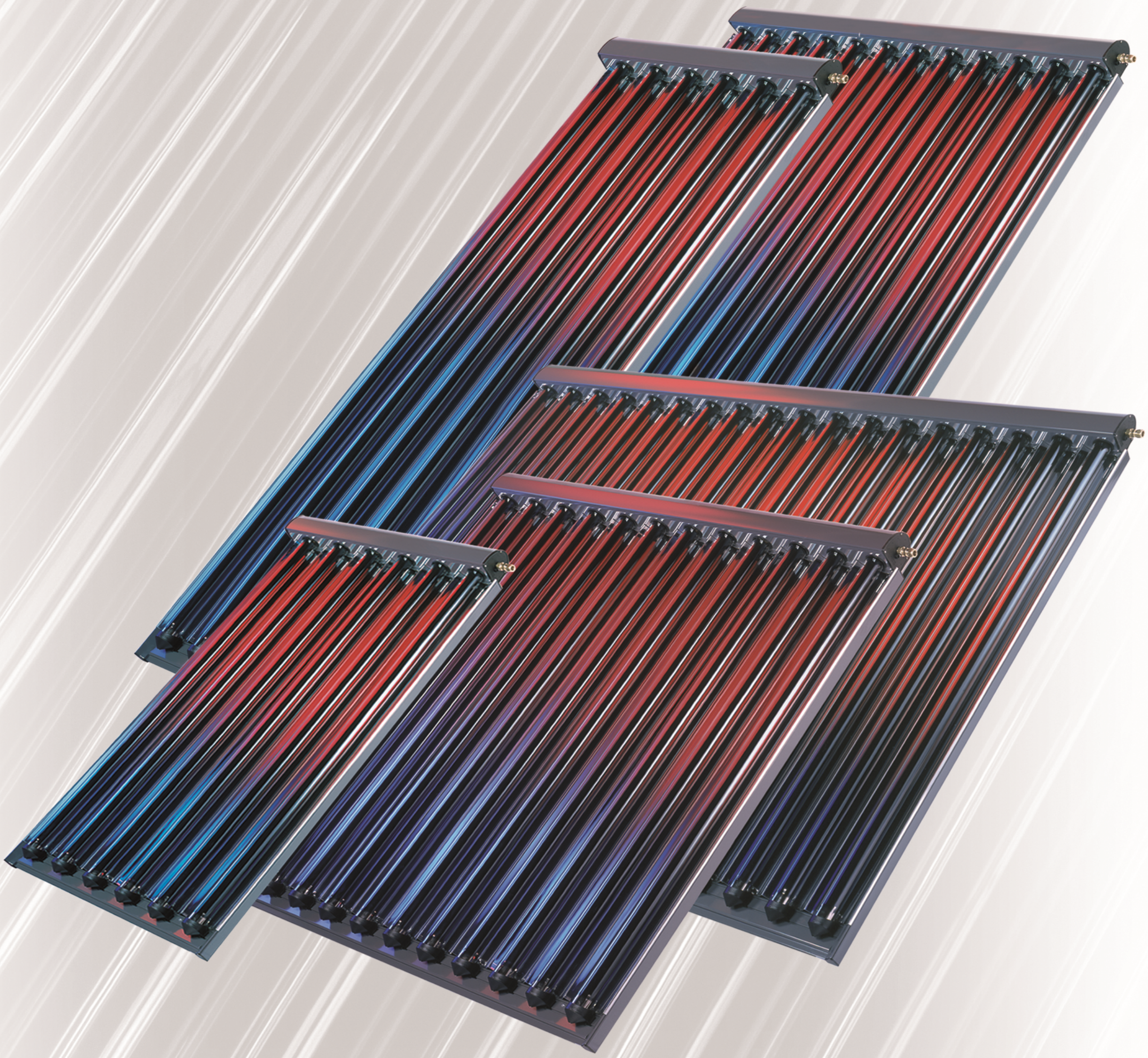
MESys Solar

# Planning Instructions



## Evacuated tube collectors

## CPC 6 OEM / INOX

## CPC 12 OEM / INOX

## CPC 18 OEM / INOX

## CPC 6 XL INOX

## CPC 12 XL INOX

**With aluminum/ stainless steel installation system**

**Subject to technical modifications without notice!**
Due to continuous development, the drawings, installation steps and technical data detailed here may change.

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# 1. About this document

### 1.1 Important information

The equipment must be installed in accordance with installation regulations required in the area where the installation is located. Local regulations must be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made.

### 1.2 Purpose of this document

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

• structure and function • technical specification • heat output • design • connection options
• installation • yield verification • certificates

### 1.3 Target group for this document

These installation instructions are intended for installation engineers.

### 1.4 Symbols used in this document

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or important information concerning product life.

| | |
|---|---|
| ⚠ DANGER | Indicates an imminently hazardous situation, which, if not avoided, will result in death, serious injury, or substantial property damage. |
| ⚠ WARNING | Indicates a potentially hazardous situation, which, if not avoided, could result in death, serious injury, or substantial property damage. |
| ⚠ CAUTION | Indicates a potentially hazardous situation, which, if not avoided, may result in moderate, or minor injury or property damage. |
| NOTICE | Indicates special instructions on installation, operation or maintenance, which are important but not related to personal injury hazards. |

### 1.5 Applicability

These installation instructions apply for the OEM/INOX and XL INOX evacuated tube collectors as of 01/01/2008.

## 2. General information

- Collectors should be aligned such that they face south where possible.
- Generally, the manifold is always to be installed uppermost.
- A minimum slope of 15° is necessary for installation on roofs, as well as on flat roofs, to facilitate self-cleaning.
- Do not remove the white protective sheet from the evacuated tubes until after the solar energy system has been commissioned.
- In the solar circuit, use brazed joints or compression ring connections only.
- Thermally insulate the pipes in accordance with local codes.
  Ensure that the pipes are heat resistant (300°F) and UV resistant (pipes laid outdoors).
- Fill the solar energy system with “Tyfocor-LS” heat transfer medium only if using Glycol.
- Using the proper heat transfer fluid, operating the solar system within the fluid’s temperature range and maintaining the fluids pH>7. is requirement of the warranty.
- The evacuated tube collectors are hail resistant in accordance with DIN EN 12975-2. However, we recommend including storm and hail damage in your building insurance. Our materials guarantee does not cover such damage.
- Work must comply with regulations of local code authorities and utility companies in the area in which it is installed.
- Solar collectors may require registration or permits in accordance with local or state building codes.
- The installer is responsible for determining structural strength of the roof. A registered structural engineer should be consulted.
- Installation, maintenance and repairs must be carried out by authorized service personnel.
- The pipe work of the solar circuit must be bonded as specified by local codes.
  The solar energy system may only be connected to existing or new lightning protection systems or equipotential bonding by authorized service personnel.
- All wiring must be in accordance with the latest edition of national Electric Code, ANSI/NFPA 70.
  In Canada use the latest edition of the Canadian Electric Code CSA C22.1

**The respective state’s specific standards and safety regulations must be adhered to.**
**Carefully read through these planning instructions.**

## 3. Benefits and advantages

**Intelligent design and installation:**

- Suitable for installation on pitched roofs, flat roofs, walls, free-standing and facade installation.
- For heating DHW, space heating, heating pools and spas, as well as for solar cooling.
- Great flexibility due to collector units of different widths.
- Up to 150 ft² can be connected in series.
- Quick installation thanks to completely pre-assembled collector units and simple, flexible on-roof and flat roof mounting hardware.
- Simple connection technology for adding multiple collectors beside one another with pre-installed screw fittings. No additional piping or thick insulation required.
- The flow and return pipe can be connected to the collector either on the left or on the right.
- Glass tubes can be replaced without draining the collector circuit - “dry connection”.
- Simple connection of hydraulic lines with compression fittings.

**Reliability:**

- High reliability and long service life via the use of high-quality, corrosion-resistant materials such as thick borosilicate glass, copper and anti-corrosion coated aluminum.
- Permanent vacuum seal of the tubes thanks to pure glass bonds without glass-metal transitions. Pure glass-glass composite, thermos flask principle.
- High reliability due to dry connection of the evacuated tubes to the solar circuit.

**Recycling:**

Fully recyclable thanks to easy-to-dismantle design and re-usable materials.

**Energy yield and performance:**

- Extremely high energy yield with small gross surface of the collectors.
- Circular absorber surface guarantees that each individual tube is always optimally aligned with the sun.
- Exceptionally high solar coverage rates are possible.
- High efficiency via highly-selective coating on absorber.
- The evacuated tubes reduce thermal losses of a solar collector as there is no air in the vacuum which could transport the heat from the surface of the absorber to the outer glass tube which is affected by the weather.
- The heat transfer medium flows directly through the tubes without an intermediate heat exchanger in the collector.
- The circular absorber collects both the direct and diffuse solar irradiation optimally at all times.
- The CPC reflector and direct flow through the evacuated tubes make a significant contribution which results in an extremely high energy yield.
- Optimal thermal insulation via a vacuum, which results in high efficiency, particularly in winter and at low irradiation.
- Unused excesses in the summer are lower than with flat plate collectors. At the same time, the yield in winter is significantly higher.
- It is also ideal for low-flow systems with stratified charging and heating support.

# 4. Structure and function of the collectors

**Historic roots - the invention of the thermos flask**

The Scottish Physicist James Dewar invented a double-walled vessel with a vacuum-insulated cavity in 1893 - the thermos flask.

Emmet developed the first evacuated tubes based on the thermos flask principle to utilize solar energy in 1909.

His patents from this time still form the basis for state-of-the-art evacuated tube technology.

The efficiency of this old and familiar thermos flask technology did not reach a high standard until state-of-the-art coating technologies and highly-selective coatings were applied.

