

CPC 14/21

Vacuum tube collector

INSTALLATION AND OPERATION GUIDE



PHÖNIX 
SonnenWärme AG

Contents

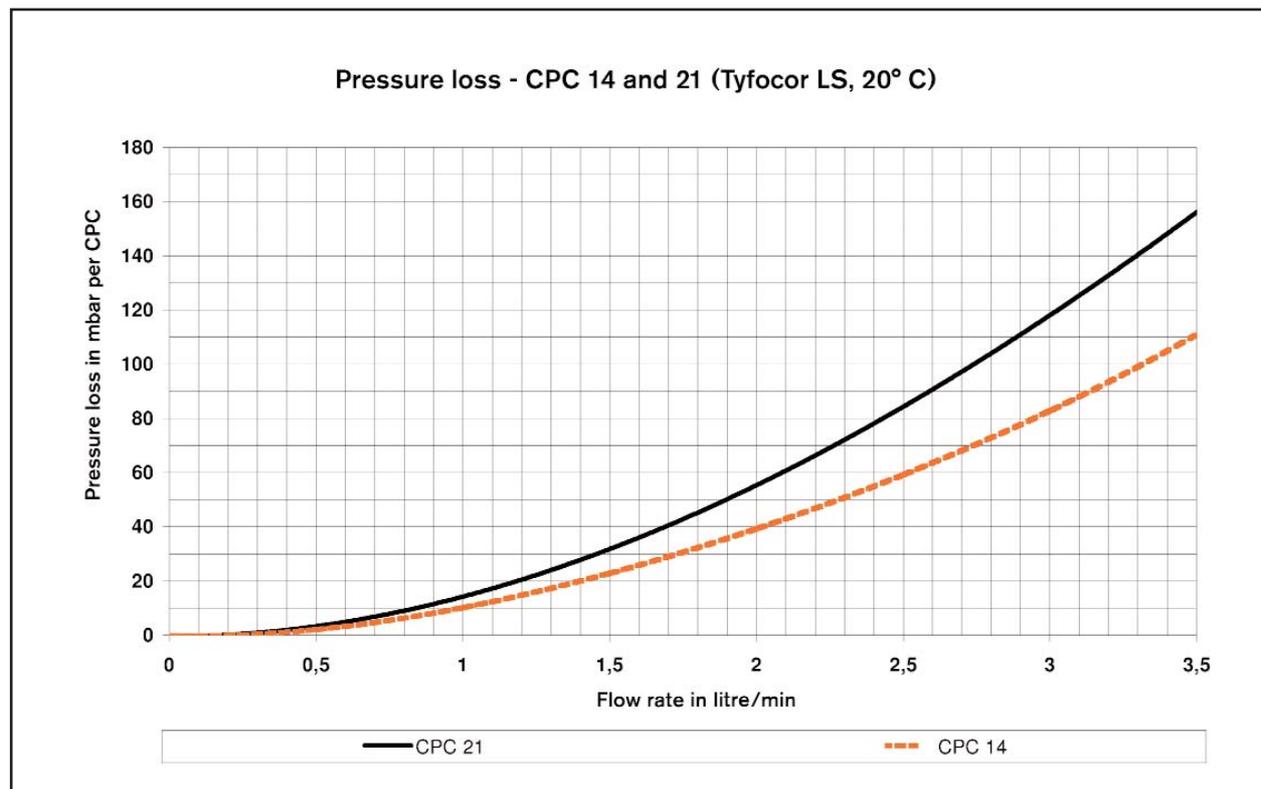
CPC 14/21 Vacuum Tube Collector

1. CPC 14/21 Data Sheet	4
2. Introduction & General mounting instructions	5
3. For your safety	6
4. Rules and Standards	7
5. Mounting of the collector	7
6. Tile roof mounting	9
7. Flat roof mounting	13
8. Connections	14
9. Tubing for the collector	16
10. Repairs	17
11. Start-up	18
12. Maintenance	18

1. CPC 14/21 Data Sheet

Type:	CPC 14	CPC 21
External dimensions:	1,65x1,63x0,14 (HxLxD)	1,65x2,39x0,14 (HxLxD)
Weight of each collector:	50 kg	65 kg
Total surface area:	2,69 m ²	3,95 m ²
Effective absorber area:	2,20 m ²	3,30 m ²
Heat transfer medium quantity:	1,1 litre	1,7 litre
Absorber:	Aluminium nitride	
Absorptance:	92%	
Optical efficiency:	65% relating to aperture area	
Emission ratio:	6%	
Loss factors:	k1: 1,016 W/m ² K, k2: 0,002 W/m ² K ²	
Max. downtime temperature:	265° C	
Collector connections:	12 mm Cu	
Collector materials:	Heat transfer tubes made of copper, heat shield made of aluminium	
Glass faceplate:	Borosilicate glass 3.3	
Test certificates:	Collector test by Fraunhofer ISE acc. to EN 12975 Test report no. KTB 2006-43-en	
Warranty:	2 years (according to terms and conditions of the PHÖNIX SonnenWärme AG)	

(subject to technical modifications)



2. Introduction

Please read this installation and operation guide carefully.

Failure to follow these instructions will void the warranty.

General mounting instructions

- The collector must always be mounted with the header on top.
- For roof top and flat roof installations, we recommend a minimum slope of 15 degrees to allow for self-cleaning of the collector.
- The collector can be easily wall-mounted. However, the required attachment material is not included in the delivery.
- Vacuum tube collectors cannot be integrated into the roof.
- When the sun is shining, the vacuum tubes must be covered up during installation (e.g. with a sheet) to prevent them from heating up.
- Use only hard brazings, compression fittings and flat gasket threadings in the solar circuit.
- To ensure safe venting, the air in the system must be evacuated when filling the solar system.
- The solar supply and return insulation must resist temperatures of up to 170 degrees C, and must also be UV resistant.

