

Installation and Operation Manual for a Solar System with KPS10 ALP Collectors



CE

EN
v. 1.0

Regulus[®]

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GENERAL INSTALLATION AND OPERATION INSTRUCTIONS

Collector description

REGULUS Flat Plate Solar Collectors are designed for solar domestic hot water heating, backup and pool heating. Solar radiation penetrates the glass and is intercepted by an efficient absorption layer applied on a serpentine-shaped copper absorber. The heat is then transferred into heat carrier fluid. The absorber is sealed in a compact frame with high quality thermal insulation. The collectors are designed for all year round operation, that's why they work in a separate primary circuit filled with antifreeze heat carrier. The collectors are **not intended** for direct water heating.

Transport and handling

Collectors shall be transported in their original packing, in upright position (standing on their shorter side) or lying horizontal with glass upwards, stack of max. 6 pieces of KPS10.

Installation

The installation must be done by a skilled worker or a specialized company. During installation and before commissioning, it is necessary to cover collectors in order to avoid overheating and possible burns caused by the hot surfaces. If the collector shall be set on a roof, appropriate safety rules must be observed.

Collector placing

The glass absorption surface should be orientated to South, with deviations not over 45° (Southwest or Southeast). For all year round operation the right inclination angle is 40° - 50°, for summer operation smaller inclination is better (30°). The collector can be positioned also vertically (inclination angle of 90°, e.g. onto an outer wall), that is the best for winter operation. The inclination angle must not be less than 20°.

It is recommended to install solar collectors close to the roof ridge due to a snow load in the winter.

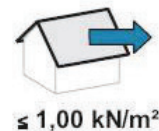
Lightning protection

Lightning protection is obligatory for solar systems. When installed on a roof, collectors must be wired to lightning protection equipment. Local standards shall be observed.

Max. permissible wind and snow load $\leq 0,8 \text{ kN/m}^2$.

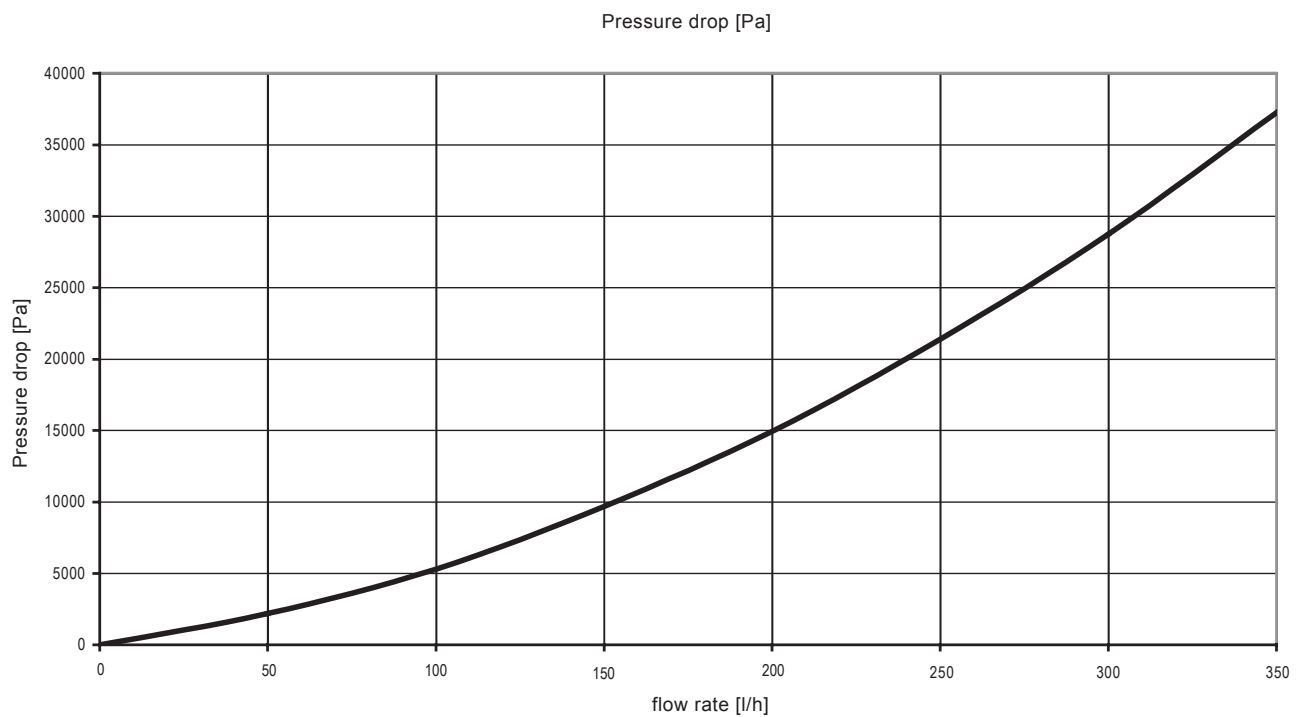


Max. permissible wind load – negative load $\leq 1,0 \text{ kN/m}^2$.




Collector Technical Data


Model	KPS10 - ALP
Dimensions W x L x H [mm]	1144 × 2044 × 80
Collector surface [m ²]	2.33
Connection dimensions	2 × Ø 12 mm
Absorber	copper / serpentine type
Absorber surface	Sunselect
Insulation thickness [mm]	40
Max. working pressure [bar]	6
Fluid volume [l]	1.6
Weight [kg]	44
Glass [mm]	4 - solar prismatic
Recommended flow rate [l/h]	60 - 120




1 Delivery of Mounting System

Handle with care, transport damage should be claimed immediately.

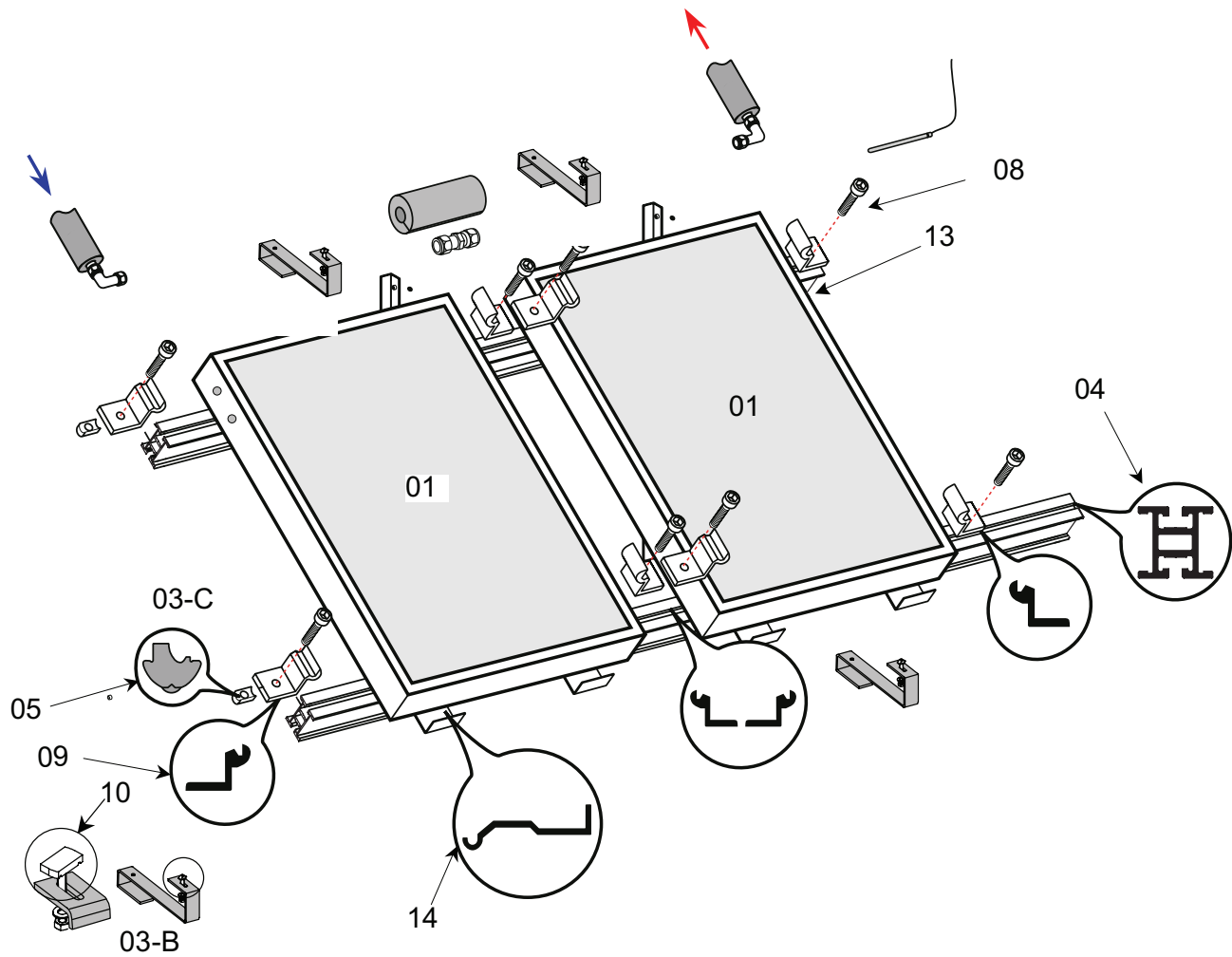
Mounting kits for fixing a collector in place		Code
	Connection kit for a KPS collector array (1/2" M straight inlet and 1/2" M straight outlet)	7229
	Roof fixing and interconnecting kit for one KPS10 collector *[for 4 anchors or 2 struts+1 wind brace]	8284
	Roof fixing and interconnecting kit for two KPS10 collectors *[for 4 anchors or 2 struts+1 wind brace]	8285
	Roof fixing and interconnecting kit for three KPS10 collectors *[for 6 anchors or 3 struts+1 wind brace]	8286
	Roof fixing and interconnecting kit for four KPS10 collectors *[for 8 anchors or 4 struts+1 wind brace]	8287
<p>* Roof fixing and interconnecting kits are necessary to create a hydraulically connected collector array fixed to 2 mounting rails. The kits contain interconnecting fittings with insulation, two mounting rails, fastening material for mounting collectors onto the rails. They do not involve any roof anchors, struts, wind braces. These shall be selected from the following chart by the roof type and roofing material.</p>		