**Today’s technology**

Linuo Ritter USA evacuated tube collectors consist of 3 main components which are completely pre-assembled:

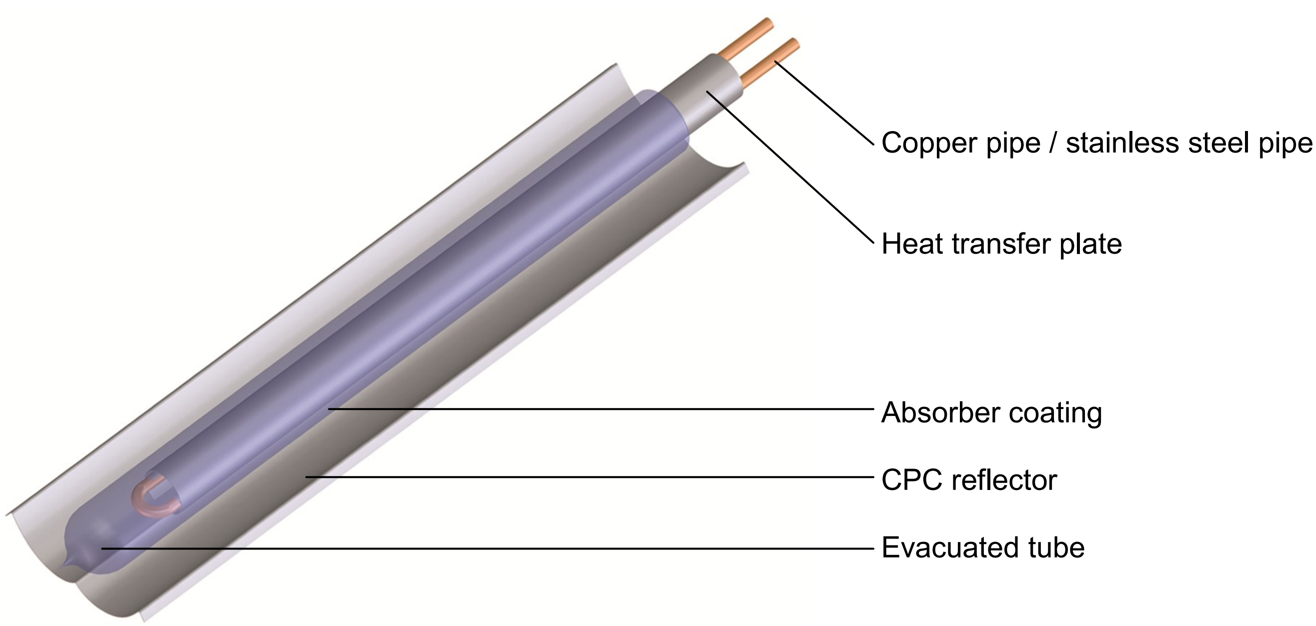
- **evacuated tubes**
- **CPC reflectors**
- **manifold with the heat conduction unit**

**Evacuated tubes**

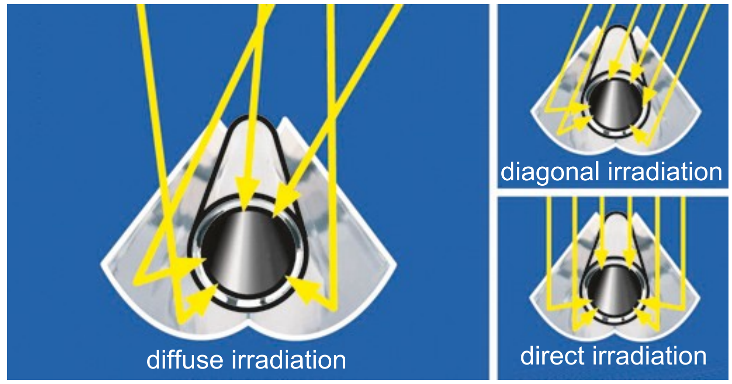
The evacuated tube is a product which has been optimized in terms of geometry and performance.

Evacuated tubes consist of two concentric glass tubes which are sealed in a semi-circular shape on one side and are joined to one another on the other side. The space between the tubes is evacuated and then hermetically sealed (evacuated insulation).

To use solar energy, the internal glass tube is coated with an environmentally friendly, highly selective layer on the outside, thus turning it into an absorber. This coating is thus protected in the vacuum cavity. The aluminum nitrite sputter coating used is characterized by extremely low emissions and excellent absorption.



### The CPC refelector




To increase the efficiency of evacuated tube collectors, a highly reflective, weather-proof CPC (Compound Parabolic Concentrator) is fitted behind the evacuated tubes. The reflector geometry guarantees that direct and diffuse sunlight strikes the absorber, even when the angles of irradiation are unfavorable. This significantly improves the energy yield of a solar collector.

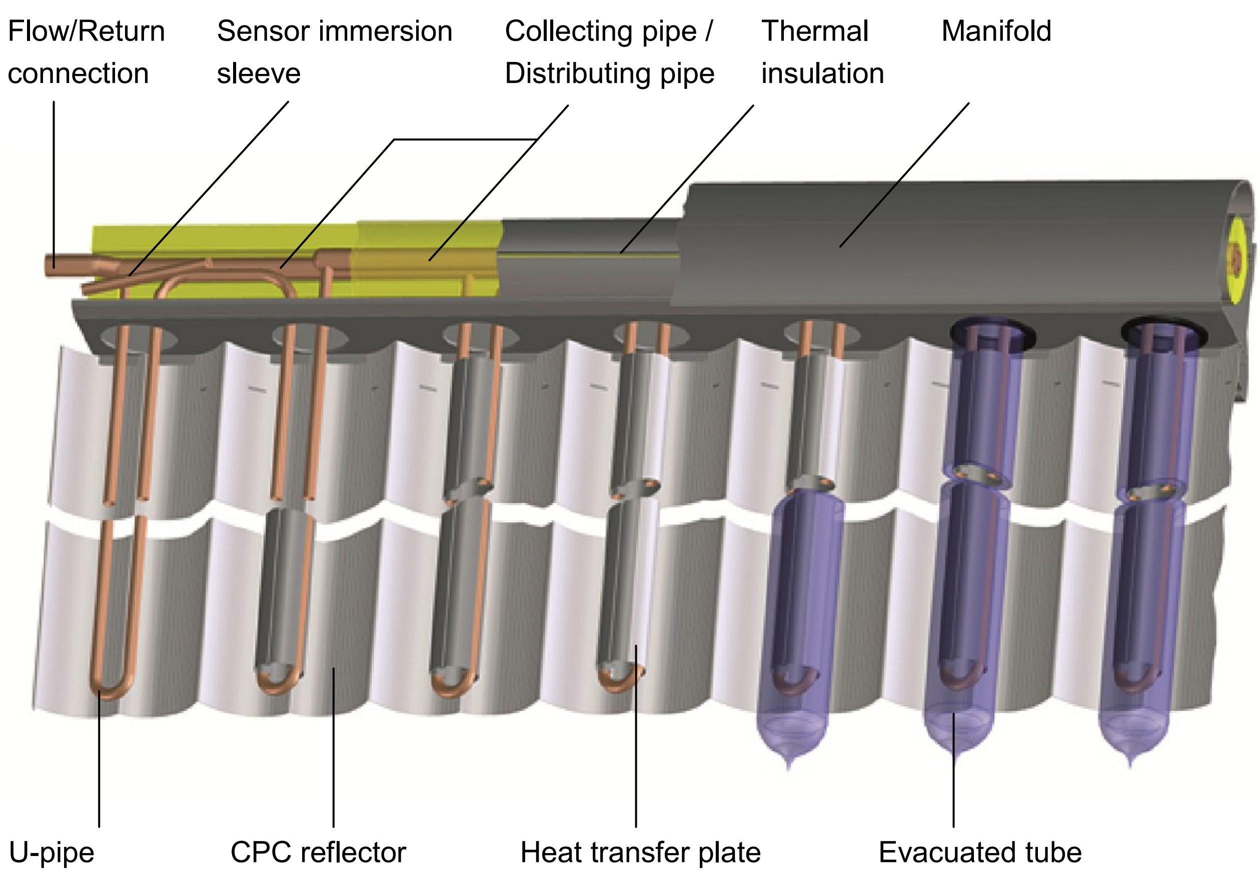
Unfavorable angles of irradiation are caused by light striking the collector at an angle (azimuth angle) (mounting surface does not face south, solar movement from east to west, diffuse irradiation).

### Manifold and heat conduction unit

The manifold contains the insulated collecting and distributing pipes.

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

Each evacuated tube contains a direct flow U-shaped pipe which is connected to the collecting or distributing pipe such that each individual evacuated tube has the same hydraulic resistance. This U-shaped pipe is pressed against the inside of the evacuated tube with the heat transfer plate.



# 5. Technical Data

## 5.1 Technical specification for CPC 6/12/18 OEM / INOX

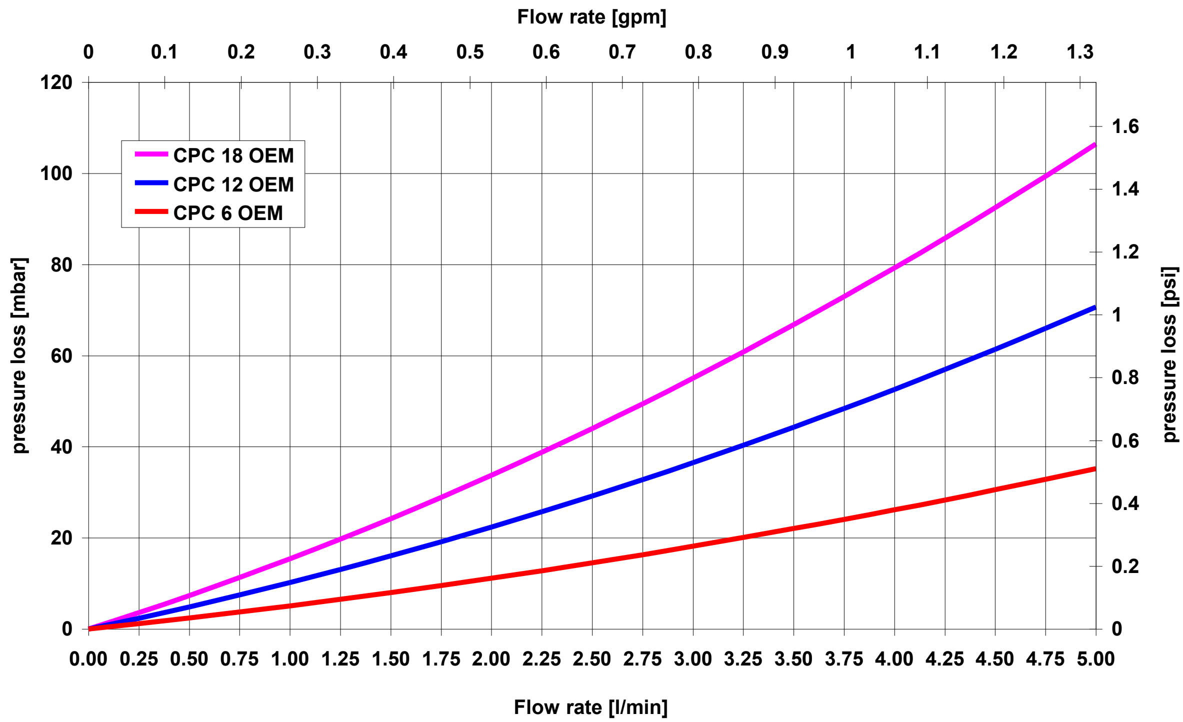
| Series | | **CPC 6 OEM/INOX** | **CPC 12 OEM/INOX** | **CPC 18 OEM/INOX** |
|---|---|---|---|---|
| Number of evacuated tubes | | 6 | 12 | 18 |
| $\eta_0$ (based on gross area) SRCC | % | 55.4 | 55.4 | 55.4 |
| $a_1$ (based on gross area) SRCC | Btu/ft².h.°F | 0.1430 | 0.1430 | 0.1430 |
| $a_2$ (based on gross area) SRCC | Btu/ft².h.°F² | 0.0003 | 0.0003 | 0.0003 |
| Yield forecast according to SRCC Clear Day, Category C | kBtu/unit | 12.1 | 24.0 | 35.8 |
| Module dimensions (width x height x depth) | in | 27.5 x 64.5 x 4 | 55 x 64.5x 4 | 82.5 x 64.5 x 4 |
| Gross surface | ft² | 12.38 | 24.54 | 36.70 |
| Aperture area | ft² | 10.76 | 21.68 | 32.29 |
| Collector content – OEM | gal | 0.2 | 0.5 | 0.6 |
| Collector content – INOX | gal | 0.2 | 0.5 | 0.7 |
| Weight – OEM | lb | 41 | 75 | 113 |
| Weight – INOX | lb | 38 | 75 | 115 |
| Max. permitted operating pressure | psi | 150 | 150 | 150 |
| Stagnation temperature, max. | °F | 522 | 522 | 522 |
| Connection width, flow/return | mm | 15 | 15 | 15 |
| Collector material – OEM | | Al / Cu / glass / silicone / PBT / EPDM / TE | | |
| Collector material – INOX | | Al / stainless steel / glass / silicone / PBT / EPDM / TE | | |
| Glass tube material | | borosilicate 3.3 | | |
| Selective absorber layer material | | aluminum nitrite | | |
| Glass tube, (ext. dim./ int. dim./ wall thickness / tube length) | mm<br>in | 47 / 36.2 / 1.6 / 1503<br>1.85 / 1.47 / 0.063 / 59.05 | | |
| Colour OEM (aluminum frame profiles, anodized) | | natural anodized (aluminium grey) | | |
| Colour INOX (aluminum frame profiles, powder coated) | | RAL 7015 | | |
| Colour (plastic parts) | | black | | |
| Heat transfer medium | | Tyfocor LS or water | | |
| Hailstone test according to DIN EN 12975-2 | TÜV No. | 435/142448 | | |
| SRCC OG-100 Certification no. - OEM | | 2008008E | 2008008D | 2008008F |
| SRCC OG-100 Certification no. - INOX | | 2008008B | 2008008A | 2008008C |

