

SKS 4.0 Series Flat Collector

ON ROOF MOUNTING
SOLAR THERMAL SYSTEMS

For heating engineers

Please read carefully prior
to commissioning and
maintenance

About this manual

This installation manual contains important information for the safe and appropriate installation of the roof mounted solar collectors.

Notes are included with important information for situations in which there is no danger for persons or equipment.

These technical documents should be retained in a safe place. These may also be inspected at the manufacturer's premises.

The activities described in the installation manual assume expertise based on completed vocational training in gas or water-related installation. Only carry out these installation steps, if you possess these skills.

- Hand these installation instructions to the customer.
- Explain to the customer the function and operation of the related devices.

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1 General information

This chapter details which technical rules and regulations apply to this installation.



USER NOTE

Observe all standards and guidelines applicable to the installation and operation of this system in your country.

UK		
Installation work on roofs	Connection of thermal solar thermal systems	Installation and equipment of DHW cylinders
The Health and Safety at Work etc Act 1974 The Management of Health and Safety at Work Regulations 1999 The Construction (Health Safety and Welfare) Regulations 1996 The Construction (Design and Management) Regulations 1994 The Lifting Operations and Lifting Equipment Regulations 1998	EN 12976: Thermal solar thermal system and their components (pre-fabricated systems). ENV 12977: Thermal solar thermal system and their components (bespoke systems). BS 6795: Code of practice for solar thermal systems for swimming pools.	BS5546: 2000 Specification for installation of hot water supplies for domestic purposes, using gas-fired appliances of rated input not exceeding 70 kW. BS6700:1997 Specification for design, installation, testing and maintenance, of servicing supplying water for domestic use within buildings and their curtilages.

Tab. 1 Technical rules for the installation of thermal solar thermal systems (selection) in UK

Lightning protection

If the building height (installation height) exceeds 20 m, and there is no lightning conductor installed, ask your local electrical contractor to connect the components on the roof which conduct electricity with an electrical earth cable of at least 16 mm² to the earth bonding.

Special measures regarding lightning protection are not required for building heights (installation heights) of less than 20 m.



Where there is a lightning conductor system installed, ask your local electrical contractor to check the inclusion of the solar thermal system into the lightning protection system.



USER NOTE

The installation of the Thermal Solar System must be carried out in accordance with the relevant requirements for safety, current IEE wiring regulations, local building regulations, building standards (Scotland) (Consolidation) regulations and by-laws of the local water company and health and safety document No 635 (Electricity at Work Regulations 1989).
 BS 6795: Latest version

2 Specifications

SKS Solar collectors		
Certificates		 
Length		2,070 mm
Width		1,145 mm
Height		90 mm
Clearance between collectors		25 mm
Fluid content, portrait version	V_f	1.43 l
Fluid content, landscape version	V_f	1.76 l
Gross absorber surface area	A_G	2.37 m ²
Net absorber surface area		2.1 m ²
Net weight, portrait version	m	46 kg
Net weight, landscape version	m	47 kg
Permissible operating pressure of the collector	p_{max}	10 bar

Tab. 2 Specifications

3 Safety

This chapter details how the notes for the installation instructions, as well as the general safety instructions, necessary for safe and trouble-free operation, are arranged in this manual.

Safety and user notes, which specifically refer to the installation, in the installation manual immediately following the individual installation steps, are found here.

Carefully read the safety instructions before commencing the installation.

Severe injury and even death, as well as material losses and environmental damage, may follow if you ignore safety instructions.

3.1 Correct use

This installation set holds the thermal solar collectors (portrait and landscape), which are installed on sloping roofs with a slope of 25° to 65°. The collectors can be installed on corrugated and sheet roofs with slopes of between 5° and 65°.

Operating conditions


Only erect the installation set on roofs whose construction can support the weight. If necessary, consult a structural engineer or a roofer.

The installation set is suitable for a max. standard wind or snow load of 2.0 kN/m² and an installation height of max. 20 m. Using appropriate accessories, the installation set can be used for a max. standard wind or snow load of 3.1 kN/m² and a max. installation height of 100 m. See Chapter 5.7 "Fitting additional rails (accessory)".

The roof installation set must not be used for fixing any other objects to the roof. The kit is intended exclusively for the safe fixing of solar collectors.


3.2 Notes structure

Two levels are identified by signal terms:

 **WARNING!**

RISK TO LIFE


Identifies possible dangers emanating from a product, which might lead to serious injury or death if appropriate care is not taken.

 **CAUTION!**

**RISK OF INJURY/
SYSTEM DAMAGE/
BUILDING DAMAGE**


Identifies potentially hazardous situations, which could lead to medium or slight injuries or to material losses.

Additional symbol for designating user notes:

 **USER NOTE**

Tip for the optimum utilisation and setting of the control(s) plus other useful information.


3.3 Please observe these safety instructions

 **WARNING!**

RISK TO LIFE

through a fall or falling parts.


- Ensure you have the correct safety equipment for working on roofs.
- Take appropriate action to prevent accidents when working on roofs.
- Whilst working on the roof, take all necessary precautions against a possible fall.
- Always wear your personal protective clothing and safety equipment.
- After completing the installation, always check the secure positioning of the installed set and that of the collectors.

 **CAUTION!**

RISK OF INJURY

Injury and operating faults can result from making changes to the system construction.

- Never change the system construction.

 **CAUTION!**

RISK OF INJURY

Some parts may cause burns, if the collector and installation materials are exposed to solar radiation for longer periods of time.

- Always wear your personal protective clothing and safety equipment.
- Cover the collector (e.g. with a covering sheet – available as an accessory) and the installation material during the installation as protection against high temperatures resulting from solar irradiation.

4 Before installation

4.1 General notes



USER NOTE

It is recommended that the services of a roofing company, who are experienced in working on roofs and will be fully aware of the risks of working at height are considered.

Make yourself familiar with the on-site conditions and local regulations before commencing the installation.



CAUTION!

RISK OF INJURY

If the collector and its installation material is left exposed to the sunlight for a long period, the parts will become hot and may cause burns.

- Wear protective clothing.
- Cover the collector (e.g. with a covering sheet – available as an accessory) and the installation material during the installation as protection against high temperatures resulting from solar irradiation.

Check

- the delivery for completeness and perfect condition.
- the optimum arrangement of the solar collectors. Take account of the direction of the sunlight (angle of inclination, southerly direction). Avoid the shade of high trees or structures and match the collector array to the shape of the building (e.g. flush with windows, doors, etc.).



USER NOTE

Only use OEM components and replace any faulty parts immediately.



USER NOTE

Remove broken pan tiles, shingles or plates in the area of the collectors and replace them.

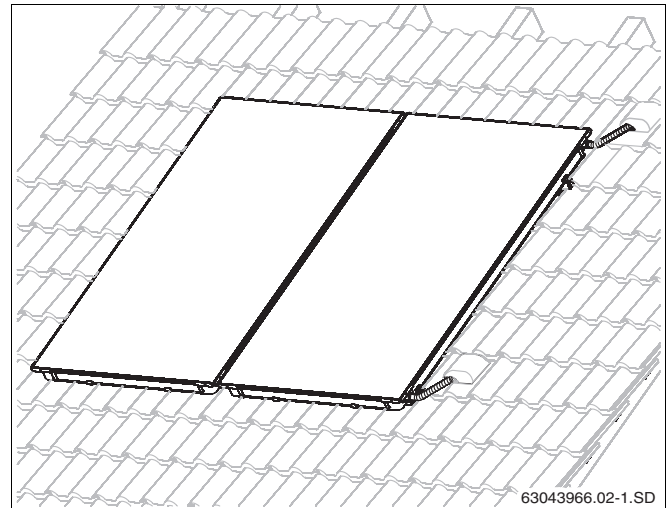


Fig. 1 General overview of collector pair – roof mounting

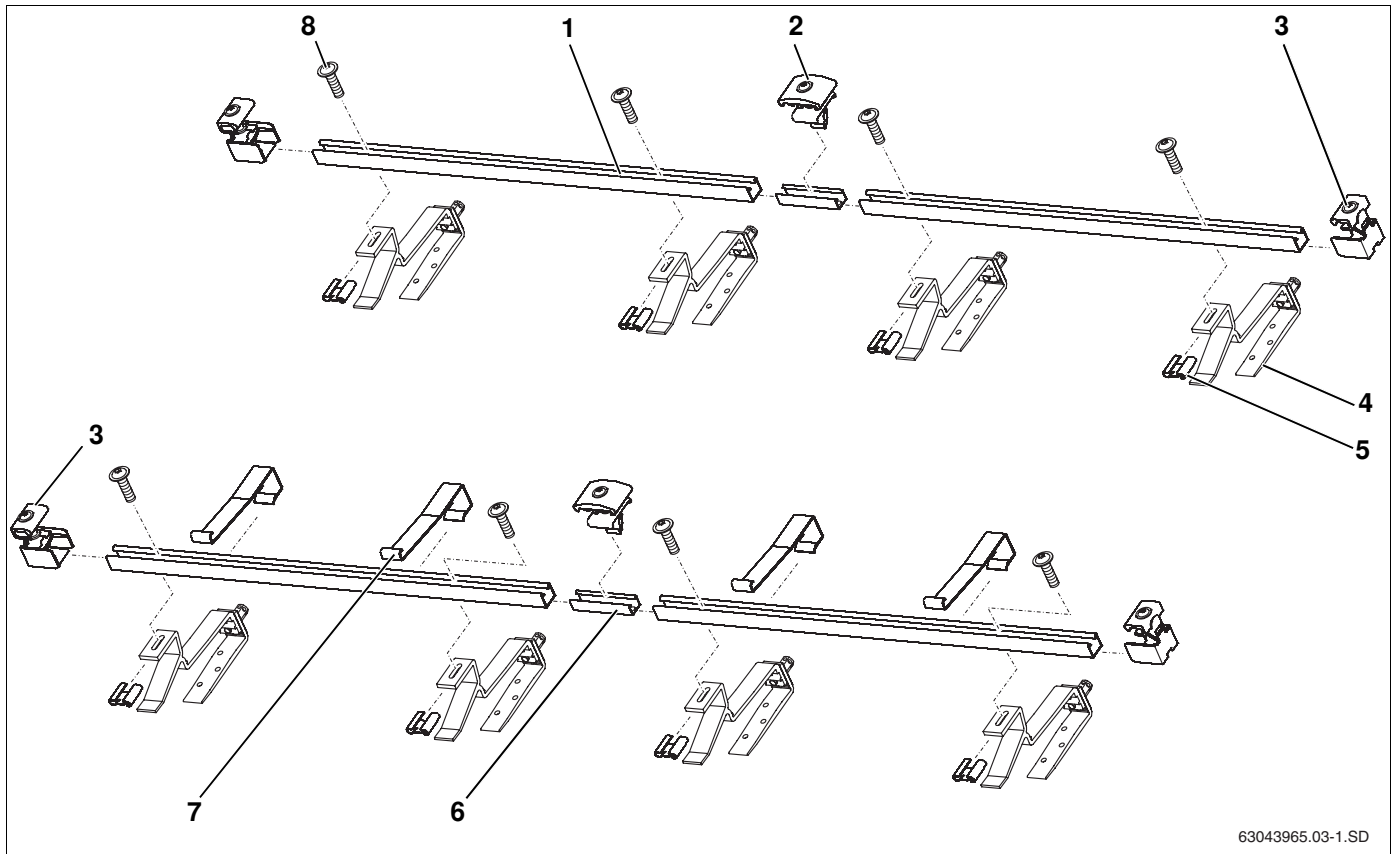
4.2 Component description

4.2.1 Installation set for the collectors



USER NOTE

The installation sets are for mounting and fixing the collectors in place.



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Fig. 2 Installation set for 2 collectors – 1 basic installation set, 1 extended installation set and 2 roof connection installation sets

Basic installation set for each collector array and for the first collector (Fig. 2):

Item 1:	Profile rail	2 ×
Item 3:	Single-sided collector clamp	4 ×
Item 7:	Anti-slip protection	2 ×
Item 8:	M8 screw	4 ×

Extended installation set for each additional collector (Fig. 2):

Item 1:	Profile rail	2 ×
Item 2:	Double-sided collector clamp	2 ×
Item 7:	Anti-slip protection	2 ×
Item 6:	Rail connector with threaded studs	2 ×
Item 8:	M8 screw	4 ×

Roof connection, pan tile roofs, per collector (Fig. 2):

Item 4	Roof hook, adjustable	4 ×
Item 5	Sliding nut	4 ×

4.2.2 Hydraulic connection



USER NOTE

One connection kit for each collector array will be required. The collectors are connected together by a connection set.

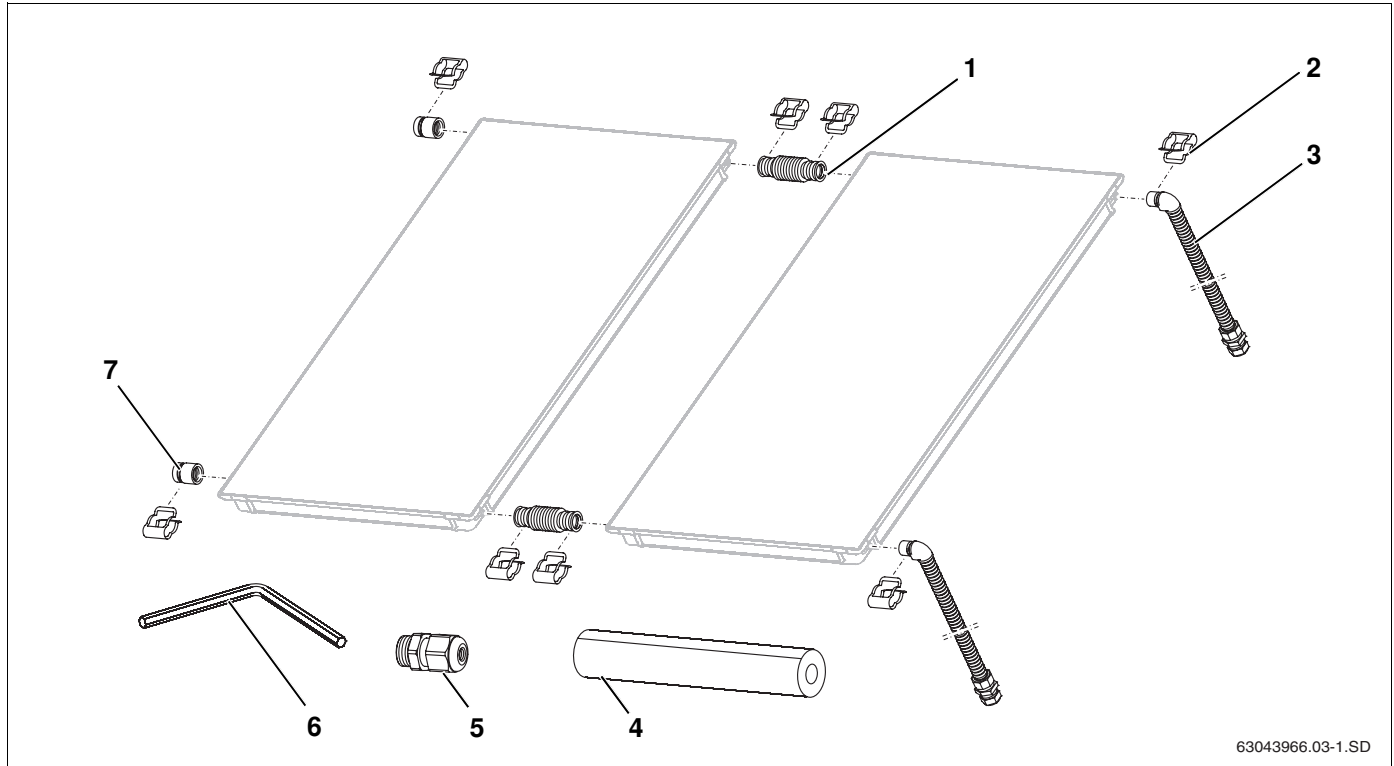


Fig. 3 Connection kit and connection set (illustration shows 2 portrait collectors)

