Powertech/Apricus™ AP Solar Collector Specifications

Via a Powertech Thermal Store, this new home in Salisbury also uses the 88 tube solar energy array (two on the east side) to heat the pool once the UFH load is no longer required, at the same time supplying mains pressure hot water on demand

An 88 AP tube heat pipe collector London, UK for part space heating and hot water

Introduction

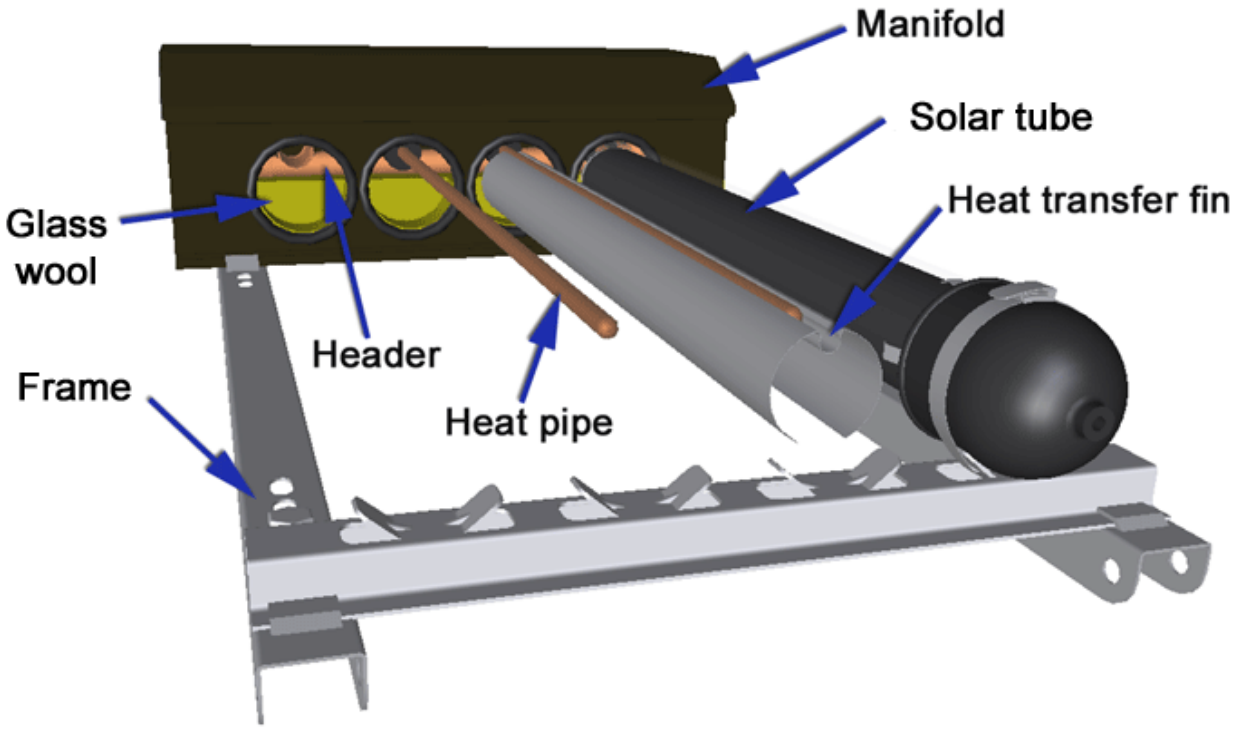
The Powertech/Apricus^{TM} AP solar collector is manufactured by Focus Technology Co., Ltd of Nanjing, China. The design was completed in partnership with Powertech Solar Ltd (UK) and has already obtained quality and performance certification from leading testing bodies SPF (Switzerland) and Bodycote Materials Testing Canada Inc (for SRCC OG100 certification, USA).

Please visit the following websites for more information:
SRCC: www.solar-rating.org
SPF: www.solarenergy.ch

At present the AP solar collector is sold in the following countries:
Australia, USA, Canada, Middle East, UK, Ireland, Italy, France, Sweden, Bulgaria, Greece, Portugal, Slovenia, Cyprus, Hungary, Spain, New Zealand, Mexico, Malaysia, Singapore and South Africa/Africa with new distributors being established in many new areas every month.

The following pages provide specifications for the AP solar collectors. Some specifications may differ from those shown in the SPF and SRCC reports. This is not because of product differences, but rather differences in standards and measurement methods between countries and testing bodies.

AP Solar Collector Key Components



Product Description

The AP range of solar collectors use twin-glass selectively coated solar tubes as the solar absorber. Each solar tube is fitted with a pair of metal heat transfer fins, which serve two purposes, firstly to aid heat transfer, and secondly to secure the copper heat transfer heat pipes tightly against the inner wall of the solar tube. **The copper heat pipes are evacuated and contain a small volume of purified H_2O, which, due to the vacuum, at low temperatures (>30^oC) boils and vaporizes.** The excellent heat transfer properties of the heat pipes facilitate the transfer of thermal energy from within the solar tubes to the collector header.

The manifold header comprises two 18mm copper pipes, which have copper "ports" brazed between them. The 18mm copper pipes are contoured to the shape of copper ports in order to increase contact area. In addition the contoured shape of the header creates turbulent water flow, thus further enhancing heat transfer. The heat pipes plug into the header ports, which are tapered at the end to ensure firm contact for optimal heat transfer. The header is insulated with compressed (~70kg/m^3) glass wool and housed by plastic powder coated (UV stabilized) 0.8mm thick aluminium.

The manifold and solar tubes are secured to a frame constructed of 1.5mm thick 304-2B stainless steel, with all bolts and fittings also made from 304 stainless steel.
The standard frame suits installation on a pitched roof (clay tiles, corrugated iron, asphalt tiles). For installation on a flat surface, a flat roof adjustable angle frame is available, which is also made from 1.5mm 304-2B stainless steel, with attachment feet made from 2mm thickness stainless steel.

The AP solar collector is suitable for installation in an active, split system configuration, in either a closed or open circulation loop. The header is suitable for potable water flow, or the use of glycol-water mix for enhanced freeze protection.

The manifold is designed to be able to withstand wet or dry stagnation without damage to the system; however in a well designed system stagnation should rarely occur.

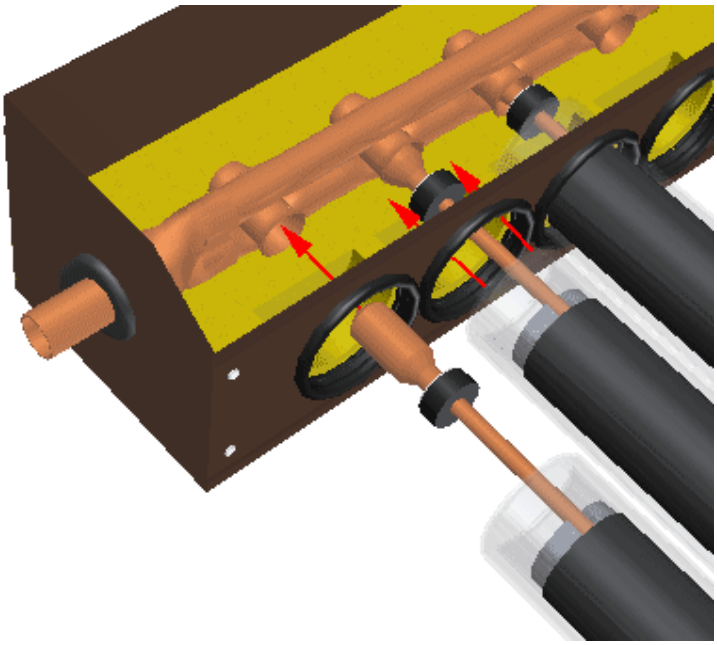
The copper header is rated to withstand a maximum pressure of 800kPa / 116psi. SPF and SRCC tested according to 600kPa max pressure (the standard in Europe and USA), but since that time sales in regions with higher mains pressure water levels have required a revision of the max pressure rating. No modifications to the design or manufacturing process have been made to the header to achieve the higher rating, with all headers individually tested to a pressure exceeding 800kPa / 116psi prior to assembly.

General Specifications

Collector Size	10 tubes	18 tubes	20 tubes	22 tubes	30 tubes
Overall Length [1]	1980mm				
Overall Height [2]	156mm (manifold + standard frame)				
Overall Width [3]	796mm	1356mm	1496mm	1636mm	2196mm
Absorber Area [4]	0.8 m^2	1.44 m^2	1.6 m^2	1.76 m^2	2.4 m^2
Aperture Area [5]	0.94 m^2	1.69 m^2	1.88 m^2	2.07 m^2	2.82 m^2
Gross Area	1.57 m^2	2.68 m^2	2.96 m^2	3.23 m^2	4.35 m^2
Gross Dry Weight (Standard Frame)	34.8kg	58.2kg	63.5kg	71.3kg	94.8kg
Fluid Capacity	290ml	490ml	520ml	550ml	710ml

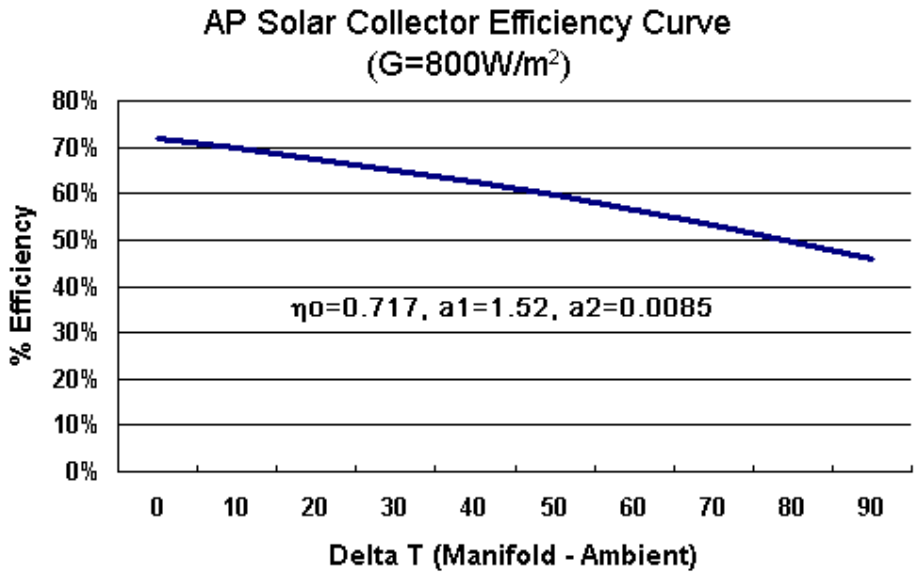
- Length of frame front track
- Height of frame front track + manifold
- Width of manifold (not including inlet/outlet ports for end port model)
- Absorber = Outside diameter of inner tube x exposed tube length
- Aperture = Inner diameter of outer glass tube x exposed tube length
- Collector model naming system: APCP-N. Eg. APKR-22, APSE-30

AP = Apricus AP solar collector
C = casing finish: *K = Black, B = Brown, S = Silver*
P = port location: *R = Rear, E = End*
N = Number of tubes: *10, 18, 20, 22, 30*



Performance and Quality

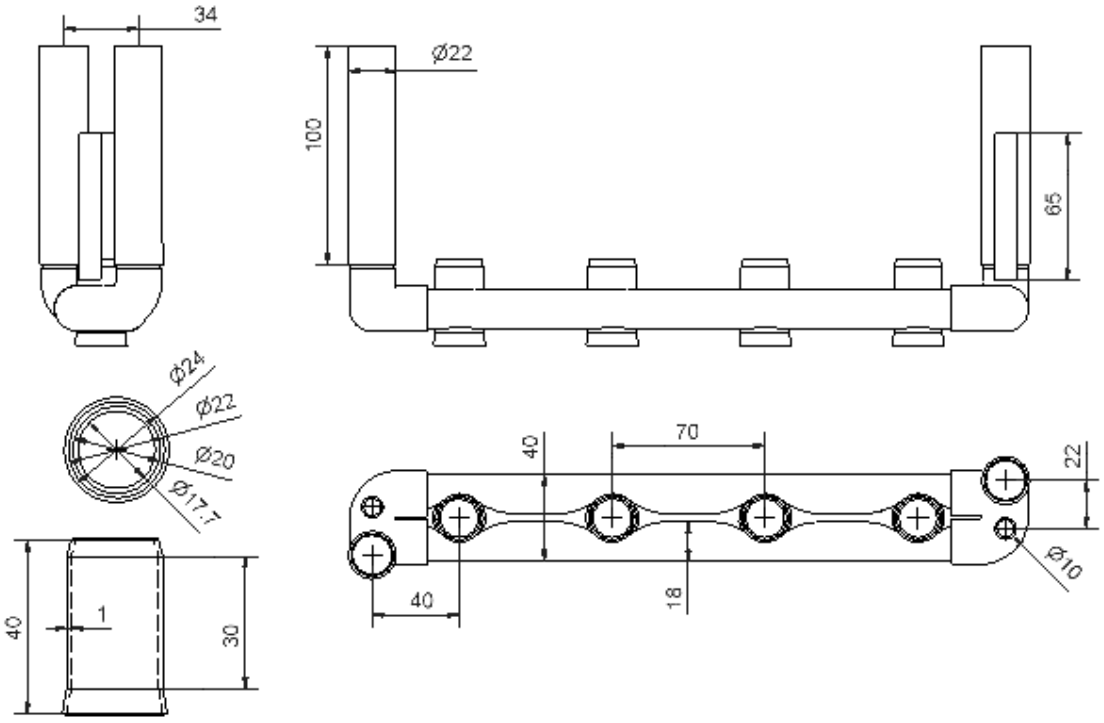
Stagnation SPF Report No. C632LPEN	245°C, when G = 1000W/m^2, Ambient Temp =30°C 477°F, when G = 317Btu/ft^2 , Ambient Temp = 86°F									
Efficiency SPF Report No. C632LPEN	ηo (-) = 0.717, a1 (W/m^{2}K) = 1.52, a2 (W/m^{2}K^2) = 0.0085 G = 800W/m^2 / 253Btu/ft^2 based on Absorber area.									
Quality Certifications	SPF Solar Collector Quality Test Certificate No. C632QPEN (SPF Quality Test According to: EN 12975-2: 2001, Section 5)									
	SRCC OG100 Award of Collector Certification Certification No. 100-2004003A,B,C,D Testing conducted by Bodycote Materials Testing Canada Inc.									
Incidence Angle Modifier	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Kθ (longitudinal)						0.93				
Kθ (transversal)	1.0	1.02	1.08	1.18	1.37	1.4	1.34	1.24	0.95	0.0



Component Specifications

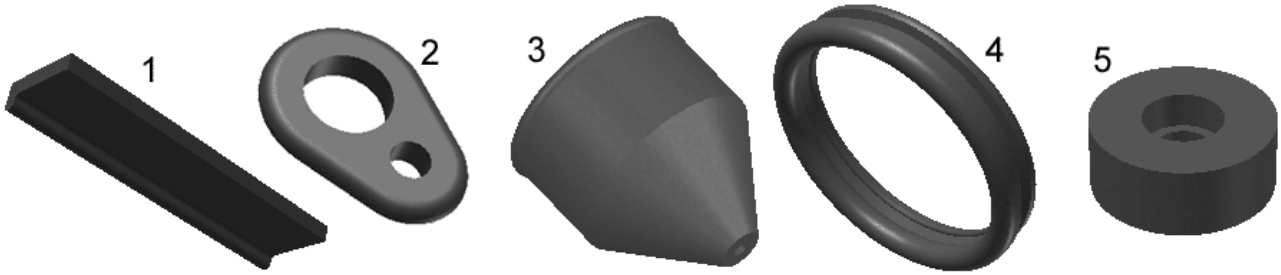
Copper Header	
Material	**>99.93% Copper** Sn<0.012%, Zn<0.04%, Pb<0.003%, Fe<0.004%, Ni<0.003%, As<0.002%, S<0.003%, Bi<0.001%, Sb<0.002%
Length (mm) Rear Port Models (Inlet center to outlet center)	**L= (X-1) x 70 + 80 (X=No. tubes)** **L = (X-1) x 2.759" + 3.15"**
Length (mm) End Port Models (overall length)	**L = (X-1) x 70 + 240 (X=No. tubes)** **L = (X-1) x 2.759" + 9.45"**
Header Pipe Dimensions	**∅18mm OD x 1.2mm** **0.7" OD x 0.047"**
Brazing Rod Material	**45% Silver, 30% Copper, 25% Zinc** **Lead and Cadmium Free**
Inlet & Outlet	**∅22mm OD x 1.2mm** **(Attachment by brass compression fittings only)**
Temperature Sensor Port	**∅10 OD x 1.0mm** **∅0.39"OD x 0.039"**
Recommended Flow Rate	**0.1L/tube/min (10tube = 1 L/min)** **0.026G/tube/min (10tube = 0.26G/min)**
Max Flow Rate	**15L/min / 3.9G/min regardless of collector size.**
Pressure Drop	**0.7kPa @ 3.3L/min for 20 tube manifold**
Max Operating Pressure Rating	**800kPa / 116psi** **(850kPa / 123psi PRV acceptable)**
Manifold Casing	
Manifold Length	**L= (X-1) x 70mm + 160mm (X=No. tubes)** **L = (X-1) x 2.759" + 6.3"**
Lid Length (mm)	**Manifold Length + 6mm / 0.236"**
Height (lid on)	**131mm / 5.157"**
Width	**140mm / 5.512"**
Tube Spacing	**70mm / 2.759"**
Manifold Material	**0.8mm Aluminium (Grade 3A21)** **Plastic Powder Coated (UV Stabilised)**
Frame	
Material	**304-2B Stainless Steel**
Thickness	**1.5mm / 0.059"**
Bolts, Washers and Nuts	**304 Stainless Steel**
Insulation	
Material	**Compressed Glass Wool**
Insulation Factor	**K = 0.043W/mK**
Max Working Temp	**300°C / 577°F**

Solar Tubes (Solar Absorber)	
Tube Length	**1800mm** (Actual length to tip = 1810-1830mm)
Outer Tube Dimensions	**∅58mm x 1.6mm / ∅2.28" x 0.063"**
Inner Tube Dimensions	**∅47mm x 1.6mm / ∅1.85" x 0.063"**
Weight	**2kg / 4.4pounds**
Solar Tubes Material	**Borosilicate Glass 3.3**
Solar Tube Coating	**Graded-index coating Al-N on Al on glass**
Thermal Expansion	**3.3x10^{-}6 ^{o}C**
Absorptance (α)	**>92% (AM1.5)**
Emittance (ε)	**<8% (80^{o}C)**
Vacuum	**P<5x10^{-3} Pa**
Stagnation Temperature	**>200^{o}C**
Heat Loss	**<0.8W/ (m^{2} ^{o}C)**
Maximum Strength	**0.8Mpa**
Absorber Area per Tube	**0.08m^{2}**
Heat Pipes & Heat Transfer Fins (Heat Transfer)	
Length	**1800mm 70.8"**
Material	**Oxygen Free Copper (TU1)** Cu+Ag> 99.99% (O_2 <16ppm)
Copper Pipe Dimensions	**∅8mm OD x 0.7mm thick**
Condenser Dimensions	**20mm OD x 30mm**
Heat Transfer Material	**Purified Water (Non Toxic)**
Maximum Working Temperature	**300^{o}C**
Startup Temperature	**<30^{o}C**
Vacuum	**P<5x10^{-3} Pa**
Vertical Installation Angle	**20-70^{o}**
Horizontal Installation Angle	**0^{o} +/- 5^{o}**
Heat Transfer Fins	**0.2mm thick Hot Dipped Zn Coated Iron (Q235 grade steel, 100g/m^{2} Zn coating)**
Freeze Protection Sleeve	**∅8mm OD x 1mm x 150mm 304-SS**
Rubber Components	
Material	**UV Stabilised Silicone Rubber**
Density	**1.15 g/cm^{3} +/- 0.05**
Durometer Hardness (Shore A)	**54**
Elongation	**320%**
Rebound	**54%**
Maximum Working Temperature	**300^{o}C**
Tensile Strength	**6.4 Mpa**
Tear Strength	**12.5 KNM**



Rubber Components

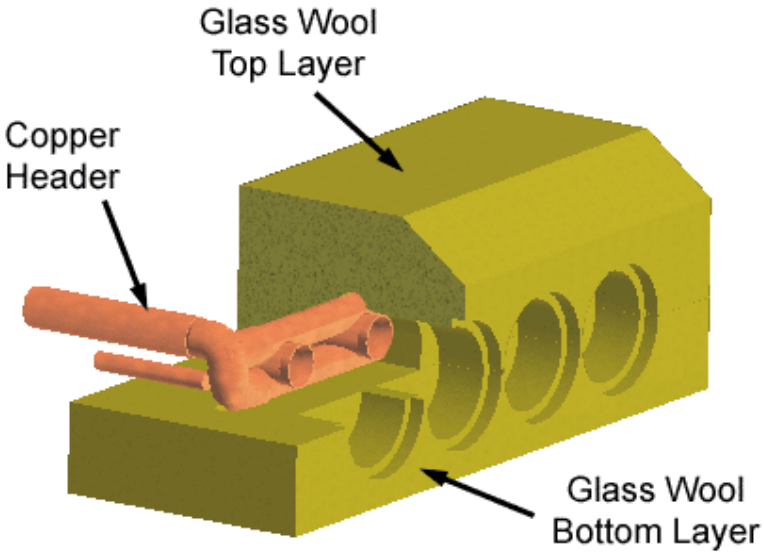
Manifold Seals (1,2,4,5)	**High Temperature UV stabilized Silicone Rubber**
Evacuated Tube Caps	**UV stabilized Rubber**



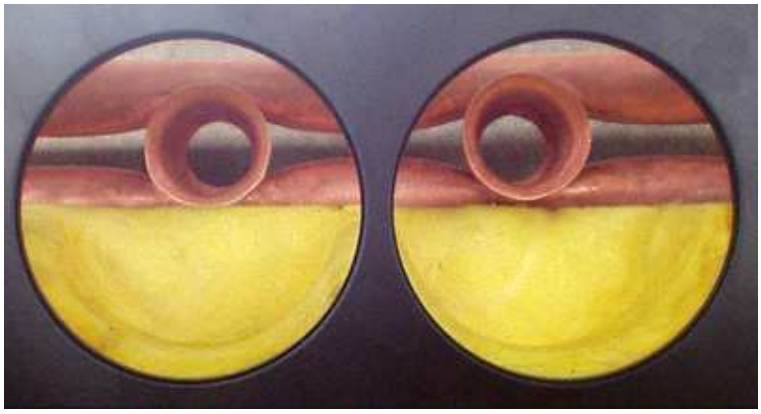
1. Manifold lid seal
2. Inlet/Outlet seal
3. Evacuated tube cap
4. Evacuated tube port seal
5. Heat pipe ring

Insulation

Material	**Compressed Glass Wool**
Insulation Factor	**K = 0.043W/mK**
Max Working Temp	**300°C**

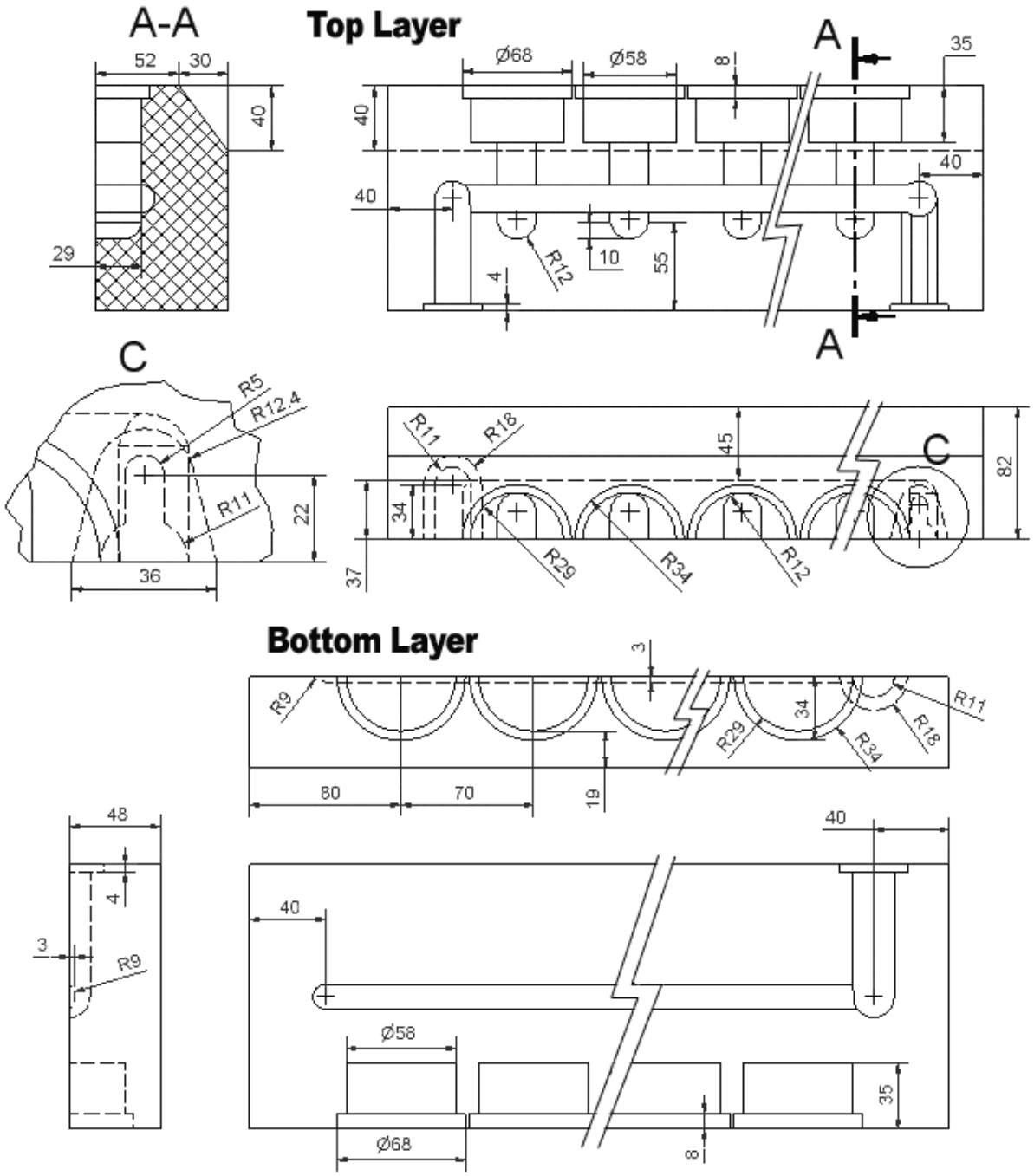


90+% of the material used is from recycled sources.



View from front of manifold showing bottom layer of glass wool and header pipe.

Glass Wool Insulation Dimensions

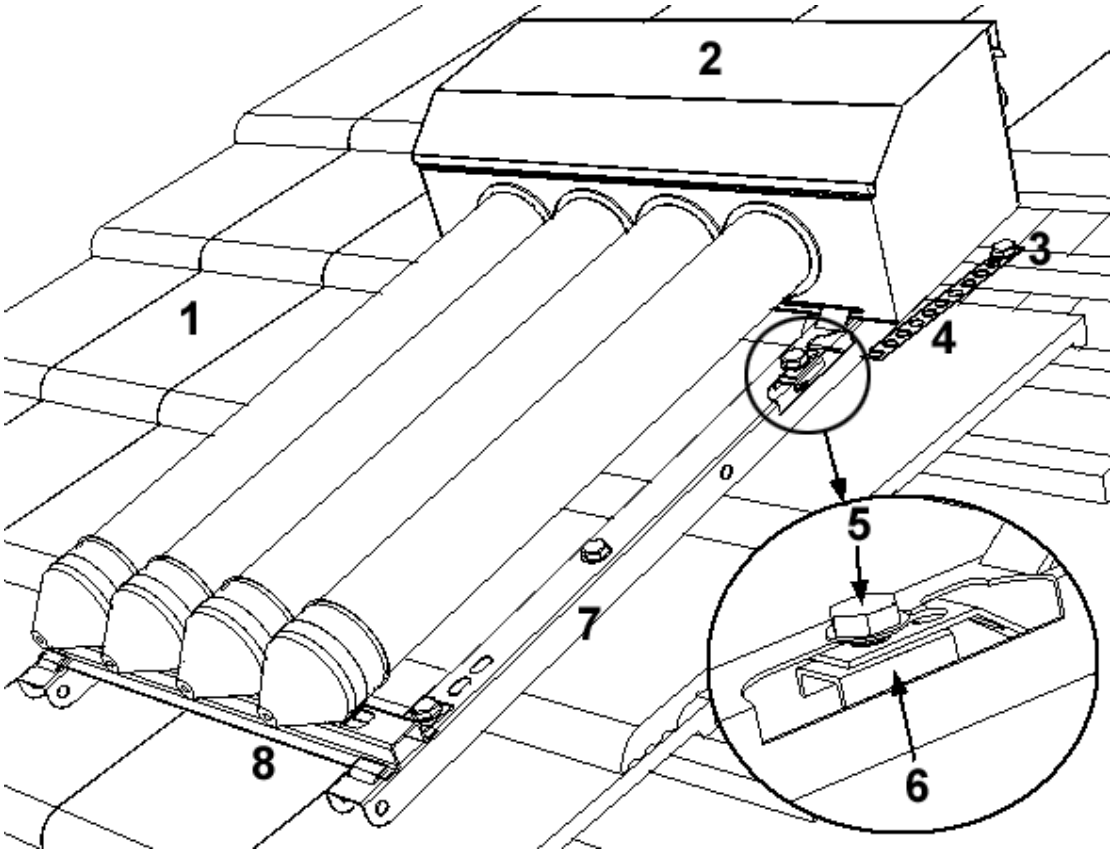


Frame

Material	304 Stainless Steel
Thickness	1.5mm
Attachment Method	M8 Bolts & SS Attachment Plates

Roof Installation

(Example only – installation will vary given different roofing surfaces)



1. Roof tiles
2. Collector manifold
3. Roof attachment point
4. Roof attachment strap
5. M8x20 bolt, washer & nut
6. Nut lock
7. Frame front track
8. Frame bottom track.

Worcester Greenskies FK240 Solar Panels – harnessing natural energy for hot water comfort

Greenskies FK240 Solar Panels

Features	Benefits
Efficient collector with 92% absorption rate.	Increases performance of panel.
Robust panel design.	Minimises risk of damage and prolongs service life.
Environmentally friendly.	All materials recyclable, environmentally conscious manufacture.
Quick Fitting.	Labour and money saving.
Easy to fit.	Reduces complexity of installation.
Simple to use controller.	Allows quick setting of functions.
Selective coating on absorber.	Increases collector performance even on cloudy days.
Strong solar glass cover.	Protects collector from damage.

Global responsibility for nature and the environment

As part of the Bosch group, Worcester Bosch is committed to environmental protection. Product development is prioritised in the interests of the safety of people, the economical use of resources and environmental sustainability.

