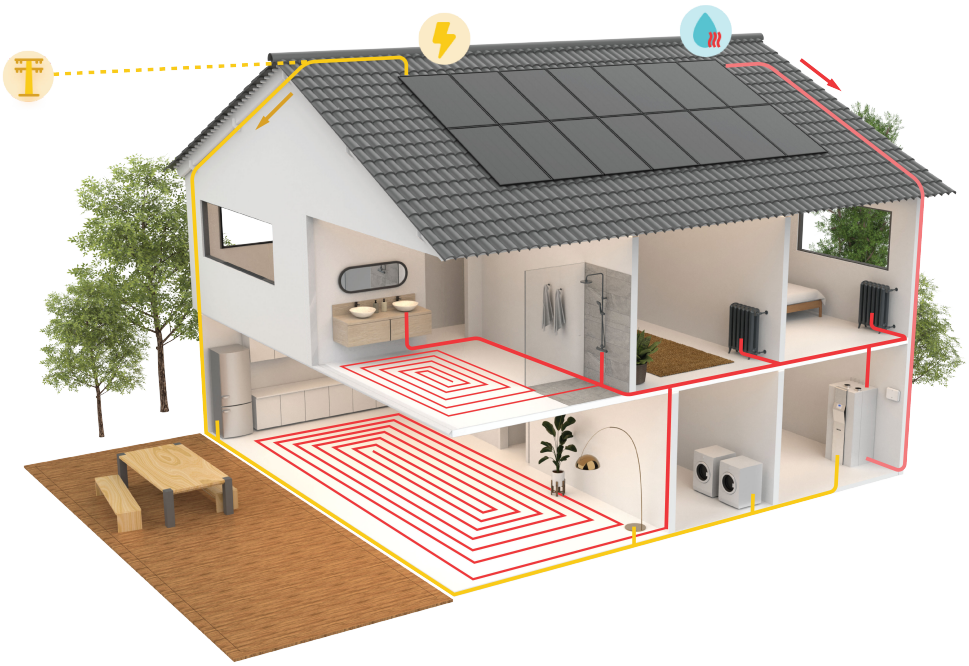


# Dualsun MAX installation and commissioning instructions: SPRING MAX + solar thermal heat pump

V2.1
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# 1. Introduction

## 1.1. General safety instructions

Please read this installation manual thoroughly and in detail in order to be able to fully exploit the functionality of the product. DualSun disclaims all liability for defetcs and damages that would result from non-compliance with the installation instructions (improper use, incorrect installation, handling error, etc.).

### IMPORTANT

- It is important to follow these instructions for personal safety. Improper mounting may cause serious injury. The end user must keep these safety instructions.
- The installation, control, commissioning, maintenance and repair of the installation must only be carried out by qualified personnel.
- The correct functioning of the installation is only guaranteed if the installation and assembly have been carried out in accordance with the rules of the art.

### CAUTION

- The entire solar installation must be installed and operated in accordance with recognized technical rules.
- All electrical work must be done according to local guidelines.
- The installation must not be used if it shows signs of damage.

### DANGER

- For installations on roofs, it is necessary to comply with personal safety standards, relating to roofing and waterproofing work and relating to scaffolding work with safety net by mounting the respective devices before starting work . Refer to the recommendation published by the national risk prevention organization.
- Gloves are compulsory when handling the panels to avoid any risk of injury or burns.
- Disconnect all connection cables from the power supply before working on the installation.

## 1.2. General standards to be observed

To ensure safe, ecological and economical operation, all applicable regional and national standards, rules and directives must be observed, particularly the international standards mentioned below:

### 1.2.1. Photovoltaic solar standards

- IEC / EN 61215 1 and 2: Design qualification and approval of crystalline silicon photovoltaic (PV) modules for terrestrial application.
- IEC / EN 61730 1 and 2: Photovoltaic (PV) module safety qualification - part 1: Requirements for construction and part 2: requirements for tests.

### 1.2.2. Solar thermal standards

- EN 12975 1 and 2: General requirements and control method for solar thermal collectors.
- EN 12976 1 and 2: General requirements and process for testing prefabricated solar thermal installations.

### 1.2.3. Standard and DTU (french standard) to be respected - Plumbing and heating systems

- DTU 65.10: implementation of pressurized hot/cold water pipes as well as wastewater and rainwater pipes inside buildings
- NF EN 15316-4-2: Energy performance of buildings - Method for calculating energy needs and system efficiencies - Part 4-2: space heating generation systems, heat pump systems module M3-8-2, M8-8-2
- NF P 52-612: Heating systems in buildings - Method for calculating low heat losses
- NF EN 12977: Solar thermal installations and their components - Custom assembled installations - Part 1: general requirements for solar water heaters and combined solar installations
- DTU 65.14: execution of hot water heated floors
- DTU 65.16: heat pump installations

The installation instructions and safety instructions must be met.

Observe the regulations on the prevention of industrial accidents prescribed by professional associations, in particular those relating to work carried out on the roof.

## 1.3. Dimensional conventions

In the content of this notice we have chosen to follow the following convention:

**Threads** : use of the EN ISO 228/1 standard. All threads are defined in inches.

**Pipe diameters** : Use of the EN ISO 6708 standard. All internal diameters are defined in mm and preceded by the prefix DN.

## 1.4. End of life of panels

DualSun panels should be recycled



# 2. Description of a solar thermal heat pump system

## 2.1. Principle of operation of a solar thermal heat pump system and definition of terms

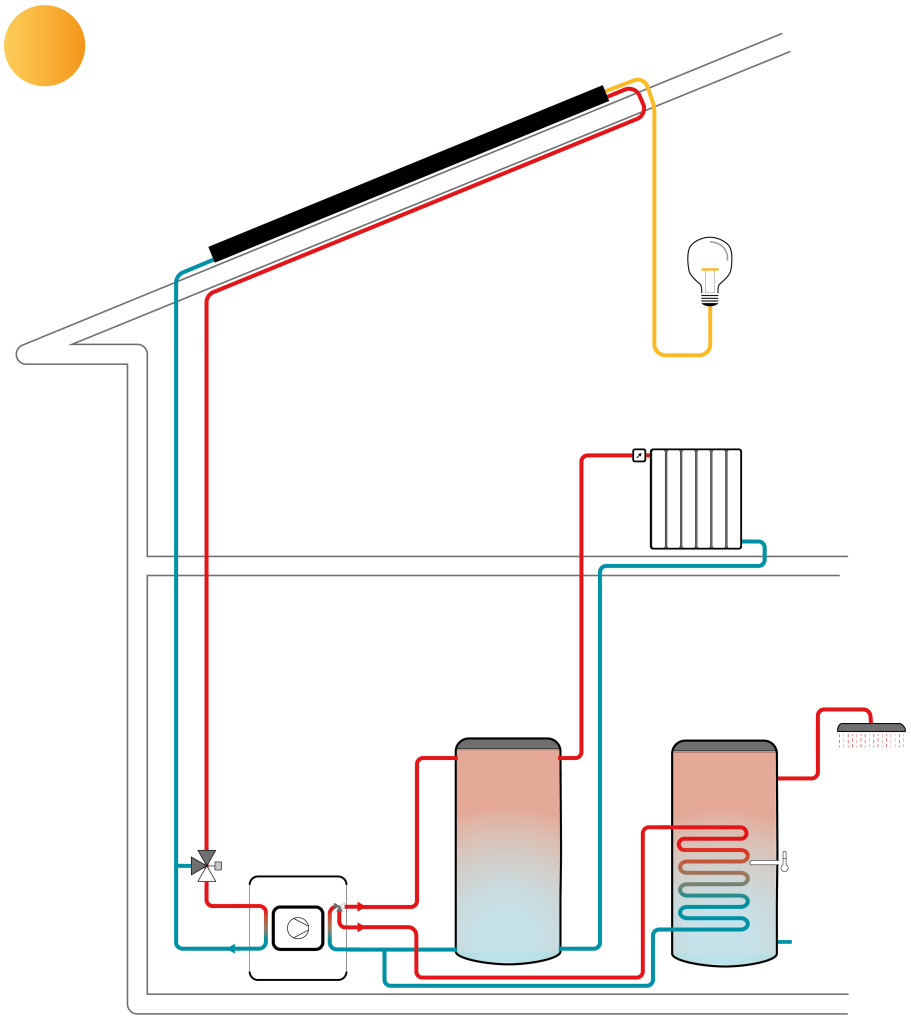
A solar thermal system is mainly composed of a glycolated water/water heat pump whose evaporator is thermally supplied by solar panels to meet the thermal needs of a building: heating and domestic hot water.

Both sides of the solar panel Dualsun SPRING MAX are used as follows:

- The heat exchanger integrated into the back side takes heat from both the outside air via the fins and from solar radiation to transfer it to the refrigerant of the heat pump via the evaporator.
- The photovoltaic cells on the front side of the panels produce electricity to partially supply the electrical consumption of the heat pump compressor.

This system combining the heat pump and hybrid solar panels improves significantly the performance of the heat pump by largely reducing its electricity consumption on the electricity grid.

The schematic diagram of this coupling is illustrated in the following figure:



**STANDARD CONFIGURATION SHOWN**

Information: In this manual, all dimensions and descriptions consider a configuration that we have defined as standard: Water/water heat pump supplying a DHW tank and a heating circuit via a buffer tank. This tank can be integrated into the domestic hot water tank (so-called combi tank) or separated. As shown in the diagram in the chapter Description of a solar thermal heat pump system [5]

## 2.2. List of components

The components of the system coupling the DualSun hybrid panels and the Water/Water heat pumps are described in the following diagram and table.

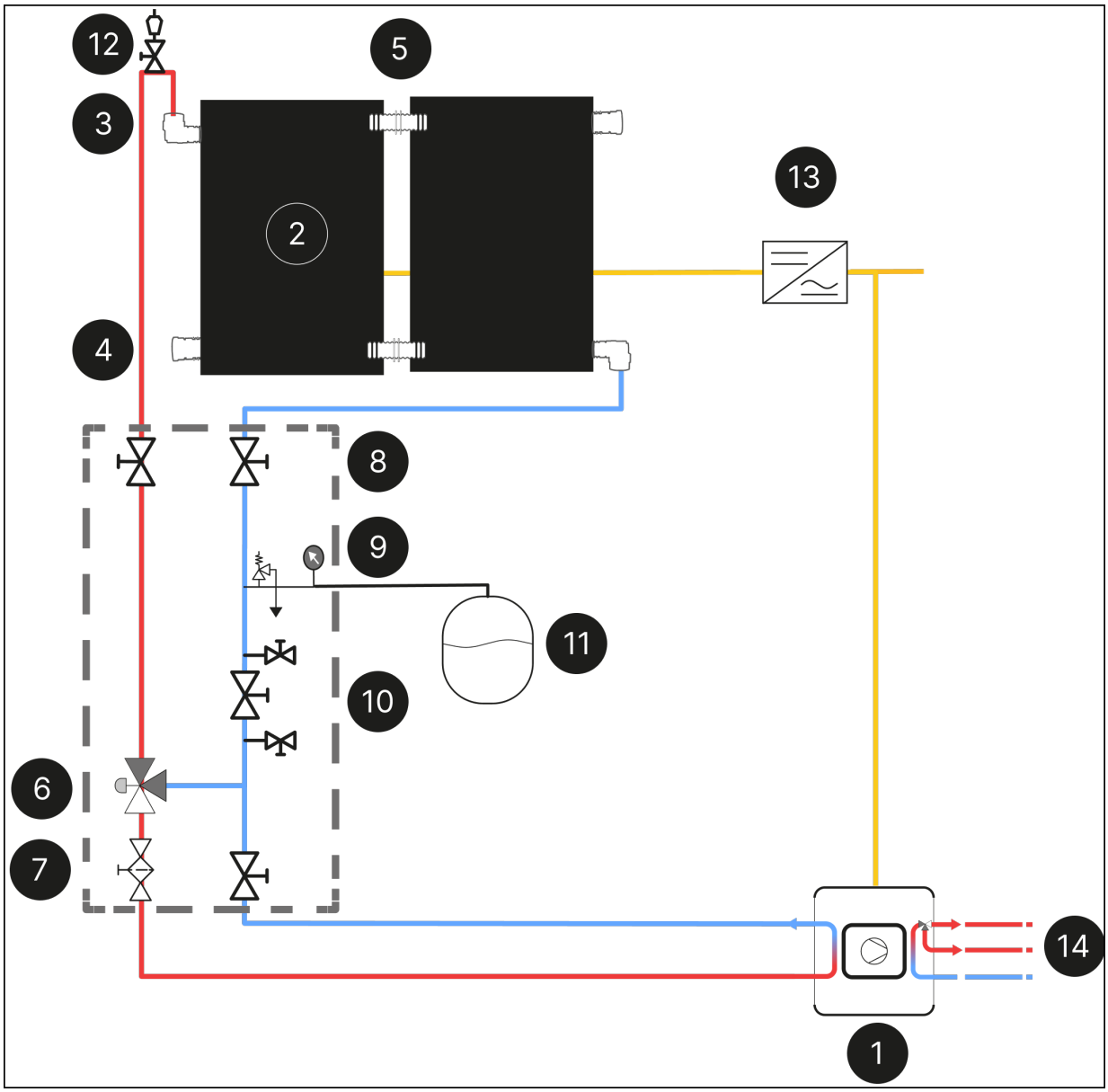


**Table 1. List of components associated with the diagram illustrating the solar thermal system**

| Number | Description | Comment |
|---|---|---|
| 1 | Glycoled water to Water heat pump (HP) | |
| 2 | Dualsun SPRING MAX | |
| 3 | 1”¼ Inlet/Outlet fitting kit | Included in the inlet outlet fitting kit |
| 4 | Plugs | Included in the inlet outlet fitting kit |
| 5 | Inter-panel connections | Included in the inter-panel kit |
| 6 | Motorized 3-way mixing valve | included in the DualSun solar thermal station |
| 7 | draining valve | included in the DualSun solar thermal station |
| 8 | Isolation valves | included in the DualSun solar thermal station |
| 9 | Security group | included in the DualSun solar thermal station |
| 10 | Filling kit | included in the DualSun solar thermal station |
| 11 | Expansion tank | |
| 12 | Automatic air vent | |
| 13 | Inverter or microinverter | Not covered in this notice |
| 14 | Start of DHW or heating circuit | Not covered in this notice |

## 2.2.1. The heat pump

### Description

The heat pump is the central component of the system. It forms the link between the collection circuit, powered by the thermal circuit of the hybrid solar panels, and the production circuit, supplying the heating system and the domestic hot water tank.