## 5.2 Technical specification for CPC 6/12 XL INOX

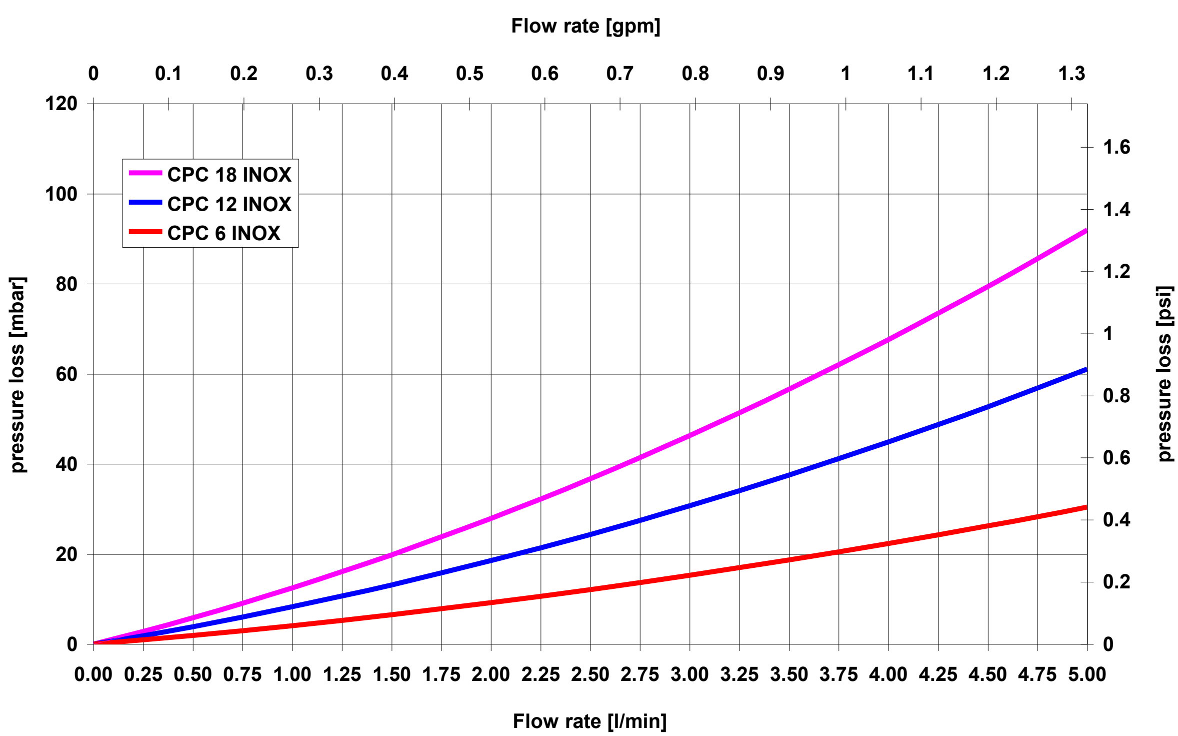
| Series | | CPC 6 XL INOX | CPC 12 XL INOX |
|---|---|---|---|
| Number of evacuated tubes | | 6 | 12 |
| $\eta_0$ (based on gross) SRCC | % | 57.8 | 57.8 |
| $a_1$ (based on gross area) SRCC | Btu/ft².h.°F | 0.14580 | 0.14580 |
| $a_2$ (based on gross area) SRCC | Btu/ft².h.°F² | 0.00036 | 0.00036 |
| Yield forecast according to SRCC Clear Day, Category C | kBtu/unit | 15.1 | 32.1 |
| Module dimensions (width x height x depth) | in | 27.5 x 81 x 4 | 55 x 81 x 4 |
| Gross surface | ft² | 14.42 | 30.66 |
| Aperture area | ft² | 13.15 | 27.80 |
| Collector content | gal | 0.3 | 0.6 |
| Weight | lb | 48 | 91 |
| Max. permitted operating overpressure | psi | 150 | 150 |
| Stagnation temperature, max. | °F | 522 | 522 |
| Connection width, flow/return | mm | 15 | 15 |
| Collector material – INOX | | Al / stainless steel / glass / silicone / PBT / EPDM / TE | |
| Glass tube material | | borosilicate 3.3 | |
| Selective absorber layer material | | aluminum nitrite | |
| Glass tube, (external dim./ internal dim./ wall thickness / tube length) | mm<br>in | 47 / 36.2 / 1.6 / 1920<br>1.85 / 1.47 / 0.063 / 75.59 | |
| Colour INOX (aluminum frame profiles, powder coated) | | RAL 7015 | |
| Colour (plastic parts) | | black | |
| Heat transfer medium | | Tyfocor LS or water | |
| Hailstone test according to DIN EN 12975-2 | TüV No. | 435/142448 | |
| SRCC OG-100 Certification no. - INOX | | 2008010C | 2008010D |

### 5.3 Pressure loss

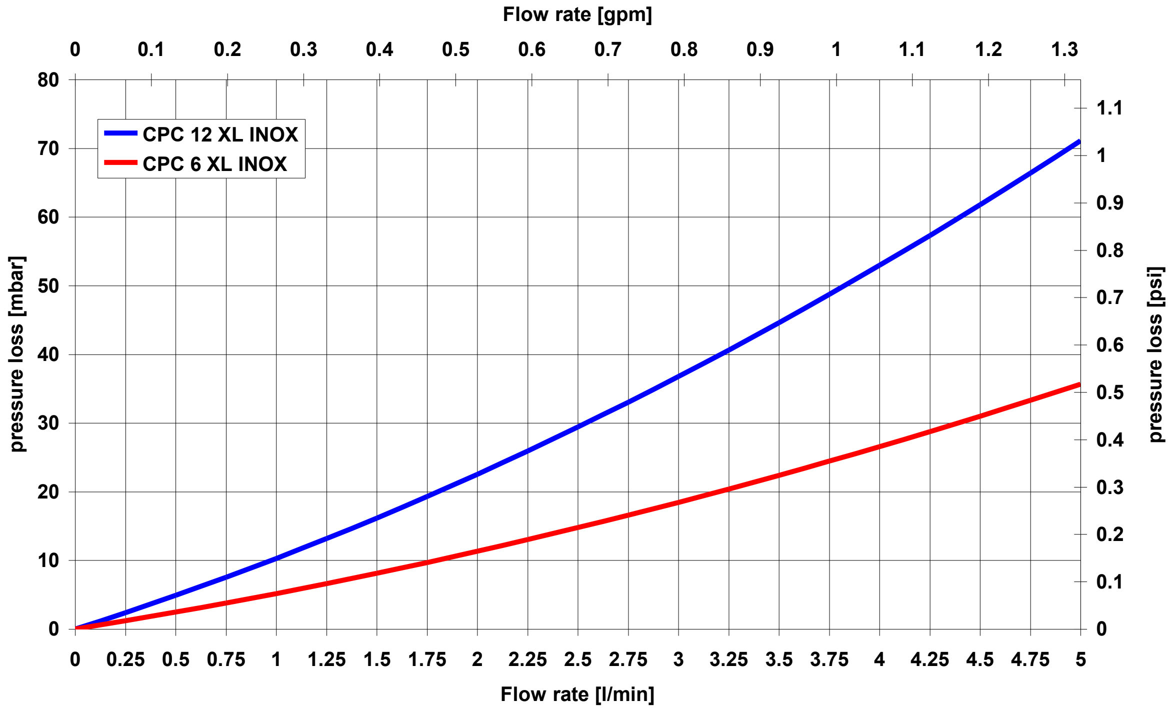
**Pressure loss of tube collector CPC 6/12/18 OEM**
**Heat transfer medium: Tyfocor LS; medium temperature: 100°F**




**Pressure loss of tube collector CPC 6/12/18 INOX**
**Heat transfer medium: Tyfocor LS; medium temperature: 100°F**



## Pressure loss of tube collector CPC 6/12 XL INOX
## Heat transfer medium: Tyfocor LS; medium temperature: 100°F



## 6. Heat output

The collector output ($\dot{Q}$) is calculated based on the collector efficiency ($\eta$) depending on the strength of the irradiation (G*) and the gross area per collector unit (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:

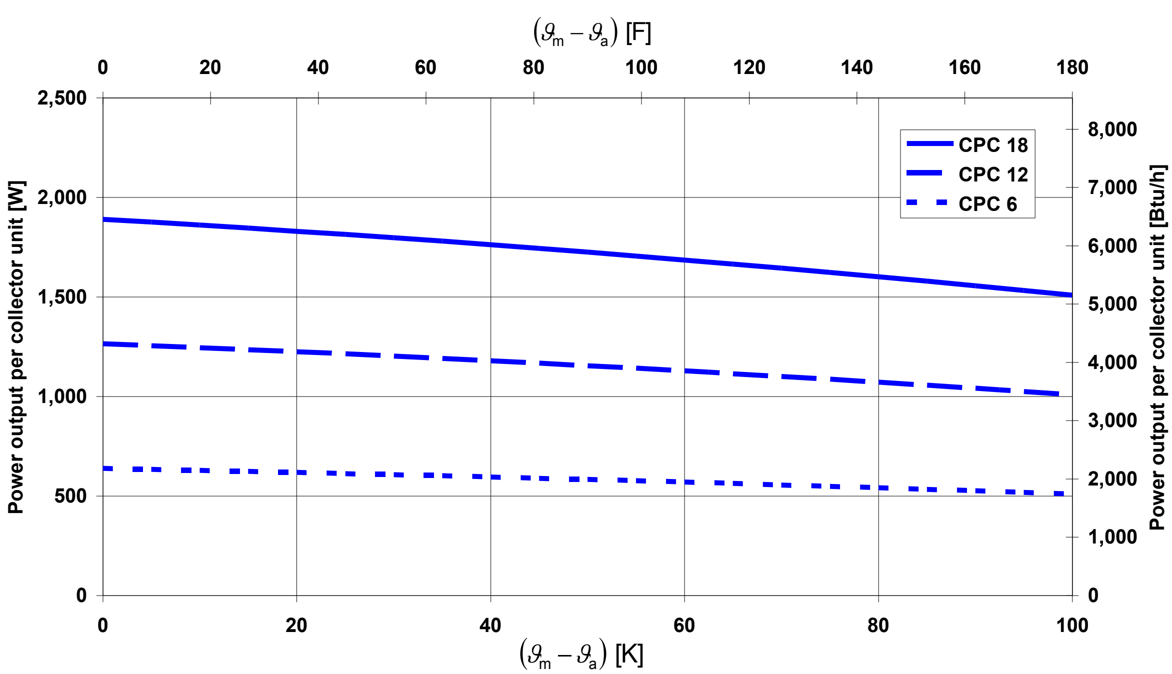
$$\dot{Q} = A \cdot G^* \cdot \eta \qquad \text{with:} \qquad \eta = \eta_0 - a_1 \frac{(\vartheta_m - \vartheta_a)}{G^*} - a_2 \frac{(\vartheta_m - \vartheta_a)^2}{G^*}$$

If the difference between the collector temperature and the ambient temperature $(\vartheta_m - \vartheta_a)$ is zero, the collector has zero heat loss to the surrounding air and the efficiency $\eta$ is maximum;
this is known as optical efficiency $\eta_0$ .
Part of the solar irradiation (G*) which strikes the collectors is “lost” due to reflection and absorption.
The optical efficiency $\eta_0$ takes these losses into consideration.

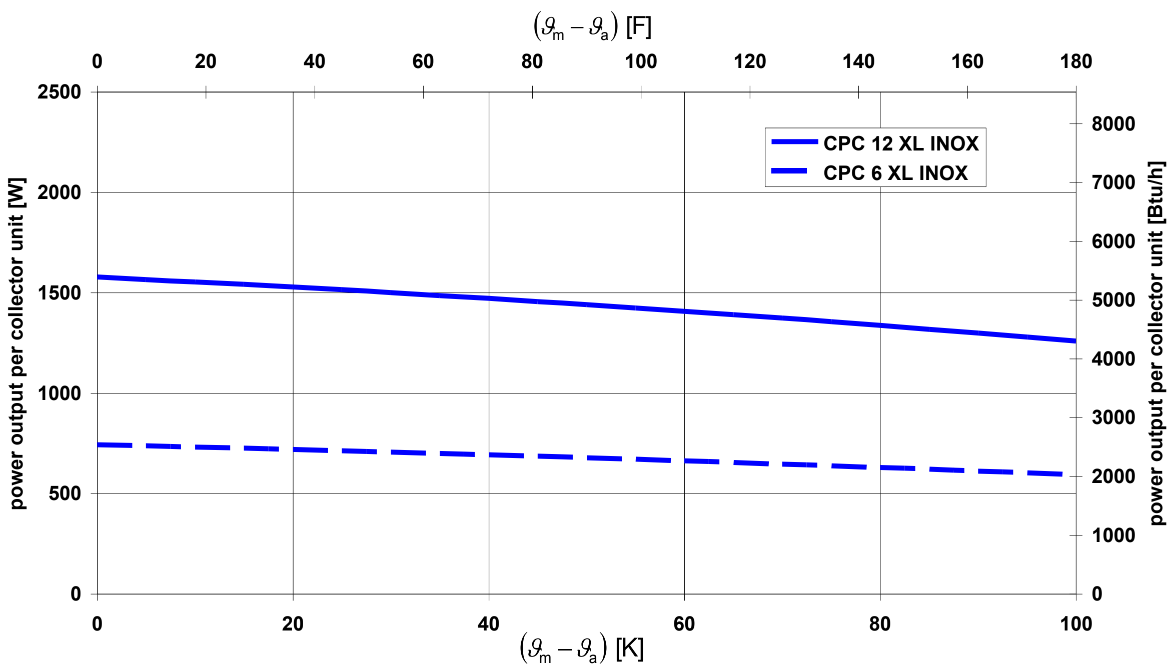
When collectors heat up, they dissipate heat to the surrounding area via conduction, radiation and convection. The heat transmission coefficient $a_1$ and $a_2$ incorporate these losses.

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

**Power curve of the CPC 6 /12 /18 OEM / INOX tube collectors at an irradiation G* of 1000 W/m² (317 Btu/ft²h)**



**Power curve of the CPC 6 /12 XL INOX tube collectors at an irradiation G* of 1000 W/m² (317 Btu/ft²h)**




In general, less solar irradiation is available for use as solar energy (for water heating and heating support) in the winter months, in transitional periods and cloudy days. The temperature differences between the collector temperature and the ambient temperature in winter are also very high due to the low temperatures outside. The following tables (source: SRCC) give an exact overview of how the collector output changes depending on the weather condition (radiation strength) and temperature difference.

COLLECTOR THERMAL PERFORMANCE RATING FOR **CPC 6**

| **Kilowatt-hours per panel per day** | | | | | **Thousands of BTU per panel per day** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY | CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY |
| B | (5 °C) | 3.7 | 2.8 | 1.8 | B | (9 °F) | 12.7 | 9.5 | 6.3 |
| C | (20 °C) | 3.6 | 2.6 | 1.7 | C | (36 °F) | 12.1 | 8.9 | 5.7 |
| D | (50 °C) | 3.2 | 2.3 | 1.3 | D | (90 °F) | 10.8 | 7.7 | 4.5 |
| E | (80 °C) | 2.8 | 1.9 | 0.9 | E | (144 °F) | 9.6 | 6.4 | 3.2 |

COLLECTOR THERMAL PERFORMANCE RATING FOR **CPC 12**

| Kilowatt-hours per panel per day | | | | | | Thousands of BTU per panel per day | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY | | CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY |
| B | (5 °C) | 7.4 | 5.5 | 3.6 | B | (9 °F) | 25.1 | 18.7 | 12.3 |
| C | (20 °C) | 7.0 | 5.2 | 3.3 | C | (36 °F) | 24.0 | 17.6 | 11.2 |
| D | (50 °C) | 6.3 | 4.5 | 2.6 | D | (90 °F) | 21.5 | 15.2 | 8..9 |
| E | (80 °C) | 5.6 | 3.7 | 1.9 | E | (144 °F) | 18.9 | 12.6 | 6.3 |

COLLECTOR THERMAL PERFORMANCE RATING FOR **CPC 18**

| Kilowatt-hours per panel per day | | | | | Thousands of BTU per panel per day | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY | CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY |
| B | (5 °C) | 11.0 | 8.2 | 5.4 | B | (9 °F) | 37.5 | 28.1 | 18.5 |
| C | (20 °C) | 10.5 | 7.7 | 4.9 | C | (36 °F) | 35.8 | 26.3 | 16.8 |
| D | (50 °C) | 9.4 | 6.6 | 3.9 | D | (90 °F) | 32.1 | 22.7 | 13.3 |
| E | (80 °C) | 8.3 | 5.5 | 2.8 | E | (144 °F) | 28.3 | 18.9 | 9.5 |

COLLECTOR THERMAL PERFORMANCE RATING FOR **CPC 6 XL INOX**

| Kilowatt-hours per panel per day | | | | | Thousands of BTU per panel per day | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY | CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY |
| B | (5 °C) | 4.6 | 3.5 | 2.3 | B | (9 °F) | 15.8 | 11.8 | 7.8 |
| C | (20 °C) | 4.4 | 3.3 | 2.1 | C | (36 °F) | 15.1 | 11.1 | 7.1 |
| D | (50 °C) | 4.0 | 2.8 | 1.6 | D | (90 °F) | 13.5 | 9.6 | 5.6 |
| E | (80 °C) | 3.5 | 2.3 | 1.2 | E | (144 °F) | 11.9 | 7.9 | 4.0 |

COLLECTOR THERMAL PERFORMANCE RATING FOR **CPC 12 XL INOX**

| Kilowatt-hours per panel per day | | | | | Thousands of BTU per panel per day | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY | CATEGORY | | CLEAR DAY | MILDLY CLOUDY | CLOUDY |
| B | (5 °C) | 9.8 | 7.3 | 4.8 | B | (9 °F) | 33.6 | 25.0 | 16.5 |
| C | (20 °C) | 9.4 | 6.9 | 4.4 | C | (36 °F) | 32.1 | 23.6 | 15.0 |
| D | (50 °C) | 8.4 | 6.0 | 3.5 | D | (90 °F) | 28.8 | 20.3 | 11.9 |
| E | (80 °C) | 7.4 | 5.0 | 2.5 | E | (144 °F) | 25.3 | 16.9 | 8.5 |

## 7. Design of the collector area

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

- for solar systems used to heat domestic hot water: hot water requirement, user behavior, consumption profile, annual energy consumed, utility bills
- for solar systems used for space heating: heat requirement, heating surface design temperatures, annual energy consumed, utility bills

This is not available in most cases.
The specifications in the following 2 tables should therefore be viewed as recommended guideline values, which can exceeded or undercut by up to 25% depending on the customer requirements (comfort, price).
The specifications were also 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. Detailed design using a simulation program is recommended in case of any deviation from these boundary conditions.