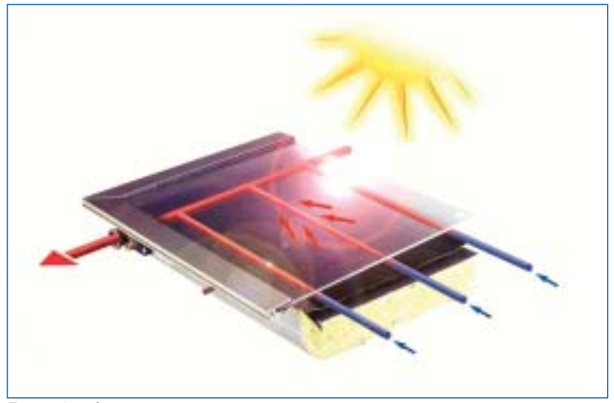
With this in mind Worcester Bosch is proud to offer a solar panel package for hot water heating which allows the consumer to take advantage of renewable and sustainable energy.

Worcester Greenskies FK240 Solar Panels harness the power in both direct and diffused sunlight and convert the energy to heat for the production of hot water for the home.

The solar panels have been designed as a complement to existing heating systems which use a store of hot water in a cylinder. The existing cylinder is exchanged for a cylinder with two heat exchanger coils; one from the boiler in the property and a second from the solar panels.

The Worcester Greenskies FK240 Solar Panels are an ideal partner to the new range of condensing Greenstar regular and system boilers, with different models available in both oil and gas, which require a separate cylinder for the storage of hot water. When used together a Greenstar boiler with solar system provides a highly efficient system to give heating and hot water comfort.

A typical well sized solar system should provide around 50% of the domestic hot water requirements of a home, representing a very worthwhile saving on hot water heating costs. The remaining hot water requirement is provided by the boiler.



Principle of operation

Greenskies FK240 Solar Panels at a glance

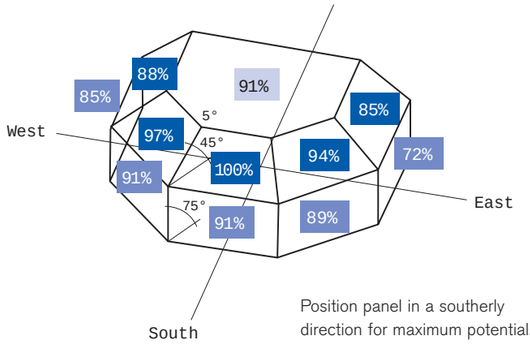
		Greenskies FK240 Solar Panel
Outer Surface		2.4m²
Absorber Surface		2.1m²
Selectivity	Absorption	92%
	Emission	12%
Min. Efficiency		525 kWh/m²a
Weight		43Kg
Max. Operating Pressure		3 bar

Worcester Greenskies FK240 Solar Panels

Operation

Worcester Greenskies FK240 Solar Panels form part of a system which remains separate from the boiler heating system.

The panels are mounted on a surface which is selected for its exposure to sunlight and usually connected, via pipe work, to the lower coil of a twin-coil solar cylinder. The energy in the sun's rays is absorbed by the panel and the heat is transferred into the pipe work in the absorber plates. The pipe work is filled with a ready-mixed liquid, containing glycol and water, which is circulated by a pump to the coil in the hot water cylinder. The heat is deposited in the storage cylinder and the glycol returns to the panel to absorb more free solar energy. The system is equipped with a simple unit to control the flow of energy from the panels to the storage cylinder.



Position panel in a southerly direction for maximum potential.

Application of Worcester Greenskies Solar Panels

Worcester offers a complete package (with the exception of the solar cylinder and ancillaries) for a solar water heating solution as an addition to an existing or replacement boiler. The solar panels can also be used for other water heating requirements such as heating of swimming pools.

The panels can be mounted directly onto sloping roofs with a variety of fixings for different roof coverings or onto a frame for flat roofs.

The solar panels should be installed in a southerly direction at an angle of around 45 degrees. Where this is not possible the installation should move towards a westerly facing direction. **East and North facing directions should be avoided**.

Panel performance

Each Worcester Greenskies FK240 collector has a net surface area of 2.1sq.m. with a minimum efficiency of 525kWh/m²a. The panels are covered with solar glass which helps the selective coating on the copper collector absorb 92% of the available energy. The panel contains 60mm of mineral wool which contributes to the low 12% emission rating.

A common question (see the FAQ section for more) about solar in the UK focuses on whether there is enough sunshine available to make solar worthwhile. The usual idea of British weather is of cloudy skies and intermittent sunshine. Worcester's solar panels have been developed with this typical weather in mind and make the most of both direct and diffused sunlight to give a useful annual contribution wherever you are in the UK.

Solar Radiation in the British Isles

Contrary to popular belief the amount of solar radiation received by the UK is enough for solar water heating to be a viable supplement to existing domestic water heating. Perhaps surprisingly the UK receives 65% of the amount of solar radiation that is received by the south of Spain. The radiation in the UK is made up of direct radiation on sunny days, which accounts for around 40%, and diffused radiation on cloudy days, accounting for 60% of the total.

Summer will provide the largest amount of radiation over the year but a useful contribution will be provided by other seasons.

As an indication, a well sized typical installation will provide the following proportion of the household domestic hot water requirement:

Season	% of requirement fulfilled by solar
Summer	80-90%
Spring & Autumn	40-50%
Winter	20-30%

This translates to roughly half of the typical annual domestic hot water requirement.

Controls

The Worcester solar package includes a simple controller (TDS10) which allows the user to select the temperature required at the hot water cylinder. The controller then automatically decides when to run the pump to bring the energy from the panels to the cylinder.

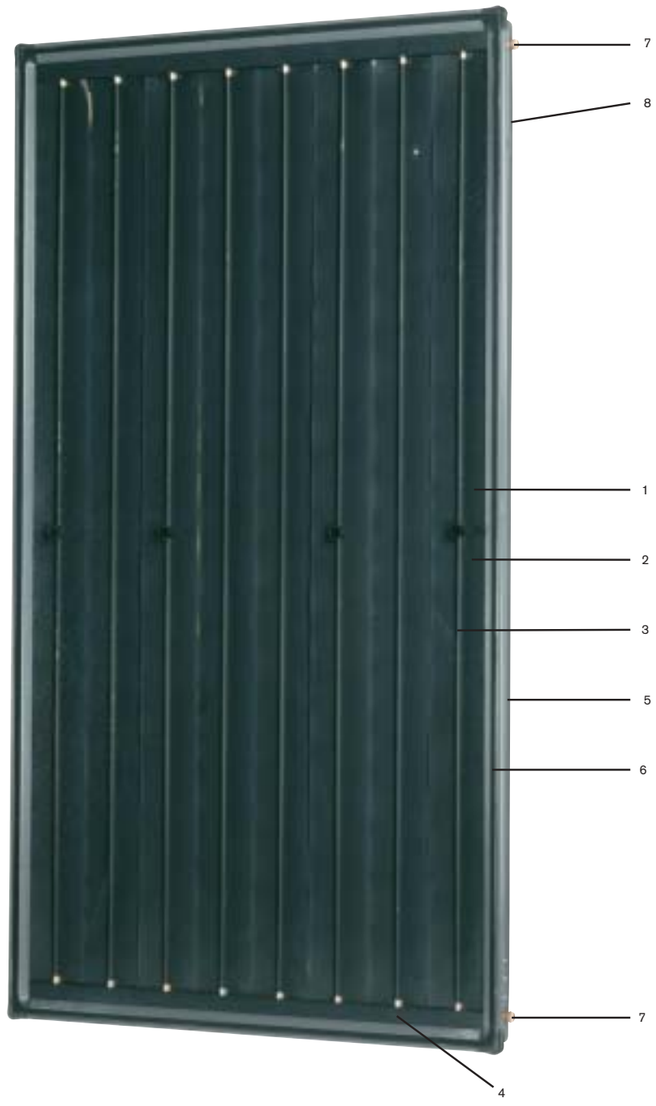
The control uses a simple temperature difference to define when the pump runs. The temperature in the panel must be 8 degrees higher than the store for the pump to start running. This will continue until the panel temperature gets to 4 degrees above the store and then the pump will stop.

This ensures that the pump is only running when the benefit from the solar panels is available.

Technical data

Classification	*Greenskies FK240 Solar Panel Package*
Panel height	112mm
Panel width	1,135mm
Panel length	2,115mm
Weight (empty)	43kg
Fluid content	1.15 litres
Gross surface area	2.4m²
Net surface area	2.1m²
Stagnation temperature	181°C
Max operation pressure	3 bar
Min efficiency	525 kWh/m²a
Absorption	92%
Emission	12%
Glycol freezing temperature	-38°C
Max collectors in series	9

Greenskies FK240 Solar Panels – up close

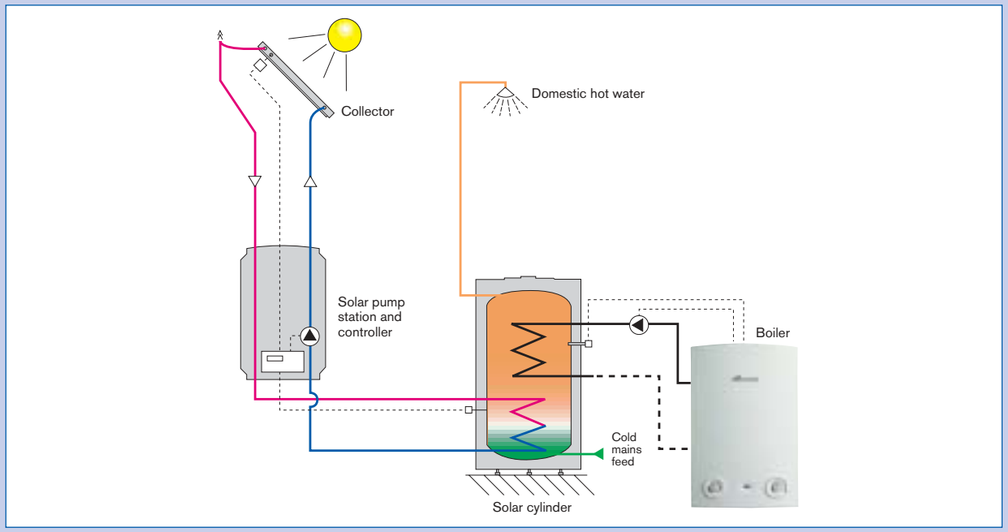


Key to components

1. Highly transparent, hardened solar glass
2. Selective coated copper absorber
3. Heat transfer tubes
4. Main collector pipe
5. Surrounding tray – UV resistant 2-layer plastic
6. Glass fibre frame
7. Pipework connections
8. Temperature-measurement point (Thermostat Pocket)

Greenskies FK240 Solar Panel System layouts

Typical solar system for hot water with twin coil cylinder and conventional boiler



The most common solar system layout uses a twin coil cylinder which is fed by both a boiler (or other heat source) and the solar panels. The solar system and the regular heating system do not come into direct contact with each other and the only shared part is the cylinder.

The solar system has its own pump, expansion vessel, pressure relief valve, air vent and controller.

The Worcester solar package is ideally suited for use with Worcester Bosch oil or gas fired regular or system boilers. These are listed below:

Worcester Bosch Boiler Compatibility

Gas

Greenstar 12i System
Greenstar 24i System
Greenstar 12Ri
Greenstar 15Ri
Greenstar 18Ri
Greenstar 24Ri
Greenstar 30CDi Conventional
Greenstar 40CDi Conventional
15SBi
24SBi
9-14CBi
14-19CBi
19-24CBi

Oil

Greenstar II HE 12/22
Greenstar Danesmoor 18/25
Greenstar Utility 18/25
Greenstar Utility 32/50
Greenstar Utility 50/70
Danesmoor WM 12/19
Danesmoor 12/14 - Kitchen, Utility and System models
Danesmoor 15/19 - Kitchen, Utility and System models
Danesmoor 20/25 - Kitchen, Utility and System models
Danesmoor 26/32 - Kitchen and Utility models
Danesmoor 32/50 - Utility models
Danesmoor 50/70 - Utility models
Danesmoor FS 12/18
Danesmoor FS 18/25

Planning

In general the installation of solar panels, as far as planning permission is concerned, is reasonably straight-forward with most local authorities regarding the panels in a similar vein as to flush fitting roof-light windows, where planning permission may not be required. However it is prudent to seek the opinion of the local authority on planning matters prior to starting work on the solar installation. Requirements vary from one authority to the next both with planning permission and building control procedures.

Installing Greenskies FK240 Solar Panels

Site preparation/portability

In addition to ensuring that the panels are sited in the correct direction and away from sources of shade, particular attention should be paid to site access and the safe installation of the panels.

When working at height care should be take to ensure that the required safety equipment is available and correctly used.

Panel dimensions and clearances

Dimension A and B

Dimensions A and B correspond to the area required for the selected number and layout of the collectors.

Dimension C

Dimension C represents at least two tiles to the ridge. A space of the equivalent of two tiles should be allowed for to avoid damage at the roof ridge, particularly if the tiles are laid in mortar.

Dimension D

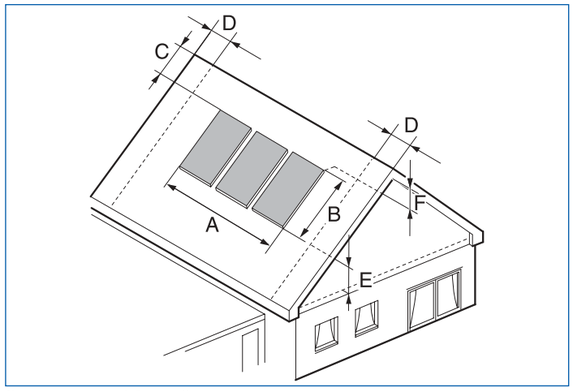
Dimension D corresponds to the roof height including the gable wall. The adjacent 50 cm clearance to the collector array is required under the roof on the right or left depending on the type of connection.

Dimension E

Dimension E corresponds to at least 30 cm, which is required in the attic for installation of the connection pipes.

Dimension F

Dimension F corresponds to at least 40 cm, which is required in the attic for installation of the connection pipes.



Space required for collector array

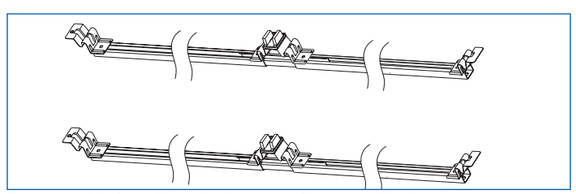
No. of collectors	*Dimension A*	*Dimension B*
2	2.34m	2.20m
3	3.51m	2.20m
4	4.68m	2.20m
5	5.85m	2.20m
6	7.02m	2.20m
7	8.19m	2.20m
8	9.36m	2.20m
9	10.53m	2.20m

Space requirement

Panel support assembly

Each panel is secured onto a pair of rails which can be assembled on the ground and then raised to the roof. The rails can then be mounted on the roof hooks, which are available to suit various roof and tile types.

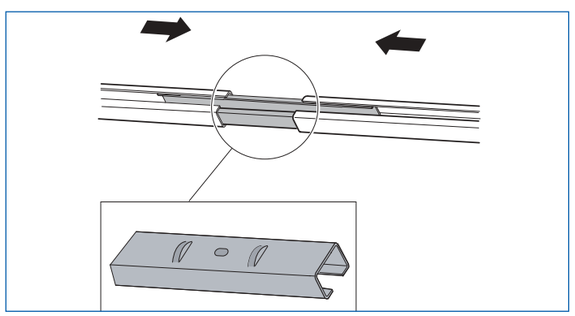
In addition, the Worcester Greenskies FK240 Solar Panels are available with a support kit for installation on flat surfaces, offering greater possibilities for installation.



Preassembled profile rails for two adjacent collectors

Connecting profile rails

Individual rails are joined with a rail connector into which the rails slide for an easy connection.

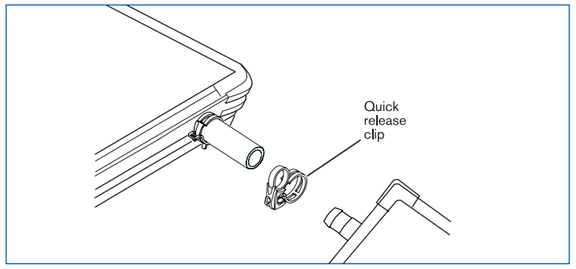


Rail connection

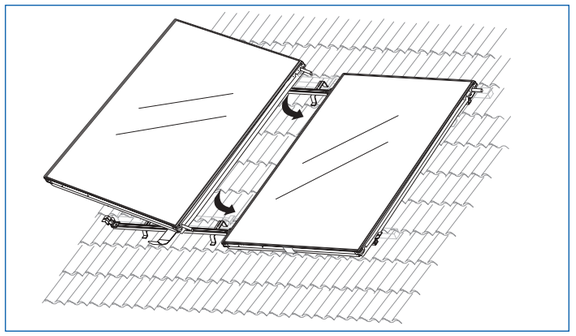
Pipework Connections

Worcester Greenskies FK240 Solar Panels are equipped with simple push-fit connections which speed installation and, with bespoke flexible hoses, aid the routing of pipework into the roofspace. Once inside the property the system should be run in copper pipe.

Flexible hose connections are secured with a simple quick release clip which closes automatically and allows the time required for pipework on the roof to be reduced.



Subsequent collectors in series also use this connection method to enable arrays to be plumbed-in with ease.



The second panel (of a two panel array) can be added easily with push-fit connections.

Cylinders

For most installations a hot water store of around 75-100 litres per collector is normally well suited. For a two panel installation a cylinder of around 175 litres offers a good combination of hot water storage and space usage.

Suitable hot water storage cylinders are available from:

Albion, Shelah Road, Halesowen, West Midlands B63 3PG
Tel: 0121 585 5151

Range, Tadman Street, Wakefield, West Yorkshire WF1 5QU
Tel: 01924 234514

Installation requirements

The installation of the Worcester solar system must be carried out in accordance with the relevant requirements for safety, current Wiring Regulations, local Building Regulations, Building Standards (Scotland), (Consolidation) Regulations and Bylaws of the local water company and Health and Safety document No. 63S (Electricity at Work Regulations 1989). It should be in accordance with the relevant recommendations of the following British Standards and Regulations:

BS 5918:1989
The Health and Safety at Work 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

The manufacturer's notes must not be taken in any way as overriding statutory regulations.

Electricity supply

A 3 amp fused three pin plug and unswitched shuttered socket outlet (both complying with BS 1363) or preferably a double pole isolator with a contact separation of 3mm in all poles supplying the controller should be used. The controller must be earthed.

Glycol heat transfer liquid

Worcester Greenskies FK240 Solar Panels and system components should be used only with the recommended heat transfer liquid – Tyfocor©L manufactured by Tyforop Chemie GmbH, available at stockists of Worcester Greenskies FK240 Solar Panels.

The heat transfer liquid uses a proven concentration of anti-freeze and water to give protection against freezing and provide optimum performance from the panels and system.

Hot water blending valve

It is recommended a thermostatic blending valve be used in conjunction with the solar cylinder in order to guard against the high hot water temperatures which the system can provide.

Insulation

Exposed pipework should be insulated according to the high temperatures that the panels are able to generate. Insulation rated to 150°C must be used. Suitable insulation is available from Armacell UK Ltd., Mars Street, Oldham, Lancashire OL9 6LY.

Pressure relief valve

The AGS2 Solar pump station in the Worcester Greenskies FK240 solar package is equipped with a 3 bar pressure relief valve which should be connected to pipe work terminating in a suitable container. An empty canister of heat transfer fluid can be used for this purpose.

Warranty

Worcester is proud to offer a guarantee of 5 years on the Greenskies FK240 Solar Panels and a 2 years warranty on other components.

FAQ's

Q. What is sustainable energy?

A. Sustainable energy is best thought of as energy which can be replenished within a human lifetime and which causes no long-term damages to the environment. Solar energy, wind energy, and geothermal energy, amongst others, are all self-sustaining. They all have sources that cannot be depleted. Extended use of these energy sources aids the conservation of other non-renewable energy sources such as fossil fuels.

Q. How does Solar technology work?

A. The idea behind technologies which use solar energy is to harness the freely available rays from the sun in a useful form. The technology used for solar water heating is simple and effective. The basic principle uses an absorber plate which is heated by the sun's rays. This heat is collected in a transfer liquid which is in turn used in a heat exchanger to heat water.

Q. What if there is no sun or it is a cloudy day?

A. Special coatings are available on the absorber plates which allow the collector to absorb energy from diffused as well as direct sunlight. This means the panel can still yield results on days when there are clouds in the sky.

Q. Is there any Government funding available?

A. The Department of Trade and Industry is funding an initiative called Clearskies which entitles home owners and not-for-profit organisations to financial help with a solar system. Householders can apply for a grant of £400 regardless of system size.

Q. Do I have to pay VAT for installing Solar panels?

A. The VAT on solar systems varies depending on who is installing it. DIY solar systems carry 17.5% VAT. A system which is installed by a professional installer carries 5% VAT.

Q. Do I still need a boiler?

A. Solar heating on a normal domestic scale in the UK will provide around 50% of the average annual household hot water requirements. Although the system may provide most of the hot water required in summer, the winter results, due to the lower intensity of the sun and the shorter daylight hours, will be reduced. As such the householder will need a boiler (or suitable alternative) to make up the difference in domestic hot water requirement and for the central heating of the house.

Q. Do I need to have a particular type of roof for Solar installation?

A. In the UK the best orientation for solar panels is facing due south and tilted at around 35 degrees from the horizontal. The gains available will reduce as the orientation moves away from due south. A variety of brackets and frames are available for solar systems to suit different roof types (pitched and flat) and different types of roof tiles.

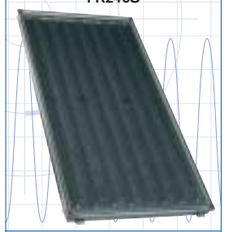
Greenskies FK240 Solar Package

Worcester Greenskies FK240 solar package contents:

1. FK240 solar panels
2. AGS2 solar pump station
3. TDS10 solar controller
4. Automatic air vent
5. Expansion vessel
6. Heat transfer fluid (glycol)
7. Variety of roof fixings

Greenskies FK240 Solar Panel and accessories

PANEL FK240S



Worcester Bosch Part No. 7 739 300 374

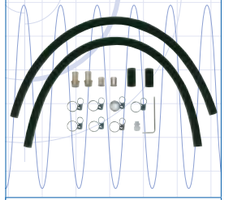
CONTROLLER TDS10

Worcester Bosch Part No. 7 739 300 378

PUMP STATION AGS2

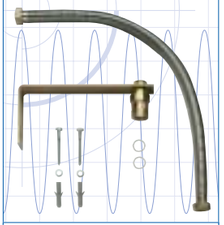
Worcester Bosch Part No. 7 739 300 377

COLLECTOR CONNECTOR FS4



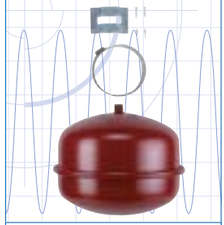
Worcester Bosch Part No. 7 739 300 376

EXPANSION VESSEL CONNECTION AAS1



Worcester Bosch Part No. 7 739 300 331

EXPANSION VESSEL SAG25



Worcester Bosch Part No. 7 739 300 119

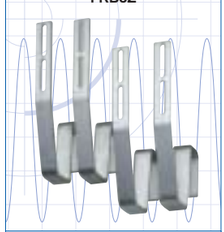
FLUID WTF25

Worcester Bosch Part No. 7 739 300 057

AIR VENT ELT4

Worcester Bosch Part No. 7 739 300 286

ADDITIONAL ROOF HOOK KIT FKB3Z

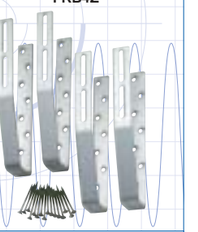


Worcester Bosch Part No. 7 739 300 280

SPECIAL ROOF HOOK KIT FKB4

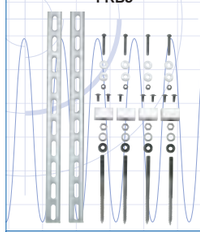
Worcester Bosch Part No. 7 739 300 281

SPECIAL ROOF HOOK KIT FKB4Z



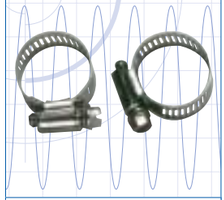
Worcester Bosch Part No. 7 739 300 282

BOLT FIXING KIT FKB5



Worcester Bosch Part No. 7 739 300 283

CLIP CONNECTOR KIT FKU10

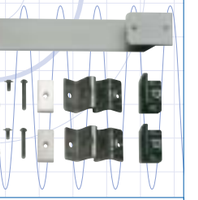


Worcester Bosch Part No. 7 739 300 284

AIR VENT CONNECTOR KIT ELT4Z

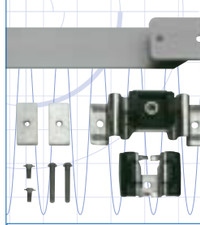
Worcester Bosch Part No. 7 739 300 287

PANEL STAND BRACER FKZ1



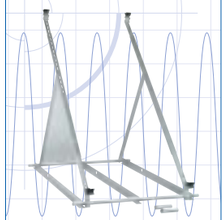
Worcester Bosch Part No. 7 739 300 295

ADDITIONAL STAND BRACER FKZ1Z



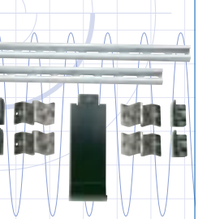
Worcester Bosch Part No. 7 739 300 296

FLAT ROOF STAND FKF1S



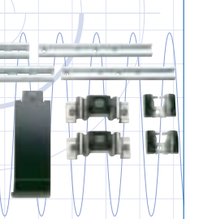
Worcester Bosch Part No. 7 739 300 294

ROOF BAR KIT FKA1S



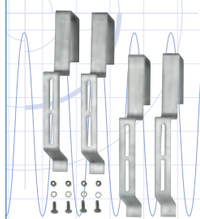
Worcester Bosch Part No. 7 739 300 288

ROOF BAR KIT 2ND PANEL FKA1SZ



Worcester Bosch Part No. 7 739 300 289

ROOF HOOK KIT FKB3



Worcester Bosch Part No. 7 739 300 279

All the technical advice you need

The Worcester Bosch Technical Helpline is a dedicated phone line – dedicated to providing the best service from any manufacturer in the industry. Our team of technical experts provide the answers to queries of a technical nature on any product in the Worcester solar range, from application to installation to performance.

Pre-sales technical team.

Post-sales technical team.

The very best training programmes from Worcester Bosch

Worcester Bosch has always placed great emphasis on support and training for installers and service engineers. Today this need is greater than ever: one in every two boilers now purchased in the UK is a combi boiler and, month by month, an increasing number of condensing boilers are being installed. The differences between a combi, conventional and condensing boiler are substantial, and the technology of each continues to advance at a rapid pace.

To ensure the highest levels of competence and expertise in the installation of all Worcester Bosch boilers and Greenskies Solar Panels, the company runs intensive training courses for installers, commissioning engineers and engineers involved with servicing and fault finding.

Courses available

The Worcester Bosch Training Department has on offer a number of courses suitable for the installer and commissioning engineers, and a more in-depth course for the servicing and fault finding engineers.

State-of-the-art Worcester Bosch Training Academy

A recent addition to the excellent training facilities at the company's Worcester headquarters, this unique and advanced academy is the only one in the UK dedicated entirely to successful installation and commissioning of gas-fired and oil-fired boilers. The set-up is unique too: 4 custom-built workshops including one for solar, guide you step by step through a first-class troubleshooting course.

Regional Worcester Bosch Training Centres

The Worcester Bosch network of regional training centres is strategically located across the country to help put you within convenient travelling distance of the courses you wish to attend.

In addition to the outstanding facilities at the company's headquarters near Worcester, there are centres at Clay Cross in Derbyshire, Rochester in Kent, Blantyre in Scotland and Bangor, Northern Ireland. There are also additional training opportunities available throughout the UK. Please phone 01905 752526 for more information about a course near you. Each course is run by specialist trainers and is superbly equipped to deliver a combination of classroom theory and practical hands-on experience that's second to none.

New Product Advance Training

Exclusive to Business Initiative members, these invaluable courses give you an introduction and insight into new Worcester Bosch products as soon as they are released on to the market.

College Links

A number of the country's leading proactive technical colleges are now equipped with Worcester Bosch products and offer excellent practical tuition on a more local level.

Distance Learning

A joint initiative from key names in the heating and plumbing industry, this offers a choice of low-cost home study elements compiled by experts. As a Business Initiative member you will receive a free Distance Learning CD which is packed with information.

Get on course for a more profitable future now

Call now for more information

01905 752526

Worcester Bosch Training Courses

Greenstar CDi, Highflow 440 and HE Plus gas-fired condensing combi boilers

Models covered	Greenstar 25/30/35/40CDi Greenstar Highflow 440 Greenstar 30/35/40 HE Plus
Duration	1 day

Greenstar i junior and Si gas-fired condensing combi boilers

Models covered	Greenstar 24/28i Junior Greenstar 25/30Si
Duration	1 day

Greenstar system and regular gas-fired condensing boilers

Models covered	Greenstar 12/24Ri Greenstar 30/40CDi Conventional Greenstar 12/24i System
Duration	1 day

i Junior and Si II gas-fired combi boilers

Models covered	24i Junior 28i Junior 24Si II 28Si II
Duration	1 day

Danesmoor, Heatslave and Greenstar HE oil-fired boilers

Models covered	Danesmoor Heatslave Greenstar
Duration	1 day

OFTEC Training

OFTEC 101

Covering	Domestic/Light Commercial Pressure Jet Commissioning and Servicing
Duration	3 day course (2 days training plus 1 days assessment)

OFTEC 105e

Covering	Domestic/Light Commercial Pressure Jet Boiler installation
Duration	1 day assessment

OFTEC 101 & 105e

Covering	Domestic/Light Commercial Pressure Jet Installation, Commissioning and Servicing
Duration	3 day course (2 days training plus 1 days assessment comprising 2 theory and 1 practical)

OFTEC 600a

Covering	Oil Tank Installation and Associated Controls
Duration	1 day assessment course

Certificate in Energy Efficiency for Domestic Heating Course

Covering	Key elements of energy-efficient heating and hot water systems and products, compliance with the latest Building Regulations, how condensing boilers work and how they differ to non condensing products.
Duration	1 day

New 'A' Rated Academy

Covering	Installation and Commissioning Flues and Air Supply Gas and Oil Supply System Design and Flushing Electrical Wiring and Control
Duration	2 days

Greenskies FK240 Solar Panels

Covering	Installation, Commissioning and Marketing
Duration	1½ days

Useful numbers

Sales

Tel: 01905 752640
Fax: 01905 456445
01905 455394

Service

Tel: 08457 256206
Fax: 01905 757536
Livingston (Scotland)
Fax: 01506 441687

Technical (Pre & Post Sales)

Tel: 08705 266241
Fax: 01905 752741

Training

Tel: 01905 752526
Fax: 01905 752535

Spares

Tel: 01905 752571
Fax: 01905 754620

Literature Line

Tel: 01905 752556

Your specialist Worcester Bosch
Greenskies Installer

The Council for Registered Gas Installers

INDUSTRIAL ASSOCIATE

RECOMMENDED

Energy Efficiency is an Energy Saving Trust initiative backed by the Government.