### Selection criteria

The criteria for choosing the heat pump are as follows:

- Heat pump with **Inverter technology**. This type of heat pump has the main advantage of modulating the speed as well as the electrical consumption of the compressor according to the thermal power requested in the home and the thermal power available in the solar collectors, unlike a pump ON/OFF heat pump more suitable for coupling with geothermal probes.
- **Low evaporator inlet temperature limit** less than or equal to -15°C. This limit has a significant impact on the seasonal performance of the system. For example, if the lower limit is -10°C instead of -15°C, this can lower the annual performance of the system by up to 25%
- **Integrated cold source defrost function**. This allows the heat pump to defrost the solar panels when necessary to avoid the thick formation of icing on their surfaces and thus degrade their thermal performance. When the heat pump does not incorporate this deicing function, a regulation external to the heat pump must be added. This regulation must be able to stop the heat pump and start a defrosting cycle when the following two conditions are maintained for more than one hour: (1) the temperature difference between the outlet of the solar panels and the outside air greater than 10K and (2) the outside temperature is lower than -5°C.
- **High temperature limit at the inlet of the evaporator** greater than + 15°C.
- **Maximum service temperature** . This temperature must depend both on the services to which the heat pump responds (domestic hot water, for example), on the type of heat emitters for heating (floor heating, water radiators, etc.) and on the level of customer comfort.
- **Integration of an electrical backup**. In most cases, the heat pump is not sized to fully meet the thermal needs of a home. If no backup is integrated into the heat pump, it must be added to the system (in line at the output of the heat pump production circuit, or inserted into the hot buffer tanks).

**WARNING**
When the choice of heat pump does not meet these criteria, the performance of the system will be degraded.

## Sizing

The heat output of the heat pump is estimated based on heat losses from the home. A simple sizing method is proposed by DTU 65.16 with the following formula:

$P_{cal,PAC}=n_{cov}*V*G*(T_{cons}-T_{base})$

Where

- $P_{cal,PAC}$ is the calorific power of the heat pump [kW] given to $T_{base}$
- $n_{cov}$ is the coverage rate, it must be between 0.8 and 1.2
- V is the volume of the hearth to be heated [$m^3$]
- G is the volumetric heat loss coefficient [W/m3.K]
- $T_{desired}$ is the desired indoor temperature [°C]
- $T_{Base}$ is the lowest outside temperature recorded at least 5 days during the year [°C]

For the dimensioning of the electrical backup, the sum of its power and that of the heat pump must be greater than 1.2 of the heat losses of the home:

$P_{appointment} \geqq 1.2*V*G*(T_{cons}-T_{base}) - P_{cal,PAC}$

## Compatibility

DualSun has studied the compatibility of a number of heat pumps. The non-exhaustive compatibility list can be found in the Dedicated FAQ on our site.

## 2.2.2. Panel Dualsun SPRING MAX

## Description

Hybrid panels Dualsun SPRING MAX constitute the only cold source of the heat pump: they are connected hydraulically to the primary circuit (capture circuit) of the heat pump. The solar installation is thus dimensioned according to the characteristics of the heat pump to supply heat to its evaporator

## Sizing

We recommend the following sizing ratios depending on the heat pump technology and the low temperature limit of its evaporator:

### Table 2. Sizing ratios

| Compressor technology | Low limit temperature at evaporator inlet [°C] | Base temperature [°C] | Sizing ratio [SPRING number per calorific kW of the heat pump at B0/W35] | SPRING number for a 9kW B0/W35 heat pump |
|---|---|---|---|---|
| Inverter | ≤-15°C | ≤-10°C | 1,5 | 14 |
| | | >-10°C | 1,3 | 12 |
| | ≤-10°C | ≤-10°C | 1,7 | 16 |
| | | >-10°C | 1,5 | 14 |

| Compressor technology | Low limit temperature at evaporator inlet [°C] | Base temperature [°C] | Sizing ratio [SPRING number per calorific kW of the heat pump at B0/W35] | SPRING number for a 9kW B0/W35 heat pump |
|---|---|---|---|---|
| ON/OFF | ≤-15°C | ≤-10°C | 1,6 | 15 |
| | | >-10°C | 1,4 | 13 |

These ratios were calculated in order to ensure a better compromise between the initial cost of the solar installation and the energy performance of the system and may change according to the details of the configuration of the installation.

The rule is simple here: the greater the number of panels used, the better the thermal performance of the heat pump. It is recommended to round this number of panels according to the constraints of the roof to favor an identical number of panels per hydraulic field. For example, if your dimensioning recommends 14 panels and the roof requires an installation on 3 lines, it is preferable to install 15 panels to have 3 hydraulic fields of 5 panels each).

**STANDARD CONFIGURATION SHOWN**

Information: In this manual, all dimensions and descriptions consider a configuration that we have defined as standard: Water/water heat pump supplying a DHW tank and a heating circuit via a buffer tank. This tank can be integrated into the domestic hot water tank (so-called combi tank) or separated. As shown in the diagram in the chapter Description of a solar thermal heat pump system [5]

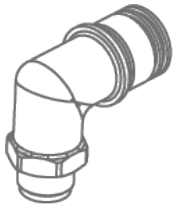
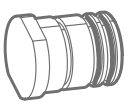
## 2.2.3. Input-output kit

### Description

The inlet/outlet kit allows you to connect a hydraulic panel line to the general piping of the heat pump's primary circuit.

It is composed of the following elements:

- Two 1" ¼ elbow connections for the inlet and outlet of the hydraulic line
- Two plugs

| Connection | Plug |
|---|---|
|  |  |
| X2 | X2 |

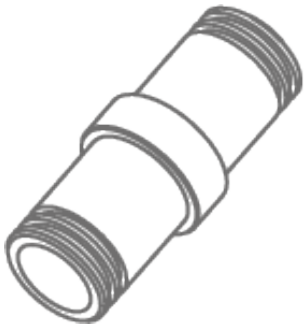
**NOTE**
The quantities presented here are in the case of a line of panels

For more information please see the data sheet of the SPRING4 1 ¼" Input/Output kit And the SPRING4 installation, use, maintenance instructions.

### Sizing
You must count one hydraulic kit per hydraulic line of panels.

## 2.2.4. Inter-panel connections

### Description

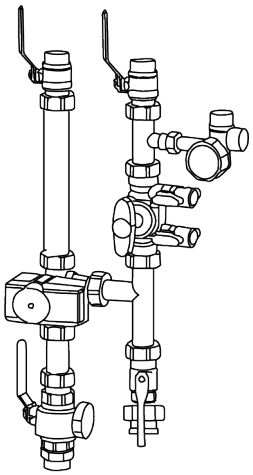


The inter-panel kit contains two hydraulic inter-panel connections allowing two panels of the same hydraulic line to be connected in parallel.

For more information please see The technical sheet of the SPRING4 inter-panel connector kit And the SPRING4 installation, use, maintenance instructions.

### Sizing
An inter-panel connection kit is required for each intersection of two panels, that is to say, for each line, add the number of panels minus 1.

## 2.2.5. The DualSun solar thermal heat pump station



The solarothermal solar station makes it possible to facilitate the installation of a Dualsun MAX system by including all the hydraulic elements necessary for the installation and maintenance of the primary heat pump circuit.

**NOTE**
If you have ordered the DualSun solar thermal station, the elements detailed in the list of components are included in the kit and constitute a single element.

## Motorized 3-way mixing valve

The mixing valve is an essential element to protect the heat pump evaporator from excessively high temperatures coming from the solar field.

It is installed at the outlet of the solar panels upstream of the heat pump. It is used to limit the temperature at the inlet of the evaporator of the heat pump when the temperature at the outlet of the solar field exceeds its set temperature by mixing with fluid coming from the evaporator as you can see in the diagram in the chapter Principle of operation of a solar thermal heat pump system and definition of terms [5].

We recommend the use of the following ESBE brand set (integrated into our solar station):

- the VRG332 DN25 valve with 1" ¼ connections under this reference 11700700.
- The CRA211 controller designed to ensure a constant temperature at the evaporator inlet when the temperature coming from the panels exceeds its set point. It is equipped with a temperature probe to be applied to the pipes and a motor compatible with the VRG332 mixing valve.



ESBE VRG332 DN25




ESBE CRA211

**IMPORTANT**
**Choice of the valve setpoint temperature:**

The valve setpoint must be set to the maximum temperature limit at the inlet of the -5K heat pump.

**IMPORTANT**
An electrical outlet must be provided nearby to power the valve using its AC/DC transformer which is supplied with the CRA211 regulator.

**NOTE**
The mixing valve must be compatible with the operating conditions of the system (temperature, pressure and type of heat transfer fluid), and must have a KVS equal to or less than 15 m3/h.

## Security group

The security group consists of two components:

- Visual pressure gauge 0-10 bar
- 6 bar safety valve




The visual pressure gauge is useful for controlling the pressure, especially when filling and purging the hydraulic circuit of solar panels. The one integrated into the Dualsun solarothermal station displays the pressure between 0 and 10 bar.

A safety valve is essential to avoid overpressure in the hydraulic circuit, thus avoiding damage to pressure-sensitive components.

The safety valve of the Dualsun solarothermal station is set to 6 bar.

**NOTE**
The safety group integrated into the Dualsun solarothermal station also allows the connection of an expansion tank.

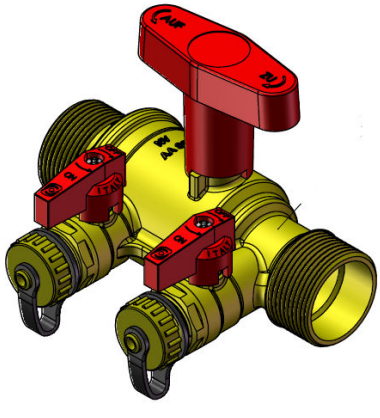
## Filling kit

A filling kit is essential to ensure the filling and commissioning of the system.

The one integrated into the Dualsun solarothermal station has a DN32 diameter and 1” ¼ connections in order to limit pressure losses in the hydraulic circuit.

The drain and fill connections are ¾” in length.

See detailed filling and commissioning steps in the chapter Filling and commissioning [36].



**WARNING**
In order to minimize pressure losses in the circuit, the filling kit must have an internal diameter equal to or greater than the diameter of the circuit piping. It should not incorporate diameter reductions inside.

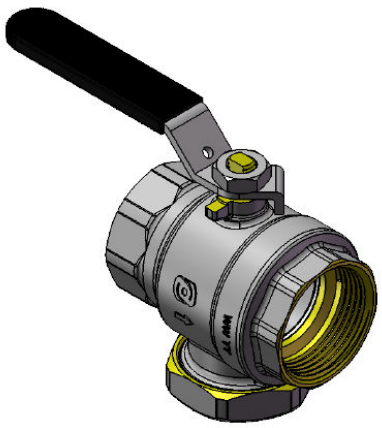
## Filter valve

As provided in DTU 65.16, we recommend installing a filter valve on the solarothermal heat pump collection circuit.

The filter valve is a ball valve equipped with an integrated filter and magnet. It ensures the filtration of the fluid contained in the solar circuit by retaining any deposits or impurities. It must be connected to the hot side of the evaporator in order to protect it from impurities upstream of the circuit

The fineness of the filter integrated into the Dualsun solarothermal station is 0.7 mm.

The hydraulic connection size of the valve integrated into the Dualsun solarothermal station is 1” ¼”.

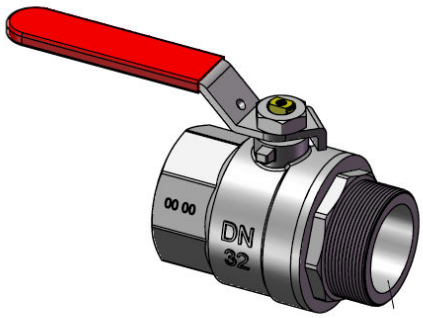


**WARNING**
In order to limit pressure losses in the hydraulic circuit during operation, the filter must be removed once the hydraulic system is filled and put into operation.

### Isolation valves

In order to be able to isolate the Dualsun solarothermal station, 3 male-male isolation valves with a size of 1" ¼ are pre-integrated in addition to the filter valve.

These 4 valves facilitate the isolation of the various components of the primary heat pump circuit (evaporator, PVT and solarothermal station) in order to facilitate their maintenance and maintenance if necessary.