Connection kit, per collector array (Fig. 3)

Item 2: Connector clip	2 ×	Item 6: Size 5 Allen key	1 ×
Item 3: Connecting pipe (insulation not shown)	2 ×	Item 7: End cap	2 ×
Item 4: Insulation for corrugated pipe connector 710 mm	1 ×	Item 8: Sensor bush plug, not shown	1 ×
Item 5: Clamped joint for collector sensor	1 ×		

Connection set between the collectors, for each collector (in two corner protectors, Fig. 4)

Item 1: Corrugated pipe connector	2 ×
Item 2: Connector clip	4 ×

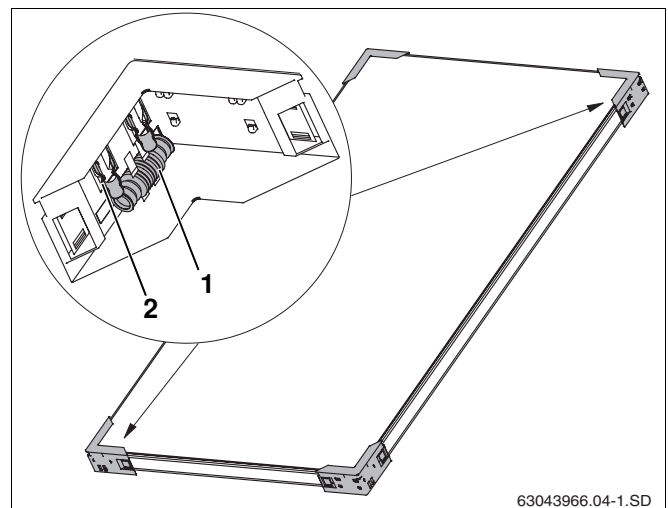


Fig. 4 Corner protectors with one connection set

4.3 Other equipment

- Spirit level
- Plumb line
- Filling pump
- Vest harness with safety rope
- Pipe insulation
- Scaffolding
- Roofing ladder
- Crane or mobile hoist



USER NOTE

When fitting the roof installation set and water connection, the only tool required is the size 5 allen key from the connection kit.

4.4 Transport and storage

Please ensure that the corner protectors are retained. They contain pipework connection pieces which are required for installation. All components are protected by transport packaging.



USER NOTE

Dispose of the transport packaging in an environmentally friendly recycling system.

Transport protection for collector connections

The collector connections are protected against damage by rubber caps.



SYSTEM DAMAGE

through damaged sealing faces.

CAUTION!

- Do not remove the rubber caps (Fig. 5, **Item 1**) until immediately prior to installation.

Storage

The collectors must be stored in dry conditions.



USER NOTE

Do not store collectors outside without protection from the rain.

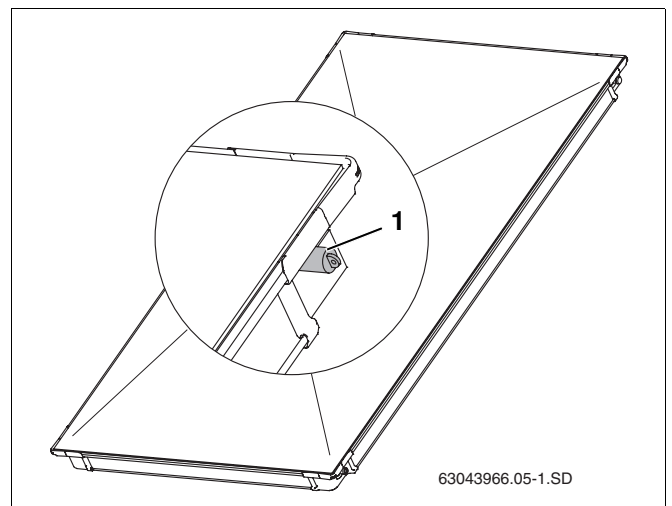


Fig. 5 Plastic caps on collector connections

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4.5 Technical documentation

The solar thermal system consists of various components (Fig. 6). Installation, operation and maintenance documentation is provided for each component. Accessories may be accompanied by a separate document.

- Item 1:** Collector: instructions for roof installation are enclosed with the connection kit
- Item 2:** Pump station: instructions enclosed with the station
- Item 3:** Solar Controller: instructions are enclosed with the controller.
- Item 4:** DHW Cylinder: instructions enclosed with the DHW cylinder.

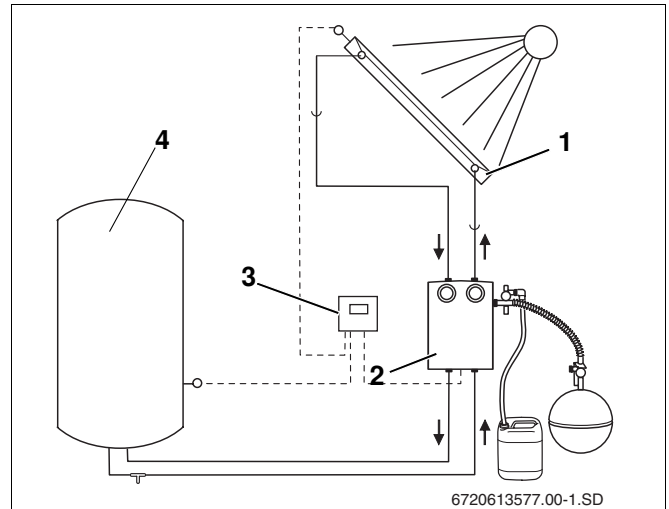


Fig. 6 Solar thermal system components and technical documentation

4.6 Determining space required on roof

Please note the following minimum space requirements.

Dimension A and B

Area required for the collector array.

Dimension C

At least two tiles to the roof or chimney. Otherwise there is a risk of damaging the tiles, particularly if the tiles are laid in mortar.

Dimension D

Roof overhang including gable wall thickness.

Dimension E

Minimum 30 cm for fitting the connection cables in the attic.

Dimension F

Minimum 40 cm for installing the connection cables in the attic (if installing a vent, sufficient space must also be allowed for in the vicinity of the flow outlet). Please note that the air vent must be the highest point of the system.

Dimension G

Minimum 50 cm left and right of the collector array for the pipework under the roof.

Dimension H

Dimension H is 1.900 mm (1.000 mm for landscape collectors) and is the minimum distance from the upper edge of the collector to the lower profile rail, which is installed first.

Space requirements for portrait collectors:

Number of collectors	Dimension A	Dim. B
2	2.32 m	2.07 m
3	3.49 m	2.07 m
4	4.66 m	2.07 m
5	5.83 m	2.07 m
6	7.06 m	2.07 m
7	8.17 m	2.07 m
8	9.34 m	2.07 m
9	10.51 m	2.07 m
10	11.68 m	2.07 m

Tab. 3 Space requirement for portrait collectors

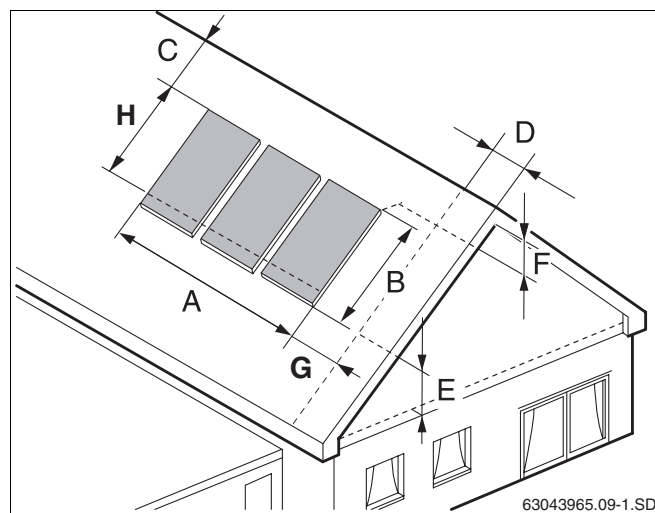


Fig. 7 Clearances to be observed

Space requirements for landscape collectors:

Number of collectors	Dimension A	Dim. B
2	4.17 m	1.15 m
3	6.26 m	1.15 m
4	8.36 m	1.15 m
5	10.45 m	1.15 m
6	12.55 m	1.15 m
7	14.64 m	1.15 m
8	16.74 m	1.15 m
9	18.61 m	1.15 m
10	20.93 m	1.15 m

Tab. 4 Space requirement for landscape collectors

5 Fitting the roof connection and profile rails

5.1 Setting clearances

The dimensions given are guide values that should be approximately maintained.



USER NOTE

On pan tile roofs the tile troughs determine the true distance between the roof hooks.

Distances of roof hooks

Every profile rail is fastened using two roof hooks (Fig. 8). See the table for the approximate distance between the roof hooks.

Installation type	Distance w	Distance x	Distance z
portrait	approx. 1170 mm	610–1030 mm	170–540 mm
landscape	approx. 2090 mm	1520–1950 mm	170–540 mm

Tab. 5 Distance of the roof hooks from one another



USER NOTE

Distances x and z should always be approximately equal to distance w.

Distances of profile rails

Set the distance between the top and bottom profile rails (Fig. 9). Use the table values.

Installation type	Distance y	
	from	to
portrait	1320 mm	1710 mm
landscape	600 mm	820 mm

Tab. 6 Distance (centre-centre) between bottom and top profile rail



USER NOTE

Landscape installation is only possible if roof battens are max. 420 mm apart.

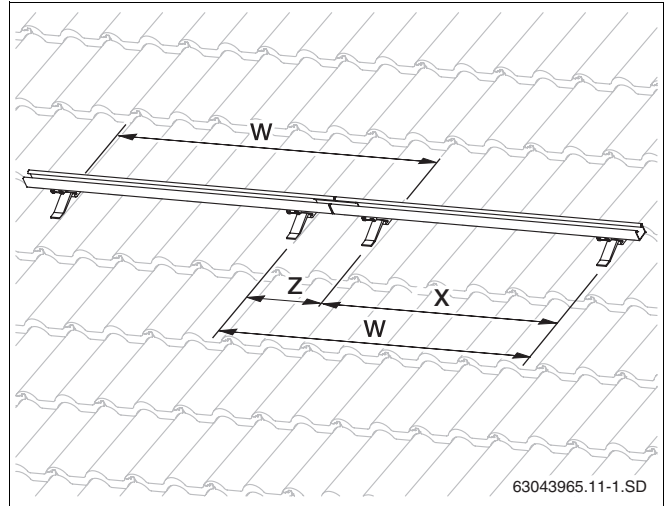


Fig. 8 Distance of the roof hooks from one another

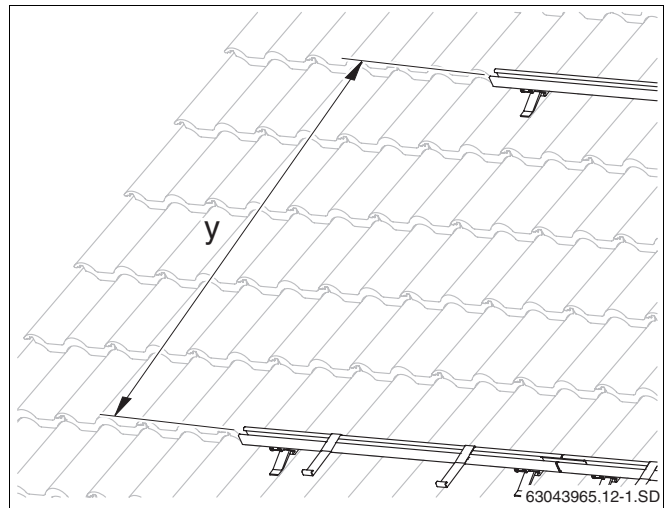


Fig. 9 Distance between the profile rails

5.2 Pan tile roofs

Fit all roof hooks according to the guide values shown in tables 5 and 6 on page 14.



USER NOTE

Do not modify the roof construction and avoid damaging the roof covering. In the case of roof tiles laid in mortar, lift the tiles starting with the 3rd row under the ridge



USER NOTE

Carefully cut away the base of the tile if necessary to ensure the tile lies correctly over the roof hook.



CAUTION!

SYSTEM DAMAGE

through subsequent loosening of the long hexagon nut on the roof hook. When the nut is tightened, adhesive is activated which bonds the joint securely after one hour.

- If the nut becomes loose after this time, it must be tightened on-site (e.g. lock washer).

5.2.1 Attaching the roof hooks over the roof batten

In its packaged state, the lower part of the roof hook is folded.

- Loosen the long hexagon nut (Fig. 11, **Item 2**) on the roof hook and move the lower part of the roof hook (Fig. 11, **Item 1**) to the correct position.
- Push the tile upwards according to the roof hook positions shown in (Tab. 5 and Tab. 6, page 14).
- Attach in the roof hook in such a way that the front brace lies in a tile trough (Fig. 12, **Item 4**).
- Push the lower part of roof hook (Fig. 12, **Item 3**) upwards until it touches the roof batten (Fig. 12, **Item 2**).
- Tighten the long hexagon nut (Fig. 12, **Item 1**). To do this, insert the size 5 Allen key into one of the holes in the hexagon nut and turn.



USER NOTE

The serrated washer (Fig. 12, **Item 5**) must grip the teeth on the lower part of the roof hook.

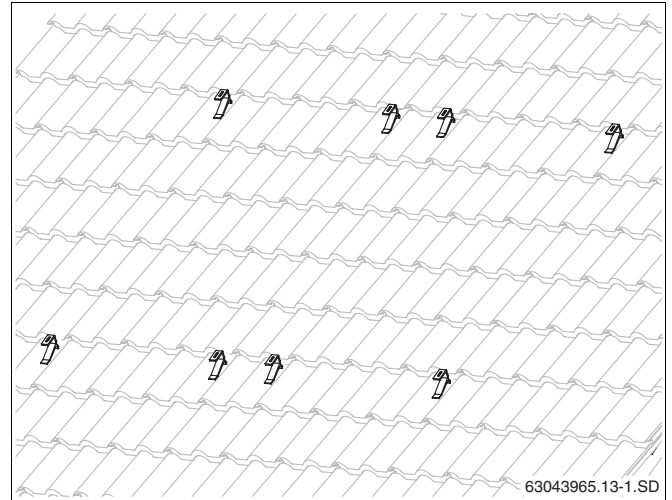


Fig. 10 Fitted roof hooks for two collectors

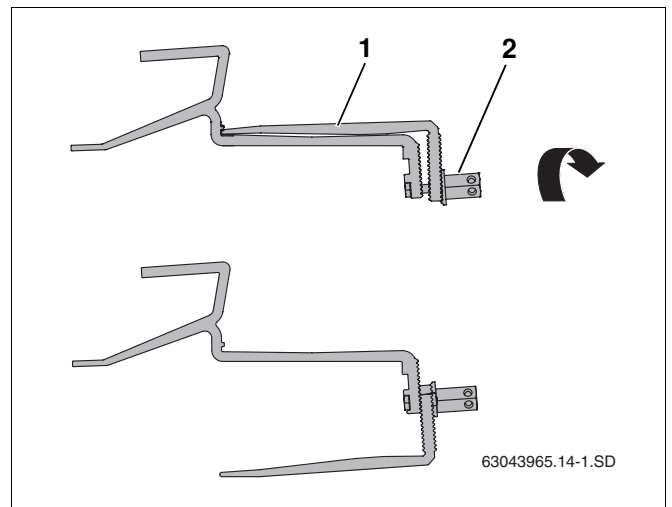


Fig. 11 Turning the lower part of the roof hook

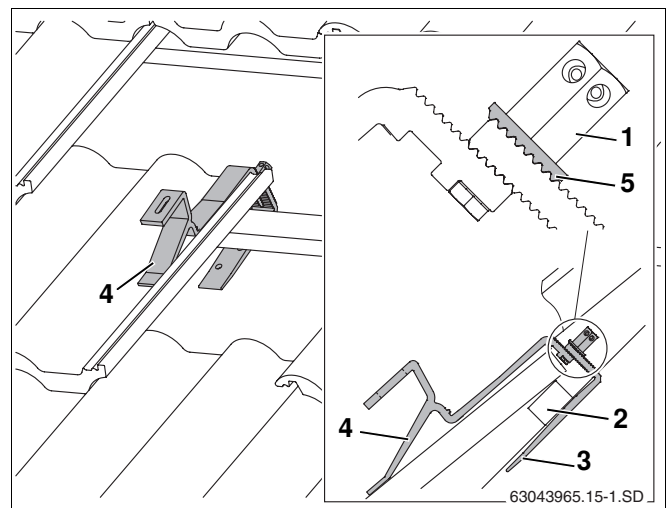


Fig. 12 Roof hook located in place (some tiles have been removed to show the example in more detail)

5.2.2 Fastening roof hooks to joists

Alternatively, the roof hook can also be used for fastening to the joist.