General requirements

The roof top mounting kit is suitable for roofs with a slope of over 15 degrees.

The mounting system is suitable for roofs with "Frankfurter Pfanne" or similar coverings and for roofs covered with flat tiles and fiber cement corrugated sheets. If your roof is covered with natural slate tiles, all work must be done by a specialized roofing company.

Please be advised that additional materials may be required. For the roof lead-through of the supply and the return, you'll need two venting tiles (available at roofing or construction material stores). Furthermore, make sure you have spare tiles on hand, in case some tiles get damaged during the collector installation. Depending on the construction of the roof, you may also need some pieces of wood to place under the rafter anchors.

You will also need some equipment to lift the collectors onto the roof.

Grounding and lightning protection

The metal tubes of the solar circuit must be connected to the main potential compensation rail of the building by at least a min. 16 mm² copper (H07 V-U or R) green/yellow conductor. If no lightning protection system exists, no further measures need to be taken. If a lightning protection system exists, the collectors must be included as well. If this is not possible, grounding must be ensured by a ground rod. The ground conductor must be placed on the exterior of the building. In this case, the ground conductor must also be connected to the main potential compensation rail, using an additional conductor that has the same cross section.

Safety instructions

Please read through these mounting instructions carefully before proceeding, and follow the safety guidelines in this brochure.

In heavy snow zones (zone 4) and installation sites located above 600 m ASL, please consult a structural engineer.

When working on the roof, please observe established occupational health and safety standards. When working on a roof, always use fall protection devices.



The collectors get very hot from the solar radiation. There is a risk of burns! If you mount the collectors on a sunny day, cover them up to prevent them from heating up.



Since it is not possible to drain the collectors completely, the solar system should only be filled with a Tyfocor LS water / antifreeze mixture. Always refill with an antifreeze mixture after a pressure or functional test.

3. For your safety

Working on the roof

When working on the roof, take appropriate measures to prevent accidents.

Follow the instructions below to safely install the solar components:

- Use fall protection devices when installing the collectors.
- Follow safety regulations when using leaning ladders.
- Be aware of the risk of breaking through roofs that are covered with corrugated sheets.
- When boring holes into fiber cement, always wear a dust mask.
- Secure work areas on steep roofs.
- Keep a safe distance away from power lines.
- Read the safety data sheet before handling antifreeze mixtures.
- Observe health and fire protection regulations when brazing.

Vacuum tube collectors can heat up to over 200 degrees when exposed to light. There is a risk of burns on the supply and return.

Become familiar with your local occupational health and safety regulations for construction work, or consult a competent professional for instructions.

Evaporation in the collector

Even at normal daylight, the fluid in the collector may evaporate. The resulting vapour can escape from the collector connections. There is a risk of burns.



Tips: Cover the vacuum tube collector with a sheet or something similar to keep it cool before installation and start-up, and to prevent burns and "shock evaporation" of the solar fluid when the system is put into operation.

Filling hot vacuum tubes can lead to premature aging of the solar fluid, or to the precipitation of a tar-like mass which, in a worst case scenario, could potentially block the whole solar system. Any damage caused by such an event will not be covered by the warranty !

Glass - Handle with care !

Do not exert pressure on components made of glass. There is a risk of cuts from broken glass.



Tip: When installing the vacuum tube collector, wear gloves and safety glasses to prevent injuries in case of glass breakage.

4. Rules and Standards

Please find below a list of the most important technical rules to be followed when installing collectors. The list does not make any claim of completeness.

The instructions for your safety are based on the occupational health and safety regulations for construction work. It is important to also follow your local regulations.

Rules of technology and standards for the installation of thermal solar systems

Installation on roofs

DIN 18338 Roofing and roof sealing work

DIN 18451 Scaffolding work

DampfkV (German steam boiler regulation)

TRD 802 Technical regulations for Group III boilers

TRD 402 Technical regulations for Group IV boilers

Connection of thermal solar systems

DIN EN 12828 Heating systems in buildings - Design of water-based heating systems

DIN EN 12975 Thermal solar systems and components

Installation and equipment for water heating installations

DIN 18380 Heating and central household water heating installations

DIN 18381 Gas, water and sewage plumbing work

DIN 18421 Insulation work on technical installations

Electrical devices

VDE 0100 Erection of power installations with voltage ratings up to 1,000 V

VDE 0185/IEC 62305 Lightning protection

VDE 0190 Main potential equalization of electrical systems

DIN 18382 Electrical supply systems with voltage ratings up to 36 kV

5. Mounting of the collector

Make sure to properly attach the vacuum tube collectors and the mounting kit so that the installation will withstand strong wind and heavy snow loads.

5.1. Steps for mounting a vacuum tube collector

- Find an appropriate location for the solar system components
- Connect the storage tank to the heater (refer to operation guide for storage tank !)
- Install the solar station
- Connect all of the tubing from the storage tank to the collector field
- Install the collector mounting kit(s)
- Hook the collector(s) into the prepared support and fasten
- Cover the collector(s)
- Connect the collector(s) to the solar tubing
- Connect the collector sensor
- Flush with antifreeze and remove dirt particles through a filter
- Perform pressure test with antifreeze
- Drain system and refill with filtered antifreeze
- Put the solar system into operation
- Remove the collector cover
- Train the system operator

5.2. Scope of delivery for the vacuum tube collector

A completely pre-mounted collector consists of:

- 14 or 21 tubes, based on the thermo flask principle
- Header with direct flow through heat transfer units and dry connection of the vacuum tubes
- CPC mirror

5.3. Collector connections

The header must always be located on top. The supply and return connections are located on the same side. However, they can also be attached to the right or to the left of the collector.

