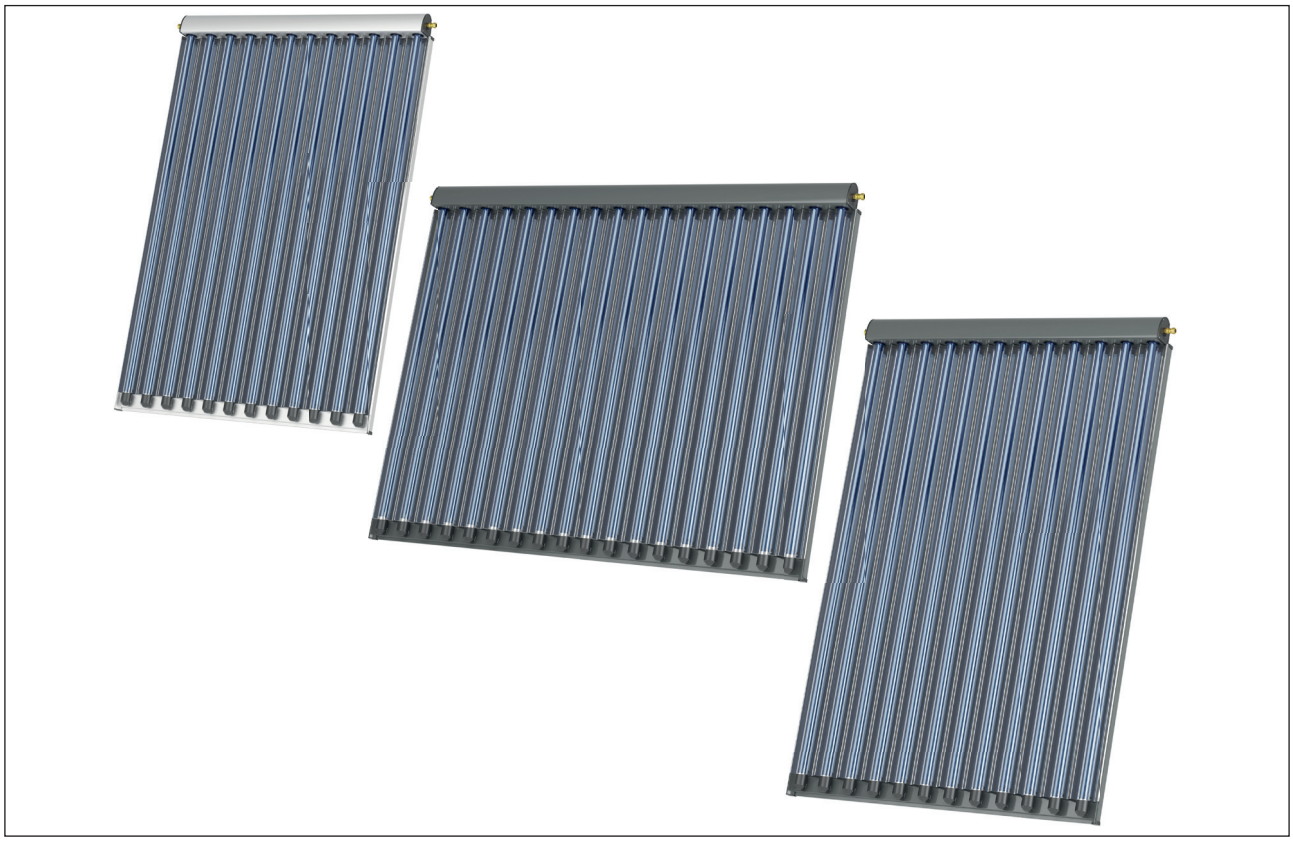
Ritter Gruppe
Evacuated tube collectors



CPC OEM/INOX and XL INOX

Instructions for installation engineers
Planning
Mounting
Commissioning
Maintenance

TDEN1044 01/19

V 2.3

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Due to continuous further development, the drawings, installation steps and technical data indicated here may differ.

Subject to technical modifications.

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1 About this document

1.1 Purpose of this document

This document is to provide you with information regarding the evacuated tube collectors of the *CPC OEM/INOX* and *CPC XL INOX* series. It contains information concerning:

- Safety
- Functioning principle
- Planning
- Mounting
- Commissioning
- Repair
- Maintenance

1.2 Target group for this document

The present document is intended for installation engineers.

1.3 Applicability of the instructions

These instructions apply to the evacuated tube collectors of the *CPC OEM/INOX* and *CPC XL INOX* series as of October 2018.

1.4 Storage of the documents

It is the responsibility of the operator of the system to store the documents so that they are available when needed.

2 Symbols and representation rules

2.1 Symbols used in this document

The following symbols are used in the present document:

DANGER

Danger to life due to electric shock!

DANGER

Warning with information about the severity of the risk

2.2 Representation rules

The following typographical conventions are used in this document:

Font and formatting

Format	Description
Text	Product names and product designations Example: *CPC 6 OEM*
[32]	Reference to page number Example: For further information, see chapter "Regulations [12]".

One-step instruction

Used for instructions that consist of only one step or for which the chronological order of the individual action steps is not essential.

► Action step

Multi-step instruction

Used for instructions that consist of multiple steps or for which the chronological order of the individual action steps is important.

1. First action step
   → Intermediate result
2. Second action step

→ End result

3 For your safety

3.1 Dangers and safety measures

The installation, the commissioning as well as any work on the unit may only be carried out by an installation engineer.

- ► The entire solar system is to be installed according to the generally recognised codes of practice.

The applicable work instructions must be complied with

- ► If there is a risk of falling, wear a safety belt without fail, especially when working on a roof.
- ► Wear gloves and safety glasses in order to avoid injuries.
- ► Make sure to observe the accident prevention guidelines stipulated by the trade associations.

Electric shock

All work involved in the electrical installation of the solar system may only be carried out by an installation engineer.

- ► Mains voltage is present at the electrical connections. This may cause an electric shock.
- ► Make sure that live parts do not become wet.

Pay attention to overhead electrical lines

- ► Appropriate safety measures must be taken when working in the vicinity of overhead electrical lines (voltage disconnection, covering, observing safety distances).
- ► Coordinate with the operator of the overhead electrical lines.

Damage due to improper installation

Improper installation may cause damage to the evacuated tube collectors.

- ► Use the specified fastening systems for the collectors.
- ► Install the collectors according to the description in this manual.
- ► Use suitable tools.

Avoid any danger caused by falling components

Falling parts can put people at risk.

- ► Never stand underneath a lifted or suspended load.
- ► Observe the regulations that apply to working at the corresponding height.
- ► Cordon off a sufficiently large fall area below the working position.
- ► Label the working position in accordance with the applicable regulations, for example by using warning notices.
- ► The maximum permissible load for the substructure must be checked before installing the collector.
- ► Observe the required distances to the roof edge when installing the collector.

In case of danger

The operator may only disconnect the solar system from the mains supply in the case of danger, e.g. in case of fire.

- ► If there is a fire, use a suitable fire extinguisher.

Avoid interrupting the power supply

Improperly shutting down the solar system can cause damage to property.

- ► Only interrupt the power supply when carrying out maintenance and repair work or in case of emergency.

Repair work

1. Do not carry out any repairs on safety-critical components.
2. If components are replaced, original replacement parts must be used.

Avoid any risk of scalding due to hot steam

In the event of a malfunction of the system, steam may escape from the safety valve of the solar station.

1. Install a temperature-resistant exhaust pipe at the outlet of the safety valve.
2. Guide the exhaust pipe downwards to a suitable (metallic) collection container.

3. Ensure that the container can accommodate the system volume that is displaced by steam above the solar station.
   The system volume displaced by steam consists of the collector content and pipe content from the flow and return.
4. Install the collection container in a non-tilting position.

Avoid any risk of burns and scalding

The interior of evacuated tube collectors can reach temperatures of over 300 °C when exposed to sunlight. This can cause burns due to hot parts and scaldings due to escaping steam.

- ► Only remove the factory-fitted sun protection sheet after the solar system has been commissioned.
- ► Wear suitable gloves when working on the collector.
- ► Use the reusable sun protection tarpaulin (accessory) in the course of maintenance and repair work.

Avoid any risk of injury and burns

When installed in gardens or on walls, evacuated tube collectors are exposed to an increased risk of being damaged.

A breakage of the evacuated tubes can cause injuries. There is also a risk of burns at the tube and/or heat conduction plate that is accessible as a result.

- ► When installing the collectors, make sure they are not accessible to unauthorised persons.
- ► Do not leave other persons, especially children, unattended when they are near the collector.

Set up potential equalisation

Due to improper installation of the system or a defective electrical cable, mains voltage can be present at the pipework. This may cause injury to persons and damage to the solar system.

- ► Make sure to observe the country-specific regulations and guidelines when establishing the main equipotential bonding.

Observe lightning protection

If a lightning protection system is installed on the building, the electrically conductive parts must be connected to the lighting protection system.

- ► Make sure to observe the country-specific regulations and guidelines regarding lightning protection.

3.2 Warnings

The warnings in these instructions are highlighted using pictograms and signal words. The pictogram and the signal word provide information on the severity of the hazard.

Structure of warnings

The warnings that precede every action are represented as follows:

DANGER

Type and source of danger

Information on the type and source of danger

- ► Measures to prevent the danger

Meaning of the signal words

DANGER	Imminent danger to life or risk of serious injury if this hazard is not avoided.
WARNING	Potential risk of serious injury if this hazard is not avoided.
CAUTION	Risk of minor injury if this hazard is not avoided.
NOTE	Risk of damage to property if this hazard is not avoided.

3.3 Regulations

Replace the regulations, standards and guidelines with the applicable country-specific regulations!

The evacuated tube collectors require registration or permission in line with the applicable country-specific regulations.

Observe the following regulations and guidelines, among others, during installation, commissioning and maintenance of the collectors:

Legal requirements

- Legal regulations governing accident prevention
- Legal regulations governing environmental protection
- Provisions stipulated by the trade associations
- German Energy Savings Act on the Saving of Energy in Buildings (EnEG)
- German Renewable Energy Heat Act (EEWärmeG)
- EnEV (German Energy Saving Ordinance)
- Building code of the respective federal state/region

Standards and guidelines

- DIN, EN and VDE safety provisions

Installation on roofs

- DIN 4420 Working and protective scaffolds
- DIN 4426 Equipment for building maintenance - Safety requirements for workplaces and accesses
- DIN 18338 Roofing and roof sealing works
- DIN 18339 Sheet metal works
- DIN 18451 Scaffolding work
- DIN EN 1991-1ff. Eurocode 1: Actions on structures
- VDI 6012 Part 1.4: Fixing of solar modules and solar collectors on buildings
- BDH Information sheet no. 49: Determining snow loads on solar thermal systems
- BDH Information sheet no. 61: Work sheet to determine wind loads on solar thermal systems

Connection of thermal solar systems

- DIN EN 12975-1 Thermal solar systems and components - Solar collectors
- DIN EN 12976-1/-2 Thermal solar systems and components, factory made systems
- DIN EN 12977-1 to -5 Thermal solar systems and components, custom built systems
- DIN EN ISO 9488 Solar energy - Terminology
- DIN EN ISO 9806 Solar energy - Solar thermal collectors - Test methods
- VDI 6002 Solar heating for potable water

General conditions for the supply of water, DVGW worksheet

- W551, W552 Technical measures to avoid legionella growth

Installation and equipment of water heaters

- DIN 18380 Central heating systems and hot water supply systems - leak test
- DIN 18381 Installation of gas, water and drainage pipework
- DIN 18421 Insulation of service installations

- DIN 1988ff. Codes of practice for drinking water installations
- DIN EN 1717 Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow
- DIN 4753ff. Water heaters

Electrical connection

- VDE 0100 Erection of electrical equipment, earthing, protective conductors, equipotential bonding conductors
- DIN EN 62305ff. Lightning protection
- VDE 0100-540 Main equipotential bonding of electrical systems
- DIN 18382 Electrical cables and lines in buildings

Other standards and regulations

- DIN 4807 Expansion vessels
- DIN EN 13831 Closed expansion vessels with built in diaphragm for installation in water
- DIN EN ISO 4126 Safety shut-off valves
- DIN 1052 Timber structures
- DIN EN 1990ff. Basis of structural design
- VdTÜV specification sheets 1453 and 1466
- DIN EN 12828 Heating systems in buildings
- TRGS 519 Asbestos, demolition, reconstruction or maintenance work

3.4 Operational conditions

DANGER

Danger to life due to collapse of the roof

Additional weight caused by the collectors and installation sets, wind and snow load and by persons during installation puts a strain on the roof. A roof that does not provide sufficient load-bearing capacity will be damaged and collapse.

- ► The maximum roof load allowed must be checked prior to installation
- ► The collectors may only be installed on roofs that provide sufficient load-bearing capacity
- ► If required, consult a structural engineer or an appropriately qualified expert

DANGER

Danger to life due to collapse of the wall

Additional weight caused by the collectors and installation sets, as well as wind and snow loads, put a strain on the wall. A wall that does not provide sufficient load bearing capacity will be damaged and collapse.

- ► The maximum load allowed on the wall must be checked prior to installation
- ► The collectors may only be installed on walls that provide sufficient load-bearing capacity
- ► If required, consult a structural engineer or an appropriately qualified expert

3.4.1 Installation angle

Install the collector with an inclination of at least 15° and a maximum of 90°.

3.5 Conformity

We as the manufacturer hereby declare that this product complies with the fundamental Directives and Regulations with regard to placing products on the market in the EU.

3.6 Specialist tradesman's duties

Please observe the following to ensure that the system is functioning correctly:

- ► Carry out all work in accordance with the applicable standards and regulations.
- ► Instruct the operator about the correct function and operation of the system.
- ► Instruct the operator about the maintenance of the system.
- ► Hand over the commissioning log to the operator.
- ► Inform the operator about possible hazards that might occur during operation of the system.

4 Product description

4.1 Use

4.1.1 Intended use

The evacuated tube collectors of the *CPC OEM/INOX* and *CPC XL INOX* series can be used for domestic water heating, for partial solar heating, for heating swimming pool water and for providing solar process heat.

The collectors are operated with the antifreeze agent *Tyfocor LS*.

This product is not intended to be used by the following persons:

- Persons with restricted physical, sensory or mental capabilities
- Persons missing the required experience or knowledge
- Children under the age of 16 years

These persons must be supervised by a person responsible for their safety or be provided with instructions on how to use the product beforehand.

Children must be supervised to make sure that they do not play with the product.

Any use other than the intended use shall not be admissible. The manufacturer is not liable for damage incurred as a result of such use. If modifications are made to the product, also for the purposes of assembly and installation, all warranty claims will be void.

Take all related documents into account during the course of all work on the product. The manufacturer shall not assume any liability for damages caused by incorrect actions.

4.1.2 Unintended Use

The evacuated tube collectors of the *CPC OEM/INOX* and *CPC XL INOX* series are **not** intended to be operated with water.

The manufacturer or supplier shall not assume any liability for damages caused by unintended use.

4.2 Type plate

The type plate contains all important specifications of the manufacturer in the form of symbols. For the meaning of the individual symbols, please refer to the following table:

Symbols	Meaning	Explanation
A_g	area $_{gross}$	Gross surface area
l x w	length x width	Dimensions (length x width)
V_f	volume $_{fluid}$	Collector content
m	mass	Weight
t_{stg}	temperature $_{stagnation}$	Stagnation temperature (at 1000 W/m² and 30 °C)
p_{max}	pressure $_{maximum}$	Maximum admissible operating pressure
y_{prod}	year $_{production}$	Year of construction

The type plate is located at the top right near the manifold.

4.3 Evacuated tube collectors CPC OEM/INOX and CPC XL INOX

The collectors of the *CPC OEM/INOX* and *CPC XL INOX* series stand out due to their high level of performance and fast installation.

The collectors are able to collect solar energy throughout the entire year even in case of diffuse irradiation. Due to the blue-black shimmering absorber coating, an extremely high energy yield is achieved in the tubes. This way, high supply temperatures can be achieved even in extremely cold weather conditions.

Performance characteristics of the CPC OEM/INOX and CPC XL INOX

The collectors of the *CPC OEM/INOX* and *CPC XL INOX* series are characterised by the following performance features:

- Suitable for on-roof installations, flat roofs, as well as wall and free-standing installations.
- Suitable for heating drinking water, heating water or swimming pool water, for partial solar heating and for providing solar process heat
- Up to 13 m² can be connected in series.
- High energy yields even in transitional periods and during winter.
- Extremely low heat losses due to high vacuum.

4.3.1 Benefits and advantages

The evacuated tube collector stands out due to the following advantages:

- Short installation times thanks to pre-assembled mounting kit without loose individual parts
- Connection set complete with cover, insulation and standardised metal-sealing clamping ring fitting
- Flow and return connection possible on manifold
- Temperature sensor can be installed on left or right side of manifold
- Faulty tubes and reflectors can be repaired without emptying collector circuit
- Maximum use of surface area through combination of various collector widths within an array

4.3.2 Operational safety

The high operational safety and the long service life of the collectors are ensured by several factors, including:

- Use of high-quality, corrosion-resistant materials such as borosilicate glass, copper, stainless steel and hard anodised aluminium
- Permanent vacuum seal of the tubes thanks to pure glass-glass composite without glass-metal transitions
- Highly reflective reflector material with permanent corrosion protection layer and anti-algae coating
- Metal-sealing, high temperature resistant and wear-free hydraulic connection via clamping ring fitting

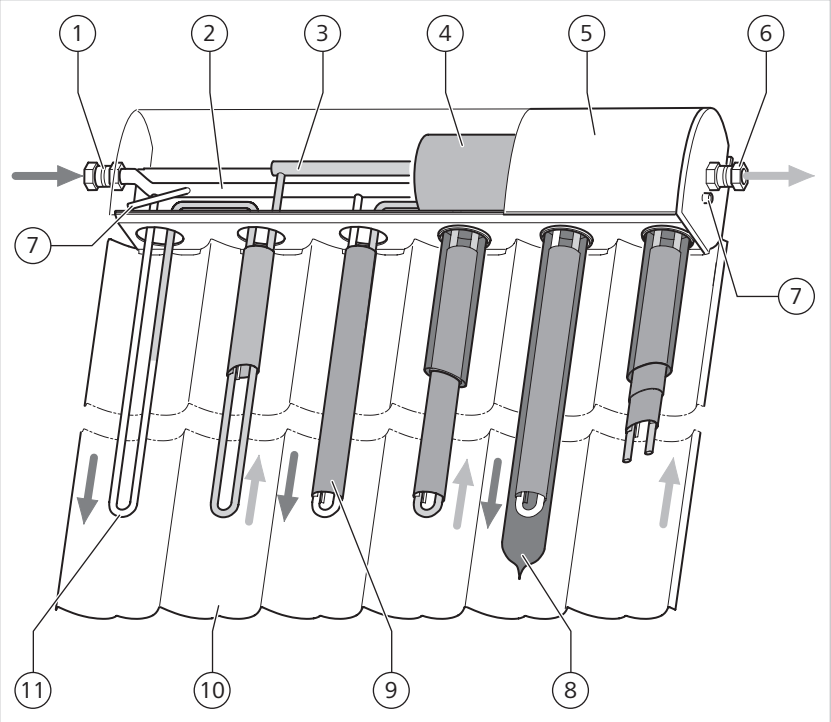
4.3.3 Energy yield and performance

With regard to energy yield and performance, the evacuated tube collector stands out due to the following factors:

- High space utilisation level with comparatively small gross surface area of the collectors
- Circular absorber surface in the individual tubes ensures optimum alignment with the sun at all times and optimum reflector geometry with maximum acceptance angle
- High solar coverage rates are possible.

