Planning and Commissioning Instruction for AKOTEC Full Vacuum Tube Collectors

1. Planning

1.1 Collector

The collector area depends largely on your own wishes and the local conditions. The following values can serve as a guide:

- System for domestic water heating: approx. 1.5 m² per person
- System for domestic hot water and space heating: from 2.5 m² per person

Our tube types

Heat pipe tubes (hp):

- Safe against overheating
- must be mounted at least 10 ° elevated
- Tube replacement possible without draining the system

Direct flow tubes (df):

- Can be mounted flat on the roof and flat on the facade

1.2 Solar storage

The tank is used to store the collected heat and should have a gross collector area of between 50 l/m² and 70 l/m². In a system with a high proportion of heating coverage and the use of collectors with hp 100 °C tubes, the storage volume can also be dimensioned significantly smaller thanks to the integrated overheating protection of the tubes.

In general, there are three types of storage:

water heater

- small drinking water tank
- when only hot water is required

Hygienic or combi tank

- Heating and drinking water storage all in one
- Integrated heat exchanger is used to heat drinking water
- comfortable and compact

buffer storage

- Heating storage
- The water is heated in connection with a service water storage tank or a fresh water station
- very effective and maximum legionella protection

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1.3 Types of installation

Our collectors are available in the following types of installation:

Heat pipe collector

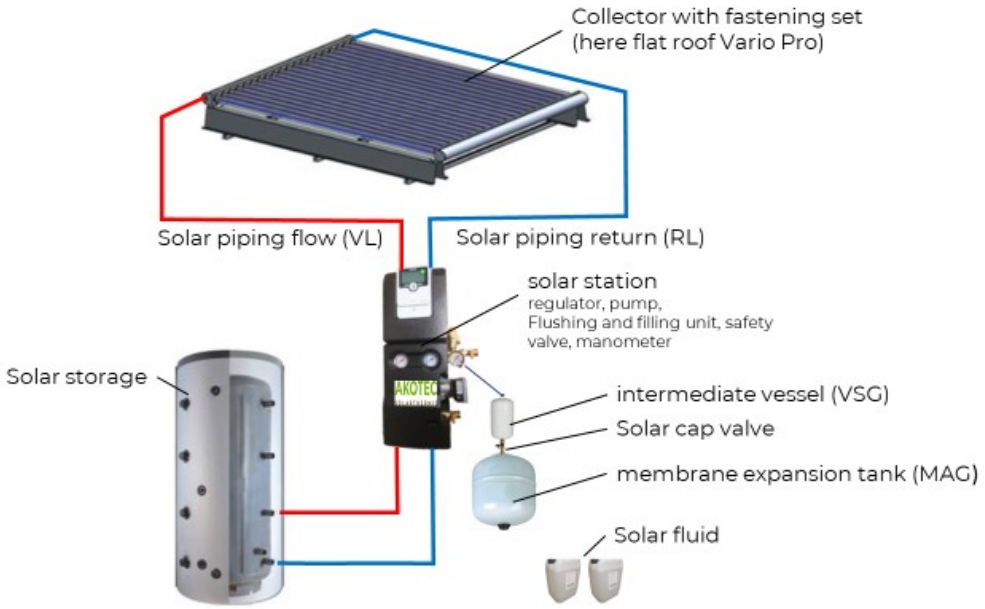
- Vertical on-roof installation
- Free positioning from 10°
- Facade mounting up to 80°

Direct flow collector

- On-roof mounting vertically and horizontally
- Flat roof mounting 0° to 90°
- Facade mounting 0° to 90°

To ensure trouble-free operation, please use our collector mounting sets only.

1.4 Composition, components and function of a solar system



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Normal operation

The sun shines on the collector and heats the absorber in the tubes. The controller monitors the collector temperature using a temperature sensor in the flow at the collector outflow.

If the temperature is high enough, the controller switches on the solar pump and transports the heated solar fluid to the storage tank. From there, the heating and the hot water network take the heat.
In addition to the pump, the solar station also contains the flushing and filling unit for filling and emptying the system. The safety valve is also installed here, which releases overpressure if the system pressure is too high to protect the system.
Right next to it is the membrane expansion vessel, which absorbs or releases liquid when the system heats up or cools down. Thus ensuring a largely constant pressure in the system.
Since there is a temperature-sensitive rubber membrane in the expansion tank, an intermediate tank is installed in front of the membrane expansion tank. This contains a certain amount of cold solar fluid and protects the membrane expansion tank from excessively high temperatures.

Stagnant operation

If the storage tank is full, the solar pump switches off to protect the system components from excessive temperatures. This is called stagnation of the system. Since this means that no more heat is removed from the collector, its temperature rises.
Depending on the collector model, the temperature in the collector rises to its standstill temperature. The standstill temperature for collectors with the hp100 tube is 125 °C and for the tube with direct flow it is approx. 192 °C. This state lasts until the radiation on the collector has decreased and the collector has cooled down again. If heat was consumed during this time and the solar storage tank temperature has dropped, the system switches back to normal operation.