Struts and braces for flat roof installations		Code
	Triangular strut for support structures - flat roof	6859
	Wind brace	6860

Roof anchors for different types of roofing		Code
	Aluminum anchor for slate or shingle roofs	6920
	Aluminum anchor for pantiles - adjustable height	7013
	Anchor for pantiles - hot-dip galvanized steel	7929
	Aluminum anchor for pantiles - rafter mounted	6932
	Stainless-steel anchor for pantiles	6857
	Bolt for fixing rails onto a roof	7320

2 Sloping Roof Mount

2.1 Overview

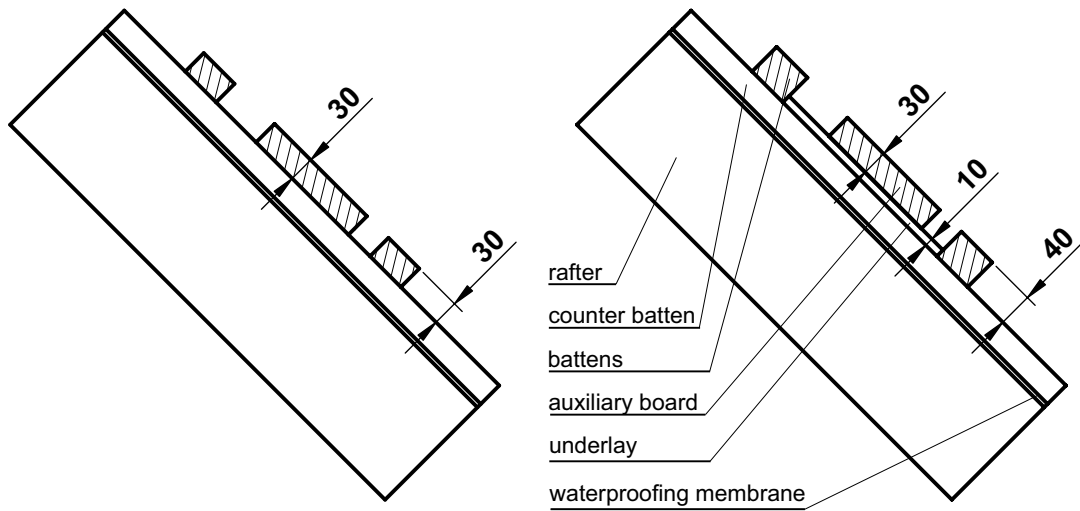


Pic. 1: Collector array and roof anchors

Pos.	Item	No. of collectors (kit code)				Code
		1	2	3	4	
		8284	8285	8286	8287	Item code
01	Flat plate collector					8258
03-B 10	Roof anchor with M8 bolt/special head for rails					6857 or other, depending on roofing type
13	Interconnecting pipes					
Fixing and interconnecting sets						
04	H profile base rail, aluminum	2 × 1.2 m	2 × 2.39 m	2 × 3.58 m	2 × 4.77 m	6949
05	M8 nut for the base rail	4 pcs	8 pcs	12 pcs	16 pcs	6925
08	M8x18 stainless-steel bolt (allen head) DIN 912/A2	4 pcs	8 pcs	12 pcs	16 pcs	8294
09	Retaining side bracket for KPS10	4 pcs	8 pcs	12 pcs	16 pcs	8278
14	Retaining bracket for KPS10 collector bottom	2 pcs	4 pcs	6 pcs	8 pcs	8279
	Threaded fittings 12-12 for KPS, straight	-	1	2	3	7630
	Self-adhesive insulation, 18 mm diam., 19 mm thick	-	0.07 m	0.14 m	0.21 m	7189

2.2 Roof anchor installation for sloping roofs

Pay attention to situations when battens are thicker than the auxiliary board (30 mm). Then the auxiliary board shall be mounted on an underlay so that its total thickness equals to that of the battens (see pic.).

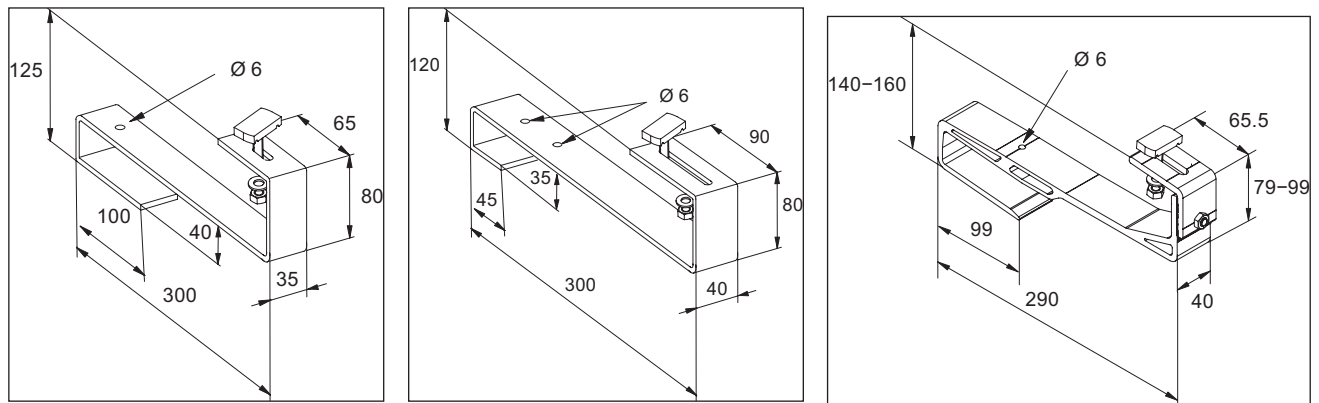


Pic. 2: Underlay to match thick battens

When installing anchors on a rafter, use an underlay as well depending on how thick the battens and counter battens are, so that the installed anchors do not hinder proper seating of tiles.

2.2.1 Installation with roof anchors and auxiliary boards

- for tile roofs, 3 cm thick additional auxiliary boards shall be mounted to the bottom side of the roof. Then hook the anchors onto the board and fix with a bolt.

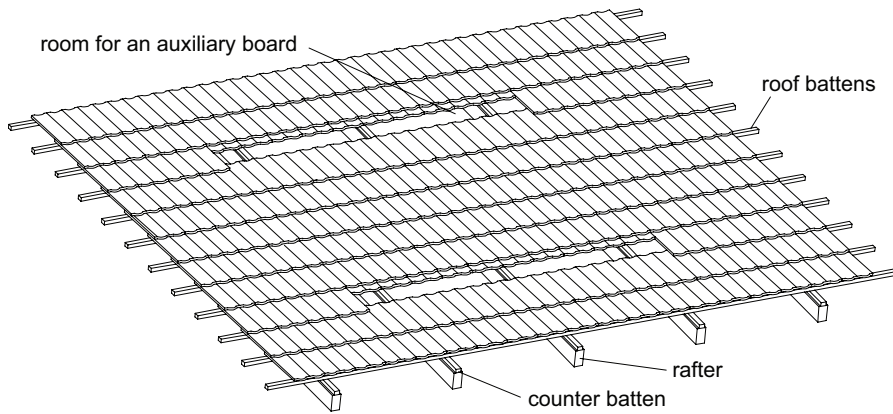


Pic. 3: Stainless-steel roof anchor

Hot-dipped steel roof anchor

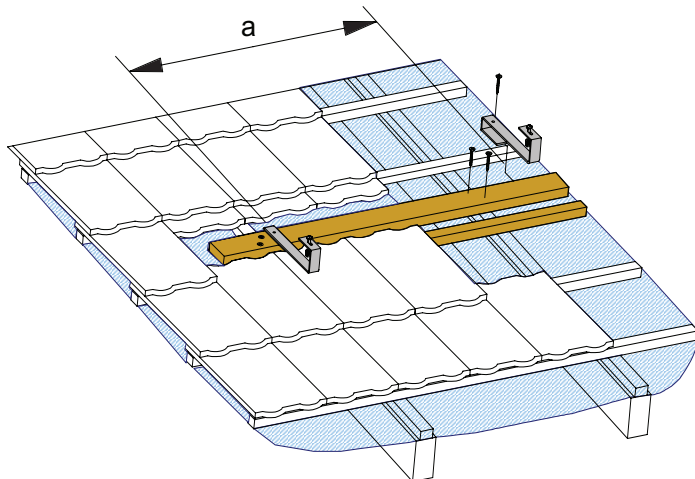
Aluminum roof anchor

- remove tiles in a line about as long as the auxiliary board. Usually it is sufficient to shift the tiles upwards.



