
- Flush with high pressure e.g. 3-4 bar

2.2 Test Tightness

- Check all connections for leakage.
- Even after emptying the system, some liquid remains in the collectors. If it was previously filled with water, it must be filled with solar liquid, otherwise the absorbers can be damaged by frost.
- Test pressure up to 5 bar.
- Fluctuations in pressure can also occur due to changes in the level of solar radiation.
- The expansion vessel must be shut off from the solar circuit before the drop in pressure can be measured.

Procedure

- Shut off the filler valve **(8)**.
- After reaching the test pressure shut off filler valve **(1)**.
- Set ball valves **(5)** and **(6)** to 45°.
- Shut-off valve **(11)** must be closed (otherwise a drop in pressure from air separation is possible).

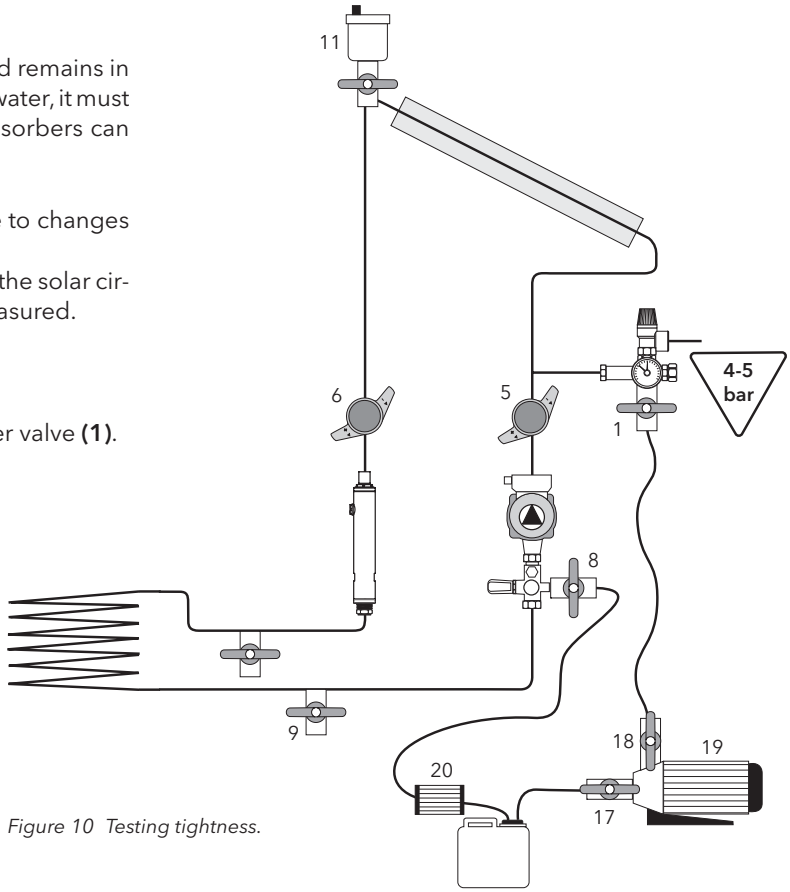

Figure 10 Testing tightness.

2.3 Draining

- This is not necessary when it has already been filled with the heat transfer medium

Procedure

- The filling pump **(19)** must be turned off.
- Disconnect suction hose from filler valve **(8)** and connect to filler valve **(9)**.
- Open valve **(9)**
- Open valve **(1)**