Heating & Hotwater Information Council

The mark of quality for domestic heating

www.worcester-bosch.co.uk

Worcester, Bosch Group,
Cotswold Way, Warndon, Worcester, WR4 9SW
Tel: 01905 754624 Fax: 01905 754619

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Heating and Hot Water Comfort

Part No. 8 716 110 080 Issue A

WH1569

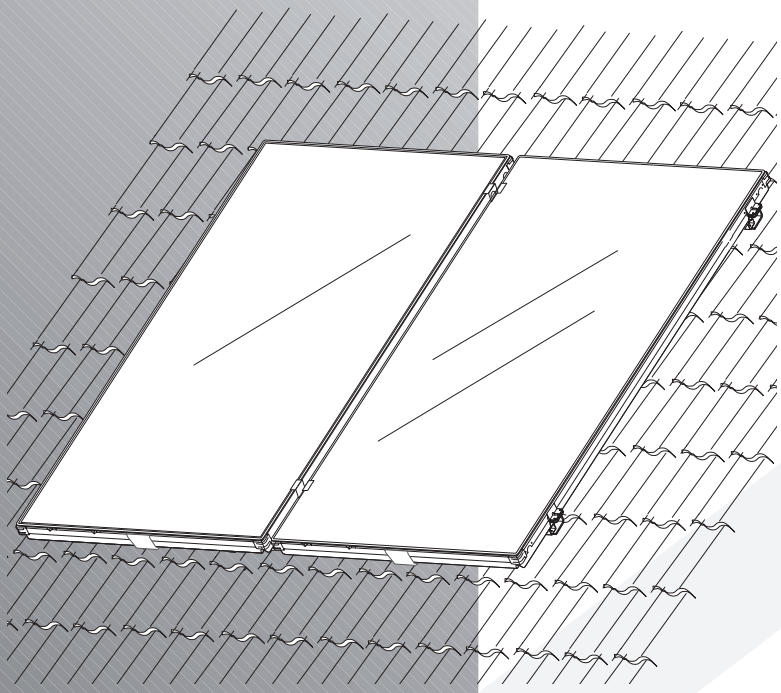
WORCESTER
Bosch Group
Heating and Hot Water Comfort

Worcester
Greenskies
FK240 Solar Panels

Technical and Specification Information

FK240 FLAT SOLAR COLLECTORS

ROOF-TOP INSTALLATION FOR WORCESTER SOLAR SYSTEMS



GB

INSTALLATION INSTRUCTIONS

WORCESTER
Bosch Group

About this manual

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

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.

RECYCLING

At the end of their service life, collectors may be returned to the manufacturer. Materials will be recycled in an environmentally appropriate manner.

Contents

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 heating 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 heating system and their components (pre-fabricated systems). ENV 12977: Thermal solar heating system and their components (bespoke systems). BS 5918: Latest version: Solar heating systems for domestic hot water.	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 heating systems (selection) in UK

1 VOB: Contract procedures for construction work, part C: General technical conditions of contract for construction services (ATV).

2 Terms of invitations to tender for construction services giving special consideration to the construction of living accommodation.

USER NOTE

The installation of the Worcester 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 5918: Latest version

2 Specifications

FK240	
Length	2115 mm
Width	1135 mm
Height	112 mm
Clearance between collectors	40 mm
Absorber liquid content	1.15 l
Gross absorber surface area	2.4 m²
Net absorber surface area	2.1 m²
Net weight	approx. 43 kg
Permissible collector operating pressure	3 bar
Type approval code	08-228-762

Tab. 2 FK240 Specifications

3 Safety

This chapter details the safety instructions in general and the meaning of user notes.

You will find the safety and user notes, which specifically refer to the installation, in this chapter and in the installation manual, i.e. immediately following the individual installation steps.

Carefully read the safety instructions before commencing the installation on the roof.

Severe injury 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, which are installed on sloping roofs with a slope of 25° to 60°.

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 standard snow load of 2.24 kN/m². If the installation set is installed in a roof with a slope of ≥ 45°, the approved snow load is 3.1 kN/m².

The mounting kit 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 which might lead to serious injury or death if appropriate care is not taken.

CAUTION!

RISK OF INJURY/SYSTEM DAMAGE

Identifies potentially dangerous situations, which might lead to mild or slight injuries or to material losses.

Further symbols identifying dangers and user notes:

WARNING!

RISK TO LIFE

from electric shock.

USER NOTE

Tip for the optimum utilisation and setting of the products 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 sheat) and the installation material during the installation as protection against high temperatures resulting from solar irradiation.

4 Before the installation

4.1 General notes

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

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 sheet) 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 locate the collectors according to the shape of the building (e.g. aligned with windows, doors, etc.).

USER NOTE

Only use OEM components and replace any damaged or faulty parts immediately.

USER NOTE

Remove broken roof tiles, shingles or plates in the area of the collectors and have them replaced.

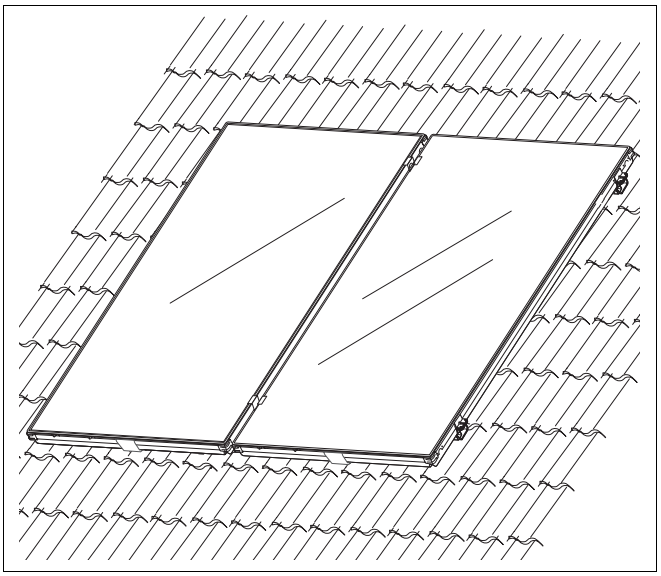


Fig. 1 General overview of collector pair – roof mounting

4.2 Component description

USER NOTE

You will need an extension set for the second and every subsequent collector and a basic pipework set for every collector array.

4.2.1 Basic set (per collector array for the first collector) – Fig. 2

Item 1:	Profile rails	2 ×
Item 2:	Antislip device	1 ×
Item 3:	Standard collector clips, incl. spacers	4 ×
Item 4:	Collector holders	4 ×
Others:	Various small components	

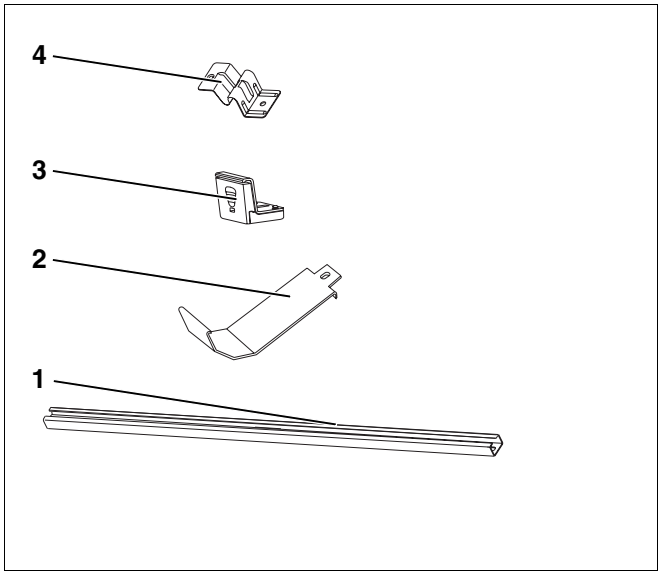


Fig. 2 Basic set

4.2.2 Extension kit (for each additional collector) – Fig. 3

Item 1:	Rail connector	2 ×
Item 2:	Profile rails	2 ×
Item 3:	Collector holder link, incl. spacers	2 ×
Item 4:	Double clips, including protective caps	2 ×
Item 5:	Antislip device	1 ×
Others:	Various small components	

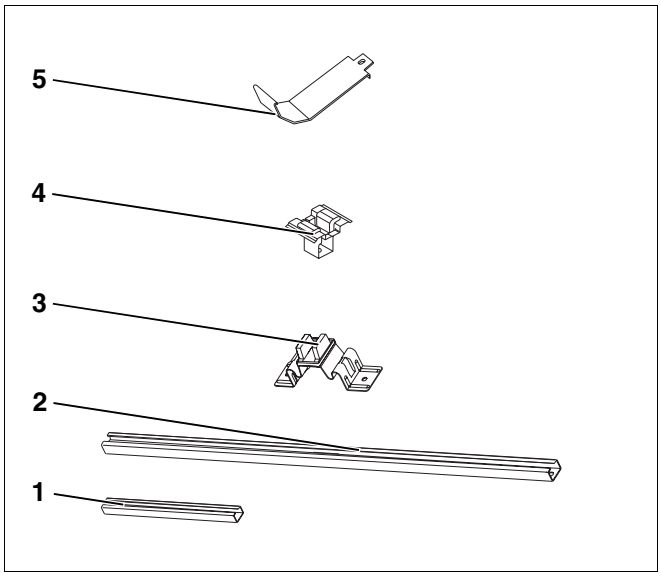


Fig. 3 Extension set

4.2.3 Basic pipe set (per collector array) – Fig. 4

Item 1:	Cable clamp for collector sensor	1 ×
Item 2:	SW 5 Allen key	1 ×
Item 3:	solar hoses, length 1000 mm	2 ×
Item 4:	solar hoses, length 60 mm (spare)	2 ×
Item 5:	Hose couplings	2 ×
Item 6:	Hose clips (including 1 x spare)	7 ×
Item 7:	Dummy plug	2 ×
Others:	Various small components	

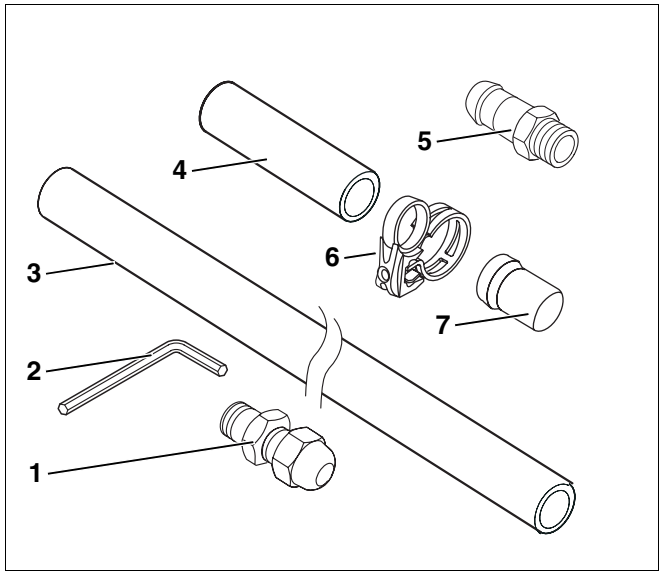


Fig. 4 Basic pipework set

4.2.4 Roof hook installation set (for pantile and brick ridges) – Fig. 5

Item 1:	Roof hook	4 ×
	Various small components	

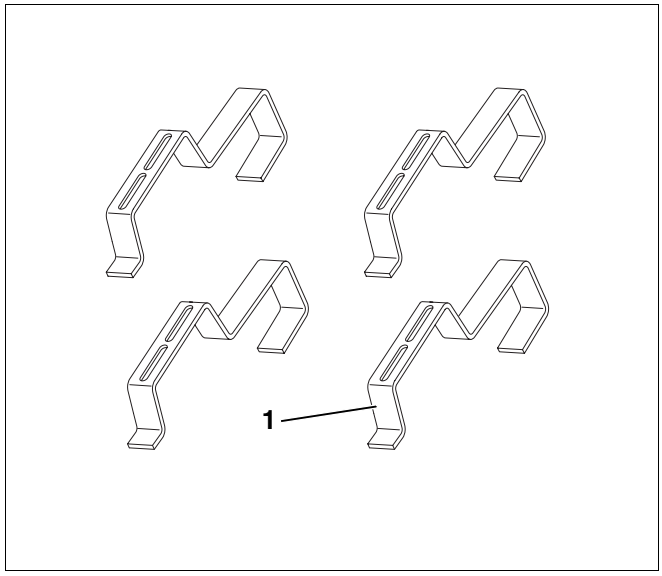


Fig. 5 Roof hook installation set

4.2.5 Roof hook additional installation set (for pantile and brick ridges; accessories, per collector) – Fig. 6

Item 1:	Additional roof hooks	4 ×

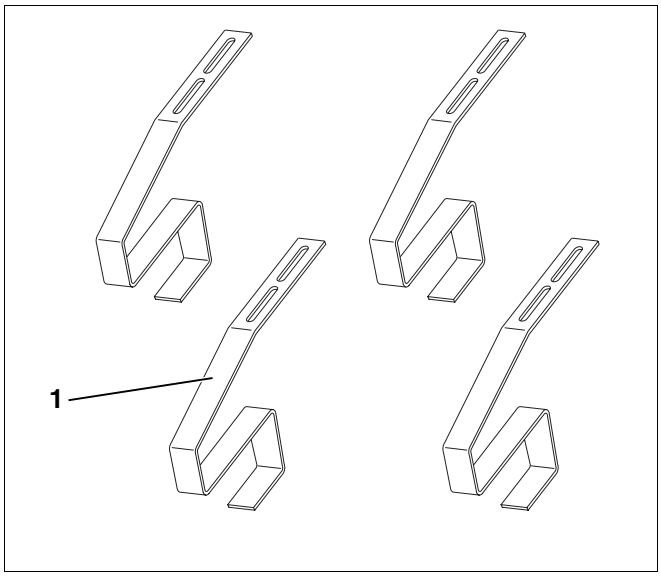


Fig. 6 Roof hook additional installation set – accessories

4.2.6 Special roof hook installation set (for slate, shingle and crown tile ridges; accessories; per collector) – Fig. 7

Item 1:	Special roof hooks	4 ×
Others:	Various small components	

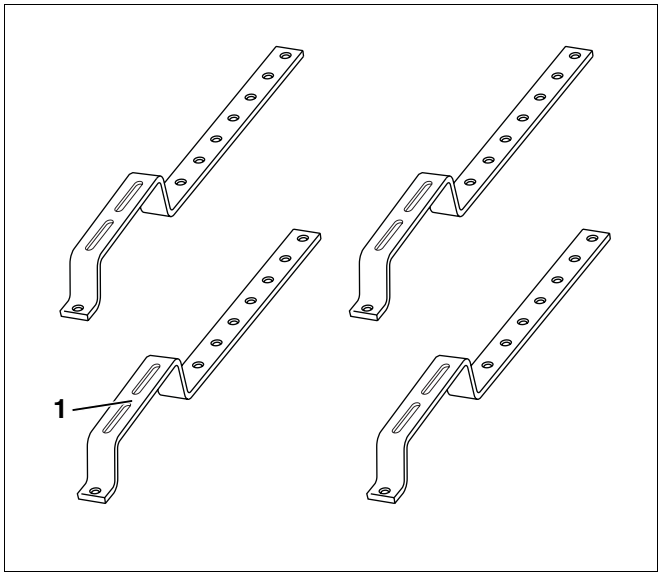


Fig. 7 Special roof hook installation set – accessories

4.2.7 Special roof hook installation set (for crown tile ridges; accessories, per collector) – Fig. 8

Item 1:	Special roof hook accessories	4 ×
Others:	Various small components	

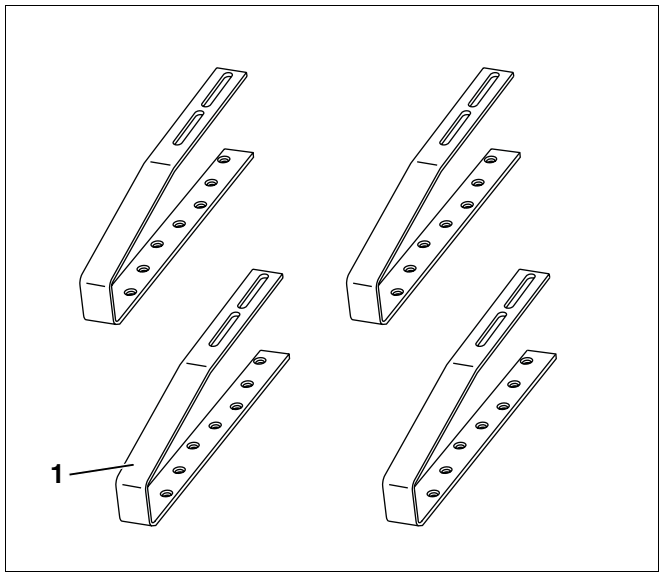


Fig. 8 Special roof hook installation set – accessories

4.2.8 Other required tools and equipment

- SW 13, 27 spanners
- Spirit level
- Suction pump (recommended but not required)
- Vest harness with safety rope
- Pipe insulation
- Scaffolding (where required by law)
- Roofing ladder

4.3 Taking measurements

USER NOTE

Carefully select the location of the collector array on the roof, and note the correct collector orientation.

4.3.1 Estimate your space requirements

Plan sufficient roof area for vertical installation.

These dimensions relate to the roof surface area, which must be available.

The dimensions stated relating to space requirements are simply the width of the collector array. In addition, allow at least 0.5 m on either side of the collector array for pipework (Fig. 9).

USER NOTE

If you install a vent, sufficient space around the flow exit must be planned during installation.

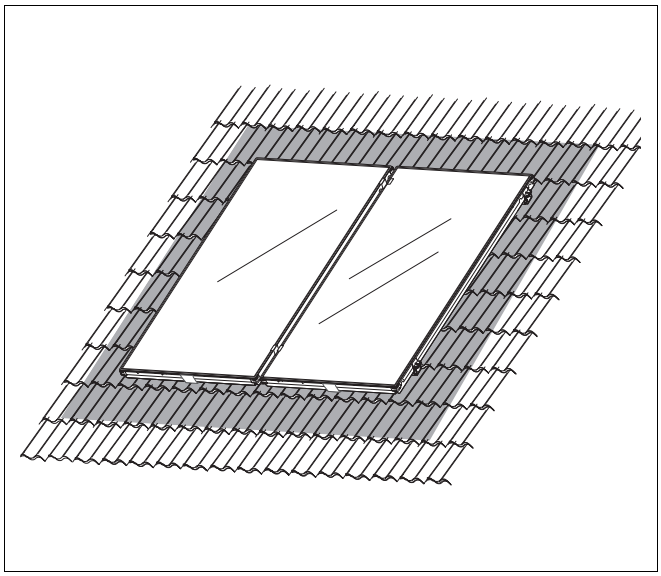


Fig. 9 Space required for collector array

4.3.2 Please observe these dimensions

Dimension A and B

Dimension A and B (Fig. 10) correspond to the area required for the selected number and layout of the collectors.

Dimension C

Dimension C represents at least two tiles to the ridge. There is a risk of damaging the tiles at the roof ridge, particularly if the tiles are laid in mortar.

Dimension D

Dimension D corresponds to the roof height including the gable wall. The adjacent 50 cm clearance to the collector array is required under the roof on the right or left depending on the type of connection.

Dimension E

Dimension E corresponds to at least 30 cm, which is required in the attic for installation of the connection pipes.

Dimension F

Dimension F corresponds to at least 40 cm, which is required in the attic for installation of the connection pipes.

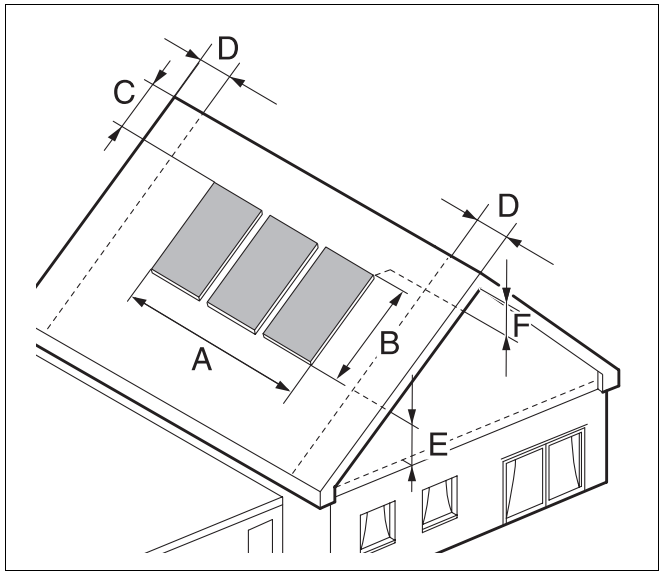


Fig. 10 Space required for collector array

Space requirement

Number of collectors	Dimension A	Dim. B
2	2,34 m	2,20 m
3	3,51 m	2,20 m
4	4,68 m	2,20 m
5	5,85 m	2,20 m
6	7,02 m	2,20 m
7	8,19 m	2,20 m
8	9,36 m	2,20 m
9	10,53 m	2,20 m

Tab. 3 Space requirement for vertically installed collectors

5 Preassembling profile rails

Before starting the installation on the roof, the profile rails for a maximum of three collectors can be preassembled on the ground.

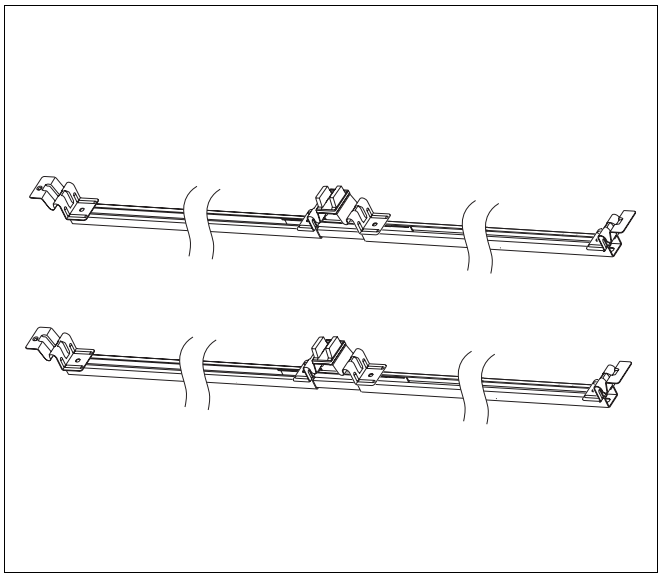


Fig. 11 Preassembled profile rails for two adjacent collectors

5.1 Connecting profile rails

If you wish to preassemble multiple collectors (at least two), the individual profile rails (top and bottom) must be connected with rail connectors (Fig. 12, **Item 1** and **2**).

- Slide the rail connectors (Fig. 12, **Item 1**) until they lock (Fig. 12, **Item 3**) in the profile rails.

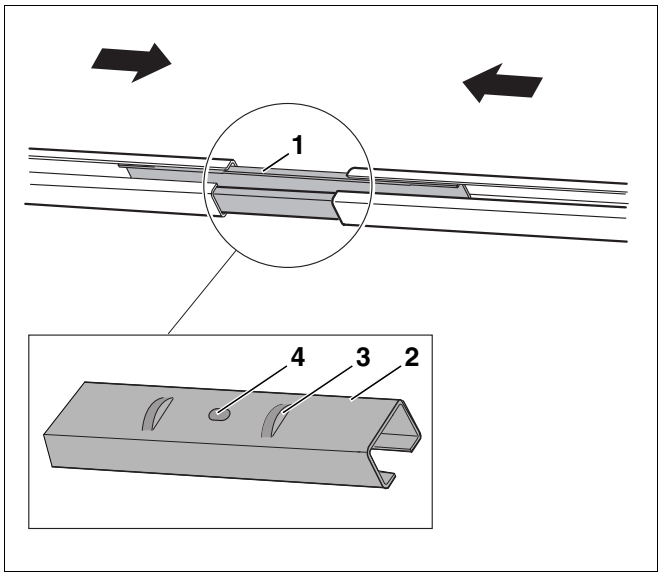


Fig. 12 Plugging profile rails together

Item 1: *Plug connector*

Item 2: *Rail connector (back)*

Item 3: *Lock*

Item 4: *Drilled hole*

5.2 Installation of the collector holder bridge

USER NOTE

The threaded plates (Fig. 13, **Item 1**) are preassembled at the factory with the pan-head screws (Fig. 13, **Item 2**) to the collector holder link (Fig. 13, **Item 4**).

The threaded plates have a self-locking, tight thread.

- Position the two collector holder links centrally Fig. 13 on the two profile rails (above the rail connector).

USER NOTE

A drilled hole (Fig. 12, **Item 4**, page 16) is present in the rail connector to check that the collector holder link is centrally positioned.

Make sure that the spacer block (Fig. 13, **Item 3** and Fig. 14, **Item 1**) is at right angles to the profile rails on the frame.

- Now fasten the collector holder link to the underlying profile rails and rail connectors with the preassembled threaded plates and pan-head screws.
- Pay particular attention to the orientation of the threaded plates in Fig. 13.

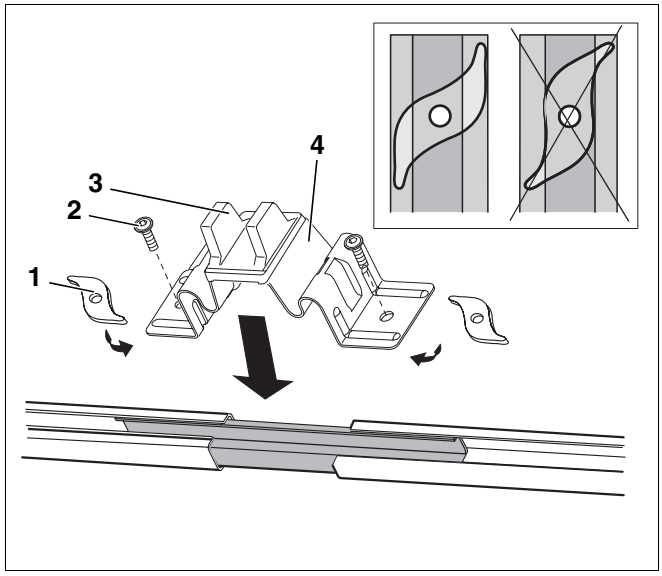


Fig. 13 Installation of the collector holder bridge

Item 1: *Threaded plate (preassembled)*

Item 2: *Pan-head screw (preassembled)*

Item 3: *Spacer block*

Item 4: *Collector holder link (preassembled)*

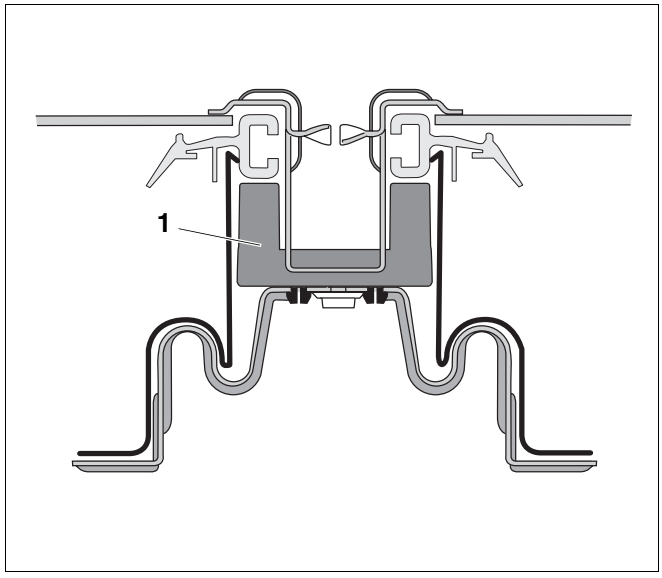


Fig. 14 View of the exact position of the spacer block

5.3 Installation of the lateral collector holder

The lateral collector holders act as lateral ends or limits of the collector array.

- Install the collector holder Fig. 15 so the edge of the threaded plate is flush with the end of the profile rail. The threaded plate must not protrude under any circumstances.
- Attach the collector holders with the preassembled threaded plates (self-locking, tight thread; Fig. 15, **Item 2**) and pan-head screws (Fig. 15, **Item 1**).

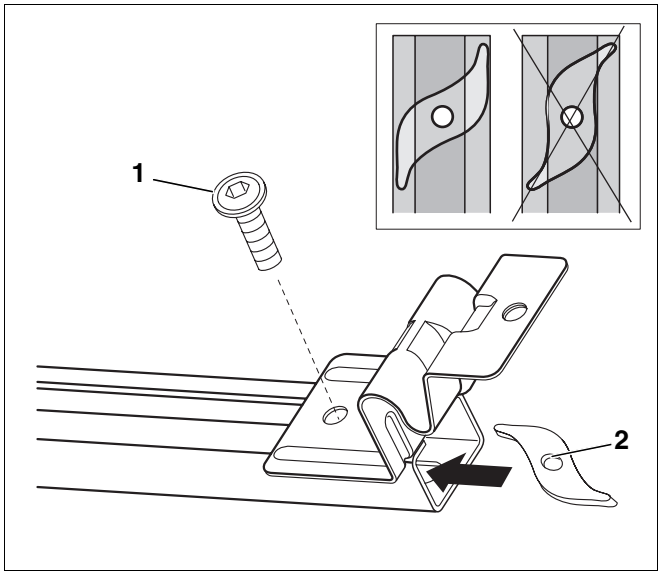


Fig. 15 Securing the collector holder flush with the profile rail

Item 1: *Pan-head screw (M8 x 16, preassembled)*

Item 2: *Threaded plate (preassembled)*

5.4 Installation of antislip protection

To be able to install the collectors safely, the antislip device (Fig. 16, **Item 1**) must be attached and secured to the bottom profile rails.

- Attach the preassembled antislip device centrally between the collector holders Fig. 16 with the threaded plates (self-locking, tight thread; Fig. 16, **Item 3**) and pan-head screws (Fig. 16, **Item 2**).
- Tighten the screws.

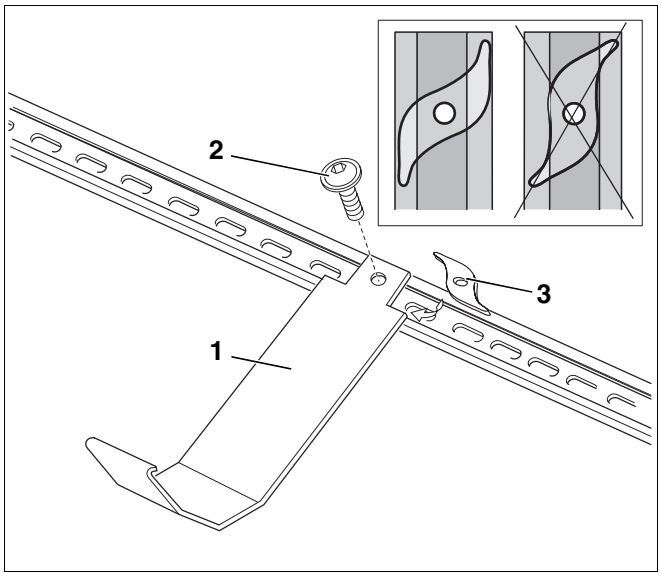


Fig. 16 Attaching antislip device

Item 1: *Antislip device*

Item 2: *Pan-head screw (preassembled)*

Item 3: *Threaded plate (preassembled)*

6 Installation of profile rails and roof hooks

WARNING!