## Correction factors

The following two tables are available for corrections of the area depending on the main usage time, the collector angle and the angle deviation from south.

Main usage period April-September, only used for domestic hot water heating

| | | Roof incline (collector incline) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Angular deviation from due south | | 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 all-year, domestic hot water heating and partial space heating

| | | Roof incline (collector incline) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Angular deviation | | 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 |

Highly recommended

Recommended

Recommended with reservations

Not recommended

**We recommend using simulation programs when designing sports facilities, hotels, apartment buildings and for precise determination of the collector area.**

## 8. Notes on solar controllers

**NOTICE**

The solar controllers for tube collector systems should have a “push-start” function. This “push-start” function prevents excessive temperature differences between the temperature measured at the collector sensor and the temperature in the lower/middle part of the tubes. The “push-start” (activation) of the pump is to be started approx. two to three times per minute for approx. 3-5 seconds when a temperature increase is detected at the collector sensor to pump the hotter solar fluid to the measuring point.

## 9. Design of the collector connection lines

An average flow rate of 0.65 – 0.9 gph per ft² of gross area (approx. 0.01 – 0.015 gpm per ft²) can be assumed when selecting the piping dimensions. We recommend low-flow operation for large-scale solar energy systems, as the specific flow rate can be reduced to 0.3 – 0.45 gph per ft² gross area (approx. 0.005 – 0.0075 gpm per ft²). In order to keep piping work to a minimum, we recommend that you connect max. 110 ft² (high-flow) and 185 ft² (low-flow) of collector gross area in series. In order to minimize the pressure loss due to the solar energy system piping, the flow velocity in the copper piping should not exceed 3.2 ft/s. We recommend flow speeds of between 1 and 2 ft/s. The cross sections should be dimensioned in accordance with flow rate and velocity as in a standard heating system. We recommend that you use type L copper piping and red brass fittings when installing the collectors.
The connection points of the pipes should be brazed or connected using compression ring connections due to the high stagnation temperatures. No galvanized pipes, galvanized fittings or graphite seals may be used. Hemp may only be used in conjunction with pressure and temperature resistant sealant. The components used must be resistant to the heat transfer medium. The thermal insulation of pipes outdoors must be temperature and UV radiation-resistant and resistant to bird damage.

Guidelines for selecting pipe diameter dimensions see next page.

**Guidelines for selecting pipe diameter dimensions**

for series connection of CPC 6/12/18 OEM / INOX collectors and a pump with a max head of 20 ft.

**High-flow**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. of tubes | | 12 | 18 | 24 | 30 | 36 | 42 | 48 | |
| Flow rate | gpm | 0.4 | 0.65 | 0.8 | 0.9 | 0.9 | 1 | 1 | |
| Copper pipe | Type L | 3/8“ | 3/8“ | 3/8“ | 1/2“ | 1/2“ | 1/2“ | 1/2“ | |
| **Low-flow** | | | | | | | | | |
| No. of tubes | | 30 | 36 | 42 | 48 | 54 | 60 | 66 | 72 |
| Flow rate | gpm | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.65 | 0.65 | 0.65 |
| Copper pipe | Type L | 3/8“ | 3/8“ | 3/8“ | 3/8“ | 3/8“ | 3/8“ | 3/8“ | 3/8“ |
| No. of tubes | | 78 | | | | | | | |
| Flow rate | gpm | 0.8 | | | | | | | |
| Copper pipe | Type L | 3/8“ | | | | | | | |

for series connection of CPC 6/12 XL INOX collectors and a pump with a max head 20 ft.

**High-flow**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. of tubes | | 12 | 18 | 24 | 30 | | |
| Flow rate | gpm | 0.5 | 0.8 | 0.9 | 1 | | |
| Copper pipe | Type L | 3/8“ | 1/2“ | 1/2“ | 1/2“ | | |
| **Low-flow** | | | | | | | |
| No. of tubes | | 24 | 30 | 36 | 42 | 48 | 54 |
| Flow rate | gpm | 0.4 | 0.4 | 0.5 | 0.5 | 0.65 | 0.65 |
| Copper pipe | Type L | 3/8“ | 3/8“ | 3/8“ | 3/8“ | 3/8“ | 3/8“ |
| No. of tubes | | 60 | | | | | |
| Flow rate | gpm | 0.8 | | | | | |
| Copper pipe | Type L | 3/8“ | | | | | |

The pipe diameter dimensions refer to a max. total pipe length of 2 x 65 ft of copper piping and an average pressure loss of the heat exchanger in the storage tank.

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

## 10. Dimensioning the expansion tank

To calculate the size of an expansion tank you must know the temperature related volume expansion of the fluid and the steam volume.

The minimum required size for an expansion tank is calculated by the following formula:

$$V_{tank} = \left(V_{exp} + V_{inital}\right) \cdot \frac{p_{safe} + 14.5}{p_{safe} - p_{inital}}$$

**Expansion volume $V_{exp}$:**
The expansion volume is the sum of the steam volume during stagnation of the system and the volume change of the fluid due to the increase of temperature.

$$V_{exp} = V_{coll} + V_{vapor} + e \cdot V_{sys}$$

- $V_{coll}$ = collector content
  The internal volume of the collector is completely filled with steam during stagnation.
- $V_{vapor}$ = content of the solar piping that is filled with steam during stagnation
  Pipes above or at the same height as the collector manifold (or the lowest manifold if there are several collectors above each other) can be filled with vapor if the solar system comes to a standstill. Thus, the content of the affected pipes must be included in the vapor volume.
- e = expansion coefficient of the solar fluid
  The expansion coefficient is 0.07 for water at a filling temperature of 50°F and a max. temperature (average temperature within the solar loop just before stagnation occurs) of 265°F.
  Ask the manufacturer of the solar fluid for the fluid and mixture specific expansion coefficient.
- $V_{sys}$ = total solar loop content consisting of the volumes of the collectors, the solar piping and the heat exchanger.

**Initial volume $V_{inital}$:**
The initial volume avoids negative pressure in the system, in case the average solar loop temperature drops bellow the initial filling temperature. It's 0.5% of the total solar loop volume $V_{sys,}$ but at least 1 gal. That means that for total volumes up to 200 gal the initial volume is always 1 gal.

**Initial pressure $p_{inital}$:**
The initial pressure $p_{inital}$ should be at least 4 psi higher than the pressure at the highest point of the system. Thus it is ensured that no air caused by a negative pressure can be sucked into the system.
Since the expansion tank is located below the collector field you have to take the static pressure into account. The static pressure is defined by the product of the difference in height between the collectors and the expansion tank $h_{sys}$ and the specific pressure difference of 0.45 psi/ft
However the initial pressure must be at least 10 psi.

$$p_{inital} = 4\,psi + h_{sys} \cdot 0.45\,psi/ft \geq 10\,psi$$

**Safety pressure $p_{safe}$:**
The max pressure should not exceed 90% of the pressure rating of the pressure relief valve.

$$p_{safe} = 0.9 \cdot PRVrating$$

**Pre-charge pressure $p_{pre}$:**

The pre-charge pressure $p_{pre}$ of the expansion tank must be 2 psi bellow the initial pressure $p_{inital}$.

$$p_{pre} = p_{inital} - 4\ psi$$

## Solar component contents

### L-copper

| Size | 3/8” | 1/2” | 3/4” | 1” |
|---|---|---|---|---|
| Content (gal/ft) | 0.00753 | 0.0121 | 0.0251 | 0.0429 |

### Collectors

| Model | CPC 6 OEM | CPC 12 OEM | CPC 18 OEM | CPC 6 INOX | CPC 12 INOX |
|---|---|---|---|---|---|
| Content (gal) | 0.21 | 0.42 | 0.63 | 0.24 | 0.48 |
| Model | CPC 18 INOX | CPC6XL INOX | CPC12XL INOX | | |
| Content (gal) | 0.69 | 0.3 | 0.6 | | |

**Example:**

Based on: 2 CPC 12 OEM / INOX collectors
Static height $h_{stat}$: 25 ft
Pipe work: 1/2“ L-copper, 2 x 50 ft
Pressure relief valve rating: 87 psi
Content of the heat exchanger and the solar pump station: e.g. 1.5 gal
Pipes in the vapor zone: 1/2“ L-copper 2 x 5 ft

The individual capacities of the system components can be ascertained from the respective data tables in the product description. The content of the collectors and for various sizes of L-copper pipe are specified in the tables above.

$$V_{sys} = 1.5\,gal + (100ft \cdot 0.0121gal/ft) + (2 \cdot 0.42gal) = 3.55gal$$

Pipes above or at the same height as the collector manifold (or the lowest manifold if there are several collectors above each other) can be filled with vapor if the solar system comes to a standstill. Thus, the contents of the affected pipes are included in the vapor volume $V_{vapor}$.

$$V_{vapor} = 2 \cdot 5ft \cdot 0.0121gal/ft = 0.12gal$$

**Calculation of the acceptance volume:**

The acceptance volume $V_{accept}$ of the expansion tank must be larger than expansion volume $V_{exp}$ of the system.

$$V_{accept} = V_{exp} + V_{inital} = (2 \cdot 0.42gal) + 0.12gal + (0.07 \cdot 3.55gal) + 1gal = 2.21gal$$

$$V_{inital} = 0.005 \cdot 4.44\,gal = 0.02gal, \text{but } V_{sys} \leq 200gal \Rightarrow V_{inital} = 1gal$$

$$p_{inital} = 4\,psi + 25\,ft \cdot 0.45psi/ft = 15psi$$

$$p_{safe} = 0.9 \cdot 87psi = 78psi$$

**Calculation of the total tank volume:**

$$V_{tank} = (1.21gal + 1gal) \cdot \frac{78psi + 14.5psi}{78psi - 15psi} = 3.25gal$$

**Calculation of the pre-charge pressure:**

$$p_{pre} = 15\,psi - 4\,psi = 11psi$$

# 11. Connection options

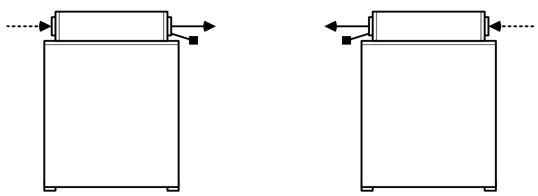
**Legend**

Corrugated hose return (cold)