## 2.2.6. Expansion tank

### Description

As with any pressurized heating system, an expansion tank is necessary to absorb/compensate for pressure variations linked to temperature variations in the solar circuit.

### Sizing

The volume of the expansion tank must be dimensioned according to the total volume in the circuit: panels and pipes.

**CAUTION**
It should be checked **if the heat pump integrates an expansion tank in the primary circuit**

In this case, the volume of the expansion tank to be added is equal to the difference between the necessary dimensioned volume and the volume of the expansion tank integrated into the heat pump.

It is also necessary to check the preset pressure on the vessel integrated into the heat pump to adjust that of the external vessel. The pressures must be adjusted so as to guarantee sufficient pressure at all points in the circuit. The pressure at the heat pump evaporator should generally not exceed 3 bar gauge. However, the pressure at the installation level at the solar installation must not exceed 4 bar gauge.

## 2.2.7. Heat transfer fluid

### Description

The choice of heat transfer fluid is crucial for the protection and functioning of the system.

In fact, its main role is to effectively transport the heat from the solar panels to the heat pump evaporator while maintaining its quality and its liquid physical state in the face of temperature variations in the circuit.

### Selection criteria

The heat transfer fluid must be a mixture of water and antifreeze (glycol type) allowing it to be used at negative temperatures without the risk of freezing.

For a heat pump whose low limit at the inlet of its evaporator is -15°C, the heat transfer fluid must have a minimum temperature of at least -30°C (taking into account thermal pressures in the solar installation and the heat pump evaporator).

The heat transfer fluid must also be able to withstand high temperatures (up to the stagnation temperature of the Dualsun SPRING MAX, i.e. 70°C).

We recommend using heat transfer fluids:

- with anticorrosion effect
- the least toxic to the environment
- the least viscous at negative temperatures
- ready to use (already mixed)

**WARNING**

Local regulations must also be taken into consideration when choosing the type of heat transfer fluid.

Here is the list of antifreeze we recommend using:

- Mixture of distilled water and 75% 1,3-propanediol (biodegradable plant-based anti-freeze), pre-mixed glycol type Greenway NEO -30
- Mixture of distilled water and 65% 1,3-propanediol (biodegradable plant-based anti-freeze), Greenway NEO -25 pre-mixed glycol type, only for locations with T_base > -10°C
- Mixture of distilled water and 50% Monopropylene Glycol (MPG)
- Mixture of distilled water and 45% Monopropylene Glycol (MPG), only for locations with T_base > -10°C

**WARNING**

In case pure glycol is used, in order to avoid the corrosion of the metals present in the capture circuit, it is important to use distilled water to dilute this glycol until the recommended percentage is obtained, verified with a refractometer.

## Sizing

The volume of the heat transfer fluid corresponds to the total volume of the solar circuit which corresponds to the sum of the following volumes:

- Volume of external hydraulic pipes, which depends on their length and radius
  $V = Pi \times r_{ext}^2 \times L_{ext}$
- Volume of internal hydraulic lines
  $V = Pi \times r_{int}^2 \times L_{int}$
- Volume of solar panels
  $V=N_{SPRING4} \times V_{SPRING4}$, where $V_{SPRING4} = 3.57$ L
- Heat pump evaporator heat exchanger volume
- Filling volume of the expansion tank

## 2.2.8. Hydraulic lines

## Description

It is necessary to use pipes with a material compatible with the operating temperatures and pressure of the solar circuit:

- -35°C to +85°C
- Pressure up to 6 bar
- Mono Propylene glycol concentration (up to 50%) or 1,3-propanediol (up to 75%)

Stainless steel or copper pipes may be used.



### NOTE

The pipes must have different specifications depending on whether they are located in the house or outside (on the roof).

- Outside: anti-UV hydraulic lines must be used.
- Inside: sufficiently insulated hydraulic lines must be used. The insulation must be airtight to prevent the penetration of water vapor. This is to prevent condensation and icing phenomena from occurring inside the fireplace



### IMPORTANT

In order to avoid condensation from the pipes in the fireplace, the pipes must be insulated with a sufficient thickness so that the surface temperature of the insulation is no lower than the dew temperature. For a minimum temperature of 20°C, a relative humidity level of 65% and a fluid temperature of -25°C, we recommend an insulator with a minimum thickness (with thermal insulation of less than 0.036 W/m.K at 0°C



### NOTE

We recommend the installation of isolation valves upstream and downstream of the various hydraulic components to facilitate the maintenance and/or replacement of these components.

**NOTE**
It is important to limit the multiplication of materials used in the circuit.

## Sizing

The diameter of the pipes must be dimensioned to ensure nominal operation in the capture circuit to optimize heat exchange in both the heat pump evaporator and the Dualsun solar panels according to the lowest possible temperature values.

This diameter thus depends on several parameters:

- nominal operation for optimal heat exchange
- the pressure height of the circulator integrated into the heat pump
- the viscosity of the heat transfer fluid
- the total pressure losses of the circuit (heat pump evaporator, solar installation, solarothermal station and pipes)

**NOTE**
The inlet/outlet kits have a 1 ¼" male thread, when the diameter of the connected hydraulic transfer lines is different, hydraulic reducers must be used.

## Sizing charts for 9 kW heat pump (B0/W35)

### Table 3. 9 kW heat pump (B0/W35) coupled to 14 Dualsun SPRING MAX (∆T evaporator <4 K for an average temperature in the circuit of -15°C)

| **Base temperature ≤ -10°C** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Heat transfer fluid** | *1,3-propanediol 75%* | | | | *MPG 50%* | | | |
| **Hydraulic configuration** | *1 common start* | | *1 start per solar line* | | *1 common start* | | *1 start per solar line* | |
| **Type of pipe** | Stainless steel | COPPER | Stainless steel | COPPER | Stainless steel | COPPER | Stainless steel | COPPER |
| **Recommended nominal diameter*** | DN25 | DN20 | DN20 | DN20 | DN32 | DN25 | DN25 | DN20 |
| **∆T evaporator [K]** | 3,6 | 3,5 | 3,8 | 2,7 | 3,1 | 3,2 | 3,2 | 3,6 |
| **Flow [L/h]** | 1555 | 1591 | 1465 | 2027 | 1647 | 1633 | 1622 | 1455 |
| **Pressure loss results for components in mH2O** | | | | | | | | |
| **Solar installation**** | 1,1 | 1,16 | 1,03 | 1,7 | 1,7 | 1,7 | 1,7 | 1,4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Evaporator** | 2,6 | 2,7 | 2,5 | 3,6 | 4,7 | 4,6 | 4,6 | 4,1 |
| **Solarothermal station** | 1,8 | 1,9 | 1,6 | 3 | 2,9 | 2,9 | 3 | 2,3 |
| **General piping** | 14,8 | 14,1 | 4,6 | 2,2 | 8,1 | 8,1 | 2,8 | 2,4 |
| **Solar pipework** | 0,6 | 0,9 | 11,6 | 8,2 | 0,4 | 0,5 | 6,1 | 8,8 |
| **Total pressure losses [mH2O]** | 21 | 21 | 21 | 18,7 | 17,8 | 18 | 18 | 19 |

* For a total length of 35 meters Round trip (averaged by solar hydraulic line).

** Solar installation of 2 hydraulic lines of 7 Dualsun SPRING MAX each one.

## Sizing charts for 12 kW heat pump (B0/W35)

### Table 4. 12 kW heat pump (B0/W35) coupled to 18 Dualsun SPRING MAX (∆T evaporator <4 K for an average temperature in the circuit of -15°C)

| **Base temperature ≤ -10°C** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Heat transfer fluid** | *1,3-propanediol 75%* | | | | *MPG 50%* | | | |
| **Hydraulic configuration** | *1 common start* | | *1 start per solar line* | | *1 common start* | | *1 start per solar line* | |
| **Type of pipe** | Stainless steel | COPPER | Stainless steel | COPPER | Stainless steel | COPPER | Stainless steel | COPPER |
| **Recommended nominal diameter*** | DN32 | DN25 | DN20 | DN20 | DN32 | DN25 | DN25 | DN20 |
| **∆T evaporator [K]** | 3,1 | 2,8 | 3,9 | 2,9 | 3,7 | 3,6 | 3,4 | 3,7 |
| **Flow [L/h]** | 2197 | 2410 | 1765 | 2383 | 1745 | 1750 | 1882 | 1730 |
| **Pressure loss results for components in mH2O** | | | | | | | | |
| **Solar installation**** | 1,1 | 1,3 | 0,8 | 1,2 | 1,1 | 1,1 | 1,3 | 1,1 |
| **Evaporator** | 2,8 | 3,1 | 2,2 | 3,1 | 3,6 | 3,6 | 3,9 | 3,6 |
| **Solarothermal station** | 3,5 | 4,2 | 2,3 | 4,1 | 3,3 | 3,3 | 3,8 | 3,2 |
| **General piping** | 10,2 | 8,0 | 6,5 | 2,6 | 8,9 | 8,7 | 3,7 | 2,9 |
| **Solar pipework** | 0,3 | 0,3 | 8,1 | 5,9 | 0,2 | 0,4 | 3,7 | 6,5 |
| **Total pressure losses [mH2O]** | 17,9 | 16,9 | 19,9 | 17,0 | 17,2 | 17,2 | 16,4 | 17,3 |

* For a total length of 35 meters Round trip (averaged by solar hydraulic line).

** Solar installation of 3 hydraulic lines of 6 Dualsun SPRING MAX each one.

### 2.2.9. Hydraulic drains

In order to effectively purge and fill solar panels, we recommend using automatic solar drains at the top of each hydraulic line in the solar system.

The drain must be automatic and installed downstream of an isolation valve at the inlet of each solar hydraulic line. The valve must be closed following filling and commissioning.

### 2.2.10. Circulator

It is essential to check the pressure height of the circulator integrated into the heat pump to ensure the flow in the capture circuit. It must be equal to or greater than the total value of the pressure losses indicated at the bottom of the design charts above at a temperature of -15 °C.

If this is not the case, an additional circulator must be added in series until the sum of the pressure head is equal to or greater than the total value of the pressure losses. If two circulators are required, they must be connected to the heat pump on the same power supply and the same control signal.

### 2.2.11. Snow guard system (protection against falling frost)

In extreme weather conditions, the operation of the heating system may cause ice sheets to form on the front of the panels.

In order to avoid the sudden sliding of these ice sheets, we recommend installing an ice/snow shield on the roof, especially in the harshest climates.

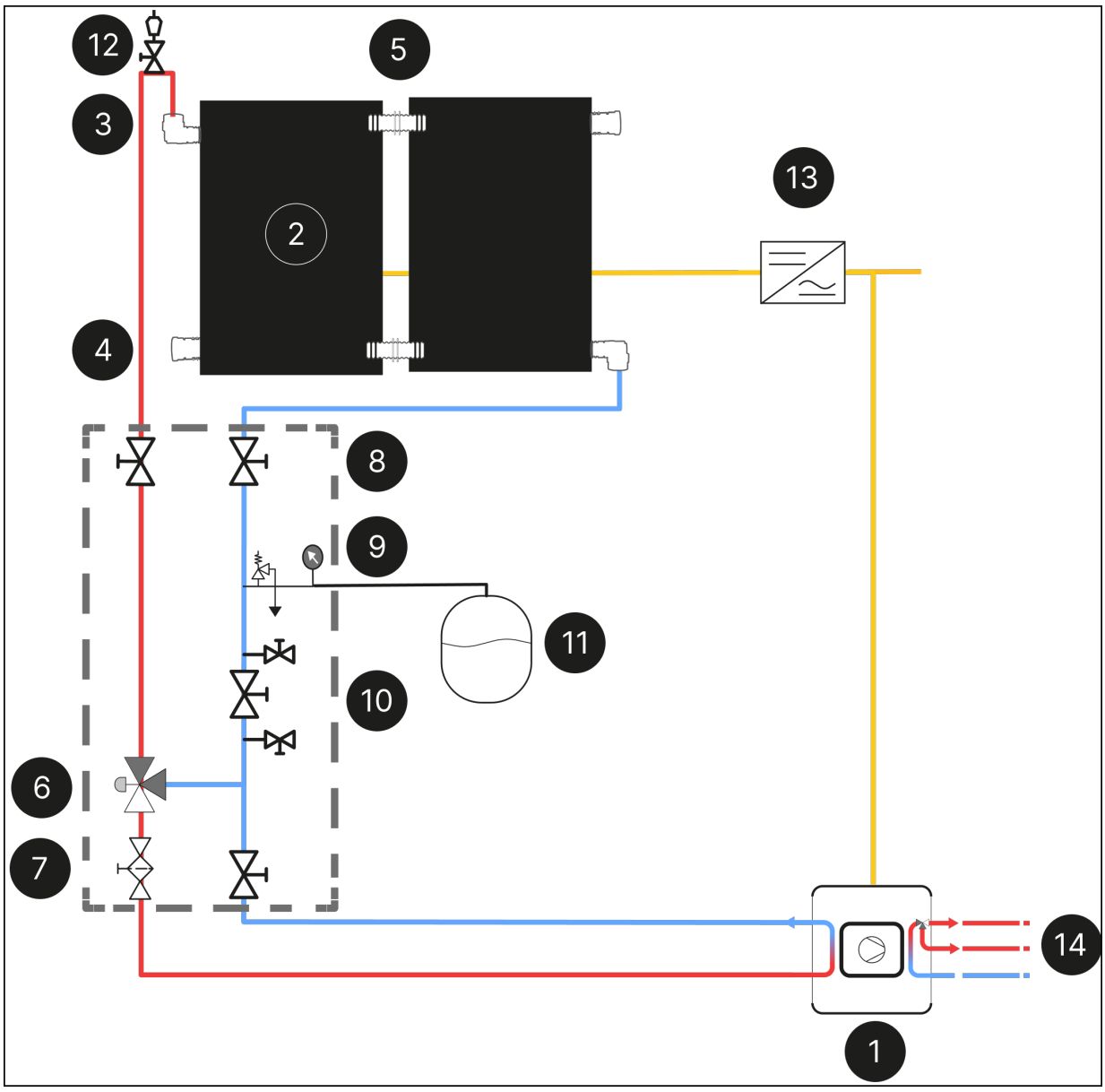
The bottom of the device should be below the glass surface of the panel.