RISK TO LIFE

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

CAUTION!

RISK OF INJURY

When working on a roof falling parts may cause serious injury.

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

USER NOTE

For better access to the roof use a scaffold tower.

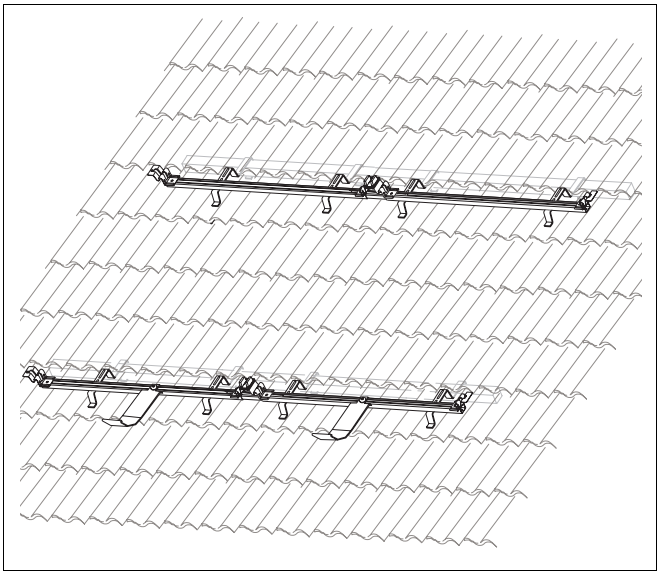


Fig. 17 Profile rails with roof hooks installed on a tile roof – for two adjacent collectors

6.1 Setting clearances

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

USER NOTE

On pantile and brick tile roofs the tile troughs determine the true distance between the roof hooks.

Distances of roof hooks

Every profile rail is fastened with two roof hooks (and if required additional roof hooks) (Fig. 18). See the table for the approximate distance between the roof hooks.

Distance w	Distance x	Distance z
approx. 1170 mm	approx. 700 mm	approx. 470 mm

Tab. 4 Distance of the roof hooks from one another

USER NOTE

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

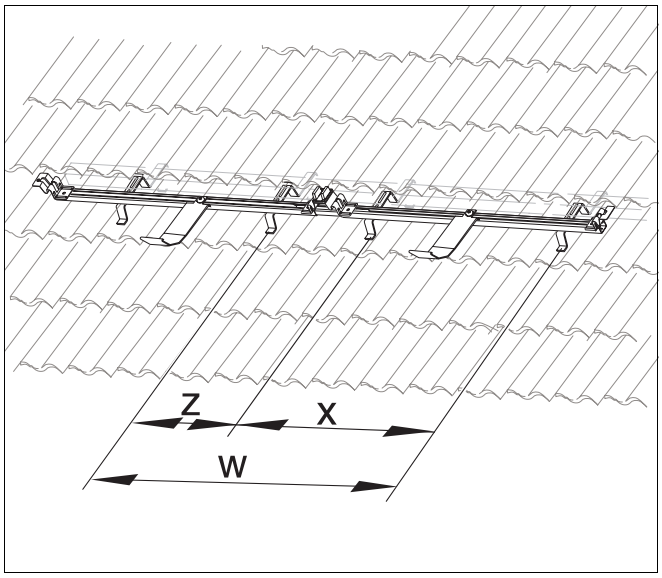


Fig. 18 Distance of the roof hooks from one another

Distances of profile rails

Set the distance (Fig. 19) between the top and bottom profile rails. Use the table values.

Distance y	
from	to
1650 mm	1690 mm

Tab. 5 Distance (centre-centre) between bottom and top profile rail

USER NOTE

The top profile rail must be between the sensor pocket and the collector connection.

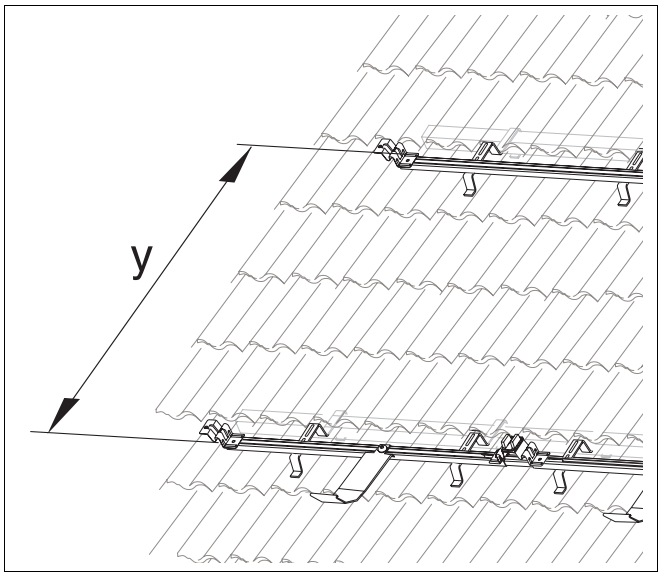


Fig. 19 Distance of the profile rails from one another

6.2 Pantile or brick tile ridge

Always install all roof hooks (and additional roof hooks if required) following the reference values specified in the tables on page 20.

USER NOTE

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

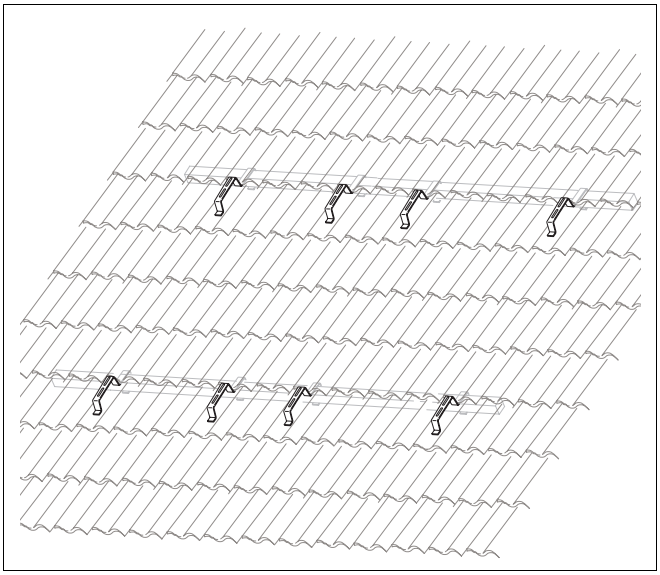


Fig. 20 View of attached roof hooks and additional roof hooks

6.2.1 Attaching roof hooks

- Lift the corresponding pantile or brick tile (Fig. 21).
- Attach the roof hook to the roof battens and position it with the bottom in a tile trough.

USER NOTE

If necessary, knock off the base of the tile so it will lie correctly back on top of the roof hook.

USER NOTE

Mark the distance of the profile rails on the roof hook.

USER NOTE

If the tiles overlap more than 95 mm, they must be notched in the area of the roof hook.

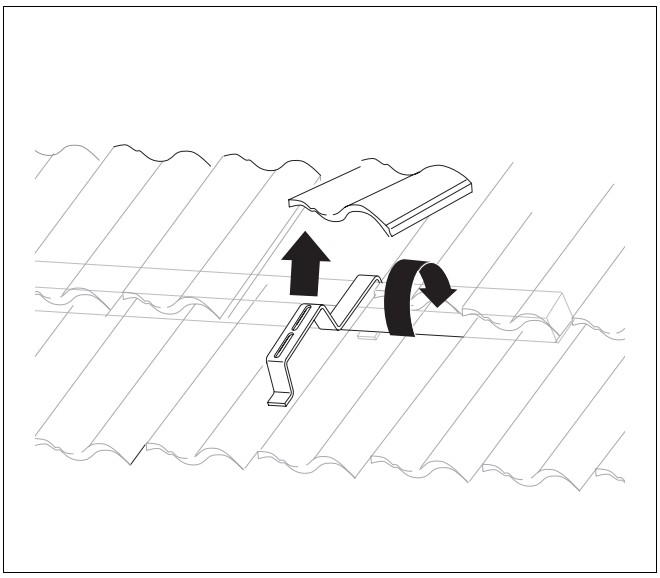


Fig. 21 Attaching roof hooks

6.2.2 Attaching additional roof hooks (accessories)

Additional roof hooks are required as well as the roof hook if:

– the roof slope is less than 30°.

– the distance to the edge of the roof or ridge is greater than three pantiles or brick tiles.

– wind forces are expected.

▶ Lift the corresponding pantile or brick tile (Fig. 22).

▶ Take the additional roof hook and guide it diagonally under the pantile or brick tile. The additional roof hook must be attached to the roof batten and be in contact with the roof hook above.

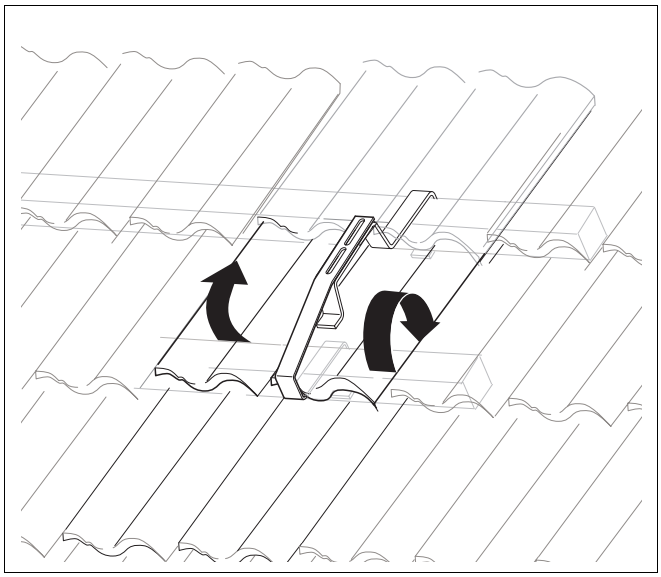


Fig. 22 Attaching additional roof hooks

6.2.3 Installing profile rails

▶ Always start with the bottom profile rail.

▶ Place the profile rails that were preassembled on the installed roof hooks (Fig. 23).

▶ As specified in Table 5, page 20 the profile rail should be positioned as far down the hook as possible (the collector later covers the additional roof hook as far as possible).
We recommend a batten gauge to maintain the correct distance of the profile rails.

▶ Align the profile rails horizontally.

▶ Connect the profile rails and roof hooks with nuts, shims and pan-head screws.

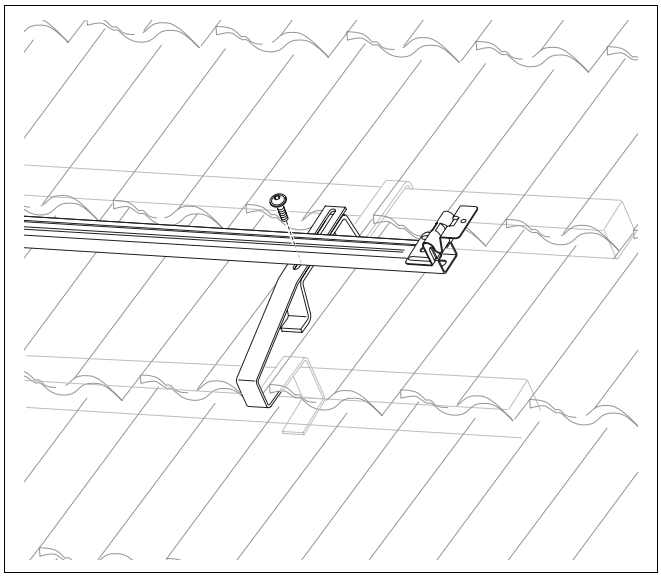


Fig. 23 Screw preassembled profile rail to roof hook and additional roof hook

6.2.4 Aligning profile rails

- Align the top profile rails to the side flush with the bottom profile rails (Fig. 24).

USER NOTE

Measure the diagonals or place a roof batten on the collector holders of the profile rails. The angle between roof batten and profile rail must be 90°.

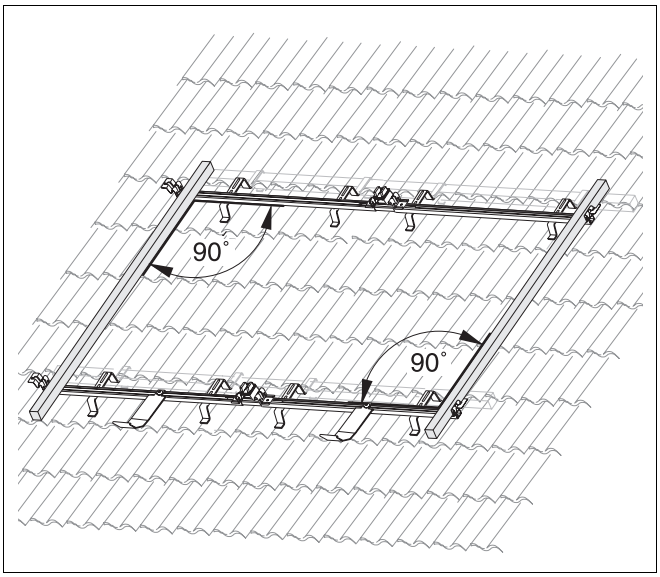


Fig. 24 Aligning profile rails

6.3 Crown tile ridges

USER NOTE

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

- During installation maintain the required distances (w, x and y) between the special roof hooks and additional roof hooks (Table 4 and 5, page 20).

BUILDING DAMAGE

caused by leaks.

CAUTION!

- Install every special roof hook and additional roof hook on the centre of a crown tile.

- Install the special additional roof hooks (accessories: conditions of use see Chapter 6.2.2 "Attaching additional roof hooks (accessories)", page 22) centrally on the crown tiles with the included screws (Fig. 25).
- Cut the adjacent crown tile (Fig. 25, dashed line).
- Attach the crown tile to the roof batten (Fig. 26).
- Fasten the special additional roof hooks to the roof batten – if necessary, additional roof hooks must be installed or the roof battens cut out so the crown tiles lie flat again.

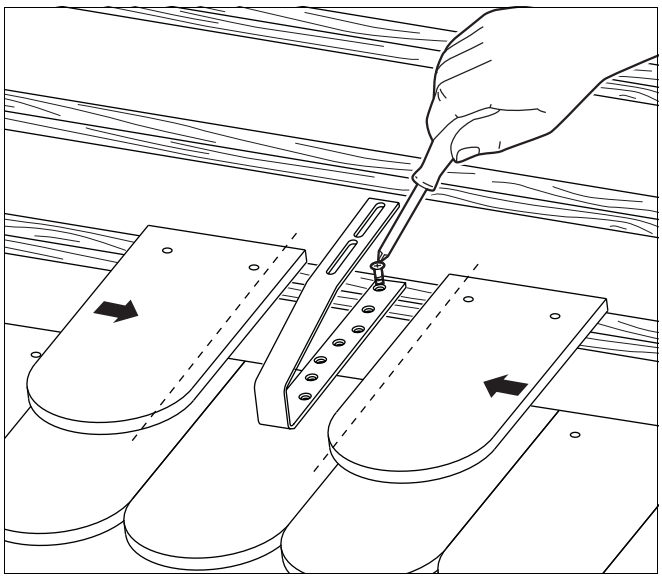


Fig. 25 Cut crown tile and install special additional roof hooks (accessories)

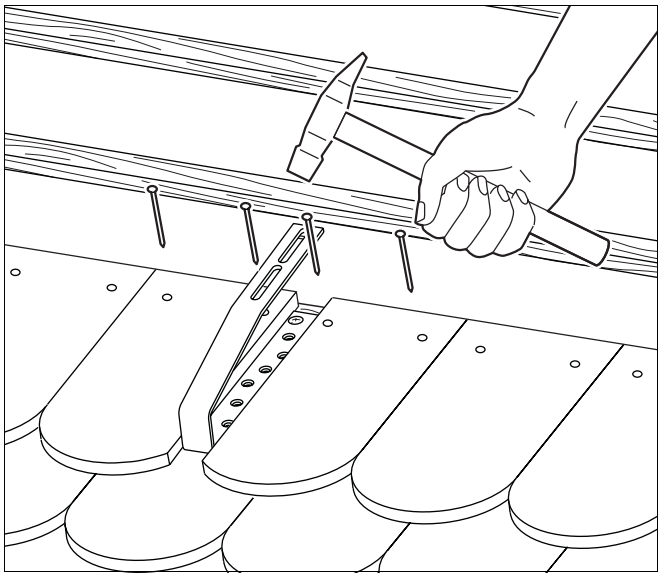


Fig. 26 Fastening crown tiles

- Place the second row of crown tiles (Fig. 27) and fasten them in place.

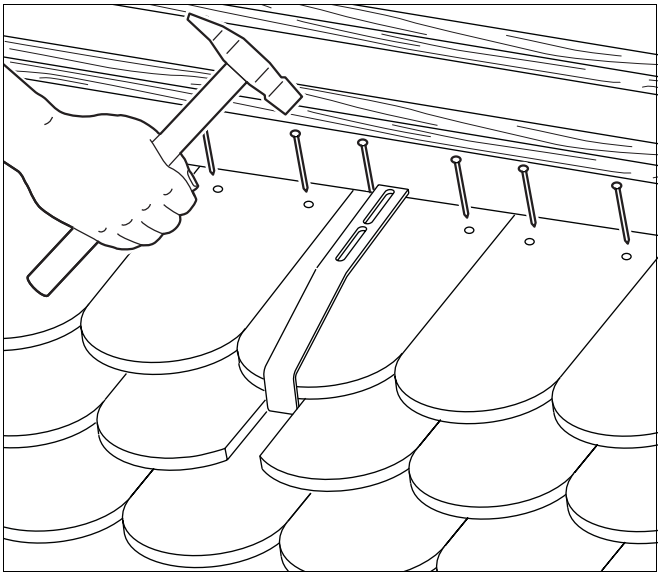


Fig. 27 Installing second row of crown tiles

- Install the special roof hooks (Fig. 28) with the included screws.

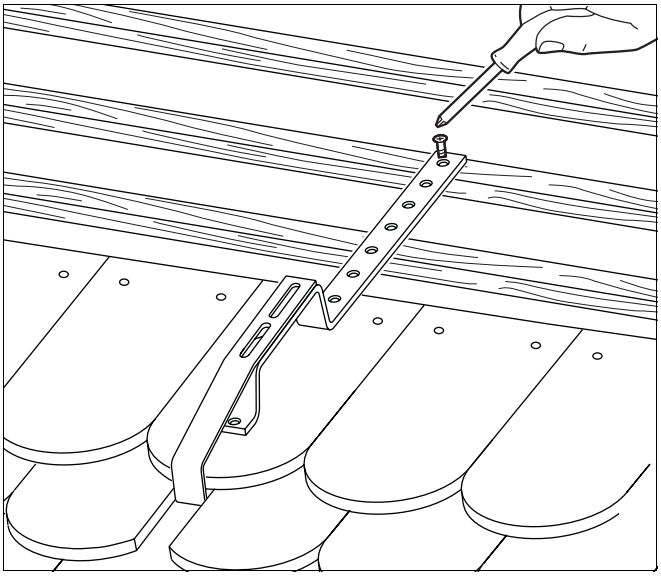


Fig. 28 Installing special roof hooks

- Cut the adjacent crown tiles (Fig. 29) and fasten them to the building.
- Finish the roof.
- Install the profile rails (see Chapter 6.2.3 "Installing profile rails", page 22).

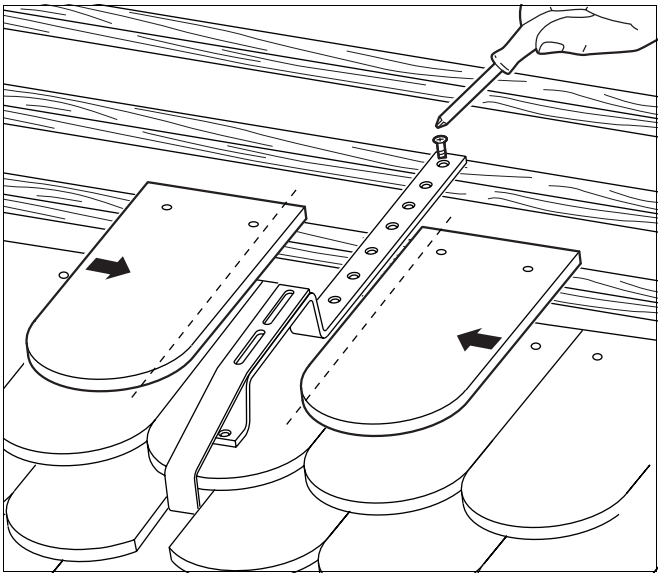


Fig. 29 Cutting and installing crown tiles

6.4 Slate/shingle ridges

USER NOTE

A roofer should carry out the installation with slates or shingles.

Here is an example of the installation of the special roof hooks and the watertight seal with on-site flashing (Fig. 31, **Item 4** and **6**) with a slate/shingle ridge.

- Fit the slate/shingle ridge according to the conditions on site.
- During installation maintain the required distances (w, x and y) between the special roof hooks and additional roof hooks (Table 4 and 5, page 20).
- Install the special roof hook (Fig. 31, **Item 5**) and the seal (Fig. 31, **Item 2** and **7**) on the slate/shingle ridge with the included screw (Fig. 31, **Item 3**).
- To ensure that the installation is watertight, flashing must be installed or positioned on the building above and below the special roof hooks (Fig. 31, **Item 4** and **6**).

USER NOTE

The special roof hooks must be positioned on the front of a multiple ridge (Fig. 31, **Item 1**).

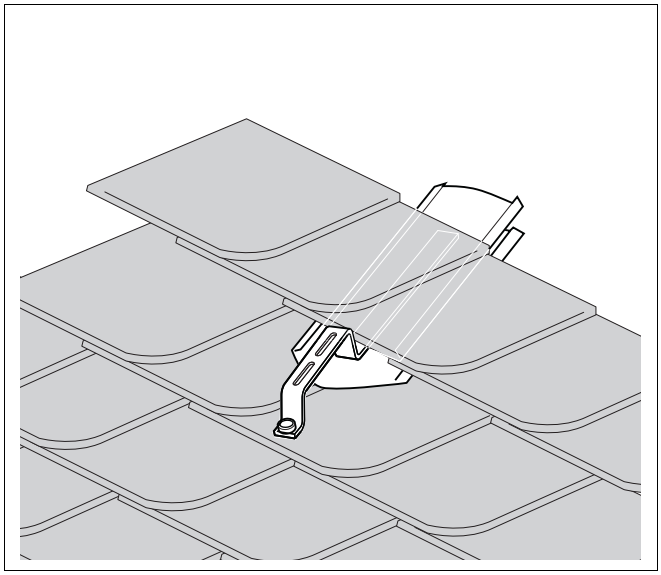


Fig. 30 Special roof hook fully installed

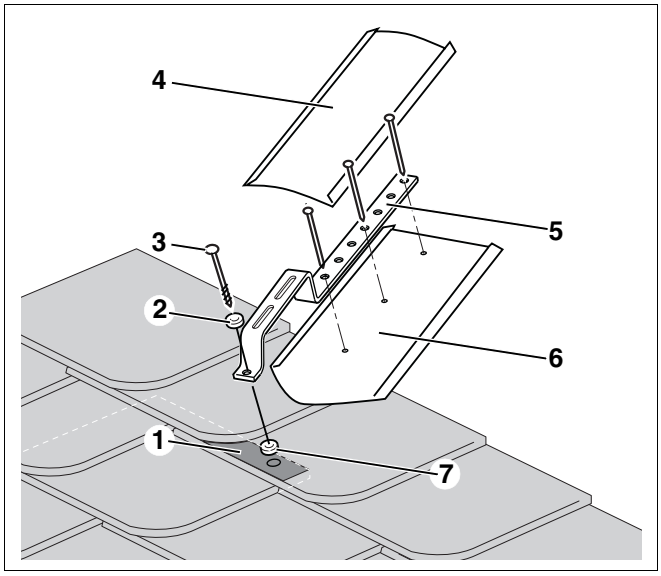


Fig. 31 Installing special roof hooks on a multiple ridge

Item 1: *View of the multiple ridge*

Item 2: *Seal (on building)*

Item 3: *Screw*

Item 4: *Flashing (on building)*

Item 5: *Special roof hooks*

Item 6: *Flashing (on building)*

Item 7: *Seal (on building)*

7 Collector installation

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

WARNING!

RISK TO LIFE

through a fall or falling parts.

- ▶ 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.

USER NOTE

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

CAUTION!

SYSTEM DAMAGE

Unsecured collectors may fall during handling and installation.

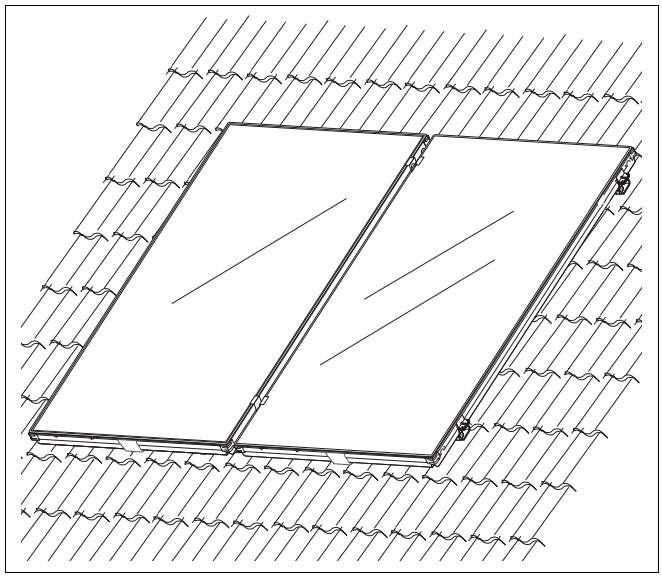


Fig. 32 View of installation on roof

7.1 Placing and connecting collectors in the collector holders

CAUTION!

RISK OF INJURY

Install collectors with at least one assistant.

- Always commence with the right hand collector.
- Position the first collector centrally into the trough of the preassembled collector holders.
- Slide the collector (Fig. 33, **Item 1 und 2**) down in front of the antislip device (Fig. 33, **Item 4**).
  Slide the antislip device up until the edge of the antislip device locks into the groove (Fig. 33, **Item 3**) in the collector frame.

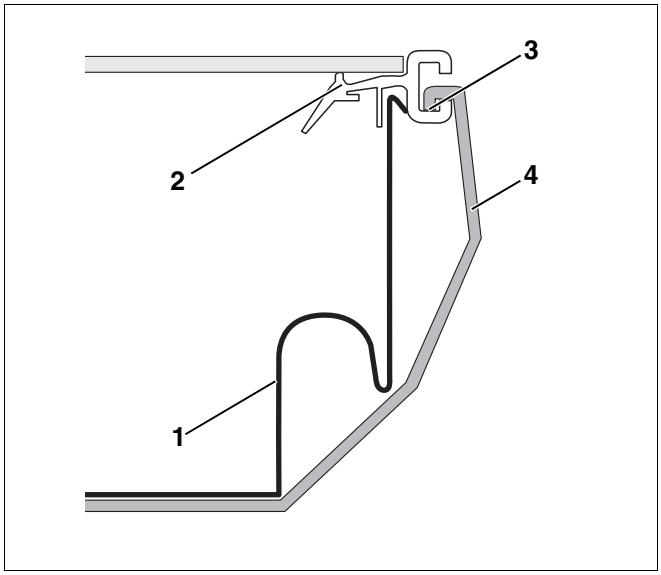


Fig. 33 Inserting the first collector

Item 1: *Collector trough*

Item 2: *Collector frame*

Item 3: *Groove on collector frame*

Item 4: *Antislip device*

As standard, the hose clip is fitted to (Fig. 34, **Item 2**) the solar hose (Fig. 34, **Item 1**).

- Before inserting the next collectors, push the hose clips (Fig. 34, **Item 2**) over the pre-assembled solar hoses (Fig. 34, **Item 1**).

USER NOTE

Ensure that the second hose clip (Fig. 34, **Item 2**) is located on the solar hose.

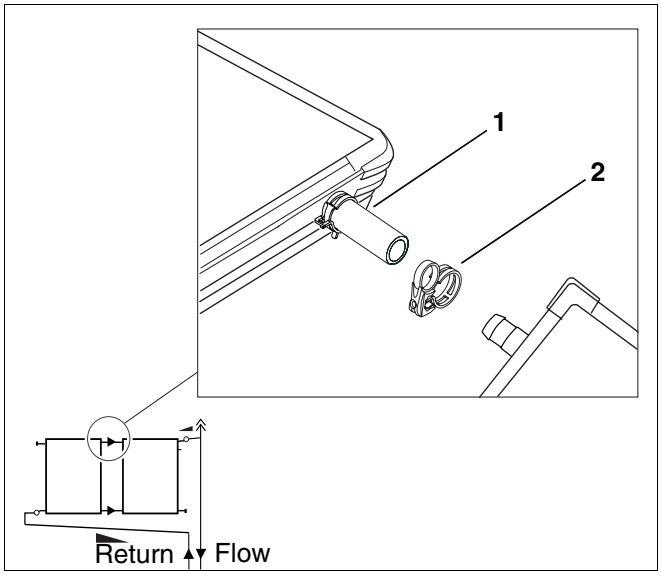


Fig. 34 Pull the hose clip over the solar hose.

Item 1: *Pre-assembled solar hose*

Item 2: *Hose clip*

- Whilst inserting the next collector, push the pre-assembled solar hoses onto the connections of the previously installed collector (Fig. 35).
- Then place the collector into the collector holders.

CAUTION!

SYSTEM DAMAGE

It is only possible to adjust the location of the hose clip with the blue clamping ring still in place and the clip in the open state. The clip should not be slackened with pliers, to avoid damage to the corrosion resistant coating on the hose clip.

CAUTION!

RISK OF INJURY

Only pull the blue ring from the clip when the solar hose is in the correctly installed position.

The blue clamping ring must be removed from the hose clip to close or secure the solar hose.