1.5 Technical specifications

Note: To plan your system, please use the **easy-planner**, which you can find and download on our website https://www.akotec.eu/deutsch/easy-anlagenplaner/ free of charge or let us plan your solar system from us.

The **easy-planner** calculates all relevant components of your solar system: Pump, expansion tank and the pipe dimensions.

1.5.1 Pressure maintenance

Maintaining the pressure serves to keep the system pressure largely constant despite the temperature expansion of the heat transfer medium. A solar system

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must therefore be equipped with an expansion tank (MAG), an intermediate tank to protect the MAG and a safety valve.

Only safety valves with a response pressure of at least 6 bar that are suitable for solar systems and the high temperatures that occur should be used.

1.5.2 System ventilation

An air separator must be provided in the flow of the solar circuit to ensure trouble-free operation. An air separator is integrated in the flow as standard in our solar stations.
In larger systems, an air pot or manual air vent should be installed additionally at the highest point upstream of the system.

Note: As with heating technology, the flow (VL) refers to the pipeline that carries the heat transfer medium heated by the collector away. The pipeline that leads the still unheated medium to the collector is called the return (RL).

1.5.3 Durchfluss und Druckverlust

The heat generated by the solar panels can only be harvested when the required flow is achieved. In order to achieve this, the pipe network and the pump must be designed correctly. Please note the pressure loss curves of our collectors, the pipes, fittings and the solar station.
You can find the pressure loss curves in the respective data sheets on our homepage https://www.akotec.eu/ or use our easy-planner.

Minimum flow

Tm-Ta=35k **collector** *ΔT=15K, G=1000W/m²*	Weiser Protect without Reflector	Weiser Protect with Reflector	Weiser Power without Reflector	Weiser Power with Reflector
Volumetric flow **Water** [l/min m²] Collector area gross	0,37	0,44	0,44	0,52
Flow rate **VT51** [l/min m²] Collector area gross	0,40	0,47	0,47	0,55

1.5.4 Verrohrung und Dämmung

Note:

- Sufficiently insulate the entire piping
- Pay attention to the temperature resistance of the insulation
- The connection line to the expansion tank must not be insulated

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- The blow-off line from the safety valve must be permanently installed and have the same nominal width as the safety valve.
- Siphon the connections to the solar tank to avoid heat loss

Use our collector connection sets to connect our collectors.

Corrugated hose assembly set

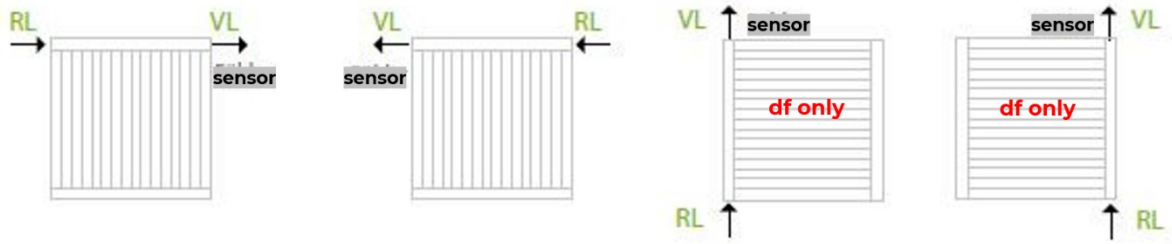
Rigid piping assembly set

1.5.5 Collector wiring and sensor position

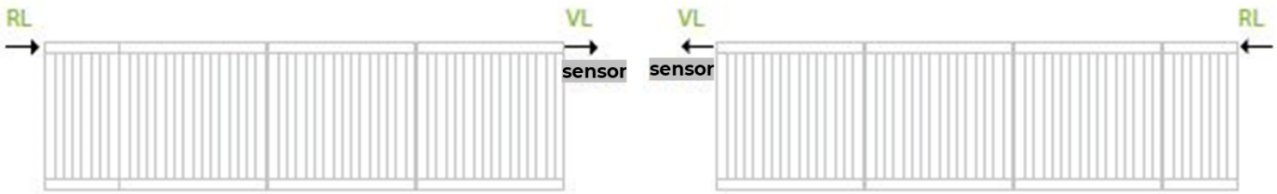
Note:

- Always install sensors on the flow side!
- hp: maximum 90 tubes in series
- df: maximum 70 tubes in series
- df: maximum one collector of 15 per row

Connection options for a collector:



Connection options for several horizontal collectors in series:



Several horizontal collectors in series and in parallel:
When connecting collector surfaces in parallel, make sure that the sub-arrays are the same size (number of vacuum tubes) and that the connection is “clean” according to Tichelmann.