According to the roof hook positions shown in (Tab. 5 and Tab. 6, page 14), sufficiently strong boards must be attached to the joists so that the roof hook can be fitted between the joists.



USER NOTE

With some roof coverings it may be necessary to underlay the lower part of the roof hook (Fig. 13, **Item 4**) with boards so that the upper part of the roof hook lies on top of the tile.

- Loosen the long hexagon nut (Fig. 13, **Item 2**).
- Insert bolt into upper hole (Fig. 13, **Item 3**).
- Loosely fasten lower part of roof hook (Fig. 13, **Item 1**). Do not tighten the connection yet.



CAUTION!

SYSTEM DAMAGE

through breakage of the roof hook if the bolt is not positioned in the upper hole, resulting in uneven load distribution.

- Lay front brace onto the tile so that when subjected to a load it lies in a tile trough (Fig. 14, **Item 3**).

The roof hook must have some clearance along the upper edge of the tile (Fig. 14, **Item 4**). Adjust the top of the tile if necessary.

- Push the lower part of the roof hook down until it lies on the joist or on the boards (Fig. 14, **Item 6**).



USER NOTE

The serated washer (Fig. 14, **Item 5**) must grip the teeth on the lower part of the roof hook.

- Tighten the long hexagon nut (Fig. 14, **Item 1**). To do this, insert the size 5 Allen key into the hole in the hexagon nut and turn.
- Using suitable screws, fasten the lower part of the roof hook into the first (Fig. 14, **Item 2**) and second holes (at least) of the joist.

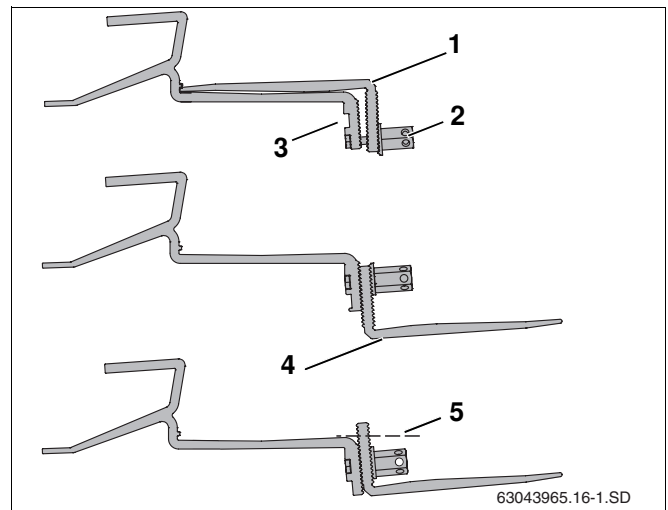


Fig. 13 Fastening roof hooks to joists

Item 1: Lower part of roof hook

Item 2: Long hexagon nut

Item 3: Upper hole for fastening the lower part

Item 4: Underlay if necessary

Item 5: Cut off if necessary

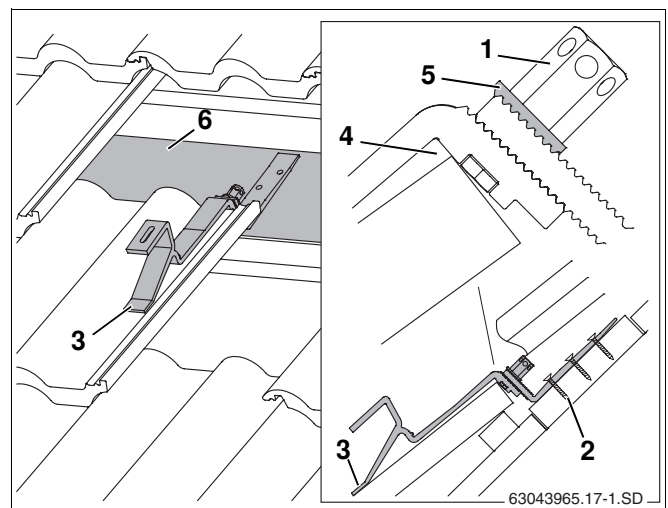


Fig. 14 Roof hook fitted (some tiles have been removed for a better view)

Item 1: Long hexagon nut

Item 2: Screw for fastening roof hook

Item 3: Front brace

Item 4: Adjust the tile as necessary to fit the roof hook

Item 5: Serated washer

Item 6: Board

5.3 Crown tile roofs



USER NOTE

Consult a roofer when installing on a roof with crown tiles.

During installation, please maintain the required distances (w, x and y) between the roof hooks as detailed in (Tab. 5 and Tab. 6, page 14).

According to the roof hook positions shown in (Tab. 5 and Tab. 6, page 14), sufficiently strong boards (Fig. 15, **Item 1**) must be attached to the joists (cut out counter-battens) so that the roof hook can be fitted between the joists.



USER NOTE

If the roof has been fitted with boards, the same roof hook as with pan tile roofs can be used (page 15). It may be possible to fit the roof hooks over battens.

Preparing roof hook

Before installing, the lower part must be moved to the correct position.

- Loosen the long hexagon nut (Fig. 16, **Item 2**).
- Insert bolt into upper hole (Fig. 16, **Item 3**).
- Loosely fasten lower part of roof hook (Fig. 16, **Item 1**). Do not tighten the connection yet.



CAUTION!

SYSTEM DAMAGE

through breakage of the roof hook if the bolt is not positioned in the upper hole, resulting in uneven load distribution.

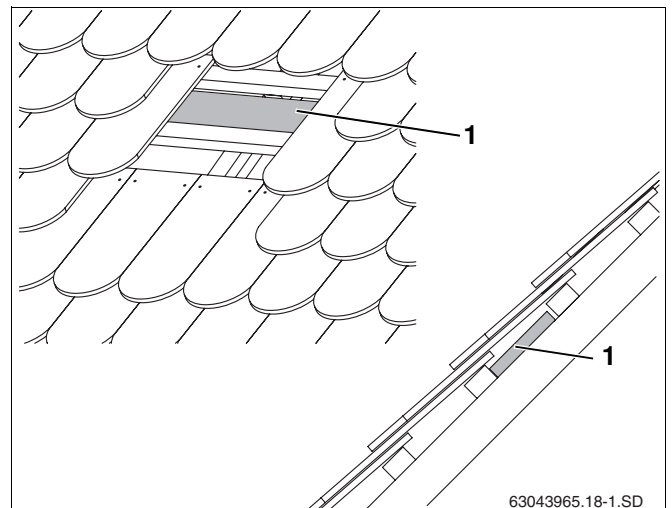


Fig. 15 Fit boards/planks if necessary

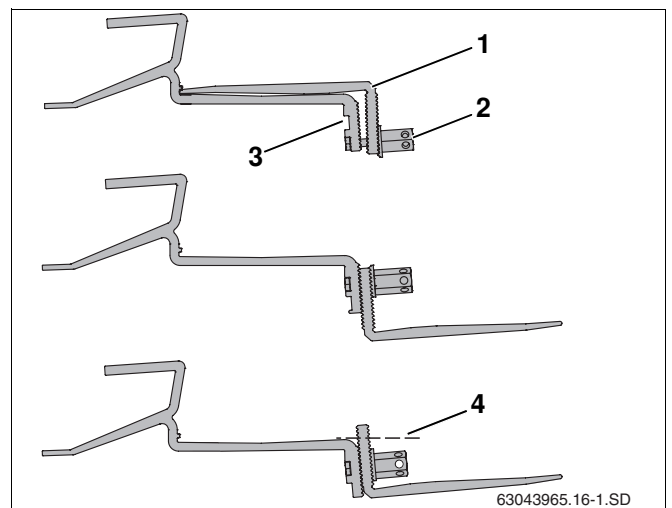


Fig. 16 Repositioning lower part of roof hook

Item 1: Lower part of roof hook

Item 2: Long hexagon nut

Item 3: Upper hole for fastening the lower part

Item 4: Cut off if necessary



WARNING!

RISK TO LIFE

Whilst working on the roof, take all necessary precautions against a possible fall.



WARNING!

RISK OF INJURY

through a fall or falling parts.

- Take appropriate action to prevent accidents when working on roofs.
- Always wear personal protective clothing and safety equipment.



USER NOTE

For better access to the roof use a roofing ladder or slide the tiles at the edge of the collector array up.

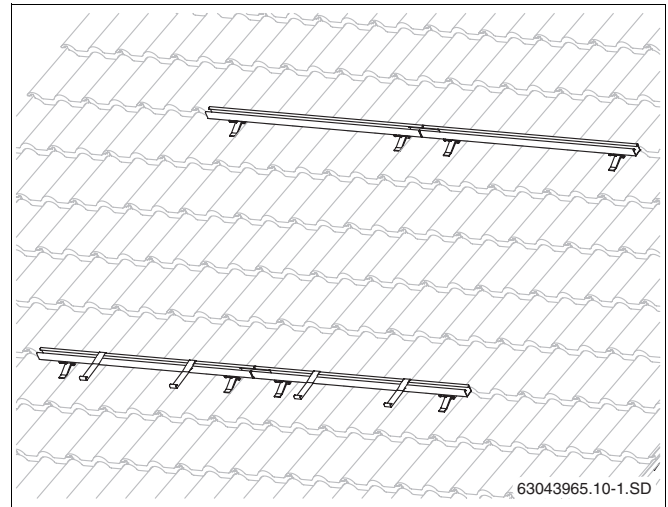


Fig. 17 Fitted profile rails for two collectors

Fitting the roof hook



BUILDING DAMAGE

caused by leaks.

CAUTION!

- Fit each roof hook centrally on a crown tile.



USER NOTE

If the roof battens are too close together, remove the lower part of the roof hook between the second and third holes.

- Push the lower part of the hook down until it lies on the joist or on the board (Fig. 18, **Item 1**).



USER NOTE

The serated washer (Fig. 19, **Item 2**) must grip the teeth on the lower part of the roof hook.

- Tighten the long hexagon nut (Fig. 19, **Item 1**). To do this, insert the size 5 Allen key into the hole in the hexagon nut and turn.
- Using suitable screws, fasten the lower part of the roof hook into the first (Fig. 19, **Item 3**) and second holes (at least) of the joist or board.

- Cut the adjacent crown tiles (Fig. 20, **Item 1**) to size (dashed line, Fig. 20, **Item 2**).

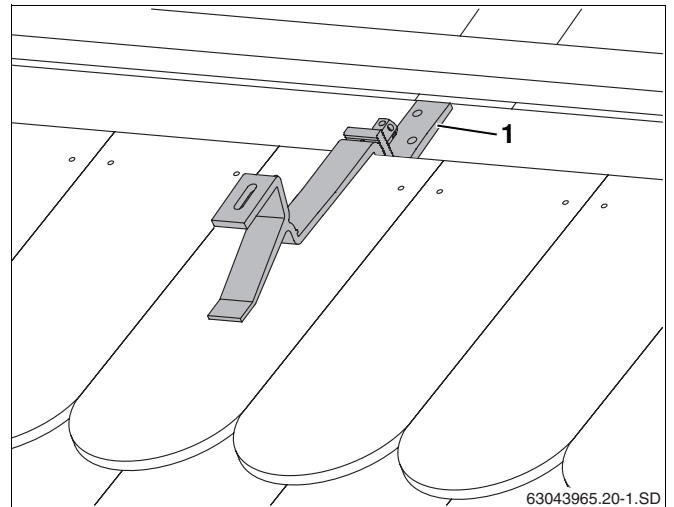


Fig. 18 Fitted roof hook

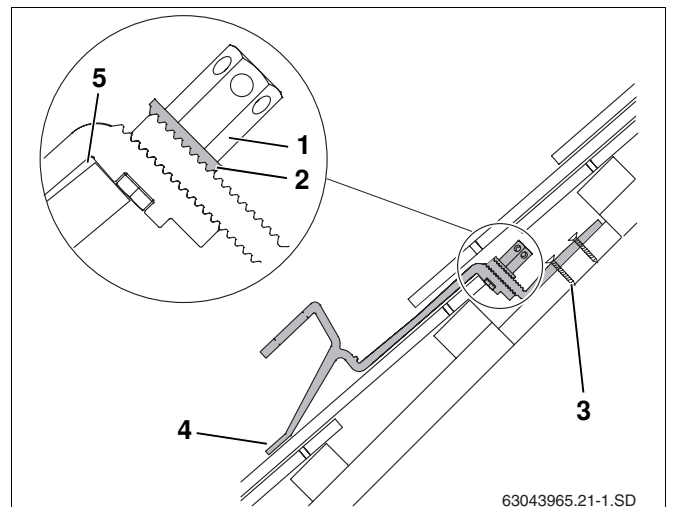


Fig. 19 Fitted roof hook – cross section showing shortened lower part of roof hook

Item 1: Long hexagon nut

Item 2: Serated washer

Item 1: Screw for fastening roof hook

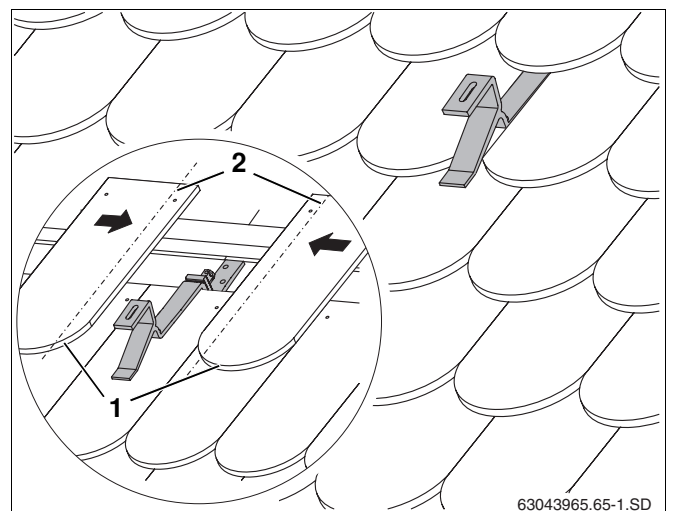


Fig. 20 Roof hook with covered roof

5.4 Corrugated sheet roofs

Carriage bolts must be used instead of roof hooks for fastening the profile rails.