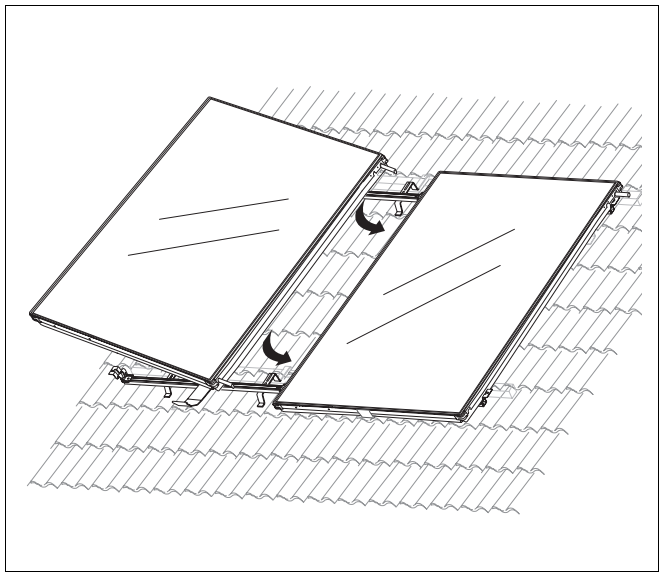


Fig. 35 Inserting the second collector and tightening the hose clip

7.2 Securing collectors

Secure the collectors with the collector clamps supplied.

- Position the edge of the double clamp onto the glass panes of the collectors (Fig. 36).

USER NOTE

Hold the collector clamps tightly when securing the clamps to ensure that they sit in proper alignment.

Ensure that the protective caps (Fig. 36, **Item 1**) of the double clamps are present.

- Secure the double clamps on the collector holders using the pan-head screws supplied.

USER NOTE

Use the Allen key SW5 to secure the collector clamps.

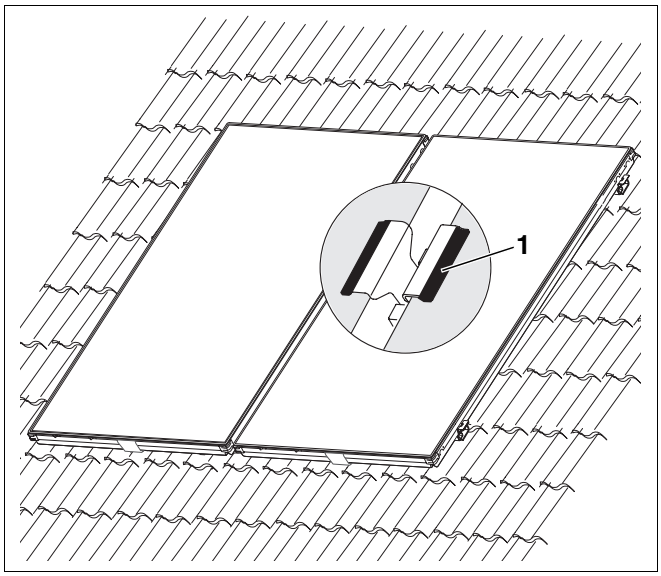


Fig. 36 Securing collectors centrally

USER NOTE

Make sure that the plastic top parts (Fig. 38, **Item 4**) of the two-part spacer blocks are located on the plastic bottom parts (Fig. 38, **Item 5**).

The plastic top parts support the collector frame.

- Tip the collector clips slightly forward and insert them into the groove in the collector frame.
- Secure the collector clips on the side collector holders using the pan-head screws supplied.

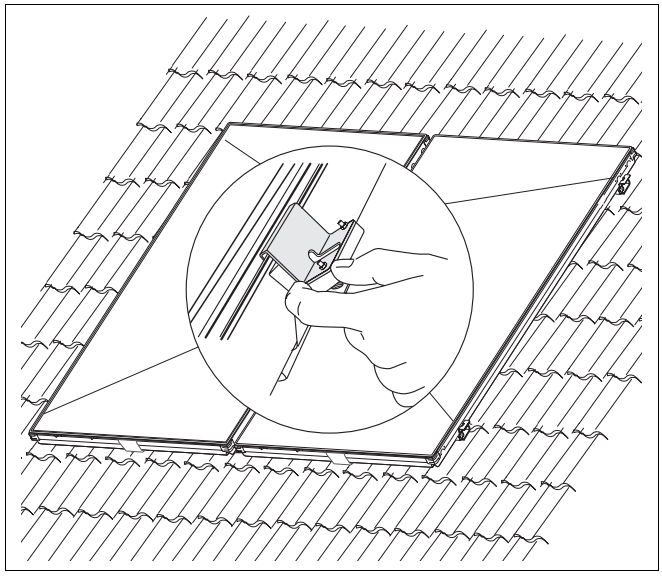


Fig. 37 Securing collectors to the side

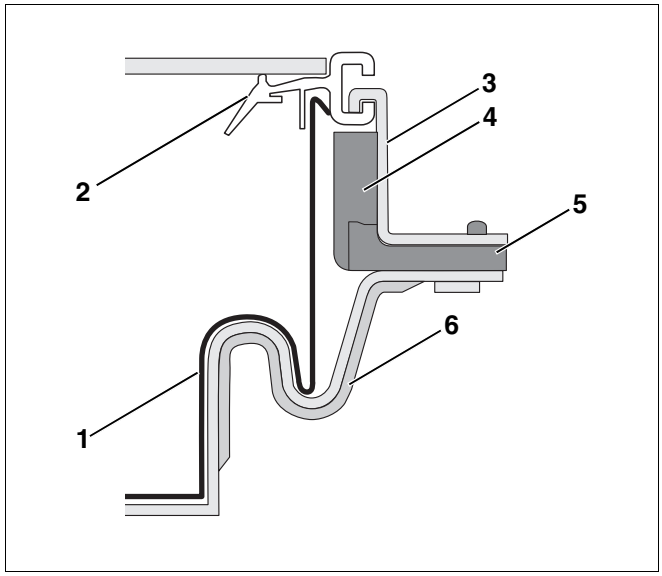


Fig. 38 Diagram of inserted collector clips

Item 1: *Collector trough*

Item 2: *Collector frame*

Item 3: *Collector clips*

Item 4: *Top spacer plastic*

Item 5: *Bottom spacer plastic*

Item 6: *Collector holder*

8 Header connection

8.1 Water connection acc. to the Tichelmann principle

Always connect the collectors according to the Tichelmann principle (Fig. 39). Install the pipework so that the same volume flow is channelled to each collector.

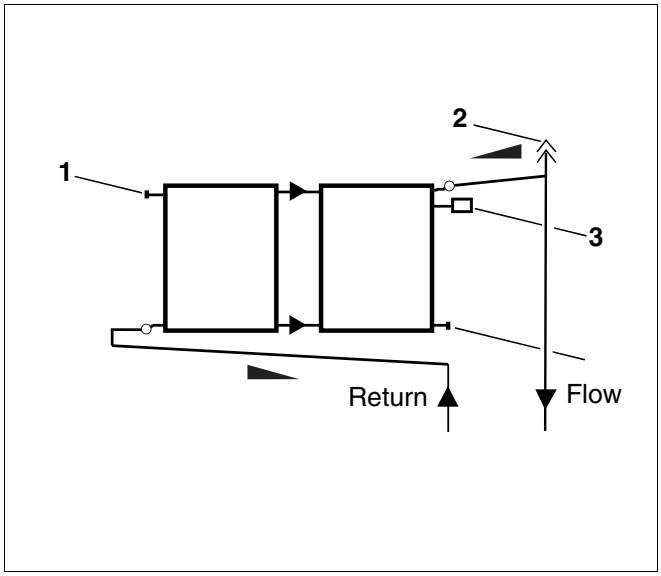


Fig. 39 Water connection acc. to the Tichelmann principle

Item 1: *Dummy plug*

Item 2: *Automatic air-vent valve (accessory)*

Item 3: *Temperature sensor*

8.2 Always ensure the system is properly vented

If you intend venting a solar heating system with automatic air-vent valves at the highest point of the system, run your pipework rising to the air-vent valve.

Avoid frequent changes in direction.

USER NOTE

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

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

USER NOTE

For solar heating systems always use all-metal air vents. Automatic vents with plastic floats will be destroyed as the liquid and steam temperatures can be in excess of 110 °C. Plastic pipes (e.g. those made from polyethylene) are also unsuitable for solar heating systems.

Function of the grub screw and the weather protection cap

The solar heating system is vented through the opened grub screw (Fig. 40, **Item 1**). The weather protection cap must always be positioned over the grub screw to prevent moisture entering through the opened shut-off screw into the solar heating system (Fig. 40, **Item 2**).

- Open the air-vent valve by unscrewing the grub screw one full revolution.

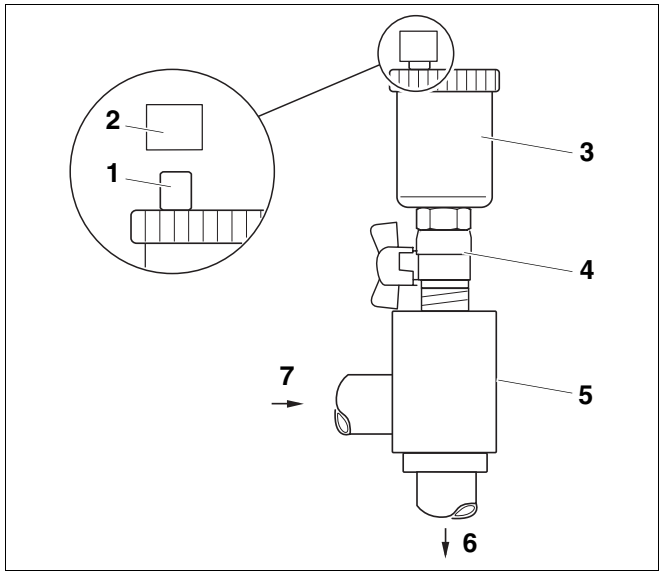


Fig. 40 View – air trap with vent valve for flow connection (accessory)

Item 1: *Grub screw*

Item 2: *Weather protection cap*

Item 3: *Automatic air-vent valve (accessory)*

Item 4: *Ball valve, 3/8", I/A with winged handle (accessory)*

Item 5: *Air trap (accessory)*

Item 6: *Solar heating station header*

Item 7: *Header from the solar collectors*

8.3 Connection flow and return lines

The manifold terminates as pipeline under the roof. The connection with the collector array is achieved via ¾inch solar hoses (part of the basic pipework set).

8.3.1 Connect flow line

- Remove the preassembled short solar hose (if the flow pipe is on the r.h. side) and replace it with the long solar hose (Fig. 41, **Item 4**) at the top connection of the collector that is the last hydraulically.
- Fasten the long solar hose to the collector with a new hose clip (Fig. 41, **Item 5**).
- Slide the second hose clip (Fig. 41, **Item 3**) over the long solar hose.

USER NOTE

Do not install the air vent (accessory) and the bleeder (accessory) yet.

You will need a conversion kit to install the bleeder above the roof. It must be ordered separately.

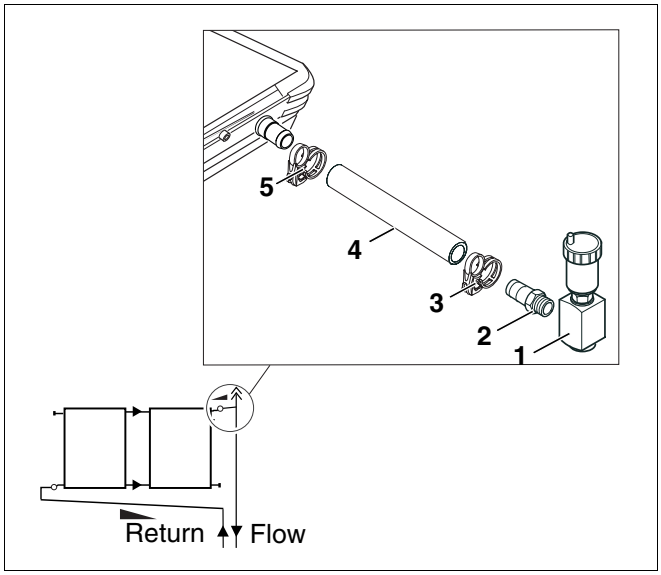


Fig. 41 Connecting flow line and air vent with bleeder

Item 1: *Air trap and venting valve (accessory)*

Item 2: *Hose coupling*

Item 3: *Hose clip*

Item 4: *long solar hose*

Item 5: *Hose clip*

- On pantile or brick tile roofs feed the flow line and the sensor cable (Fig. 42, **Item 1 and 2**) into the attic through an air pantile (Fig. 42, **Item 3**) or an antenna barrel.

USER NOTE

Use a roofing company for a sheet steel roof.

Use a specially shaped insert on corrugated roofs.

- Connect the air vent with bleeder (accessories) (Fig. 41, **Item 1**) to the hose coupling (Fig. 41, **Item 2**) on the long solar hose in the attic if possible. The hose coupling is included with the basic piping set.

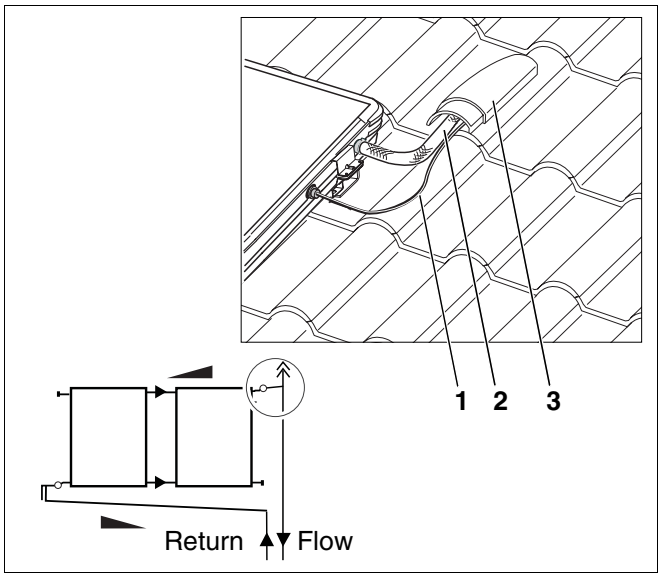


Fig. 42 Laying out flow pipe and sensor cable

Item 1: *Sensor cable*

Item 2: *Flow line*

Item 3: *Air pantile*

8.3.2 Connection of the return pipe

USER NOTE

During the installation ensure that the return pipe is run below the collector array rising to the array (Fig. 43).

- Fasten the long solar hose (Fig. 43, **Item 2**) to the collector with the hose clip.
- Slide the second hose clip over the long solar hose.
- Guide the return line into the attic through a suitable roof opening (e.g. soil vent cover) (Fig. 43, **Item 1**).
- Slide the supplied hose coupling onto the pipe.

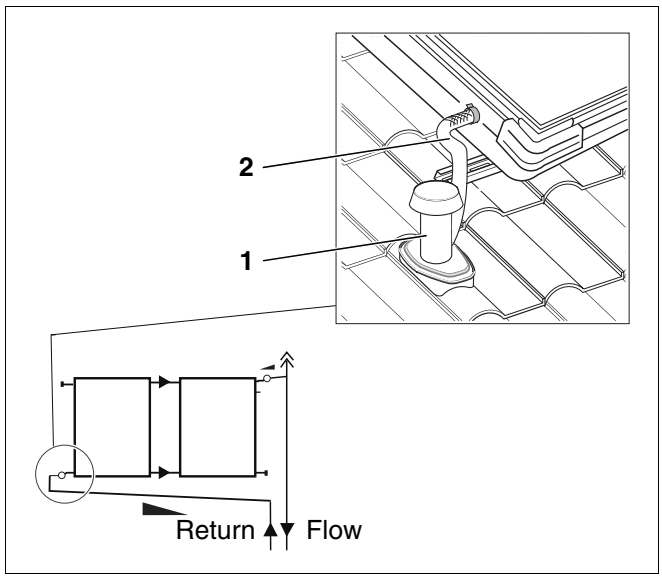


Fig. 43 Connecting return line

Item 1: *soil vent cover*

Item 2: *long solar hose*

8.4 Connection of air trap and venting valve (accessory)

- Connect the system to the air vent (Fig. 44, **Item 4**) in the flow (Fig. 44, **Item 3**) at the highest point of the system with the supplied hose coupling.
- Slide the hose clip up to the air vent.

CAUTION!

SYSTEM DAMAGE

It is only possible to adjust the location of the hose clip with the blue clamping ring still in place and the clip in the open state. The clip should not be slackened with pliers, to avoid damage to the corrosion resistant coating on the hose clip.

CAUTION!

RISK OF INJURY

Only pull the blue ring from the clip when the solar hose is in the correctly installed position.

The blue clamping ring must be removed from the hose clip to close or secure the solar hose.

- Pull the serrated washers of the hose clips.

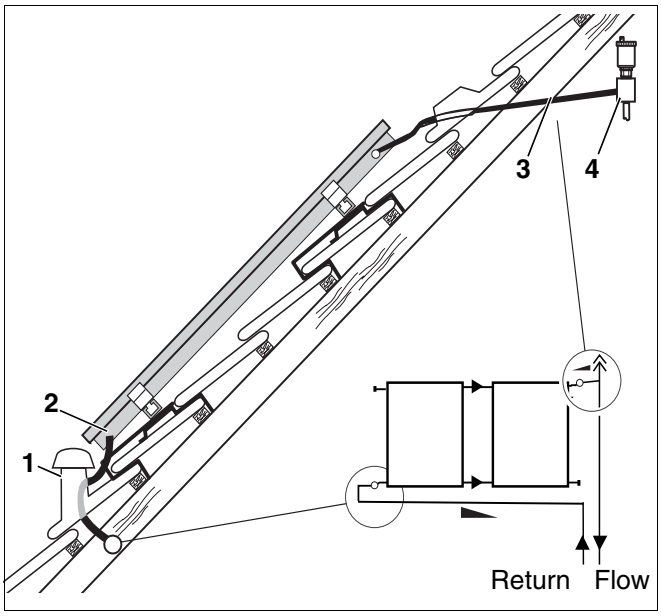


Fig. 44 Position of air vent with bleeder

Item 1: *soil vent cover*

Item 2: *Return line*

Item 3: *Flow line*

Item 4: *Air trap and venting valve (accessory)*

8.5 Dummy plug installation

Seal the collector connections, which are not required, using the dummy plugs supplied with the basic pipeline kit.

- To do this, insert the dummy plug (Fig. 45, **Item 1**) head first into the short solar hose.
- Push the hose clip (Fig. 45, **Item 2**) up to the head of the dummy plug (Fig. 45, **Item 1**).

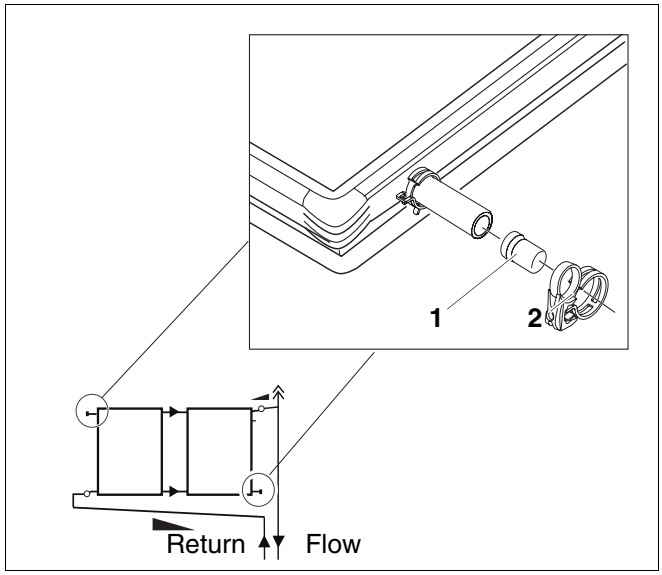


Fig. 45 Dummy plug installation

Item 1: *Dummy plug*

Item 2: *Hose clip*

9 Collector sensor connection

USER NOTE

Observe the installation location for single or dual row collector systems.

Location

– Insertion point (Fig. 46, **Item A**) for single row collector systems.

– Insertion point (Fig. 46, **Item B**) for dual row collector systems.

Collector sensor connection

USER NOTE

The collector sensor is part of the control unit package.

- ▸ Insert the collector sensor (Fig. 46, **Item 1**) through the compression fitting (Fig. 46, **Item 2** and **3**) and push the collector sensor approx. 170 mm until it reaches the end of the sensor pocket (Fig. 46, **Item 4**).
- ▸ Thread the bottom part of the compression fitting (Fig. 46, **Item 3)** into the sensor pocket thread (Fig. 46, **Item 4**).
- ▸ Tighten the compression fitting (Fig. 46, **Item 2** and **3**).

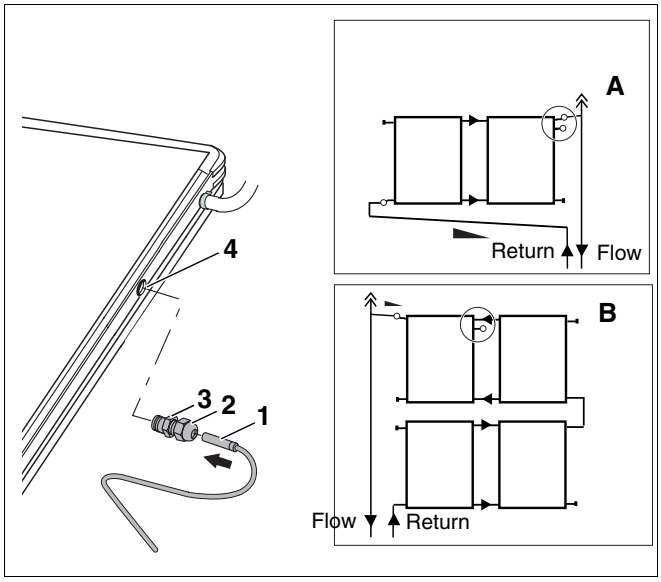


Fig. 46 Collector sensor connection

Item 1: *Collector sensor*

Item 2: *Upper part - compression fitting*

Item 3: *Lower part – compression fitting*

Item 4: *Sensor pocket for collector sensor*

10 Insulating the connection and header pipes

USER NOTE

Carry out the following insulating work only after completion of the pressure test and when all connections are tight.

- Finally, check the secure positioning of the installed set and that of the collectors.

Insulation of internal and external manifolds

– For the insulation of external pipework, use only UV and high temperature resistant insulating materials.

– For the insulation of internal pipework, use only high temperature resistant insulating materials, e.g. Armaflex HT for solar installations.

USER NOTE

Also insulate the connections between the collectors.

INSTALLATION INSTRUCTIONS

EXCELLENCE COMES AS STANDARD
Worcester, Bosch Group
Cotswold Way, Warndon, Worcester WR4 9SW
Telephone: (01905) 754624 Fax: (01905) 754619
Worcester, Bosch Group is a trading name of BBT Thermotechnology UK Ltd.
www.worcester-bosch.co.uk

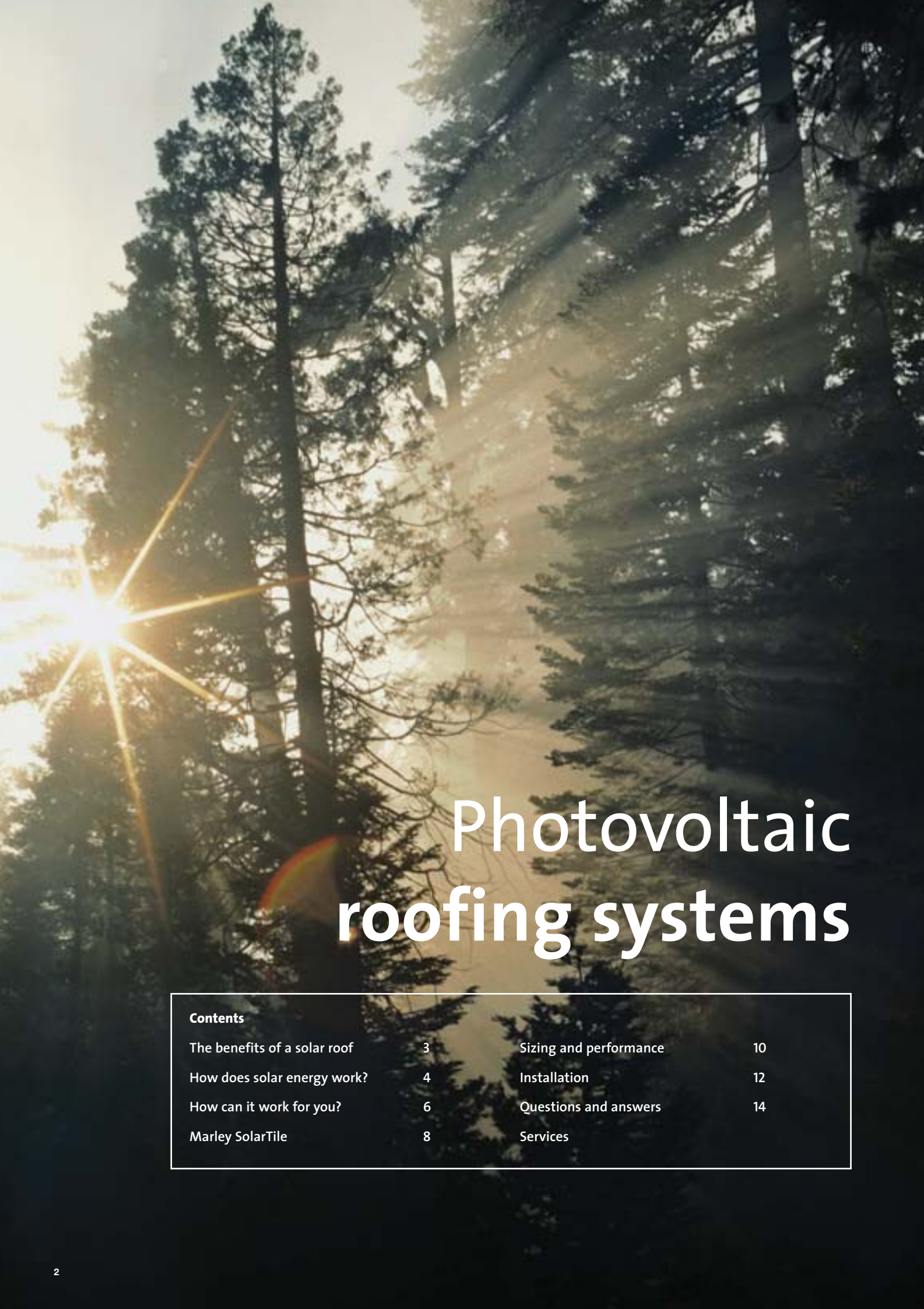
6 720 612 202 (05.03) SD

WORCESTER
Bosch Group

MARLEY ROOFING

CI/SfB | | (47) | No | (Q7) |
February 2005

Solar Roofing System



Photovoltaic **roofing systems**

Contents

The **benefits** of a solar roof

- Dedicated, clean and safe power source
- Reduces electricity bills
- Increases property value
- Minimal maintenance
- Long functional life
- Silent operation
- Encourages efficient use of energy
- Reduces CO_2 emissions
- Pitched roofs provide optimum position

‘The use of photovoltaic roofing systems can provide **a clean, silent, safe and free source of electricity into buildings.**’

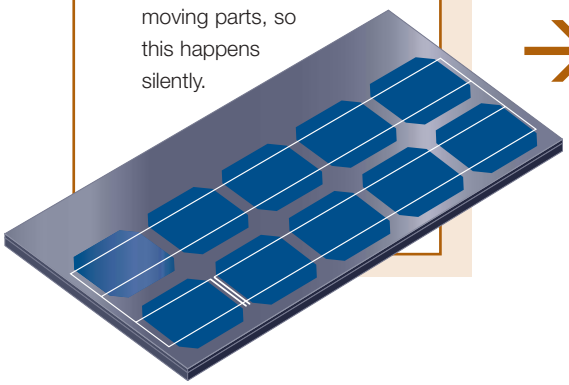
For 80 years, Marley Roofing has been providing innovative pitched roofing solutions for residential and commercial buildings and the company is committed to developing sustainable construction methods.

Solar power is one of the fastest growing markets in the world, with continued developments leading to solar cells that are ever-more efficient and economical. The technology of photovoltaics is proven and safe and such products do not release any emissions that contribute to global warming.

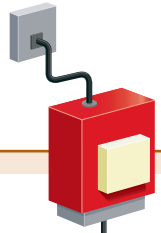
This brochure provides answers to the most frequently asked questions about photovoltaics used in roofing and describes the features, benefits and usage of the Marley SolarTile system.

How does **solar energy work?**

1 Daylight hits the PV tile and is converted to clean electricity. There are no moving parts, so this happens silently.

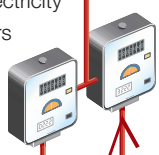


2 The electricity is DC (Direct Current). An inverter converts it to AC (Alternating Current, to match mains electricity) so that it can be used normally or it can be stored as DC for future use.

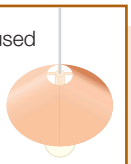


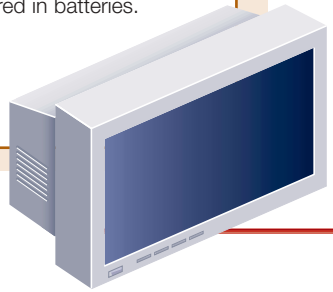
3 The solar roofing system is connected to the mains via a fuse box, for safety.

4 The PV roof generates electricity all day. Meters register the amount of electricity generated.

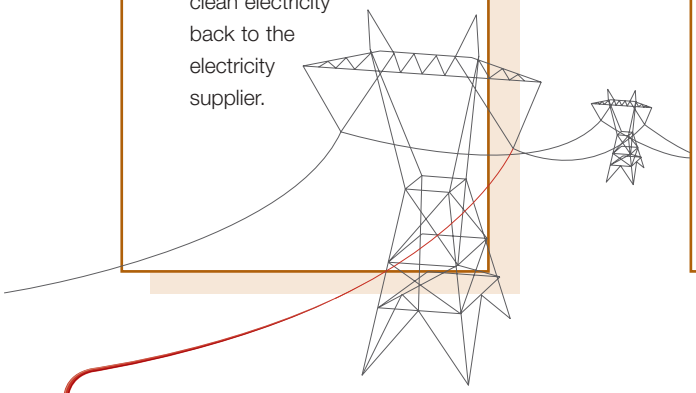


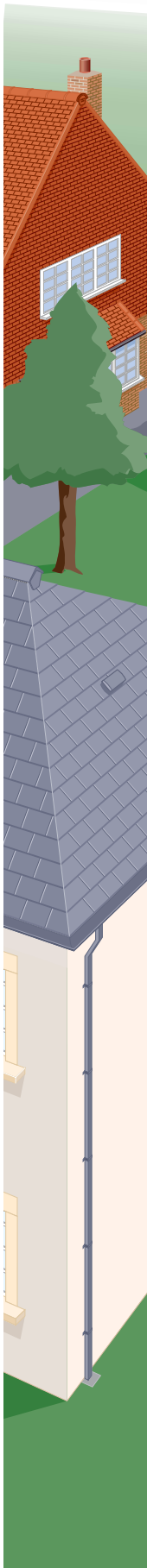
5 Electricity can be used for household consumption. Spare electricity automatically flows out to the grid or can be stored in batteries.





6 In some cases it is now possible to sell spare, clean electricity back to the electricity supplier.





Producing electricity from light
This illustration diagrammatically represents the production of electricity from light using the Marley SolarTile. All connections would be contained within the building envelope.

How can solar energy **work for you?**

What is solar energy?