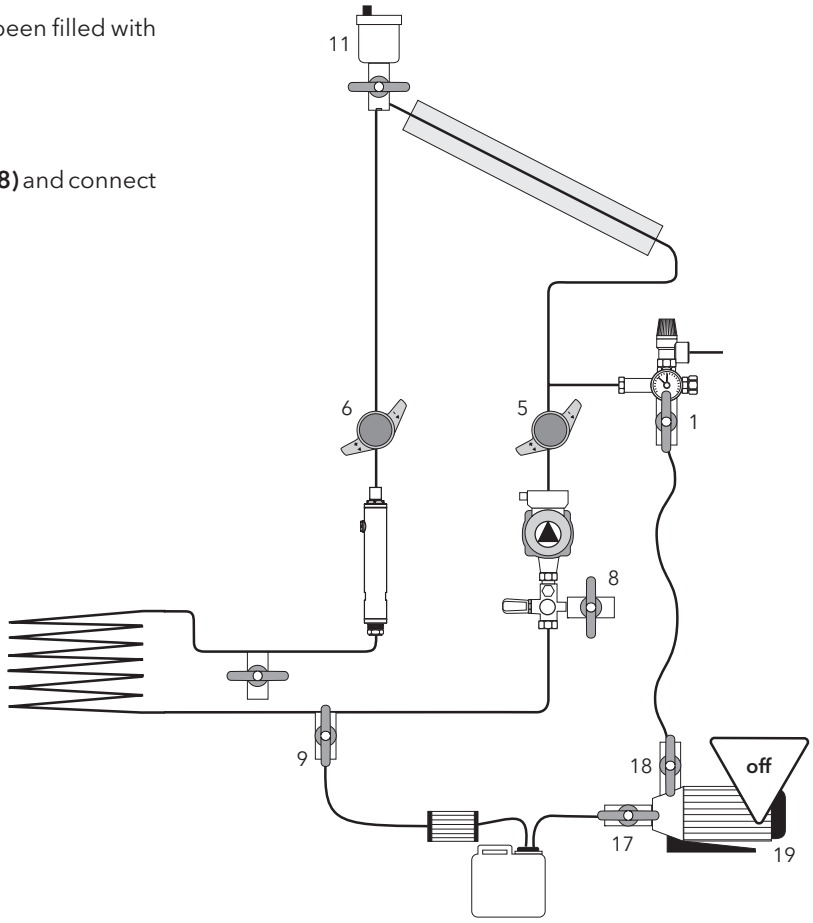

Figure 11 Draining.

2.4 Mixing the Heat Transfer Medium

According to the danger of frost the heat transfer medium DC20 should be diluted with water with at least 30% DC20 and this should be well mixed. Observe references in the data sheets.

Table 1 Mixing ratios for concentrate DC20.	
Volume percentage DC 20 [%]	**Freezing point [°C]**
30	- 14
40	- 21
50	- 32
100	- 50

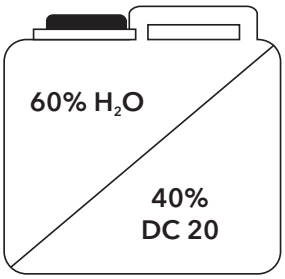

Figure 12 DC20 for flat plate collectors.

Figure 13 Frost protection tester.

Table 2 Volume of different components of the system for the calculation of the filling volume *					
Collectors [litre]		**Tank / heat exchanger [litre]**		**Pipes [Litre/metre]**	
EURO C20 HTF / C20 AR	1.3	ECOplus 300	8.5	Cu 28x1 mm	0.52
EURO C22	1.0	ECOplus 400	10.0	Cu 22x1 mm	0.31
LB 5	2,6	TERMO 700	12,9	Cu 15x1 mm	0,13
LB 6,4	3,0	TERMO 1000	14,1	Twinflex TVA DN 16	0,28
LB 7,6	3,5	ECObasic 300	7,5	Twinflex TVA DN 20	0,44
LBM 67	4,9	ECObasic 400	9,4		
LBM 100	7,5				
* without fluid content of the expansion vessel					

2.5. Filling and Purging

Procedure

- Disconnect suction hose from filler valve **(9)** and connect to filler valve **(8)**.
- Shut off valve **(9)**
- Open filler valves **(8)** and **(1)**
- Set ball valve **(5)** to horizontal
- Close shut-off valve **(11)**
- Switch on filling pump **(19)**
- Use the filling pump until no more air bubbles can be seen in the liquid container **(15)**
- Vent the pump line and if necessary the solar circuit pump (figure 16)
- Shut off the filler valve **(8)**
- When the desired pressure has been reached shut off the filler valve **(1)** (see chapter 2.6)
- Open the shut-off valve **(11)** under the automatic air release valve to purge the remaining air.