It is also advisable to add a grid to the device to prevent smaller pieces from falling out.





# 3. Installation of solar components




## 3.1. Heat pump installation

To install the heat pump please refer to the technical documentation provided by the heat pump manufacturer.

## 3.2. Installation of hybrid panels Dualsun SPRING MAX

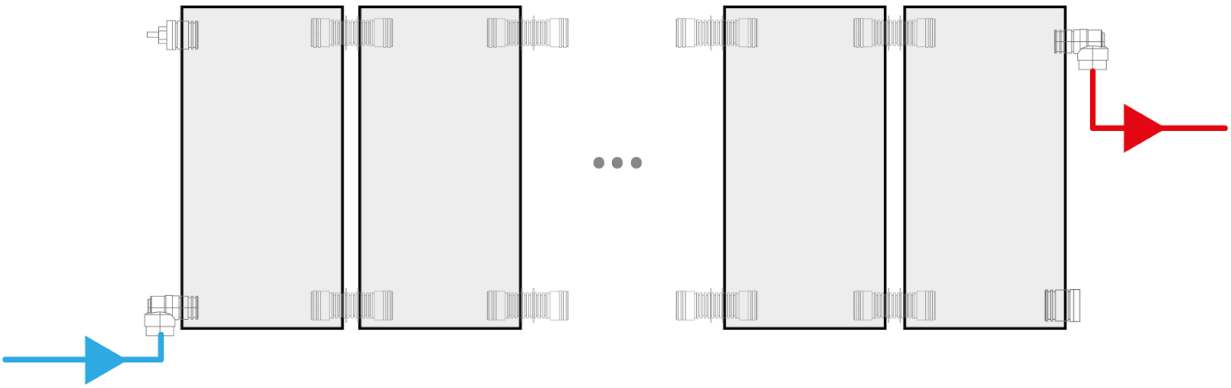
To install the solar panels you can refer to the associated instructions:Installation, use, maintenance instructions SPRING4 in which you will find all the instructions.

When coupling with a solarothermal heat pump, the subject of this manual, it is necessary to maximize exchanges between the outside air and the heat exchanger located at the back of the panel. Dualsun SPRING MAX to optimize the functioning of the system, especially at night (where solar rays are not present).

We therefore recommend taking into account a few specifications:

- **Electrical conversion** : we recommend an electrical coupling of our panels with a centralized inverter.
  In this configuration, unlike a configuration with microinverters associated with each of these panels, the heat exchange between the air and the heat-transfer fluid is better because the air circulates more freely on the back of the panels.
  The use of microinverters is possible with , however, none of them should be in direct contact with the back side of the panel. A minimum distance of 13 mm between the microinverter or optimizer and the back of the module must be respected. The greater this difference, the better the exchanges with the air will be.
  Moreover, coupling with microinverters makes intervention in the event of failure of one of them more complicated because it will require the emptying of part of the hydraulic circuit in order to access the faulty microinverter.
- **Installation system** : the installation system must be chosen to guarantee maximum space between the roof and the top of the rail where the .
  The greater the distance, the better the heat exchange with the air. A rail height of 50 mm or more is ideal.
- **Inter-field space** : If the layout includes several fields of panels arranged one above the other, we recommend spacing them at least 10 cm apart to allow air circulation. The greater the distance, the better the exchanges will be.
- **Orientation** : From a thermal point of view, the orientation (East, West, South or North) has very little influence on the performance of the solarothermal heat pump (having a maximum limit at the inlet of its evaporator): the are capable of producing the thermal energy necessary for the proper functioning of the system regardless of their orientation.
  However, the orientation will have a strong impact on the photovoltaic production of the solar installation. An orientation to the South will receive the most solar energy during a day and throughout the year. If it is not possible to put everything in South orientation, favor an East/West orientation which will optimize electrical self-consumption. An orientation to the North is therefore to be avoided.
- **Inclination** : you should not opt for angles less than 20°, which degrade exchanges with air and therefore the efficiency of the system.
  The influence of the inclination is negligible in the range 20 to 60° on the performance of the heat pump. To maximize photovoltaic production, the inclination depends on the geographical area.
  In areas with a lot of snow, slopes of less than 30° should be avoided, in order to ensure the sliding of snow on the surface of the panels.
- **Layout** : The pose of , used for the Solarothermal heat pump system must be done in Portrait (impossible in landscape), because the fins would not be parallel to the air circulation on the back of the panels, which will degrade the heat exchange with the heat transfer fluid.

### 3.2.1. Hydraulic panel connection



All hydraulic connection directions can work with the panels Dualsun SPRING MAX. On the other hand, to optimize thermal production we impose a so-called Z connection: input at the bottom of the panel and exit at the top on the opposite side

For the details of the operations for the hydraulic connection of the inputs/outputs to the panels and the inter-panel connections, refer to the Instructions for installation, use, maintenance, Dualsun SPRING4.

### 3.2.2. Hydraulic balancing

If the number of panels Dualsun SPRING MAX is greater than 7 (maximum number of panels that can be connected hydraulically on the same field), or if roof constraints impose it, it will be necessary to provide several solar hydraulic lines.

It is essential to balance these lines hydraulically to ensure homogeneous flows between them.

The different possibilities for doing this are listed below for an example of 2 lines of 7 Dualsun SPRING MAX (14 panels in total) on the roof.

**IMPORTANT**

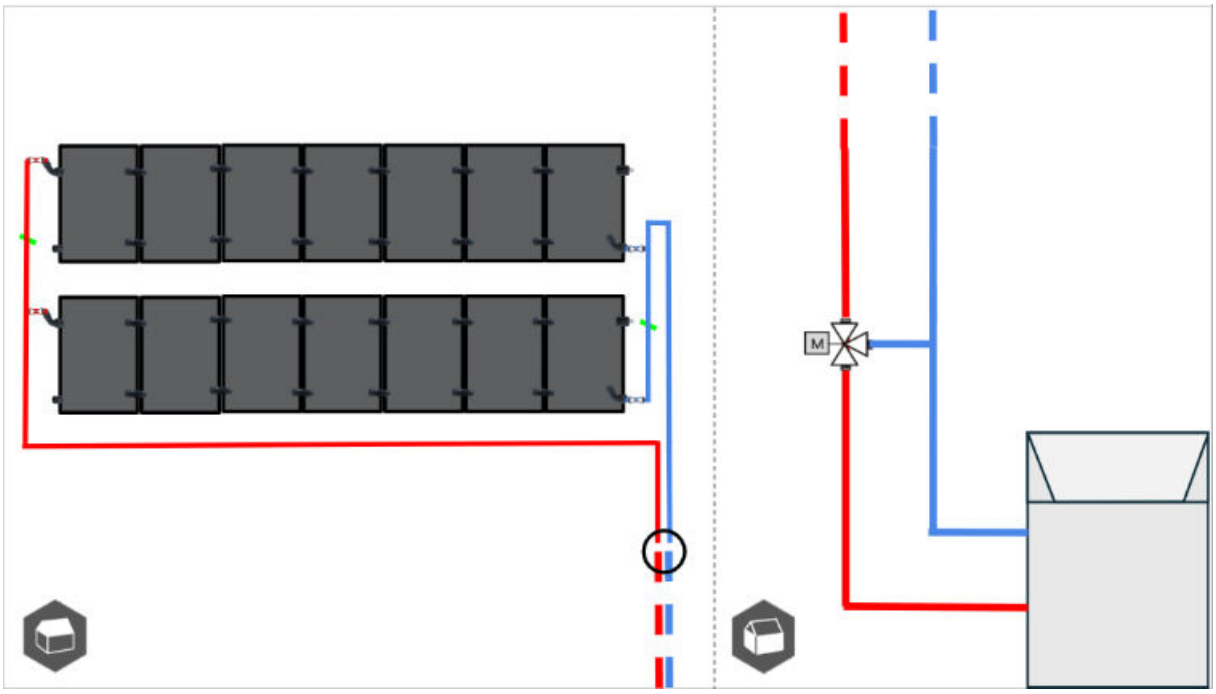
For efficient filling of the panels, we recommend installing shut-off valves at the outlet and inlet of each solar hydraulic line.

**Common start: Tichelmann**

Two pipes (one way and one return) connect the technical room (Solarothermal station and heat pump) and the roof (panels) with hydraulic balancing using the Tichelmann loop principle.

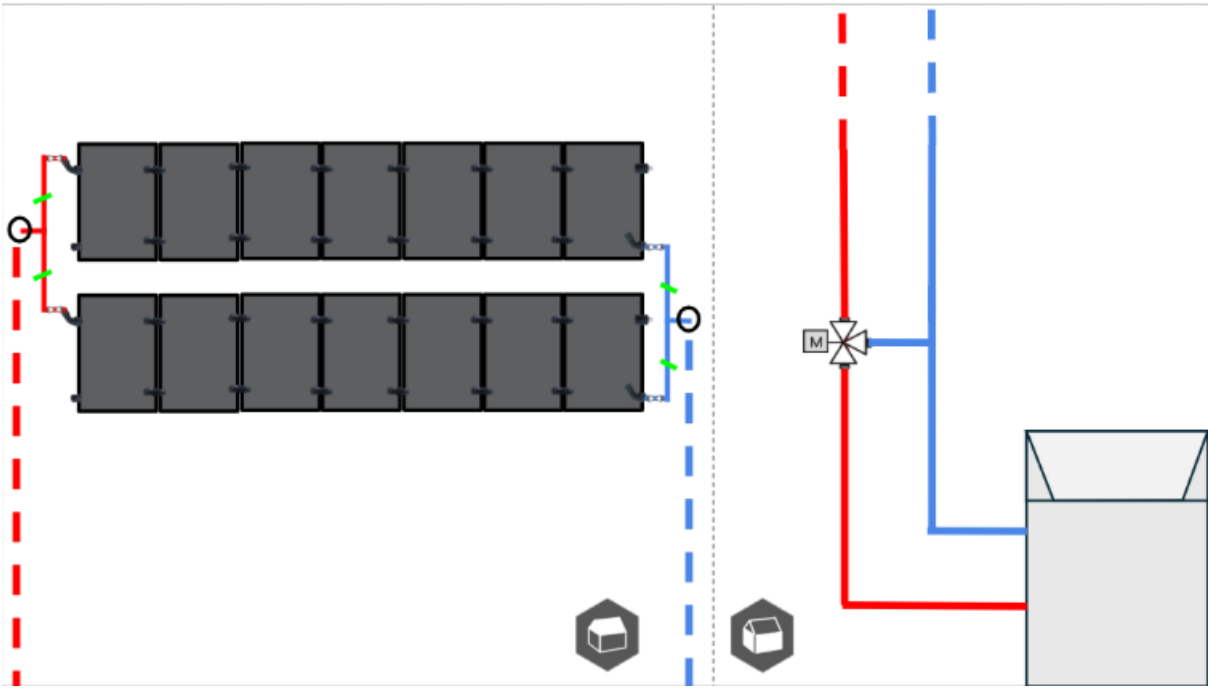
Here the panel fields are identical with the same number of panels, placed in the same direction. The pipes entering and leaving the panel field must be of the same length.

To limit heat loss, it is preferable to extend the cold inlet pipes.




**Common start: Symmetry**

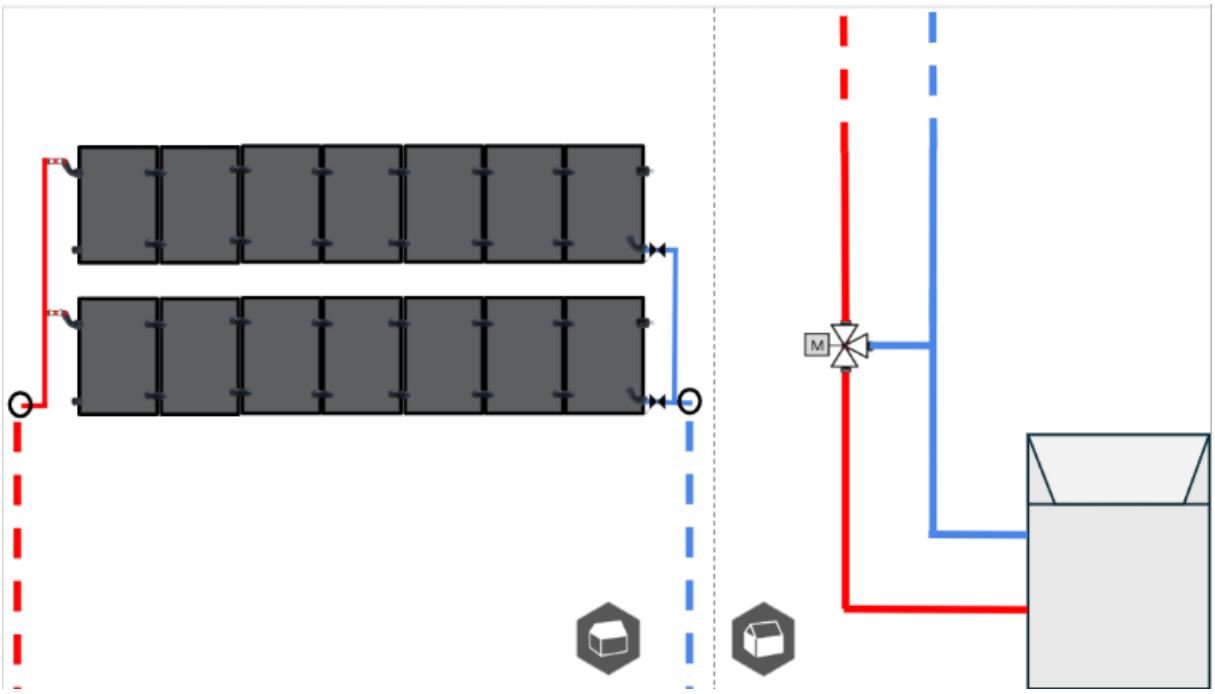
Two pipes (one outgoing and one return) connect the technical room (Solarothermal station and heat pump) and the roof (panels) with hydraulic balancing by ensuring that the length of the pipes at the entrance and exit of the various lines of panels is identical, with distribution by symmetry.