The CPC is delivered pre-mounted for a right-hand side connection. However, the connections can also be put on the left side without any problems. In this case, remove the black plastic cover (on the header side) and install the U-shaped compression ring fitting on the opposite side.

5.4. Collector tilt

For roof top and flat roof installations, a minimum slope of 15 degrees is recommended to allow for self-cleaning of the collector.

5.5. How to get the collector onto the roof



Beware of the wind when lifting the collector onto the roof. When lifting the collector onto the roof, make sure not to damage the back of the collector.

Damage to the CPC mirrors may result in impaired performance of the collector.

6. Tile roof mounting

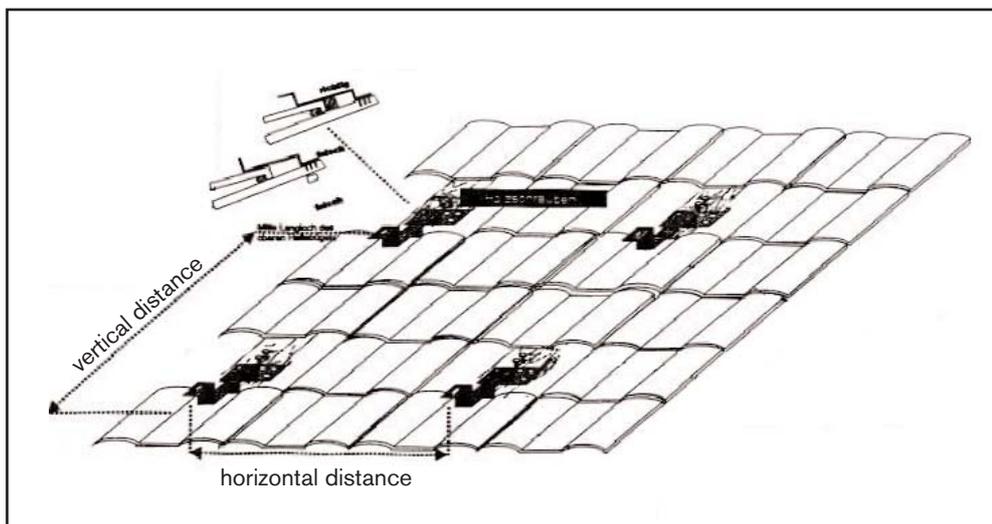
For mounting on a tile roof, the vacuum tube collector will be mounted on the roof membrane. Only the roof hooks will penetrate the roof membrane.

Required material

2 venting tiles (the quantity depends on the number of roof penetrations)

	Number of bars	Number of roof hooks
CPC 14	2	4
CPC 21	2	4

How to mount the roof hooks



Distance between the roof hooks (per CPC):

horizontal distance

for CPC 14, approx. 0.8 m

for CPC 21, approx. 1.5 m

vertical distance

for CPC 14 and CPC 21, approximately three rows of roofing tiles

How to mount the roof hook

Required tools



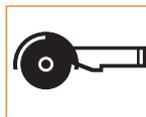
Open-jaw wrench, 22 and 30mm



Tubing pliers



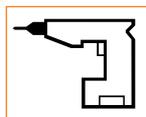
Ring wrench, 13 and 17mm



Angle grinder with stone grinding disc



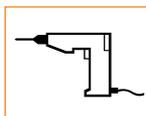
Hammer



Cordless screw driver with 17 mm nut



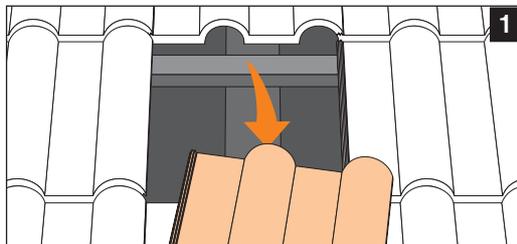
Screwdriver



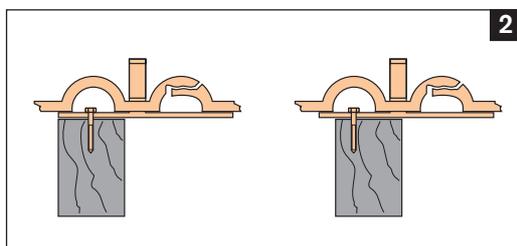
Drill with 6 mm drill bit

How to mount the roof hooks

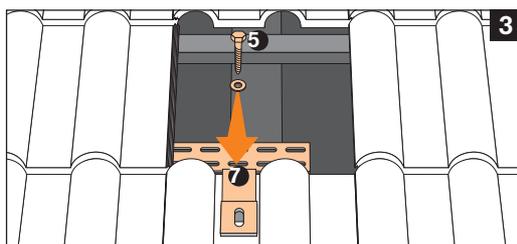
For all options, the rafter anchors are mounted in the same way.