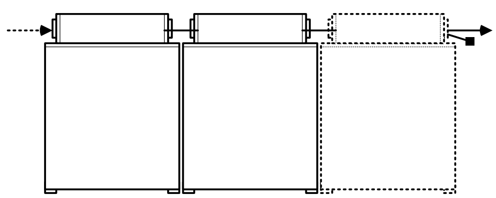
Corrugated hose supply (hot) with collector sensor

**! CAUTION** Sensor must be located on the supply side (hot outlet)

## Connection options for 1 collector

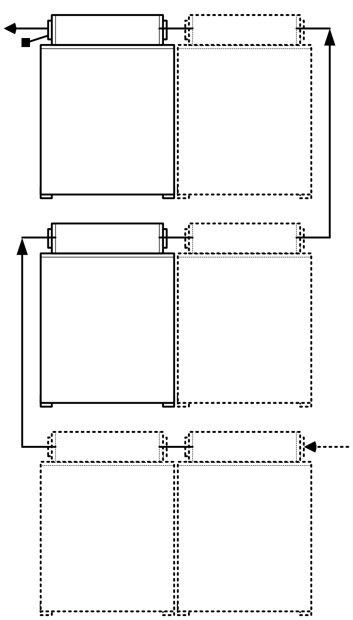


## Connection options for 2 or more adjacent collectors

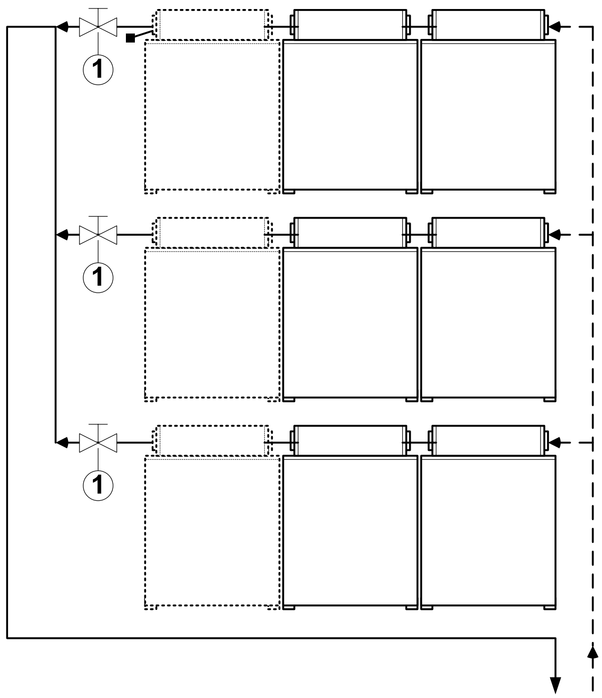


Reverse connection of the flow direction is possible

## Connection options for 2 or more collectors above one another



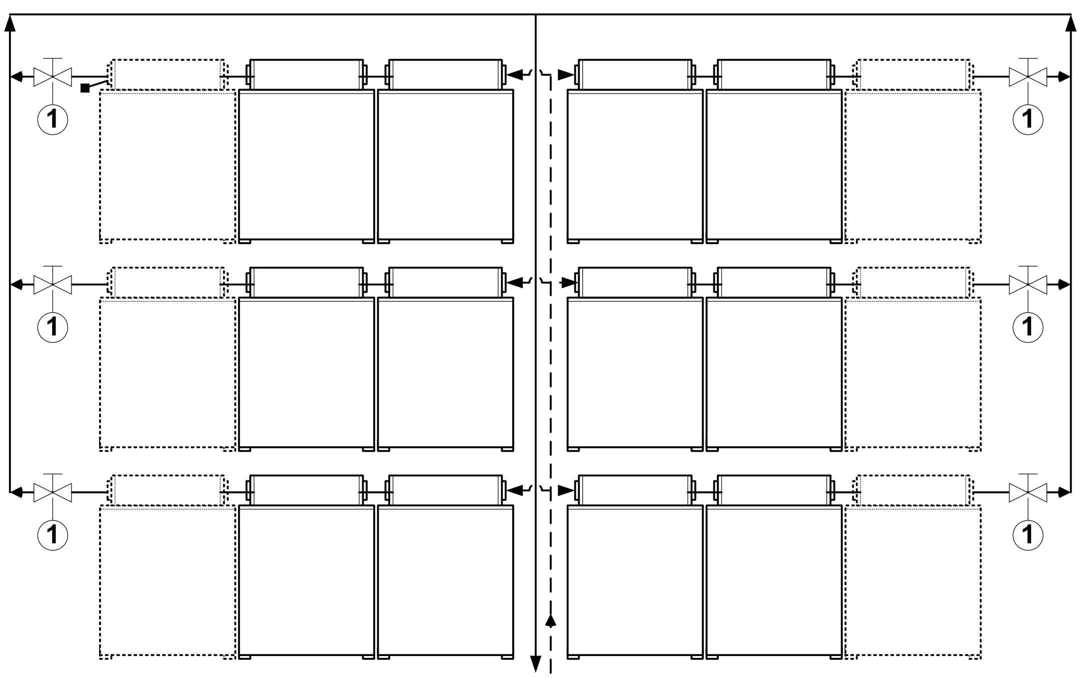
### Connection options for 1 or 2 adjacent collectors and 2 or 3 collectors above one another




## NOTICE

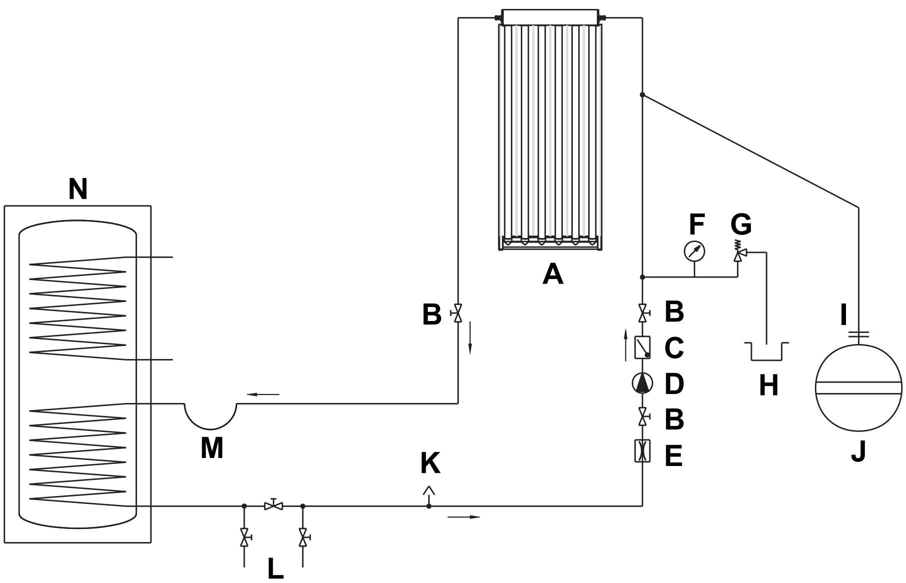
**In order to facilitate bleeding and equalize the collector arrays, one shut-off ball valve ① should be built into each outlet.**

### Connection options for 1 or 2 adjacent series connections and multiple series connections above one another



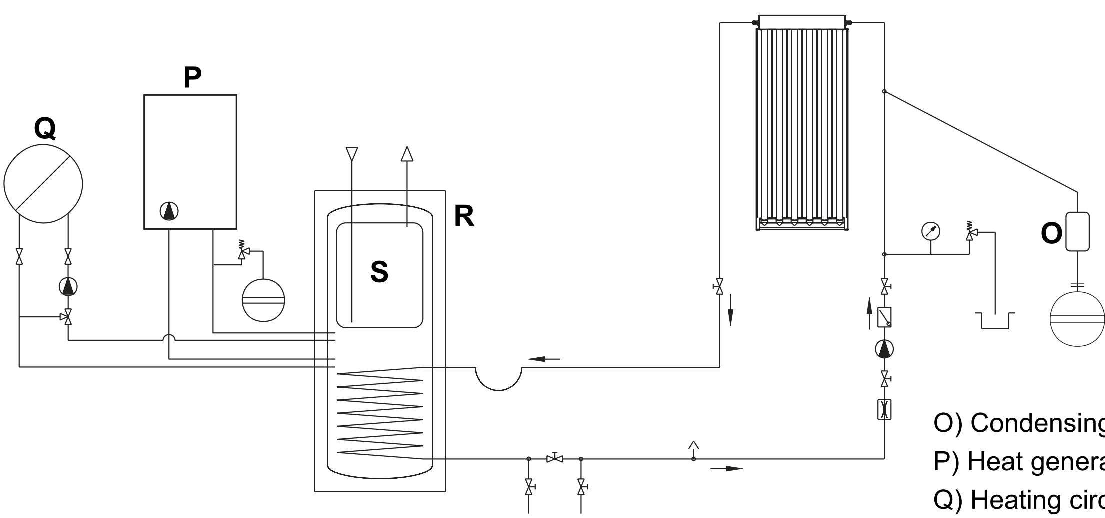
## 12. Sample system

### 12.1 Sample system for solar water heating




A) Collector
B) Gate valve
C) Check valve
D) Solar pump
E) Flow setter
F) Pressure Gauge
G) Pressure relief valve
H) Drain tank
I) Stop valve
J) Expansion tank
K) De-aerator
L) Filling fitting
M) Thermosiphon to prevent micro-circulation in the pipeline
N) Hot water storage tank

### 12.2 Sample system for solar water heating with heating support



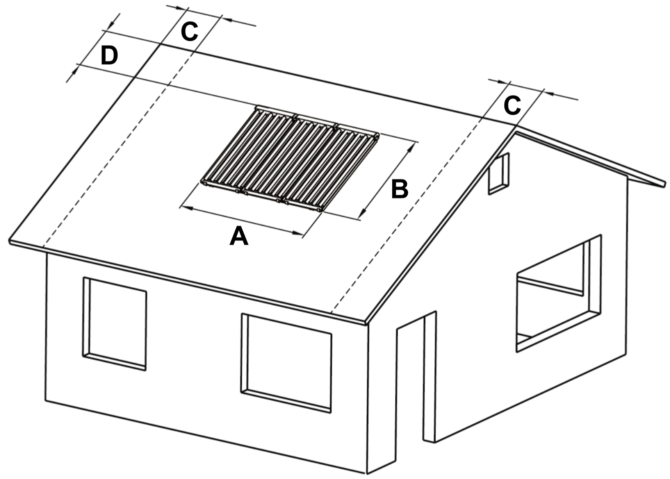

O) Condensing tank
P) Heat generator
Q) Heating circuit
R) Buffer storage tank with integrated hot water storage tank
S)

**NOTICE**

For solar energy systems with heating support, we recommend that you install a condensing tank. Solar energy systems which are too large for the six summer months often stagnate, i.e. the membrane of the expansion tank is protected by the cold primary content of the primary tank.