- High efficiency due to highly selective coating on absorber and high-reflection reflector
- Efficient reduction of thermal losses thanks to high vacuum
- The circular absorber and the CPC reflector geometry always ensure optimum capture of direct solar irradiation at different angles of incidence and diffuse solar irradiation
- High energy yield due to the CPC reflector and the direct throughflow of the evacuated tubes
- High efficiency even in winter and in the event of low irradiation thanks to the best possible qualification of output-related parameters such as reflection of the reflector, absorption, emission of the absorber and vacuum quality of the evacuated tubes.
- Higher yields during heating periods than with flat plate collectors
- Also ideal for systems with stratified charging, target temperature control and heating support

4.4 Product components



Product components

1	Flow/return connection	7	Sensor immersion sleeve
2	Distributing pipe	8	Evacuated tube
3	Collecting pipe	9	Heat transfer plate
4	Thermal insulation	10	CPC reflector
5	Manifold	11	Meander pipe
6	Flow/return connection		

The evacuated tube collector consists of three main components which are completely pre-assembled:

- evacuated tubes
- CPC reflector
- Manifold with heat conduction unit

Evacuated tube

The evacuated tubes consist of two concentric glass tubes. On one side, the glass tubes are sealed in a semi-circular shape and joined to one another on the other side. The space between the tubes is evacuated and then hermetically sealed. This way, an evacuated insulation is created.

In order to use solar energy, the internal glass tube is coated with an environmentally friendly, highly selective absorber layer on the outside. This coating is thus protected in the vacuum cavity.

The high-selective absorber coating is characterised by extremely low emissions and excellent absorption.

CPC reflector

In order to increase the efficiency of the evacuated tube collectors, a highly reflective, weather-proof CPC (Compound Parabolic Concentrator) reflector is fitted behind the evacuated tubes.

The optimised reflector geometry guarantees that direct and diffuse sunlight strikes the absorber especially when the angles of irradiation are unfavourable. This significantly improves the energy yield of the collector.

Unfavourable angles of irradiation are caused by light striking the collector at an angle, e.g. when the mounting surface does not face south, during solar movement from east to west or in case of diffuse irradiation such as that caused by clouds scattering the light.

The highly reflective reflector surface is sealed with an effective corrosion protection layer that also largely prevents the growth of algae. The protective layer guarantees a uniform and long-lasting appearance in the case of elevated mounting and visible overhead installation.

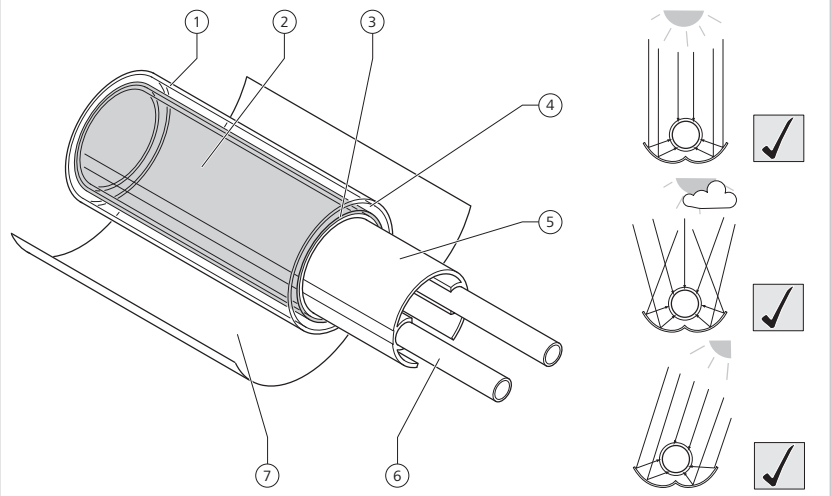
Manifold with heat conduction unit

The manifold contains the insulated collecting and distributing pipes.

The flow or return pipe can be connected on the left or on the right, as selected.

Each evacuated tube contains a meander pipe that features direct flow-through of the heat medium. The meander pipe is connected to the collecting or distributing pipe in such a way that each individual tube has the same hydraulic resistance. The meander pipe is pressed against the inside of the tube with heat transfer plates.

4.5 Functional description



Structure of CPC evacuated tube collector

1	Outer glass tube	5	Heat conduction plate
2	Absorber layer	6	Stainless steel tube
3	Inner glass tube	7	Highly reflective CPC reflector
4	High vacuum		

The solar irradiation striking the collector is reflected to the absorber layer (2) of the evacuated tubes by the highly reflective CPC reflector (7). The absorber layer (2) converts the solar irradiation into thermal energy and heats up the inner glass tube (3). The heat transfer plate (5) transfers the heat from the inner glass tube (3) to the stainless steel tube (6).

The heat from the collector is conveyed to the storage tank via the heat transfer medium in the stainless steel pipes (6).

A high vacuum (4) in the evacuated tubes and the selective absorber layer (2) prevent the heat from being lost to the surrounding area. The vacuum between the outer (1) and inner (3) glass tube is ideally suited to providing thermal insulation. The vacuum fully prevents both convection heat losses and losses caused by gaseous conductivity.

The CPC reflector (7) enables the collection of a maximum of solar energy even if the angles of irradiation are unfavourable. The solar irradiation is also reflected onto the absorber layer by the CPC reflector if the sunlight strikes the reflector at an angle or in case of diffuse solar irradiation.

4.6 Heat output

The collector output $\dot{Q}$ depends on the following factors:

- Collector efficiency (η) depending on the irradiance (G)
- Gross area per collector module (A)

It provides information on the thermal output of the collector at a specific irradiation strength.

The following equation is used to calculate the collector output:

$\dot{Q} = A \cdot G * \eta$ with $\eta = \eta_0 - a_1 [(\vartheta_m - \vartheta_a)/G] - a_2 [(\vartheta_m - \vartheta_a)^2/G]$

If the difference between the collector temperature and the ambient temperature $(\vartheta_m - \vartheta_a)$ is zero, the following applies:

- no heat loss of the collector to the surrounding area
- maximum efficiency (η)

This is the optical efficiency η_0. A part of the solar irradiation (G) which strikes the collectors is lost due to reflection and absorption. The optical efficiency η_0 takes these losses into account.

When the collectors heat up, they dissipate heat to the surrounding area by conduction, radiation and convection. The heat transmission coefficients a_1 and a_2 incorporate these losses.

The almost horizontal power curves mean that the evacuated tube collectors generate high outputs even at great temperature differences between the collector temperature and the ambient temperature, in contrast to flat plate collectors.

In general, less solar radiation is available for use as solar energy (for domestic water preparation and heating support) in the six winter months and in transitional periods, e.g. 400 W/m². The temperature differences between the collector temperature and the ambient temperature are also very high due to the low temperatures outside.

The following tables provide an exact overview of how the collector output changes depending on the irradiance and temperature difference. The values specified refer to vertical solar radiation.

4.6.1 Collector output per module

CPC 6 OEM/INOX

$(\vartheta_m - \vartheta_a)$ [K]	**Irradiance**		
	400 W/m²	700 W/m²	1000 W/m²
0	258 W	451 W	644 W
10	250 W	443 W	636 W
30	231 W	424 W	617 W
50	208 W	402 W	595 W

CPC 12 OEM/INOX

$(\vartheta_m - \vartheta_a)$ [K]	**Irradiance**		
	400 W/m²	700 W/m²	1000 W/m²
0	515 W	901 W	1287 W
10	499 W	885 W	1271 W
30	462 W	848 W	1234 W
50	417 W	803 W	1189 W

CPC 18 OEM/INOX

$(\vartheta_m - \vartheta_a)$ [K]	**Irradiance**		
	400 W/m²	700 W/m²	1000 W/m²
0	773 W	1353 W	1932 W
10	749 W	1329 W	1908 W
30	693 W	1272 W	1853 W
50	626 W	1206 W	1786 W

CPC 6 XL INOX

$(\vartheta_m - \vartheta_a)$ [K]	**Irradiance**		
	400 W/m²	700 W/m²	1000 W/m²
0	332 W	582 W	831 W
10	322 W	571 W	821 W
30	298 W	547 W	797 W
50	270 W	519 W	768 W

CPC 12 XL INOX

$(\vartheta_m - \vartheta_a)$ [K]	**Irradiance**		
	400 W/m²	700 W/m²	1000 W/m²
0	662 W	1159 W	1656 W
10	642 W	1139 W	1636 W
30	594 W	1091 W	1588 W
50	537 W	1034 W	1531 W

4.7 Solar controller

The solar controller for tube collector systems must have a tube collector function (push-start function). The push-start function prevents overshooting of the collector temperature.

Push-start function

This push-start function prevents excessive temperature differences between the following measuring points:

- measured temperature at the collector sensor
- temperature in the lower/middle part of the tube

If a temperature increase is detected at the collector sensor, the pump must be started approx. two to three times per minute for approx. 3 to 5 seconds. This way, the hotter solar fluid is pumped to the measuring point.

The following types of push-start function are possible:

- Push-start function via temperature increase
  If the measured collector temperature increases by a few degrees, e.g. 2 K (kelvins), the throughflow of the collector array is enabled for a brief period, e.g. 15 sec.
- Push-start function via time
  The throughflow of the collector array is cyclically enabled for a brief period, e.g. for 15 sec. every 15 min.
  If the solar controller also features a date and time function then the push-start functions can be blocked at night, e.g. between 20:00 and 06:00.

In order to activate the tube collector function featured in the controller, proceed as follows:

1. Set the maximum storage temperature to a high value, e.g. 90 °C, and install a domestic water mixer
2. If a blocking time for the solar circuit pump is set in the controller, disable the blocking time and set to 0 sec.

Collector cooling function

If the solar controller features a collector cooling function, this must be disabled for the CPC collectors.

The collector cooling function may be suitable for flat plate collectors, but not for evacuated tube collectors. Due to the low heat loss of evacuated tube collectors, such a function is almost entirely ineffective and can lead to overshooting, system switch-off or frequent stagnation.

5 Planning

► Please make sure to observe the following chapters in the planning phase.

5.1 Design of the collector area and storage tank

The dimensioning of the collector and the storage tank is based on the number of persons.

The following parameters must be known for the precise design of a solar energy system:

- for solar systems used for domestic water preparation:
  - hot water requirement
  - user behaviour (consumption profile)
- for solar systems used to provide heating support:
  - hot water requirement
  - user behaviour (consumption profile)
  - heat requirement
  - heating surface design temperatures

Design values for the collector area

When designing the collector area, the following average values can be assumed:

- Collector area for domestic water heating = number of persons + 1 m^2
- Collector area for partial solar heating = 2 × number of persons + 1 m^2

  Deviations of ± 25 % are admissible.
- Storage tank content: approx. 80 l per m^2 collector area for domestic water heating and/or partial solar heating

Note

The average values are recommended guide values.

Depending on the customer requirements (comfort, price), these values can be exceeded or undercut by up to 25 %. If these values are exceeded or if the system is oversized, the frequency and duration of stagnation shall increase.

We recommend performing close monitoring of the heat transfer medium Tyfocor LS and replacing the heat transfer medium at an earlier stage if necessary.

These specifications have been made under the assumption of an approximately south-facing alignment of the collector array and a roof pitch between 25° and 50° in Würzburg, Germany.

If the framework conditions should deviate from these, we recommend a detailed design process using simulation programs.

Example

Domestic water heating for 4 persons: number of persons + 1 m^2 = 4 + 1 m^2 = 5 m^2

Collector options: 2 × CPC 12 OEM / OEM INOX or 1 × CPC 18 OEM / OEM INOX + 1 × CPC 12 OEM / OEM INOX; or 2 × CPC 12 XL

Heating support for 4 persons: 2 × number of persons + 1 m^2 = (2 × 4) + 1 m^2 = 9 m^2

Collector options: 4 × CPC 12 OEM or 5 × CPC 12 OEM; or 3 × CPC 18 OEM or 3 × CPC 12 XL

5.1.1 Correcting the collector area

The corrections of the collector area area depending on the following factors:

- Main usage period
- Collector angle
- Angle deviation from south

► Please observe the following tables.

Domestic water preparation

Angular deviation from due south		Roof incline (collector incline)									
		0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
South	0°	1,2	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,6	2,0
	15°	1,2	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,5	1,9
	30°	1,2	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,5	1,8
S.-East / S.-West	45°	1,2	1,1	1,1	1,1	1,1	1,1	1,2	1,3	1,5	1,8
	60°	1,2	1,1	1,1	1,1	1,1	1,2	1,3	1,4	1,6	1,9
	75°	1,2	1,1	1,1	1,2	1,2	1,3	1,4	1,5	1,7	2,0
East / West	90°	1,2	1,2	1,2	1,3	1,3	1,4	1,6	1,7	2,0	2,4

Main usage period April to September

Domestic water preparation and partial solar heating

Angular deviation from due south		Roof incline (collector incline)									
		0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
South	0°	2,0	1,5	1,2	1,1	1,0	1,0	1,0	1,0	1,1	1,2
	15°	2,0	1,5	1,2	1,1	1,0	1,0	1,0	1,0	1,1	1,3
	30°	2,0	1,5	1,3	1,2	1,1	1,0	1,0	1,0	1,2	1,4
S.-East / S.-West	45°	2,0	1,6	1,4	1,3	1,2	1,2	1,2	1,2	1,3	1,5
	60°	2,0	1,7	1,5	1,4	1,3	1,3	1,4	1,4	1,6	1,8
	75°	2,0	1,8	1,7	1,6	1,6	1,6	1,6	1,7	2,0	2,3
East / West	90°	2,0	2,0	2,0	2,0	2,0	2,1	2,1	2,2	2,7	3,2

Main usage period all-year

	highly recommended
	recommended
	recommended with reservations
	not recommended

Note

We recommend using simulation programmes when planning larger solar systems (e.g. for sports facilities, hotels and apartment blocks) and for precise determination of the collector area.

In the case of low-pitched roofs, we recommend using the pitch correction featured in the PLUS installation system.

5.2 Pressure loss of the evacuated tube collectors

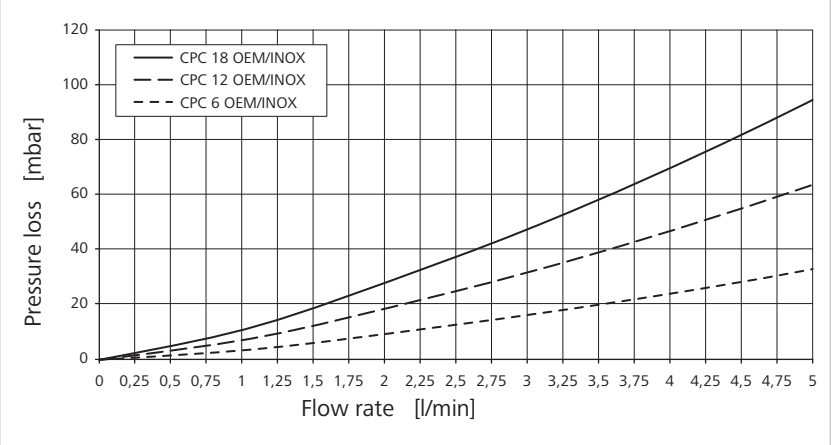
By means of the pressure loss diagram, you can determine the pressure losses for various collector circuits. To begin with, the system is determined by specifying the number of collectors. Afterwards, proceed with the interconnection into parallel strings covering areas of equal size according to the specifications.

By multiplying the area of an individual collector string with the square-meter-specific flow rate, you can determine the flow rate of each individual string. By means of this flow rate, you can determine the pressure loss for the respective collector type using the diagram.

The overall pressure loss is then calculated by adding the pressure losses of the collectors connected in series within a string.

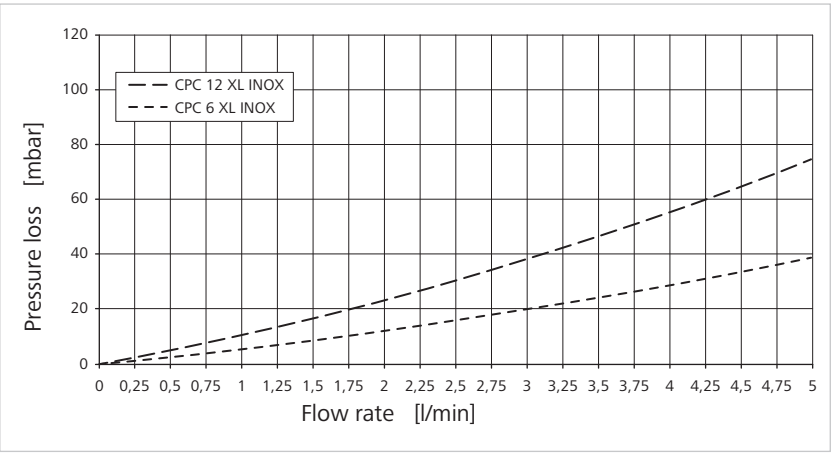
The collectors are filled with the heat transfer medium *Tyfocor LS*.

Collectors CPC 6/12/18 OEM /INOX



Pressure loss of CPC 6/12/18 OEM/INOX at 40 °C (Tyfocor LS)

Collectors CPC 6/12 XL INOX



Pressure loss of CPC 6/12 XL INOX at 40 °C

5.3 Dimensioning the expansion tank

The formulas specified below assume that a 6 bar safety valve is used.

For precise calculation of the expansion tank volume, first determine the volumes of the following system components to then calculate the tank volume using the formula below.

V_{nom}	= nominal volume of the expansion tank (l)
V_{system}	= content of the entire solar circuit (l)
V_{steam}	= content of the collectors and pipes which are in the steam zone (l)

Calculation formula for determining the expansion tank size

$$V_{nom} \geq (V_{system} * 0.1 + V_{steam} * 1.25) * 4.8$$

Example for calculating the individual volumes

Specification

Collectors:	2 no. CPC 12 OEM/INOX
Pipework:	Cu 15 mm, 2 x 15 m length
Static height:	9 m
Content of the storage tank heat exchanger and the solar station:	e.g. 6.4 l
Pipes in the steam zone:	15 mm Cu pipe, 2 x 2 m

Information on the individual content of the system components is provided in the respective data tables in the product description. The content of the standard-sized Cu pipes and the content of the CPC evacuated tube collectors are specified in the following tables.

V_{system} = Content of: Storage tank heat exchanger + pipes + collectors

= 6.4 l + 30 m * 0.133 l/m + 2 * 1.74 l = 13.87 l

Pipes above or at the same height as the manifold (or the lowest manifold if there are several collectors above one another) can be filled with steam if the solar system is idle. The steam volume V_{steam} includes the content of the pipes and collectors affected.

V_{steam} = 2 * 1.74 l + 4 * 0.133 l/m = 4.01 l

(Contents of 2 x CPC 12 OEM + 4 m pipe Cu 15 mm)

If V_{system} and V_{steam} have been calculated, the minimum size of the expansion tank can be determined.

$V_{nom} \geq (V_{system} * 0.1 + V_{steam} * 1.25) * 4.8$

$V_{nom} \geq (13.87\ l * 0.1 + 4.01\ l * 1.25) * 4.8 = 30.72\ l$

An expansion tank with a nominal volume of 35 l is selected from the following expansion tank sizes: 18 l, 24 l, 35 l, 50 l, 80 l, 105 l and 150 l.

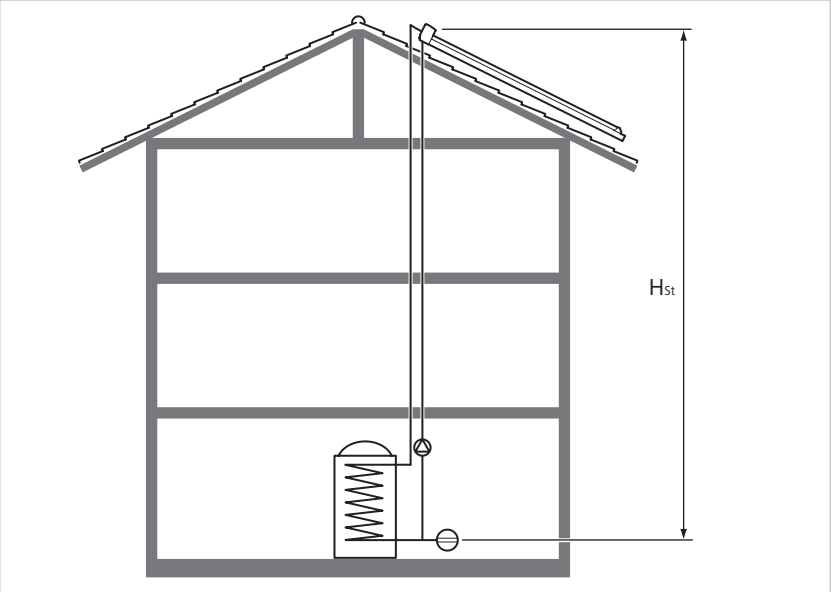
Determining the volumetric content, initial pressure and operating pressure

Volumetric content of the system components

Component	Type	Unit	Content
Copper pipe	Cu 12 Cu 15 Cu 18 Cu 22 Cu 28	l/m	0.079 0.133 0.201 0.314 0.491
The collectors may	CPC 6 OEM/INOX CPC 12 OEM/INOX CPC 18 OEM/INOX CPC 6 XL INOX CPC 12 XL INOX	l	0.87 1.73 2.60 1.06 2.11

To determine the required volume of solar fluid, add the partial volume in the corresponding expansion tank to the system volume (V_{system}).