Pic. 4: Remove roof tiles to fix the board

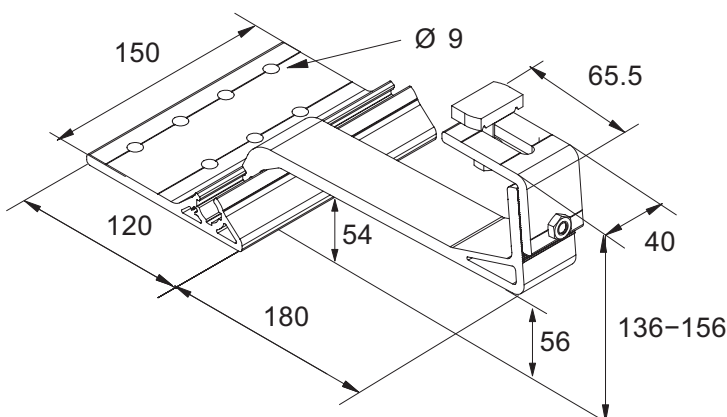
- screw the auxiliary boards so high that the roof anchor does not hinder placing the roof tile with the right overlap
- hang the roof anchor onto the auxiliary board in a place where it will not hinder the right tile positioning, and screw the roof anchor with stainless-steel bolts
- fix all the following roof anchors in the same way. Place the anchors about the presumed middle of the collector (distance *a*)



Pic. 5: Fixing an auxiliary board and roof anchors

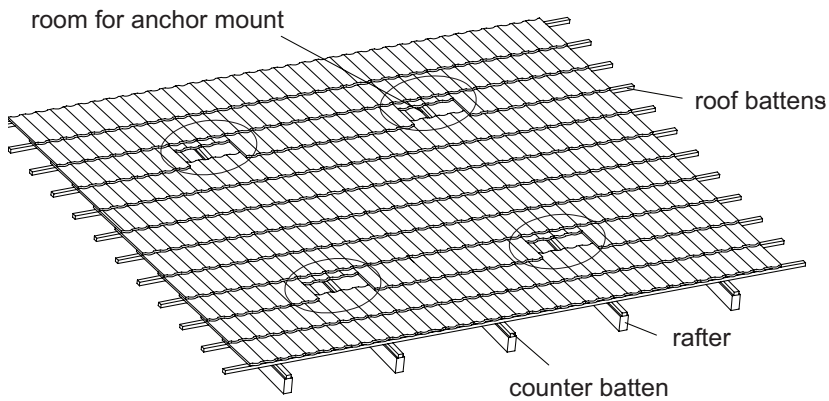
2.2.2 Installation with roof anchors and rafters

For tiled roofs, rafter anchors can be used. The anchor with a board is made of aluminum and enables horizontal shift of the anchor along the fixing board.



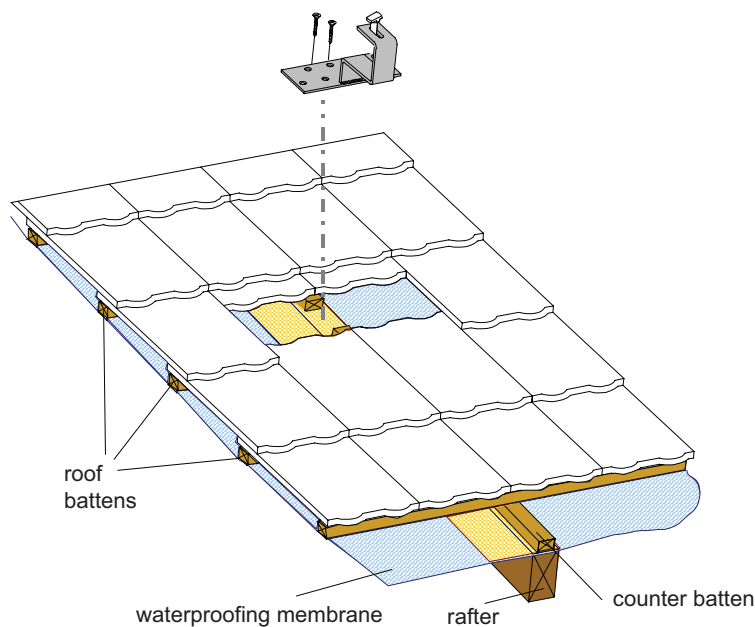
Pic. 6: Roof anchors for rafters

- remove roof tiles where the anchors shall be mounted



Pic. 7: Opening the room for anchor installation

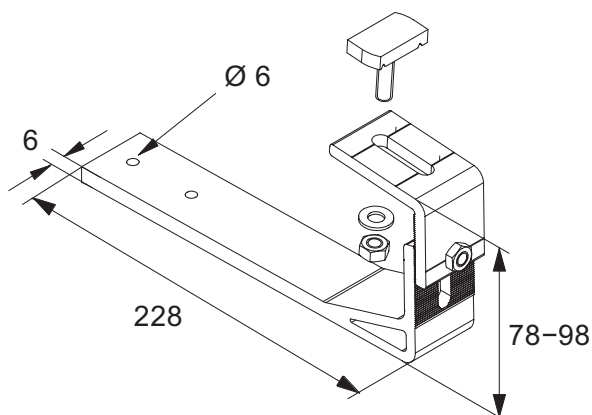
- cut the counter batten used for fixing the waterproofing membrane and if necessary, use an underlay depending on the desired anchor height



- screw a roof anchor to a rafter and shift it in the groove horizontally so that it does not hinder the right tile positioning
- fix all the following roof anchors in the same way. Place the anchors about the presumed middle of the collector

Pic. 8: A place for mounting a roof anchor on a rafter - detail

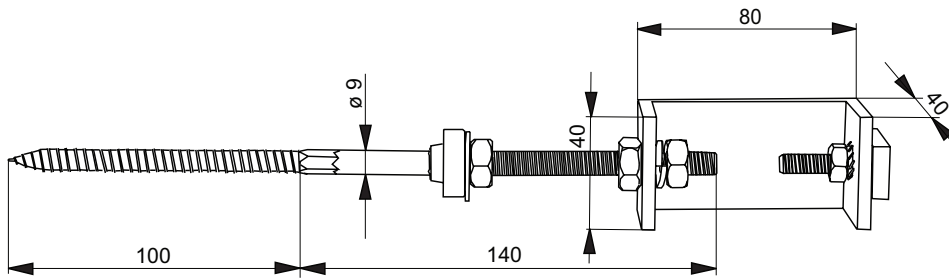
2.2.3 Installation with roof anchors for slate, shingle or metal roofs



- Simply lay the anchor onto the roof tiles in a place where the roof is supported with a strong roofing element (a beam or another support) and fix it with stainless-steel bolts. Cover the anchors with sheet metal to prevent water leakage or use another suitable method recommended by the roofing manufacturer.

Pic. 9: A roof anchor for slate, shingle or metal roof

2.2.4 Installation with bolts for fixing rails onto a roof

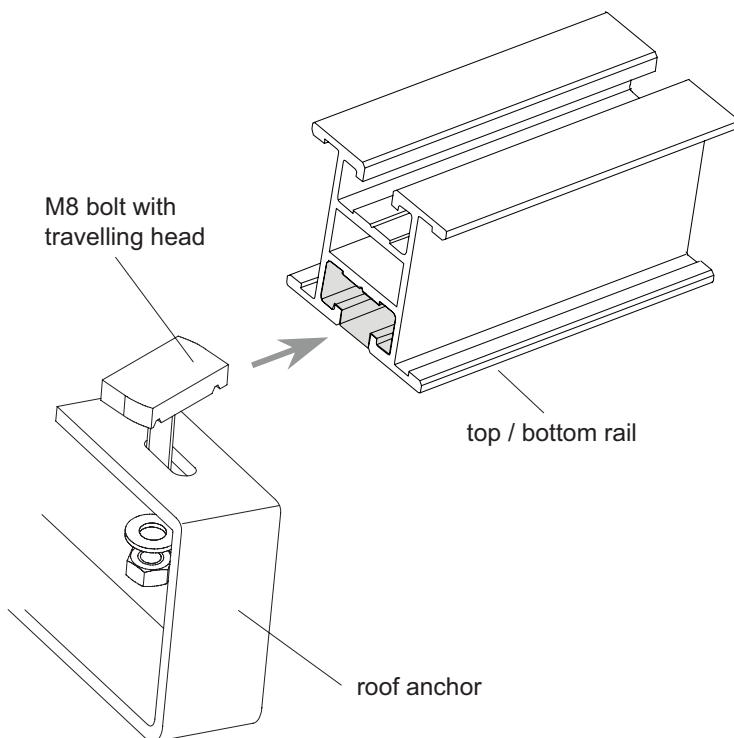


This method of installation is preferably used for roofs of bitumen corrugated sheets like Gutta or Onduline etc., or for corrugated eternit or metal sheets. The bolt shall be screwed into a rafter or another massive wooden roof element using

spanner No. 8. Pre-drilling 6 mm diam. holes is recommended. Holes should be always drilled in the crest of the roofing wave, not in its valley to avoid leakage. After screwing the bolt in, put on the rubber seal and using a washer and nut, seal the drilled hole. Then mount the U-shaped bracket on the bolt, between two nuts with a serrated washer. Then M8 bolt with floating head (for rails) shall be mounted into the other end of the bracket. First insert the floating head into the groove of the rail, and then tighten the bolt together with the rail to the U-shaped bracket using a nut and a serrated washer.

2.3 Mounting rails on roof anchors

• have ready two rails in the length required for the number and type of collectors to be installed. Align the travelling screw head (10) with the horizontal rail and shift the rail onto it, or shift the screws into the rail and fix to the anchors. Use serrated lock washers to fix the nuts.