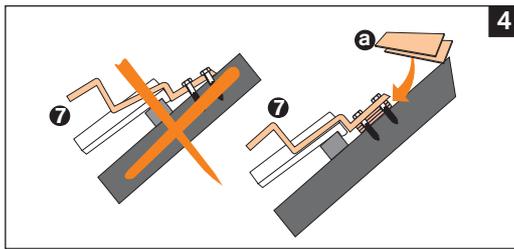
According to the relevant scheme (see mounting options), remove one tile per roof hook above the rafter. Any rafter can be used to fasten the hook.



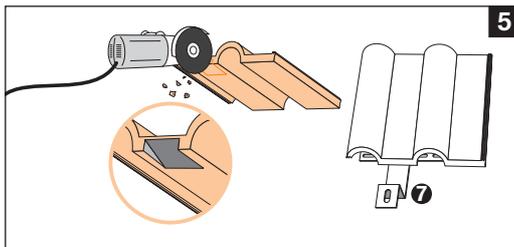
The wide fastening border of the roof hook allows you to always fasten the anchor in the tile valley.



Align the roof hooks ⑦ with a spirit level and fasten with wood screws and washers ⑤. Use two screws per roof hook.

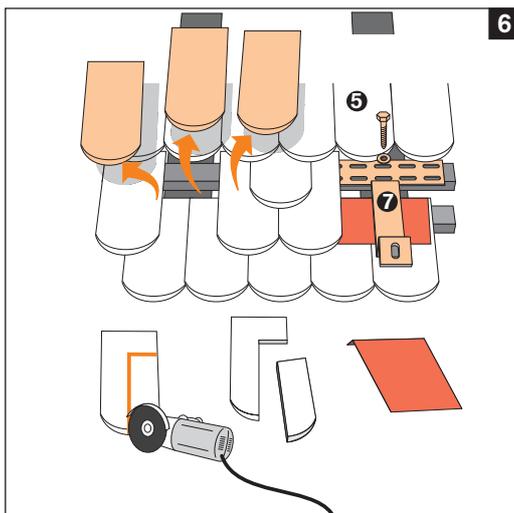


Ensure that the roof hook 7 does not touch the tiles, otherwise there is a risk that the tiles may be damaged when there are strong gusts of wind. If required, put some pieces of wood a under the roof hook.

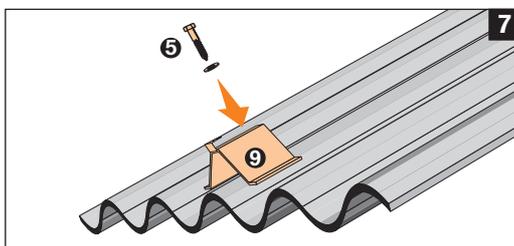


For the lead-through of the roof hook, grind notches along the bottom of the respective tiles by using an angle grinder with a stone grinding disc. Afterwards, return the tiles to their places.

Alternative mounting options



When the roof is covered with flat tiles, several tiles per roof hook must be removed. The roof hook will be fastened to the roof lath after putting an additional metal piece (not included in delivery) under the roof hook. Here again, cut out the lead-through.

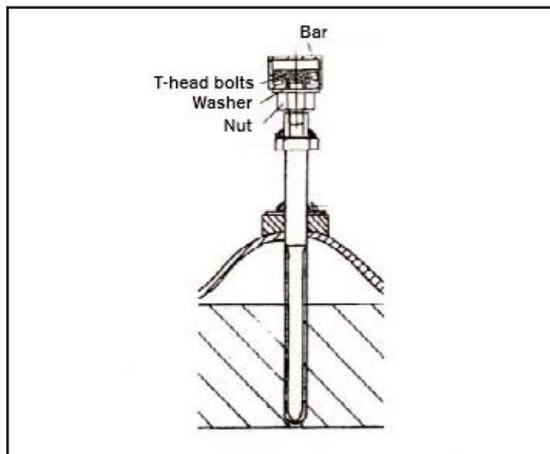
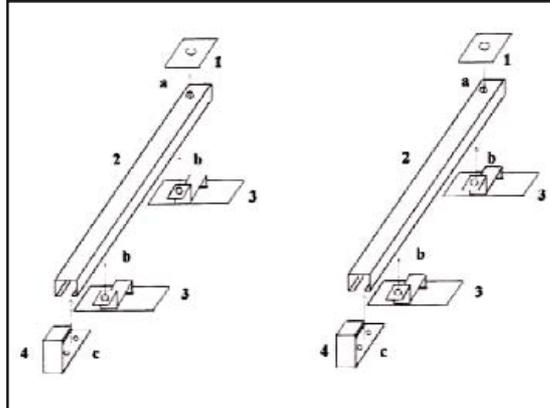


On roofs with corrugated sheets, put the roof hook on top of the sheet and fasten it to the rafter by threading through the sheet. The drill hole in the corrugated sheets must be sealed to protect against humidity and leaks. Ensure that the rafter anchor, at its bearing points, does not push down on the corrugated sheet, thus causing leaks. If required, counter-balance the supporting points of the roof hook.

6.2. How to install the supporting bar and the collector

Tile roof mounting

1. Place the collector in its approximate position on the roof. Its precise position will be determined later by horizontally and/or vertically sliding the collector along the bars.
2. Locate the rafters and remove the tiles required to mount the roof hooks. Mount two roof hooks at a distance of about three tiles per rafter.
3. Measure the height of the lathing and determine the required underpadding for the roof hooks. Make sure that the roof hooks are placed about 2-3 mm above the tile, and if possible, in the tile valley (for the case of roofing tiles).
4. The underpadding must be 2-3 mm thicker than the tiles to prevent pressure on the tiles.
5. Pre-drill the rafters, then place the roof hook onto the rafter and the underpadding, and fasten with wood screws.
6. Fit in the tiles removed earlier (if required, remove the lower "tile nose" above the roof hook) and recover the roof.
7. Attach the lower bracket to the bar using two T-head bolts. The hole in the supporting bar must be oriented towards the top ridge. The groove on the bar must be oriented towards the bottom.
8. Attach the bar to the roof hooks, using a T-head bolt for each roof hook. Adjust the bar in such a way that the overlaps on both sides are approximately the same length. Align the bar in a straight line.
9. Place the collector onto the bar and slide it into the lower bracket.
10. Attach collector on top with a screw.