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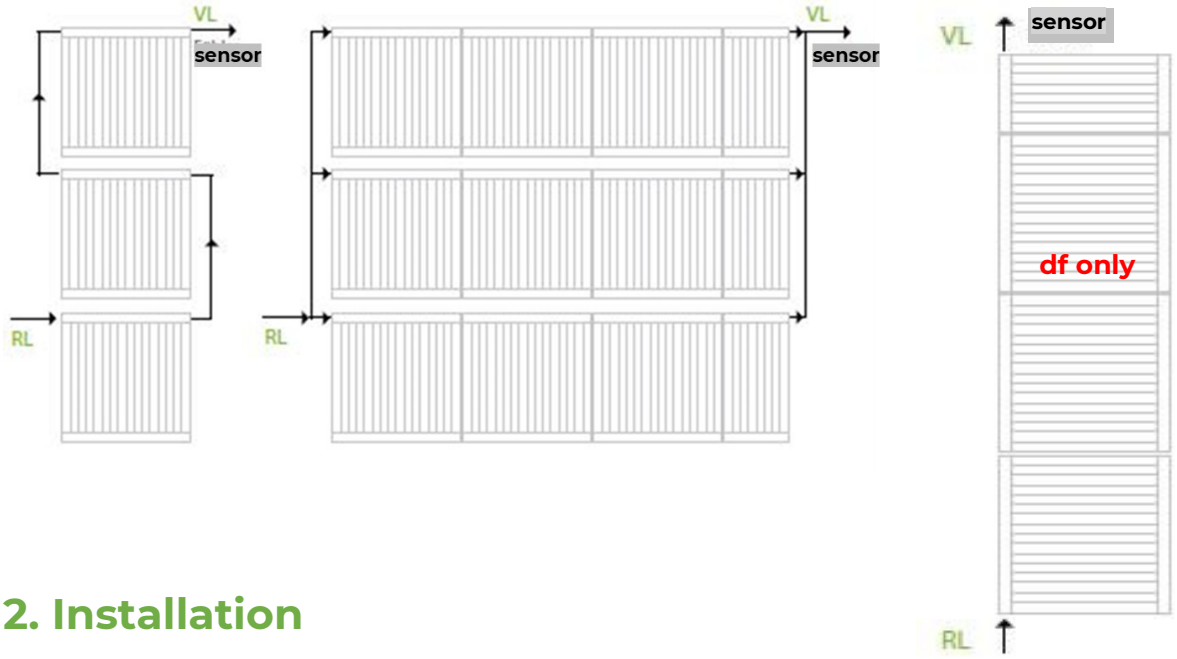

2. Installation

2.1 General notes

The mounting must be performed by qualified staff.

The following regulations must be observed:

- Legal regulations for accident prevention
- Legal regulations for environment protection
- Professional association regulations
- Safety conditions of DIN, EN, DVGW, TRGI, TRF and VDE.
- ÖNORM, EN, ÖVGW-TRF and ÖVE
- SEV, SUVA, SVGW, SVTI, SWKI and VKF

Observe the respective assembly instructions for the individual components.

Improper installation can cause damage to the collectors.

Risk of injury: Handle the full vacuum tubes carefully, they can break.

For df tubes: When dismantling the solar system and changing the tubes, empty the tubes immediately after dismantling and do not store them in the sun. Otherwise, fluid residues can cause steam to be suddenly emitted. Risk of injury!

For hp tubes: Do not store tubes in the sun! The condenser can reach high temperatures. Risk of injury!

Attention:
If the solar system is not filled with fluid immediately after installation, the collectors can be damaged. The collectors

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must therefore be protected from the sun with a cover. Large systems can be commissioned field by field. Appropriate shut-off devices must be provided for this purpose.

The collectors must be installed in low-radiation weather.

Note the thermal expansion of the pipe. A ΔT of 200 K can be expected for df collectors, and 130 K for our overheating-proof collectors.

Use gunmetal fittings, brass fittings, corrugated tubing or copper tubing for installation.

Use hemp only in connection with special pressure and temperature resistant solar sealant. Common Teflon sealing tape is not suitable for solar systems.

Do not solder in the area of the collector and on the collector! The design of the collector must not be changed!

For soldered connections: Due to the high temperatures, hard solder must be used.

When mounting with press fittings, the O-ring must be temperature-resistant.

Do not use annealed copper pipes on compression fittings.
When installing with compression fittings, all pipe ends must be square and deburred. Push the union nut and clamping ring onto the pipes and coat the threads with a little oil. Push the pipe into the compression fitting as far as it will go. Tighten the nut by hand first, then tighten ¾ of a turn with a wrench.