Standard delivery (Fig. 21):

Item 1:	M8 screw	4 ×
Item 2:	Holding bracket	4 ×
Item 3:	M12 nut	4 ×
Item 4:	Washer	4 ×
Item 5:	Sealing disc	4 ×
Item 6:	M12 carriage bolt	4 ×

On corrugated roofs, the peaks determine the true distance between the carriage bolts. During installation, please maintain the required distances (w, x and y) between carriage bolts as detailed in (Tab. 5 and Tab. 6, page 14).



SYSTEM DAMAGE

due to an insufficiently strong subframe.

CAUTION!

- Check that the subframe is strong enough. To fasten the carriage bolts, timber supports of at least 40 × 40 mm thickness are required.
- If necessary, fit additional timber supports to maintain the measurements shown in Tab. 5 and Tab. 6.

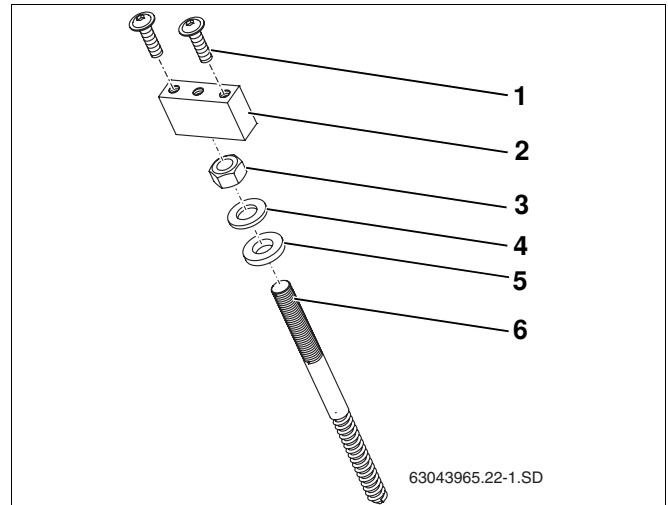


Fig. 21 Roof connector for corrugated steel sheets

Additional tools required

- Cordless screwdriver
- Tape measure
- Wood drill, Ø 6 mm (drill bit length see Chapter "Fitting the carriage bolts", page 21)
- Metal drill, Ø 13 mm
- Spanner size 15 and 19

Fitting the carriage bolts



USER NOTE

Using the wood drill, drill precisely at a 90° angle through the roof subframe to obtain a flat, level surface between the holding bracket and profile rail.



BUILDING DAMAGE

caused by leaks.

CAUTION!

- Never drill into a tile trough.

- Drill through the corrugated metal roof using a metal drill (\varnothing 13 mm) taking note of the positions of the carriage bolt (see Tab. 5 and Tab. 6). Do not drill into the wood beneath!
- Feed wood drill (\varnothing 6 mm) through the hole and drill vertically into the subframe (timber support).
- When fitting the carriage bolts, note the sequence of the individual parts (Fig. 23).
- Turn holding bracket (Fig. 23, **Item 1**) until it touches the carriage bolt (Fig. 23, **Item 5**).
- Screw the pre-assembled carriage bolt into the roof using a size 15 spanner until distance B is reached.



USER NOTE

When screwing in Carriage bolts, ensure that the distance B (Fig. 24) is the same for all carriage bolts.

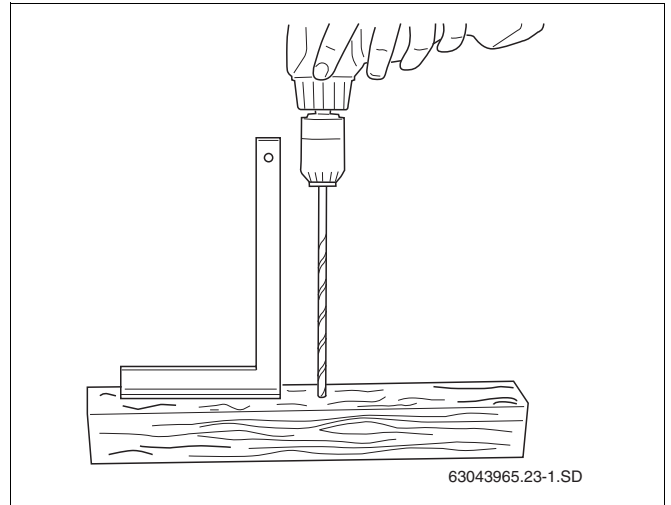


Fig. 22 Creating a drilling template

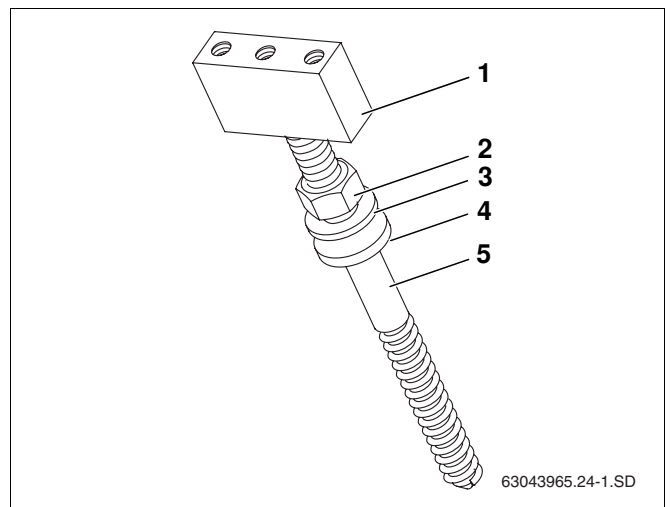


Fig. 23 Fitting the carriage bolts – sequence

Item 1: Holding bracket

Item 2: M12 nut

Item 3: Washer

Item 4: Sealing disc

Item 5: M12 carriage bolt

- Tighten the nuts (Fig. 24, **Item 2**) until the sealing disc (Fig. 24, **Item 3**) is lying completely flush on the roof.



USER NOTE

- The holding bracket must be screwed fully onto the carriage bolt.

Height of peak, dim. A	Dim. B
35 mm	70 mm
40 mm	65 mm
45 mm	60 mm
50 mm	55 mm
55 mm	50 mm
60 mm	45 mm

Fastening the profile rail

Please also note Chapter 5.8.1 "Connecting profile rails".

- Fasten each profile rail (Fig. 25, **Item 2**) with two bolts (Fig. 25, **Item 1**).



USER NOTE

The profile rails must not sag due to differences in level of the joists.

- Use a plumb line to check. If necessary, pack the profile rails at the holding bracket.

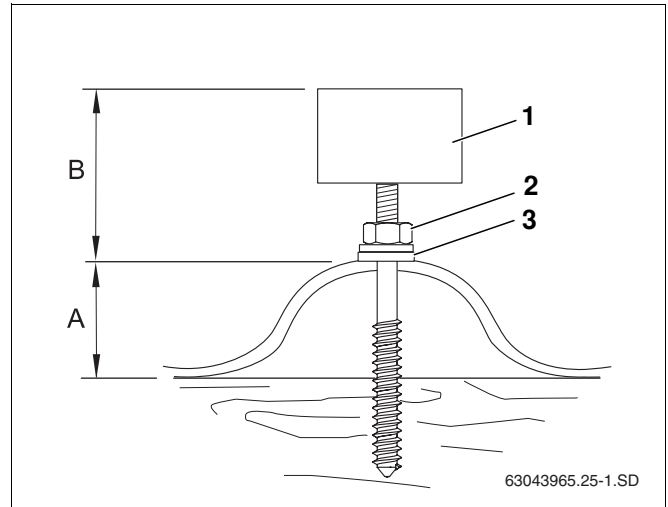


Fig. 24 Carriage bolt fitted to corrugated roof

Item 1: Holding bracket

Item 2: Nut, M12

Item 3: Sealing disc

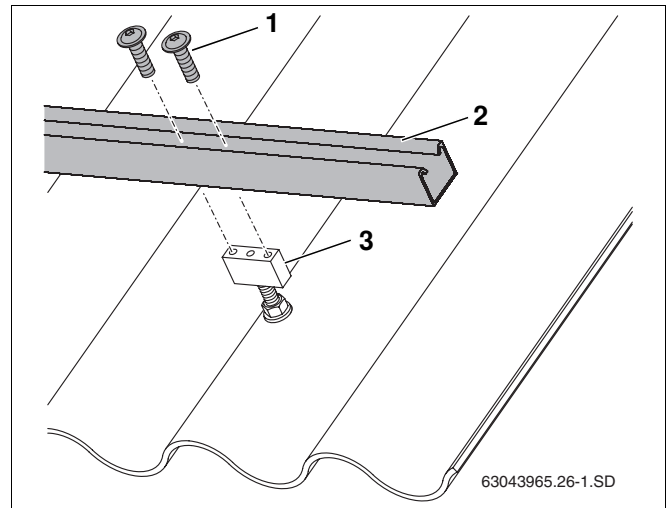


Fig. 25 Fastening the profile rail to the holding bracket

Item 1: Screw

Item 2: Profile rail

Item 3: Holding bracket

5.5 Slate/shingle roofs



USER NOTE

A roofer must carry out the installation on slates or shingles.

Here is an example of the installation of the special roof hooks and the watertight seal with custom flashing (Fig. 26, **Item 1** and **2**) with a shingle/slate roof.

During installation, please maintain the required distances (w, x and y) between the special roof hooks as detailed in (Tab. 5 and Tab. 6, page 14).

- Fit special roof hook (Fig. 26, **Item 5**) and gasket (Fig. 26, **Item 4**) to the slate/shingle roofs using screw (Fig. 26, **Item 6**).
- To ensure that the installation is watertight, flashing (Fig. 26, **Item 1, 2**) must be installed on the building above and below the special roof hooks.



USER NOTE

The special roof hooks must be positioned on the front of a multiple roof (Fig. 26, **Item 3**).

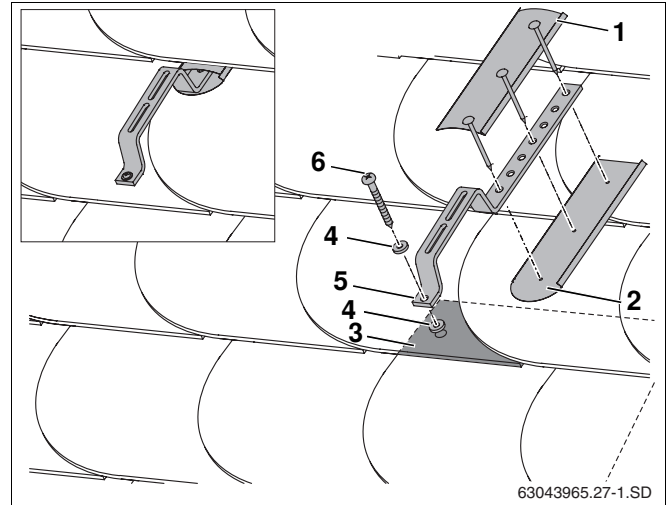


Fig. 26 Mounting on slate/shingle roof

Item 1: Flashing (on building)

Item 2: Flashing (on building)

Item 3: Multiple tiles

Item 4: Gasket (on building)

Item 5: Special roof hooks

Item 6: Screw

5.6 Sheet roofs



USER NOTE

A roofer must carry out the installation on a sheet roof.

Carriage bolts (Fig. 27, **Item 5**) must be used instead of roof hooks for fastening the profile rails. During installation, please observe the distances (w, x and y) between Carriage bolts as detailed in (Tab. 5 and Tab. 6, page 14).

To ensure the roof is water tight, sleeves for the carriage bolts (Fig. 27, **Item 5**) must be soldered onto the sheet roof.



USER NOTE

For the fitting sequence for carriage bolts and profile rails, and the relevant instructions, see Chapter 5.4 "Corrugated sheet roofs".

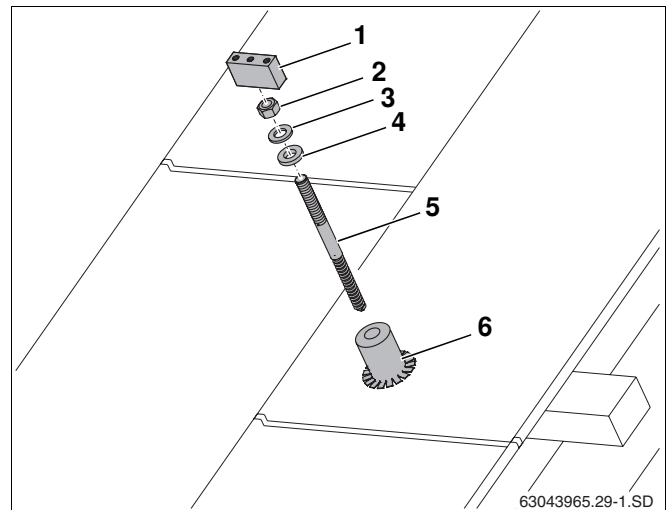


Fig. 27 Mounting on sheet roof

Item 1: Holding bracket

Item 2: M12 nut

Item 3: Washer

Item 4: Sealing disc

Item 5: M12 carriage bolt

Item 6: Sleeve (not supplied)

5.7 Fitting additional rails (accessory)

Additional measures are needed for installation heights of 20 to 100 m and/or with standard wind or snow loads of 2.0 to 3.1 kN/m².



USER NOTE

The example here shows an installation on pan tile roofs. The additional rails can also be installed on other types of roof described in this manual.

Fitting additional roof hooks

Additional roof hooks must be fitted for attaching the wind or snow load profiles.

- Fasten additional roof hooks (Fig. 28, **Item 1**) as centrally as possible between the upper and lower roof hooks already fitted.



USER NOTE

There must be at least one free row of tiles between the upper, middle and lower roof hooks.

Fastening the wind or snow load profile to the roof hooks

- Push sliding nut (Fig. 29, **Item 1**) onto the roof hook in the direction of the arrow.
- Place the wind or snow load profile (Fig. 29, **Item 2**) onto the roof hooks and tighten using an M8 bolt (Fig. 29, **Item 3**).
- Make sure wind or snow load profiles are level and flush (use string line).

Installing the profile rails

The profile rails must be joined before they are fastened. Please see Chapter 5.8.1 "Connecting profile rails".

- Place the profile rails (Fig. 30, **Item 1**) into the indentations (Fig. 30, **Item 2**) on the wind or snow load profiles and loosely fasten using bolt and sliding nut (Fig. 30, **Item 3**) so that the profile rails can still be aligned.
- Carry out the same procedure for the other profile rails.

To continue with the installation, see Chapter 5.8.3 "Aligning the profile rails".