The partial volume in the expansion tank is produced by filling the solar system from initial pressure to operating pressure depending on the static height H.



Static height

Static height (H)	Partial volume in the diaphragm expansion tank (as a % of the tank's nominal volume)	Initial pressure	Operating pressure
0-5 m	14%	2.0 bar	2.5 bar
5-10 m	12.5%	2.5 bar	3.0 bar
10-15 m	11%	3.0 bar	3.5 bar
15-20 m	10%	3.5 bar	4.0 bar

Calculation formula for partial volume (example with static height of 9 m)

$V_{partial\ volume}$ = selected tank nominal volume · Partial volume in the diaphragm expansion tank

$V_{partial\ volume} = V_{nom} \cdot 12.5\ \% = 35\ l \cdot 0.125 = 4.4\ l$

Calculation formula for required volume of solar fluid (V_{tot})

$V_{tot} = V_{system} + V_{partial\ volume} = 13.87\ l + 4.4\ l = 18.27\ l$

Result

- Expansion tank with 35 l is sufficient
- Initial pressure 2.5 bar
- Operating pressure 3.0 bar
- Solar fluid content 18.27 l

5.4 Hydraulic connection

The hydraulic interconnection of the collectors depends on the available delivery height of the pump.

Note We recommend connecting as large a collector area in series as possible. Install the collectors one above the other.

Note The maximum permissible collector area in series connection is 15 m².

The following clearances must be maintained between the collectors:

- 150 mm for collectors positioned above one another

► Make sure that the collector sensor is always installed at the hot outlet (flow) of the collector.

Legend for connection options

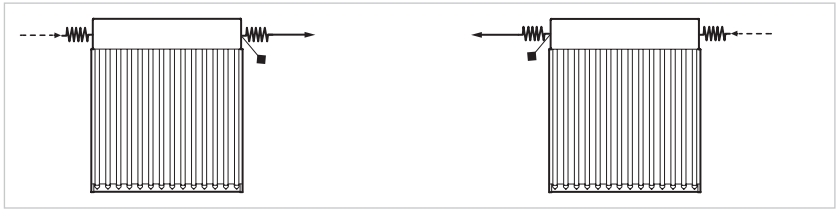
	Return pipe (cold)
	Flow pipe (hot)
	Collector sensor
	Corrugated tube

Connection options

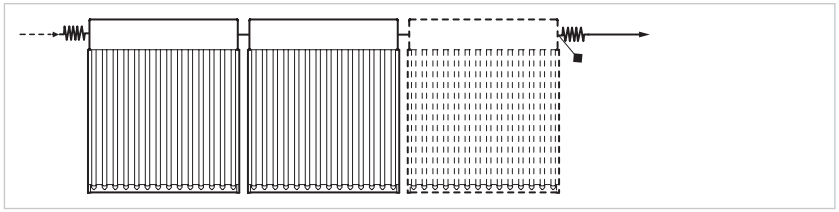
Note Always connect the collectors to the main, distribution and connection pipes using flexible tubes (connecting tube set).

The following connection options are available:

1 collector

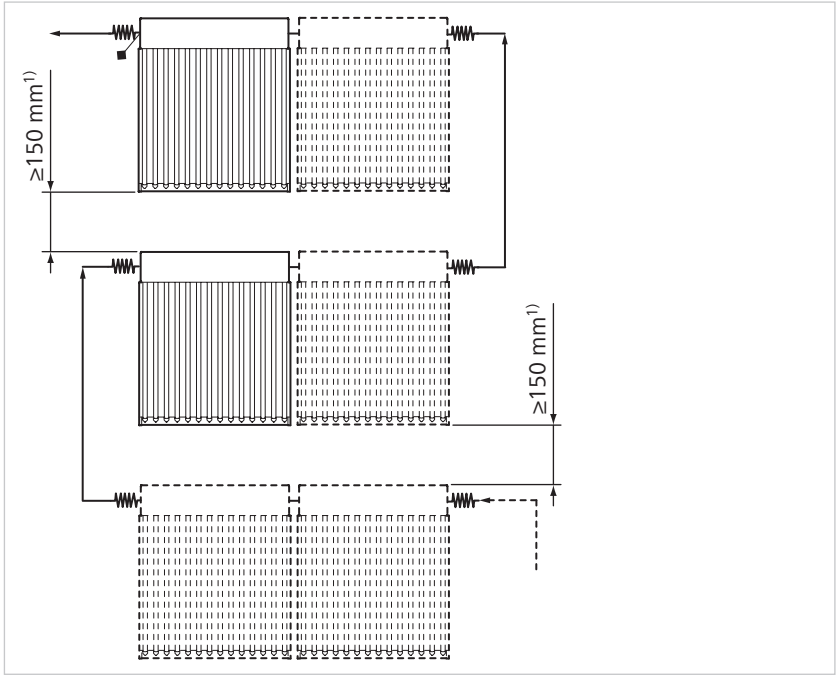


2 or more adjacent collectors



Note Reverse connection of the flow direction is possible.

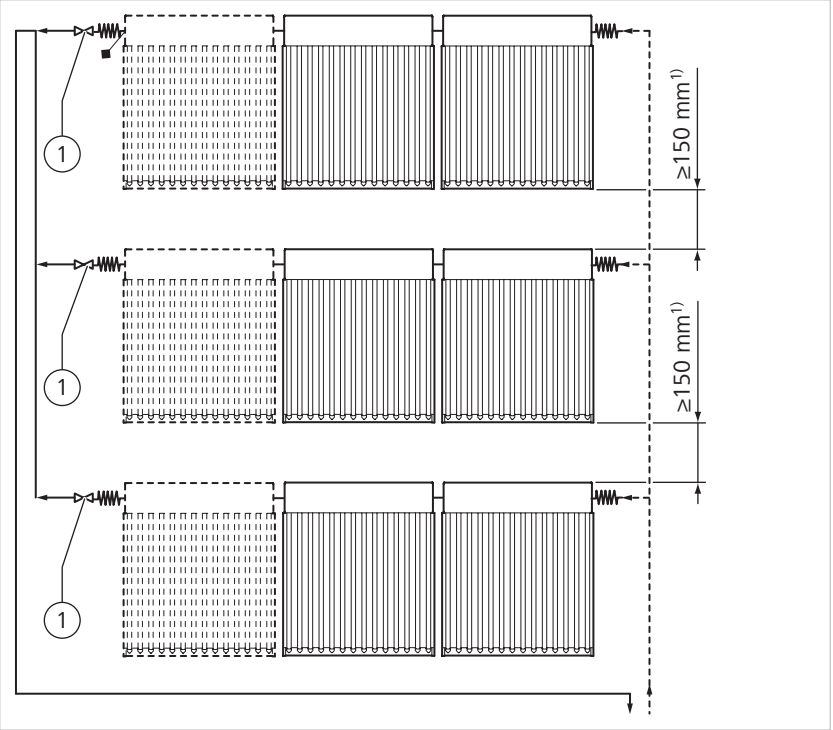
2 or more collectors arranged above or behind one another



[1] on-roof installation only
Minimum clearances for installation on flat roofs and walls are stated in TD-1050 Flat Roof/Wall Installation System PLUS.

Multiple adjacent collectors and 2 or 3 collectors above one another

Note Each string must be provided with a temperature-resistant shut-off valve in the hot flow line.

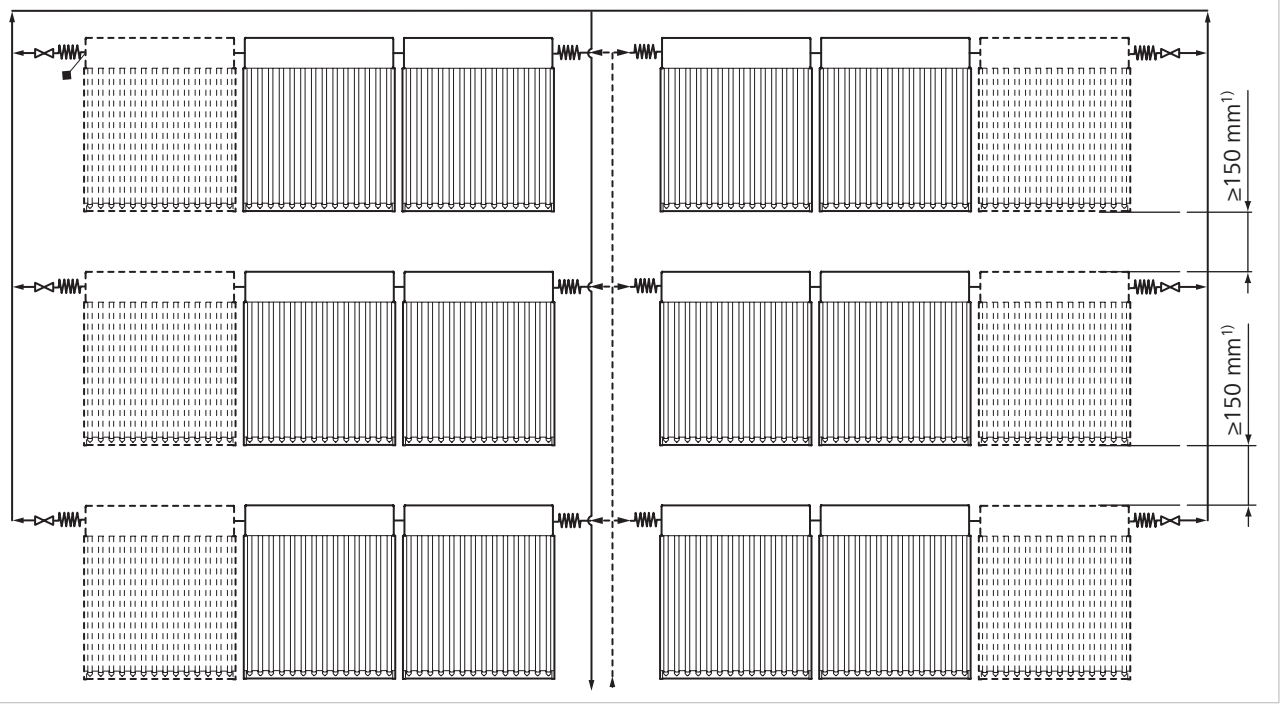


1	Shut-off valve

[1] on-roof installation only
Minimum clearances for installation on flat roofs and walls are stated in TD-1050 Flat Roof/Wall Installation System PLUS.

Options for up to 2 adjacent series connections and multiple series connections above one another

Note Each string must be provided with a temperature-resistant shut-off valve in the hot flow line.



1	Shut-off valve

[1)] on-roof installation only
Minimum clearances for installation on flat roofs and walls are stated in TD-1050 Flat Roof/Wall Installation System PLUS.

6 Pipework

6.1 Information on the design

Please observe the following requirements in order to ensure safe and faultless operation at the best possible level of energy efficiency:

- Only use pipes with an admissible diameter. The flow speed in the pipe must always be > 0.4 m/s to ensure self-venting.
- Ensure a steady and continuous flow rate providing the required nominal flow.
- Make sure to provide sufficient thermal insulation for the pipes.
- Do not use any galvanised pipes, galvanised fittings or graphite seals.
- Due to the high stagnation temperatures, only clamping ring fittings or brazed connections may be used in the solar circuit.
- Do not use soft solders.
- If soldered connections are made in the solar circuit, use only the following brazing alloys:
  - Ag brazing alloy
  - Cu brazing alloy
- The components used must be resistant to the heat transfer medium.
- Do not use any flux containing chloride.

6.2 Diameter of the ascending pipes

You can vary the specific flow rate in the collector. Depending on the purpose and the size of the collector array, the flow rate may range from approx. 14 l/m²h (0.25 l/m²min low flow) to approx. 60 l/m²h (1 l/m²min high flow). The nominal flow rate is 0.4 l/m²min.

With regard to the dimensioning of the tube, the flow speeds must not exceed 1 m/s or fall below 0.4 m/s. Flow speeds of over 1 m/s lead to unnecessarily high pressure losses. Flow speeds of under 0.4 m/s prevent self-venting within the pipe. In order to ensure faultless operation of the solar system, avoid flow speeds of under 0.4 m/s in the pipe. This also applies in the case of speed control and low flow operation.

If you set up multi-row collector arrays and use distributing pipes, you must ensure that the diameter of the distributing pipes corresponds to the respective flow rate. A minimum flow rate of 0.4 m/s must also be maintained in the distributing pipes.

The maximum possible pipe lengths can be determined on the basis of the overall pressure loss and the characteristic curve of the pump.

The following tables feature suggested riser pipe dimensions for the respective flow rate ranges in accordance with the size of the collector array.

Series connection of the collectors CPC 6/12/18 OEM/INOX

Specific flow rate > 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
2.3	1 x CPC 12 or 2 x CPC 6	2.0	Cu 12 x 1	0.42
3.4	1 x CPC 18 or 3 x CPC 6	2.0	Cu 12 x 1	0.42
4.6	2 x CPC 12	3.5	Cu 15 x 1	0.44
5.7	1 x CPC 12 + 1 x CPC 18	3.5	Cu 15 x 1	0.44

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
6.9	3 x CPC 12 or 2 x CPC 18	3.5	Cu 15 x 1	0.44
8.0	2 x CPC 12 + 1 x CPC 18	4.0	Cu 15 x 1	0.50
9.1	4 x CPC 12	4.0	Cu 15 x 1	0.50

Specific flow rate > 0.25 l/m²min and < 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
5.7	1 x CPC 12 + 1 x CPC 18	2.0	Cu 12 x 1	0.42
6.9	3 x CPC 12 or 2 x CPC 18	2.0	Cu 12 x 1	0.42
8.0	2 x CPC 12 + 1 x CPC 18	2.0	Cu 12 x 1	0.42
9.1	4 x CPC 12	3.0	Cu 12 x 1	0.64
10.2	3 x CPC 18	3.0	Cu 12 x 1	0.64
11.5	5 x CPC 12	4.0	Cu 15 x 1	0.50
12.5	3 x CPC 18 + 1 x CPC 12	4.0	Cu 15 x 1	0.50
13.6	4 x CPC 18	4.0	Cu 15 x 1	0.50
14.8	3 x CPC 18 + 2 x CPC 12	4.0	Cu 15 x 1	0.50

Series and parallel connection of the collectors CPC 6/12/18 OEM/INOX for a collector area of up to 20 m²

Specific flow rate > 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
11.4	2 rows: (1 x CPC 12+ 1 x CPC 18)	5.0	Cu 18 x 1	0.41
13.8	2 rows: (3 x CPC 12)	6.0	Cu 18 x 1	0.50
15.9	2 rows: (2 x CPC 12 + 1 x CPC 18)	7.0	Cu 18 x 1	0.58
18.4	2 rows: (4 x CPC 12)	8.0	Cu 22 x 1	0.42
22.7	4 rows: (1 x CPC 12 + 1 x CPC 18)	10.0	Cu 22 x 1	0.53

Specific flow rate > 0.25 l/m²min and < 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
17.0	3 rows: (1 x CPC 12+ 1 x CPC 18)	5.0	Cu 18 x 1	0.41
22.7	4 rows: (1 x CPC 12 + 1 x CPC 18)	6.0	Cu 18 x 1	0.50

Series connection of the collectors CPC 6/12 XL INOX

Specific flow rate > 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
2.9	1 x CPC 12 XL or 2 CPC 6 XL	2.0	Cu 12 x 1	0.42
4.4	1 x CPC 12 XL + 1 x CPC 6 XL	3.5	Cu 15 x 1	0.44
5.8	2 x CPC 12 XL	3.5	Cu 15 x 1	0.44
7.3	2 x CPC 12 XL + 1 x CPC 6 XL	5.0	Cu 18 x 1	0.41
8.7	3 x CPC 12 XL	5.0	Cu 18 x 1	0.41

Specific flow rate > 0.25 l/m²min and < 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
5.8	2 x CPC 12 XL	2.0	Cu 12 x 1	0.42
7.3	2 x CPC 12 XL + 1 x CPC 6 XL	2.0	Cu 12 x 1	0.42
8.7	3 x CPC 12 XL	2.5	Cu 12 x 1	0.53
10.2	3 x CPC 12 XL + 1 CPC 6 XL	2.5	Cu 12 x 1	0.53
11.6	4 x CPC 12 XL	3.5	Cu 15 x 1	0.44
13.1	4 x CPC 12 XL + 1 x CPC 6 XL	3.5	Cu 15 x 1	0.44
14.5	5 x CPC 12 XL	4.0	Cu 15 x 1	0.50

Series and parallel connection of the collectors CPC 6/12 XL INOX for a collector area of up to 20 m²

Specific flow rate > 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
11.6	2 rows: (2 x CPC 12 XL)	5.5	Cu 18 x 1	0.46
14.5	2 rows: (2 x CPC 12 XL + 1 x CPC 6 XL)	8.0	Cu 22 x 1	0.42
17.4	2 rows: (3 x CPC 12 XL)	8.0	Cu 22 x 1	0.42
21.8	3 rows: (2 x CPC 12 XL + 1 CPC 6 XL)	10.0	Cu 22 x 1	0.53

Specific flow rate > 0.25 l/m²min and < 0.4 l/m²min

Collector surface area [m²]	Collector selection (example)	Flow rate [l/min]	Diameter [mm]	Flow speed [m/s]
17.4	2 rows: (3 x CPC 12 XL)	4.5	Cu 18 x 1	0.42
21.8	3 rows: (2 x CPC 12 XL + 1 x CPC 6 XL)	5.5	Cu 18 x 1	0.52

Note The values are reference values which must be determined precisely on a case-by-case basis.

6.3 Thermal insulation of pipes

The thermal insulation of the pipes is especially important, in particular on the exterior, to avoid heat losses.

In order to ensure a safe and faultless operation at best possible level of energy efficiency, please observe the following:

- The thermal insulation must be temperature and UV radiation resistant.
- The thermal insulation must be resistant to bird damage.
- The pipes must be completely thermally insulated. Design according to EnEV (German Energy Saving Ordinance)
- Rainwater must not penetrate the insulation

7 Mounting

DANGER

Danger to life due to collapse of the roof

Additional weight caused by the collectors and installation sets, wind and snow load and by persons during installation puts a strain on the roof. A roof that does not provide sufficient load-bearing capacity will be damaged and collapse.

- ► The maximum roof load allowed must be checked prior to installation
- ► The collectors may only be installed on roofs that provide sufficient load-bearing capacity
- ► If required, consult a structural engineer or an appropriately qualified expert

DANGER

Danger to life due to collapse of the wall

Additional weight caused by the collectors and installation sets, as well as wind and snow loads, put a strain on the wall. A wall that does not provide sufficient load bearing capacity will be damaged and collapse.