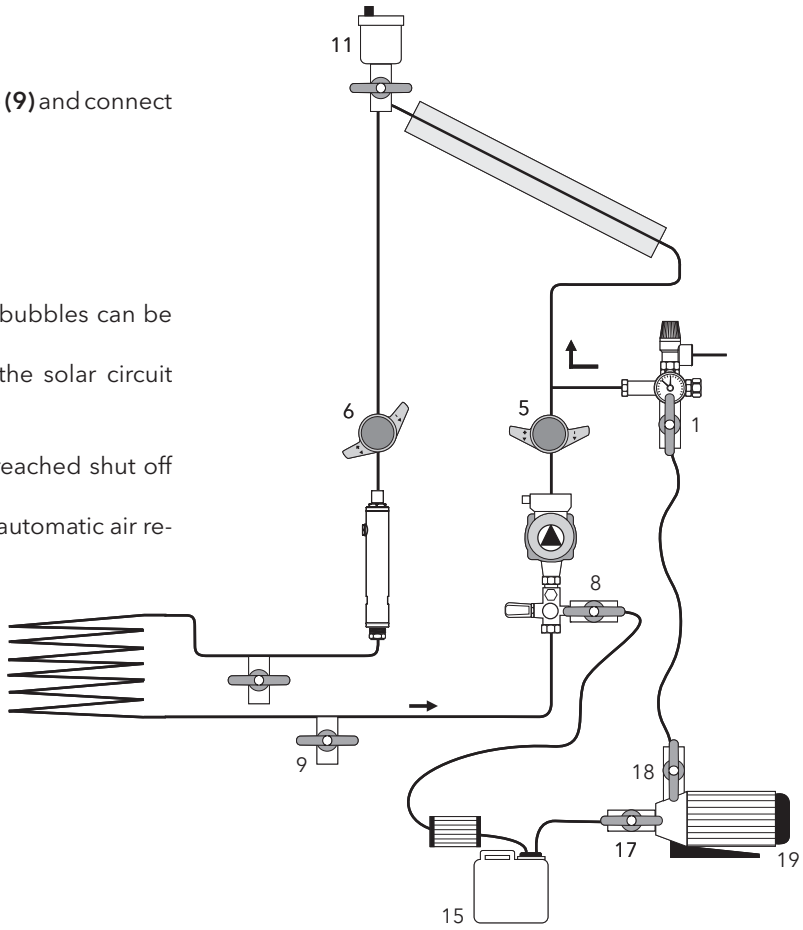

Figure 14 Filling and purging.

Venting the pump line

- Set the ball valve **(6)** horizontal and the ball valve **(5)** to 45°.
- Run the filling pump **(19)** for approximately 20 seconds.
- Close the filler valves **(8)** and **(1)** and turn off the filling pump.

Vent the solar circuit pump if necessary

- Turn on the solar circuit pump (chose the maximum speed) and vent through the bronze screw at the front of the pump. Please observe the instructions of the pump manufacturer.
- Final deaeration:
  vent air at air vent valve of the CIRCO station several days after installation.

Tip:

- Flush with high pressure e.g. 3-4 bar
- If necessary turn the pump on and off several times in order to accelerate air extraction.
- If necessary turn off the valve **(8)** – the pressure of the system will increase – then open again to get rid of any air pockets.
- If necessary the flow direction can be changed to completely purge the heat exchanger in the storage tank.

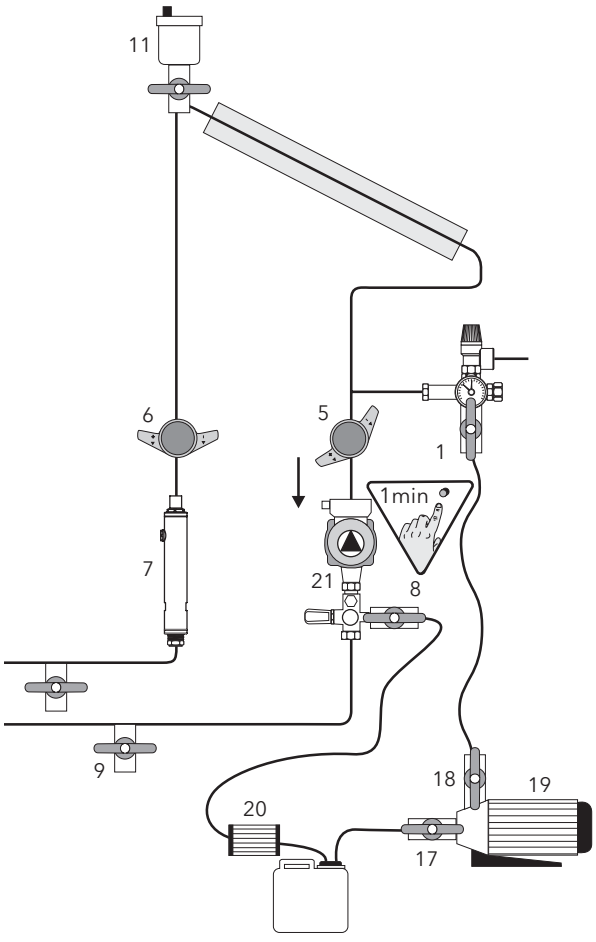

Figure 15 Venting the pump line.