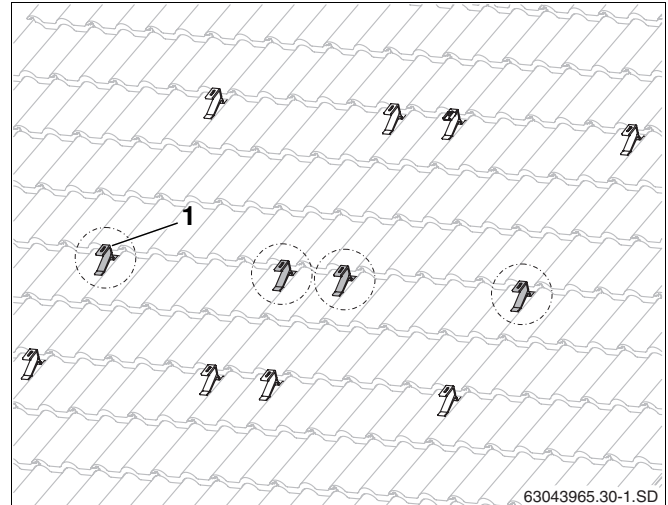


Fig. 28 Additional roof hooks for the wind or wind or snow load profile (here: for two collectors)

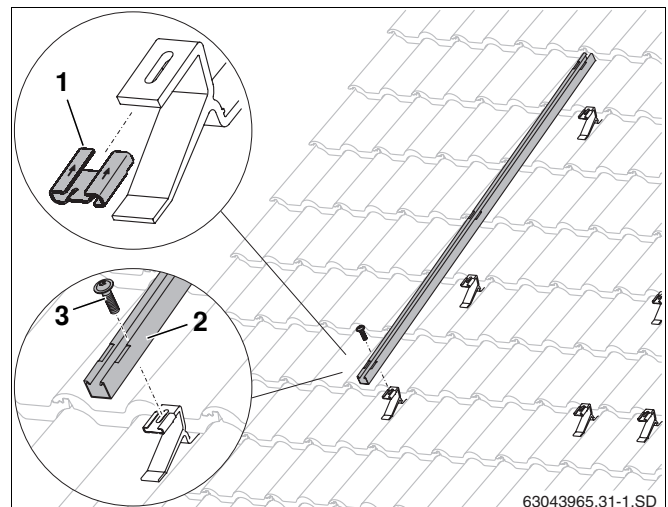


Fig. 29 Fastening the wind or snow load profile

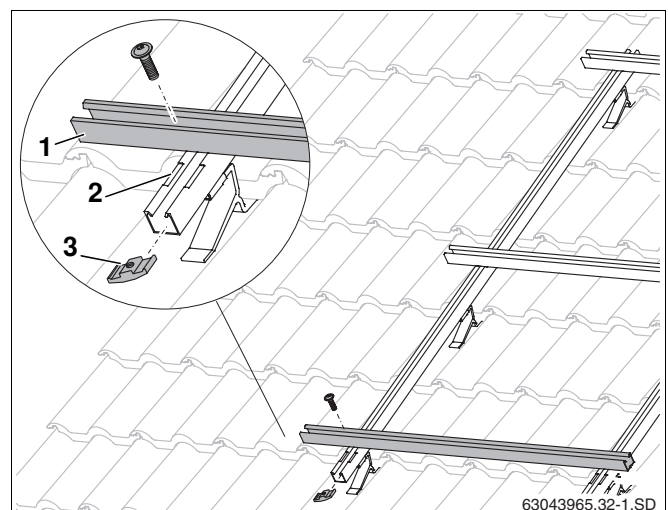


Fig. 30 Fitting landscape profile rails

5.8 Installing profile rails

The profile rails must be joined together using rail connectors. Each collector has been provided with an upper and lower profile rail.

5.8.1 Connecting profile rails

- Push rail connector (Fig. 31, **Item 1**) as far as it will go into both profile rails (Fig. 31, **Item 2**).
- To lock, tighten both fitted M10 threaded studs (Fig. 31, **Item 3**) in the rail connector using a size 5 Allen key.

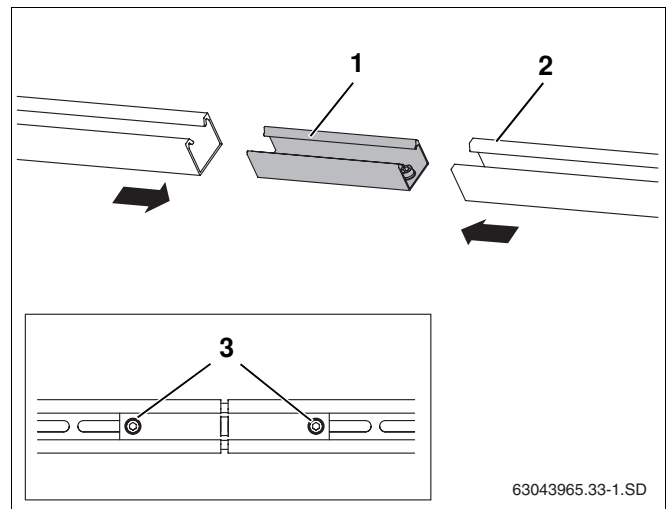


Fig. 31 Connecting profile rails

Item 1: Rail connector

Item 2: Profile rail

Item 3: M10 threaded stud

5.8.2 Installing profile rails

- Push sliding nut (Fig. 32, **Item 1**) onto the roof hook in the direction of the arrow.
- Place the lower profile rails (Fig. 32, **Item 2**) onto the roof hooks and loosely fasten M8 bolt (Fig. 32, **Item 3**) so that the profile rails can still be aligned.
- Carry out the same procedure for the upper profile rails.



USER NOTE

Care should be taken not to over-tighten the stud in the rail connector to avoid deforming the material.

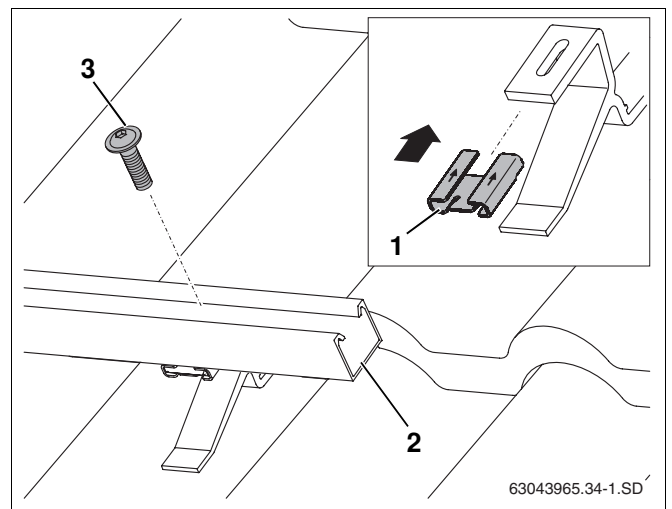


Fig. 32 Fastening profile rails to the roof hook

Item 1: Sliding nut

Item 2: Profile rail

Item 3: Bolt

5.8.3 Aligning the profile rails

- Align the upper and lower profile rails to the side flush with each other and level them (Fig. 33, use a spirit level)..



USER NOTE

Measure the diagonals or place a roof batten (Fig. 33, **Item 1**), for example, at the ends of the profile rails. The angle between roof batten and profile rail must be 90°. Align the profile rails over the slotted holes.

- Tighten the screws.



USER NOTE

The profile rails must not sag due to differences in level of the joists.

Check using a plumb line.

5.8.4 Installation of anti-slip protection

To prevent the collectors from slipping, you must fasten two anti-slip protectors to the lower profile rails for each collector.

- Push each anti-slip protector (Fig. 34, **Item 3**) into the innermost slotted holes (Fig. 34, **Item 1**) over the profile rails until it clicks into place (Fig. 34, **Item 2**).

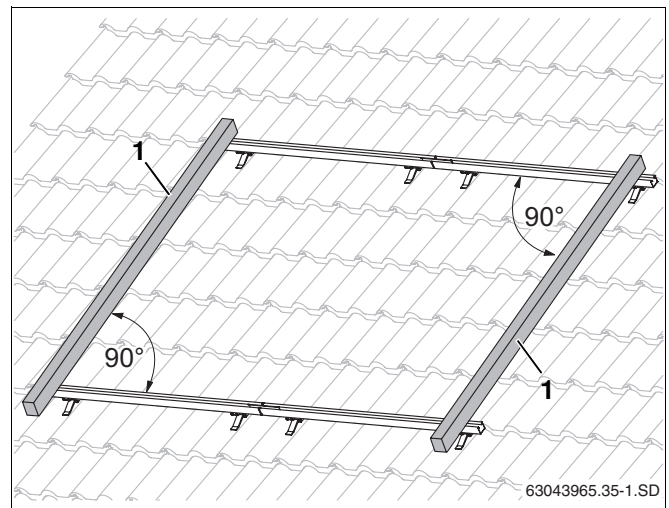


Fig. 33 Aligning the profile rails

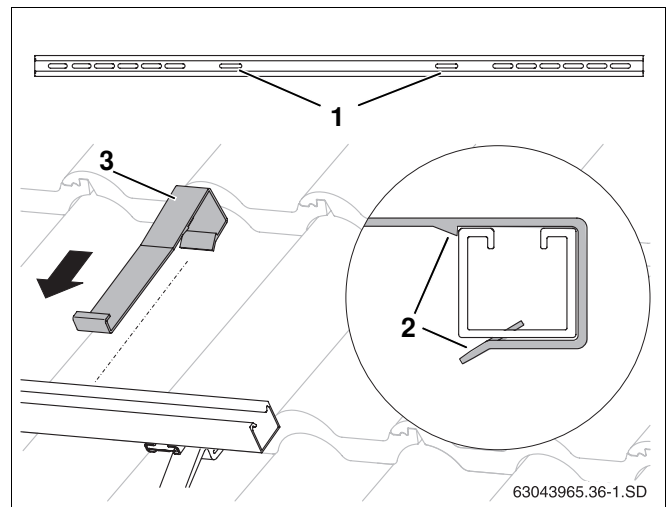


Fig. 34 Attaching anti-slip protection

Item 1: Fixing holes for the anti-slip protection

Item 2: Clicking the anti-slip protection into place

Item 3: Anti-slip protection

6 Collector installation

Observe the following safety and user instructions when commencing the collector installation.



RISK TO LIFE

through a fall or falling parts.

WARNING!

- Take appropriate action to prevent accidents when working on roofs.
- Whilst working on the roof, take all necessary precautions against a possible fall.
- Always wear your personal protective clothing and safety equipment.
- After completing the installation, always check the secure positioning of the installed set and that of the collectors.
- Ensure that the correct equipment is used for working on roofs.



SYSTEM DAMAGE

through interruption of work.

CAUTION!

- Secure the collectors against falling.
- Stabilise the collector array.



USER NOTE

Use lifting equipment as used by roofing contractors or sufficient suction handles for the installation.



USER NOTE

Unsecured collectors may fall during handling and installation.

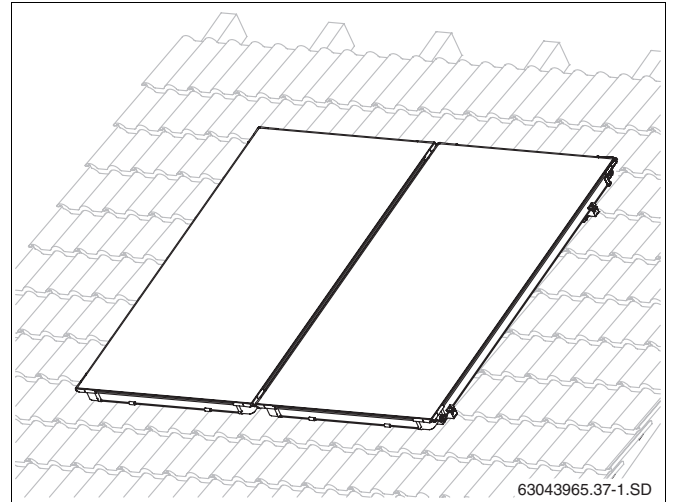


Fig. 35 View of roof mounting with collectors

6.1 Preparing to install the collectors

Before beginning actual installation on the roof, preassemble the end caps on the ground to make work on the roof easier.

To secure the end caps (and later the corrugated pipe connectors and connecting pipes as well), attach brackets to the connections.



CAUTION!

SYSTEM DAMAGE

through leaks in the collector connections.

The corrugated pipe connectors, connecting pipes and collector connections must not display any signs of damage or contamination.

- The collector connections have had special grease applied in the factory to make installation easier. Do not use any other grease.

6.1.1 Pipework connections

The collectors must be installed in such a way that the sensor bushes that receive the collector sensor (Fig. 37, **Item 1**) are at the top.



USER NOTE

The water connection pipes can be connected on the right (Fig. 36) or left (Fig. 37). In this manual, the connection pipes are shown on the right.

The pipework in the collector is designed as a double meander, which enables you to carry out two different water connections:

single-sided connection of up to 5 collectors

Up to 5 collectors can be connected one side of a collector array (Fig. 36 and Fig. 37).

Two-way connection of up to 10 collectors

If there are more than 5 collectors installed in one collector array, the water connection must be two-way (Tichelmann principle, Fig. 38).

The two-way connection can also be made if there are fewer than 6 collectors (Fig. 38).

If more than 10 collectors are required then a further AGS pump station is required.

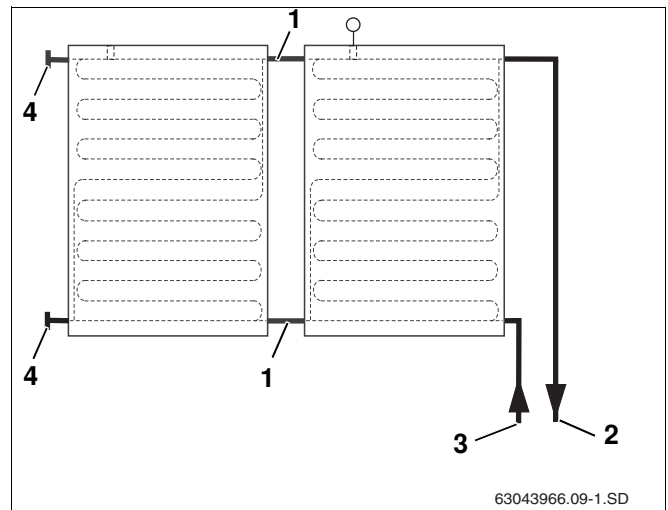


Fig. 36 Water connection (right) up to max. 5 collectors

Item 1: Corrugated pipe connector

Item 2: Flow line

Item 3: Return line

Item 4: End cap

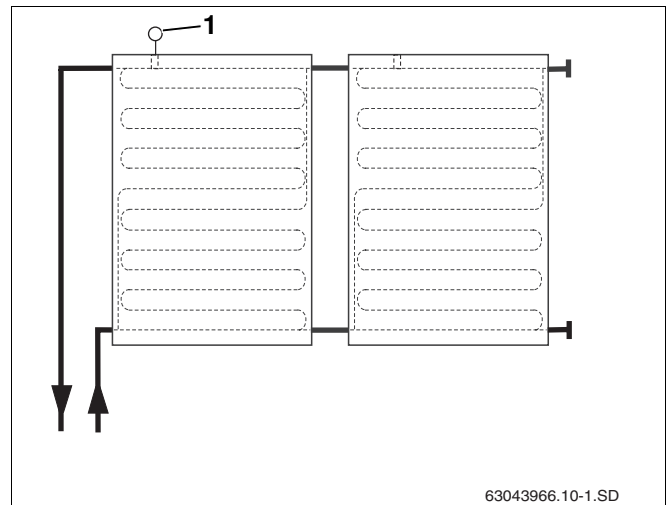


Fig. 37 Water connection (left) up to max. 5 collectors

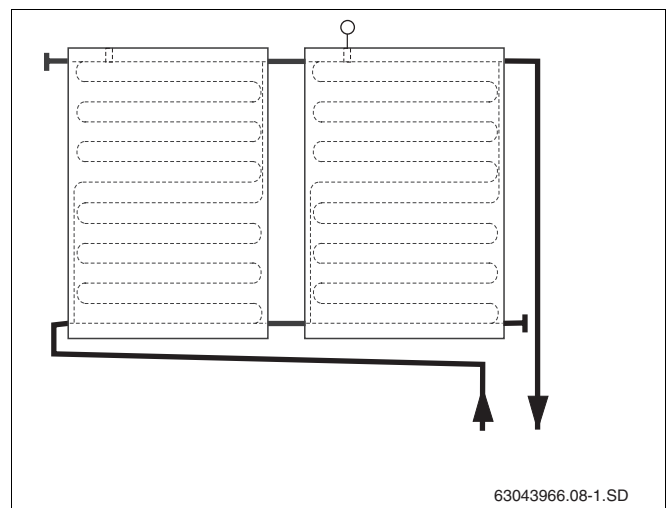


Fig. 38 Two-way pipework connections

6.1.2 Fitting the end cap

Not all the connections are needed when connecting a collector array. Those that are not used must be closed.