Make sure to strongly tighten each of the threadings.

7. Flat roof mounting



Take special care in gardens where children may play to ensure that there is no risk of burns or glass breakage.

7.1. How to orient and install the collector

Orient the collector towards the south. A +/- 60 degree deviation is possible. The mounting site must be chosen in such a way that no shadowing of the collector surface happens during the main period of use.

General requirements

The free-standing kit is suitable for free-standing collectors, collectors on flat (or slightly sloped) roofs, or façade mounting. The mounting angle is 45 degrees and cannot be modified due to the triangular design.

The kit for free-standing collectors does not include 900 mm stainless steel pipes for the roof lead-through.



The collectors are either fastened onto a bed-plate, concrete plates, a steel frame or onto an appropriate façade. If the collector is fastened to a bed-plate or concrete plates, you will need two concrete plates for each collector, with a length of around 1.50 to 2.00 m and a weight of around 200 kg. To protect the roof membrane on flat roofs from damage, put hard-rubber plates under the concrete (available in specialized shops).

Safety instructions

Please read through these mounting instructions carefully before proceeding, and follow the safety guidelines in this brochure.



Before mounting the collectors, please check the static load-carrying capacity of the roof or the façade. Please observe established occupational health standards when working on the roof.

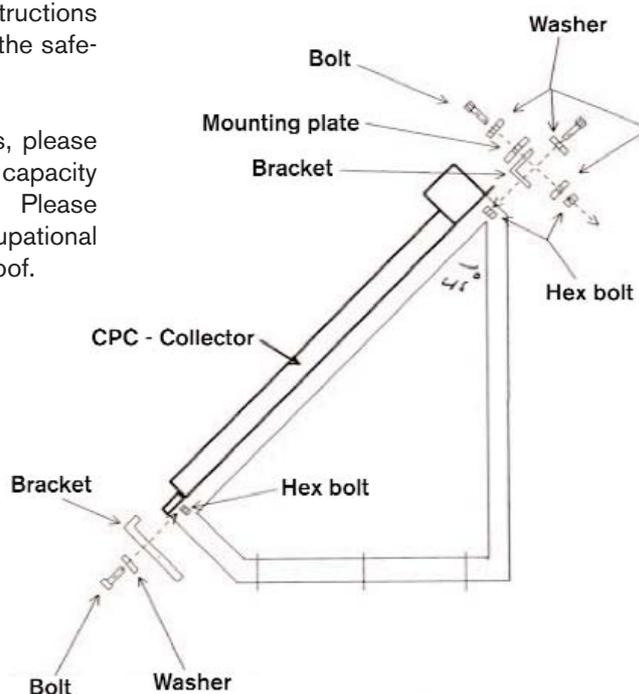
Venting: The solar circuit is vented at its highest point.

Frost/freeze protection: Since the collectors cannot be completely emptied, the system must always be filled with a Tyfocor LS antifreeze mixture ! After pressure testing the system, it is strongly recommended to fill it with an antifreeze mixture.

Grounding and lightning protection

The metal tubes of the solar circuit must be connected to the main potential compensation rail of the building by at least a min. 16 mm² copper (H07 V-U or R) green/yellow conductor. If no lightning protection system exists, no further measures need to be taken. If a lightning protection system exists, the collectors must also be included. If this is not possible, grounding must be ensured by a ground rod.

The ground conductor must be placed on the exterior of the building. In this case, the ground conductor must be connected to the main potential compensation rail using an additional conductor that has the same cross section.



8. Connections

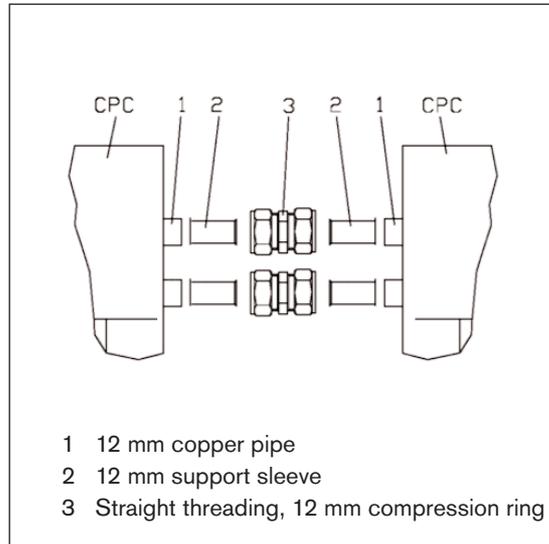
8.1. How to connect two collectors in series

If you want to connect two CPCs in series, you will have to connect their hydraulic manifolds. If the collector field supply and return of the outer right CPC are to be placed from the right header side towards the roof, the plastic cap on the left side of the header and the compression ring fitting beneath (U tube with two 12 mm compression ring) will have to be removed.

Insert the support sleeves (2) into the collector fittings. Place the compression ring (3) onto one collector and tighten slightly. Then insert the fitting of the collector beside it into the other side of the compression ring fitting until the stop, and tighten both sides securely.