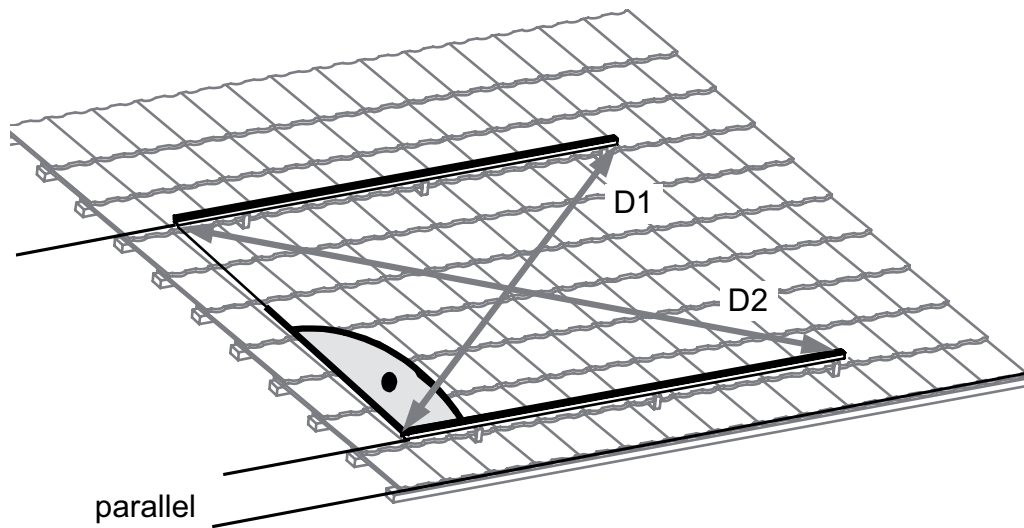


Pic. 10: Fixing the rail onto the roof anchors

- Align the rails so that they lie in parallel to roof tiles. The diagonal between the rails must be of the same length:

$$D1 = D2$$

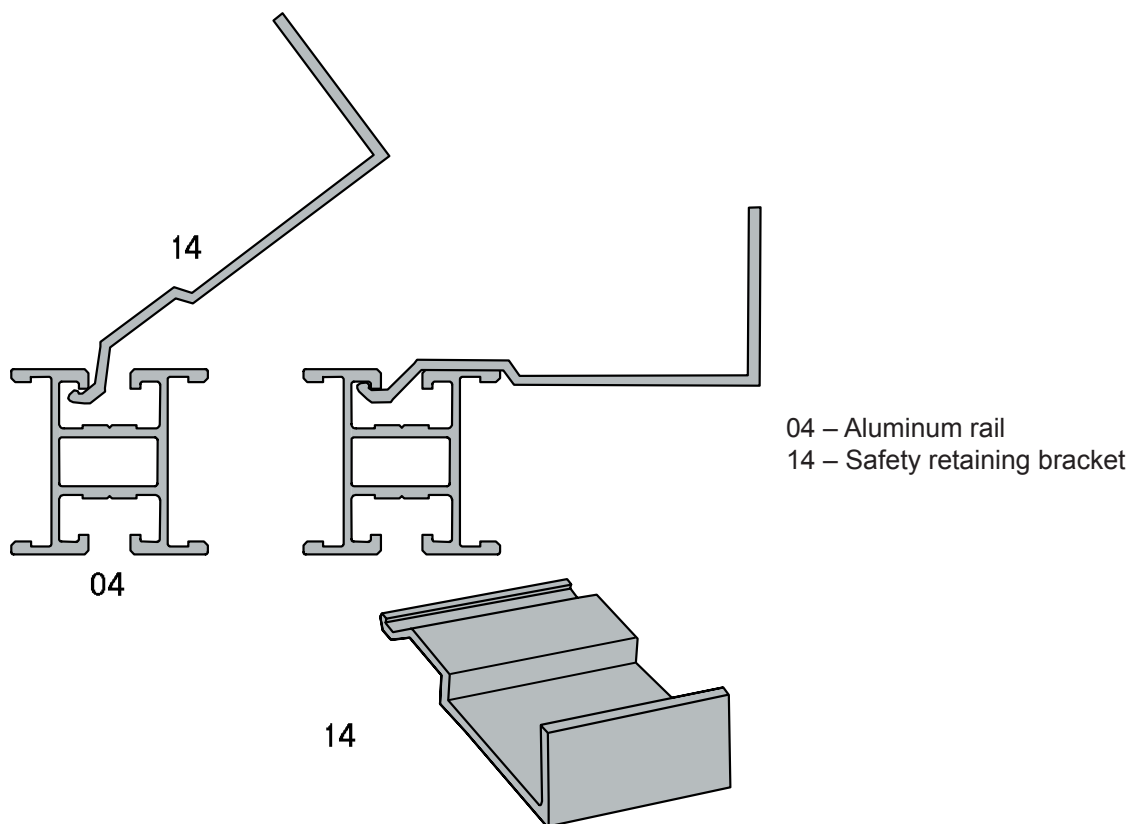
Then tighten the nuts on fixing screws.



Pic. 11: Alignment of base rails

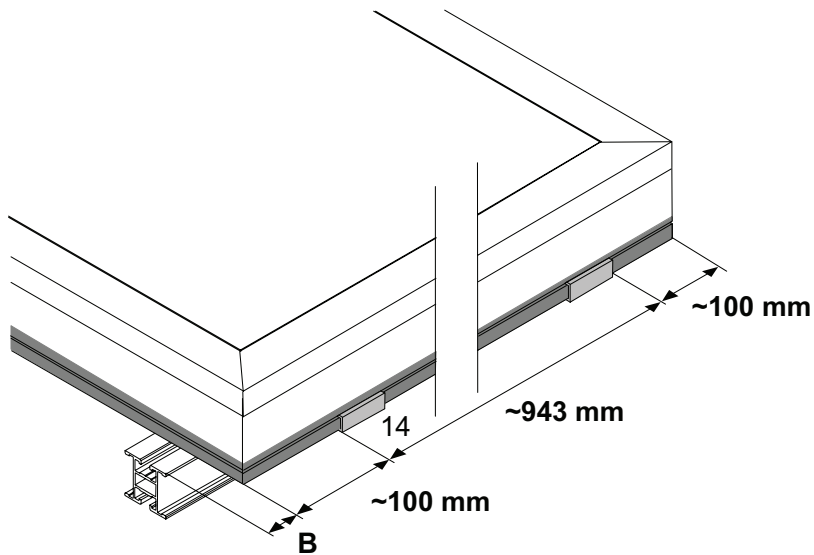
2.4 Collector mounting

- collectors must be covered during mounting
- insert safety retaining brackets into the bottom rail, 2 brackets per a collector



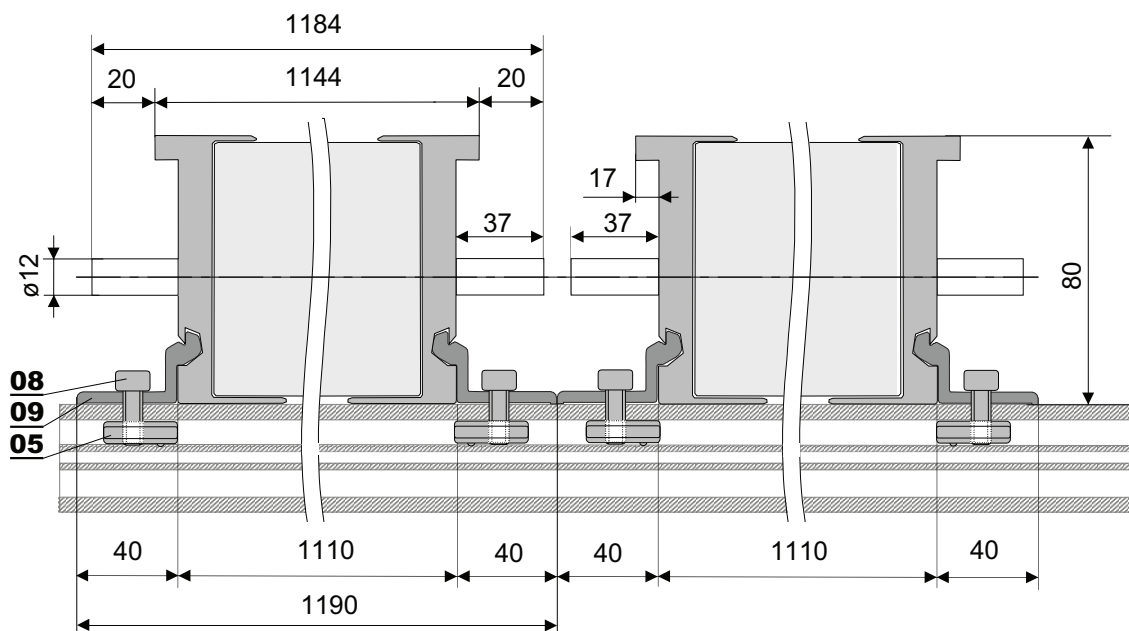
Pic. 12: Inserting safety retaining brackets

- insert the retaining brackets into the bottom rail about 100 mm from the collector edge
- lay the first collector on the rails and align it. The distance between the collector edge and the end of the bottom rail is $B = 25$ mm.



Pic. 13: Distance between the safety retaining brackets

- insert nuts into both the rails. Put the retaining side brackets on the rails and fix the collector using M8x14 bolts.