## 13. Installation instructions

### 13.1 Space requirements for pitched roofs




**Dim. A**

| | CPC OEM / INOX | | | CPC XL INOX | |
|---|---|---|---|---|---|
| | 6 | 12 | 18 | 6 | 12 |
| **Number of adjacent collectors** | **[in]** | **[in]** | **[in]** | **[in]** | **[in]** |
| 1 | 27 1/2 | 55 1/8 | 82 5/8 | 27 1/2 | 55 1/8 |
| 2 | 55 1/8 | 110 1/4 | 165 3/8 | 55 1/8 | 110 1/4 |
| 3 | 84 5/8 | 165 3/8 | 248 | 84 5/8 | 165 3/8 |
| 4 | 112 1/4 | 220 1/2 | 328 3/4 | 112 1/4 | 220 1/2 |
| 5 | 139 3/4 | 275 5/8 | 411 1/2 | 139 3/4 | 275 5/8 |
| 6 | 167 3/8 | 330 3/4 | 494 | 167 3/8 | 330 3/4 |

**Dim. B**

| | CPC 6/12/18 OEM/INOX | CPC 6/12 XL INOX |
|---|---|---|
| **Number of collectors above on another** | **[in]** | **[in]** |
| 1 | 64 1/2 | 81 1/8 |
| 2 | 135 | 169 |
| 3 | 206 | 256 |

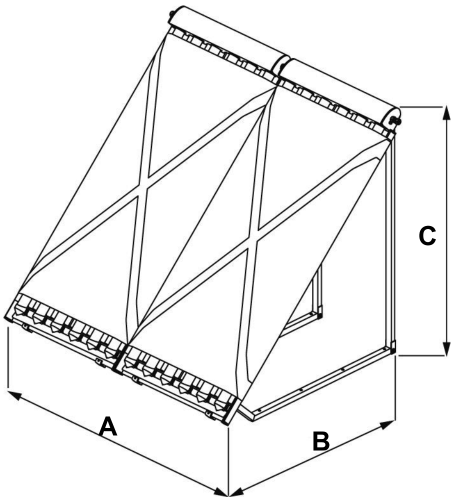
**Dim. C**
corresponds to the roof overhang including the thickness of the end wall. The adjoining 12 in distance from the collector is required for hydraulic connection below the roof.

**Dim. D**
Observe the local building code.

### 13.2 Space requirements for pitched roofs

The CPC OEM/INOX and XL INOX evacuated tube collector can be installed on flat roofs, on slightly sloping roofs (up to 20°) or in gardens. The spacing between the angle frames must also be adhered to on sloping roofs. It may be necessary to add auxiliary rafters. If applicable, a stress analysis is to be carried out on the substructure.

**Space requirements for a single-row collector array:**



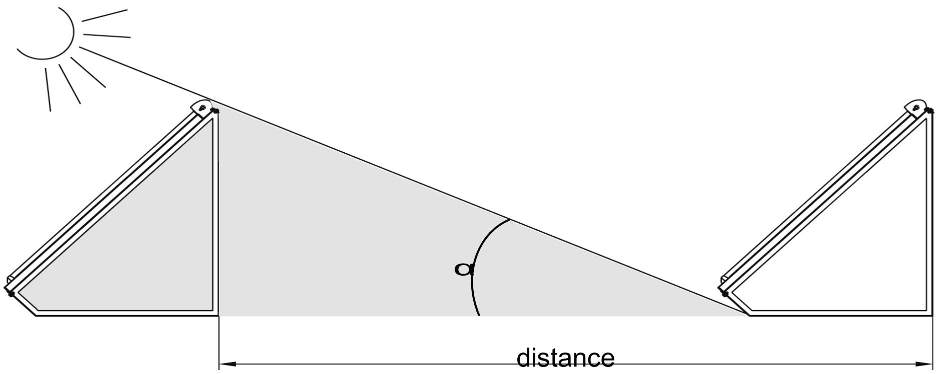

**Dimension A according to the number of collectors**

| | CPC OEM / INOX | | | CPC XL INOX | |
|---|---|---|---|---|---|
| | 6 | 12 | 18 | 6 | 12 |
| **Number of collectors** | [in] | [in] | [in] | [in] | [in] |
| 1 | 27 1/2 | 55 1/8 | 82 5/8 | 27 1/2 | 55 1/8 |
| 2 | 55 1/8 | 110 1/4 | 165 3/8 | 55 1/8 | 110 1/4 |
| 3 | 84 5/8 | 165 3/8 | 248 | 84 5/8 | 165 3/8 |
| 4 | 112 1/4 | 220 1/2 | 328 3/4 | 112 1/4 | 220 1/2 |
| 5 | 139 3/4 | 275 5/8 | 411 1/2 | 139 3/4 | 275 5/8 |
| 6 | 167 3/8 | 330 3/4 | 494 | 167 3/8 | 330 3/4 |

**Dimension B and C according to installation angle**

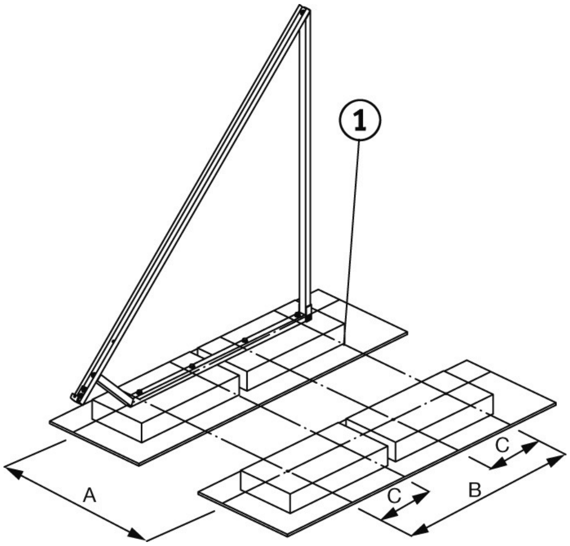
| | CPC 6/12/18 OEM/INOX | CPC 6/12 XL INOX |
|---|---|---|
| **Installation angle** | [in] | [in] |
| Dim. B 30° | 56 3/4 | 71 5/8 |
| Dim. B 45° | 47 1/4 | 59 |
| Dim. C 30° | 41 | 48 7/8 |
| Dim: C 45° | 53 1/8 | 64 1/4 |

### Distance between the collectors, for double-row or multi-row collector arrays




| | | Distance [ft] a= 30° | | Distance [ft] a= 45° | |
|---|---|---|---|---|---|
| **Type of use** | **Main usage period** | **CPC 6/ 12/ 18 OEM / INOX** | **CPC 6/ 12 XL INOX** | **CPC 6/ 12/ 18 OEM / INOX** | **CPC 6/ 12 XL INOX** |
| **System location between 50° and 40° northern latitude:** | | | | | |
| DHW | May to August | 7 | 8.5 | not recommended | not recommended |
| DHW | April to September | not recommended | not recommended | 8.75 | 10.5 |
| DHW and heating | March to October | not recommended | not recommended | 10.5 | 12.75 |
| DHW and heating | All year | not recommended | not recommended | 16 | 18 |
| **System location between 40° and 30° northern latitude:** | | | | | |
| DHW | May to August | 6 | 7.5 | not recommended | not recommended |
| DHW | April to September | 7.25 | 9 | not recommended | not recommended |
| DHW and heating | March to October | 8.75 | 10.5 | 8.25 | 11.25 |
| DHW and heating | All year | 10.25 | 12.5 | 11.75 | 14.25 |
| **System location between 30° and 20° northern latitude:** | | | | | |
| DHW | May to August | 5.5 | 6.75 | not recommended | not recommended |
| DHW | April to September | 6.4 | 7.75 | not recommended | not recommended |
| DHW and heating | March to October | 7.5 | 9 | not recommended | not recommended |
| DHW and heating | All year | 8.5 | 10.5 | not recommended | not recommended |

### 13.3 Weight and positioning of the concrete blocks




**CAUTION**

**Flat roofs covered with gravel :**
**clear gravel from the area where the concrete slabs are to be placed.**
**Flat roofs with plastic roof sheeting:**
**place the concrete slabs on protective overlays (building protection mats, pos.1).**

Arrange the concrete slabs as shown in the figure to the left.

| | CPC OEM / INOX | | | CPC XL INOX | |
|---|---|---|---|---|---|
| | **6** | **12** | **18** | **6** | **12** |
| Dim. A (in) | 22 | 43 | 55 | 22 | 43 |
| Dim. B 30° (in) | 41.34 | | | | |
| Dim. B 45° (in) | 31.89 | | | | |
| Dim. C 30° (in) | 13.78 | | | | |
| Dim. C 45° (in) | 10.63 | | | | |

**Building height of up to 8 m**

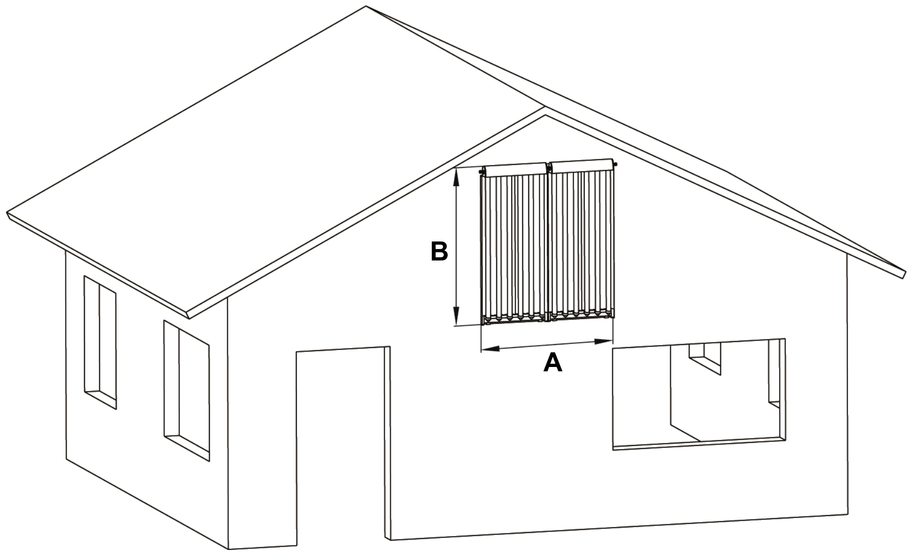
| Collector type | Number of the angle frames | Angle of the frame | Required weight of the front concrete slab | Required weight of the rear concrete slab |
|---|---|---|---|---|
| CPC 6/12/18 OEM/INOX | 2 | 30° | 75 kg | 75 kg |
| CPC 6/12 XL INOX | 2 | 30° | 75 kg | 75 kg |
| CPC 6/12/18 OEM/INOX | 2 | 45° | 75 kg | 75 kg |
| CPC 6/12 XL INOX | 2 | 45° | 75 kg | 75 kg |

**Building height of up to 20 m**

| Collector type | Number of the angle frames | Angle of the frame | Required weight of the front concrete slab | Required weight of the rear concrete slab |
|---|---|---|---|---|
| CPC 6/12/18 OEM/INOX | 2 | 30° | 112 kg | 112 kg |
| CPC 6/12 XL INOX | 2 | 30° | 112 kg | 112 kg |
| CPC 6/12/18 OEM/INOX | 2 | 45° | 112 kg | 112 kg |
| CPC 6/12 XL INOX | 2 | 45° | 112 kg | 112 kg |

### 13.4 Space requirement for vertical facade installation

The CPC INOX can also be installed vertically on a wall by means of the retaining clamps for pan tiles. A specific clearance of the piping length must be maintained beneath the array.