- Remove rubber caps (transport protection) from the relevant collector connections.
- Push end cap with the O-rings (Fig. 39, **Item 1**) onto the collector connection.
- Push bracket (Fig. 39, **Item 2**) over the end cap and collector connection to secure the connection.

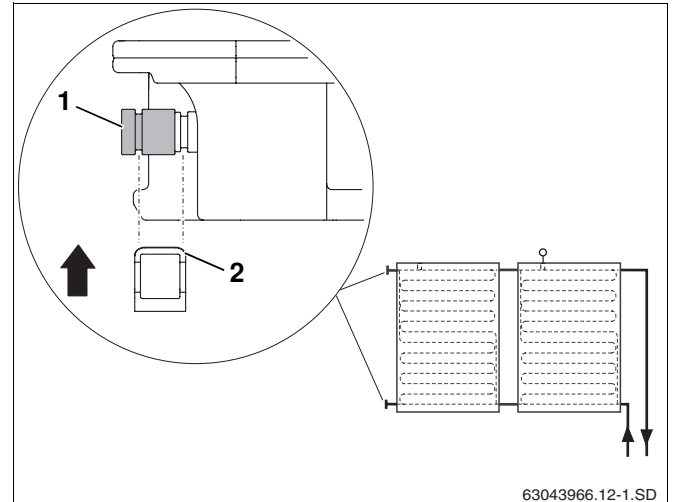


Fig. 39 Securing end cap with bracket

6.2 Fastening the collectors

The collectors are fastened to the profile rails using the single-sided collector clamps (Fig. 40, **Item 2**) at the beginning and end of a collector array, and double-sided clamps (Fig. 40, **Item 1**) between each collector.

In addition, the anti-slip protectors prevent the collector from slipping.



USER NOTE

The plastic parts on the collector clamps do not have any support function. They are simply intended to make installation easier.

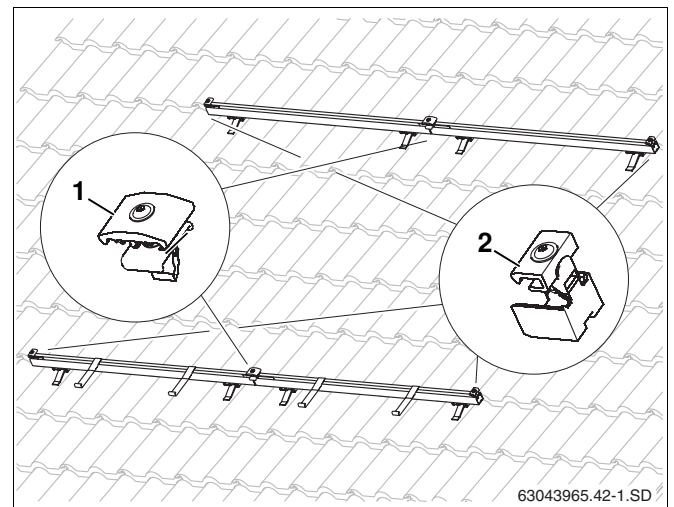


Fig. 40 Fasteners for the collector

Pushing on the single-sided collector clamp on the right

- Push single-sided collector clamps (Fig. 41, **Item 1**) into the profile rails at the right-hand end of the collector array until they click into place in the first slotted hole on the profile rails.



USER NOTE

Do not fit the single-sided collector clamps to the left-hand side of the collector array until the last collector has been installed.

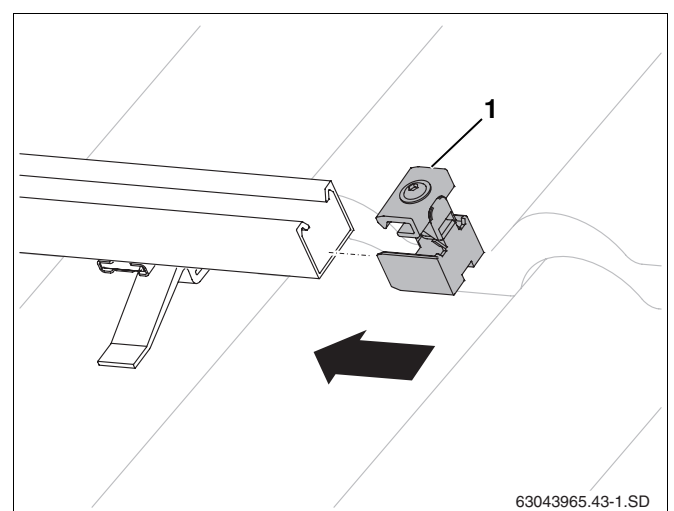


Fig. 41 Pushing on the single-sided collector clamp

Putting the first collector in place

Lay the collector on the profile rails in such a way that the sensor bush is at the top to receive the collector sensor. Begin by laying the collectors on the right-hand side of the profile rails.



CAUTION!

RISK OF INJURY

Install collectors with at least one assistant.

- Place the first collector onto the profile rails and allow it to slide into the anti-slip protectors (Fig. 42).

The lower collector edge must lie in the opening of the anti-slip protector (Fig. 42, **Item 1**).

- Carefully push collector (Fig. 43, **Item 1**) up against the single-sided collector clamp and align horizontally.
- Screw in single-sided collector clamp (Fig. 43, **Item 2**) using size 5 Allen key.



USER NOTE

When the screw is tightened, the plastic lugs at the pre-determined cut-off points break away and can be discarded.

The grip on the collector clamp (Fig. 43, **Item 2**) now grips the lower collector edge.

Inserting a double-sided collector clamp

- Insert the double-sided collector clamp, nut first, into the opening made by the profile rail and plug connector so that the plastic spacer (Fig. 44, **Item 1**) surrounds the profile rail.
- Push double-sided collector clamp up against the collector frame.



USER NOTE

Do not tighten the screw until the second collector has been pushed up against the double-sided collector clamp.

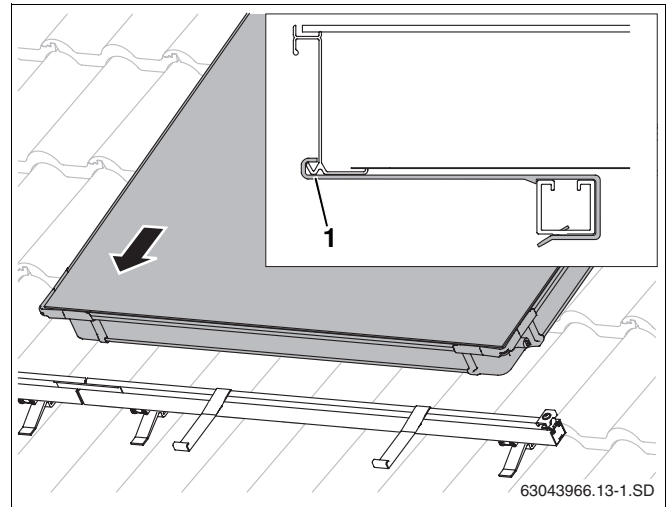


Fig. 42 Laying the first collector on the profile rails

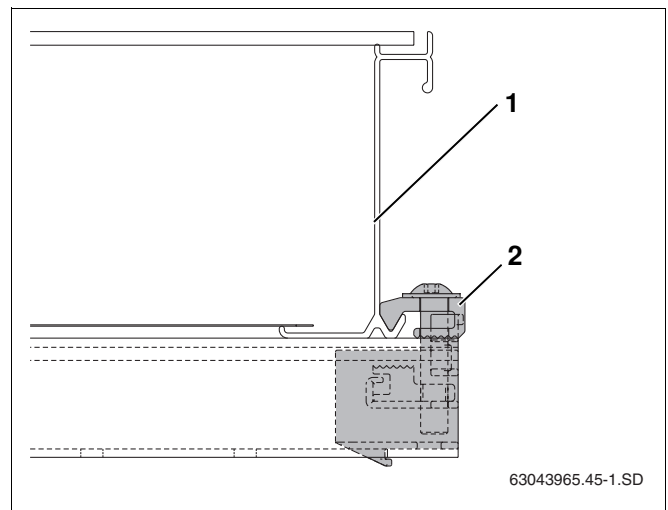


Fig. 43 single-sided collector clamp screwed in place

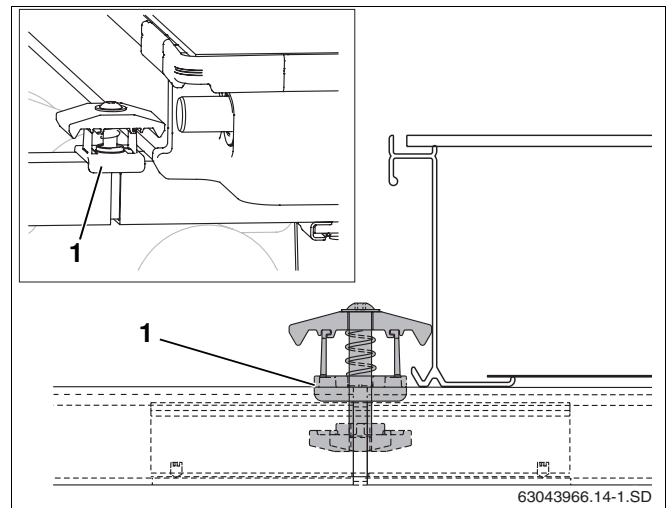


Fig. 44 Fitting a double-sided collector clamp

Fitting corrugated pipe connectors to the first collector

- Remove the rubber caps from the connections.
- Push corrugated pipe connectors (Fig. 45, **Item 1**) onto the left-hand connections on the first collector.
- Push bracket (Fig. 45, **Item 2**) over the corrugated pipe connector and collector connection to secure the connection.

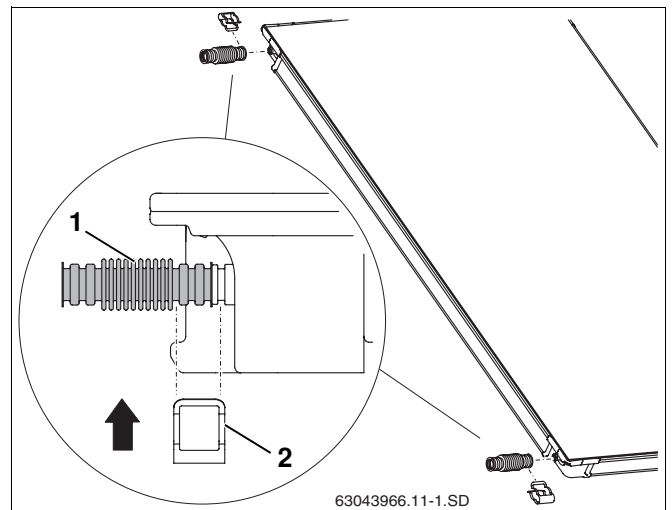


Fig. 45 Fitting corrugated pipe connectors to the first collector

Putting the second collector in place

- Place the second collector onto the profile rails and allow it to slide into the anti-slip protectors.



CAUTION!

SYSTEM DAMAGE

through damaged corrugated pipe connectors.

- Do not use any tools, e.g. pliers (Fig. 46, **Item 2**). These could render the corrugated pipe connector unusable.

- Push the second collector on to the first in such a way that the collector connections are pushed into the preassembled corrugated pipe connectors (Fig. 46, **Item 1**) on the first collector.
- Place second bracket (Fig. 46, **Item 3**) over the corrugated pipe connector and collector connection.



CAUTION!

SYSTEM DAMAGE

through unsecured corrugated pipe connectors and end caps.

- Secure each end cap with one bracket and each corrugated pipe connector with two brackets (Fig. 47, **Item 1**).

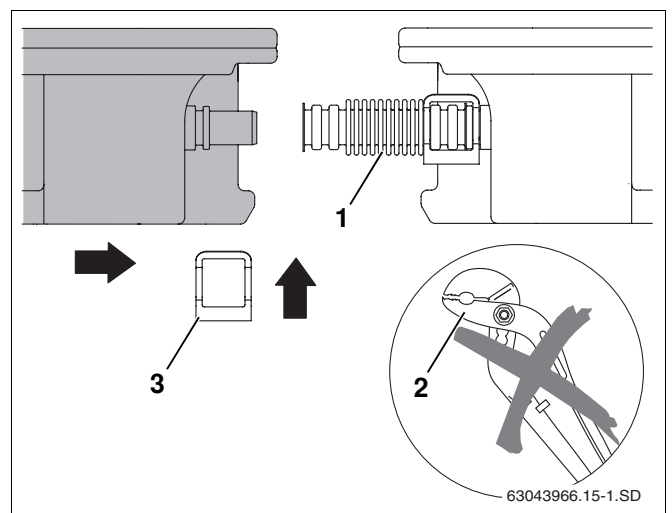


Fig. 46 Pushing second collector towards the first

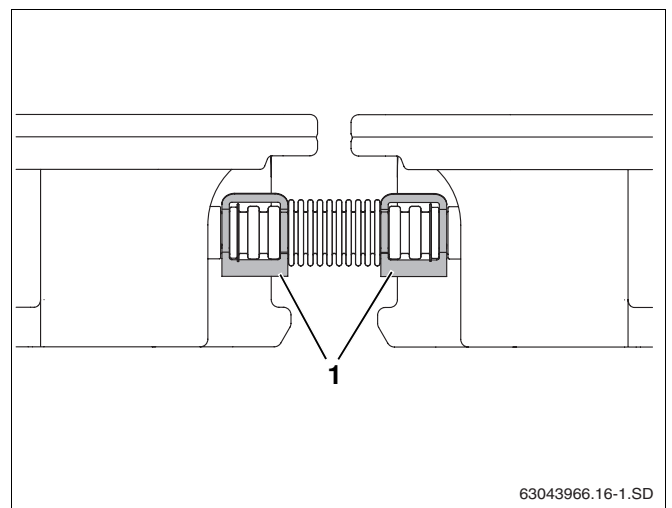


Fig. 47 Corrugated pipe connector secured with brackets

- Tighten the screw on the double-sided collector clamp using the size 5 Allen key.

**USER NOTE**

When the screw is tightened, the plastic lugs at the pre-determined cut-off points break away.

The grip (Fig. 48, **Item 1**) on the collector clamp now grips the lower collector edges.

Repeat the procedure for all the other collectors.

Fitting the single-sided collector clamp on the left

Once all collectors are fitted, the two remaining single-sided collector clamps can be attached.

- Push single-sided collector clamp (Fig. 49, **Item 1**) into upper and lower profile rails.
- Push collector clamp up against the collector frame and screw in place using size 5 Allen key (Fig. 49, **Item 2**).

**USER NOTE**

When the screw is tightened, the plastic lugs at the pre-determined cut-off points break away and can be discarded.