2.6 Setting the Pressure of the System

- Prerequisite: The expansion vessel must have the correct admission pressure when it is installed. In pre-filled systems the admission pressure can only be determined if the expansion vessel is blocked and pressureless (through an optional capped shut-off valve).
- Within a few days of being filled the pressure of the system can decrease further due to separation of air.

Tip:
When filling the system the pressure should be set at 0.1-0.2 bar higher than the value given in the table.

Table 3 Recommended pressure levels for the system		
Height of system [m]	**Expansion vessel admission pressure [bar]**	**System pressure* [bar]**
5	0.6 – 0.7	0.7- 0.8
8	0.9 – 1	1.0 – 1.2
10	1.2	1.2 – 1.3
15	1.7	1.7 – 1.8
20	2.3	2.3 – 2.5
* When the system is cold		

2.8 Setting the Volume Flow

- Set the flow meter in the solar station to maximum. If necessary turn the 4 mm socket screw completely to the left
- Set the pump to the lowest speed
- Set the pump speed of solar controls with variable speed to 100%
- Recommended volume flow (except for low-flow systems): 40 litre/m² collector area and per hour
  Example:
  Collector surface area 12 m² > flow volume [litre/min] = 40 l/m² h x 12 m²: 60 min/h = 8 l/min
- Chose the pump speed so as to achieve the recommended flow rate.

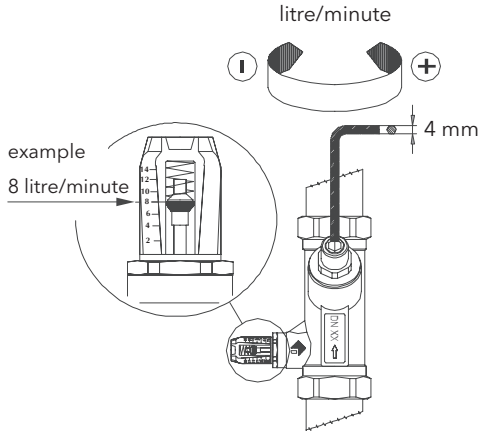

Figure 17 Setting the volume flow.

2.7 Operation Mode

- The position of the valves in operation mode shows Figure 16.
- Put an empty container of heat transfer fluid **(15)** under the safety valve's exhaust line **(2)**.
- Close the shut-off valve **(11)** after a few days.
- The shut-off valve **(11)** must stay closed while in operation so that vapor built up at stagnation does not escape.