The sun produces energy in the form of both heat and light. It is the light energy, and not the heat from the sun, that creates the power source for photovoltaic (PV) systems. This means that, even in regions where the daytime sky is frequently overcast, such as the UK, there is still ample light for electricity production using a PV system.

What are the benefits?

The PV roof generates electricity all day and can provide enough energy for the daily electrical requirement of the building (lights, appliances, etc.), excluding central and water heating, and also the energy used by the system itself. A solar tile roof not only cuts the household electricity bill, but can also produce surplus electricity, which can be sold to the National Grid.

> ‘The surface on which the PV array is mounted should receive as much light as possible. **The more light received, the more electricity will be generated.**’

Why install a PV system?

Solar is a non-polluting energy source, increasingly recognised as a major renewable technology for the future. Installing your own solar PV system means that you can generate your own electricity from the free and inexhaustible energy from the sun. A photovoltaic system never needs refuelling, has no moving parts, emits no pollution, is silent, and requires minimal maintenance. And, of course, your electricity bills can be substantially reduced.

Is solar energy safe?

When installed correctly, solar panels are completely safe. The roof installation process is similar to that of normal roof tiles and electrical connection is risk free.

There is no radiation risk – the panels simply harness the sun’s rays. The use of solar technology will contribute towards the reduction of total CO_2 emissions from the building in line with Building Regulations.

Fig 1 – Finding the optimum roof orientation

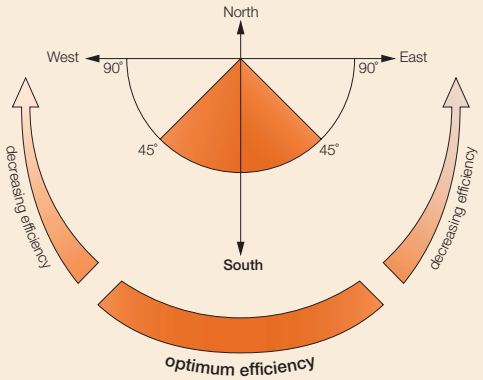
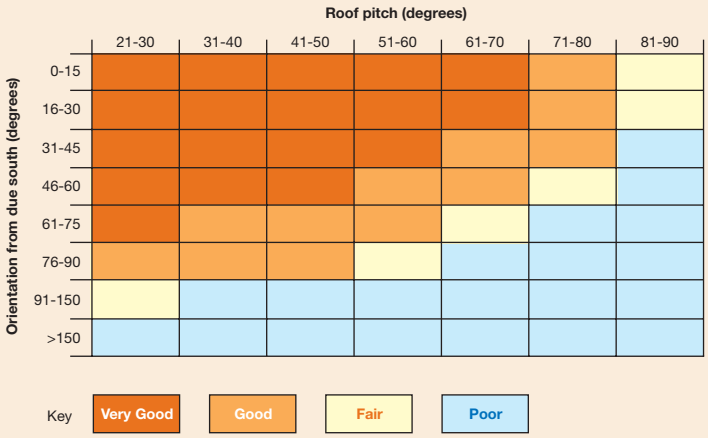


Fig 2 – Finding the optimum roof pitch



‘Photovoltaic modules can be placed on almost any building surface **which receives daylight for most of the day.**’

Can a PV system be installed on any building?

Photovoltaic modules can be placed on almost any building surface which receives daylight for most of the day. Roofs are the most efficient location for PV systems as they are orientated towards the sun, but photovoltaic modules can also be placed on façades, conservatories, atrium roofs, sunshades, etc.

The surface on which the PV array is mounted should receive as much light as possible as the more light received, the more electricity will be generated. (See Figs 1 and 2, above). The three issues which affect how much light a surface receives are:

- **Orientation:** due south is the best possible orientation. Systems should preferably be within 45 degrees of south facing.
- **Pitch:** a pitched array will receive more light than a vertical array. The optimum roof pitch should be between 20 and 50 degrees.
- **Shadowing:** shadowing, for example from tall trees or neighbouring buildings, can reduce system performance considerably (See Fig 3, right).

In addition, the area needed for a PV array depends on the output electricity desired and the type of module used.

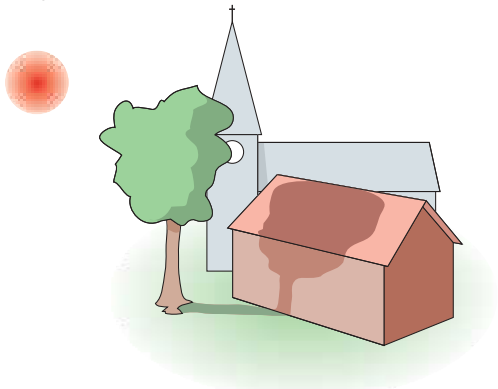
Does PV technology need bright sunshine to work properly?

The electrical output of a PV cell is dependent upon the intensity of the light to which it is exposed. So PV cells will tend to generate more electricity on bright days than when skies are overcast. However, photovoltaics do not need to be in direct sunlight to work, so even on overcast days a PV cell will be generating electricity.

How many Solar Tiles will I need?

The calculation which determines how many tiles are required against your building’s electrical consumption is called ‘sizing’. This is explained in detail on page 11.

Fig 3 – Avoid shadows from trees and tall buildings where possible



Marley SolarTile®

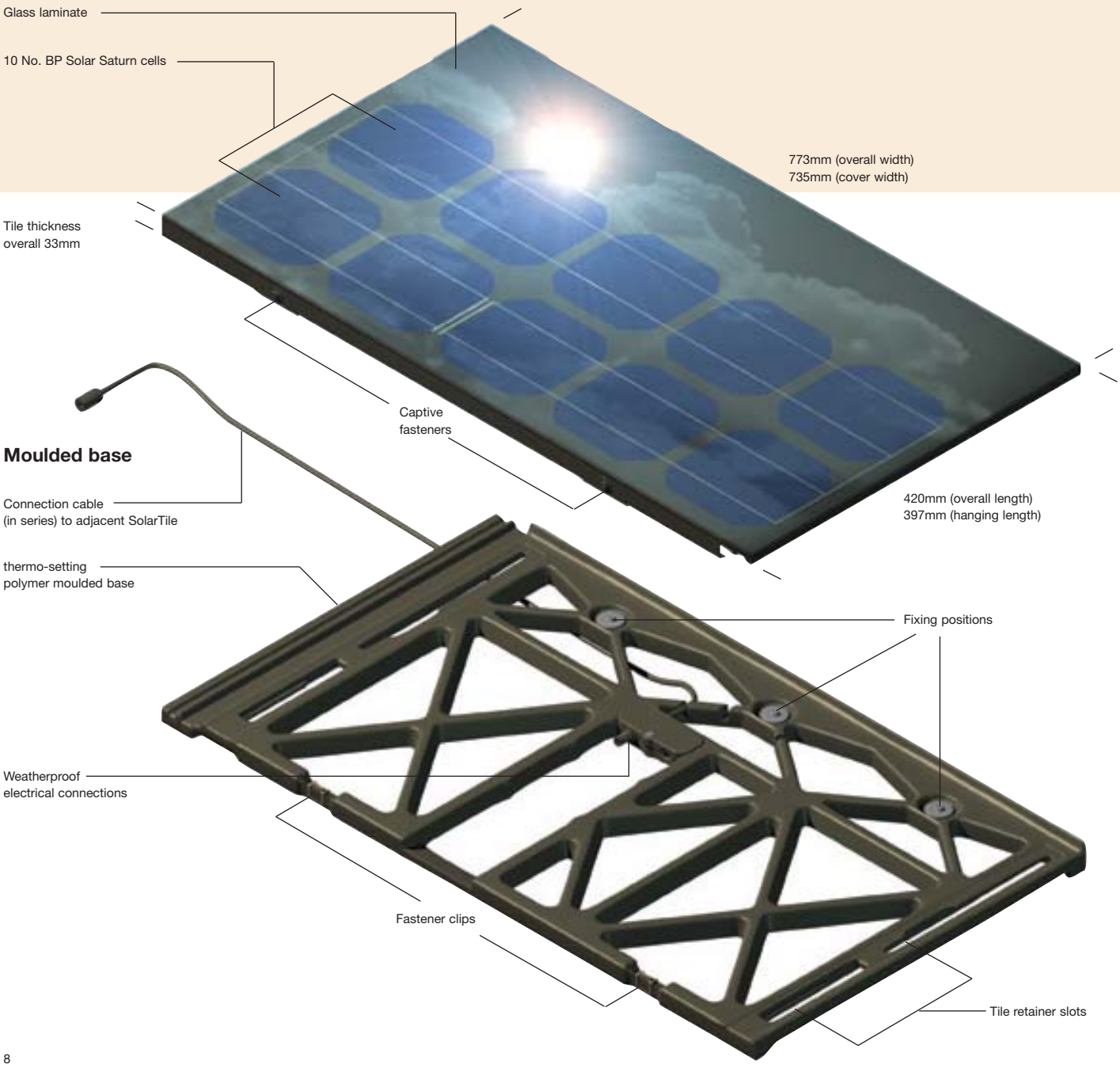
The Marley SolarTile® System achieves a high level of efficiency and is designed to integrate with large format interlocking roof tiles which are easily installed by fixing to standard roofing battens.

The system will supply energy in both sunny and cloudy conditions and blends in perfectly with the roofscape.

Marley SolarTile is manufactured under license from PowerTile™.

Module statistics	
Size	773 x 420mm
Effective cover (75mm lap)	735 x 345mm
Roof area coverage	0.25 m^2
Laid weight	40 kg/m^2
Output	23 Wp (Watts peak)
Output/m^2	0.92 kWp/m^2
Short circuit current	5 Amps
Open circuit voltage	6.1 Amps
Maximum power point voltage	5 Volts

Solar top



Benefits of the Marley SolarTile

- Fully compatible with Marley Modern tiles
- Suits roof pitches of 17.5° to 60°
- Suits headlaps of 75 to 100 mm
- Resists wind uplift loads to BS 5534
- Fully weatherproof and wind tunnel tested against driving rain
- PV laminate meets requirements of 1EC 61215 Standard.
- Easily fixed using standard components
- Life expectancy in excess of 20 years
- Can be easily serviced or replaced without disturbing surrounding tiles
- Resale value of property is enhanced
- Unobtrusive and aesthetically pleasing
- Seamlessly integrates into the roof covering
- No moving parts and completely silent
- Researched and developed in the UK
- Fully patented

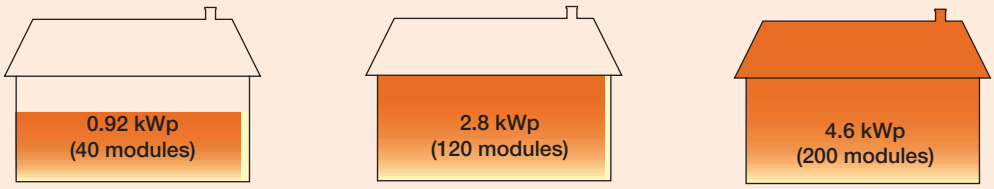
Sizing and performance

‘Sizing a system means determining **how much energy is required** for a given building and **how many solar modules are needed** to generate that energy.’

Marley SolarTile® performance

Output (kWp)	PV area (m²)	No. of modules	Power (kWh/year)†
0.92	10	40	690
1.4	15	60	1,050
1.8	20	80	1,350
2.8	30	120	2,100
3.7	40	160	2,775
4.6	**50**	**200**	**3,450***

† based on south-facing roof generating 750 kWp/year per kWp installed
* Average four-person household yearly electricity requirement = 3,450 kWh



Composition

Each Marley SolarTile is a two-piece photovoltaic assembly, comprising a glass laminate top with BP Solar Saturn cells, which is located onto a base. Each module is supplied with electrical connectors and fixings to link to adjacent modules and integrate with surrounding roof tiles.

Sizing

'Sizing' a system means determining how much energy is required for a given building and how many solar modules are needed to generate that energy.

A SolarTile system can provide enough energy to replace that consumed by the daily electrical load of the building (lights, appliances, etc.) plus an allowance for the energy used by the system itself.

There are two main requirements, which should be determined at the design stage:

- how much electricity will the building use?
- how much electricity will be produced by each SolarTile module?

Electrical load

The total electrical load of the building can be calculated by adding together the total requirements of the lighting and each appliance or piece of equipment in watts/hour. This is the power rating in watts multiplied by the average amount of time in hours that each appliance or system operates on a daily basis.

In addition to the electricity used by the building appliances, some power is also consumed by the SolarTile system itself, especially by the inverter used to convert the electricity from DC to AC. A factor to allow for this should be added to the calculations. The electrical output from each SolarTile module is expressed in Watts Peak (Wp).

Performance of Marley SolarTile

The Watts Peak, cell make up and total number of Marley SolarTiles required to provide a given electrical output (kWp) is expressed in the diagrams shown above.

The standard condition of irradiance of 1000W per m² is set at 250 for SE England (the standard measurement calculated for the UK). A 10 - 15% reduction in irradiance should be allowed for latitudes further north.

Critically, the average yearly electricity consumption for a four-person household is 3,450 kW/h. An area of 50 m² of SolarTile is required to meet this level of consumption.

Roof design and layout

Marley SolarTiles are laid adjacent to each other, typically covering the southerly facing slope of a roof ideally pitched at 40 - 45°. It is necessary to maintain a band of at least one course of tiles at the eaves, verge and ridge and at least three tile widths at roof junctions (valleys, hips, etc.) to surround the area of the SolarTile modules.

The most economical layout can be determined by the Marley Technical Advisory Service, based on the output demand, and the location and orientation of the roof.

Installation

Marley SolarTiles are easy to install, using standard battening and counter battening and are completely modular to **meet the requirements of any roofing application,** whether new or old.

Workmanship

The installation of Marley SolarTiles should only be carried out by competent and fully trained installers. A list of suitable installers can be obtained on request to the Marley Roofing Technical Advisory Service.

SolarTiles may be laid over a fully boarded (sarking or insulation board) roof or open-rafter roof construction. In both instances, it is important to ensure that a 50mm gap is maintained beneath the modules, to allow for ventilation. This can be achieved by the use of timber counter-battens laid over the boarding (sarking) or roof underlay.

The eaves and ridge details should be constructed to ensure that a clear continuous ventilation path to the void beneath the modules is provided from eaves to ridge equating to 25,000 mm^2/m at eaves and 5,000 mm^2/m at the ridge.*

* This requirement can be satisfied by the use of the Marley Roofing 25mm Eaves Vent System, Marley Ventilated Dry Ridge System and RidgeFast. Alternative systems, including the Marley Abutment Vent System and Marley Contour Vent or Tile Vent Systems, can also be used.

Installing SolarTile

1 The roof should be felted, counter-battened and battened in the normal manner for large format interlocking tiles. All the SolarTile base units should be laid across the entire area of roof required, in a broken or straight-bonded layout, ensuring that roof perimeters have at least one course of normal tiles.

2 Each base unit is twice screw-fixed at the head to the tiling battens.

3 Clip each base unit at the left hand tail of the interlock, using standard clips and nails.

4 As each base unit is fixed, the electrical cable with pre-fitted connectors, is linked and clamped into the adjacent base in accordance with the wiring layout (supplied with product).

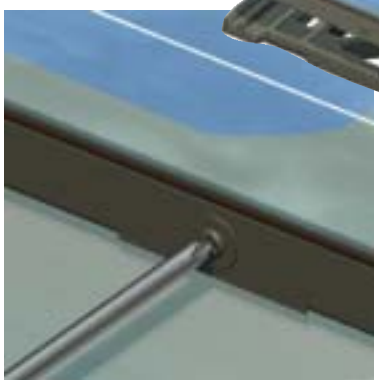
5 After the complete array of bases has been fitted, and the cable connections made, the laminate tops can then be fitted to each base.

6 Commencing at the top of the roof, the lugs of the top units are located into the base unit rebates and slid upwards into position. As the laminate top is locked into position, the electrical connections are automatically made with the connectors in the base unit.

7 Each top is then secured with two security screws on the leading edge. These fixings, combined with the slide rails, allow for easy access to the base unit, should it be necessary to inspect or replace the glass laminate top at any time.

SolarTile bases should be fixed at the same time as Marley Modern tiles and wired together before the glazed tops are fitted.

Lower top into slots and slide up into final position. Electrical connections are automatically made when tops are clicked into place.



Tops are secured or removed using the two locking fasteners on the leading edge.

Questions and answers

How is the SolarTile connected to the National Grid?

Solar panel systems can be either stand-alone or grid-connected. Legislation and the requirements of the Regional Electricity Company govern grid-connected systems.

The DC electricity produced by the SolarTile is converted by the inverter to AC, and then connected to the mains via a fuse box, so that any spare electricity automatically flows out to the grid. It is possible to have an extra electricity meter fitted to measure how much is exported. Of course, if you require more electricity then your solar panels are currently providing, this is still automatically drawn from the grid.

Income generated from selling electricity back to the Grid can be used to reduce the pay-back period. Details of current arrangements can be obtained from your Regional Electricity Company.

How will do I get permission?

Installations must be connected to the grid to receive funding under the programme. Connecting a PV system to the distribution network will require permission from the local Distribution Network Operator (DNO). The system installer will make the necessary arrangements with the local DNO for grid connection.

What if I'm not on the National Grid?

If connection to the National Grid is not available, any power generated must be stored in batteries. Please contact the Marley Technical Advisory Service for guidance in the use of Marley SolarTile for 'off grid' applications.

What will I be paid for excess electricity generated by my PV system?

Different electricity suppliers will pay different rates for any excess electricity exported back to the grid. You may need to change your electricity supplier to take advantage of the best possible deal for exported electricity that you generate.

Does solar PV provide hot water or heating?

Solar PV systems provide electricity, which can then be used for a variety of purposes including of course, powering electric boilers or water heaters. Solar PV technology does not however directly generate hot water.

How do I design a roof?

The pitched roof is ideal for solar power systems and roofs can be constructed in the normal way. The Marley Technical Advisory Service is able to offer assessment, design, planning and installation advice whether you are building a new house or merely refurbishing your roof.

What are the environmental benefits?

Life Cycle Analysis of Photovoltaic systems indicates energy payback times of 4 - 9 years for grid connected systems with a system lifetime of 25 years.

Will I require planning permission?

Planning permission is not normally required. However, exceptions may apply for systems on listed buildings or in areas of outstanding natural beauty. In all cases it is best to check with your local council Planning Department. If you do require planning permission, you will need to get this approval before funding can be awarded under the programme.

How do I purchase a 'SolarTile' system?

Via Marley Roofing Stockists and suppliers.

Marley SolarTiles are generally delivered to site by Marley Roofing. They can also be purchased through builders merchants and contractors throughout the UK. Please contact Customer Services for more information.

What components do I need?

SolarTile panels for the roof and Inverters to convert the solar power to usable electricity (see pages 4 and 5).

How do I get a SolarTile system installed?

Marley Roofing have created partnerships with a number of Approved PV Contractors who will assemble and install the system, carry out the necessary electrical connections and commission and test the systems functionality.

To find your nearest Approved PV contractor please call Customer Services on 08705 666400.

What maintenance or cleaning is required?

There are no moving parts to the system and no maintenance is necessary, Generally, SolarTiles are self cleaning but normal glass cleaning products can be used to remove dirt.

The SolarTiles have a self locking fixing system that allows the glass laminate to be easily removed for inspection, cleaning or replacement.

Are there any guarantees?

Marley SolarTiles are produced to the highest technical specification using components which are fully tested to meet the stringent IEC 61215 Standard.

As an integrated product, they are also designed to meet the same rigorous performance standards as the surrounding roof tiles and have been tested under driving rain and wind uplift conditions in our own test laboratory.

All Marley SolarTiles carry a 25 year energy performance guarantee and are guaranteed to perform as a weather-proof roof covering for 15 years, if part of a Marley Assured Roofing Specification.

Is PV expensive? How much will it cost to install?

Over the last 20 years the price of PV modules has fallen dramatically, by around 500%. It is anticipated that solar roofing systems will continue to become more cost effective as technology improves.

There are a number of factors which can influence the cost:

- If the system is being installed to an existing property or as part of a new build process.
- A larger system may be cheaper per kWp than a smaller system.
- If the roof is a complicated shape or requires complicated scaffolding, costs will be higher.

What is the PV grant scheme?

This £20 million scheme is the first phase of the Department of Trade and Industry's Major Photovoltaic Demonstration Programme. Substantial grants are available towards the installation of PV equipment to generate electricity.

The programme is divided into two application streams based on the size of the PV system being installed. The size of PV installations is expressed by their kilowatt peak (kWp) potential, which is an indication of how much electricity the installation could generate in peak conditions.

Stream 1 – covers small scale installations with a potential of 0.5 to 5 kWp. Typical examples are individual properties, for example houses, small commercial properties or schools. Stream 1 applications are received and processed on a continuous basis.

Stream 2 – covers medium to large scale installations with over 5 kWp potential. Typical examples include large commercial and public buildings. All stream 2 applications should be submitted before the quarterly deadline for assessment.

Who can apply?

Anybody in the UK can apply, from an individual homeowner, to private businesses and public sector organisations..

What funding is available?

Stream 1 applications are eligible for funding of up to 50% or £4,250/kWp of the total installation costs, whichever is the lesser.

Stream 2 funding varies between 40-55% but is dependent on the type of organisation making the application.

What is included in the total installation cost?

PV grants help to cover the costs of the equipment and work directly relates to the PV system, including the modules, inverter(s), installation, grid connection and warranty, but not associated building works. VAT will be paid as part of the grant if you are not VAT registered. If you are VAT registered, the grant will only be paid on total installation cost net of VAT.

Does the programme have approved products and installers?

Yes, the programme has lists of accredited installers and products, which must be used for any application funded under the programme, to help ensure that your proposed system is installed to high standards, delivers a high performance and meets recognised/certified requirements. These lists are available from the website at: **www.est.co.uk/solar** or by calling the enquiry line on 0800 298 3978.

How do I apply for funding?

Applying for a grant is simple. You can start the process online – www.est.co.uk/solar – by downloading the application form or call the enquiry line on 0800 298 3978 for a hard copy of the application form.

How do I find out more?

For further information on Solar PV Grants please access the website www.est.co.uk/solar, email solarpvgrants@est.co.uk, or call freephone 0800 298 3978.

For more information about Marley SolarTile, visit www.marleyroofing.co.uk/solar or contact the Marley Technical Advisory Service on 08705 626900.

Services

Marley Assured Roofing Specification Scheme

Operated through Marley Roofing's Technical Advisory Service, this unrivalled and comprehensive advice and support service for specifiers of major roofing projects offers the following:

- In depth technical advice
- Project-specific fixing specifications
- Project-specific NBS clauses
- Project-specific calculations for all roofing materials and fittings

Projects built to a MARS specification are indemnified for the following:

- Design performance
- Fixing specification
- Product durability

Under the MARS scheme, a complete Marley Roofing system is guaranteed to remain secure and weathertight for a period of 15 years.

Technical Advisory Service

Marley Roofing provides a free Technical Advisory Service which is staffed by a highly qualified team with specialist knowledge of the use of all Marley Roofing products and systems. Services include:

- **Fixing specifications**
  Bespoke fixing specifications can be provided, taking into account location, dimensions and degree of exposure for individual buildings.
- **Estimating tile quantities**
  Calculation of all materials required for any roofing project including tiles, battens, underlay, ancillary fittings and accessories
- **National Building Specification clauses (NBS)**
  All essential clauses for Marley roof specifications are available, detailing all work items in section H65 'Single lap roof tiling' and H60 'Plain roof tiling'.

Customer Services

Marley Roofing has a reputation for providing first class customer care, which is supported by the operation of a dedicated Customer Services department. Wherever you are, Customer Services can be easily reached by simply dialling the numbers shown below. Your call will be answered by one of our specialist team who are able to offer a range of services that include:

- Quotations and ordering information
- Literature – all current product and technical literature can be downloaded from: www.marleyroofing.co.uk/downloads
- Stockist information – to find details for stockists of Marley Roofing systems, visit: www.marleyroofing.co.uk/stockists

T 08705 626400 **F** 08705 626450 **E** roofingsales@mbm-marley.co.uk
www.marleyroofing.co.uk

Intellectual Property

Patents and Patent Applications

EP00940495.5
ZA20019802
JP515861/2001
US6856496
US11/028,987
GB0502120.9

Registered Trade marks

UK Registered Trade Marks 571759 & 2170425
Community Registered Trade Mark 1845122
UK and EU Unregistered Design Right

Authority

SolarTile is manufactured under license from PowerTile™.

Marley Roofing reserves the right to revise specifications and products without notice. For specific applications users should refer to Marley Roofing Technical Advisory Service and relevant Standards and Codes of practice for guidance.

Customer Services
T 08705 626400 **F** 08705 626450 **E** roofingsales@mbm-marley.co.uk

www.marleyroofing.co.uk/solar

Marley Roofing, Station Road, Coleshill, Birmingham B46 1HP

The Complete Solar Roof™

C21e C21t

solar **electric** & solar **thermal** roof tiles

solarcentury

A house with **C**21**e** and **C**21**t** tiles integrated into the roof can supply the owners with two thirds of their domestic hot water needs and half their electricity.

Why install the **Complete**Solar**Roof**™**?**

Installation Benefits for the Developer

Improve your chances of gaining planning permission

Incorporating C21 solar tiles helps developers gain planning permission by reducing the carbon dioxide emissions from their developments. As planning rules strengthen, the use of renewable technology is becoming a prerequisite for every building developer in the country. Local Authorities are redrafting their Local Development Frameworks (LDFs) to comply with Central Government guidelines (Planning Policy Statement 22) and demanding that all new developments, over a certain size, provide a proportion of their energy from on-site renewables. (see www.TheMertonRule.org)

Incorporating the Complete Solar Roof helps ‘fast track’ planning applications.

Simple, standardised installation

The Complete Solar Roof is an advanced solar solution that has been designed specifically to avoid the complications associated with conventional ‘bolt on’ solar panels. The tiles sit flush with the roof avoiding any change to roof layout and are quickly and easily fitted by the roofing contractor. All plumbing and electrical work is undertaken at the usual time in the build program by the existing contractors. There is no need to compromise the design or aesthetic of the house, or the standard build programme.

Publicity and Sustainability

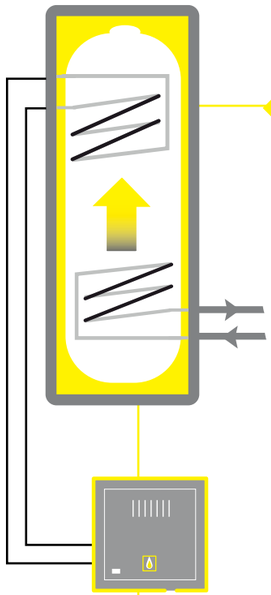
Incorporating The Complete Solar Roof into a project presents several opportunities for developers to promote their commitments to sustainability. Eco-measures, such as solar tiles, and carbon reduction initiatives are extremely topical and generate significant publicity. Pro-active developers can gain significant marketing advantage and media exposure by emphasising their contributions to the UK’s $C0_2$ reduction target (reducing emissions by 10% by 2010) through the incorporation of renewable energy technology.

As fuel prices rise and renewable energy moves up the political and media agenda, house buyers are becoming increasingly interested in sustainability measures. The Complete Solar Roof can play an important part in a developer’s marketing strategy.

C21t Solar Thermal Roof Tile

The heated fluid circulating through the thermal tiles is transferred to a heat exchanger in the base of the hot water cylinder.

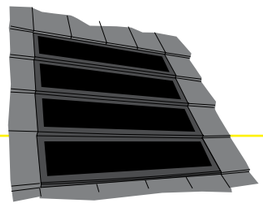
The heat exchanger transfers the suns thermal energy to the water and the heated water rises to the top of the tank ready for use.

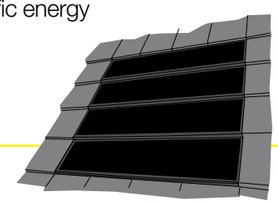


The traditional boiler is connected to the top of the cylinder, providing additional heat to the water if required.

Hot water is delivered for use throughout the house in the normal way.

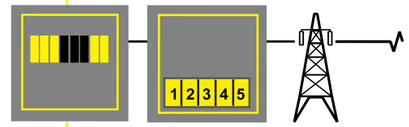
The ‘mix and match’ design of the thermal and electric tiles allows for complete flexibility in any roof layout to meet the specific energy requirements of different homes.





C21e Solar Electric Roof Tile

The electrical energy is sent from the tiles to a inverter, usually installed in the loft. This converts the DC current to AC for use in the building.



The AC electricity then passes through a fuse box and metering system, where power from the grid supplements the PV energy if required.

Finally, the clean solar electricity is used in the home exactly the same as normal grid power.

How The System **Works**

Once installed the **Complete**Solar**Roof** provides reduced cost electricity and hot water, protecting the homeowner from unpredictable rises in energy prices, with no perceivable difference in supply.

TheCompleteSolarRoof™
Key Features

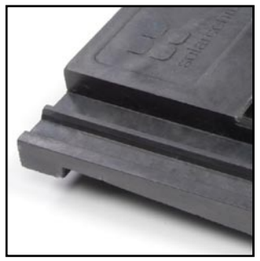
No extra planning - no need to alter roof lines, colour or pitch. C21 tiles sit flush with conventional roof tiles.

Standard installation - tiles fit with conventional roofing practice without the need to adjust battens. One solar tile takes the place of four standard tiles.

No specialist skills - all roofing work carried out by the roofing contractor allowing electrical and plumbing work to follow build programme.

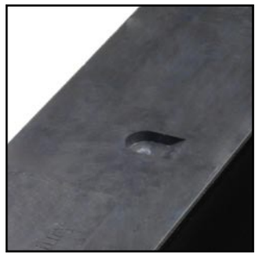
Fast to fit - tiles are integrated in exactly the same way as conventional interlocking tiles.

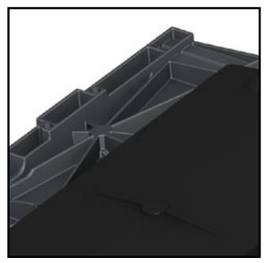
Interlock design allows compatibility with many leading roof tiles and a wide range of accessories.



Pre-fitted connections allow fast roof installation.

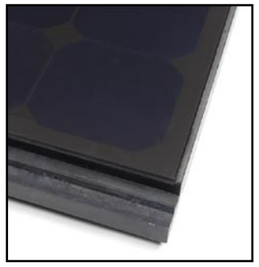
Standard screw fixings enable fast, efficient installation.