Pic. 14: Fixing the retaining brackets

- 05 – M8 nut for rails
- 08 – M8x14 allen head bolt
- 09 – Retaining bracket

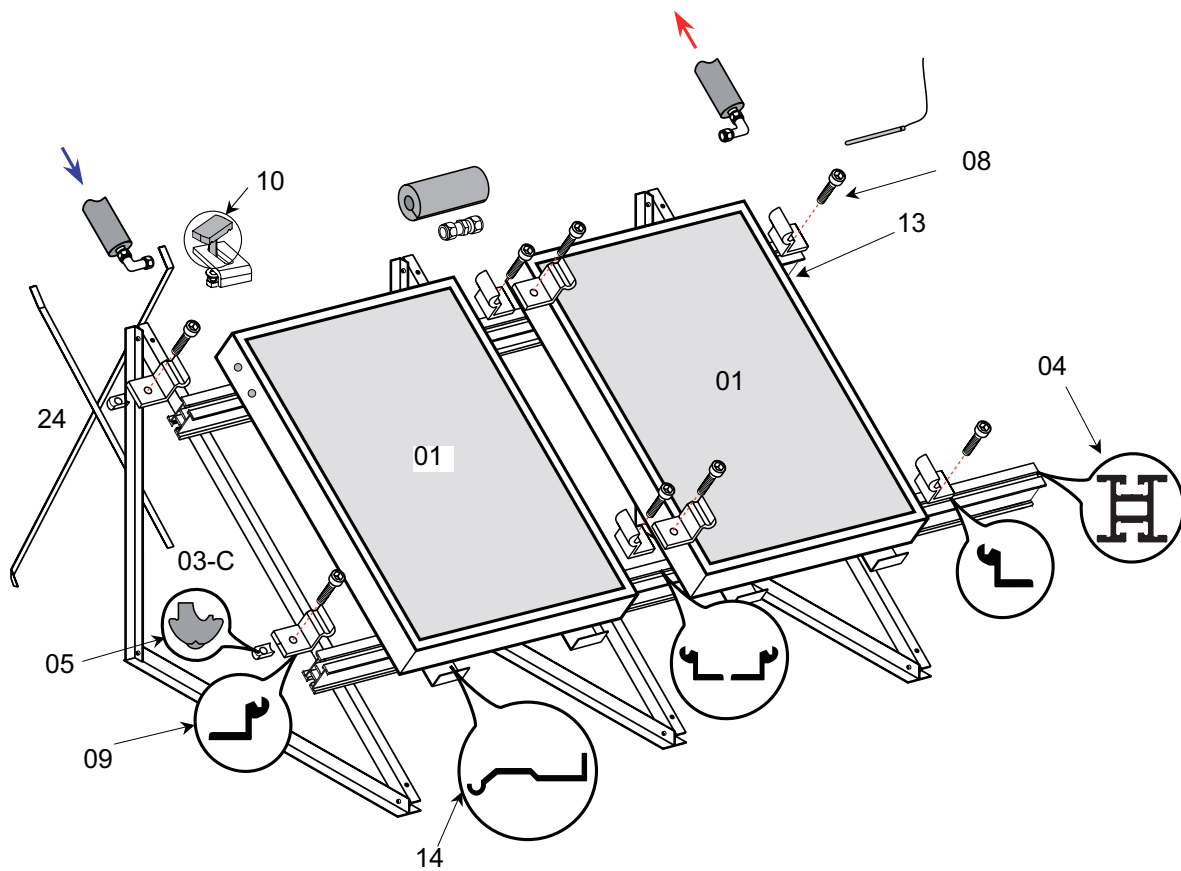
- lay the following collector next to the first one, maintaining a sufficient gap. Then put on the threaded fittings and push the collector to the already mounted one until stop. Hold the fitting with a spanner to prevent turning and tighten the nuts. More on this in chapter **5 Hydraulic Connection (see page 18)**.
- continue mounting further collectors in the same way.

3 Connection Pipe Passage through a Roof

For passing the connection pipes through a roof e.g. ventilation tiles can be used, where the hole is modified according to the diameter of the pipe with insulation. However, any preferred method must comply with the standards of the roofing manufacturer.

4 Flat Roof Mount

4.1 Overview



Pic. 15: Triangular support and wind brace

Pic. 16: Collector array

Pos.	Item	Number of collectors (kit code)				Code
01	Flat plate collector	1	2	3	4	8258
03-C	Triangular support					6859
24	Wind brace					6860
13	Interconnection pipes					
Fixing and interconnecting kits						
		Number of collectors (kit code)				Item code
		1	2	3	4	
		8284	8285	8286	8287	
04	Aluminum base rail	2 × 1.2m	2 × 2.39m	2 × 3.58m	2 × 4.77m	6949
05	M8 nut for the base rail	4 pcs	8 pcs	12 pcs	16 pcs	6925
08	M8x14 stainless-steel bolt (allen head) DIN 912/A2	4 pcs	8 pcs	12 pcs	16 pcs	8294
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14	Retaining bracket for KPS10 collector bottom	2 pcs	4 pcs	6 pcs	8 pcs	8279
	Threaded fittings 12-12 for KPS, straight	-	1	2	3	7630
	Self-adhesive insulation, 18 mm diam., 19 mm thick	-	0.07 m	0.14 m	0.21 m	7189

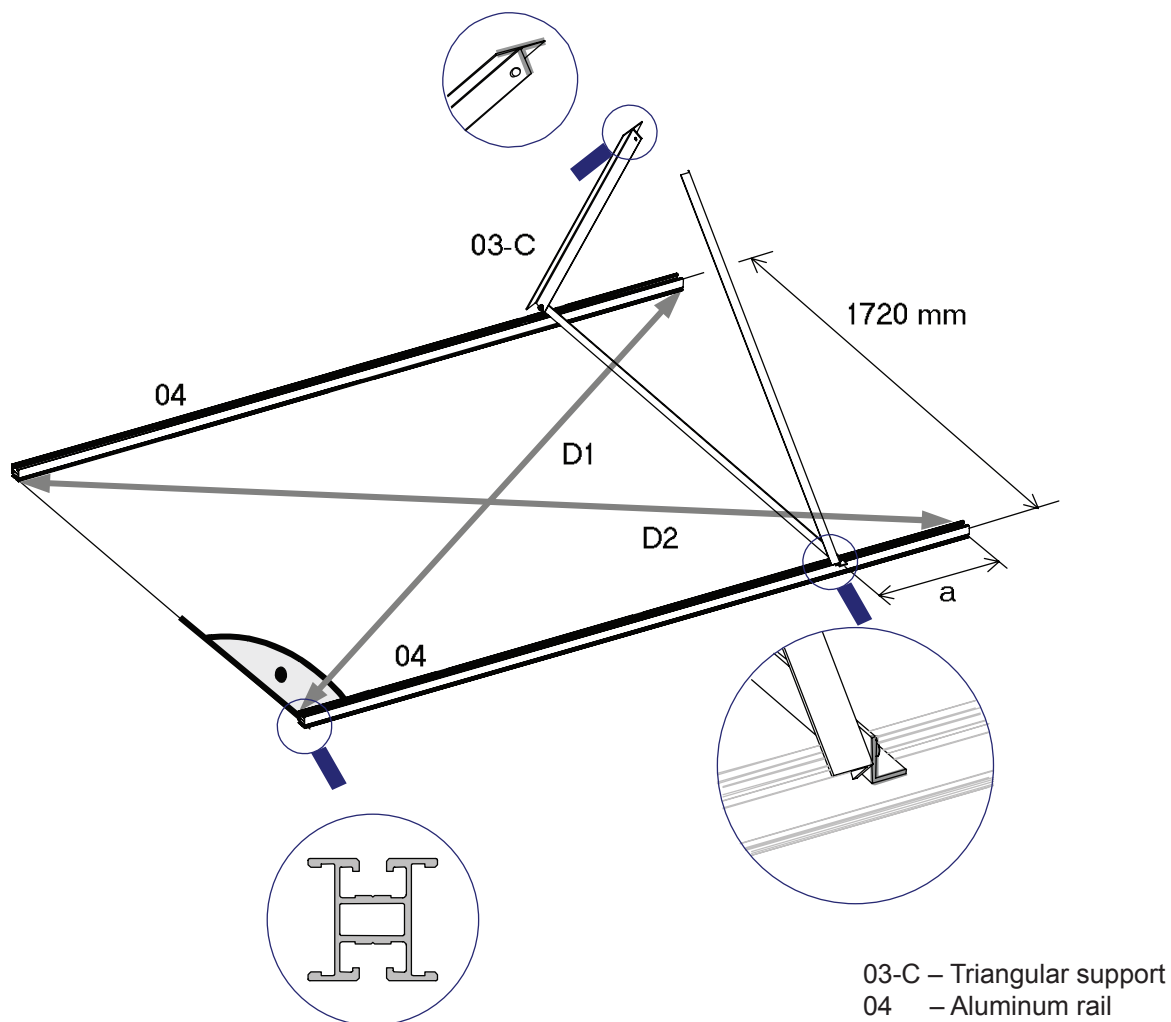
4.2 Flat roof support mounting

A flat roof support consist of two rails, triangular supports and one wind brace. The number of triangular supports depends on the number of collectors. Use one support for each collector. One wind brace is sufficient up to the rail length of 6.15 m.

- lay two rails on the mounting surface and insert the nuts into their grooves

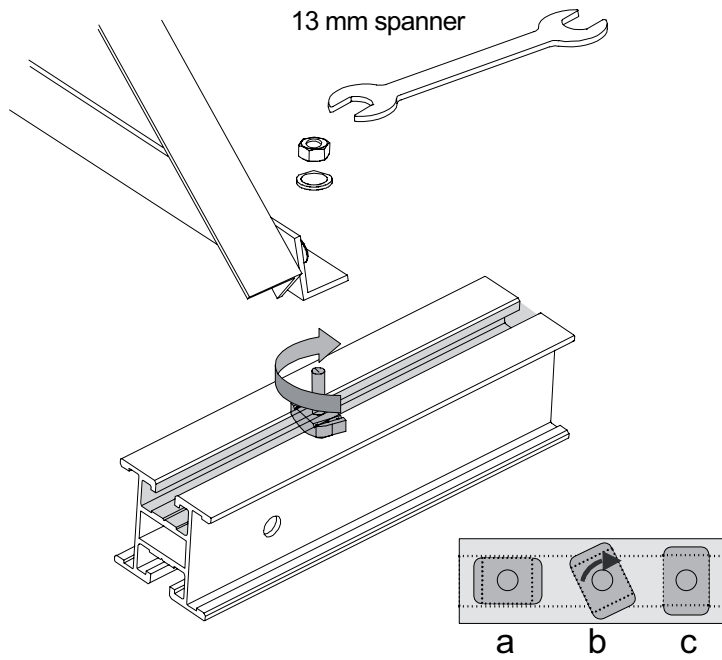
Distance between the rails = 1720 mm

The diagonals between the base rails must be of the same length: **D1 = D2**



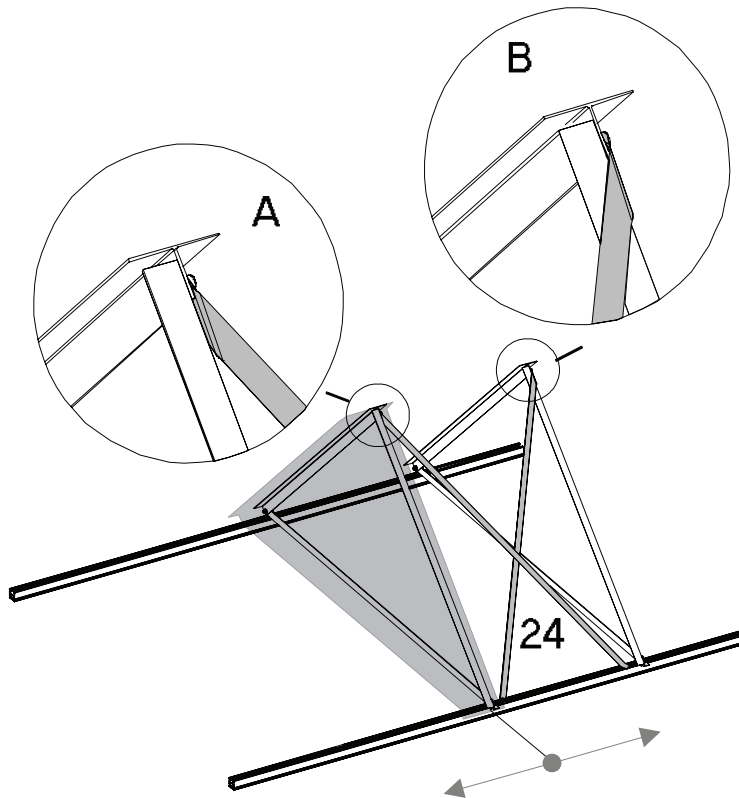
Pic. 17: Aligning the rails and mounting the first triangular support

- the triangular supports come screwed together with two bolts. Fix the loose support ends with a bolt. The distance of the first triangular support from the end of the rail is **a ≈ 600 mm**.
- fix the triangular support to the rail with travelling screws with a special head, serrated lock washers and nuts. Secure the travelling screws inside the rail by 90° turn (see pic. 18).