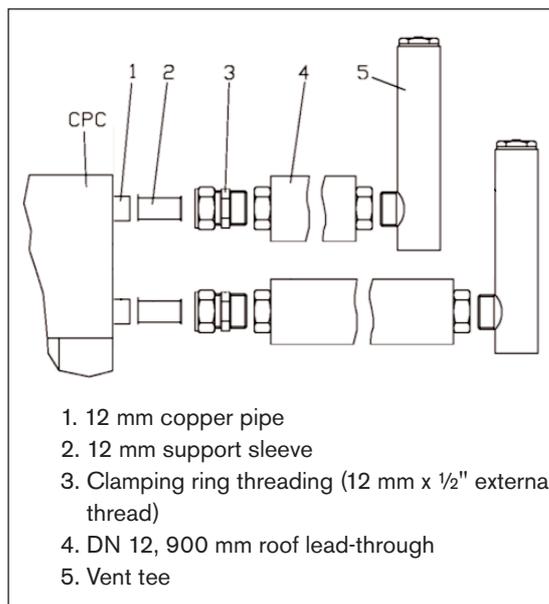


The collector connections are hard-soldered. Make sure to hold the middle hex head with a wrench to avoid twisting the collector connections. Any damage/leakage resulting from non-compliance with these instructions will void the warranty. We also recommend insulating the connections between the collectors once they have been installed.



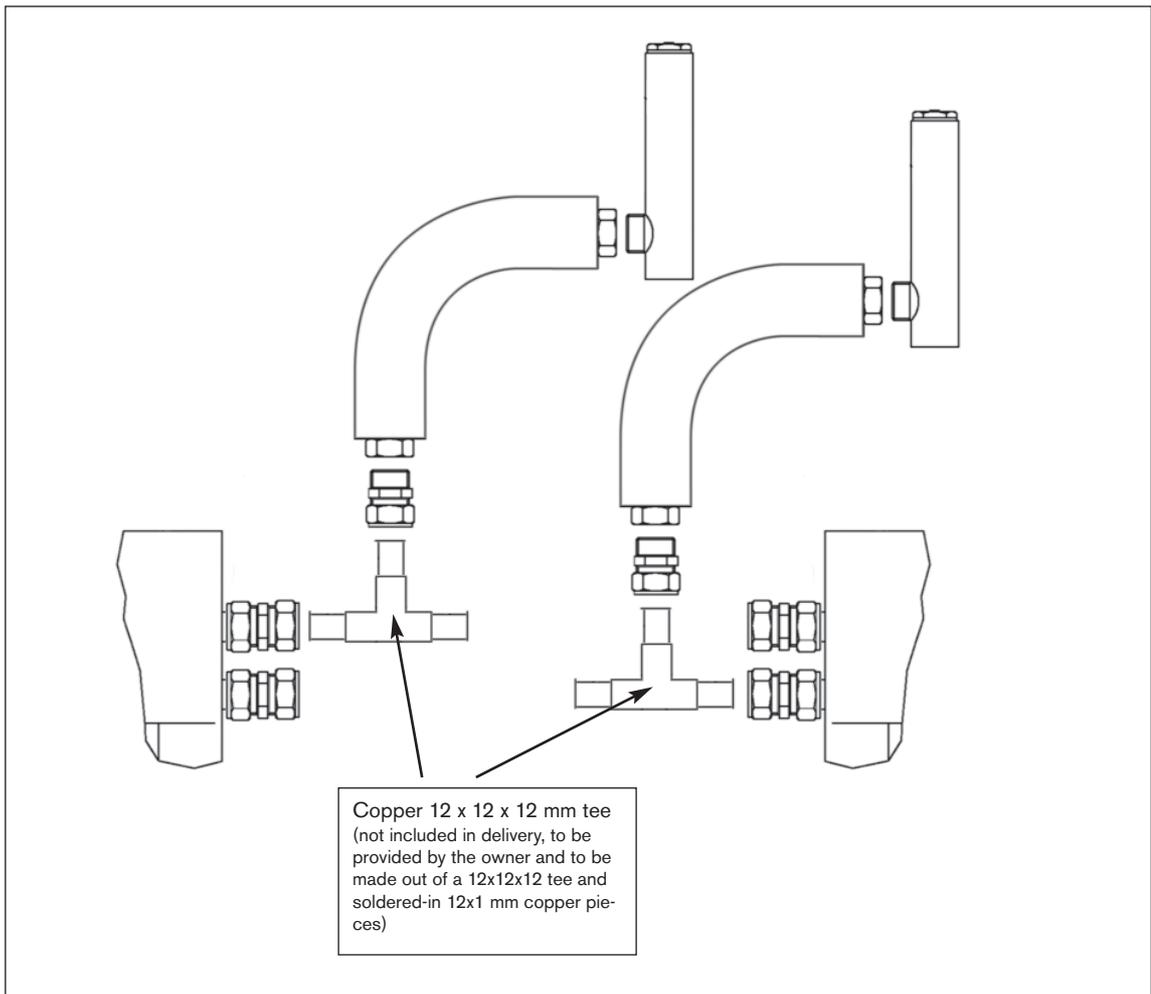
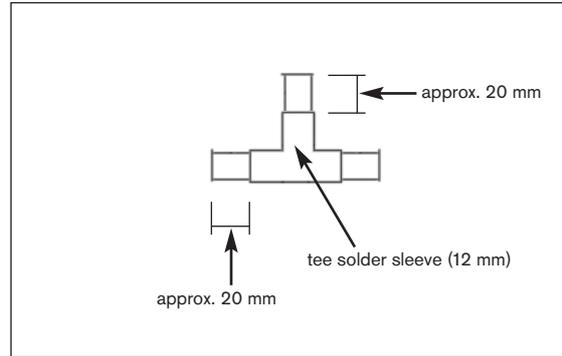
8.2. How to connect the vent

To install the vent for the collector supply and return, use the parts shown in the figure on the right. Make sure that the roof lead-through from the collector to the vent leads upwards to allow for venting at the highest point.