- ► The maximum load allowed on the wall must be checked prior to installation
- ► The collectors may only be installed on walls that provide sufficient load-bearing capacity
- ► If required, consult a structural engineer or an appropriately qualified expert

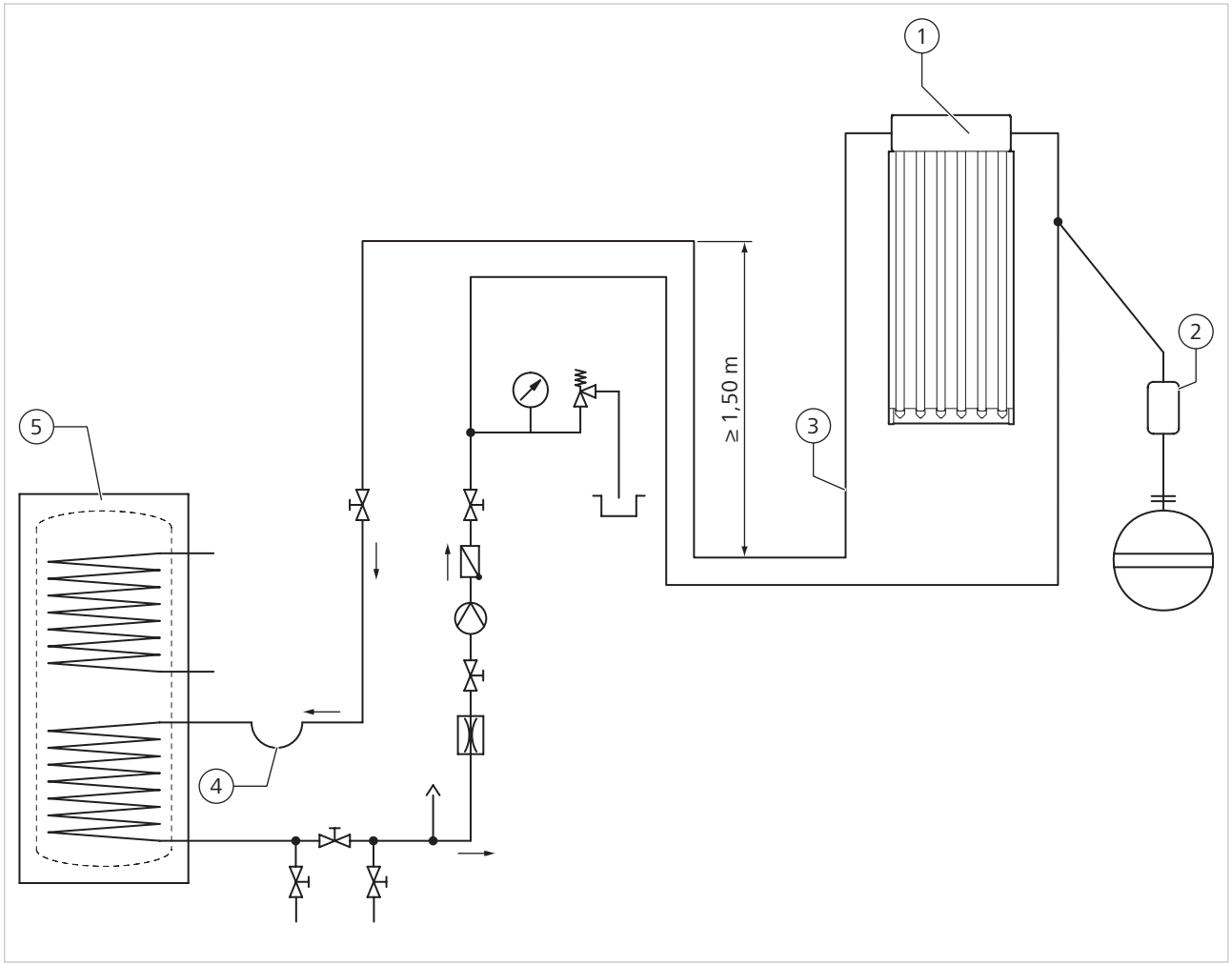
7.1 Requirements regarding the installation location

7.1.1 Attic solar heating system

If the storage tank and the solar station are housed in the attic, this is known as an "attic solar heating system". In most cases, this means that the collector is at the same height, or perhaps even lower than the solar station.

When the solar system comes to a standstill and vapour forms in the collector, the following measures are necessary in order to prevent the solar station from overheating:

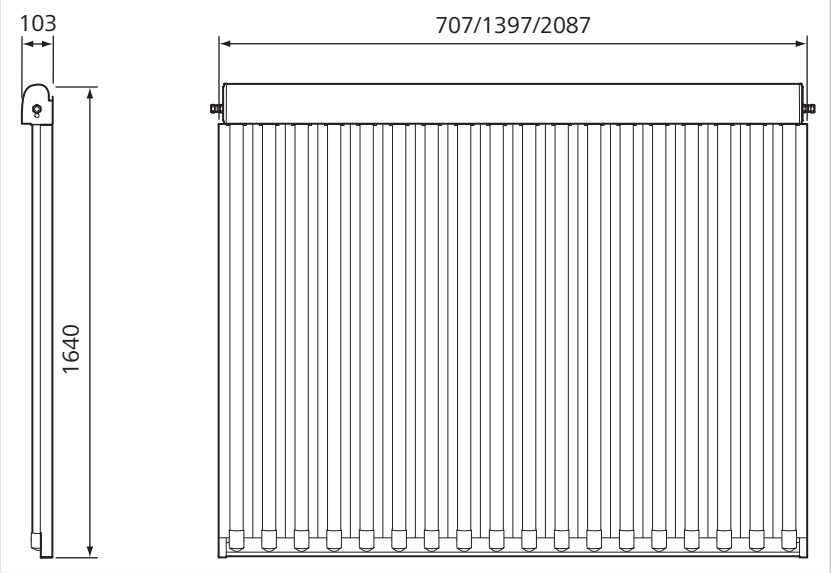
- Install a pipe siphon with a height of at least 1.5 m.
- Install the expansion tank in the vertical pipe between the pipe siphon and the collector.
- To protect against overheating of the membrane in the expansion tank, connect a primary tank with "cold primary content" upstream.
- Install a gravity loop to avoid micro circulation in the piping.



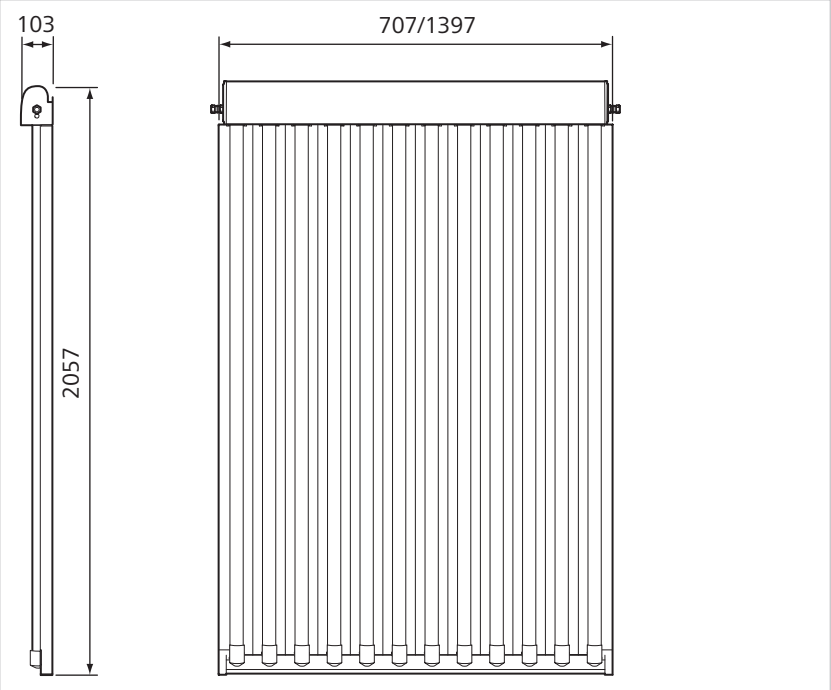
Attic solar heating system

1	Collector	4	Gravity loop
2	Primary tank	5	Storage tank
3	Pipe siphon		

7.2 Dimensions



Dimensions (mm) CPC 6/12/18 OEM/INOX



Dimensions (mm) CPC 6/12 XL INOX

7.3 Checking the scope of delivery

Check the scope of delivery for damages and completeness.

The scope of delivery includes:

- 6, 12 or 18 evacuated tubes according to the thermos flask principle with heat transfer plates
- Manifold with directly flown through heat conduction units and dry connection of the evacuated tubes, including a straight clamping ring fitting for flow and return
- CPC reflector

7.4 Required accessories for collector installation

The following accessories are required and must be ordered if necessary:

- *CPC SPEED* connection kit
- Shut-off valve, temperature-resistant up to 400 °C
- Connection kit for 2 or more connected in series
- On-roof installation system *PLUS* or flat roof/wall installation system *PLUS*

7.5 Notes on carrying out the installation

Note Please observe the following notes on installation and safety in order to avoid injuries to persons or damage to property.

- Scaffoldings, protective walls, safety harnesses, leaning ladders, intercepting scaffoldings, roof scaffolds or the like are to be used in order to avoid any risk of falling or danger due to falling objects.
- Perform the working steps on the ground whenever possible.
- Only remove the sun protection sheet on the collectors after the solar system has been commissioned, however, the sheet must not be left on the collector for more than 4 weeks.
- If the solar system has not been operated after 4 weeks, replace the sheets with reusable sun protection tarpaulins (available as accessories).
- Make sure that the thermal insulation of all pipework and fittings in the solar circuit is resistant to temperatures of up to 150 °C.
  On the exterior, the thermal insulation must be UV-resistant.
  The insulation must be designed such that it cannot be penetrated by rainwater.
- The collector is to be aligned as much to the south as possible.
- Shading is to be avoided.
- The manifold of the collector is always to be installed on top.
- Plastic piping and press-fitting connections are not permissible in the solar circuit.
- All hydraulic connections in the solar circuit are to be realised using clamp ring connections or, if required, brazed joints.
- If soldered connections are made in the solar circuit, use only the following brazing alloys:
  - Ag brazing alloy
  - Cu brazing alloy
  If parts of the solar system have been hard-soldered, the first 2 litres of antifreeze agent are to be drained into a separate collection vessel during the filling process and disposed of.
- Do not use soft solders.
- Do not use any flux containing chloride.
- When brazing, comprehensive fire protection and sufficient ventilation are to be ensured.

7.6 Notes on the installation system

Note Approved installation sets enable quick and reliable installation of the collectors on various roofs and facades. Information on the approved Ritter installation system PLUS is available in the documents TD-1047 On-Roof Installation Set PLUS and TD-1050 Flat Roof/Wall Installation System PLUS.

DANGER

Danger to life due to collapse of the roof

Additional weight caused by the collectors and installation sets, wind and snow load and by persons during installation puts a strain on the roof. A roof that does not provide sufficient load-bearing capacity will be damaged and collapse.

- ► The maximum roof load allowed must be checked prior to installation
- ► The collectors may only be installed on roofs that provide sufficient load-bearing capacity
- ► If required, consult a structural engineer or an appropriately qualified expert

DANGER

Danger to life due to collapse of the wall

Additional weight caused by the collectors and installation sets, as well as wind and snow loads, put a strain on the wall. A wall that does not provide sufficient load bearing capacity will be damaged and collapse.

- ► The maximum load allowed on the wall must be checked prior to installation
- ► The collectors may only be installed on walls that provide sufficient load-bearing capacity
- ► If required, consult a structural engineer or an appropriately qualified expert

7.6.1 Installation conditions

7.6.1.1 Installation angle

Install the collectors at an angle of at least 15° and no more than 90°. The collector cannot self-clean at an installation angle of < 15° and the collector has to be cleaned by hand when necessary.

7.6.1.2 Mounting

Only install the collectors using an approved installation system. A range of PLUS installation rail systems featuring various roof hooks and screws are available from Ritter, with individual options suitable for installing collectors on sloped roofs, flat roofs and facades respectively.

7.6.1.3 Space requirement

The space requirement of each installation system is stated in the corresponding installation manual.

7.6.1.4 Application limits

The application limits of each installation system are stated in the corresponding installation manual.

7.7 Transporting the evacuated tube collector

DANGER

Danger to life caused by falling components

Loads that are incorrectly secured work themselves loose from the transport vehicle and fall.

- ► Never stand underneath a lifted or suspended load
- ► Cordon off areas in the falling space freely and properly
- ► Designate areas with signs
- ► Follow procedures for work at great heights

NOTICE

Collector damage due to improper use of carrying aid

If the carrying aid is used improperly, it may tear, come loose or suffer material failure.

- ► Strap loops on collector may only be used as carrying aid
- ► Do not use strap loops as load handling equipment, e.g. as a sling on a crane

Carrying straps have been punched into the lower left and lower right of the collector packaging to ensure safe and upright transport on the ground.

1. Ensure secure positioning of tube retainers before transporting the collector onto the roof
2. Always transport the collector in an upright (vertical) position to make sure that the tubes are optimally protected
3. Remove the strap before transporting the collector onto the roof
4. Transport the collector onto the roof in its packaging in order to prevent damage to the back of the collector. Transport the collector onto the roof without any packaging when using a construction site crane or truck-mounted crane

Strap loops are located on both sides on the back of the collectors. The strap loops serve as a carrying aid and must not be used as a sling.

1. Lifting a collector onto the roof using a transport aid (e.g. a crane)
2. Additionally secure the collector with ropes to prevent swinging or lateral tilting. Note the wind direction

Transporting the collector onto the roof is easier with a construction crane or mobile crane. If no crane is available, an inclined hoist can be used.

1. Additionally secure the collector with ropes to prevent swinging or lateral tilting
   Note the wind direction.
2. If no motorised auxiliary equipment is available, pull the collector onto the roof
   Use single ladders and mason's planks as a slide.
3. Use suitable load-bearing equipment
4. Take care to ensure that the load handling equipment cannot slip out
5. Remove the packaging from the collector once it has been transported onto the roof

7.8 Installing the collector

NOTICE

Collector damage due to removal of sun protection

Without sun protection, the unfilled collector is subject to significant overheating as a result of solar irradiation.

► Only remove the factory-installed sun protection after commissioning

7.8.1 On-roof installation

In the case of on-roof installation, the collectors are affixed to rails.

The lower end profile of the collector fits precisely on the lower horizontal rail and is held by the lower retaining claws that are pre-installed there. The upper section of the collector is fixed in place by the upper retaining claws, which are pushed against the collector and screwed tight. The upper retaining claws are pre-installed on the upper horizontal rail and rotated 180° such that they are hand-tight.

Requirements

The on-roof installation set PLUS has been fully and correctly installed in accordance with the corresponding installation manual.

7.9 Connections with clamping ring fittings

Clamping ring fittings are easy to install, temperature resistant and wear-free.

► Clamping ring fittings should preferably be used in the collector circuit.

NOTICE

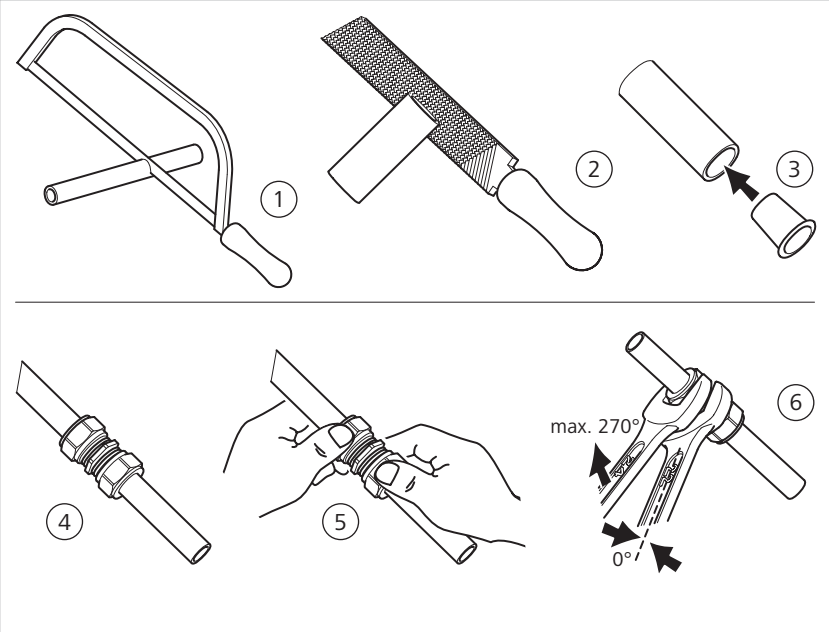
Material damage when tightening the clamp fitting

The pipe can over-tighten and break when tightening the clamp fitting.

► Always counter the force with a second open-ended spanner

Appropriate support sleeves must be used when using copper pipes (soft) in order to create a permanently tight connection.

The following section details the procedure for installing a clamping ring fitting on a copper connecting pipe.



Connecting the clamping rings

Proceed as follows to connect the clamping rings:

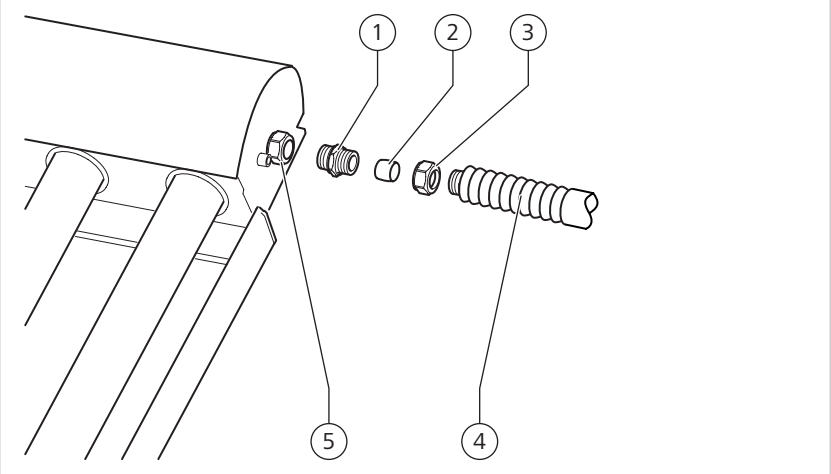
1. Cut the pipe to the required length (1).
   Clamping ring fittings with a size of 12 mm have an insertion depth of 18.5 mm.
2. Remove the internal and external burrs (2).
3. Insert appropriate support sleeves into the pipe end (3) when using copper tubes (soft).
4. Check the pipe ends for scratches, soiling and deformations.
5. Check that the clamping ring is correctly positioned at the fitting.
6. Push the pipe through the clamping ring and into the fitting until reaching the stop (4).
7. Tighten the union nut by hand (5).
8. During initial installation, tighten to max. 270°; in doing so, counter the force using a second open-ended spanner (6)
9. After each loosening, tighten the fittings during reinstallation such that they are hand-tight, then use an open-ended spanner to further tighten these by 45° to max. 90° while countering the force with a second open-ended spanner
10. After installation, check that the connection is leak-tight
    If the connection is not leak-tight, loosen it and check the pipe for damage.

8 Installing the hydraulics

8.1 Flow and return pipe at the collector

The flow or return pipe can be connected on the left or on the right.

An integrated sensor sleeve is located on both sides of the collector.



Installation of flow and return pipe

1	Double nipple	4	Flexible pipe
2	Clamping ring	5	Clamping ring fitting
3	Clamping ring fitting		

1. Connect pipes with 15 mm clamping ring fittings (double nipple included)
2. Install the collector sensor at the hot outlet (flow) of the collector
3. Check the flow direction in the solar circuit prior to installing the corrugated tube
4. Use suitable transition pieces from the respective manufacturer to establish sealed connections with a stainless steel corrugated pipe or spiral pipe on site Eliminate the risk of leaks: do not use any transition pieces from third-party manufacturers.

8.2 Installation of the CPC SPEED connection kit

Ensure that the connection set is fully and correctly installed. See the *CPC Speed OEM* installation manual (TDM1051) for more information.

8.3 Installing the shut-off valve

In the case of solar systems with several collector lines operated in parallel you must install a shut-off valve in each collector line in order to be able to shut off and flush the collector lines separately. Install the shut-off valve in the flow line only.