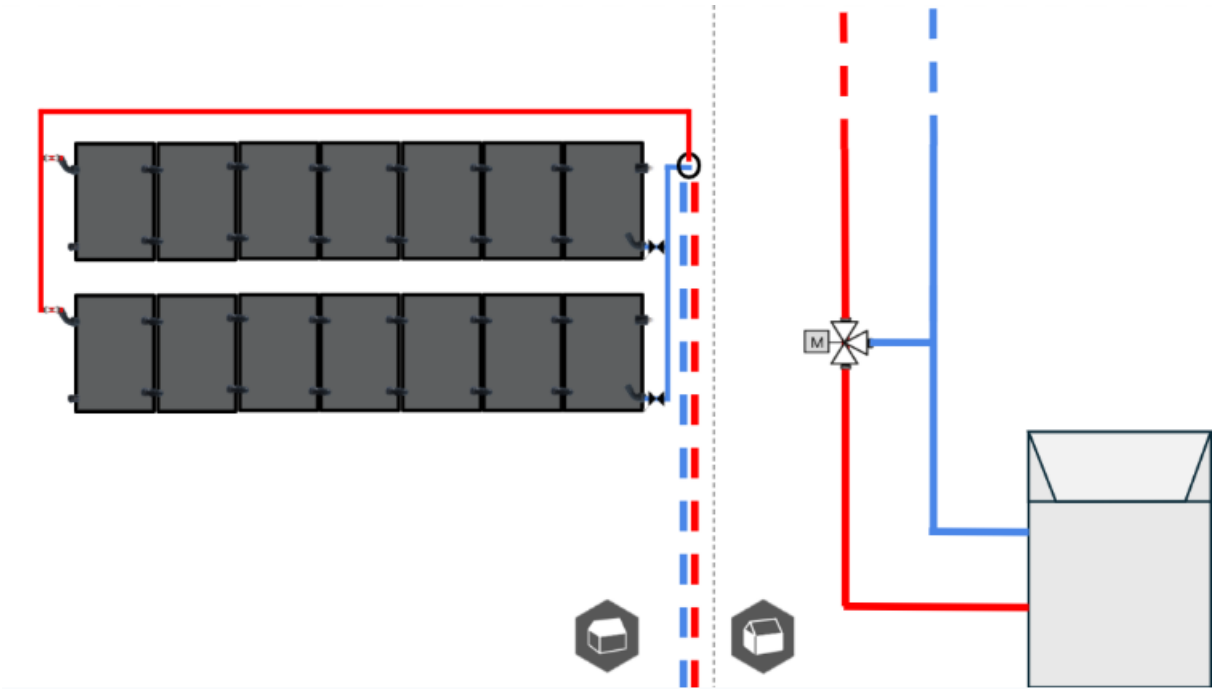

**Common start: Balancing valves**

Two pipes (one outgoing and one return) connect the technical room (Solarothermal station and heat pump) and the roof (panels) with balancing by balancing valves.

The choice of balancing valves depends on the acceptable glycol level, the operating temperatures (minimum and maximum) as well as the pressure losses (see Balancing valves paragraph [28]).




It is possible to provide two distinct outlets on the roof or a common outlet for both pipes (see diagram below):



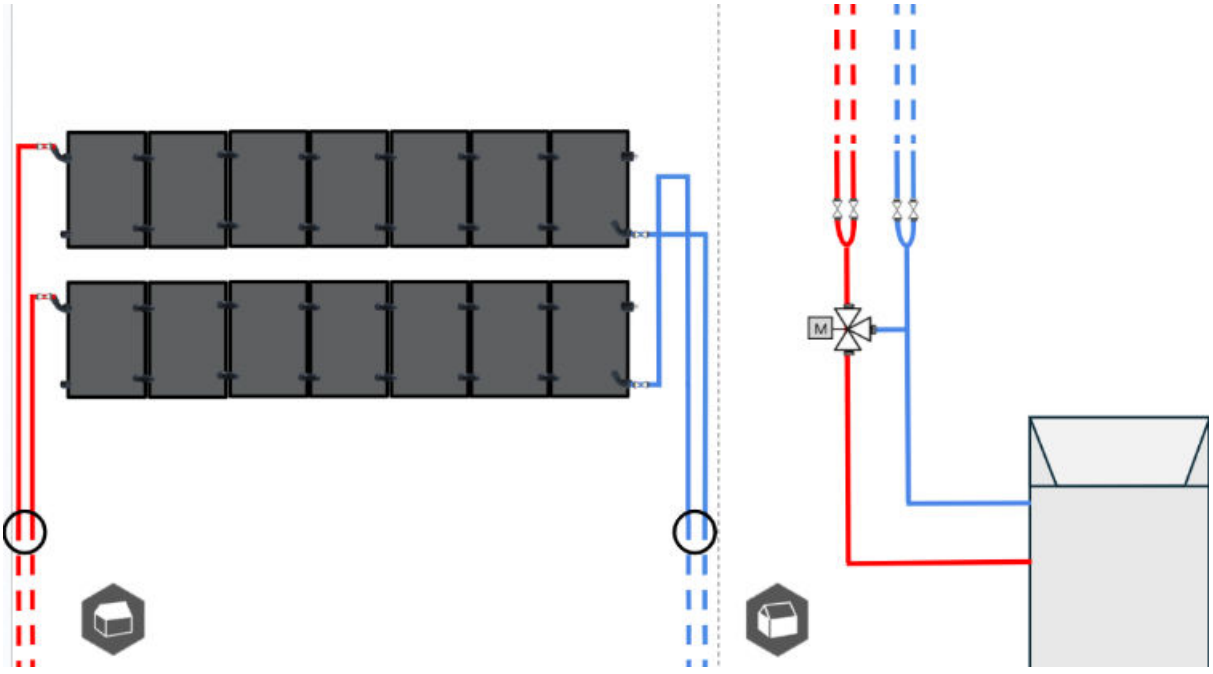

The choice of balancing valves depends on the acceptable glycol level, the operating temperatures (minimum and maximum) as well as the pressure losses (see Balancing valves paragraph [28]).

**Departures dedicated to each hydraulic line: Tichelmann**

Here, each line of panels on the roof is directly connected to the heat pump (in the technical room) by two dedicated pipes (one outgoing and one return).

Hydraulic balancing is carried out by the principle of the Tichelmann loop. The total length of the pipes (to and from) connecting each panel field must be the same.

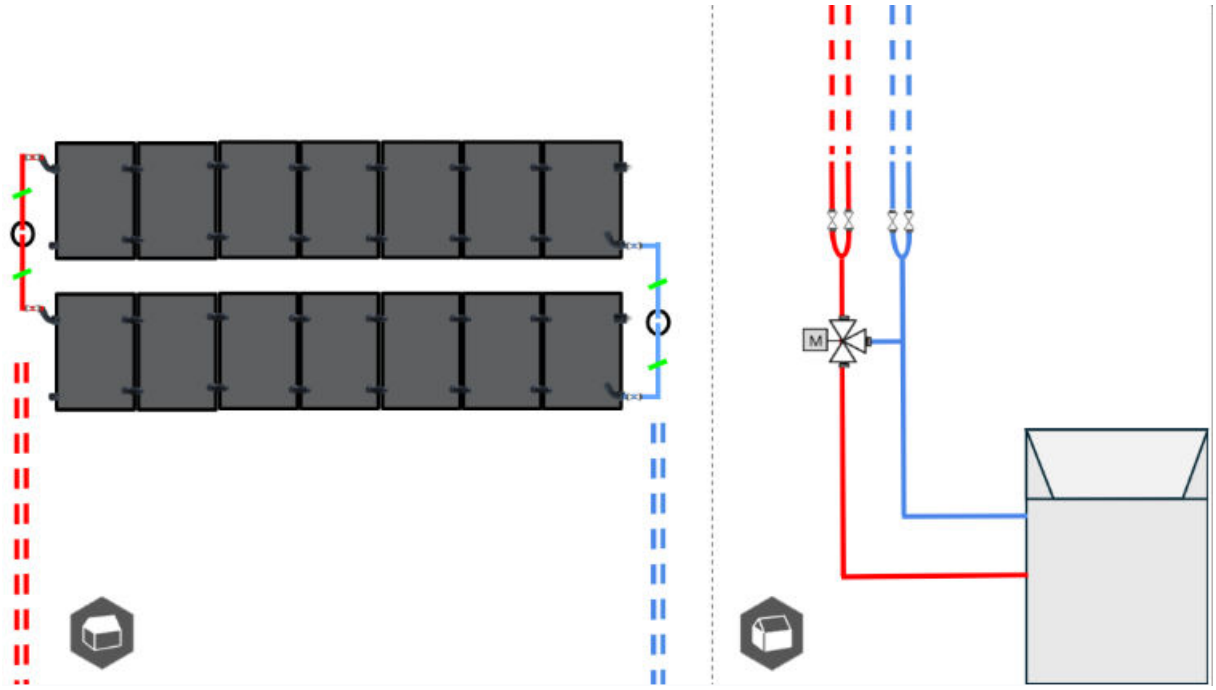
To limit heat loss, it is preferable to extend the cold inlet pipes.




**Departures dedicated to each hydraulic line: Symmetry**

Here, each line of panels on the roof is directly connected to the heat pump (in the technical room) by two dedicated pipes (one outgoing and one return).

Hydraulic balancing is achieved by ensuring that the total lengths (to and from) of the pipes in each line are identical, with symmetric distribution.

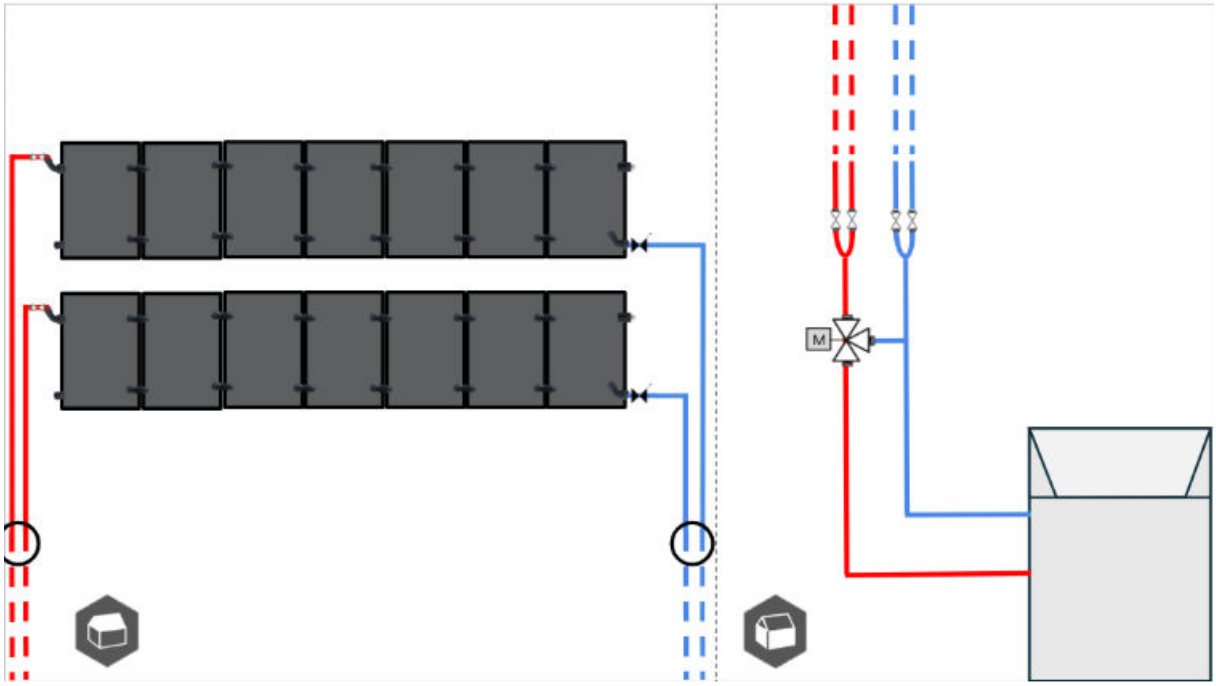



**Departures dedicated to each hydraulic line: Balancing valves**

Here, each line of panels on the roof is directly connected to the heat pump (in the technical room) by two dedicated pipes (one outgoing and one return) with balancing by balancing valves.