**Dimension A according to the number of collectors**

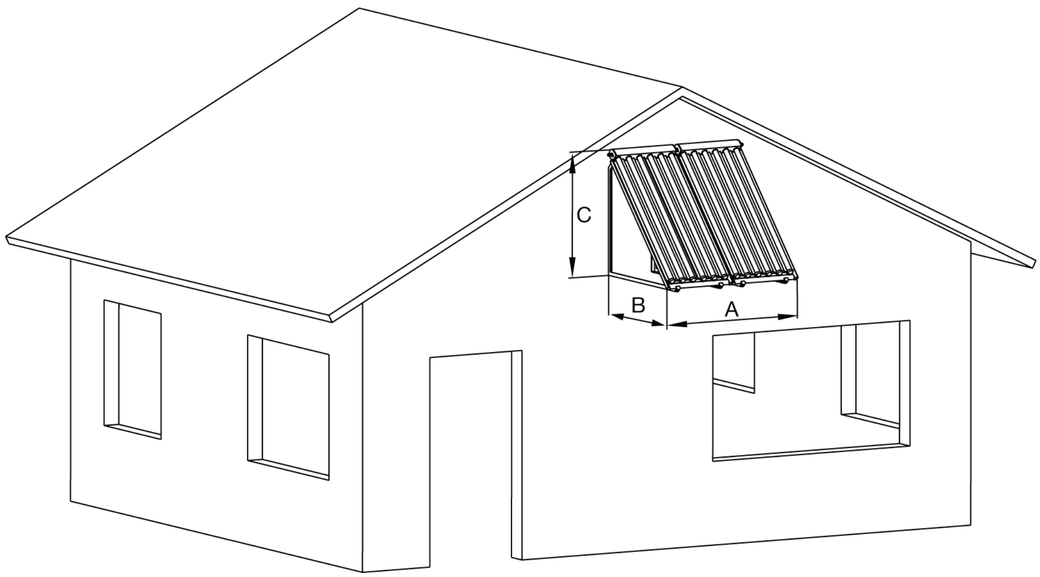
| | CPC OEM / INOX | | | CPC XL INOX | |
|---|---|---|---|---|---|
| | 6 | 12 | 18 | 6 | 12 |
| Number of collectors | [in] | [in] | [in] | [in] | [in] |
| 1 | 27 1/2 | 55 1/8 | 82 5/8 | 27 1/2 | 55 1/8 |
| 2 | 55 1/8 | 110 1/4 | 165 3/8 | 55 1/8 | 110 1/4 |
| 3 | 84 5/8 | 165 3/8 | 248 | 84 5/8 | 165 3/8 |
| 4 | 112 1/4 | 220 1/2 | 328 3/4 | 112 1/4 | 220 1/2 |
| 5 | 139 3/4 | 275 5/8 | 411 1/2 | 139 3/4 | 275 5/8 |
| 6 | 167 3/8 | 330 3/4 | 494 | 167 3/8 | 330 3/4 |

**Dim. B**

| | CPC 6/12/18 OEM/INOX | CPC 6/12 XL INOX |
|---|---|---|
| Number of collectors above on another | [in] | [in] |
| 1 | 64 1/2 | 81 1/8 |
| 2 | 135 | 169 |
| 3 | 206 | 256 |

### 13.5 Space requirement for facade installation with 45° or 60° angle frames

The CPC OEM/INOX and CPC XL INOX can be installed on a wall by means of the angle frames for 45° or 60° slopes. For a 60° slope, 3 feet space must be kept free beneath the collector.




**Space requirement for a single-row collector array:**

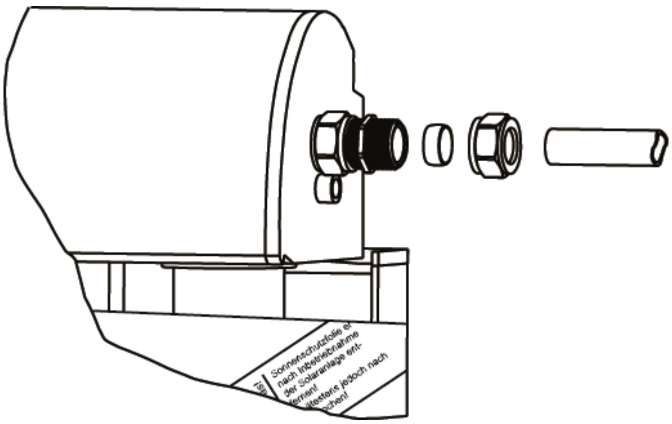
**Dimension A according to the number of collectors**

| | CPC OEM / INOX | | | CPC XL INOX | |
|---|---|---|---|---|---|
| | 6 | 12 | 18 | 6 | 12 |
| **Number of collectors** | [in] | [in] | [in] | [in] | [in] |
| 1 | 27 1/2 | 55 1/8 | 82 5/8 | 27 1/2 | 55 1/8 |
| 2 | 55 1/8 | 110 1/4 | 165 3/8 | 55 1/8 | 110 1/4 |
| 3 | 84 5/8 | 165 3/8 | 248 | 84 5/8 | 165 3/8 |
| 4 | 112 1/4 | 220 1/2 | 328 3/4 | 112 1/4 | 220 1/2 |
| 5 | 139 3/4 | 275 5/8 | 411 1/2 | 139 3/4 | 275 5/8 |
| 6 | 167 3/8 | 330 3/4 | 494 | 167 3/8 | 330 3/4 |

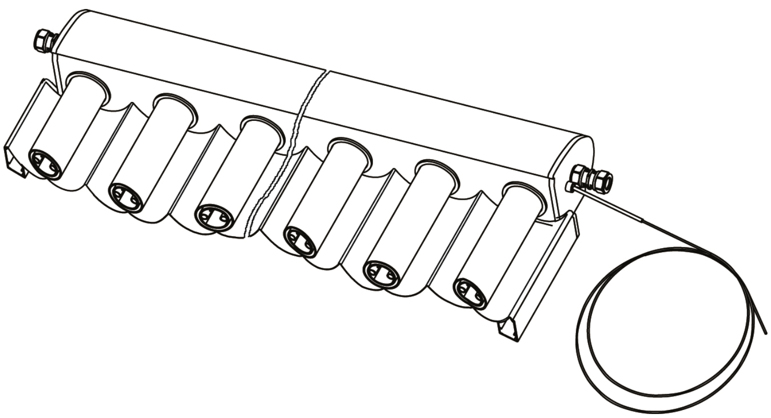
**Dimension B and C according to installation angle**

| | CPC 6/12/18 OEM/INOX | CPC 6/12 XL INOX |
|---|---|---|
| **Installation angle** | [in] | [in] |
| Dim. B 30° | 53 1/8 | 64 1/8 |
| Dim. B 45° | 39 3/4 | 47 1/4 |
| Dim. C 30° | 47 1/4 | 59 |
| Dim: C 45° | 58 1/4 | 72 1/2 |

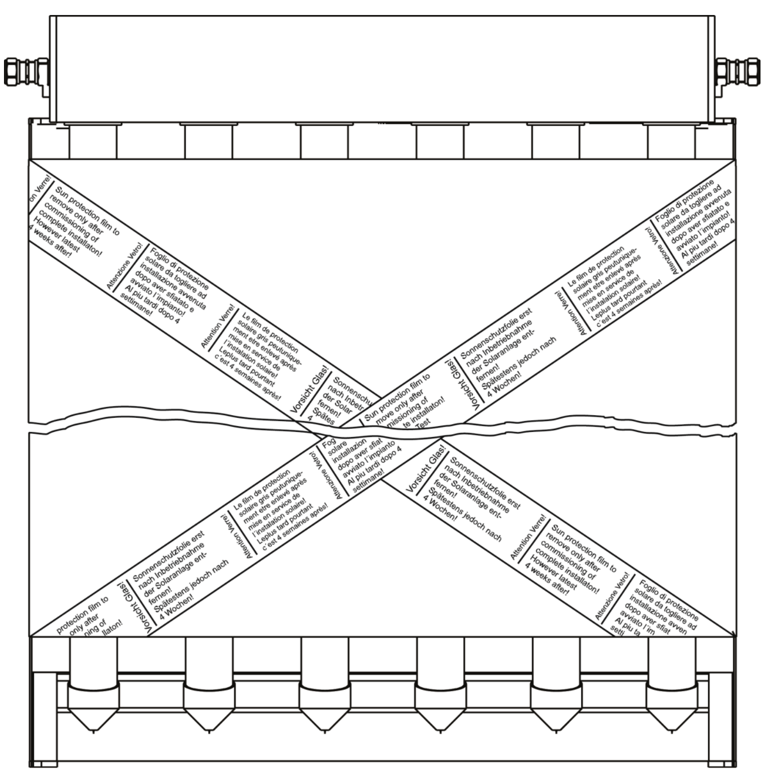
### 13.6 Specifications



The flow or return pipe can be connected to the collector on the left or on the right, as selected.
The connection is made using compression ring fittings. A 15 mm fitting is pre-assembled. Adapter fittings to 1/2” or 3/8” L-copper are available.



One integrated sensor immersion sleeve is available on each collector connection side. The sensor is always located on the hot flow side.



Upon delivery, the collector is covered by a sun protection film. This facilitates trouble-free commissioning of the solar energy system even in strong sunlight. It prevents the heat transfer medium being vaporized, rendering commissioning impossible. Remove the sun protection sheet after commissioning.

**NOTICE**

**The collector must be commissioned 4 weeks after installation. The sun protection film will become brittle after 4 weeks of exposure.**