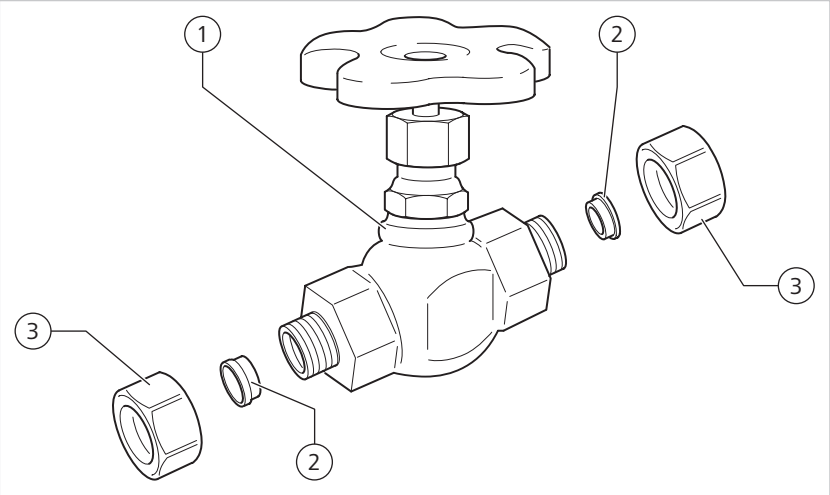
The shut-off valve is opened during operation.

Requirements

Make sure to observe the following points when installing the shut-off valve:

- No shut-off in place between the collector and the expansion vessel
- No shut-off in place between the collector and the safety valve
- Heat insulate the shut-off valve completely
  Use UV-resistant and weather-resistant heat insulation only.
  It is essential to attach the insulation, not only to ensure thermal insulation but also for the purpose of corrosion protection.
- Shut-off valve installed in the flow line only
- Do not install the stop valve in the return
  Do not connect the stop valve directly to the collector; instead, connect it downstream of the corrugated tube set.

Component overview



Component overview

Pos. no.	Component	Quanti-ty
1	Shut-off valve, temperature-resistant up to 400 °C	1
2	Cutting rings 15 mm	2
3	Union nuts	2

In order to install the shut-off valve, proceed as follows:

1. Install the shut-off valve (1) with cutting ring fittings (2, 3) in the collector's flow line
   Install a shut-off valve in every flow of a collector line.
2. Make sure that all cutting ring connections (2, 3) are leak-tight.

Note

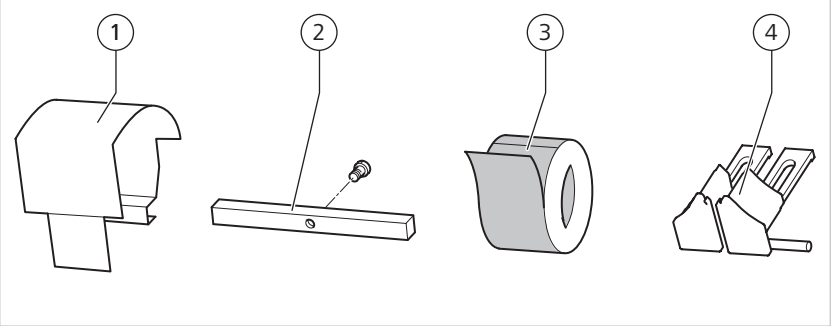
Appropriate support sleeves must be used when using soft copper pipes in order to create a permanently tight connection.

The support sleeves are not included in the scope of delivery.

8.4 Installing another collector using a connection kit

You can connect several collectors using the connection kit.

The connection kit consists of the following components:



Component overview for connection kit

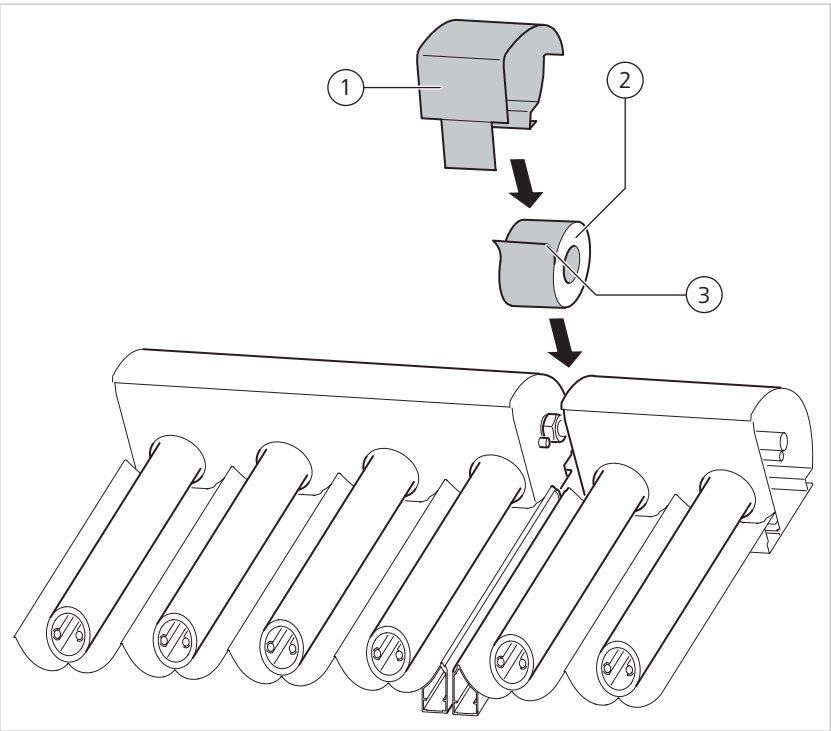
Pos. no.	Component	Quantity
1	Cover plate	1
2	Square-end retainer with screw	1
3	Thermal insulation	1
4	Connection plug	2

The following tools are required for installing the connection kit:

- Screwdriver
- Hammer

In order to install the connection kit, proceed as follows:

1. The second collector must be positioned and aligned.
   The collectors to be connected must be precisely aligned so that the flow an return connections are in alignment with one another.

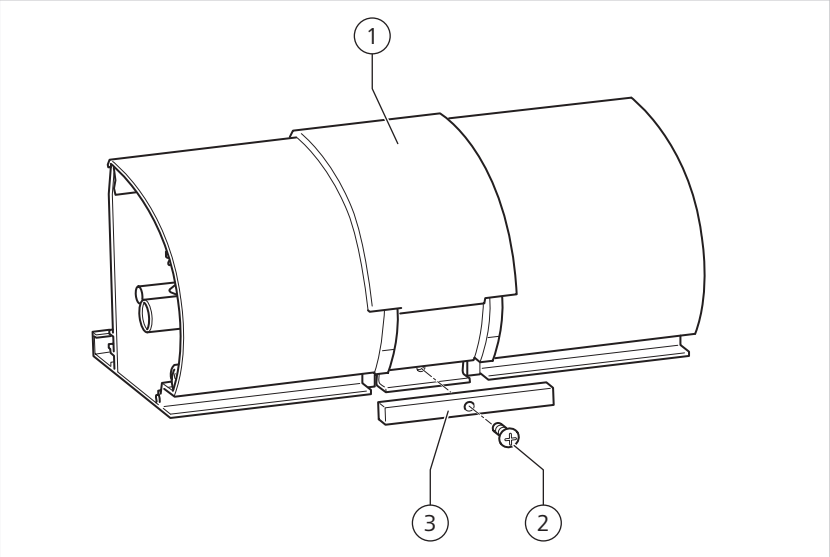


Installing the thermal insulation and cover plate

1	Cover plate	3	Adhesive strap

2	Thermal insulation		

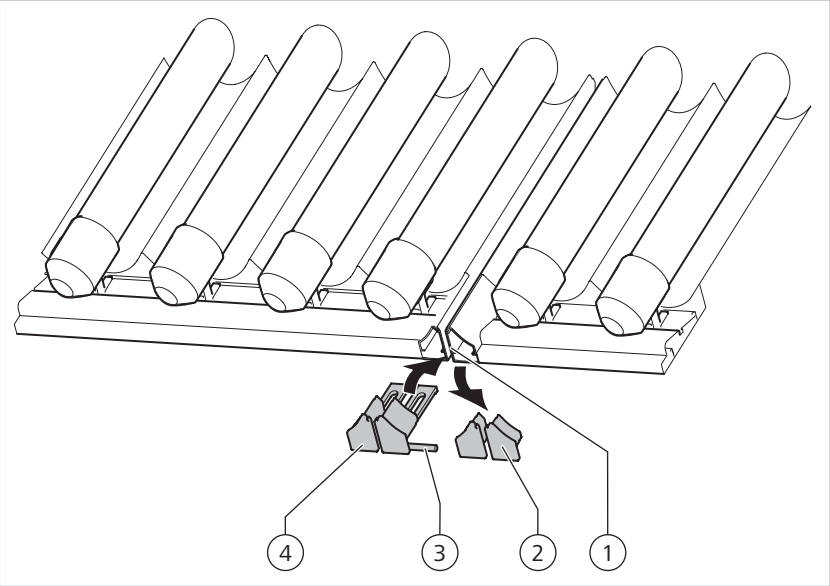
2. Slide the thermal insulation (2) over the screw fitting from bottom to top and seal it using the adhesive strap (3).
3. Slide on the cover plate (1).
4. Let the cover plate (1) lock into place on the rear side of the manifold.



Fixing the square-end retainer

1	Cover plate	3	Square-end retainer
2	Screw		

5. Insert the square-end retainer (3) into the mounting profiles of the collectors.
6. Screw the square-end retainer (3) to the cover plate (1) using the screw (2).



Installing the connection plugs

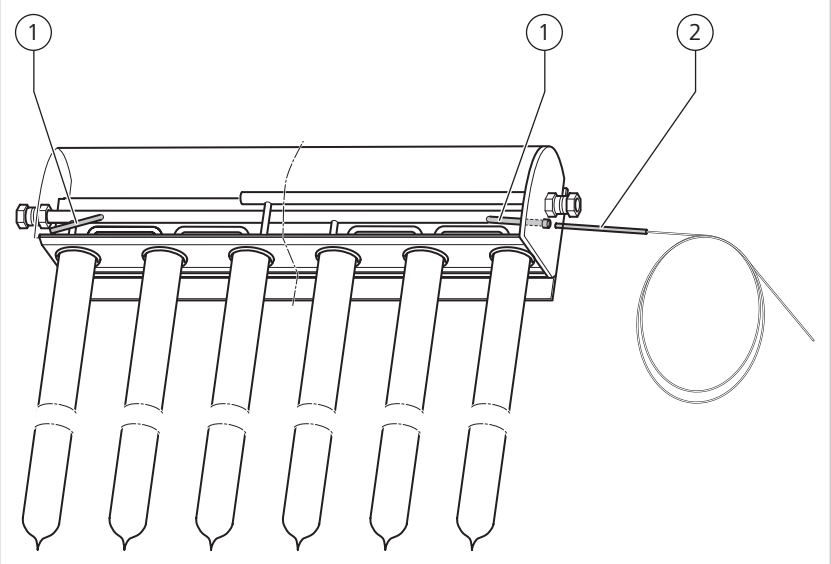
1	Collector frame profile	3	Metal pin
2	Original plug	4	Connection plug

7. Remove the original plugs (2) from the right and left hand side of the collector frame profiles (1).
8. Insert the connections plugs (4) into the right and left hand side of the collector frame profile (1).
9. Use the hammer to force the metal pin (3) into the side of the connection plugs.

8.5 Connecting the temperature sensor

An integrated sensor sleeve is located on both sides of the collector.

Note Always connect the temperature sensor to the hot flow side.



Connecting the temperature sensor

1	Sensor sleeve	2	Temperature sensor

► Push the temperature sensor into the sensor sleeve as far as it will go.

9 Commissioning

The initial start-up may only be carried out by an installation engineer.

► Enter the measurement values into the log provided for this purpose.

9.1 Check the system for tightness.

Note Perform the pressure test ideally using compressed air and a leak detector spray or simply using Tyfocor LS.

In order to check the tightness of the solar system, proceed as follows:

1. Carry out the pressure test on the system according to the applicable standards and guidelines.
2. Check the pipes and connections for tightness including the hydraulic components of the solar station, the collector and the flushing and filling faucets.
3. Repair any detected leaks and carry out the test again.

9.2 Setting the admission pressure of the expansion tank

The admission pressure of all expansion tanks must be set to a target value before filling the system.

In order to calculate the target value for the admission pressure, the static height must be determined first. The static height is the height difference between the expansion tank and the highest point of the solar system.

Static height	Initial pressure	Operating pressure
0-5 m	2.0 bar	2.5 bar
5-10 m	2.5 bar	3.0 bar
10-15 m	3.0 bar	3.5 bar
15-20 m	3.5 bar	4.0 bar

In order to ensure the functioning of the solar system, the expansion tank must be sufficiently dimensioned and the pressures must be correctly set.

9.3 Flushing, venting and filling the solar circuit

Due to the sun protection sheet on the collector, the solar system can also be filled in sunny conditions.

Note The solar system may not be filled if the collectors were previously or are currently exposed to direct solar radiation.

1. Only the antifreeze agent *Tyfocor LS* may be used for filling and flushing the solar system.
   Tyfocor LS has a tendency to generate foam and microbubbles during flushing. This lends the fluid a milky appearance.
   Keep performing the flushing procedure until the *Tyfocor LS* that flows back out of the system is clear.
2. The solar system is to be filled using a motor-operated rinsing pump.

Note The pump should have a minimum flow rate of 5 l/min at 6 bar.

Note If parts of the solar system are hard-soldered, the first 2 litres of the frost protection agent are to be drained into a separate collection vessel. Dispose of the drained antifreeze agent afterwards.

In order to flush, vent and fill the solar system, proceed as follows:

1. Fully open the slide valves, flow control valves, check valves or gravity brakes.
2. Fill the solar system with the frost protection agent *Tyfocor LS* through the filling armature.

3. Make sure that the *Tyfocor LS* that flows back from the system is clear.
4. Flush the solar system until no more air exits at the drain faucet.
5. Perform a leak check and ensure that the safety device is functioning properly.
6. Perform a pressure check. Observe the admissible operating pressure
   The pressure must not drop for half an hour.
   Examine the system for leaks during the pressure check. Even the smallest leaks must be eliminated.
7. Flush the solar system again to completely remove any remaining air.

There may be air in the line going to the expansion tank.

In order to make the expansion tank air-free, proceed as follows:

1. Let the operating pressure increase to the maximum admissible value.
2. Quickly open the drain faucet.
   → The air is flushed out of the expansion tank.
3. Repeat the procedure until no more air exist from the expansion tank.
4. The solar circuit is to be flushed both in the flow direction as well as against the flow direction.
5. Bring the solar system up to the appropriate operating pressure, see chapter "Setting the admission pressure of the expansion tank [47]"
6. Close the filling armature.
7. Bring the slide valves, flow control valves, check valves or gravity brakes into operating position.

Note If automatic breathers are used, the upstream shut-off valves are to be closed.

The shut-off valves prevent that breather parts are thermally destroyed in the event of steam formation.

We recommend using *SpiroVent AutoClose* as an air separator.

Note If the collectors are connected in parallel, all collector strings must be flushed separately.

Proceed as follows:

1. Open the shut-off valve of the collector string to be flushed.
2. Close the shut-off valves of all remaining collector strings.
   → The collector strings are flushed.
3. Open the shut-off valves again after flushing.

9.4 Adjustment of the flow rate

Depending on the purpose and the collector array size, you can vary the specific flow volume in the collector between approx. 0.25 l/m²min and approx. 1 l/m²min. The nominal flow rate is 0.4 l/m²min. Multiply the desired specific flow volume by the installed collector area.

Notes

- The flow volume must not fall below 0.25 l/m²min.
- The flow speed in the pipes must not fall below 0.4 m/s, see chapter 6.2 "Diameter of the ascending pipes [30]".
- These specifications also apply in the case of speed control. Increase the speed until the minimum values are reached and set this speed as the lower limit.

Note First set the rough flow volume by selecting the pump level. Then configure the fine setting on the flow control valve.

9.5 Completing the commissioning

In order to ensure a trouble-free commissioning, the following is to be checked:

- Check the frost protection and pH value of the heat transfer medium *Tyfocor LS* using a suitable frost protection tester and pH test strip.
- Check the electrical connections.
  - Make sure that the plug-in connections and line ducts are firmly seated.
  - Check the lines for damages.
- Start the control mechanism and check the switching function.
- Check the circulating pump and flowmeter
  If the minimum throughput of the system in question cannot be viewed on the flowmeter, install a flowmeter with a suitable display area if necessary and/or set the pump output in constant pressure operation to the highest level.
- Remove the sun protection sheet from the collector.

9.6 Checking the system after commissioning

In order to ensure safe operation of the system, it must be checked 2 to 4 weeks after commissioning.

Check the system pressure and the correct functioning of the system itself. If the system is not free of air or bubbles, it must be subject to a flushing process.

10 Maintenance

Service the system annually providing no other service interval is specified.

CAUTION

Danger of burns due to hot surfaces and hot components

Component surfaces and parts are extremely hot during the course of operation.

► Wear protective gloves.

10.1 Checking the operating pressure

The operating pressure of the system may be reduced due to pressure drops.

Reasons for a pressure drop include:

- leaks
- discharge of the safety valve
- insufficient admission pressure in the expansion tank
- In the case of systems featuring *SpiroVent AutoClose*, a pressure drop may also be caused by a faulty diaphragm in the expansion tank. Check these and replace the diaphragm or the entire expansion tank if necessary.

In order to check the operating pressure, proceed as follows:

1. Compare the operating pressure with the target values and/or with the initial setting values provided in the commissioning log
2. If the operating pressure does not correspond to the values in the commissioning log, check the initial pressure in the expansion tank. For this purpose, cover the collectors completely and allow them to cool off. Connect the cap valve to the diaphragm expansion tank, drain the initial volume, check the initial pressure and reconfigure this if necessary.
3. If required, set the operating pressure back to the target value by topping up the heat transfer medium

10.2 Checking the pumps, valves and gravity brakes

The correct functioning of the pumps, valves and gravity brakes ensures the correct flow of the heat transfer medium in the heating system.

► Make sure that the pumps, valves and gravity brakes are fully operational.

► Make sure that the safety devices are fully operational.

10.3 Checking the freeze protection of the solar fluid

In order to check the freeze protection of the solar fluid, proceed as follows:

1. Check the freeze protection before the beginning of winter using a freeze protection tester.
2. If required, re-establish frost protection by replacing the solar fluid.
3. *Tyfocor LS* must be refilled undiluted.
4. If required in the event of solar irradiation, cover the collectors with reusable sun protection tarpaulins (accessories).

10.4 Checking the corrosion protection

In order to check the corrosion protection of the solar fluid, proceed as follows:

1. Check the corrosion protection using a pH measuring stick.
2. If the pH value falls below 8, the solar fluid must be completely replaced.

10.5 Checking collectors and connections

When visually inspecting the collectors and connections, make sure to observe the following:

- Check the collectors for damages.
  Tubes are defective if the silver-coloured coating at the base of the tube has changed into a white film due to air penetration.
- If required, replace any damaged tubes.
- Check the connections for tightness.

11 Log/check list

Log

	Initial start-up	Flow rate at initial start-up (l/min)
Value:	----------	
On:		----------
By:		----------

	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance
On:							
By:							

Check list for maintenance

	Function	Freeze protection	PH value	Filling pressure	Safety devices	Flow rate
On:						
On:						
On:						
On:						
On:						

12 Repair

12.1 Replacing the tubes

CAUTION

Gashes due to glass splinters and sharp edges

Vacuum tubes are made of fragile glass. Parts of the collector have sharp edges.

- ► Wear protective gloves.
- ► Wear protective glasses.

WARNING

Danger of burns due to hot surfaces and hot components

Solar radiation causes the U-tube, the heat conduction plate and the inside of the vacuum tube to be extremely hot.

- ► Wear protective gloves.
- ► Wear protective glasses.

Note Damaged evacuated tubes can be separately replaced. The solar system can remain in operation when repairs are carried out.

Tubes are defective if the silver-coloured coating at the base of the tube has changed into a white film due to air penetration.