These can be installed in the technical room or on the roof.

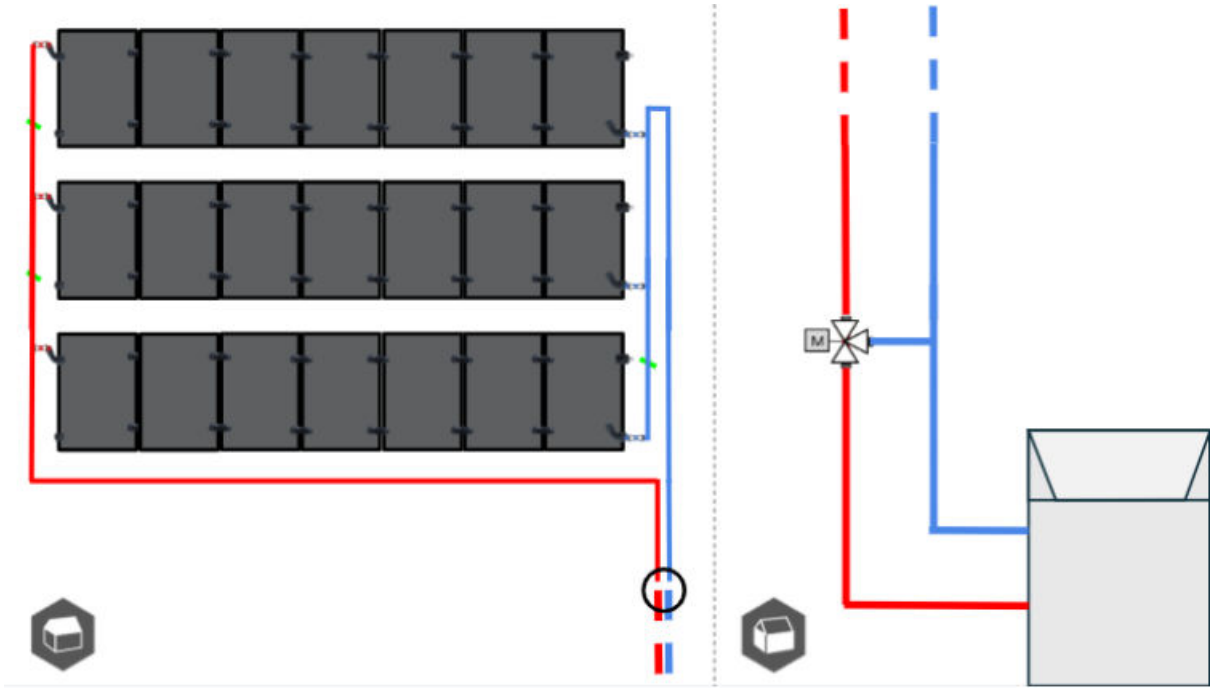
The choice of balancing valves depends on the acceptable glycol level, the operating temperatures (minimum and maximum) as well as the pressure losses (see Balancing valves paragraph [28]).



**Additional hydraulic lines for solar panels (joint departure: Tichelmann)**

All the possibilities described above can be replicated in the event that additional lines are required.

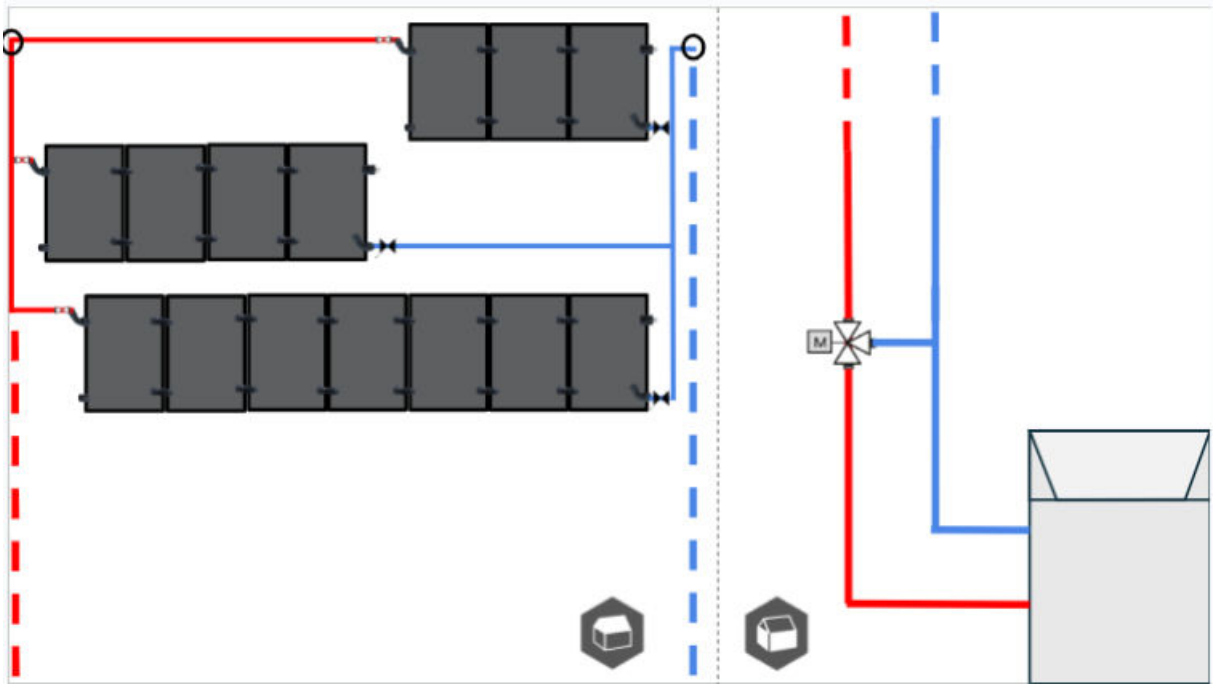
As shown in the diagram below with a common start and hydraulic balancing by Tichelmann loop.



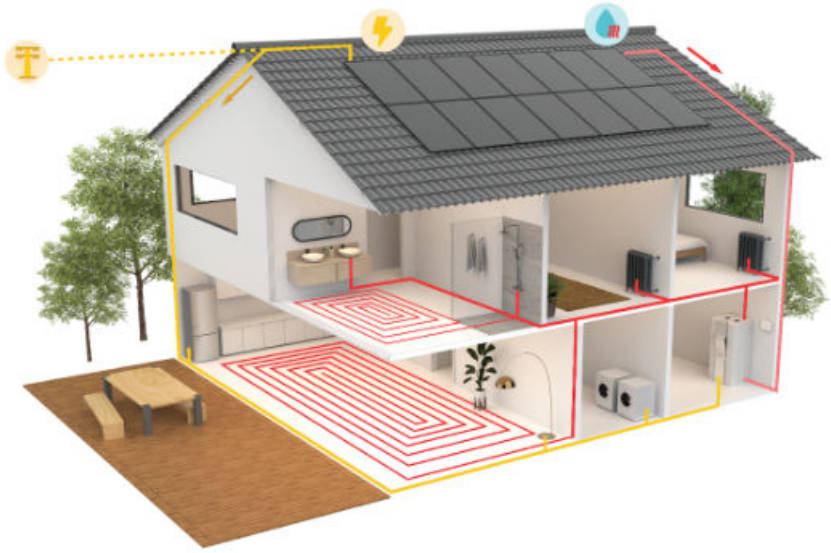
**Several hydraulic lines with a different number of solar panels**

To adjust the balancing of the flows of an installation composed of several unbalanced lines, balancing valves must be used at the inlet of each panel line.

The choice of balancing valves depends on the acceptable glycol level, the operating temperatures (minimum and maximum) as well as the pressure losses (see Balancing valves paragraph [28]).



## 3.3. Installing pipes and accessories



### 3.3.1. Piping installation

**Passage of the pipe from the outside:**

It is preferable to run the pipes connecting the roof panels to the heat pump in the technical room outside the building. This makes it possible to:

- maximize heat exchanges with air
- not having to insulate external pipes (economic gain)
- facilitate implementation

The pipes can be installed discreetly on the front of the house in a false downspout for example or, in the case of a new construction, directly in a channel on the facade outside the house.

**WARNING**
Here, it will be necessary to ensure that the pipes, which become damp due to condensation, are not in direct contact with an insulator sensitive to humidity (provide space so that air can circulate freely around the pipes).

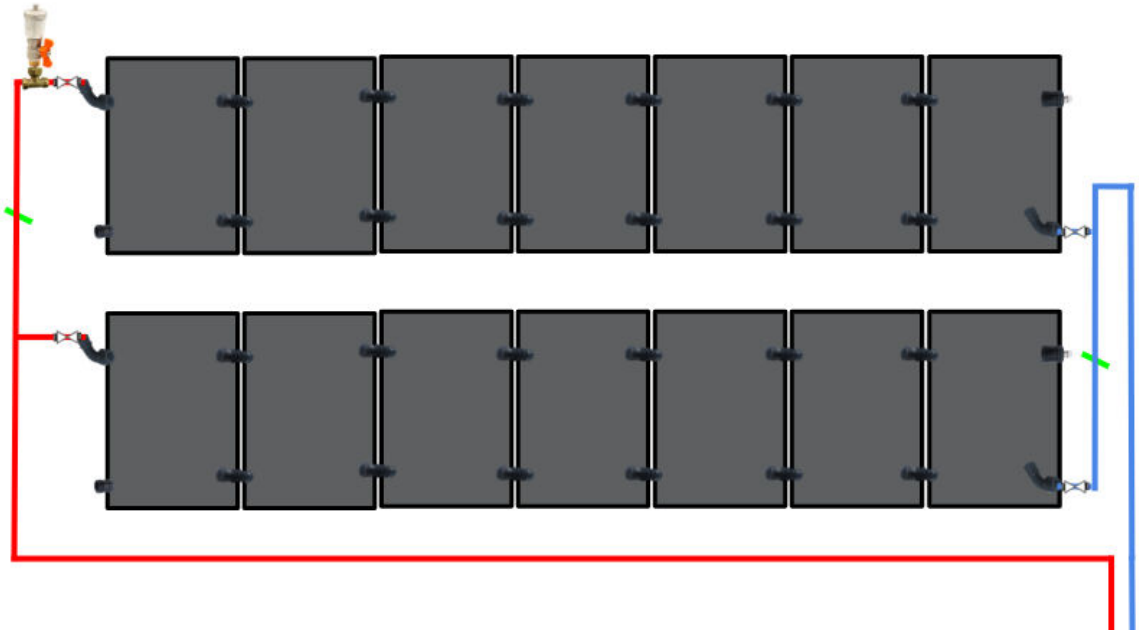
**Passage of the pipe from the inside:**

If the pipes are to be installed inside the house, special attention should be paid to the insulation.

An insulation thickness of at least 19 mm closed at the ends with an anti-condensation tape must be selected (lambda value ≤ 0.037 W/mK at 0°C).

Incomplete pipe insulation can cause water damage due to condensation.

## 3.3.2. Installing air vents



All the high points of the panel fields must be equipped with air vents.

In the case of automatic air vents, they must be mounted on a valve inserted between the sensor and the drain.

Once the installation is in operation and the air is purged, the valves must be closed. The joysticks can be removed. The trap can be dismantled for aesthetic reasons.

## 3.3.3. Installing balancing valves

In the event that balancing via Tichelmann cannot be performed and the installer wishes to use balancing valves, pay particular attention to:

- Acceptable glycol content
- operating temperature range (especially the minimum temperature)
- pressure losses (Kvs value). In order to minimize them, balancing valves must have an internal diameter equal to or greater than the diameter of the circuit piping. Pay attention to internal diameter reductions.

## 3.4. Installation of the Dualsun Solarothermal Station

The Dualsun solarothermal station allows the panels to be connected hydraulically Dualsun SPRING MAX (top) to the heat pump (bottom) including all necessary hydraulic components.

### 3.4.1. Installation of the solarothermal station

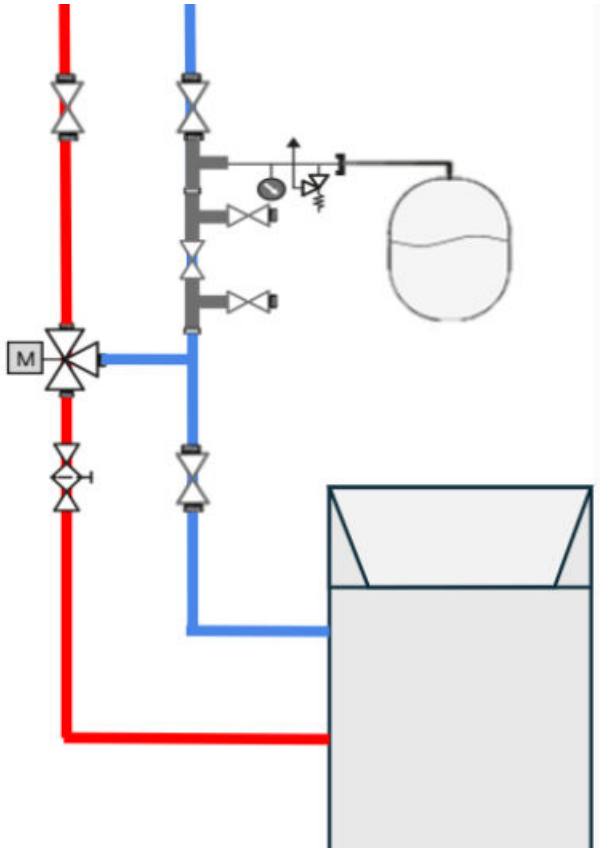
The solarothermal station is delivered assembled and must be fixed to the wall vertically using fixing clamps (not supplied).