8.3. How to connect two collectors / collector rows in parallel

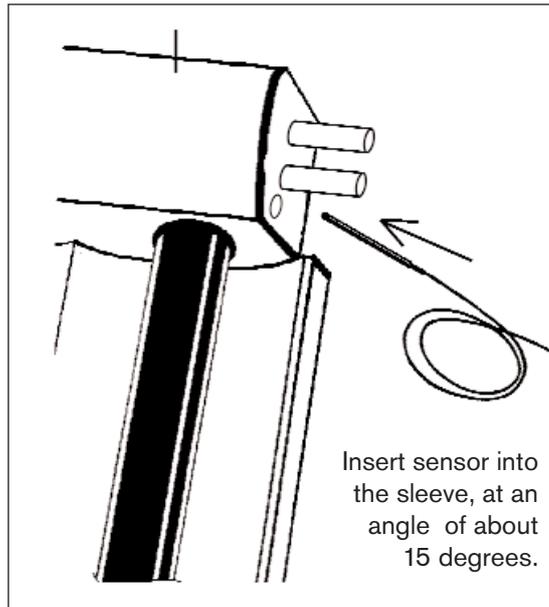
Usually no more than 2 CPCs can be connected in series, since otherwise the loss of pressure in the collector field will be too high. Therefore, larger collector fields must be divided into several rows. Two rows of collectors can be controlled by a tee in the collector field supply and return, so that only one roof lead-through will be required for the collector field supply and return. The 12 x 12 x 12 mm (copper) tee must be provided by the installer/owner. The copper tubes (dia = 12 mm) to be hard-soldered into the sleeve fittings must protrude by about 20-25 mm, so that the compression ring fittings can be threaded onto the CPC fittings and the roof lead-through later on.



8.3. How to install the collector sensor

There is an integrated sensor spout on both the left and right hand sides of the collector header. Before mounting the sensor, push the rubber membrane open with a sharp object (such as a screwdriver), insert the sensor into the spout and push the sensor into the sleeve until the stop.

Since the sensor cable can only withstand temperatures of up to 180 degrees, do not place it between the tubing and the insulation.



9. Tubing for the collector

9.1. Requirements for the installation of the solar circuit

The solar system must be a closed system, otherwise the antifreeze inhibitors will be consumed too quickly by the ozone in the incoming air.

Do not install any galvanized heat exchangers, storage tanks, containers or tubes on the primary side since the 1,2-propylene glycol in the antifreeze will damage the zinc.

Make sure that all of the insulation and connecting material used in the solar circuit can withstand the maximum standstill temperature.

It is preferable to use metal tubes as flexible connecting elements.

Make sure that the system components that come into contact with the antifreeze are free of foreign potential. This restriction does not apply to system components made of copper. However, in this case, the foreign potential must not exceed a certain limit (about 1.5 volts).

All the pipes must be installed in such a way that the circulation won't be perturbed by pockets of gas or scales.

The circuit must always be filled up to the highest point with heat transfer fluid. There must be a shut off valve, at the highest point, to vent the gases (refer to section 8.2. in this guide).

The supply and return pipes must have a regular slope to ensure unobstructed venting through the roof.

9.2. Hard soldering

Use argentic or copper hard soldering material. Do not use fluxing agents that contain chloride.

The use of soft soldering materials will void the warranty.

9.3. Dirt in the tubing



During installation and prior to filling, the system and its components must be protected from dirt and water leaks into the system. After the system has been successfully installed, clean the inner parts (by flushing) to eliminate any solid particles (such as metal chips, bits of leftover packaging, wood chips or dust, etc.) and any fitting devices. Please also refer to the mounting and operating instructions for the solar station.

9.4. Expansion vessel

Membrane expansion vessels must conform to the German Industrial Standards DIN 4807 and DIN 4757.

10. Repairs

10.1. How to replace a tube

Required tools and materials

Screwdriver, if required, a bucket and a brush for broken glass, gliding paste or soap suds, and replacement tube

10.2. Devices for your protection

When replacing broken tubes, always wear gloves and safety glasses.

10.3. How to detect a broken tube

Vacuum tubes are permanently air-tight. If a tube is destroyed or is no longer air-tight, it must be replaced. However, it is not always easy to detect a damaged tube. Typically, a damaged tube is characterized by a whitish film on the silver mirror (barium getter) caused by the air flowing in at the bottom of the tube.

10.4. How to remove a tube

a) that is no longer intact: Carefully remove the broken glass without destroying the CPC mirror surface. Remove the broken glass from the collector header. Then remove the tube support (as described under b).

b) that is intact but not functioning:

First, remove the tube support at the lower end. To do this, slide the tube about 5 mm up into the header to remove pressure from the support. Loosen the tube support threads, and remove the support.

Lift the tube a bit and remove it by slightly turning it around along its longitudinal axis.