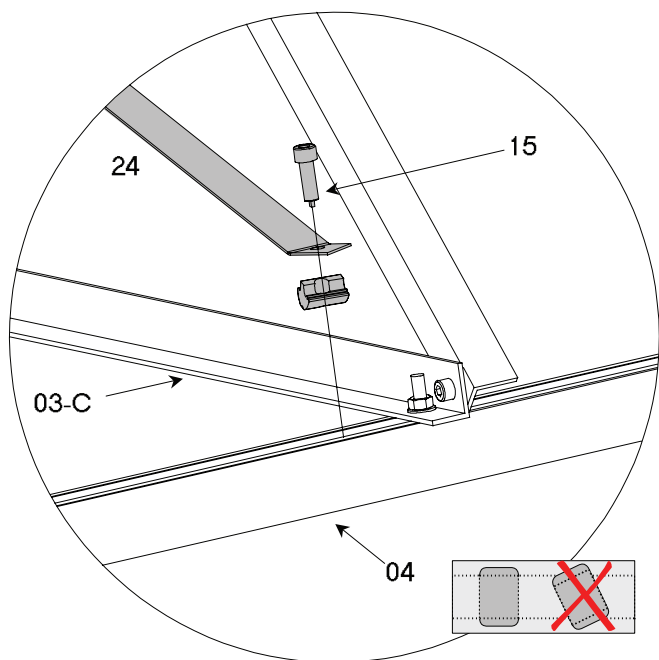
Pic. 18: Assembly by means of the travelling screws with a special head

- fix further triangular supports to the rails in the same manner. Always adjust the distance between them in such a way that the triangular support is positioned approximately under the middle of a collector. If you install also the X-shaped wind brace between the supports, tighten only one support. The X-shaped wind brace will set the right distance between the supports.
- fix the X-shaped wind brace to a triangular support and to the rail (see pic. 19). One X-shaped wind brace is sufficient for one support structure (up to the H-rail length of 6.15 m).

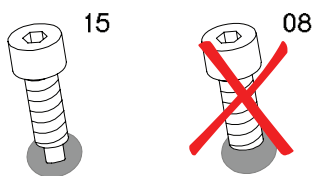


Pic. 19: Fixing the X-shaped wind brace

• insert M8 nuts (23) into the rail (04). For fixing the wind brace to the rail, use special bolts with a stop. The bolt stop will bore itself into the rail when tightened, thus the precise bolt position is fixed and prevents possible coming loose of the wind brace. That's why a click can be heard during tightening. This means that the bolt position is already fixed towards the rail. After this click, tighten the bolt completely.

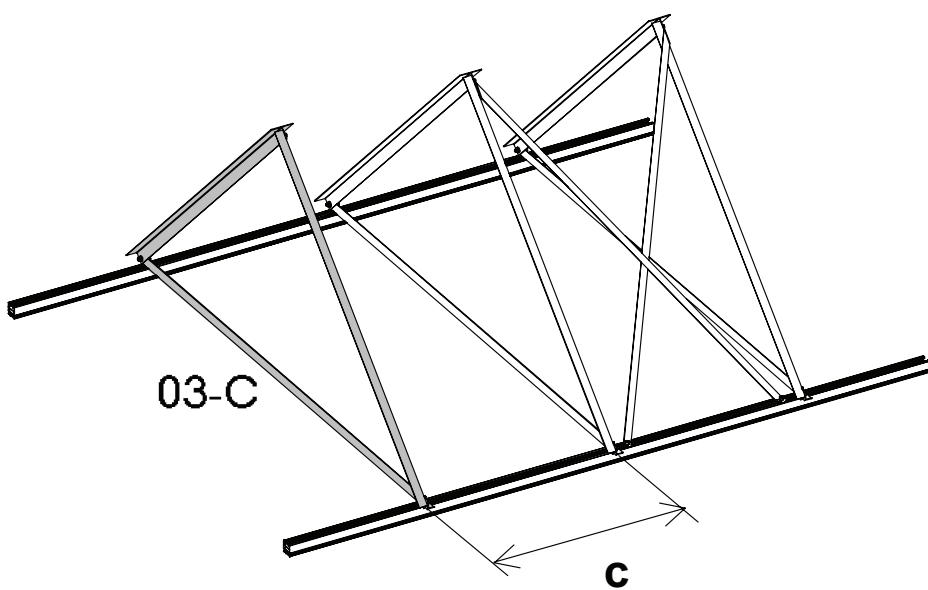


- 03-C – Triangular support
- 04 – Aluminum rail
- 08 – M8x16 bolt with allen head
- 15 – M8 bolt with a stop
- 24 – Wind brace



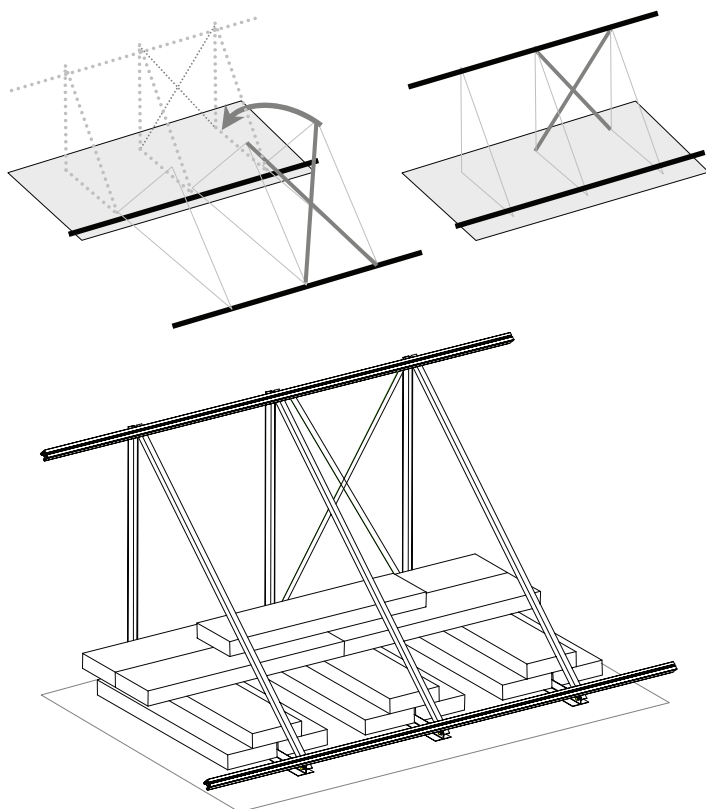
Pic. 20: Wind brace and rail assembly

• go on assembling the remaining triangular supports so that the individual supports lie at the presumed collector middle, i.e. $c \approx 1190$ mm.



Pic. 21: Mounting further supports

- tip over the support structure into its working position (Pic. 22 - the windbrace vertically). Secure the support structure either by screwing it into the roof, or applying a burden. If secured with a burden, for a wind load up to the building height of 8 m and snow load up to 0.75 kN/m², the burden must be distributed according to the following table:



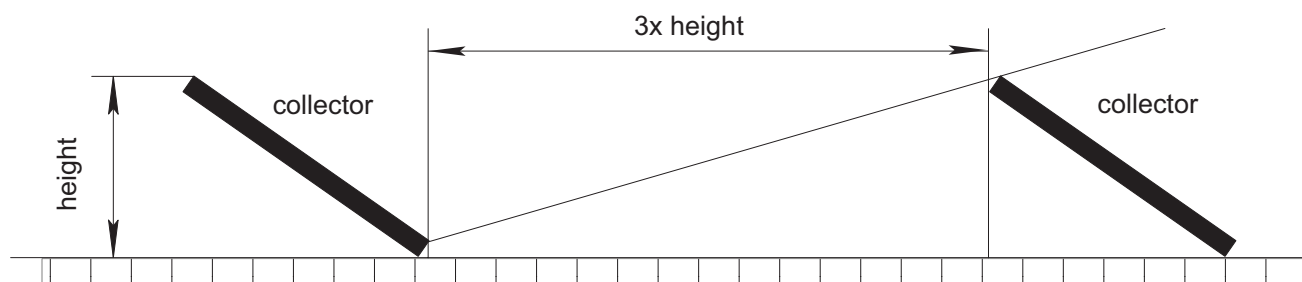
Pic. 22: Static safety (burden)

Flat roof mount	up to 8 m
1 collector	290 kg
2 collectors	580 kg
3 collectors	870 kg
4 collectors	1160 kg

In no event the permissible roof load shall be exceeded; consulting a static expert in advance is recommended. A damaged roof must be re-insulated by a specialist.