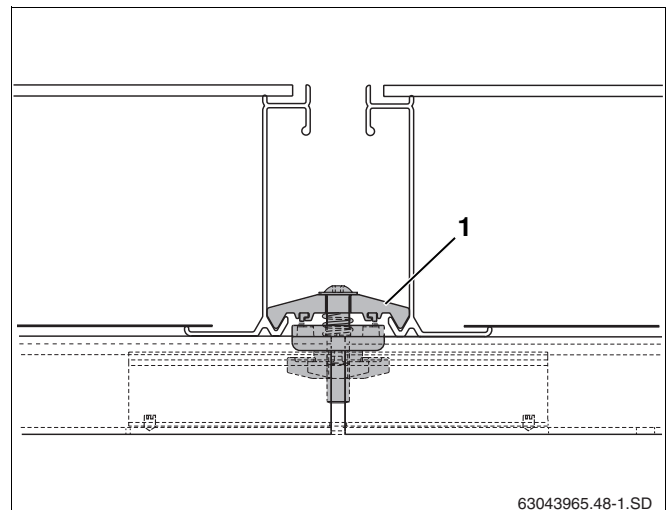


Fig. 48 Double-sided collector clamp between two collectors

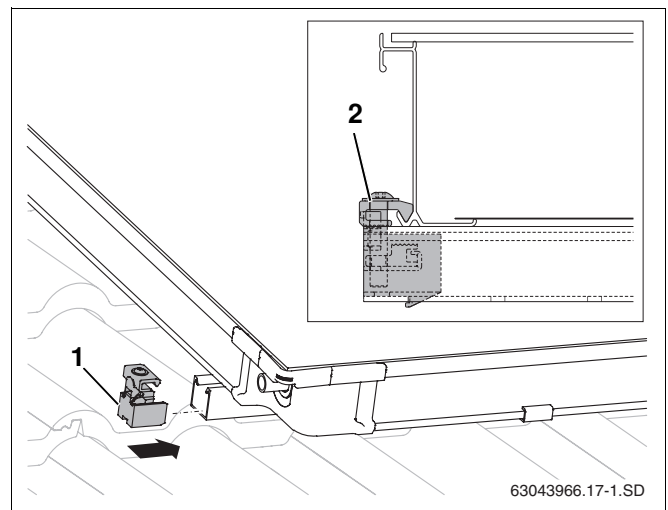


Fig. 49 single-sided collector clamp (left)

7 Collector sensor connection



USER NOTE

The collector sensor is supplied with the solar controller.

Observe the installation location for single or dual row collector systems (Fig. 50).



SYSTEM DAMAGE

through faulty sensor cable.

CAUTION!

- Protect the cable from possible damage.

Insertion point

The collector sensor must be fitted in the collector nearest to the flow connection (Fig. 50, **Item 2**).

- Insertion point (Fig. 50, **Item A**) for single row collector systems.
- Insertion point (Fig. 50, **Item B**) for dual row collector systems.

Installing the collector sensor

For perfect functioning of the solar thermal system, the collector sensor (Fig. 51, **Item 1**) needs to be inserted into the sensor guide tube as far as it will go (approx. 250 mm).

- Using the collector sensor or screwdriver, push through the sealing membrane on the sensor bush (Fig. 51, **Item 3**).
- Screw clamped joint (Fig. 51, **Item 2**) into sensor bush.
- Insert collector sensor approx. 250 mm into the sensor guide tube (as far as it will go).
- Tighten clamped joint (Fig. 51, **Item 2**), counterhold if necessary.



USER NOTE

If you accidentally push through the sensor bush (Fig. 51, **Item 3**) on the wrong collector, it can be resealed using the plug from the connection kit. You must first remove the nut in the sensor bush using the cable gland (Fig. 51, **Item 2**).

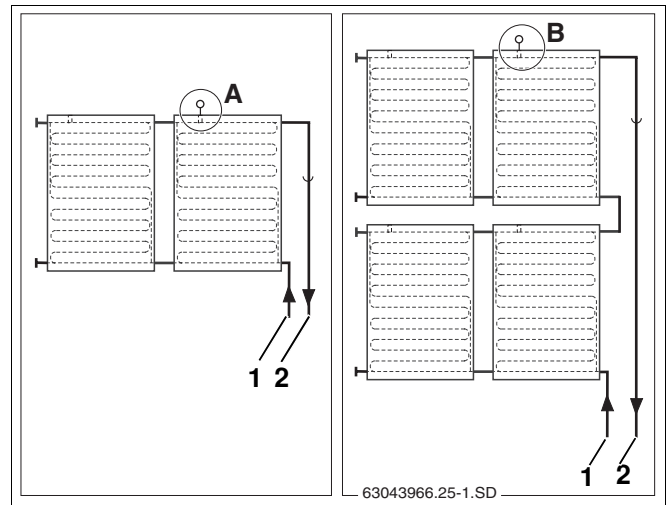


Fig. 50 Collector sensor installation location (schematic)

Item 1: Return line

Item 2: Flow line

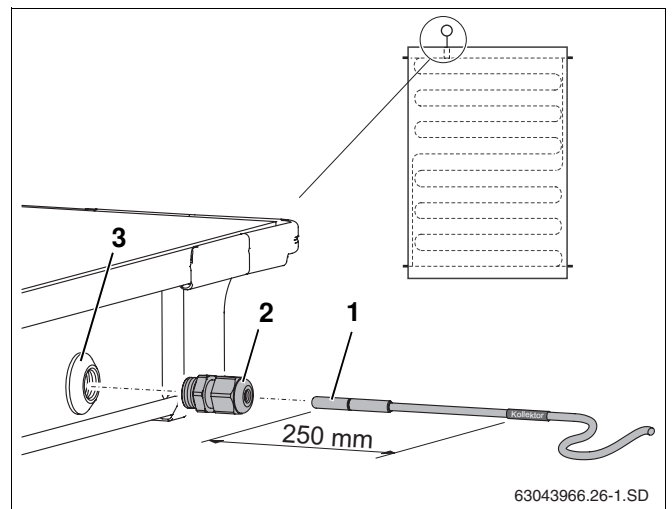


Fig. 51 Pushing the collector sensor into the collector

Item 1: Collector sensor

Item 2: Clamped joint

Item 3: Sensor bush

8 Header connection

Information on laying the header pipes can be found in the complete station installation instructions.

The pipework connection to the header pipes is made using the long flexible connection pipes. It is not permitted to connect a fixed header pipe directly to the collector.



USER NOTE

Use standard ventilation tiles or lead flashing when laying the connection pipes under the roof.

Use a specialist company to route the connection pipes under the roof.



USER NOTE

Feed the sensor cable together with the flow line through the ventilation tile under the roof.



USER NOTE

If you intend to vent the solar thermal system with an automatic air-vent valve (accessory) at the highest point of the system, run the flow line rising to the air-vent valve and the return line rising to the collector array.

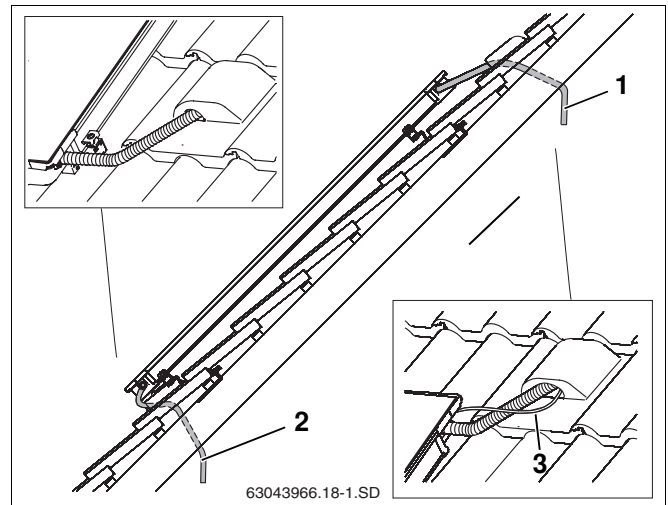


Fig. 52 Routing connection pipes under the roof

Item 1: Flow line (shown without insulation)

Item 2: Return line (shown without insulation)

Item 3: Sensor cable

8.1 De-airing through pressure filling

If venting of the solar thermal system is carried out using an electric pressure filling pump, no vent is required on the roof for installations of less than 20 collectors.

- Push connection pipe (1.000 mm, Fig. 53, **Item 1**) onto the flow connection on the collector array and fix in place using bracket (Fig. 53, **Item 4**).
- Feed connection pipe together with the sensor cable through the ventilation tile (Fig. 53, **Item 3**) and through the roof insulation.
- Connect header pipe to the compression fitting (Fig. 53, **Item 2**).

Perform the same procedure with the return connection.

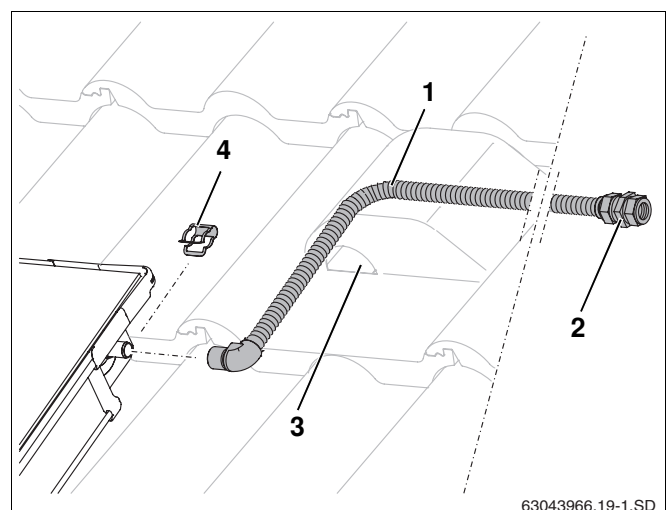


Fig. 53 Fitting flow line (with no vent at highest point in the system)

8.2 De-airing through air vent (accessory) on roof

If you intend to vent the solar thermal system with an automatic air-vent valve (accessory) at the highest point of the system, run the flow line rising to the air-vent valve (Fig. 54, **Item 2**) and the return line rising to the collector array (Fig. 54).

Avoid frequent changes in direction.



USER NOTE

For each change of direction downwards and each new rise, install an additional with air vent.

If you cannot provide an automatic air vent valve due to space restrictions, install a manual air vent valve.

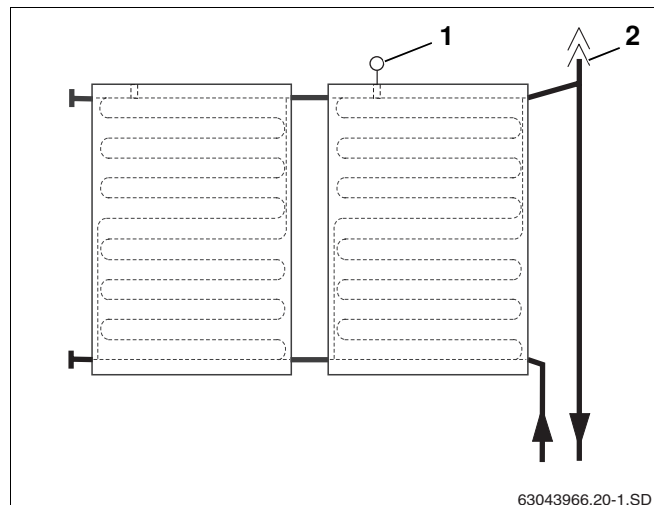


Fig. 54 View – with vent valve for flow connection

Item 1: Collector sensor

Item 2: Automatic air vent valve on roof

Function of the weather protection cap and weather protection cap on the automatic air vent valve

The solar thermal system is vented through the opened weather protection cap. When in operation, the weather protection cap (Fig. 55, **Item 1**) must always be positioned over the weather protection cap to prevent moisture entering through the opened weather protection cap into the solar thermal system).

Open the air vent valve by unscrewing the weather protection cap one full revolution.

Universal air vent set (Fig. 55):

Item 1:	Weather protection cap	1 ×
Item 2:	Automatic air vent	1 ×
Item 3:	Ball valve	1 ×
Item 4:	Gasket	1 ×
Item 5:	Vent pot	1 ×
Item 6:	Double threaded fitting with O-ring	1 ×
Item 7:	Threaded fitting R ^{3/4}	1 ×
Item 8:	Union nut	2 ×
Item 9:	Gasket	1 ×
Item 10:	Large diameter washer	1 ×
Item 11:	Clamping disc	1 ×

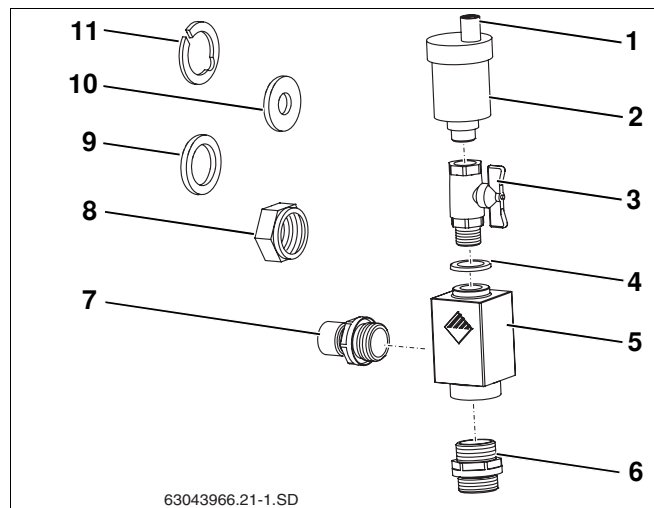


Fig. 55 Universal air vent set

8.2.1 Fitting the air vent valve under the roof

- Push connection pipe (Fig. 56, **Item 3**) onto the flow connection on the collector array and fix in place using bracket (Fig. 56, **Item 5**).
- Feed connection pipe together with the sensor cable through the ventilation tile (Fig. 56, **Item 4**) and through the roof insulation.

Perform the same procedure with the return connection.

- Remove nut and compression fitting from connection pipe.
- Firmly screw connection pipe (Fig. 56, **Item 3**) and double threaded fitting (Fig. 56, **Item 1**) into air pot (O-ring gasket).
- Connect header pipe to double threaded fitting with compression fitting (Fig. 56, **Item 1**).

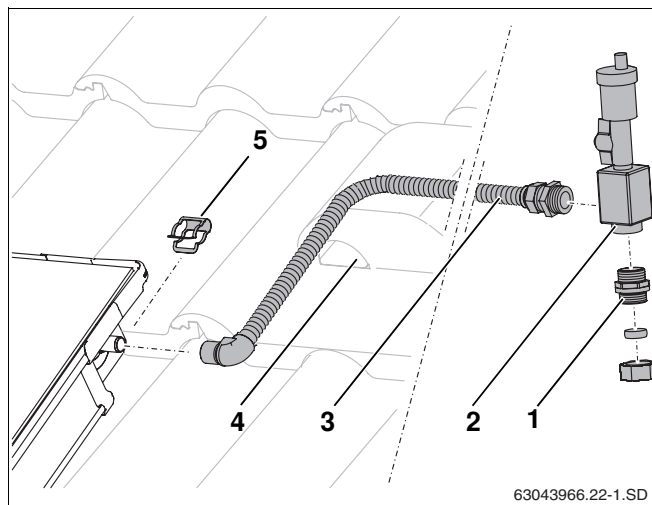


Fig. 56 Fitting the air vent valve under the roof

Item 1: Double threaded fitting with O-ring

Item 2: Air pot

Item 3: Connection pipe

Item 4: Ventilation tile

Item 5: Bracket

8.2.2 Fitting the air vent valve on the roof

To connect the connection pipe to the air vent (flow connection), the elbow must be removed from the connection pipe and the double threaded fitting fitted.

- Cut elbow (Fig. 57, **Item 1**) from connection pipe using pipe cutter.
- Push union nut over the connection pipe.

Making the sealing face:

- Place clamping disc (Fig. 57, **Item 2**) behind the first rib and press together. The clamping disc must lie evenly on the collar of the nut.
- Put large diameter washer (Fig. 57, **Item 3**) into the union nut in front of the cut surface of the connection pipe.
- Firmly screw double threaded fitting (Fig. 57, **Item 4**) into union nut, so that a flat sealing surface is created on the connection pipe.
- Remove double threaded fitting and large diameter washer and check that a flat sealing surface has been created.
- Remove any burrs as required.
- Insert gasket (Fig. 57, **Item 5**) and screw in double threaded fitting.