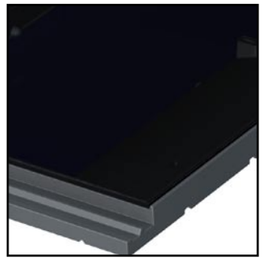




Highly engineered structural frame designed for optimal strength to weight ratio

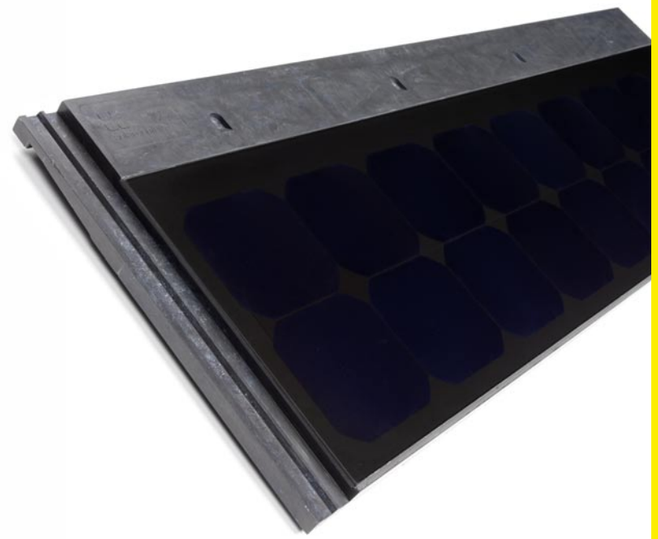
‘Super subtle’ SunPower laminate delivers maximum efficiency for C21e.





Selectively coated collector plate and high efficiency solar glass maximise energy absorbed by C21t.

C21e - Solar Electric Roof Tile



High power output - 52Wp per tile, less than 8 square metres per kWp (kilowatt peak).

Discrete ‘SunPower’ PV laminate blends superbly with regular roof tiles offering an unrivalled aesthetic.

Back mounted contact strips increase effective collector area and reduce surface glare, typical with standard solar cell technology.

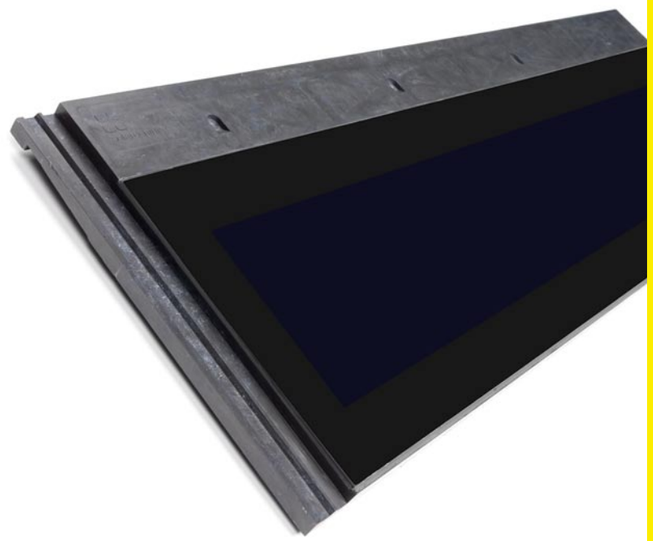
Integrated ‘thru-flow’ ventilation enhances PV performance.

Power output is guaranteed to 90% of generation performance for 10 years from date of commissioning.

No electrical work required on roof.

Tiles arrive on site as complete units avoiding the need for on-roof assembly.

C21t - Solar Thermal Roof Tile



High power output per tile, less than 8 square metres of C21t would provide roughly two thirds of the hot water for an average three bedroom home.

High efficiency solar glass, designed to maximise heat transmission to the collector plate and reduce reflection.

Latest insulation technology maximises heat retention.

The system is designed to work in both pressurised and unpressurised installations.

No plumbing required on roof.

Tiles arrive on site as complete units avoiding the need for on-roof assembly.

Ease of Installation

As a **building integrated solution** C21 takes the place of four conventional tiles, fixing to standard roof battens with simple screw fixings.

Fast to Fit

C21 tiles are as fast to install as conventional tiles. Each unit can be easily carried onto the roof by a single person. Tiles hook onto the roof battens and are secured with simple fixing screws. C21 is designed to interlock directly with additional solar tiles or regular roof tiles, without the need for specialist flashings. All external roofing can be carried out by the regular roofing contractor after minimal training, which solarcentury can provide.

Connecting the system

C21e tiles connect together with simple push-fit connectors, with the electrical installation carried out within the building by the electrical contractor. C21t tiles arrive on site as pre-assembled pairs, and all system connections are made within the building, avoiding the need for plumbing work to take place on the roof.

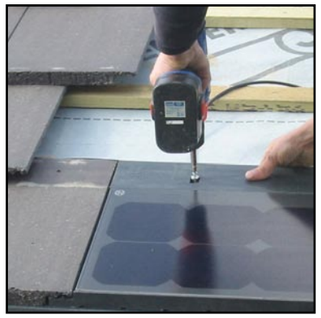
The **Complete**Solar**Roof** has been designed to fit as part of a standard roofing installation. It avoids delays to the building programme by reducing the need for specialist skills and bespoke roof layouts.

1.

C21 tiles are easily manoeuvred into position on the roof.

2.

The tiles simply hook on to normal roofing battens.

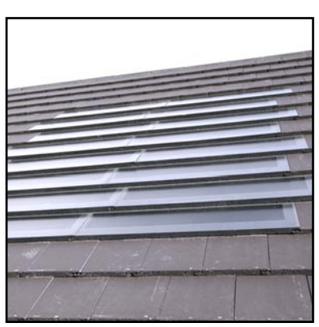


3.

C21 is secured with simple screw fixings, in the same way as regular tiles.

4.

The tiles are overlaid and quickly cover the roof. This example took under two hours to complete.

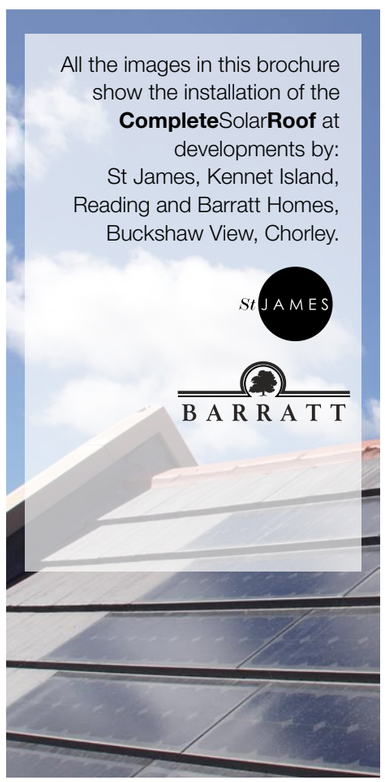


5.

The finished installation is weather proof and requires no additional exterior work.

“I thought it was going to be really technical, but having done it, it’s really very simple.”

Bob McGrath, roofing contractor working on a Complete Solar Roof installation



FAQ

Does it work in the UK?

Yes. The photovoltaic cells used in C21e do not need to be in direct sunlight to work, and will generate electricity even on cloudy days. The brighter the day the greater the energy generated. C21t will supply hot water on bright days in summer and winter, typically delivering over 60% of hot water demand over the course of a year.

Isn't solar power expensive?

The Complete Solar Roof adds as little as 4% to the build cost of an average three bedroom home, but over 10%* to its final value when sold. It also helps 'future proof' a home against rising fuel prices making properties doubly attractive to price conscious house buyers; as fuel prices continue to rise, energy efficient renewably powered homes will continue to sell at a premium.

Is the C21 system compatible with the tiles I want to use in my development?

C21 has been designed to integrate with a range of tiles from leading roof tile manufacturers. (Please refer to datasheet for detailed specification)

Does the system need batteries?

No local battery storage is required as the C21e system connects to the local electricity supply, and any excess power can be sold back to the electricity company.

Do solar systems require planning permission?

The benefit of C21's building integrated design is that no additional planning consent is required for standard new-build developments.

Do the C21 tiles need maintenance?

C21e tiles are silent in operation and have no moving parts, so no maintenance is required. Scheduled servicing of the C21t hot water system would normally take place at the same time as conventional boiler maintenance.

The design of the tiles means that any dust or dirt that accumulates on the tiles is washed off during normal rainfall.

* Energy Saving Trust
'Green homes are hot property'
27 March 2006

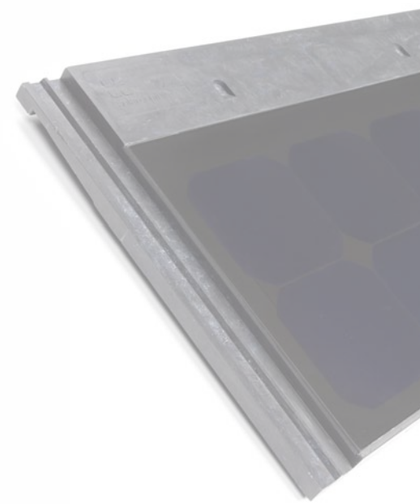
System sizing

As an example, a **Complete**Solar**Roof** comprised of 30 C21e tiles and 16 C21t tiles, requiring less that 18m^2 of roof area, would provide approximately a third of the electricity demand and two thirds of the hot water demand for a typical 3 bedroom home.

C21e system sizing

The modular nature of the C21e design provides the opportunity to select the appropriate number of C21e tiles to meet the energy generation required for each home.

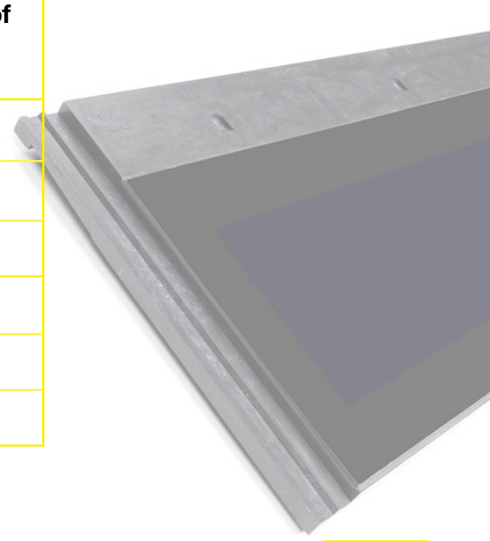
Number of C21e Tiles	Total C21e tile coverage area (m^2)	Energy Yield per year (kWh)*
20	7.8	**800**
30	11.7	**1200**
40	15.6	**1600**
60	23.4	**2400**
80	31.2	**3200**



C21t system sizing

Similarly, C21t provides the flexibility to meet the hot water needs of different sized homes by varying the quantity of tiles. The table below provides an indication of the number of tiles required to meet approx. 60% of the hot water demand for various homes

Number of C21t tiles	Total C21t tile coverage area (m^2)	Will provide 60% of hot water for a:
10	3.9	**2 person home**
12	4.7	**2-3 person home**
16	6.2	**3 person home**
20	7.8	**3-4 person home**
24	9.3	**4 person home**
28	10.9	**4-5 person home**



* Based on south facing roof system, generating 800 kWh per kWp

solarcentury

For more information on the **Complete**Solar**Roof** visit solarcentury.com

If you have a particular development that you would like to discuss,
please email commercial@solarcentury.com

C21e

Best Exterior Product - Interbuild 2004

Building Magazine's award for Innovation in their 2005 sustainability awards.

Best Sustainable Product Award - Construct 2006, Northern Ireland's major construction show.

SUNPOWERED

C21e features SunPower solar cells, the most efficient solar cells available today.

solarcentury is the only accredited solar photovoltaic CPD provider

Patents and Patent applications
GB2407634
WO2005045328
Patent pending worldwide

Registered design
3013535
3024160

Registered Trade Mark
C21

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F+44 (0)20 7803 0101
www.solarcentury.com

Printed on recycled paper using waterless printing

Solar Hot Water Sunstation®

Low Carbon Building Products™

solarcentury

Solar Hot Water Sunstation®

Application:

Solar Hot Water **Sunstations** use solar energy to heat water for washing, bathing and heating. Available in two different formats, the 'Solar thermal' **Sunstation** can be fitted to sloping roofs or mounted on flat roofs using a specially designed framing system.

The sloping roof system can be integrated into the roof, or retrofitted over conventional tiles. The integrated solution utilises a wooden backing to minimize embodied energy and improve recyclability.

An electronic controller constantly compares the temperature of the water within the **Sunstation** with that of the domestic hot water cylinder. When the **Sunstation** is hotter than the cylinder, the controller switches on the system's pump. A mixture of anti freeze and water is circulated through the cylinder's heat exchanger, heating the cylinder in just the same way as a regular boiler but without burning fossil fuels.

Solar Hot Water **Sunstations** provide hot water all year round

Features:

- High efficiency - a specially coated copper collector plate maximises the energy absorbed
- Versatility - water resistant internal wooden frame or metal mounting systems available
- Thermal protection - mineral wool thermal insulation
- High quality - special solar glass with minimal iron content
- Lasting finishes - powder coated aluminium cover profiles
- Discrete - matt black collector plate and frame

Solar Hot Water **Sunstations** are easily mounted on flat roofs

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For more information, call **solarcentury**
T+44 (0)20 7803 0100

www.solarcentury.com

Low Carbon Building Products™

solarcentury product code **ST-C21-P170A-2GRY**

Datasheet

solar**thermal**roof**tile** C21t

Building Integrated solar thermal roof tile

High power output per tile, less than 8 square metres of C21t would provide roughly two thirds of the hot water for an average three bedroom home.

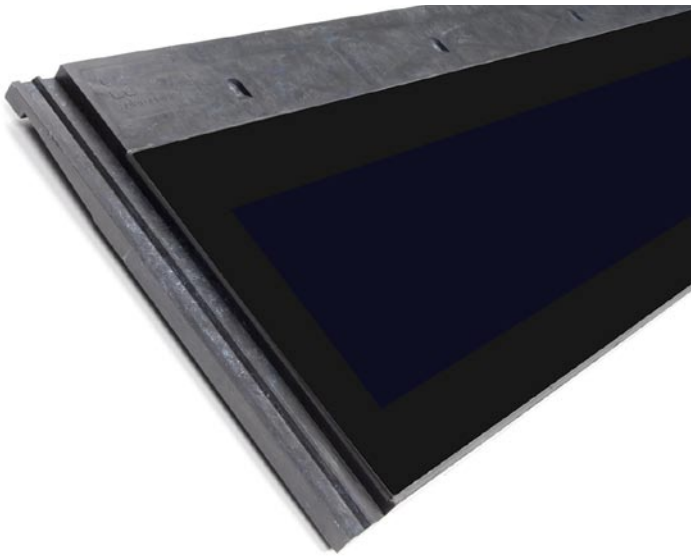
High efficiency solar glass, designed to maximise heat transmission to the collector plate and reduce reflection.

Latest insulation technology maximises heat retention.

The system is designed to work in both pressurised and unpressurised installations.

No plumbing required on roof.

Tile pairs arrive on site as complete units avoiding the need for on-roof assembly.



No extra planning - no need to alter roof lines, colour or pitch. C21 tiles sit flush with standard roof tiles.

Simplicity of installation - tiles fit with traditional roofing practice without the need to adjust battens. One solar tile takes the place of four standard tiles.

No specialist skills - all roofing work carried out by the roofing contractor, allowing plumbing work to follow build programme.

Fast to fit - tiles are integrated in exactly the same way as interlocking concrete roof tiles.

solarcentury

solarcentury is the UKs leading solar solutions brand. We work with architects, housing developers and home owners to deliver renewable energy and carbon reduction solutions.

We are also the sole UK distributor for the world's leading solar electric technologies and have helped more homes and businesses go solar than anyone else in Britain.

solarcentury product code **ST-C21-P170A-2GRY**

solarthermalrooftile C21t

Specification

Aperture area*	0.686m²
Absorber area*	0.448m²
Absorber type	Flat Plate
Absorber material	0.5mm aluminium sheet
Absorber coating	Alanod Microtherm Sunselect
Solar absorption (AM1.5)	94%
Thermal emission (100°C)	5%
Fluid volume*	0.175L
Insulation type	Aspen Aerogel Spaceloft AR 5106C
Thermal conductivity of insulation	0.013W/mK
Covering	Toughened solar glass
Light transmission	91.2%

Dimensions

Tile size	1220mm x 420mm overall
	1180mm x 330mm exposed (recommended)
Minimum pitch	22.5° (90mm headlap)
Headlap	75mm (minimum)
	90mm (maximum)
Gauge (batten spacing)	345mm (maximum)
	330mm (minimum)
Covering width	1180mm
Covering capacity (net.)	3 solar thermal tiles/m² (90mm headlap)
Individual tile weight	7kg
Weight of tiling	21kg/m² (90mm headlap)
Batten size	38mm x 25mm (minimum - for rafters
	not exceeding 600mm c/c nailed to BS 5534-1: 1997)
Battens required	3.1m/m² (90mm headlap)
Screws and fixings	4 No. 4.5mm x 40mm self tapping stainless steel screws
	(supplied with tile) edge clips may also be required

Accreditations and Standards

External fire exposure test to BS 476-3: 1975, indicative AA rating
Designed & manufactured to BS EN 490: 1994 where appropriate
Weather-tightness indicative testing to PIT Agreed Roofing Industry standards

System sizing

No of Tiles	Tiled Area m²	To provide 60%** of hot water for:
10	3.9	2 person home
12	4.7	2-3 person home
16	6.2	3 person home
20	7.8	3-4 person home
24	9.3	4 person home
28	10.9	4-5 person home

Roof Tile Compatibility

Marley (Eternit)
Modern, Duo Modern

Redland (Lafarge)
Mini Stonewold

Russell (Cemex)
Grampian, Highland

Sandtoft
Calderdale Slate

Scott (CRH)
Slemish Mk 2

Quinn
Western slate

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* All figures relate to a tile pair where appropriate.
** Based on a south facing roof system with typical usage profile.

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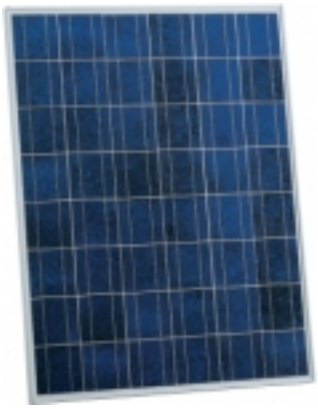
Sharp 160W



Sharp's NDQ0E3E / ND160E1 photovoltaics module is designed for large electrical power requirements. Based on the technology of crystal silicon solar cells cultivated for over 40 years, this module has superb durability to withstand rigorous operating conditions and is suitable for grid connected systems.

Applications:
• Grid connected residential systems
• Office buildings
• Solar power stations
• Solar villages
• Villas, mountain cottages
• Pumps
• Lighting equipment
• Traffic signs
• Radio relay stations
• Beacons
• Telemeter systems
• Telecommunication systems

Features
• High-power module (160W) using 155.5 mm square polycrystalline silicon solar cells with 12.2 % module conversion efficiency
• Photovoltaic module with bypass diode minimizes the power drop caused by shade. Anti Reflection corting and BSF (Black Surface Field) structure to improve cell conversion efficiency: 13.8 %
• Using white tempered glass, EVA resin, and a weatherproof film along with an aluminium frame for extended outdoor use
• High-voltage output for grid-connected system
• Output terminal: Lead wire with waterproof connector
• NDQ0E3E: manufactured in Japan & ND160E1: manufactured in UK Apart from the place of manufacture the models are identical in construction

Datasheet:

Manufacturer	Sharp
Country of Origin	Japan / UK
Rating (W)	160
Height (mm)	1318
Width (mm)	994
Depth (mm)	46
Weight (Kg)	16

Solar Evacuated Tube Collectors

Navitron 20’s combined to give 14 kWh/day output peak output during the summer months.

Navitron panels in the UK absorbing energy from the autumn sun

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Freestanding collector designed for use with flat roof applications.

Welcome to the Navitron Evacuated Tube Solar Collector! Whether you have just purchased your collector or are researching before you buy you have taken an important step to reducing pollution and carbon dioxide emission, whilst enjoying piping hot water heated by nature. This 'solar collector' has been manufactured to the very highest standards, and will provide you with many years of service, with the minimum of maintenance required. This brochure explains how your collector is intended to work, and provides information to allow you to complete a solar water heating installation. If, after reading this document, you have further questions, please contact your distributor, who will be happy to help you.

Monthly Irradiation Figures:
(Solar energy reaching each $1m^2$ of the earth's surface at UK latitudes)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MJ/m^2 day	2.3	4.2	7.0	11.6	15.0	18.0	16.0	13.0	10.0	6.0	2.8	1.7
kWh/day	0.64	1.17	1.94	3.22	4.17	5.00	4.44	3.61	2.78	1.67	0.78	0.47

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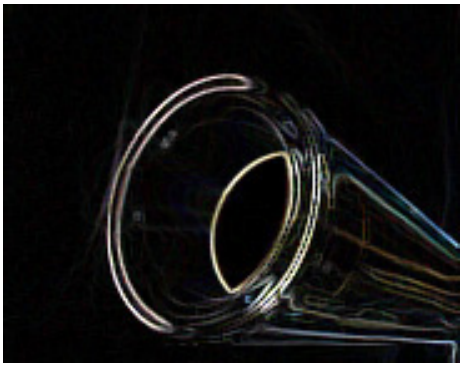
Design:

Our collectors are suitable for applications where aesthetics as well as efficiency are important. These collectors allow for easy installation and they are suitable for single unit installations or modular large-scale installations for heating or air conditioning projects. The main features are:



- Long service life
- Elegant aesthetically pleasing design
- Easy integration into buildings
- Improved power conversion at low solar irradiation levels

Collector Dimensions

The collector consists of the array of tubes, a heavily insulated manifold header, stainless steel support frame and standard mounting frame package. Each tube is 47mm x 1500mm and the overall dimensions of the panel are 1760x1500x180mm. A 30 tube unit is also available for larger households.

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Vacuum Tubes

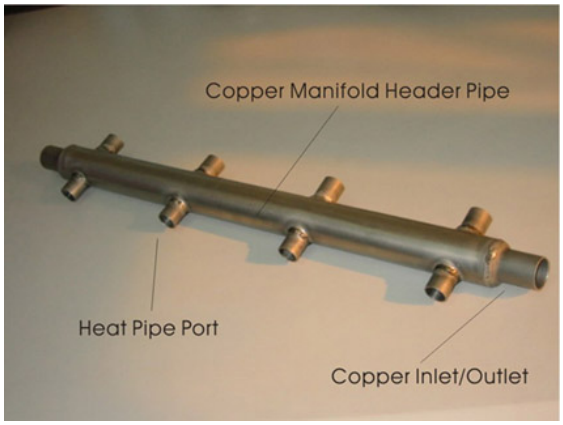
Unlike cheaper panels, this system does not heat the water directly within the vacuum tubes. Instead, a sealed copper ‘heat pipe’ transfers the heat via convection of its internal heat transfer fluid to a ‘hot bulb’ that indirectly heats a copper manifold within the header. The heat pipes are inserted into curved absorbers forming an assembly which in inserted into the glass tubes. The tubes are made of borosilicate glass, which is strong and has a high transmittance for solar irradiation. In order to reduce the convection heat lost, the glass tubes are evacuated to vacuum pressure or less than 10^{-3} Pa. Stable vacuum seals are ensured by using a patented technique employing high heat and pressure. In order to keep the stability of the vacuum for a long time, a barium “getter” is used (the silver coating at the tip of the tube). This rare metal coating absorbs any gases that might eventually enter the tube, increasing the lifespan of the vacuum seal. Through evacuating air out of the glass tube the absorber material and selective coating are protected from corrosion and other environmental influences. This ensures a lifetime of at least 15 years without loss of efficiency. The getter also acts as an indicator and will turn white instantly should the tube be broken.

Header Pipe

The manifold has been designed around the use of a small diameter header pipe (28mm ID). This allows for a small manifold casing while still maintaining at least 50mm of insulation. The water volume capacity of the header pipe is less than 1.5 litres for the 30 tube collector, thus allowing fast heating during even overcast conditions. This is important for areas with lower solar irradiation or overcast conditions, as the heat from the manifold can be quickly harnessed, then held in the storage tank.

The header pipe is brazed with Copper-Phosphorus brazing material (BcuP6), giving excellent joint penetration and smooth brazing. This result is a join that is not only strong, but also very neat. As the brazing material is primarily copper (94%), rapid heating and cooling of the header pipe does not compromise the weld integrity.

4 tube header pipe.



Close up of brazed header joint
(CuP6 brazing rod)

After brazing, every header pipe is pressure tested to ensure weld integrity. The inlet and outlet are formed in standard 22mm copper to enable the use of conventional compression fittings for the manifold plumbing. The copper manifold is heavily insulated using compressed rock wool. This reduces heat loss to a minimum at night, and during cold weather. In conjunction with our freeze-protection controller, there should be no requirement for antifreeze. The 50mm thick insulation is been used to protect against heat loss.

The connection between the heat pipe and manifold is critically important to ensure optimal heat transfer. The manifold header pipe is mounted within the manifold casing and is made of 28mm diameter, 1 mm thick copper pipe rated for a maximum pressure of 10 kg/cm^2, the standard operational maximum being 6kg/cm^2. The 'hot bulb' section of the heat pipe fits tightly in the heat pipe port in the manifold. Silicone heat-transfer compound (supplied with each kit) ensures a good transfer between heat pipe and the header pipe in the manifold. Heat transfer is by conduction allowing the manifold to remain fully sealed ensuring water can never leak at the connection.

- Sealed manifolds make collector modules particularly suitable for areas with hard water (limescale)
- Sealed manifolds allow the system to operate with high pressures of up to 10 bar, especially useful in large heating or air conditioning projects.
- Sealed manifolds eliminate leakages between manifold and vacuum tube.
- Sealed manifolds make it easy to replace collector tubes at any time without interrupting the operation of system.

Rock Wool Insulation

The choice of rock wool insulation is important for a number of reasons:

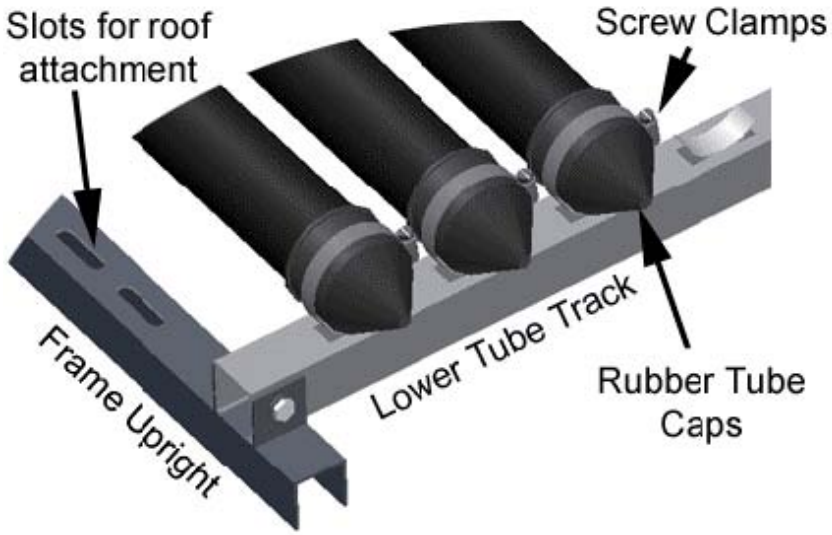
- Rock wool can handle high temperatures, in fact it is non-flammable
- Provides excellent insulation performance (often used in cavity insulation)
- Is environmentally friendly as it is a natural, recyclable material

Many companies are still using polyurethane, which provides excellent insulation performance, but is far from environmentally friendly. Focus collectors are as much as possible, a "**Green**" product.

As you can see from the above picture, the rock wool is compressed into blocks. Each block is 73cm long, so 4 are used for a 20 tube collector, 6 in a 30 tube collector. The mold shape fits tightly around the header pipe and tube port shape to ensure maximum insulation performance.

Frame

Each collector is supplied with a stainless steel adjustable width frame. The frame is supplied plain, to match the manifold.

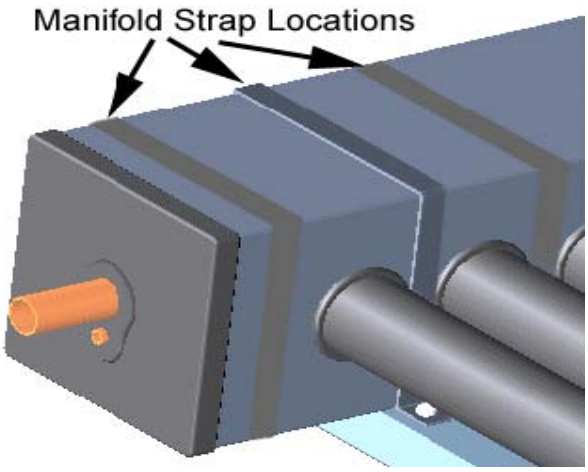


Uprights: Run the full height of the collector and are used for attachment to the mounting surface (roof, wall). Slots are punched out along the length for the attachment of mounting straps (stainless steel 'builders strap' is ideal). Additional brackets/holes may be made according to your specific mounting requirements. The width between uprights is adjustable to suit individual installation requirements.

Lower Tube Track: Used for the support and attachment of the evacuated tubes. The cups for the support of each tube are punched out of the stainless steel track with holes provided for the screw clamp to pass through.

Screw Clamps: Because each heat pipes needs to maintain firm contact with the header pipe (for optimal heat transfer) it is important that every evacuated tube is held securely in place along the lower tube track. For this reason instead of plastic or rubber straps, stainless steel screw clamps are used. These clamps provide a convenient and fast attachment method that ensures secure tube attachment for the life of the collector. Installation or removal of a tube is quick and straightforwards, only a screwdriver is required to loosen the clamp

Manifold Straps: The manifold is secured to the uprights by means of aluminium or stainless steel straps (2 for 20 tube, 3 for 30 tube collector). The uprights are already fitted with nuts, so attachment with screws is a trouble free process. As the width between uprights is adjustable, the upright and straps location may be altered. Please note that the location of the upright and manifold strap (for various width adjustments) will always line up with the space between two tube ports (or outside the first and last tube). Both left and right uprights have 4 to 5 possible locations providing plenty of flexibility in the selection of frame width.



The key features are as follows:

- High performance, reliable, glass evacuated tubes
- Heat pipe uses non-toxic, in-organic heat transfer compound
- Low heat pipe start up temp (<35deg C)
- Manifold casing available in plain matt finish 304 stainless steel
- Adjustable width frame available in Stainless steel.
- Compressed rock wool insulation (non-flammable, recyclable)
- Copper header pipe – twice pressure tested to 160psi
- ABS plastic (UV stabilized) manifold end caps
- UV stabilized rubber manifold seals and evacuated tube caps
- 8mm ID temperature sensor port
- Screw clamp individual tube attachment
- Compact manifold size HxW of 130x140mm (5.1” x 5.5”)
- Header pipe design enhances heat transfer by creating turbulent water flow.

Model Type	Navitron SFB20
Construction	Vacuum Tube Collector
No. of Collector Pipes	20
Tube Diameter (OD)	47mm
Panel area	2.25m^2
Absorber Surface	2.20 m^2
LxWxH (mm)	1760x1500x130
Weight	55kg
Fluid Content	1.5 l
Pressure Drop@100 l hr^{-1}	10mBar
Angle of Inclination	15-90degrees
Max. Temp (°C)	190°C
Stagnation Temp (°C)	247°C
Heat exchanger material	Copper
Permissible Operating Pressure	6bar
Test Pressure	10bar
Manifold Connection Diameter	22mm
No. of Vacuum Tube Port Diameter	20
Component material specification	Stainless steel / Aluminium header with rockwool insulation
Interconnection Facility for multiple units	yes
Connection Diameter	2 x 22mm

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Additional Product Information and Background

Sealed Glass Evacuated Tubes

Evacuated tubes are the key component of the solar collector. The following information will provide you with insight into the history, manufacturing process and general specifications of evacuated tubes.