If there is not enough space to do this, as in the case of a flat roof mounting, proceed as follows: Important: Support the end of the tube with your gloved hand and pull it down towards the ground, then pull the end of the tube in a straight line along the ground. Make sure that the 8 mm copper tube does not rise more than 20 degrees above the level of the collector, otherwise there will be a risk of breakage.

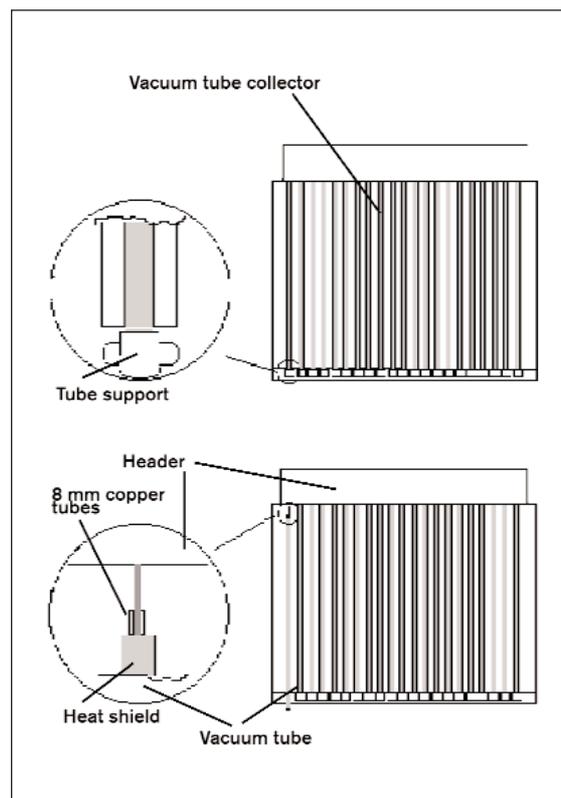
10.5. How to install a tube

Ensure that the silicone ring is properly seated in the header.

Lubricate the upper end of the tube with gliding paste or soap suds to facilitate sliding the tube through the silicone ring onto the header. Then replace the new tube using the same method you used to remove the broken one. Make sure that the 8 mm copper tubes with the heat

shields do not rise more than 20 degrees above the level of the collector.

Protect the end of the tube by holding it with your glove. Slide the tube through the silicone ring into the header by rotating the tube a little. Put the tube support on the end of the tube and attach it onto the frame using the two screws and their prepared holes. Pull the tube down into the tube support until the stop.



11. Start-up

11.1. Frost/freeze protection

To prevent damage to the solar system, the heat transfer medium must never be frozen.

11.2. Filling, pressure testing and flushing

Use only the ready-to-use antifreeze mixture to fill, pressure test, and flush the solar system. Do not pressurize the tubes with water, since some water will remain in the collector. Once water gets into the collector, protection against freezing and corrosion can no longer be guaranteed.



Caution ! If there is strong sunlight or if the day is bright:

As described before, the aperture surface (the tubes and CPC mirrors behind them) must be covered up immediately after the collectors have been installed to prevent them from heating up excessively.

When the collector is protected from the sun, it will be cool enough to be filled even when the sun is shining. Do not fill the system after the collectors have been or are still exposed to direct sunlight, or if the sky is very bright. Several tubes may be damaged due to temperature shock, and venting may be heavily impeded due to numerous "vapour clouds". Moreover, the antifreeze mixture could be seriously damaged and age prematurely. The resulting sludge could completely block the system, requiring a very costly flushing of the whole system to re-establish all of its functions. However, that will only happen if you don't follow the instructions described above. Any damage resulting from failure to follow the instructions above will not be covered by the warranty.

Fill the solar system with an engine-driven pump or with a water pressure pump. Continue filling the system until no more air comes out of the vent.

Tip: Filling the system with an engine-driven pump (e.g. a domestic water station with a filtering station in between) will guarantee good venting of the system. After filling the system, make sure that there are no air pockets left in the system. Then pressure test the system and perform a leakage test in accordance with the German Industrial Standard DIN 18380. After that, flush the solar system with plenty of the ready-to-use antifreeze mixture. After leaving the system, the antifreeze must be filtered before it can be re-used. Please follow the instructions for filling and flushing the solar station. After flushing and venting the system, set it to the recom-

mended operating pressure.

If the filled solar system will not be used for a length of time (e.g. if no hot liquid is removed from the system), the collectors must be covered up, otherwise the solar fluid will evaporate completely, and the system will be blocked with sludge. Failure to follow these instructions will void the warranty.

11.3. Start-up of the control

Please refer to the start-up instructions for the control. When the tube collector function is existent, it **MUST** be activated in the controller.

11.4. Grounding and lightning protection

The metal tubes of the solar circuit must be connected to the main potential compensation rail of the building by a min. 16 mm² copper (H07 V-U or R) green/yellow conductor.

If a lightning protection system exists, the collectors must be included as well. If this is not possible, grounding must be ensured by a ground rod. The ground conductor must be placed on the exterior of the building. In this case, the ground conductor must be connected to the main potential compensation rail using an additional conductor that has the same cross section.

11.5. Lightning protection regulations

Follow your local lightning protection regulations.

11.6. Integration with an existing lightning system

Establish a conductive connection using a copper cable (with a minimum cross section of 10 mm²) between the mounting frames and the tubing. The tubing must be connected to the main potential equalization by a conductive cable with a minimum cross section of 10 mm².

12. Maintenance, inspection

We recommend a yearly inspection by an authorized company. Perform a yearly check of the frost protection for the heat transfer medium and then verify that the operating pressure of the system is within normal parameters.

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