It is important to check the tightness of the various nuts to ensure that they have not loosened during transport.

### 3.4.2. Connection of Dualsun SPRING MAX at the solarothermal station

The pipes coming from the panels must be connected to the top of the solarothermal station.

In the case of a **Common start** :

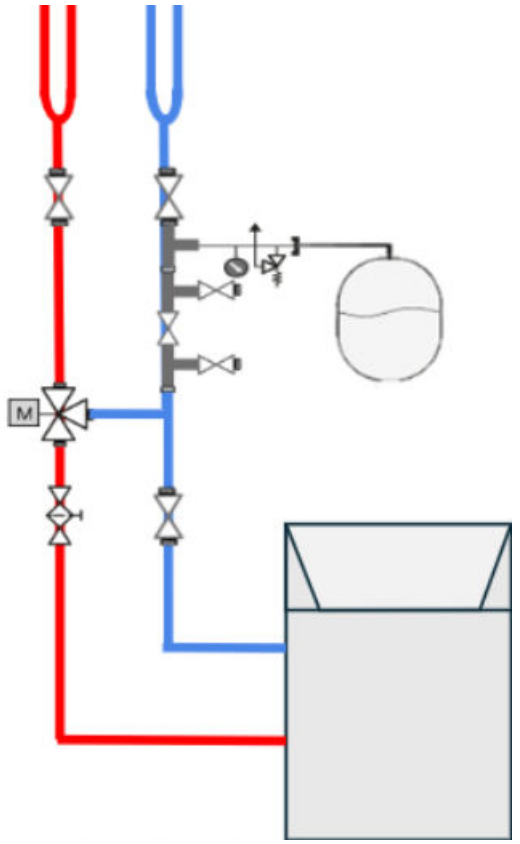



On the left, connect the “Solar Departure” (exit from the panels) and on the right the “Solar Return” (entry into the panels).

**NOTE**
Use High Temperature Flat Fiber Joints.

The outlet isolation valves have a 1” ¼ male G thread.

In the case of **several hydraulic starts (1 start per line)** :




On the left, connect the “Solar Departure” (exit from the panels) and on the right the “Solar Return” (entry into the panels).

**NOTE**
Use High Temperature Flat Fiber Joints.

The outlet isolation valves have a 1” ¼ male G thread.

**NOTE**
Several solutions are possible to distribute the various pipe lines: use tees, a hydraulic manifold (clarinet) or manufacture a custom part

### 3.4.3. Connecting the solarothermal station to the heat pump

The pipes coming from the heat pump must be connected to the bottom of the solarothermal station.

On the left, under the filter valve and the three-way valve, connect the evaporator inlet, and on the right connect the evaporator outlet.

**NOTE**
Use High Temperature Flat Fiber Joints.

**IMPORTANT**
As a reminder, all the pipes installed inside the house must be insulated.

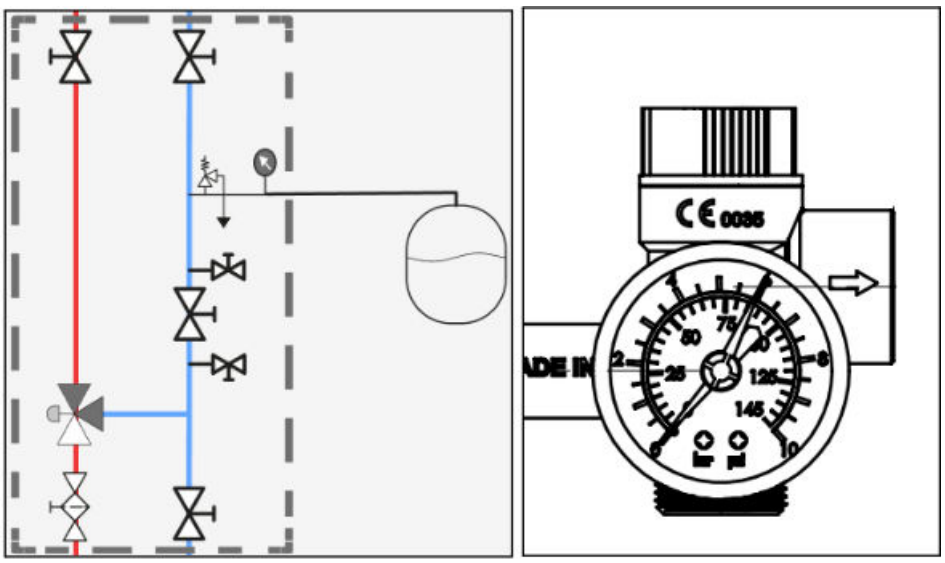
An insulation thickness of at least 19 mm closed at the ends with an anti-condensation tape must be selected (lambda value ≤ 0.037 W/mK at 0°C).

Incomplete pipe insulation can cause water damage due to condensation.

### 3.4.4. Expansion tank connection

The solarothermal station is delivered without an expansion tank, but it includes an outlet to add one if necessary.

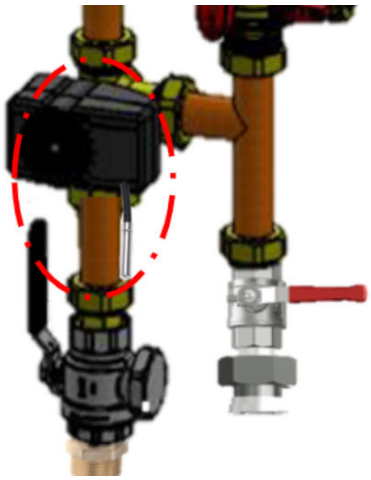
If there is a need to add an expansion tank to the collection circuit (see Expansion tank paragraph [14], it is to be installed at the outlet of the safety group, G ¾" male outlet.



### 3.4.5. Adjusting the three-way mixing valve

An electrical outlet (230 V AC) must be provided to power the valve regulator: See CRA 211 Manual)

The temperature probe is to be placed on the mixed outlet of the valve (marked C in the diagram below).



The valve setpoint must be set to the maximum temperature limit at the inlet of your heat pump - 5K.

To set this temperature:

1. Check the current set temperature by pressing the joystick




2. To change the set temperature, turn the joystick to the right to increase the temperature or to the left to decrease it.
3. Confirm the new command by pressing the joystick.

It is then necessary to check the direction of opening of the valve:

1. Connect the power cable by turning the joystick to the right



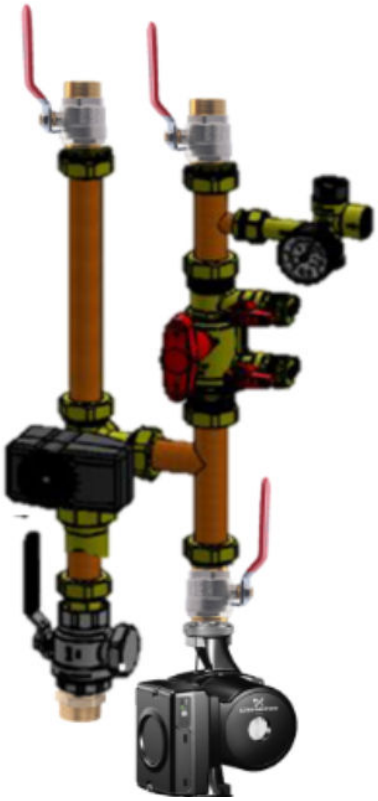

2. The screen should show an opening to the right (in the same direction as the red plastic slider above).




### 3.4.6. Addition of a circulator

In the event that the pressure height of the circulator internal to the heat pump is not sufficient to ensure the nominal operation of the capture circuit in relation to the total HMT required (see The Circulator paragraph [19], a second circulator will have to be added.

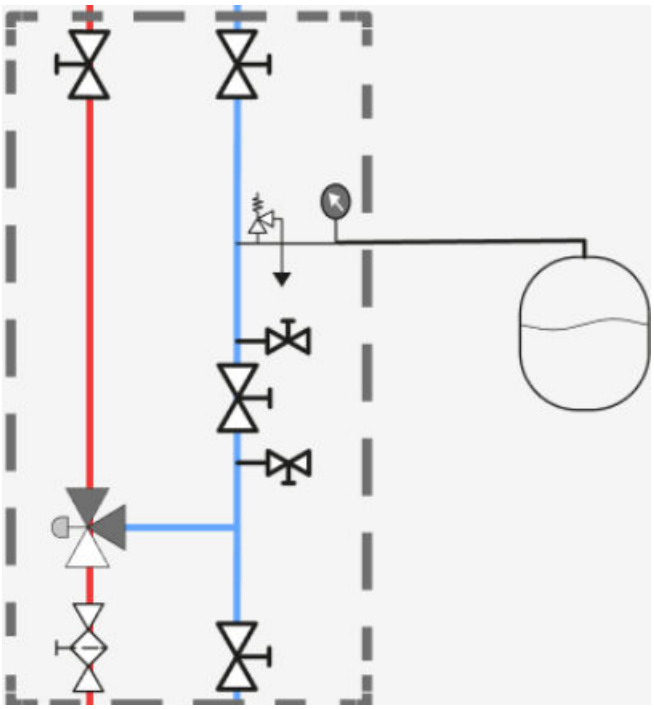
It can be installed on the Dualsun solarothermal station, at the outlet of the evaporator, on the Solar Departure (on the right). It will then be necessary to connect it electrically to the heat pump (supply and control). To do this, refer to the heat pump instructions.



## 3.5. Installation without Dualsun solarothermal station

If the Dualsun solarothermal station is not used, then it is the responsibility of the installer to custom assemble a hydraulic unit with the various components. As a reminder, a mixing valve is **Indispensable** to the proper functioning of the system. It prevents glycol liquid from entering the heat pump too hot and damaging it. The solarothermal station makes it possible to facilitate the installation of a solarothermal system

The assembly must respect the following diagram:



Several constraints must be taken into account. The various components chosen must respect our conditions of use (glycol content, minimum and maximum temperatures and pressure losses).

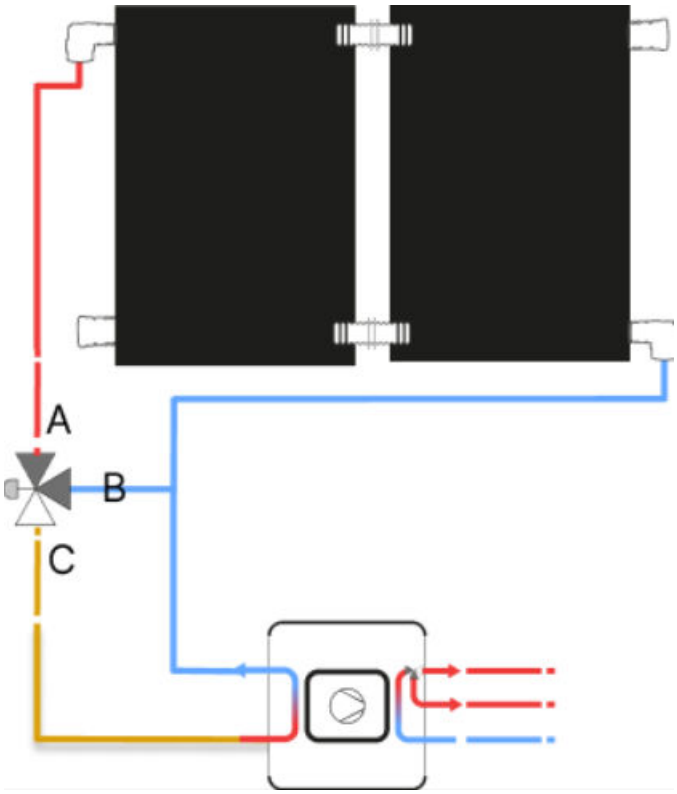
Please pay particular attention to the three-way valve and the filling unit used (potential source of significant pressure losses).

We also recommend a filter valve with a magnet and a removable filter.

### 3.5.1. Mixing valve installation

The hydraulic connection of the mixing valve must comply with the following diagram:

- the output of the solar panels is the hot inlet of the valve (marked A on the diagram below)
- the outlet of the evaporator of the heat pump is the cold inlet of the valve (marked B in the diagram below)
- the inlet of the evaporator of the heat pump is the mixed outlet of the valve (marked C on the diagram below)




To mechanically install the mixing valve and its regulator, refer to the manufacturer's instructions.

# 4. Filling and commissioning

Once the entire hydraulic circuit is connected and isolated, be sure to follow the steps for complete commissioning.

The commissioning steps are as follows:

1. Airtightness test [36]
2. Hydraulic filling [39]
3. Pressure adjustment [42]
4. Commissioning [42]

**WARNING**
Attention, in this manual we only deal with the commissioning of the capture circuit on the solar side.

**IMPORTANT**
It will be necessary to contact the manufacturer of the heat pump to put it into operation.

## 4.1. Airtightness test

Before refilling with glycol, it is important to do an air test of the entire hydraulic system to prevent leaks.

We propose a meticulous method to ensure the tightness of the hydraulic circuit:

**Solar panel field tightness test**

After installing a field of complete panels, it is a good idea to test its tightness.