2.2 Lightning Protection

Grounding: the piping system of the solar circuit is to be electrically connected to the potential equalization in the lower part of the building according to VDE. Equipotential bonding may only be carried out by authorized specialists.

3. Commissioning

3.1 Set the pre-pressure of the MAG

The calculated admission pressure must be set on the MAG with an unloaded expansion vessel. The solar system can be tested for pressure tightness before filling with antifreeze, water or air. This prevents unnecessary loss of antifreeze in the event of larger leaks. When checking with water, drain this completely before filling with antifreeze.

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Setting the operating pressure

The system is to be operated in such a way that, even in the event of stagnation, no unnecessarily high temperatures and steam hammers occur in the system. The system pressure must be adjusted that the highest point in the system is about 1.5 bar. The following calculation method must be observed for this:

The operating pressure (min. operating pressure) of system P_0 should be set when cold (20°C) so that there is a pressure of approx. 1.5 bar at the height of the collectors (collector).

Example:
The collector was installed at a height of 10 m above the membrane expansion tank (MAG).

P_0 = (h x 0,1) + 1,5 bar
P_0 = (10 x 0,1) + 1,5 bar
P_0 = 2,5 bar

The admission pressure of the MAG should be set approx. 0.3 below the system pressure P_0 in the depressurized state.

For an exact calculation, please use our **easy-planner**!

3.2 Filling the system

Attention:
The solar circuit may only be filled with a heat transfer medium from AKOTEC (frost protection down to −28 °C). The heat transfer medium must not be diluted with water. If the system is set up in climate zones in which the frost protection of -28 °C is not sufficient, please contact AKOTEC.
If the system is operated with water, VDI 2035 must be observed and appropriate measures taken to prevent frost damage

The heat transfer fluid must be filled with an electric flushing pump/solar filling station. It is essential to observe the minimum flushing time of 30 minutes so that the heat transfer fluid no longer contains any air pockets.

Then close the drain cock of the solar station and adjust the system pressure with the flushing pump.

The filling quantity depends on the number of collectors installed and the line lengths.

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Number of tubes	20	30	40	50	60	80	100	120	140
hp collector system approx. heat transfer fluid [l] with 40 m pipeline	20 l	25 l	25 l	35 l	40 l	40 l	55 l	60 l	70 l
df collector system approx. heat transfer fluid [l] with 40 m pipeline	25 l	30 l	35 l	45 l	50 l	65 l	80 l	90 l	105 l

3.3 Controller settings

Note: Observe the installation instructions for the controller or solar station!

Target and minimum flow rate

The correct volume flow and the minimum volume flow can be set via the pump speed on the solar controller.

Tube collector function

In order to ensure trouble-free operation, the tube collector function (sometimes also called the start function or flushing function) must be activated on the controller. We recommend a rinsing interval of 5 minutes with a 15 s running time.

Maximum operating temperature

The pump switch-off temperature (sometimes also max. operating temperature, collector emergency temperature, max. collector temperature) should be set to 120 °C.

3.4 Miscellaneous

The process water temperature must be limited with a scalding protection or mixing valve so that high storage tank temperatures do not reach the tap.

4. Inspection

Annual visual inspection of the system.
To check is:

- Insulation
- System pressure, MAG pre-pressure
- Freezing point and color of the heat transfer fluid
- Tube inspection (broken glass or loss of vacuum visible from white discoloration at the bottom end of the tube)
- Plausibility check of the temperature sensors

5. Troubleshooting

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Problem	Possible cause	Clearing
No flow	Air in the system	Operate manual air vents, flush the system again
	Fault of the power supply	Check power supply and plug
	Shut-off equipment is closed	Open shut-off equipment
	Pump speed set too low on the controller	Increase minimum pump speed.
	Frost in the system (only for water systems)	check for leaks after thawing
Collector overheated	The system has switched off automatically because the tank is full.	No action necessary
	Air in the system	After the system has cooled down: Operate the manual air vent, flush the system again
	Incorrect controller setting, tube collector function not activated.	Check controller setting
	Flow too low	Check minimum flow
No system pressure	Liquid leakage after a stagnation event	Check the size of the expansion tank
	System is leaking	Check system for leaks
Storage does not get hot	more consumption than solar yield	No action necessary, possibly increase the collector area
	Insufficient insulation	Check insulation and connections
Collector does not get hot	Collector is shaded	Eliminate shading if possible
	Collector does not get as hot as expected	When operating correctly, the collector has a temperature that is approx. 5 to 15 °C higher than the storage return. If the temperature is lower, the flow may be too high.
	Tube is defective (broken glass or white discolored end of tube (loss of vacuum))	Change the tube
The system is off even though the sun is shining	Storage is full	No action necessary. It may be possible to increase the maximum storage tank temperature in the controller
	→ please see collector overheated	
Heat transfer fluid has turned dark	System is often in stagnation	Replace liquid, check size oft he system

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