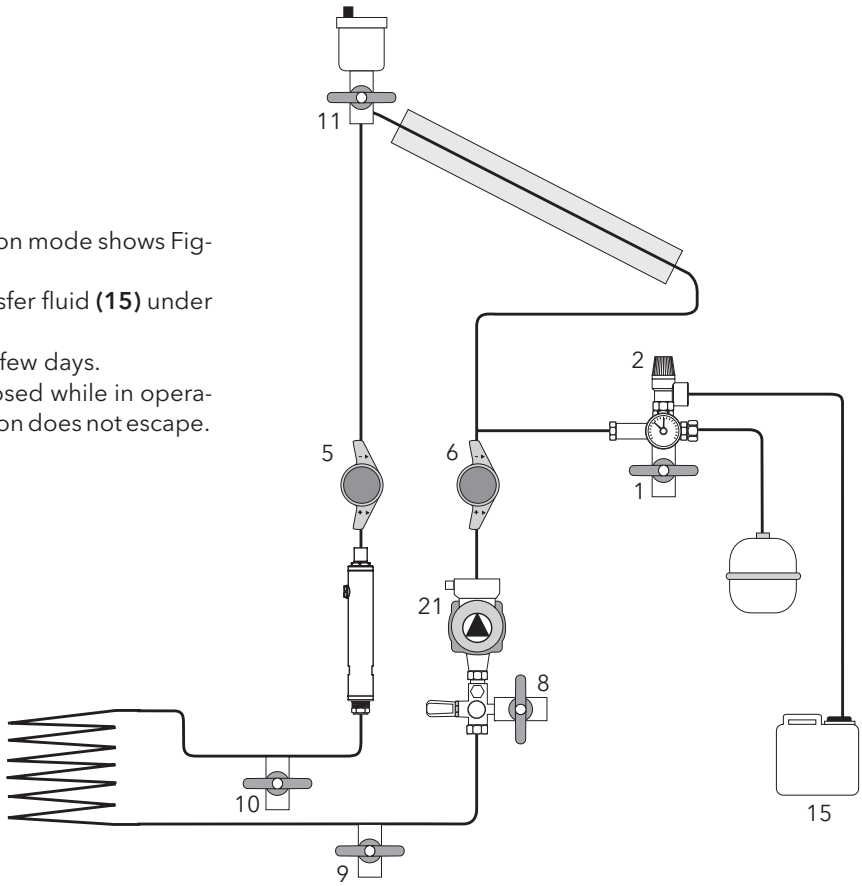

Figure 16 Operation mode.

3. Service Information

Table 4 Fault	Cause	Solution
The pump is not running – no noise or vibrations	No electrical supply	Check the electric circuit
	The temperature difference set at the control is not reached	Check the settings of the control
	The maximum tank temperature has been reached	If permitted > increase the maximum tank temperature
The pump is not running but noise can be heard	The pump shaft is stuck	● Set the maximum pump level (on the pump) and pump speed (on the control) ● Loosen the ventilation screw and and carefully move the pump shaft with a screw driver
The pump is running but there is no circulation	There is a block in the solar circuit: ● Flow meter ● Ball valve in the solar circuit unit	Open the block
	There is air in the solar circuit	Remove air with the ventilation components or pump it again with the filling pump and if necessary fill it up with heat transfer medium
Very noisy pump	The pump has not been properly bled	Bleed the pump
	Air in the solar circuit	See "The pump is running but there is no circulation"
Pump clocking	Flow and return flow pipes of the solar circuit have been mixed up	Change connections
	Delta T is set too low at the control	Increase Delta T
The pump keeps running	The sensor is faulty	● check the cable connections ● compare the resistance of the sensor with the table
The difference in temperature between flow and return flow is too high	Pump level is too low	Increase pump level
	Air in the solar circuit	See "The pump is running but there is no circulation"
The storage tank is cooling down	Non-return valve is turned open	Set the correct operation
	Non-return valve is dirty	Use the pump at the maximum rotations per minute and switch the non-return valve on and off several times.
	Non-return valve is faulty	Replace the non-return valve
	Gravitation force circulation in the warm water circulation	Install a flap trap or check the existing one
	Long operation time of the hot water circulation pump	Reduce the operation time or adjust the time and temperature settings
	The storage tank sensor of the solar control is fixed too low	Correct the position of the sensor between the lower third and the middle of the heat exchanger
Drop in pressure at the pressure gauge	Air was released by air separator or release valves	Fill up with heat transfer medium
	The solar circuit is not watertight	Check all connections

4. Maintenance

Table 5 Protection from frost	Protection from corrosion of the heat transfer medium	Protection from corrosion of the storage tank
● Recommended frost protection temperature of heat transfer medium -19 °C. Test at time of commissioning ● Then test at least every 2 years.	● pH > 6.6 – otherwise exchange the heat transfer medium ● Check the pH every 2 years ● If the solar fluid is black or smells bad it has to be changed and the solar circuit has to be rinsed. ● Any remaining heat transfer medium in an emptied system can result in corrosion through contact with air.	● Magnesium anode: protective current > 0.3 mA, test at least every 2 years ● External current anode: observe control lamp
Pressure of the system	**Volume flow in solar circuit**	**Visual check**
● Observe the system pressure ● For correct value see chapter 2.6 ● When refilling several times with water check the frost protection temperature	● Recommended volume flow: per m^2 collector surface = 0.5-0.8 l/min	● Collectors, connections and pipes and their insulation ● Check the sensor cables

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