For this:

- Close the isolation valve on the solar return
- Connect the compressor to the isolation valve of the Solar Start
- Put on pressure (about 3 bars) and check that there is no leak by listening for potential hisses.
- Switch off the compressor and check that the pressure remains stable for at least 5 minutes.
- Repeat for each panel field.



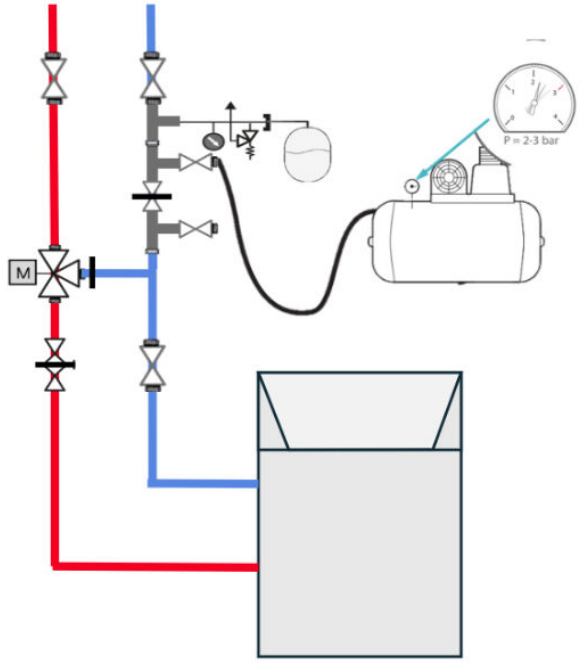

**NOTE**
We recommend using a portable, compact and portable air compressor to easily mount it on the roof.

**Solar circuit tightness test**

Once the panel fields have been tested and connected, the piping and connections of the panel circuit must now be tested.

For this:

- Connect the compressor to the top valve of the solarothermic station filling unit.
- Close the filling unit isolation valve.
- Close the filter valve
- Make sure the filter valve is 100% open (no mixing)
- Put on pressure (about 3 bars) and check that there is no leak by listening for potential hisses.
- Switch off the compressor and check that the pressure remains stable for at least 30 minutes (1 hour maximum).

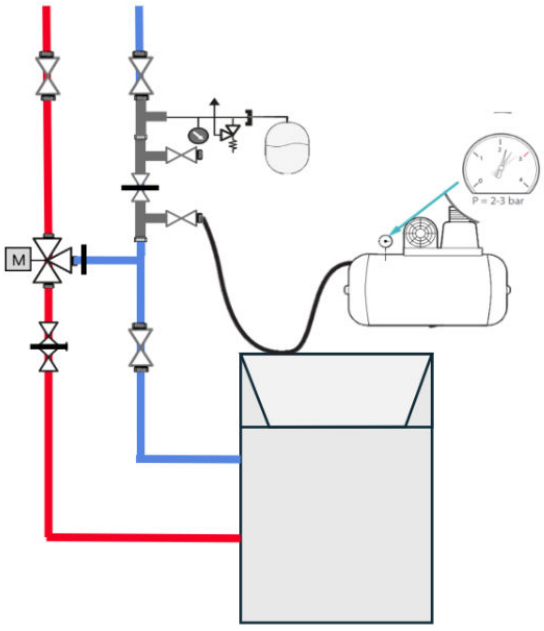



**Evaporator circuit tightness test**

It remains to test the tightness of the heat pump evaporator circuit piping.

For this:

- Connect the compressor to the bottom valve of the solarothermal station filling unit.
- Close the filling unit isolation valve.
- Close the filter valve.
- Ensure that the filter valve is 100% open (no mixing).
- Put on pressure (about 3 bars) and check that there is no leak by listening for potential hisses.
- Switch off the compressor and check that the pressure remains stable for at least 5 minutes.



## 4.2. Hydraulic filling

Once the tightness of the circuit has been validated, it is possible to fill the hydraulic circuit with glycol.

**Glycol dilution**

If the glycol needs to be diluted, it is important to do so **Before** to inject it into the circuit. It is very important not to fill with pure glycol and to then inject water into the hydraulic circuit. The dilution will be poor and the frost protection performance will not be achieved. Refer to the glycol manufacturer's instructions for more details.

**IMPORTANT**
If necessary, always use pure water to mix with pure glycol.

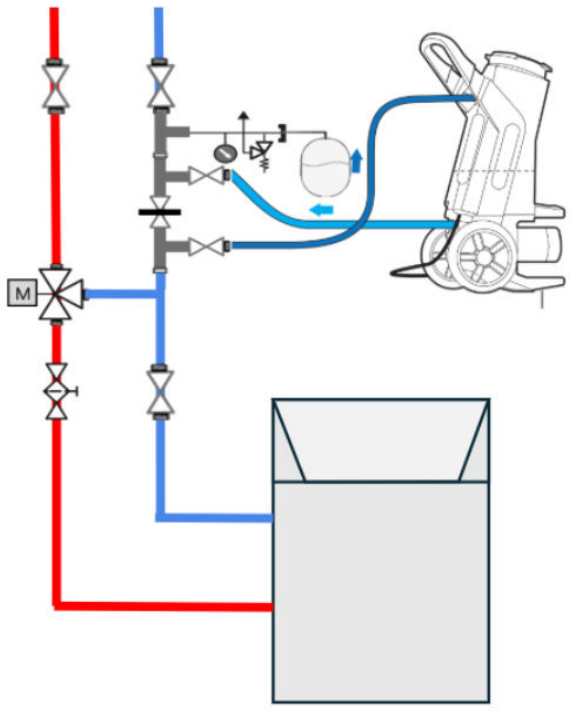
**Connecting the filling station**

First, you must connect the filling station: the inlet to the upper valve and the outlet to the lower valve of the filling unit.

Then close the filling unit isolation valve.

Open the two drain and inlet valves of the filling unit (which are now connected to the filling station).

Fill the filling station tank with dilute glycol.




**Opening the mixing valve**

Use the three-way valve in manual mode: turn the central knob so that it “comes out” of its housing.

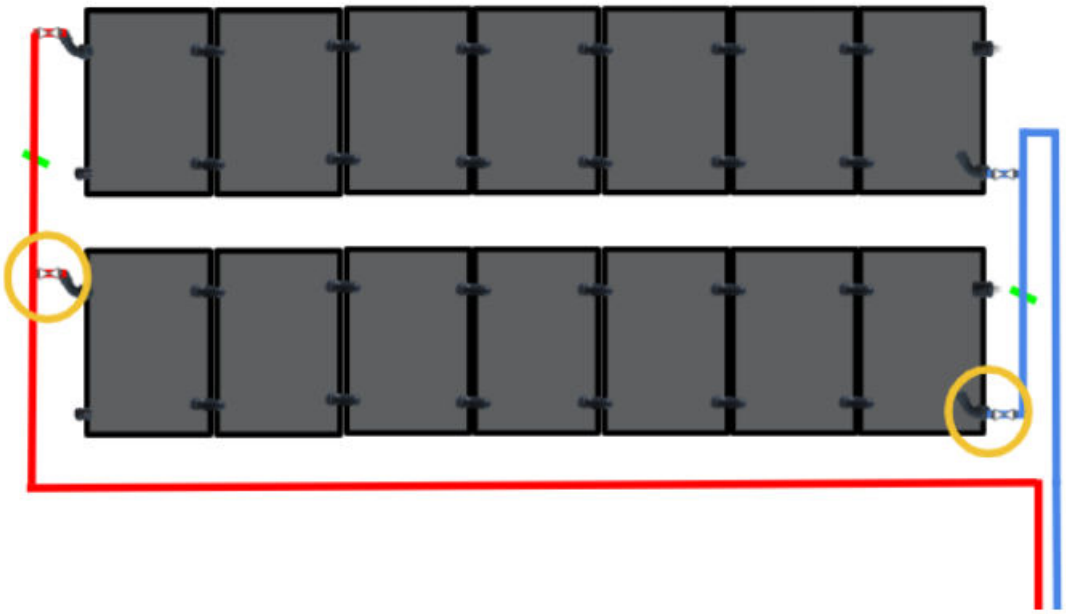
Open the valve to 100% (mix with the cold off) by turning the central knob to the right as far as possible.




**Isolation of solar panel fields**

In order to guarantee refilling with glycol and effective purging (eliminating air bubbles), it is imperative to fill with glycol field by field.

To do this, close the isolation valves at the entrance and exit of the fields to leave only one field open.



**Opening steam traps**

Open the automatic drains at the exit of the panels.

**Refilling the circuit**

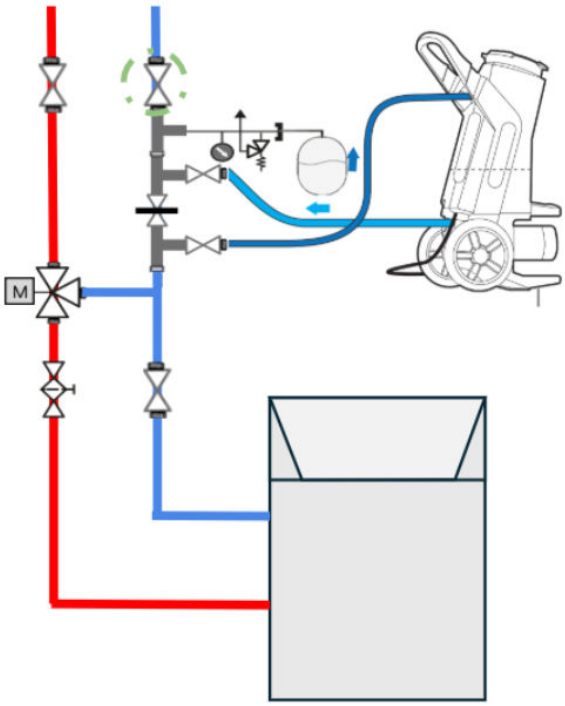
It is now possible to refill with glycol. We recommend filling the panels with a low flow rate by blocking it by closing the isolation valve of the solarothermal station

Depending on the length of the pipe, allow the filling station to run until all the air is exhausted. Attention, fill the tank of the filling station **Before** that it is not empty so as not to let air into the circuit.

We recommend using “water hammer” to remove stuck air bubbles: close the inlet (or drain) valve on the filling unit, pump in operation, then open it all at once to create an overpressure phenomenon.

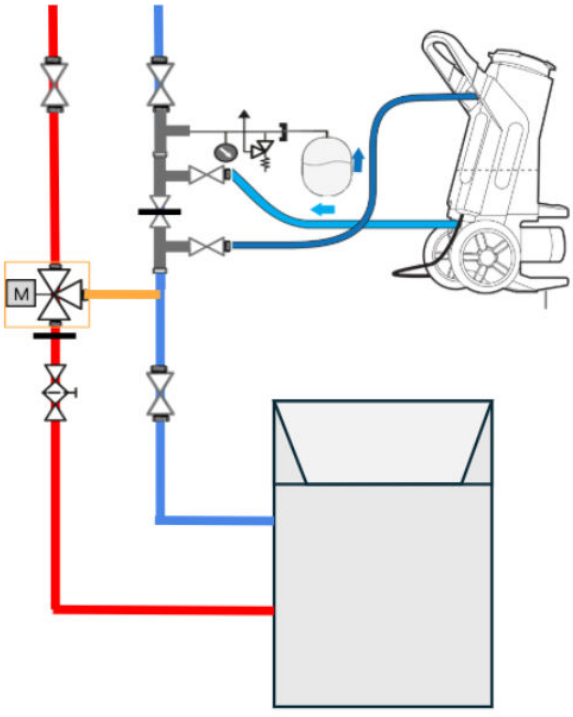
It is important to let the filling station run long enough to expel the air properly (essential to subsequently ensure a good flow in the capture circuit), at least 1 hour depending on the length of the pipes.

Then repeat these operations for each panel field by isolating the fields already filled in.




**Shutting off the mixing valve**

Close the valve to 100% (mixing with the cold open) by turning the central knob to the left as far as possible. The aim is to fulfill the bond.




**Filter removal**

Switch off the filling station. Close the filter valve then remove the filter from the filter valve and then close the valve again. In operation, it is not necessary to keep this filter (only present to recover impurities during commissioning).

**Final Purge**

Open the mixing valve to 100% (by turning the central knob to the right as far as possible).

Open all isolation valves on the roof.

Open the filling unit isolation valve to fill it and then close it again.

One last time, do a few pressure surges to remove the last air bubbles and then let the filling station run until you hear that there is no more air and there is no more foam in the filling station tank. Depending on the length of the pipe, it may be necessary to let the filling station run for several hours.

## 4.3. Adjusting the pressure

Once the purge is complete, close the automatic roof drains.

Refer to the heat pump operating pressure to ensure that the maximum allowable pressure in the heat pump collection circuit is not exceeded.

To pressurize the capture circuit, keep the hydraulic connection preceding the filling station.

Rely on the pressure of the safety group pressure gauge.

Play with the two valves in the filling unit (inlet and drain) to reach the right pressure (between 1.5 and 2.5 bars generally).

Once the correct pressure has been reached, with both valves in the filling unit completely closed, unplug the filling station.

The hydraulic commissioning of the collection circuit has been completed.

## 4.4. Commissioning of the heat pump

Once all these filling and pressurization steps have been completed, you can put the heat pump into service by following the recommendations of the heat pump supplier.

Follow the recommendations of the heat pump manufacturer.