Connection to the collector:

- Firmly screw threaded fitting (Fig. 58, **Item 5**) and connection pipe (Fig. 58, **Item 2**) into air pot (O-ring gasket).
- Push air pot (Fig. 58, **Item 1**) and threaded fitting onto collector connection and secure with bracket (Fig. 58, **Item 6**).
- Feed connection pipe together with the sensor cable through the ventilation tile (Fig. 58, **Item 4**) and through the roof insulation.
- Connect header pipe to the compression fitting (Fig. 58, **Item 3**).



USER NOTE

Install return connection as described in Chapter 8.1 "De-airing through pressure filling".

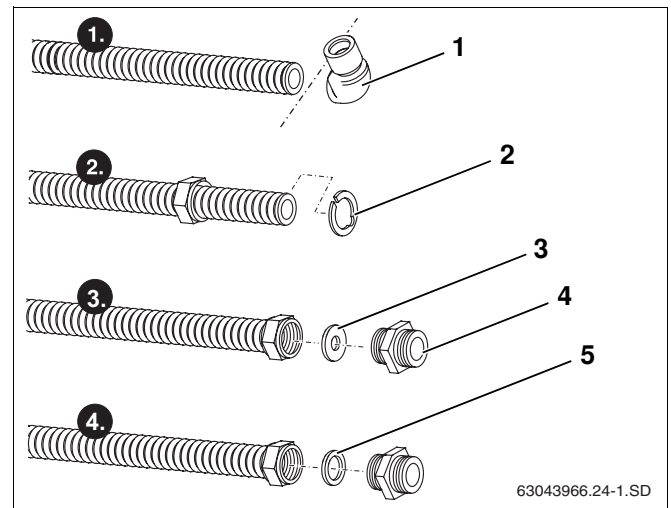


Fig. 57 Preparing the connection pipe

Item 1: Bracket

Item 2: Clamping disc

Item 3: Large diameter washer (for making sealing face)

Item 4: Double threaded fitting

Item 5: Gasket

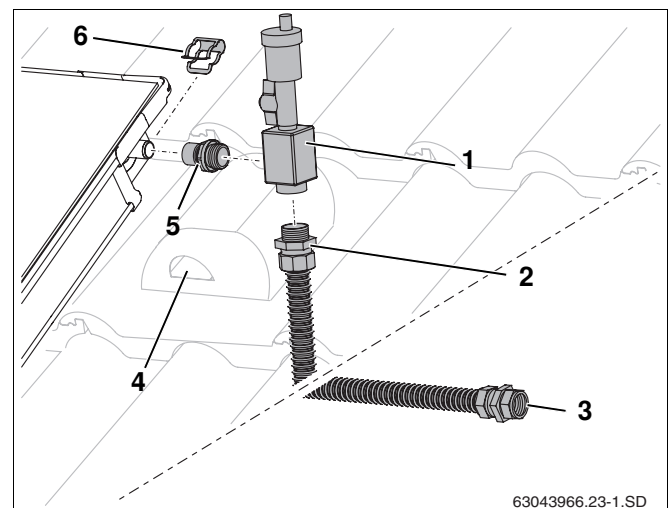


Fig. 58 Fitting the air vent

Item 1: Air pot

Item 2: Connection pipe

Item 3: Compression fitting 15 mm

Item 4: Ventilation tile

Item 5: Threaded fitting R $\frac{3}{4}$

Item 6: Bracket

9 Fitting the connection set for two rows (accessory)

The connection set (Fig. 59, **Item 9**) is available as an accessory, and connects two rows of collectors.



USER NOTE

Fit as many connection parts as possible to the collectors on the ground. This makes installation on the roof easier.

Scope of supply (Fig. 59)

Item 1:	End cap	2 x
Item 2:	Connection pipe	1 x
Item 3:	Bracket	1 x
Item 4:	Gasket	1 x
Item 5:	Large diameter washer	1 x
Item 6:	Clamping disc	1 x
Item 7:	Olive	2 x
Item 8:	Nut	1 x

Fitting additional end caps

Use the end caps to close up any collector connections not in use (Fig. 59, **Item 1**, see Chapter 6.1.2 "Fitting the end cap", page 29).

Installing the connection set

- Remove double threaded fitting and compression fitting from connection pipe.



USER NOTE

If you need to shorten the connection pipe (Fig. 60, **Item 1**), observe the installation steps described in "Making the sealing face:", page 37.

- Insert gasket (Fig. 60, **Item 2**) into nut.
- Insert bracket (Fig. 60, **Item 3**) into nut, align and screw tight.
- Push connection pipe (Fig. 60, **Item 1**) onto the collector connections and fix in place using brackets (Fig. 60, **Item 4**) from the connection kit.

Extending the connection set

- Fit olive (Fig. 61, **Item 2**) and nut to bracket (Fig. 61, **Item 3**).
- Push copper pipe (cut to appropriate length) (15 mm, Fig. 61, **Item 1**) into compression fittings.
- Tighten the fittings.

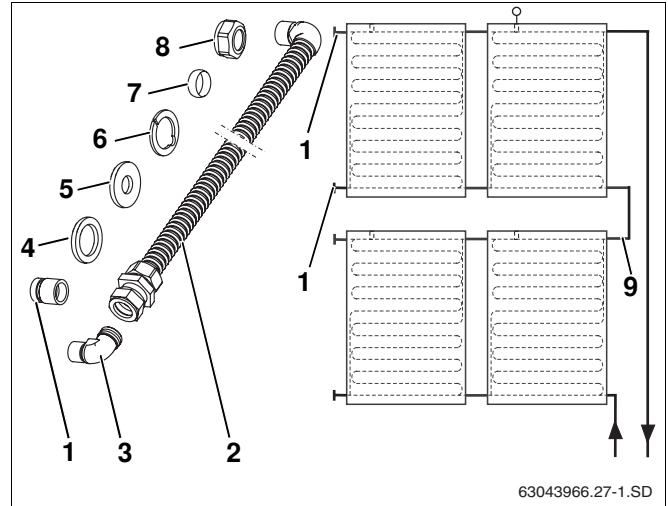


Fig. 59 Schematic diagram and scope of supply

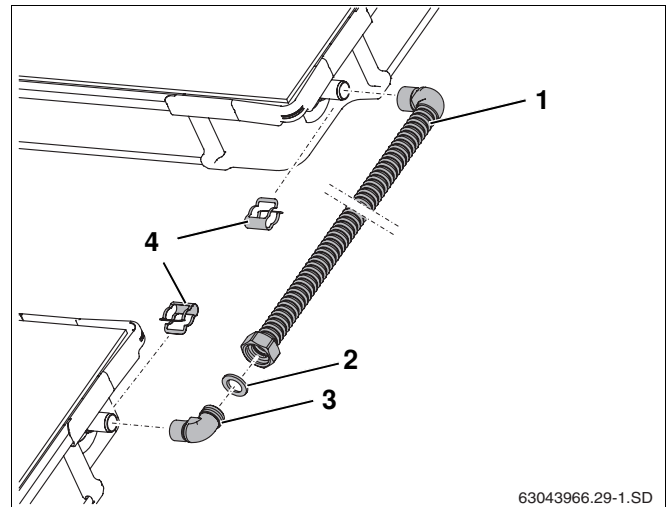


Fig. 60 Connection set between two collector rows

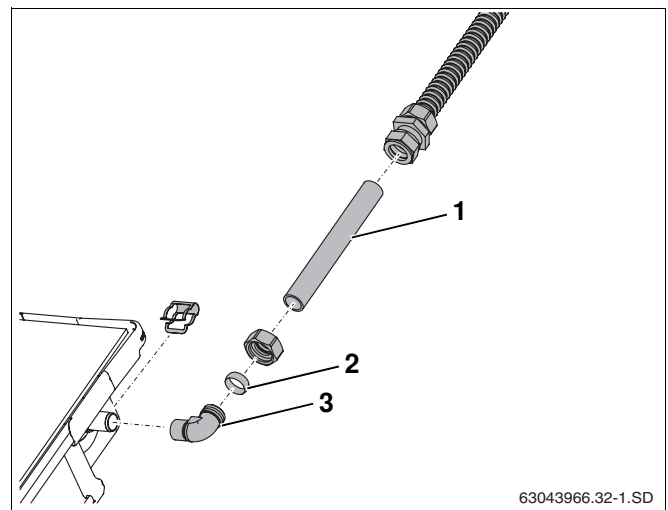


Fig. 61 Lengthening the connection pipe

10 Final activities

10.1 Checking the installation


CAUTION!
SYSTEM DAMAGE

through corrosion if water remains in the solar thermal system for an extended period after it has been flushed or after a pressure test.

- Start up the solar thermal system immediately after flushing/pressure test with solar fluid (for instructions on flushing/pressure test see pump station instructions). Otherwise, carry out flushing/pressure test later.


USER NOTE

Carry out the final insulating work only once the appropriate checks have been performed.

Checks

1.	Corrugated pipe connector, end caps and connection pipes secured with clips?	<input type="checkbox"/>
2.	Profile rails connected to roof hook and sliding nut?	<input type="checkbox"/>
3.	Anti-slip protection installed and clicked into place in profile rails?	<input type="checkbox"/>
4.	Sensor inserted as far as it will go and secured with clamped joint?	<input type="checkbox"/>
5.	Pressure test carried out and all connections leak-proof (see pump station instructions)?	<input type="checkbox"/>


USER NOTE

If you are venting the solar thermal system with an automatic air vent valve (accessory), you must close the ball valve after the venting procedure (see pump station installation instructions).

10.2 Insulating the connection and header pipes

- Cut enclosed insulation (710 mm long) into 88 mm lengths and place around the corrugated pipe connectors between the collectors.

Insulation of the manifolds in internal or external installations

- For the insulation of external pipework, use only UV and high temperature resistant insulating materials, rated to 150 °C.
- For the insulation of internal pipework, use only high temperature resistant insulating materials, rated to 150 °C.
- Make the insulation bird-proof.

11 Quick reference guide for pan tile roof and pressure filling

These instructions are only intended as an overview of the work to be carried out. You **MUST** follow the detailed descriptions for the work on the pages mentioned, and all safety and user instructions.

Fitting roof hooks and profile rails

1. Turn lower part of roof hook and hook complete roof hook into a tile trough, observing the distances given in (Chapter 5.1 "Setting clearances", page 14). p. 15
2. Lift lower part of roof hook and tighten fitting. p. 15
3. Connect profile rails together using plug connectors. p. 25
4. Fasten profile rails to roof hook p. 25
5. Align profile rails horizontally and laterally flush with each other. p. 26
6. Install anti-slip protectors into the two inner slotted holes on the lower profile rails. p. 26

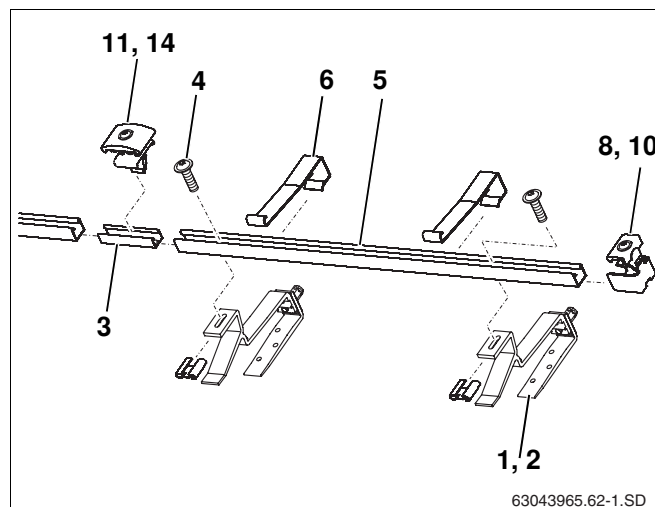


Fig. 62 Roof mounting

Preparing to install the collectors

7. Push end caps onto those connections that are not required and secure using brackets. p. 29

Fastening the collectors

8. Push single-sided collector clamp (right) into profile rails. p. 29
9. Place first collector (right) onto profile rails and push onto collector clamp. p. 30
10. Screw up collector clamp on the right. p. 30
11. Place double-sided collector clamp into profile rail and push onto first collector. p. 30
12. Push corrugated pipe connectors onto the connections on the first collector and secure with brackets. p. 31
13. Push second collector towards the first and fit second bracket. p. 31
14. Tighten screws on the double-sided collector clamp. p. 32
15. Repeat the procedure for all other collectors. p. 32
16. Fit single-sided collector clamps on the left p. 32

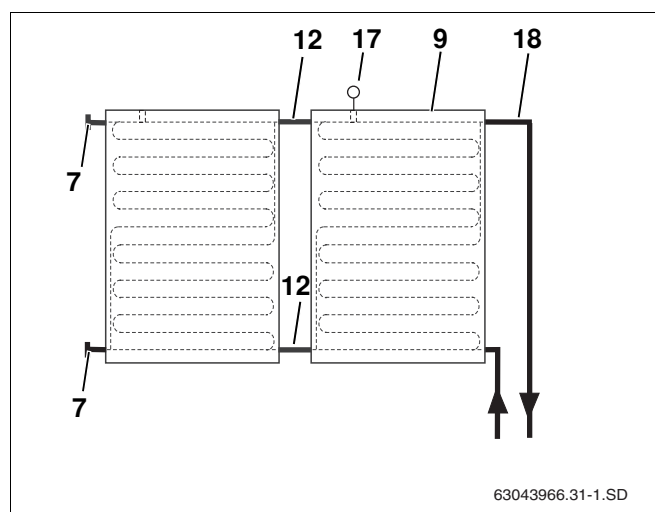


Fig. 63 Water connections

Header connection

17. Insert collector sensor as far as it will go into the collector with the flow line to be connected, and screw tight. p. 33
18. Push connection pipes onto flow and return connections and secure with brackets. p. 34
19. Feed flow connection pipe together with sensor cable through ventilation tile or lead flashing and roof insulation. p. 34
20. Perform installation checks. p. 39
21. Insulate header pipes and corrugated pipe connectors with UV and high temperature resistant material. p. 40

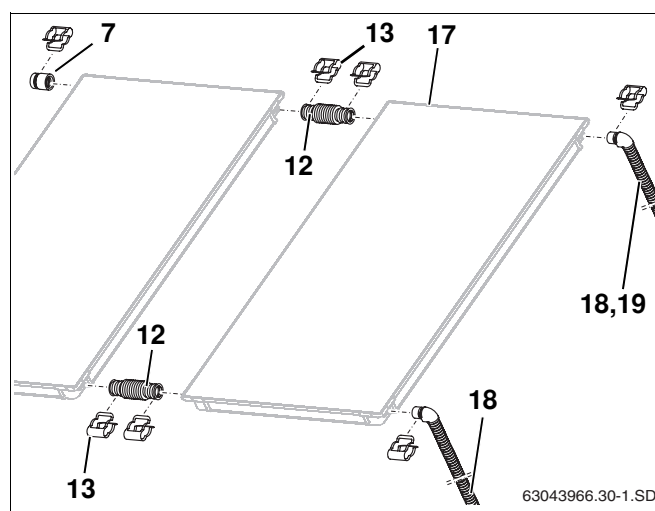


Fig. 64 Fitting the collector sensor and header pipes

Buderus
Cotswold Way, Warndon, Worcester WR4 9SW
Customer service: 0870 421 5933
Technical support: 0870 421 5944
Fax: 01905 753130
www.buderus.co.uk

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