Place the collectors on the support structures and fix to the rails in the same manner as if installing on an inclined roof (see point 2.5).

Minimum distance between collector fields see pic. 23.

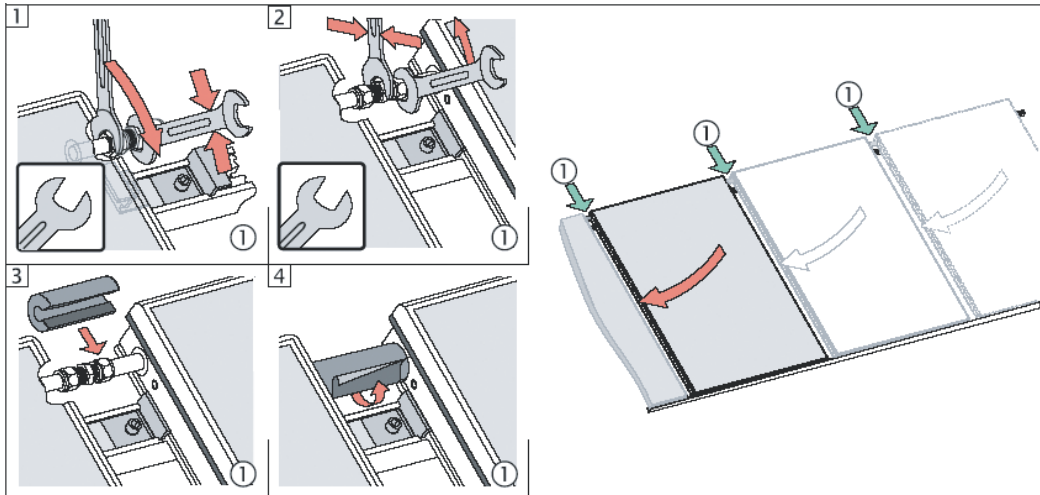


Pic. 23: Minimum distance between collector fields

5 Hydraulic Connection

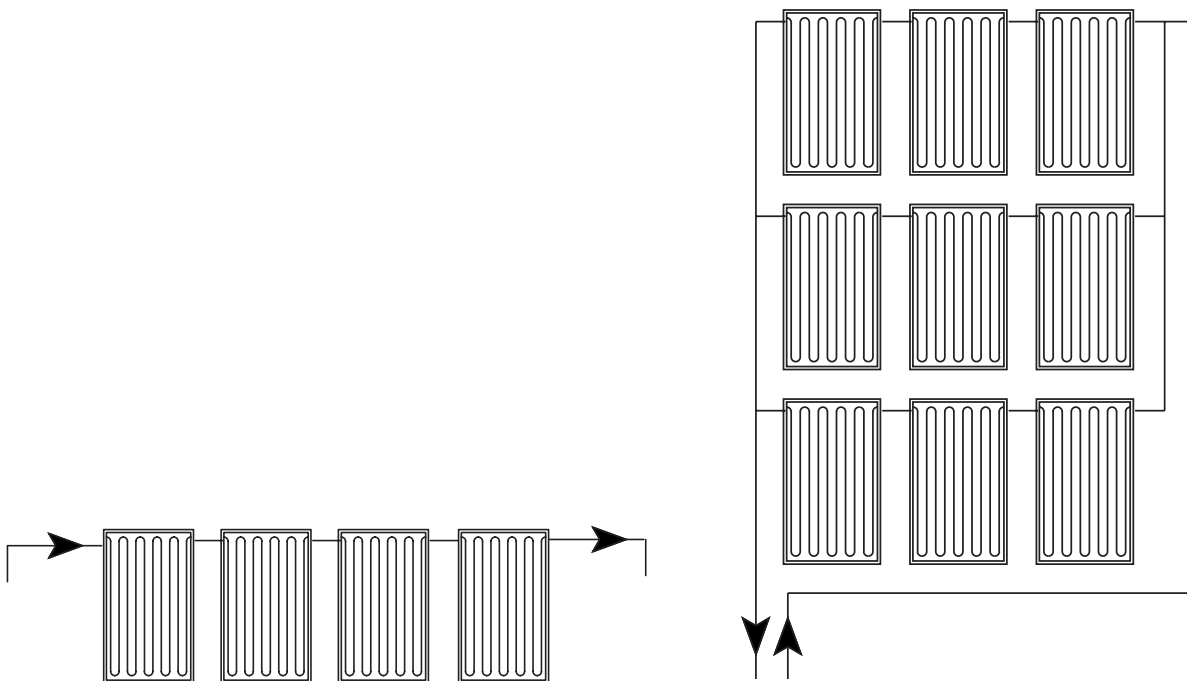
5.1 Collector connecting

For collector mounting follow the instructions in chapter 2.4. Fasten the first collector and lay the following one next to the first one, maintaining a sufficient gap. Then put on the threaded fittings and push the collector to the already mounted one until stop. Hold the fitting with a spanner to prevent turning and tighten the nuts. Continue in the same way with further collectors. **Put the insulation on the threaded fittings only after a successful leak test.**



Pic. 24: Collector connecting

5.2 Collector interconnecting



Pic. 25: Collector interconnecting

Pic. 26: Parallel connection in series
(Tichelmann principle)

In a row, maximum of 4 collectors may be connected in series (see pic. 25). Further collectors shall be connected in parallel (see pic. 26). It is advisable to keep the connection piping from collectors as short as possible. The recommended pipe diameters and flow rates through collectors are shown in Tab. 1.

Number of collectors	Connection scheme	Flow rate	Connecting pipes	Max. pipe length
1 - 4	1 - 4 in series	2l/min	Cu 15 x 1	Max. 30m of the inlet and outlet piping together
6	2 x 3 in parallel	4l/min	Cu 18 x 1	
8	2 x 4 in parallel	4l/min	Cu 18 x 1	
9	3 x 3 in parallel	6l/min	Cu 22 x 1	
12	4 x 3 in parallel	8l/min	Cu 28 x 1.5	

Tab. 1: Recommended pipe diameters

All solar components must be carefully and safely sealed and must be made of material resistant to glycol and temperatures up to 160 °C.

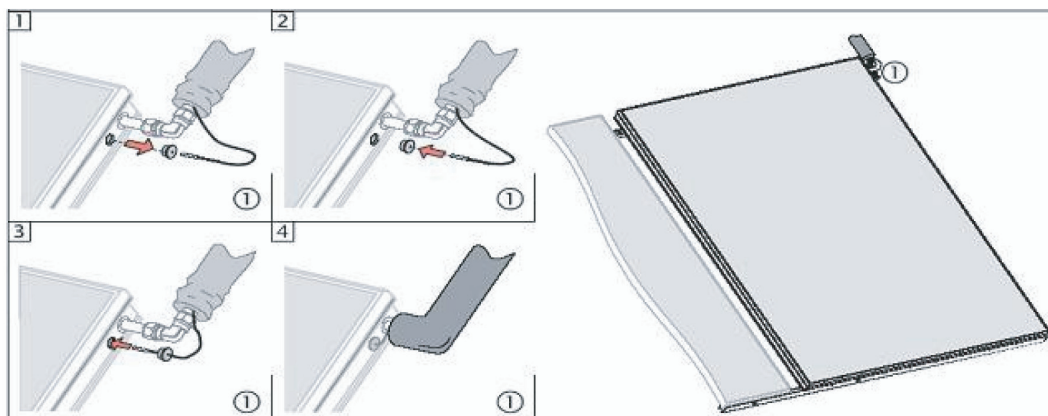
For connection piping we recommend using KOMBIFLEX stainless-steel flexible pipes, or copper pipes connected by soldering. **In no event plastic tubes can be used for inlet/outlet piping as they do not meet the requirements for solar systems.**

Pipes for collectors can be lead through disused chimneys, ventilation shafts or grooves in a wall. In order to prevent high thermal losses through convection, open shafts shall be properly sealed. Also thermal dilatation shall be remembered and pipes fitted with compensators or other compensation elements. Piping shall be connected to the house earthing.

Pipes of the solar system must be fitted with thermal insulation e.g. of AEROFLEX type, so that thermal dissipation from the pipes does not deteriorate a total efficiency of the solar system. The thermal insulation must be resistant to temperatures up to 160 °C, for outdoor piping also a UV protection is essential as well as non-deliqescence of the material. For indoor piping, the thermal insulation should be at least 13 mm thick, for outdoor piping at least 19 mm.

6 Temperature Probe Positioning

- place the thermal probe into the pocket of the last collector, see pic. 27
- use a twisted wire 2x1 mm², non-shielded, separated from power cables.
Its maximum length is 100 m. Minimize the number of electrical boxes a terminal blocks
connection length: up to 25 m cross section: 0.25 mm²
connection length: up to 50 m cross section: 0.5 mm²
connection length: up to 100 m cross section: 1.0 mm²
- the thermal and mechanical resistance of the wire used must correspond to the environs the wire passes through



Pic. 27: Position of a temperature probe

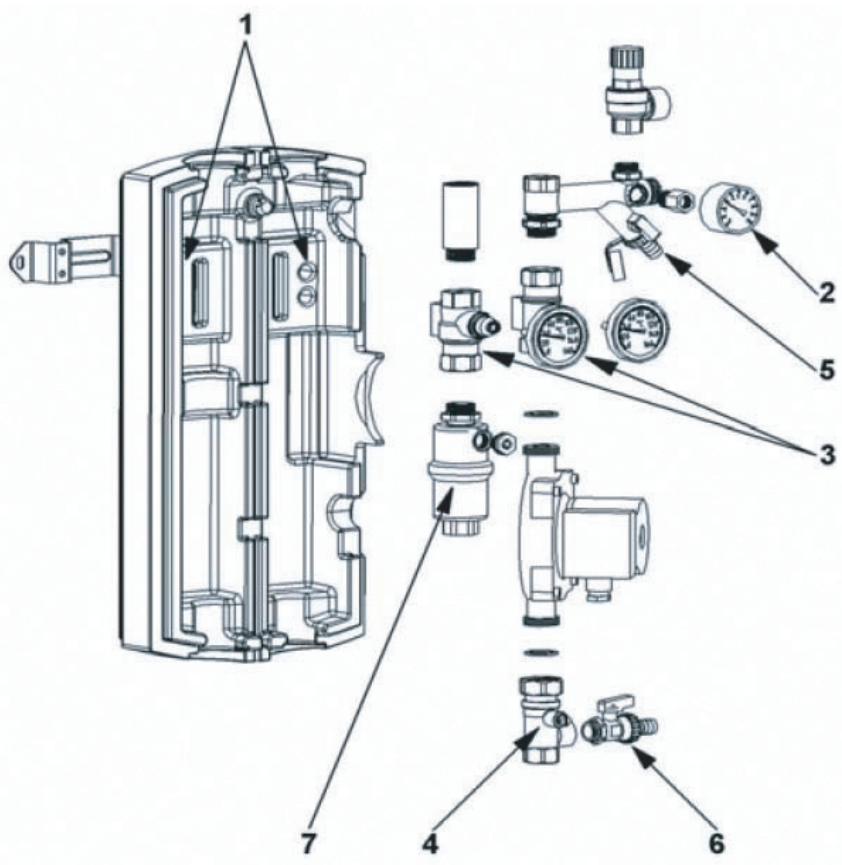
7 Pump Station

The pump station shall be installed in accordance with the respective manual.