12.1.1 Removing mechanically damaged tubes

In order to remove a broken tube from the collector, proceed as follows:

1. Carefully remove the glass shards without damaging the CPC reflector.
2. Remove the residual glass from the manifold.
3. Remove the tube retainer.

12.1.2 Removing defective tubes

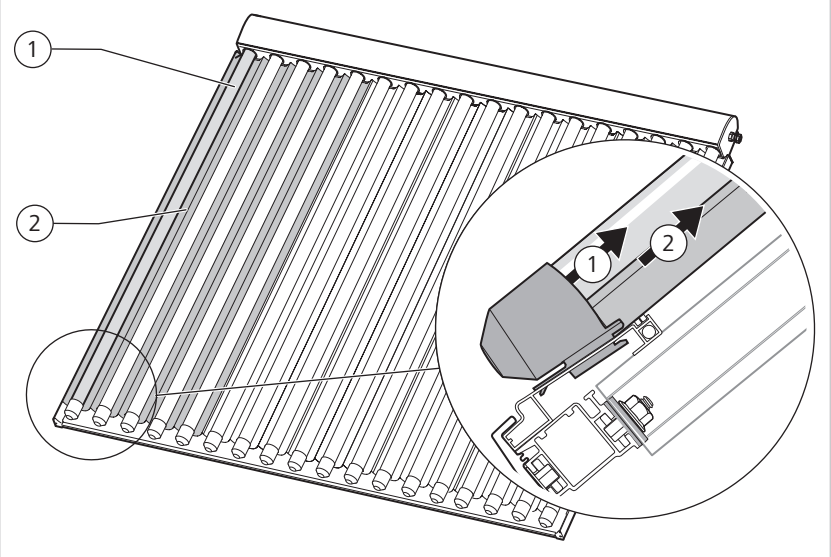
NOTICE

Damage to collector during replacement of tubing

The register breaks if bent over 20° to the collector plane.

- ► Bend the register upward 20° maximum.

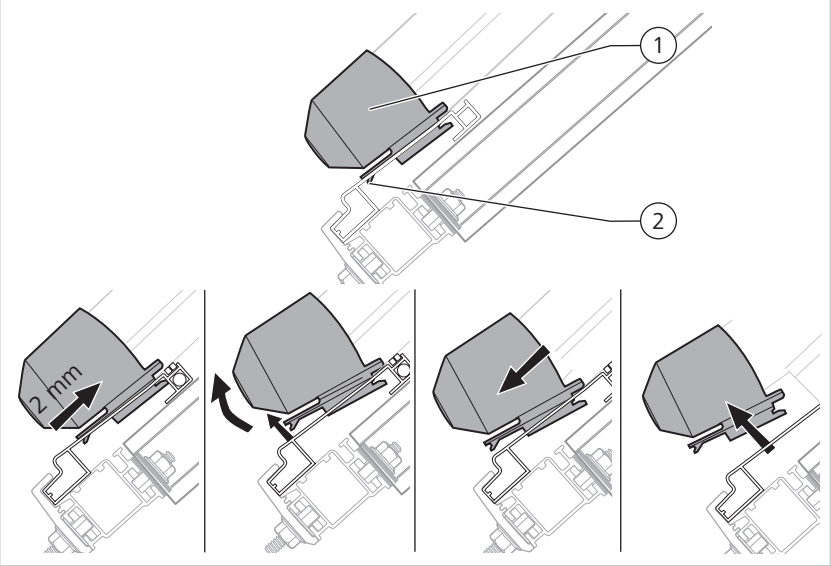
In order to remove a defective tube, proceed as follows:



Releasing tube retainer

1	Tube	2	Reflector plate

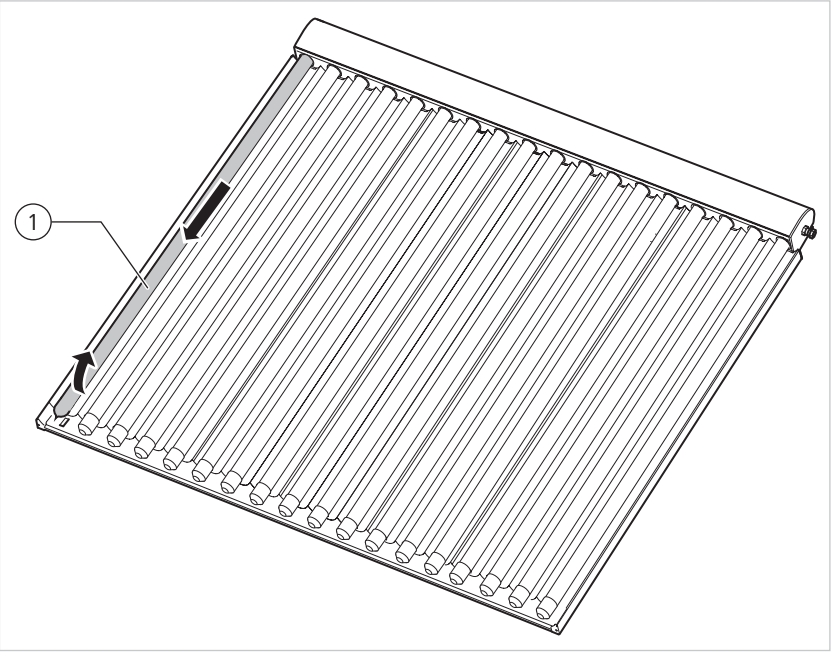
1. Push defective tube (1) up into the manifold
   The tube can be pushed into the manifold a few millimetres.
2. Push the mirror segment (2) located beneath the defective tube up to the stop in the direction of the manifold
   → The tube retainer is released.



Remove the tube retainer.

3. Push the tube retainer (1) approx. 2 mm in the direction of the manifold.
4. Raise the locking catch (2)
   Carefully lever out the locking catch from above using a flat-head screwdriver. In the process, insert a flat-head screwdriver from the front into the gap between the tube retainer and collector profile to the right or left of the locking catch.

5. Pull the tube retainer (1) down.
6. Take the tube retainer up and out and disconnect it from the tube.

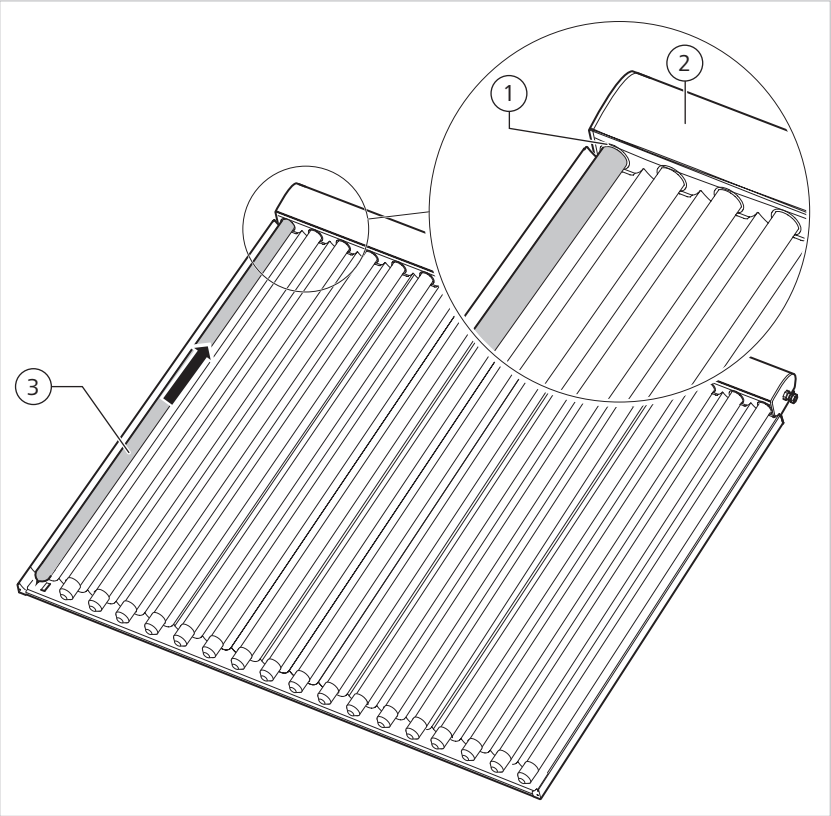


Removing a tube

7. Lift defective tube (1) slightly
   Lift the tube 20° maximum to the collector level.
8. Pull the defective tube (1) out of the manifold
   Turn the tube slightly in the process.
9. Pull the defective tube (1) down in a straight line
   If the space to the bottom is obstructed, you can lift the tube 20° maximum to the collector level.

12.1.3 Inserting a new tube

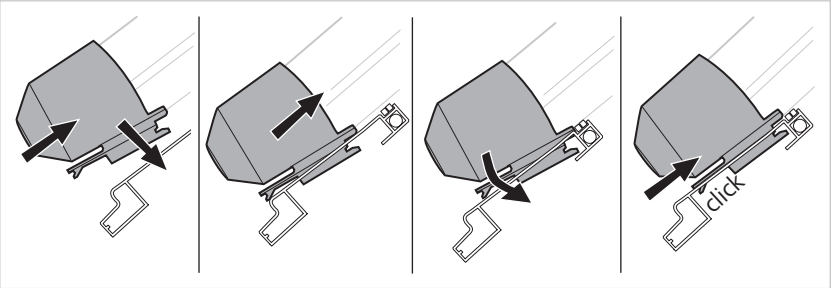
In order to insert the tube, proceed as follows:



Inserting a tube

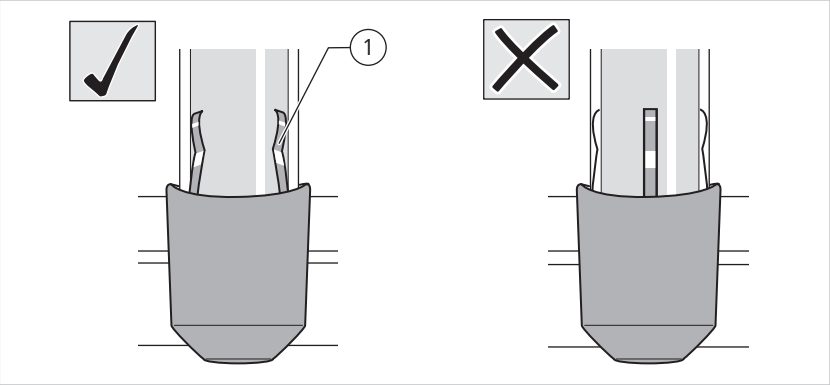
1	Silicone ring	3	Tube
2	Manifold		

1. Check that the seating of the silicone ring (1) in the manifold (2) is clean.
2. Apply grease paste or soap solution to the upper tube end.
   → The (3) tube slides through the silicone ring (1) more easily.
3. Lift the tube retainer (3) and push it up in the direction of the manifold.
4. Push the tube (3) through the silicone ring (1) in the manifold (2)
   Turn the tube slightly in the process.



Attaching tube retainer

5. Push the tube retainer onto the tube
6. Insert the tube retainer into the recess in the bottom edge profile
7. Push the tube retainer up in the direction of the manifold until it audibly clicks



Aligning tube

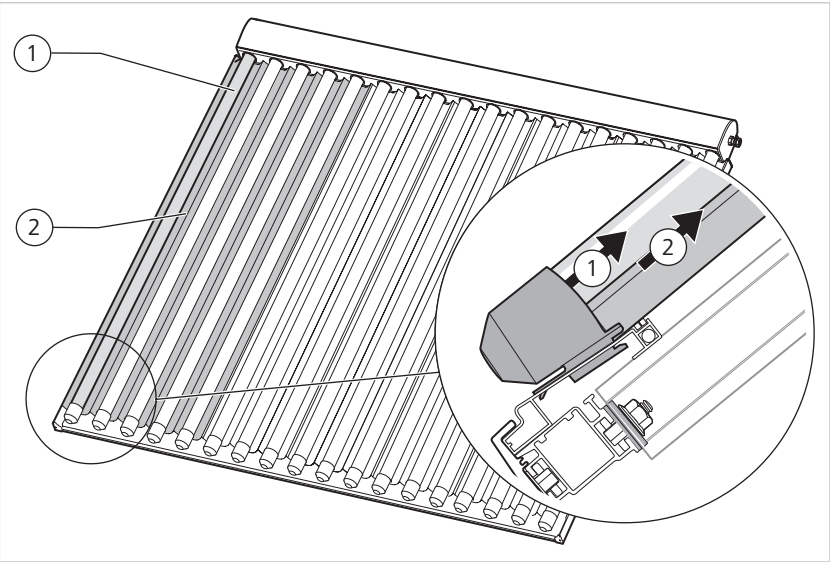
8. Align the tube
   Make sure that the spacers (1) are positioned correctly, see drawing.
9. Make sure that the tube retainers are firmly seated
10. Check the tube's alignment

12.2 Replacing the reflector plate

If a reflector plate of the collector is damaged, the reflector plate must be replaced.

Note Dismount all the tubes located above the damaged reflector plate. In addition, dismount one tube on the left and right.

In order to replace the reflector plate, proceed as follows:

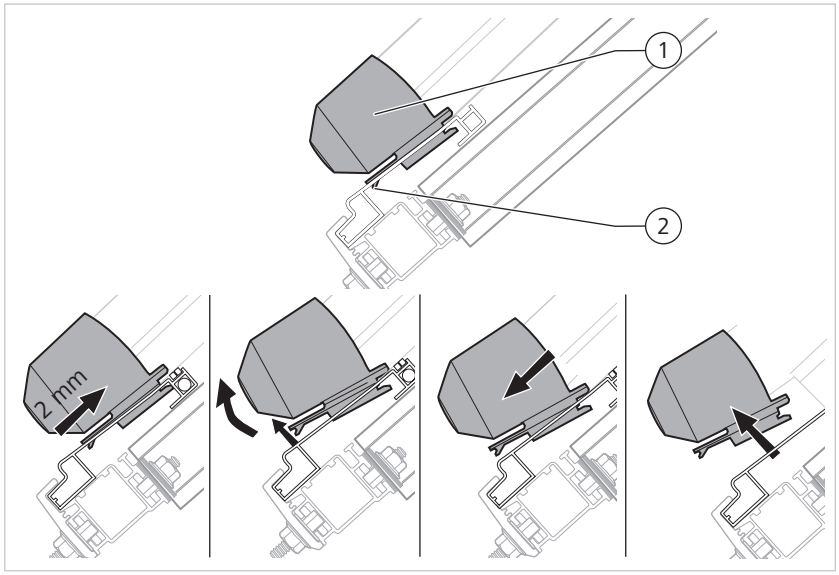


Releasing tube retainer

1	Tube	2	Reflector plate

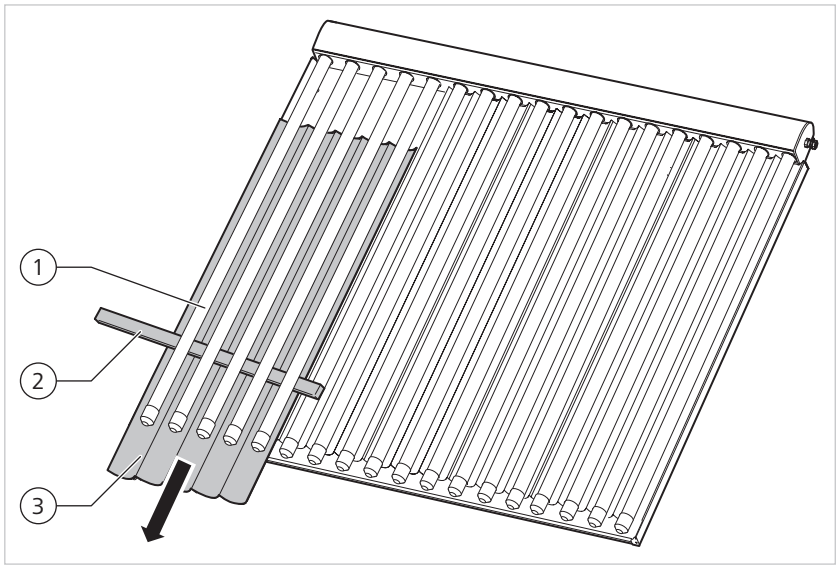
1. Push tube (1) up into the manifold
   The tube can be pushed into the manifold a few millimetres.
2. Push the mirror segment (2) up to the stop in the direction of the manifold

   → The tube retainer is released.



Remove the tube retainer.

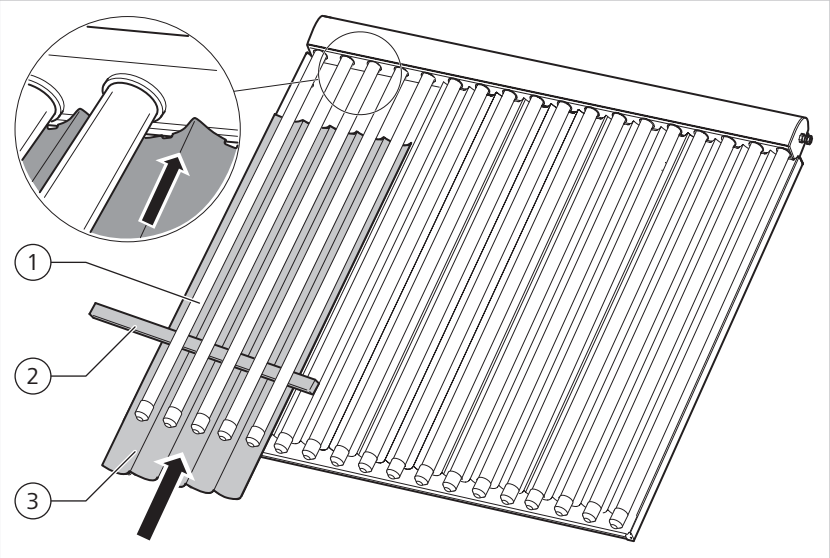
3. Push the tube retainer (1) approx. 2 mm in the direction of the manifold.
4. Raise the locking catch (2)
   Carefully lever out the locking catch towards the top using a flat-head screwdriver. In the process, insert a flat-head screwdriver from the front into the gap between the tube retainer and collector profile to the right or left of the locking catch.
5. Pull the tube retainer (1) down.
6. Take the tube retainer up and out and disconnect it from the tube.



Pulling out the reflector plate

1	Tube	3	Reflector plate
2	Batten		

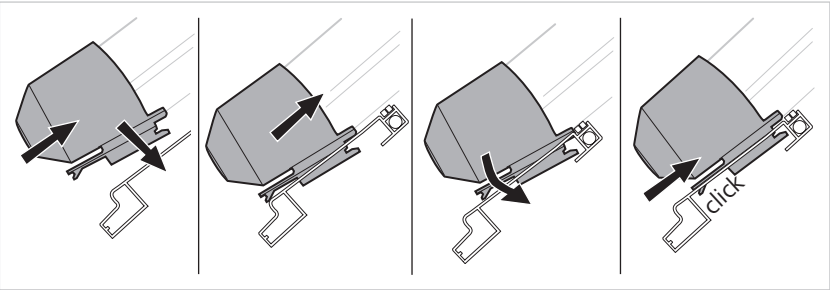
7. Remove the reflector plate (3) by pulling it out downwards.



Inserting the reflector plate

1	Tube	3	Reflector plate
2	Batten		

8. Slide the new reflector plate (3) under the tubes (1) with the notches facing up and clamp it onto the top of the manifold.



Attaching tube retainer

► Remount the tube retainer and let it lock into place.

→ The reflector plate (3) is now clamped in again.

12.2.1 Number of reflector plates per collector type

The following table shows the number of reflector plates for the various collector types.

Designation	**CPC OEM/INOX**			**CPC XL INOX**	
	CPC 6	**CPC 12**	**CPC 18**	**CPC 6**	**CPC 12**
Reflector plate CPC, triple, for 3 tubes, Al	2 pieces	4 pieces	6 pieces	2 pieces	4 pieces

13 Disposal

The device as well as the accessories and the transport packagings are, for the most part, made of recyclable materials.

You can dispose of the device, the accessories and the transport packagings at collection points.

► The applicable national regulations must be observed.

13.1 Disposal of the packaging

The transport packagings are disposed of by the installation engineer who has installed the device.