Regulus pump stations contain these principal components:

- circulation pump
- thermometer for return line, or also feed line if two-pipe station is used
- return line with a ball valve and a check valve
- integrated flowmeter
- safety valve, pressure gauge and expansion vessel connection
- fill and drain valve
- thermal insulation

An example of a pump station is shown in Pic. 28.



Pic. 28: FlowConB pump station

- 1 - Assembly holes
- 2 - Pressure gauge
- 3 - Ball valve with a check valve and thermometer
- 4 - Ball valve and flowmeter
- 5 - Fill valve
- 6 - Drain valve
- 7 - Air separator with manual discharge
(not included in FlowConB package)

Safety valves are always included in pump stations. If no pump station is used in the installation, the solar system shall be equipped with a 6bar safety valve, resistant to high temperatures (usually up to 160 °C).

8 Expansion Vessel Sizing and Working Pressure Calculation

(valid for height up to 20 m only, otherwise the size shall be calculated)

8.1 Expansion vessel sizing

A solar expansion vessel shall be sized for a temperature difference between the min. winter temperature (as low as -20 °C) and the max. summer temperature, and to contain fluid volume of all collectors in case of stagnation (max. collector temperature at no flow and high sunshine intensity). In solar systems with forced circulation only such pressure expansion vessels shall be used that are fitted with a propylene-glycol resistant membrane and whose min. working pressure is 6 bar.

The recommended size of an expansion vessel see Table 2.

Number of collectors	Expansion vessel size	Max. piping length
up to 3	18	Max. 30 m of the inlet and outlet piping together
4	25	
6	60	
8	60	
9	80	
12	100	

Tab.2: Expansion vessel recommended size



Pic. 29: Expansion vessel

8.2 Calculation of a system working pressure

The overpressure in the solar system is calculated using the relation

$$p = 1.3 + (0.1 h)$$

p...pressure in a solar system [bar]
h...height from a pressure gauge to the middle of a collector field [m]

Adjust the overpressure by discharging solar liquid after the pressure test is done.

8.3 Calculation of an expansion vessel preset pressure

Before filling the system, adjust the initial overpressure in the expansion vessel to a value by 0.5 bar below the calculated system overpressure.

$$p_{\text{exp}} = p - 0.5 \text{ [bar]}$$

In order to set the overpressure, use a current car-tyre pressure gauge of a suitable pressure range. The expansion vessel has a current tyre valve under its lid.

8.4 Examples of calculating working pressure and expansion vessel pressure

8.4.1 An example of calculating system working pressure

The height from a pressure gauge to the middle of a collector:

$$h = 10 \text{ m}$$

Overpressure in the solar system (the solar system is to be pressurized to this value):

$$p = 1.3 + (0.1 h) = 1.3 + (0.1 \cdot 10) = 2.3 \text{ bar}$$

8.4.2 An example of calculating expansion vessel pressure

Before filling the system, the preset pressure in the expansion vessel shall be adjusted to the value of:

$$p_{\text{exp}} = p - 0.5 = 2.3 - 0.5 = 1.8 \text{ bar}$$

9 Installation of Air Release Valves

When using KPS10, it is not necessary to install an air vent at the highest point of the system supposed the fluid speed in a pipe will be over 0.4 m/s. This speed is guaranteed when the recommended pipe diameters are respected, cf. Tab. 1. In this case it is sufficient to fit the pump station with an air separator (see pic. 31).



Pic. 30: Horizontal air separator and an automatic air vent



Pic. 31: Air separator

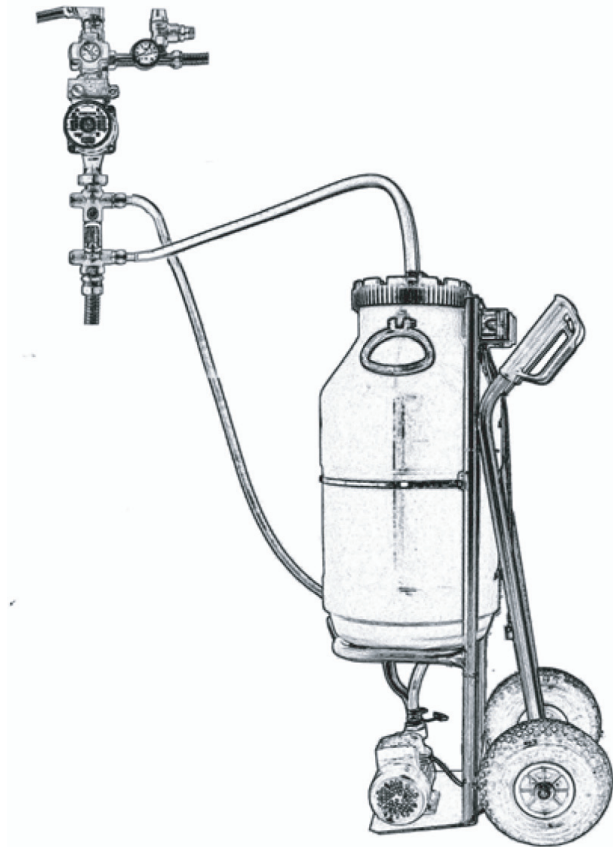
If pipes of a bigger diameter are used than recommended in Tab. 1, an air vent shall be installed at the highest point of the system. It is recommended to amend the air vent with a local pipe widening that calms down the stream and helps in good separating bubbles from the fluid (see pic. 30).

10 System Filling, Flushing, Leak Test and Air Bleeding

The below listed procedures are valid when a Regulus pump station is used.

10.1 Filling

- in order to fill the system, use a filling device with a reservoir for solar liquid and a filling pump (see pic. 32)
- attach the filling hose to the feed valve and open the valve completely
- attach the return hose to the bleed valve and open the valve completely
- close the integrated ball valve in the flowmeter (the groove in the flowmeter's adjusting screw must be horizontal). Open the check valve above the pump by turning the ball valve by 45° (intermediate position between opening and closing)



Pic. 32: Filling a solar system

- turn on the filling pump and pour sufficient quantity of solar fluid into the reservoir of the filling device and fill the solar system

10.2 Flushing

- flush the solar system for at least 15 minutes using the filling device. In order to bleed air from the system perfectly, open shortly the integrated ball valve of the flowmeter from time to time (the groove vertically).

10.3 Air bleeding

- with the filling pump running, close the bleed valve and increase the pressure up to about 5 bar
- close the feed valve and turn off the filling pump, open the regulation screw on the flowmeter (groove horizontally), do not disconnect the filling-pump hoses!
- set the circulation pump(s) to the highest speed and repeat switching on and off to air-bleed the system (an air-free pump works almost noiselessly)
- watch the system pressure and when it starts falling, increase it by turning on the filling pump and opening the feed valve to 5 bar
- repeat air bleeding so long until the float in the flowmeter's regulation valve takes a steady position during pump operation and bubbles stop appearing in the flowmeter. After that, let the circulation pump run for at least 5 minutes.
- in case an automatic air vent/s is/are used anywhere in the solar system, close this valve after air bleeding.

10.4 Leak test

- examine the whole system at 5 bar pressure (all connections, solar collectors, valves etc.), no visible leaks are allowed. Leave the system under pressure for at least 2 hours, then examine the system repeatedly.
- consider the test result successful if no leaks appear and/or no noticeable pressure drop appears in the system
- set the working pressure by point **8.2 Calculation of a system working pressure**
- set the pump to a suitable speed and set the flow by the flowmeter and data in Tab. 1/page 18
- disconnect the hoses of the filling device and screw caps on the feed and bleed valves
- **open entirely** the ball valve **above the pump**
- after several days of operation, air-bleed the system again

Do not flush the system with water.

Since it is impossible to empty it completely, a risk of frost damage appears.

11 Commissioning

- adjust the solar regulator according to the respective instruction manual
- remove collector covers
- place a sufficiently sized vessel (to hold the entire solar fluid volume) under the outlet of the safety valve
- check if the circulation pump switches when the preset temperature difference between solar collectors and secondary circuit is reached

12 Operation, Checks and Maintenance

The solar system offers unmanned and almost maintenance-free operation. Despite that, it is important to check the right functioning of the system within the first days of operation. First of all the temperature, system pressure and pump operation shall be checked. Once a year, preferably during a sunny day, it is necessary to check the working order and tight fixing of the collectors, verify the system tightness and pressure (incl. pressure in the expansion vessel) and the pump operation. At least once in every 2 years the heat carrying fluid shall be checked for its antifrost properties. The system shall be always replenished with the same fluid as the original filling was.

The system must not be replenished with water.

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