13.2 Disposing of device and accessories

The device and accessories may not be disposed of along with household waste.

1. Make sure that waste equipment and any possibly existing accessories are disposed of in accordance with regulations.
2. The applicable national regulations must be observed.

13.3 Disposal of antifreeze agent

The antifreeze agent must be disposed of in accordance with the local regulations.

► The antifreeze agent and any contaminated packagings must be disposed of at a suitable disposal site or suitable incineration plant.

14 Technical data

14.1 CPC 6/12/18 INOX

		CPC 6 INOX	CPC 12 INOX	CPC 18 INOX
Number of evacuated tubes	No.	6	12	18
Collector yield class (50 °C/75 °C) (Solergy) [1]		AA/AA	AA/AA	AA/AA
Collector yield (50 °C Würzburg)	kWh/ year	664	1329	1996
Collector output per module [2]	W	606	1212	1821
Collector output per module [3]	W	644	1287	1932
Product data in line with EU Regulations 811/2013 and 812/2013 (ErP-relevant data) relating to reference surface area				
A_{sol} collector reference surface area (gross)	m^2	1.16	2.29	3.42
η_0 optical efficiency		0.555	0.562	0.565
η_{col} collector efficiency	%	52	53	53
a_1 linear heat transmission coefficient	$W/(m^2 K)$	0.65	0.65	0.66
a_2 quadratic heat transmission coefficient	$W/(m^2 K^2)$	0.004	0.004	0.004
IAM incident angle modifier		1.00	1.00	1.00
Other product details				
Gross surface area	m^2	1.16	2.29	3.42
Grid dimensions (length x Width x height)	m	1.64 x 0.71 x 0.10	1.64 x 1.40 x 0.10	1.64 x 2.09 x 0.10
Collector content	l	0.87	1.73	2.60
Weight (empty)	kg	17.4	32.7	48.0
Max. permissible operating overpressure	bar	10	10	10
Max. idle temperature	°C	301	301	301
Connector width, clamp fitting	mm	15	15	15
Sensor sleeve	mm	6	6	6
Colour (aluminium frame profile, powder coated)		RAL 7015		
Colour (plastic parts)		black		
Conformity [4]		Pressure Equipment Directive 2014/68/EU		
Hail impact resistance as per ISO 9806	mm	35		
Tests and approvals		ISO 9806, Solar Keymark		
DIN CERTCO registration number		011-7S134R		

[1] can only be used with own Solar Keymark certification, for details see: www.initiative-sonnenheizung.com and www.dincertco.de

[2] at 1000 W/m² and 40 K temperature difference between mean collector temperature and ambient temperature

[3] at 1000 W/m² and 0 K, temperature difference between mean collector temperature and ambient temperature

[4] existing certification of collectors by TÜV SÜD Industrie Service GmbH for Ritter Energie- und Umwelttechnik GmbH & Co.KG; only valid within Germany. Certification in accordance with the Pressure equipment directive can be requested from the TÜV if required.

14.2 CPC 6/12/18 OEM

		CPC 6 OEM	CPC 12 OEM	CPC 18 OEM
Number of evacuated tubes	No.	6	12	18
Collector yield class (50 °C/75 °C) (Solergy) [1]		AA/AA	AA/AA	AA/AA
Collector yield (50 °C Würzburg)	kWh/ year	664	1329	1996
Collector output per module [2]	W	606	1213	1821
Collector output per module [3]	W	644	1287	1932
Product data in line with EU Regulations 811/2013 and 812/2013 (ErP-relevant data) relating to reference surface area				
A_{sol} collector reference surface area (gross)	m^2	1.16	2.29	3.42
η_0 optical efficiency		0.555	0.562	0.565
η_{col} collector efficiency	%	52	53	53
a_1 linear heat transmission coefficient	$W/(m^2 K)$	0.65	0.65	0.66
a_2 quadratic heat transmission coefficient	$W/(m^2 K^2)$	0.004	0.004	0.004
IAM incident angle modifier		1.00	1.00	1.00
Other product details				
Gross surface area	m^2	1.16	2.29	3.42
Grid dimensions (length x Width x height)	m	1.64 x 0.71 x 0.10	1.64 x 1.40 x 0.10	1.64 x 2.09 x 0.10
Collector content	l	0.87	1.73	2.60
Weight (empty)	kg	17.4	32.7	48.0
Max. permissible operating overpressure	bar	10	10	10
Max. idle temperature	°C	301	301	301
Connector width, clamp fitting	mm	15	15	15
Sensor sleeve	mm	6	6	6
Colour (aluminium frame profile, anodised)		aluminium grey		
Colour (plastic parts)		black		
Conformity [4]		Pressure Equipment Directive 2014/68/EU		
Hail impact resistance as per ISO 9806	mm	35		
Tests and approvals		ISO 9806, Solar Keymark		
DIN CERTCO registration number		011-7S134R		

[1] can only be used with own Solar Keymark certification, for details see: www.initiative-sonnenheizung.com and www.dincertco.de

[2] at 1000 W/m² and 40 K temperature difference between mean collector temperature and ambient temperature

[3] at 1000 W/m² and 0 K, temperature difference between mean collector temperature and ambient temperature

[4] existing certification of collectors by TÜV SÜD Industrie Service GmbH for Ritter Energie- und Umwelttechnik GmbH & Co.KG; only valid within Germany. Certification in accordance with the Pressure equipment directive can be requested from the TÜV if required.

14.3 CPC 6/12 XL INOX

		CPC 6 XL INOX	CPC 12 XL INOX
Number of evacuated tubes	No.	6	12
Collector yield class (50 °C/75 °C) (Solergy) [1]		AA/AA	AA/AA
Collector yield (50 °C Würzburg)	kWh/ year	859	1711
Collector output per module [2]	W	783	1561
Collector output per module [3]	W	831	1656
Product data in line with EU Regulations 811/2013 and 812/2013 (ErP-relevant data) relating to reference surface area			
A_{sol} collector reference surface area (gross)	m^2	1.45	2.87
η_0 optical efficiency		0.573	0.577
η_{col} collector efficiency	%	54	54
a_1 linear heat transmission coefficient	$W/(m^2 K)$	0.67	0.67
a_2 quadratic heat transmission coefficient	$W/(m^2 K^2)$	0.004	0.004
IAM incident angle modifier		1.00	1.00
Other product details			
Gross surface area	m^2	1.45	2.87
Grid dimensions (length x Width x height)	m	2.06 x 0.71 x 0.10	2.06 x 1.40 x 0.10
Collector content	l	1.06	2.11
Weight (empty)	kg	21.1	39.9
Max. permissible operating overpressure	bar	10	10
Max. idle temperature	°C	301	301
Connector width, clamp fitting	mm	15	15
Sensor sleeve	mm	6	6
Colour (aluminium frame profile, powder coated)		RAL 7015	
Colour (plastic parts)		black	
Conformity [4]		Pressure Equipment Directive 2014/68/EU	
Hail impact resistance as per ISO 9806	mm	35	
Tests and approvals		ISO 9806, Solar Keymark	
DIN CERTCO registration number		011-7S134R	

[1] can only be used with own Solar Keymark certification,
for details see: www.initiative-sonnenheizung.com and www.dincertco.de

[2] at 1000 W/m^2 and 40 K temperature difference between mean collector temperature and ambient temperature

[3] at 1000 W/m^2 and 0 K, temperature difference between mean collector temperature and ambient temperature

[4] existing certification of collectors by TÜV SÜD Industrie Service GmbH for Ritter Energie- und Umwelttechnik GmbH & Co.KG; only valid within Germany. Certification in accordance with the Pressure equipment directive can be requested from the TÜV if required.

15 Antifreeze agent safety data sheet

The latest safety data sheet for the antifreeze agent is available at:

https://www.tyfo.de/product/tyfocor-ls/

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006 Revision date 01.05.2017

Version: 3.1, ID-No.: 2600-01_GB-GB Page 1/7

SECTION 1: Identification of the substance/mixture and of the company

1.1. Product identifier: **TYFOCOR® LS®**
ready mixed, frost protection -28 °C

1.2. Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: Heat transfer fluid for solar thermal systems

1.3. Details of the supplier of the safety data sheet

Company: TYFOROP Chemie GmbH, Anton-Rée-Weg 7, D-20537 Hamburg
Telephone/Telefax: Tel.: +49 (0)40 20 94 97 0, Fax: +49 (0)40 20 94 97 20
E-Mail: msds@tyfo.de (E-Mail adress of person responsible for SDS)

1.4. Emergency telephone number: Tel.: +49 (0)551-19240 GIZ-Nord Poison Center

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

The product is not subject to classification.

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

The product is not subject to labelling.

2.3. Other hazards: None known.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

Chemical nature: Aqueous solution of Propane-1,2-diol (propylene glycol) with inhibitors.

Hazardous components

Substance / REACH registration number	Content	CAS number	EC number	INDEX number	Classification acc. CLP
1,1'-Iminobis-2-propanol 01-2119475444-34	> 1 % - < 3 %	110-97-4	203-820-9	603-083-00-7	Eye Irrit. 2, H319

The full text of the abbreviations is listed in section 16.

SECTION 4: First aid measures

4.1. Description of first aid measures

Protection of first-aiders: No special precautions are necessary for first aid responders.

If inhaled: If inhaled, remove to fresh air. Get medical attention if symptoms occur.

On skin contact: Wash thoroughly with soap and water. Get medical attention if symptoms occur.

On contact with eyes: Wash affected eyes for at least 15 minutes under running water with eyelids held open. Get medical attention if irritation develops and persists.

On ingestion: Rinse mouth thoroughly with water. Get medical attention. DO NOT induce vomiting. Get medical attention if symptoms occur.

4.2. Most important symptoms and effects, both acute and delayed

None known.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment: Symptomatic treatment (decontamination, vital functions), no known specific antidote.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media: Water spray. Alcohol-resistant foam. Dry powder. Carbon dioxide (CO_2).

Unsuitable extinguishing media: None known.

5.2. Special hazards arising from the substance or mixture

Specific hazards during firefighting: Exposure to combustion products may be a hazard to health.

Hazardous combustion products: Carbon oxides. Nitrogen oxides (NOx).

5.3. Advice for fire-fighters

Special protective equipment: In the event of fire, wear self-contained breathing apparatus. Use personal protective equipment.

Specific extinguishing methods: Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water spray to cool unopened containers. Remove undamaged containers from fire area if it is safe to do so.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions: Use personal protective equipment. Follow safe handling advice and personal protective equipment recommendations.

6.2. Environmental precautions

Discharge into the environment must be avoided. Prevent further leakage or spillage if safe to do so. Prevent spreading over a wide area (e.g. by containment or oil barriers). Retain and dispose of contaminated wash water. Local authorities should be advised if significant spillages cannot be contained.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up: Soak up with inert absorbent material. For large spills, provide dyking or other appropriate containment to keep material from spreading. If dyked material can be pumped, store recovered material in appropriate container. Clean up remaining materials from spill with suitable absorbent. Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable. Sections 13 and 15 provide information regarding certain local or national requirements.

6.4. Reference to other sections: See sections 7, 8, 11, 12 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Technical measures: See Engineering measures in section 8.

Local/total ventilation: Use only with adequate ventilation.

Advice on safe handling: Handle in accordance with good industrial hygiene and safety practice. Take care to prevent spills, waste and minimize release to the environmt.

Advice on protection against fire and explosion: Observe the general rules of industrial fire protection.

Hygiene measures: When using do not eat, drink or smoke. Wash contaminated clothing before re-use.

7.2. Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers: Store containers tightly sealed in a cool, dry and well ventilated place. Store in accordance with the particular national regulations.

Advice on common storage: Do not store with strong oxidizing agents. Keep away from food, beverages and animal feedstuffs.

7.3. Specific end uses

For the relevant identified uses listed in section 1 the advice mentioned in this section 7 is to be observed.

SECTION 8: Exposure control/personal protection

8.1. Control parameters

Components with occupational exposure limits

Information on component Propane-1,2-diol

Legal basis	Value type	Control parameters	Further information
GB EH40	TWA (Particles) TWA (Total vapour and particles)	10 mg/m^3 10 mg/m^3 474 mg/m^3, 150 ppm	Where no specific short-term exposure limit is listed, a figure three times the long-term exposure should be used.

DNEL values - information on component Propane-1,2-diol

End use	Exposure routes	Potential health effects	Value
Workers	Inhalation	Long-term local effects	10 mg/m^3
Workers	Inhalation	Long-term systemic effects	168 mg/m^3
Consumers	Inhalation	Long-term local effects	10 mg/m^3
Consumers	Inhalation	Long-term systemic effects	50 mg/m^3

DNEL values - information on component 1,1'-Iminobis-2-propanol

End use	Exposure routes	Potential health effects	Value
Workers	Inhalation	Long-term systemic effects	16 mg/m^3
Workers	Skin contact	Long-term systemic effects	12.5 mg/kg body weight/day
Consumers	Inhalation	Long-term systemic effects	3.9 mg/m^3
Consumers	Skin contact	Long-term systemic effects	6.3 mg/kg body weight/day
Consumers	Ingestion	Long-term systemic effects	1.3 mg/kg body weight/day

PNEC values - information on component Propane-1,2-diol

Fresh water	Marine water	Water (intermittent release)	Fresh water sediment	Marine water sediment	Soil	Sewage treatment plant
260 mg/l	26 mg/l	183 mg/l	572 mg/kg	57.2 mg/kg	50 mg/kg	20000 mg/l

PNEC values - information on component 1,1'-Iminobis-2-propanol

Fresh water	Marine water	Water (intermittent release)	Fresh water sediment	Marine water sediment	Soil	Sewage treatment plant
0.2777 mg/l	0.02777 mg/l	2.777 mg/l	2.19 mg/kg	0.219 mg/kg	0.275 mg/kg	15000 mg/l

8.2. Exposure controls

Engineering measures: Ensure adequate ventilation, especially in confined areas. Minimize workplace exposure concentrations.

Personal protective equipment

Eye protection: Safety glasses with side-shields (frame goggles, e.g. EN 166).

Hand protection: Chemical resistant protective gloves (EN 374). Material: butyl rubber. Protective index 2. Break through time: >30 minutes. Glove thickness: 0.7 mm. Material: nitrile rubber. Protective index 2. Break through time: >30 minutes. Glove thickness: 0.4 mm. Remarks: Choose gloves to protect hands against chemicals depending on the concentration and quantity of the hazardous substance and specific to place of work. For special applications, we recommend clarifying the resistance to chemicals of the aforementioned protective gloves with the manufacturer. Wash hands before breaks and at the end of workday.

Skin and body protection: Wash skin thoroughly after contact.

Respiratory protection: Use respiratory protection unless adequate local exhaust ventilation is provided or exposure assessment demonstrates that exposures are within recommended exposure guidelines. Filter type: Particulate type (P).

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance:	liquid.	
Colour:	red fluorescent.	
Odour:	faint.	
Odour threshold:	No data available.	
pH value (20 °C):	9.0 - 10.5.	(ASTM D 1287)
Freezing point:	ca. -25 °C.	(ASTM D 1177)
Frost protection:	ca. -28 °C.	(calculated)
Solidification temperature:	ca. -31 °C.	(DIN ISO 3016)
Initial boiling point/boiling range:	>100 °C.	(ASTM D 1120)
Flash point:	not applicable.	(DIN EN 22719, ISO 2719)
Evaporation rate:	No data available.	
Flammability (solid, gas):	not applicable.	
Upper explosion limit:	12.6 % vol.	(Inform. on Propylene glycol)
Lower explosion limit:	2.6 % vol.	(Inform. on Propylene glycol)
Vapour pressure (20 °C):	ca. 20 hPa.	(calculated)
Vapour density:	No data available.	
Density (20 °C):	ca. 1.034 g/cm^3.	(DIN 51757)
Solubility:	Water solubility: soluble.	
Partition coefficient n-octanol/H_2O:	log P_{ow} (20.5 °C): -1.07.	(Inform. on Propylene glycol)
Auto-ignition temperature:	No data available.	
Decomposition temperature:	No data available.	
Viscosity (kinematic, 20 °C):	ca. 5.0 mm^2/s.	(DIN 51562)
Explosive properties:	not explosive.	
Oxidizing properties:	not oxidizing.	
9.2. Other Information:	No other information.	

SECTION 10: Stability and reactivity

10.1. Reactivity:	No hazardous reactions if stored and handled as prescribed/indicated. Corrosion to metals: No corrosive effect on metals.
10.2. Chemical stability:	The product is stable if stored and handled as prescribed/indicated.
10.3. Possibility of hazardous reactions:	No hazardous reactions if stored and handled as prescribed/indicated.
10.4. Conditions to avoid:	No conditions to avoid anticipated.
10.5. Incompatible materials:	Substances to avoid: strong oxidising agents.
10.6. Hazardous decomposition products:	No hazardous decomposition products if stored and handled as prescribed/indicated.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Information on likely routes of exposure:	Inhalation. Skin contact. Ingestion. Eye contact.
Acute toxicity:	Not classified based on available information. Information on component 1,1'-Iminobis-2-propanol: Acute oral toxicity: LD50 (Rat): >2000 mg/kg, method: OECD test guideline 401. Acute inhalation toxicity LC0 (Mouse): >2069 mg/m^3, exposure time: 3 hours, test atmosphere: dust, mist. Acute dermal toxicity: LD50 (Rabbit): 8000 mg/kg.
Skin corrosion/ irritation:	Not classified based on available information. Information on component 1,1'-Iminobis-2-propanol: No skin irritation (Rabbit), method: OECD test guideline 404.
Serious eye damage/ eye irritation:	Not classified based on available information. Information on component 1,1'-Iminobis-2-propanol: Irritation to eyes, reversing within 21 days (Rabbit), method: OECD test guideline 405.
Respiratory or skin sensitisation:	Skin sensitisation: Not classified based on available information. Respiratory sensitisation: Not classified based on available information.

SECTION 11: Toxicological information - Continuation

	Information on component 1,1'-Iminobis-2-propanol: Skin contact: not sensitising (Guinea pig, Buehler Test), method: OECD test guideline 406.
Germ cell mutagenicity:	Not classified based on available information. Information on component 1,1'-Iminobis-2-propanol: Genotoxicity in vitro: not mutagenic: Tests: 1. Bacteria, AMES Test, mehod: OECD test guideline 471, 2. Chromosome aberration test in vitro, method: OECD test guideline 473, 3. In vitro mammalian cell gene mutation test, method: OECD test guideline 476.
Carcinogenicity:	Not classified based on available information. Information on component 1,1'-Iminobis-2-propanol: Not carcinogenic (Rat), application route: ingestion, exposure time: 94 weeks.
Reproductive toxicity:	Not classified based on available information. Information on component 1,1'-Iminobis-2-propanol: Effects on fertility: negative (Rat, One-generation reproduction study, application route: ingestion. Effects on foetal development: negative (Rat, embryo-foetal development), appl. route: ingestion, method: OECD test guideline 414.
Specific target organ toxicity (single exposure):	Not classified based on available information.
Specific target organ toxicity (repeated exposure):	Not classified based on available information.
Aspiration toxicity:	Not classified based on available information.

SECTION 12: Ecological information

12.1. Toxicity

Information on component 1,1'-Iminobis-2-propanol

Toxicity to	Value / exposure time	Species
fish	LC50: 1466 mg/l / 96 h	Brachydanio rerio (Zebra fish) Method: OECD test guideline 203
daphnia and other aquatic invertebrates	EC50: 277.7 mg/l / 48 h	Daphnia magna (Water flea)
algae	EC50: 339 mg/l / 72 h NOEC: 125 mg/l / 72 h	Desmodesmus subspicatus (Green algae)

12.2. Persistence and degradability:	Information on component 1,1'-Iminobis-2-propanol: Biodegradability: Biodegradation: 94 % (28 d), method: OECD test guideline 301. Result: readiliy biodegradable.
12.3. Bioaccumulative potential:	Information on component 1,1'-Iminobis-2-propanol: Partition coefficient n-octanol/H_20: log P_{ow}: -0.88.
12.4. Mobility in soil:	No data available.
12.5-Results of PBT and vPvB assessment:	The product does not contain a substance fulfilling the PBT criteria (persistent/bioaccumulative/toxic) or the vPvB criteria (very persistent/very bioaccumulative).
12.6. Other adverse effects:	No data available.
12.7. Further information:	No further information.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product:	Dispose of in accordance with local regulations. According to the European Waste Catalogue (EWC), waste codes are not product specific, but application specific. Waste codes should be assigned by the user, preferably in discussion with the waste disposal authorities.

SECTION 13: Disposal considerations - Continuation

Contaminated packaging: Dispose of as the product. Empty containers should be taken to an approved waste handling site for recycling or disposal.

SECTION 14: Transport information

	ADR/ RID	ADN	IMDG	IATA/ ICAO
	Not classified as a dangerous good under transport regulations			
14.1. UN number	-	-	-	-
14.2. UN proper shipping name	-	-	-	-
14.3. Transport hazard classes	-	-	-	-
14.4. Packing group	-	-	-	-
14.5. Environmental hazards	-	-	-	-
14.6. Special precautions for user	-	-	-	-

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not evaluated.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance/mixture

Legal basis	Remark / Evaluation
Regulation (EC) No. 649/2012 of the European Parliament and the Council concerning the export and import	Not applicable
REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59)	Not applicable
Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer	Not applicable
Regulation (EC) No. 850/2004 on persistent organic pollutants	Not applicable
Seveso III - Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances	Not applicable

Other regulations
No further information.

15.2. Chemical Safety Assessment
A Chemical Safety Assessment was not carried out for the product.

SECTION 16: Other information

Full text of the abbreviations of classifications and H-Statements used in sections 2 and 3

Eye Irrit. 2	Eye irritation, Category 2
H319	Causes serious eye irritation

Other abbreviations used in this safety data sheet in alphabetical order

ADN	European agreement concerning the international carriage of dangerous goods by inland waterways
ADR	European agreement concerning the international carriage of dangerous goods by road
ASTM	American Society for Testing and Materials
CAS number	Chemical Abstracts Service number
CLP	Regulation (EC) No. 1272/2008 on classification, labeling and packaging of chemical substances and mixtures
DIN	German Institute for Standardisation/German Industrial Standard
DNEL	Derived No Effect Level
EC50	Median Effective Concentration

SECTION 16: Other information - Continuation

EC number	EINECS number (European Inventory of Existing Substances) or ELINCS number (European List of Notified Chemical Substances)
GB EH40	UK EH40 WEL - Workplace Exposure Limits
GB EH40 TWA	Long-term exposure limit (8-hour TWA reference period)
IATA	International Air Transport Association
IBC	International Bulk Chemicals
ICAO	International Civil Aviation Organization
IMDG	International Maritime Dangerous Goods Code
INDEX number	Identification code for hazardous substances, Annex VI of Regulation (EC) No. 1272/2008
ISO	International Organisation for Standardisation/International Standard
LC0	Threshold concentration without harmful effect
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
MARPOL	International Convention for the Prevention of Marine Pollution from Ships
NOEC	No Observed Effect Concentration
OECD	Organisation for Economic Cooperation and Development
PNEC	Predicted No Effect Concentration
REACH	Regulation (EC) No. 1907/2006 on Registration, Evaluation, Authorisation and Restriction of Chemicals
RID	Regulation concerning the international carriage of dangerous goods by rail

Further information

Sources of key data used to compile the safety data sheet: Internal technical data, data from component SDS, OECD eChem Portal search results and European Chemicals Agency [ECHA].

Revision date: 01.05.2017
Date of previous version: 01.06.2015

Vertical lines in the left hand margin indicate an amendment from the previous version.

The information provided in this safety data sheet (SDS) is correct to the best of our knowledge, information and belief at the date of its publication. The information is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and shall not be considered a warranty or quality specification of any type. The information provided relates only to the specific product identified at the top of this SDS and may not be valid when the SDS product is used in combination with any other materials or in any process, unless specified in the text. Product users should review the information and recommendations in the specific context of their intended manner of handling, use, processing and storage, including an assessment of the appropriateness of the SDS product in the user's end product, if applicable.

16 Solar Keymark certificates

DIN CERTCO
Gesellschaft für Konformitätsbewertung mbH

CERTIFICATE

Certificate holder	**Ritter Energie- und Umwelttechnik GmbH & Co. KG** **Kuchenäcker 2** **72135 Dettenhausen** **GERMANY**
Production facility	Dettenhausen
Product	Solar collectors
Type, Model	CPC 6 INOX, CPC 6 XL INOX, CPC 12 INOX, CPC 12 XL INOX, CPC 18 INOX, CPC 6 OEM, CPC 12 OEM, CPC 18 OEM
Testing basis	DIN EN 12975-1:2011-01 DIN EN ISO 9806:2014-03 Specific CEN Keymark Scheme Rules for Solar Thermal Products Version 28.00 (2015-12)
Mark of conformity	
Registration No.	011-7S134 R
Valid until	2020-11-30
Right of use	This certificate entitles the holder to use the mark of conformity shown above in conjunction with the specified registration number. See annex for further information.

2016-04-04
Dipl.-Wi.-Ing. (FH) Sören Scholz
Head of Certification Body

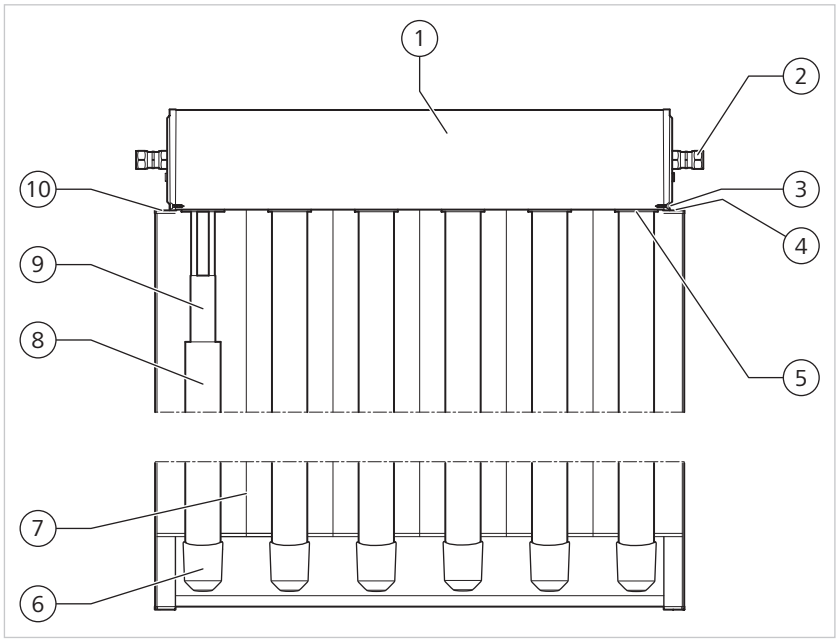
DAkkS Deutsche Akkreditierungsstelle D-ZE-11125-01-00

GESELLSCHAFT FÜR KONFORMITÄTSBEWERTUNG MBH DIN CERTCO

DIN CERTCO Gesellschaft für Konformitätsbewertung mbH · Alboinstraße 56 · D-12103 Berlin · www.dincertco.de

17 Overview of spare parts

17.1 CPC 6/12/18 OEM/INOX and CPC 6/12 XL INOX



Overview of spare parts

			CPC 6/12/18 OEM	CPC 6/12/18 INOX	CPC 6/12 XL INOX
Position	**Designation**	**VE**	**Order no.**	**Order no.**	**Order no.**
1	Cover for manifold CPC 6	1	08-9113	08-9110	08-9110
1	Cover for manifold CPC 6 INOX, CPC 6 XL INOX, with screws	1	08-0814[6)]	08-0811[1)]	08-0811[2)]
1	Cover for manifold CPC 12	1	08-9125	08-9122	08-9122
1	Cover for manifold CPC 12 INOX, CPC 12 XL INOX, with screws	1	08-0815[7)]	08-0812[3)]	08-0812[4)]
1	Cover for manifold CPC 18	1	08-9139	08-9136	--
1	Cover for manifold CPC 18 INOX, CPC 18 XL INOX, with screws	1	08-0816[5)]	08-0813[8)]	--
2	Straight screw connection, 15 mm, brass	1	08-6059	08-6059	88-6059
3	Screws, 3.5 x 16, stainless steel	6	08-9238	08-9238	08-9238
4	Rubber plug for side profile right, TPE 90	1	08-0886	08-0886	08-0886
5	Sealing ring tube rubber black, EPDM 55	1	88-9001	88-9001	88-9001
6	Tube retainer black, PBT 40 (up to 12/14)	1	88-8001	88-8001	88-8001
6	Tube retainer OEM (from 01/15)	1	08-0999	08-0999	08-0999
6	Set OEM tube retainers (1 x 88-8001 and 1 x 08-0999)	1	08-1061	08-1061	08-1061
7	Reflector plate CPC OEM, triple, for 3 tubes, Al	1	88-2011	88-2011	--
7	Reflector plate CPC XL, triple, for 3 tubes, Al	1	--	--	88-2013
8	Evacuated tube, L = 1500 mm, borosilicate glass in shock and fall proof individual packaging	1	88-1042	88-1042	--
8	Evacuated tube, L = 1500 mm, borosilicate glass	6	08-1036	08-1036	--

			CPC 6/12/18 OEM	CPC 6/12/18 INOX	CPC 6/12 XL INOX
Position	**Designation**	**VE**	**Order no.**	**Order no.**	**Order no.**
8	Evacuated tube, L = 1500 mm, borosilicate glass	12	08-1037	08-1037	
8	Evacuated tube, L = 1500 mm, borosilicate glass	18	08-1916	08-1916	
8	Evacuated tube, L = 1920 mm, borosilicate glass in shock and fall proof individual packaging	1	--	--	88-1040
8	Evacuated tube, L = 1920 mm, borosilicate glass	6	--	--	08-1040
8	Evacuated tube, L = 1920 mm, borosilicate glass	12	--	--	08-1041
8	Evacuated tube, L = 1920 mm, borosilicate glass	18	--	--	08-1918
9	Spare part set heat conduction plate CPC, Al	1	88-2522	88-2522	--
9	Spare part set heat conduction plate CPC XL, Al	1	--	--	88-2520
10	Rubber plug for side profile left, TPE 90	1	08-0885	08-0885	08-0885
not shown	Angle fitting, 90 , 15 mm, brass	1	08-6064	08-6064	08-6064
not shown	Reduction 15x12 mm, for clamping ring fitting, brass	1	08-9209	08-9209	08-9209
not shown	Support sleeve 12 mm, brass	1	08-6046	08-6046	08-6046
not shown	Support sleeve 15 mm, brass	1	08-6047	08-6047	08-6047

[1] as of collector serial number 10008167900001; delivery as of approx. 01/2012

[2] as of collector serial number 10008989800001; delivery as of approx. 01/2013

[3] as of collector serial number 10008031800001; delivery as of approx. 11/2011

[4] as of collector serial number 10008351400001; delivery as of approx. 04/2012

[5] as of collector serial number 1000872700025; delivery as of approx. 11/2012

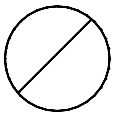
[6] as of collector serial number 10009263800006; delivery as of approx. 06/2013

[7] as of collector serial number 10009028500046; delivery as of approx. 02/2013

[8] as of collector serial number 1000914390001; delivery as of approx. 04/2013

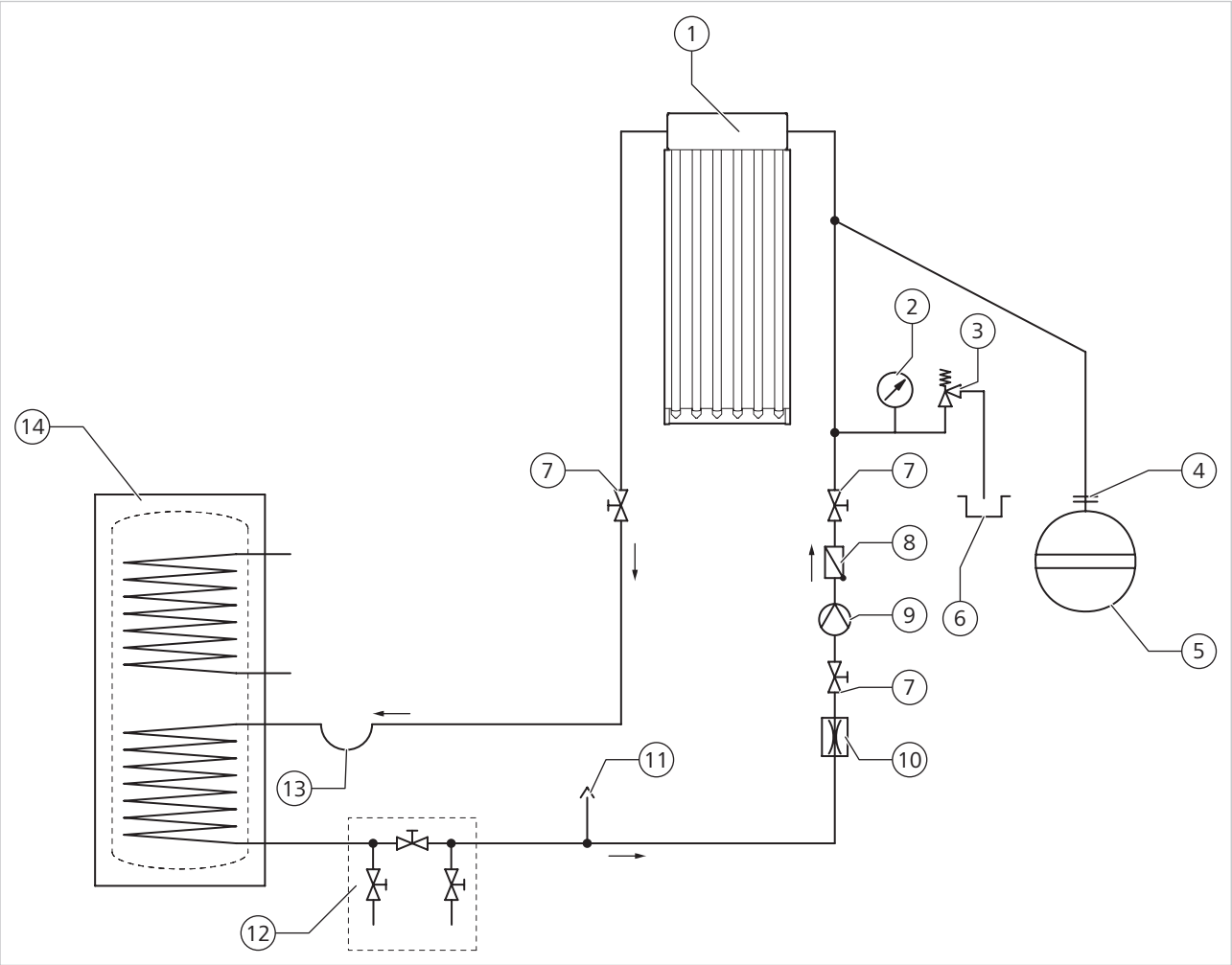
18 Examples of a hydraulic system

18.1 Symbols

Symbols used in this document			
	Safety valve		Pump
	Shut-off device (faucet, valve ...)		Expansion tank
	Check valve		Heating circuit
	Collection container		Flow control valve
	De-aerator		Pressure gauge
	Primary shut-off		Primary tank

18.2 Hydraulic diagrams

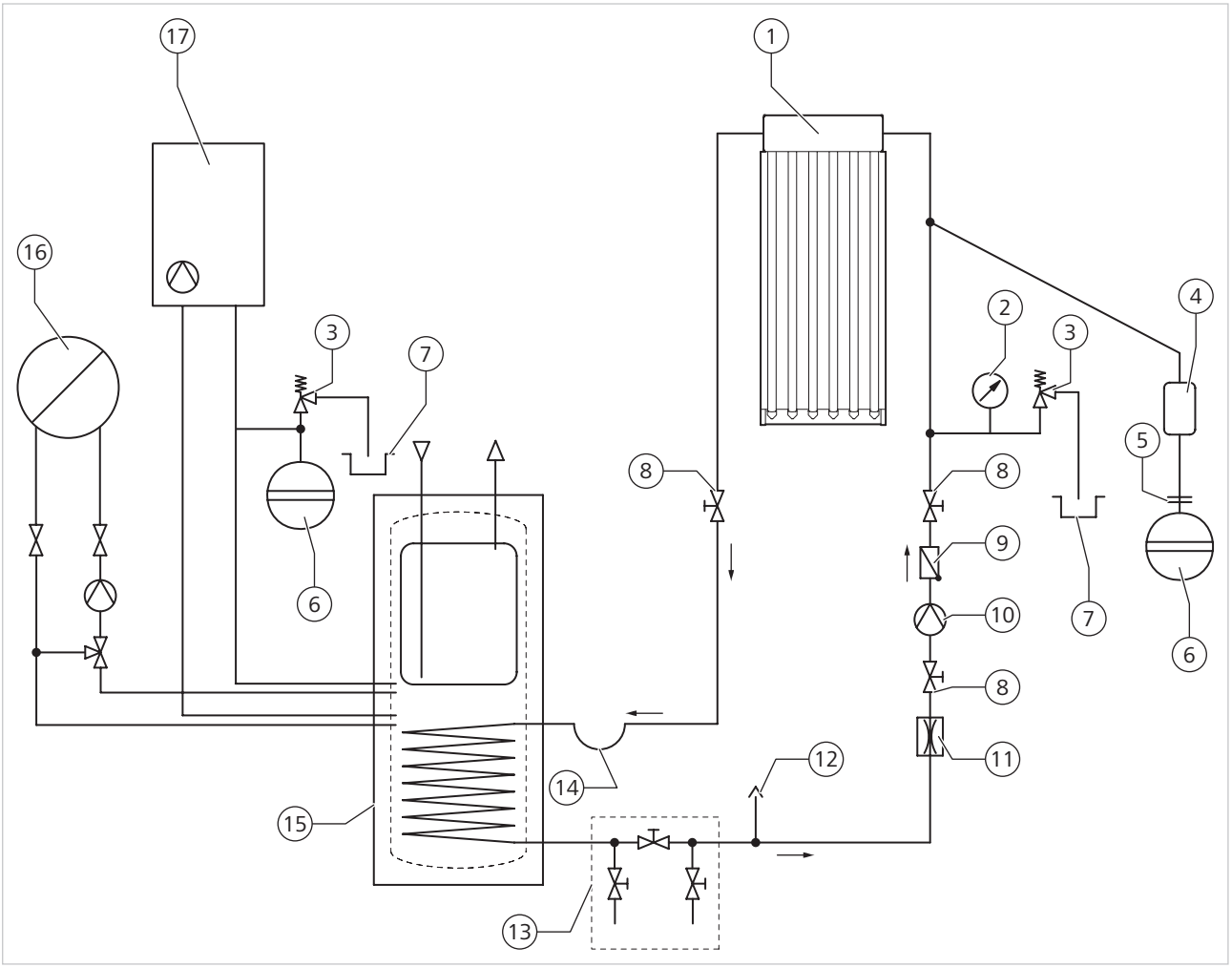
Hydraulic diagram of drinking water storage tank



Hydraulic diagram of drinking water storage tank

1	Collector	8	Check valve
2	Pressure gauge	9	Solar pump
3	Safety valve	10	Flow meter
4	Primary shut-off expansion tank	11	De-aerator
5	Expansion tank	12	Filling fitting
6	Collection container	13	Gravity loop
7	Slide valve	14	Drinking water storage tank

Hydraulic diagram of combination storage tank



Hydraulic diagram of combination storage tank

1	Collector	10	Solar pump
2	Pressure gauge	11	Flow meter
3	Safety valve	12	De-aerator
4	Primary tank	13	Filling fitting
5	Primary shut-off expansion tank	14	Gravity loop
6	Expansion tank	15	Combination storage tank
7	Collection container	16	Heating circuit
8	Slide valve	17	Heat generator
9	Check valve		

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