Evacuated Tube History

The evacuated tube technology was initially developed by Qing Hua University in Beijing in the early eighties, with pilot manufacturing in 1985. By 1988 annual manufacturing volume by Qing Hua had reached 30,000 tubes. By 1996 with the aid of significant financial support from the Chinese government, Qing Hua reached an annual production capacity of 2 million tubes. Continued infrastructure development led to 2.5 million tubes being sold in 1997.

The majority of the tubes were used to supply the local market, with a small percentage (100,000 in 1995) being supplied to Japan, Europe, South America and South-East Asia. The main barrier to large export sales was the technology of the solar system (tank/manifold). Although the tubes performed well, the quality of the storage tanks was average, and did not meet the requirements of the European market. The non-pressure thermosiphon systems did, however, meet the needs of the Chinese market, and therefore sales grew and grew.

In 1998 Qing Hua held 70% of the Chinese solar water heating market. With the breakup of some of the key members of the Qing Hua Solar board members, the patent protection for the tube technology was no longer enforceable, and so other Chinese companies began producing the evacuated tubes. The equipment and machinery used to produce all tubes in China is therefore the same as that developed by Qing Hua. For this reason, if engineering standards are followed, and good quality raw materials use, all tubes manufactured in China should be the same, and provide the same performance. You will find that all Chinese companies provide tubes with the same specifications. Having said this though, there are many companies who use poor quality raw material and make short cuts on engineering requirements. Selection of a professional tube manufacturer is therefore very important.

Navitron Product Development

Full scale production of the Navitron model solar collector began in early April of 2002. Since then collectors have been sold to the UK, France, Germany, Italy, The Netherlands and Ireland.

Communication with customers and solar experts in Germany, the UK, Italy and the US provided the basis for many of the Navitron design features. For this reason it is very well suited to the needs of these markets, particularly in relation to packing and freight, installation, aesthetics, performance and overall quality.

During the development of this collector it became clear that the European and US market needed a solar collector that met the following criteria:

- High performance evacuated tube heat pipe based design
- “Plug and Play” heat pipe system for easy transport, installation and maintenance (changing broken tubes)
- Use of non-toxic heat pipe transfer liquid (not acetone)
- High quality long lasting components (corrosion resistant materials)
- High quality stainless steel finish
- Excellent insulation properties (>50mm thick rock wool)
- Small manifold water volume to ensure fast heating time
- Environmentally friendly through the use of non-polluting, recyclable materials
- Accept mains pressure water supply (6kg/cm^2 / 85psi)
- Corrosion resistant manifold header pipe (copper)
- Suitable for open or closed flow operation
- Accept a standard sized temperature sensor
- Compact frame that could be packed with the manifold
- Adjustable width frame to allow for varying installation surfaces
- Quick and simple tube attachment system – permitting easy removal of any one tube
- Compact manifold size
- Cost competitive with high quality flat plate collectors

Certification

Please note that the Navitron collector is manufactured in accordance with ISO9002, and it is currently undergoing testing to BS EN 12975 It is from these tests that the absorption (93%) and emission (7%) efficiency values have been verified. The glass manufacturing plant, ensures that quality is controlled throughout every step of the process. They have obtained a wide range of quality management and quality control certificates including the internationally recognized ISO9002 management standard.

EVACUATED TUBE & HEAT PIPE CHARACTERISTICS

The heat pipe and evacuated tube will not get hot after one minute of sitting in the sun – so don't expect it too. The sealed glass tubes have a short start-up time as the inner glass tube, heat pipe fins and air within the tube must first be heated before the temperature will start to rise considerably. In good conditions it will take less than 5 minutes for the tip of the heat pipe to get too hot to hold (>50deg C). The advantage of the sealed glass evacuated tube is that is acts as a heat store, providing a stable supply of heat to the manifold even during intermittently overcast weather. The tube will continue to provide heat even after the sun has set.

A good test to show the heat storage capacity of the tube is to let the tube heat up outside until the heat pipe tip is hot. Run the tip under cold water for 10 seconds or so to cool it down (drain some of the heat). Stand the tube back up, and within seconds the tip will be red hot again. This can be repeated several times before the heat is "used up".

Another example of the heat storage is to let a tube heat up outside in the sun, and then bring it inside. You will find after half an hour the tip will still be hot, thus demonstrating the store of heat (energy) inside the tube.

The sealed glass evacuated tube provides a stable supply of heat even during intermittent weather. There is minimal "peaking and troughing" of heat supply as the clouds intermittently block the sunlight. Heat supply can therefore continue even when there is no sunlight striking the collector, due to the store of heat within the evacuated tube.

NB – DO NOT EXPOSE TUBES TO SUNLIGHT FOR EXTENDED PERIODS WITHOUT COOLING THE TIPS, OR DAMAGE MAY OCCUR. Install header first, and shade tubes from sunlight until the water flow and control is operational

Heat Pipes

In addition to the evacuated tubes the copper heat pipe is also vital to the performance of the collector. The heat pipe is an essential link in the heat transfer chain. If this link is poor quality then the efficiency of the whole system will be compromised, regardless of how good the evacuated tubes are.

The key factors to consider when choosing a heat pipe are:

- Operating Temperature Range
- Heat transfer compound
- Heat transfer performance
- Operating life expectancy

Heat pipes in the Navitron collector are custom made using patented inorganic, nontoxic heat transfer compound.

The Inorganic heat pipes have the following features:

- Continuous operating life of more than 110,000 hours (5 year warranty)
- Effective thermal conductance of 25,000 – 30,000 times that of silver.
- Heat flux density of 27.2MW/m^2.
- Heat pipe internal surface is coated with 3 layers, which delay corrosion and oxidation and prevent the production of oxy hydrogen, thus improving the performance stability and operation life of the heat pipe.
- The heat pipe transfers heat along the full length of the heat pipe in a sine wave pattern, with a thermal resistance of almost zero.
- Heat transfer compound is non-toxic if ingested and nonirritant to either eyes or skin.
- Vacuum level of 4×10^{-6} Pa which reduces the boiling temp of the liquid to as low as 25-30deg C

In addition to having a high quality heat pipe, the fins used within the evacuated tube are curved copper fins. We have found a performance increase of 5% using this new fin design when compared to the flat fins previously used.

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HEAT PIPE CHARACTERISTICS

The heat pipes used by Navitron Ltd are different to some other heat pipes, which use acetone as the heat transfer compound. Acetone heat pipes will transfer heat with just the bottom 5 to 10cm placed in a cup of hot water (50deg C). Ours will not. This is not because the performance is poor, but rather because the nature of the heat transfer compound is quite different. Under the vacuum conditions that exist in the heat pipe, and at low heat pipe temperatures (<30^{o}C), this mixture will form a frozen “ball” located in the heat pipe tip. For this reason, when you vigorously shake the heat pipe you will hear a rattling sound and feel an object in the heat pipe tip. If you were to cut the heat pipe open, the vacuum will be lost and you will not find any ball inside, just some orange colored liquid.

The presence of this “ball” indicates the heat pipe has a good vacuum level – although you must consider the ambient air temperature when doing this test. If the ambient temperature is already 30deg the ball may have mostly melted and so no sound will be heard.

If you heat the bottom of the heat pipe with a moderate temperature liquid (50^{o}C), the heat will not be enough to travel to the tip and “melt” the ball. If however you pour that same temperature water along the length of the heat pipe, the heat will quickly melt the ball and heat transfer to the tip will rapidly occur.

As the evacuated tube provides heat along the full length of the heat pipe, rapid “melting” of the ball and subsequent heat transfer will occur at temperatures as low as 30deg C. As you expose the heat pipe to hotter and hotter temperatures, the ball will continue to melt and contribute to the heat transfer process. Once a hot enough temperature is reached the ball will have totally melted and there will be no sound if shaken.

For demonstration purposes, hot water (>45 deg C) can be poured along the bottom two-thirds of the heat pipe. This will ensure rapid melting of the ball and subsequent heat transfer to the tip. Within 60 seconds the tip can achieve a temperature, which is 90-95% of the temperature it is exposed to. The tip can never get hotter than the heat level it is exposed to (not 100% efficient).

Although the heat pipe can transfer heat at temperatures of around 30-35^{o}C, the heat transfer to the tip will only reach 28-32^{o}C, which will not feel hot to the touch. So don’t try and use warm water for demonstration purposes. Use hot water.

NB – DO NOT EXPOSE TUBES TO SUNLIGHT FOR EXTENDED PERIODS WITHOUT COOLING THE TIPS, OR DAMAGE MAY OCCUR. Install header first, and shade tubes from sunlight until the water flow and control is operational

Assembling The Navitron Solar Collector

Collector Frame

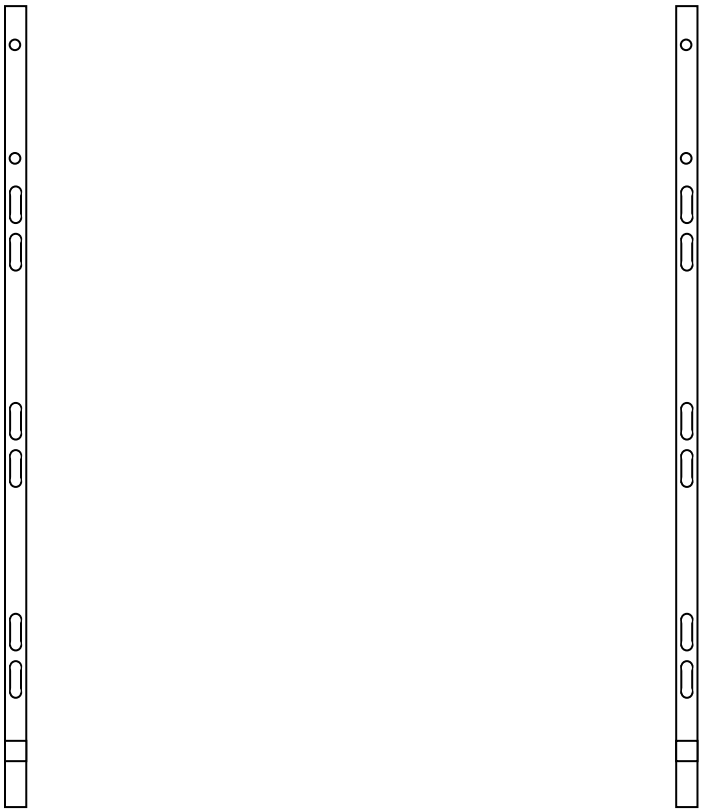
There are many different types of roofing materials, and solar collectors can be mounted at various angles, either on the surface of the roof or on a framework to achieve the optimum angle on shallow pitch roofs. The mounting frame provided consists of two side rails and a top and bottom support assembly. All frames are made of stainless steel and are designed to be quick and easy to install on all roof types. There are two ways to fix the frame to the roof – either drill directly through the tiles and use coach screws into the rafters (the most popular method among professional installers) – you can then seal the hole with silicone sealant. Alternatively, use builders strap available at any builders' merchants. Simply slide these up underneath the tiles (fixing directly to the rafters underneath the tiles.

1. Frame Assembly

(1) Assemble Uprights

Nb:The frame should be fully assembled prior to installation of vacuum tubes.

Assemble the 2 uprights as shown below:



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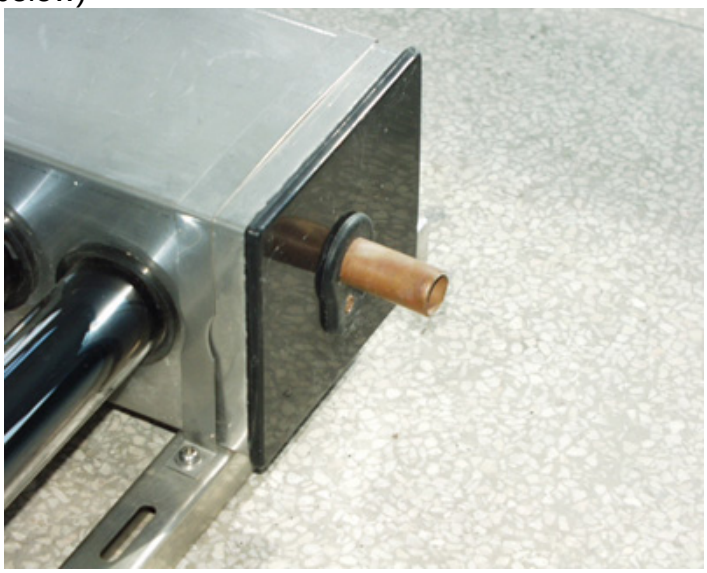
(2) Attach the manifold

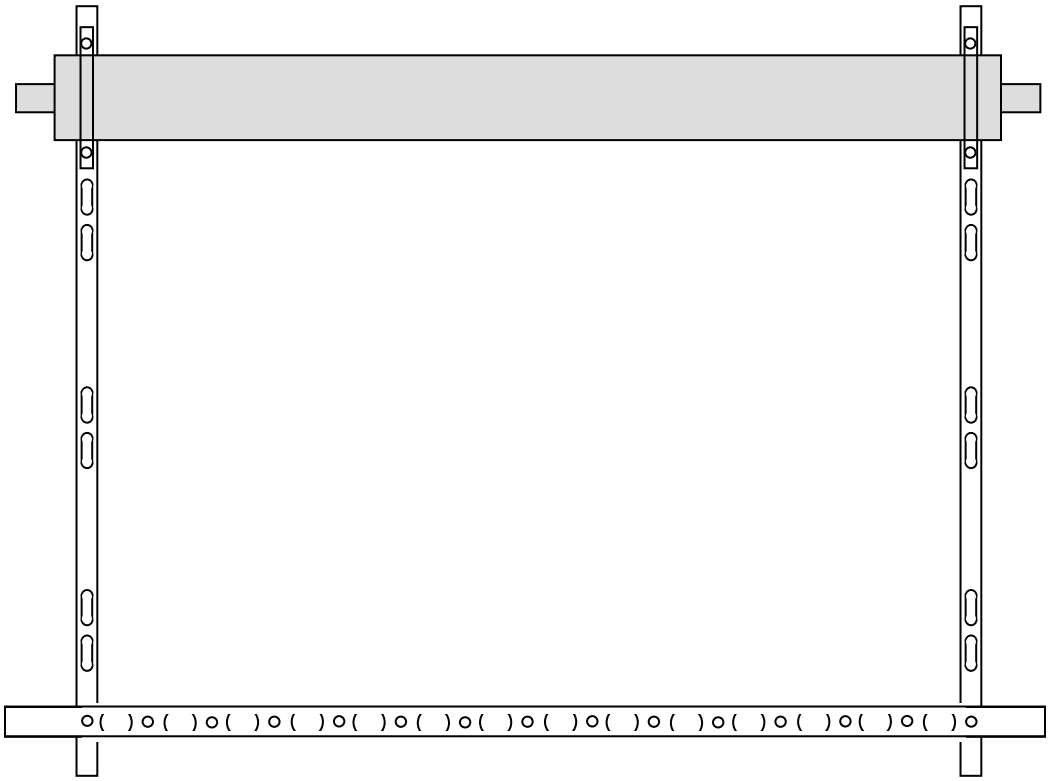
Attach the manifold to the uprghts, securing the manifold with the Manifold Fixing Loop, secured by the screws enclosed with the collector. (See below)



(3) Fix the Lower Tube Track

Attach the tube track to the protrusions of at the base of the uprights, fixing with long screws. (See picture below)

You have now finished the frame/manifold assembly. (The diagram below shows how the assembled item will look)



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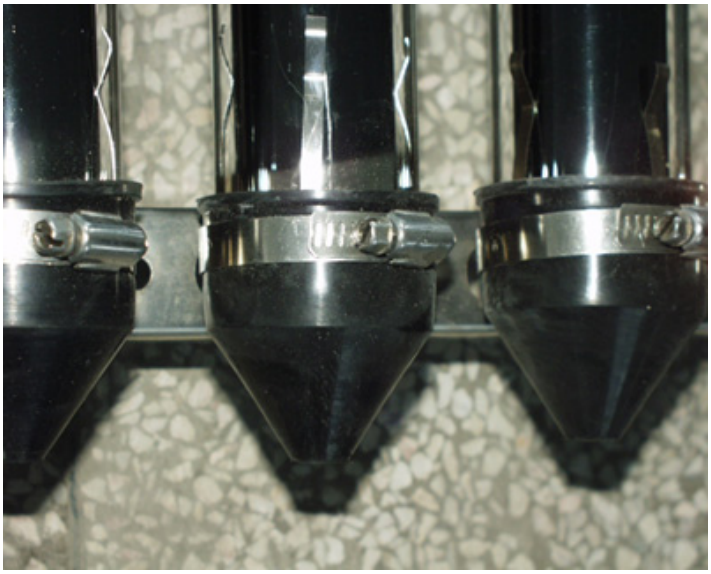
2. Install the vacuum tubes

- Place the rubber cap on the end of the first evacuated tube.
- Apply silicon grease to the top of the evacuated tube (the copper section), then insert into the manifold.
- Secure the end of the vacuum tube to the frame bar with the ‘jubilee’ screw clamp, clamping the protective rubber cap.
- Repeat the installation with each of the remaining vacuum tubes as described above.
- When installing vacuum tubes ensure they are always held securely either in the box or in the frame. Never put them down unsecured on a roof.
- Ensure vacuum tubes are covered during installation. The tubes can be become dangerously hot during the day before water is flowing in the manifold header. Only remove the cover when the system has water running through it.



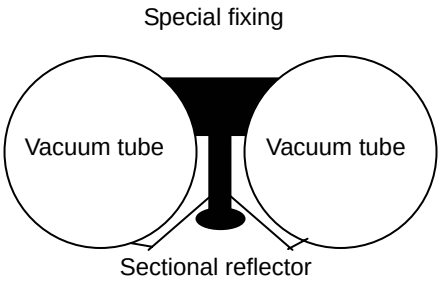
3. Install the sectional reflector

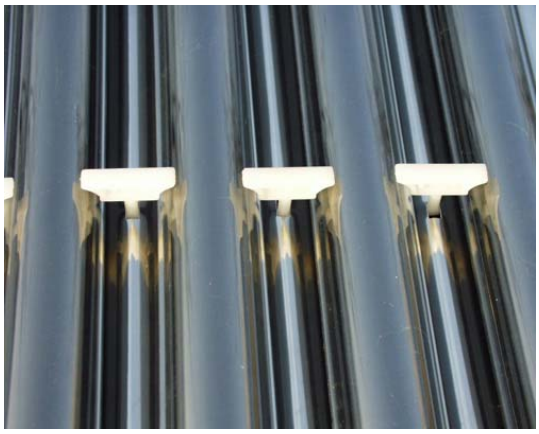
Reflectors

The efficiency of the panel is increased by fitting reflectors so that the sunlight falling between the tubes is not wasted. The reflector is supplied as a set of 19 pressed stainless forms which are clamped between each tube using special plastic clips. The diagrams below demonstrate how the reflectors are assembled:

- Put one section of reflector between two vacuum tubes.
- Insert the Special fixings (Plastic clips) into the hole at one end of the reflector and rotate 90°. Now one end of the reflector is fixed between two vacuum tubes.
- Similarly, secure the other end of the reflector.
- Repeat for the remaining 18 sections of reflector as described above.

The sketch below shows a cutaway view of reflector installation.





The Finished Picture of ‘Navitron’ SFB20

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Solar Controller: Essential for efficient use of Solar Heating

The solar controller is an essential part of the solar heating system, in all but gravity-fed systems (where the Navitron Solar Collector is situated lower than the hot water cylinder, and circulation is effected by thermo-syphoning). In all other systems, it will be necessary to use a controller to switch on the pump when the panel is hotter than the hot water storage cylinder. The controller may also be configured to circulate the water to heat the panel in the event that the solar collector becomes dangerously close to freezing. This will only happen in exceptionally cold weather, and will represent a negligible energy drain. Controllers should be fitted that allow the installer to adjust the temperature differential to suit different pipe runs with different heat-losses. More advanced controllers will display the temperature of the collector and of the hot water cylinder, or can control more than one pump or control valve, to allow multiple panels on different roof elevations. We recommend RESOL controllers, as they are the industry-leaders, and produce high quality, reliable equipment. The B1 Controller is the simplest and cheapest unit, but is extremely effective. We recommend this for most installations.

For more than 25 years the controller RESOL B1 leads by its simple and robust concept. Due to its huge adjustment range and its adjustable temperature difference, this low-priced universal differential temperature controller is usually first choice for solar heating systems.

- Low-priced differential temperature controller for solar-heating- and air conditioning systems
- Adjustable temperature difference from 2 ... 16 K
- Power supply 230 V (AC)
- 2 temperature sensors are provided (included in full kit)

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PG 51.02 and PG 53.02

Thanks for buying a RESOL.
Read this manual carefully to get the best performance from this unit.

DeltaSol® B
The controller RESOL **DeltaSol®** B is used for applicatio
solar thermal
systems as well as in heating and air conditioning system
persuades by its clear
operation concept.
A newly developed, multi-functional display enables the u
simultaneously request two
temperatures (e.g. collector and store temperature). No a
switching-over, no
guessing but easy pictograms give the user clear informa
function and operating
status of the controller and the system.
The version PG 53.02 is equipped with 2 standard relay o
version PG 51.02 is
equipped with 1 standard relay output as well as 3 senso
Pt1000-sensors, store
temperature limitation and manual switch. The central ele

DeltaSol® B The controller RESOL **DeltaSol®** B is used for application in standard solar thermal systems as well as in heating and air conditioning systems and persuades by its clear operation concept. A newly developed, multi-functional display enables the user to simultaneously request two temperatures (e.g. collector and store temperature). No annoying switching-over, no guessing but easy pictograms give the user clear information on function and operating status of the controller and the system. The version PG 53.02 is equipped with 2 standard relay outputs, the version PG 51.02 is equipped with 1 standard relay output as well as 3 sensor inputs for Pt1000-sensors, store temperature limitation and manual switch. The central element is the 3-key-field below the display. The newly developed combined LC-
display enables an intuitive and reliable controller configuration as well as a comprehensive visualisation of the system status. Collector cooling and recooling function as well as security switch-off, but also a thermostat function can be easily realised. The controller **DeltaSol** B is also available as individual OEM-version, so that further system adaptions are possible.

Technical data
Housing: plastic, PC-ABS and PMMA
Protection type: IP 40 / DIN 40050
Size: 172 x 110 x 46 mm
Installation: wall mounting, mounting into patch panels is possible
Display: LCD, multi-functional combined display with 8 pictograms, two 2-digit text fields and two 4-digit 7-segment displays as well as one 2-coloured luminescent diode
Operation: by three pushbuttons in the front of the housing
Functions: standard solar controller with adjustable values: minimum-maximum temperature limitation, switch-on and switch-offtemperature difference. Frost protection / cooling function, security

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Solar Collector Installation

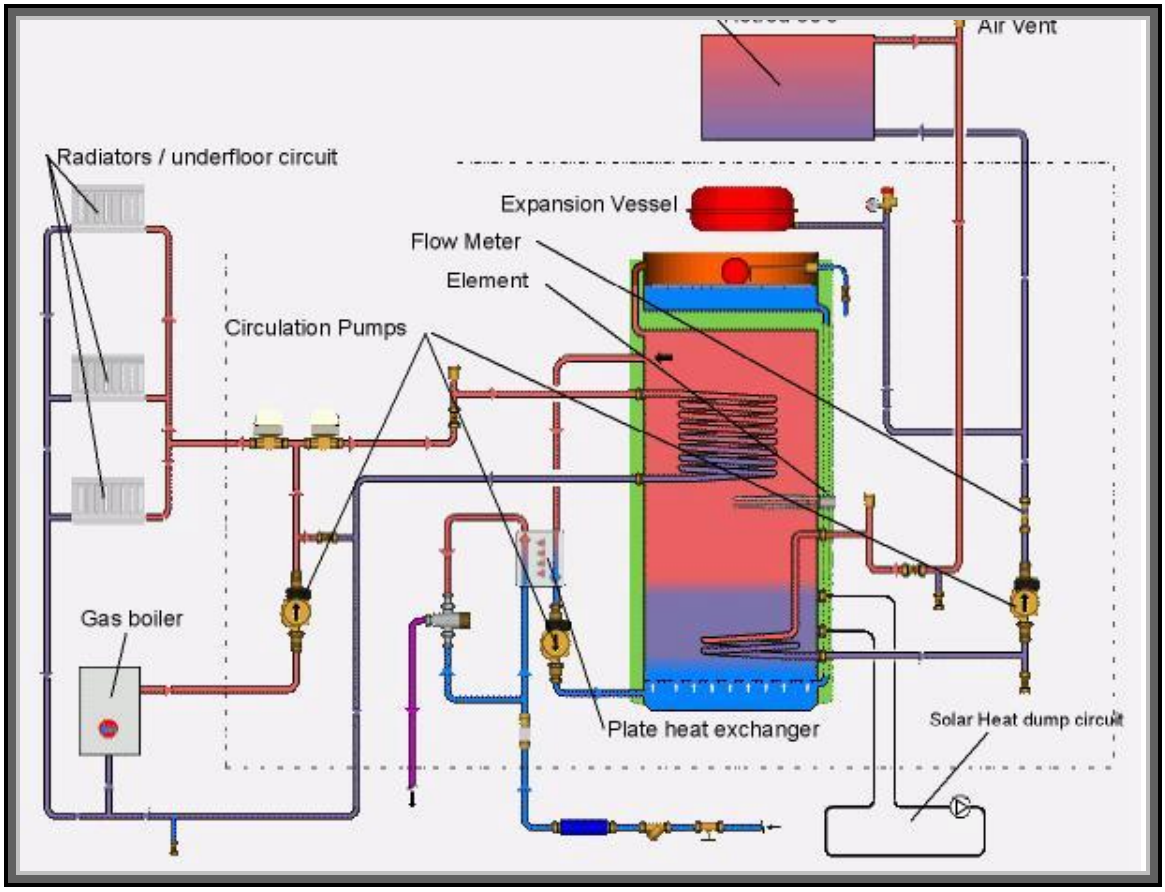
The installation of a Navitron solar collector can be completed in many ways, depending on a number of factors, such as:

- climate (freeze protection, overheating concerns)
- storage tank type (mains pressure, thermal store, gravity fed)
- flow configuration (open flow, closed flow)
- Controller configuration (PV powered pump, Delta T controller)
- Installation location (roof, ground, wall)
- System size (domestic, large scale application)
- System purpose (water heater, central heating, refrigeration)

As a professional solar installer, Navitron expects that you will know how to correctly install the collector to ensure efficient performance and system reliability. We can provide you some technical advice as required, but we may not be that familiar with the specifics of your region. When completing a system design the following points should be noted.

1. The heat pipes do not have a temperature cut off like Thermomax, so pressure release valves and/or expansion chambers are required. Pressure should not exceed 85psi under normal use.
2. The system is well insulated, and subzero temperatures will not damage the evacuated tubes or heat pipes, however the header and associated plumbing may be damaged by if the water freezes. Circulation of water through the collector when ambient temperatures are low is suggested as the best “anti-freeze” method. Electrical supply to the pump must be guaranteed, to account for power blackouts (eg DC pump with battery backup).
3. If using a closed system a glycol water mix can be used to provide adequate freeze protection.
4. The manifold is not guarantee against limescale formation, so ensure that water is of suitable quality (closed loop system is suggested for areas with water that is acidic, hard or has high chloride levels)
5. The following is a basic example of a configuration using a thermal store tank, collector and instant gas water heater. This system just supplies domestic hot water, but could easily be configured to also supply heat for infloor/ventilation heating. Thermal stores can be fitted with electric immersion heating as backup, and can accept direct heat input from gas, electric or wood heating sources.

Typical solar integrated heating system and domestic hot water for all year use.



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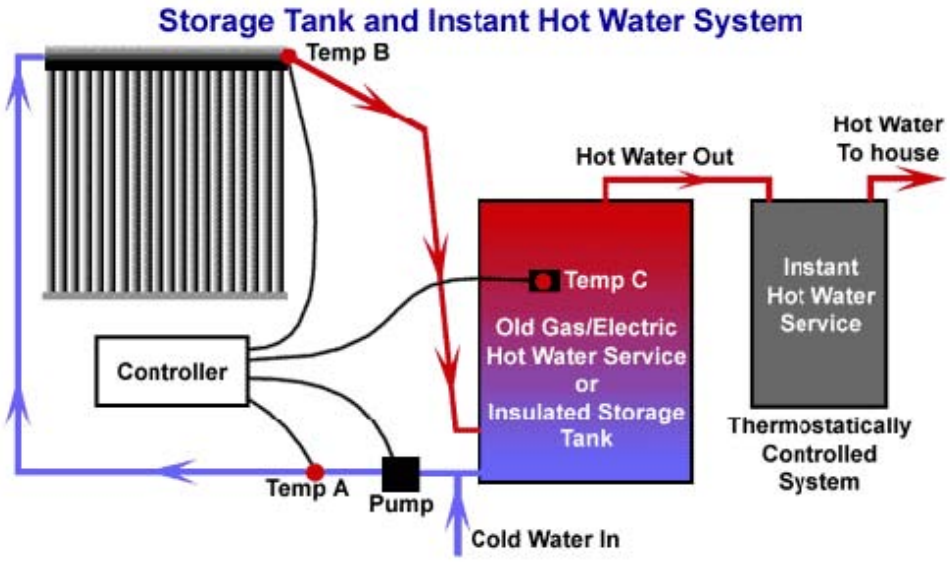
Evacuated Tube Solar Domestic Hot water pre heat installation, gas backup



Thermal Stores

Thermal Stores offer the following key features:

- Mains pressure hot water from an open-vented low-pressure tank (via brazed plate heat-exchanger)
- Light, inexpensive and easy to install
- Excellent corrosion resistance due to anaerobic tank environment
- Provides passive thermal expansion and overheating protection via built in expansion chamber.
- Can accept heat from secondary sources such as wood stove or gas burner.
- Can supply hot water for in-floor heating, air-ventilation heating, spa heating.
- Does not require complicated or expensive plumbing
- Can use a glycol/water mix to provide enhanced freeze protection
- Ideal for use with an “instant” (on demand) gas water heaters, thus ensuring virtually limitless hot water supply (Never run out of hot water again).

What is required for a DIY Installation?

You can install a solar hot water heating system with a minimum of components, but there are many desirable components which improve efficiency and enhance the installation.

ESSENTIAL:

Navitron Solar manifold with 20 Vacuum Solar Heater Tubes
Pipework
Pipe insulation

DESIRABLE

Controller (essential if not using thermo-syphon principle)
Twin coil Solar Hot Water Storage Cylinder
Circulating Pump
Automatic Air Vents

OPTIONAL (depending on installation design):

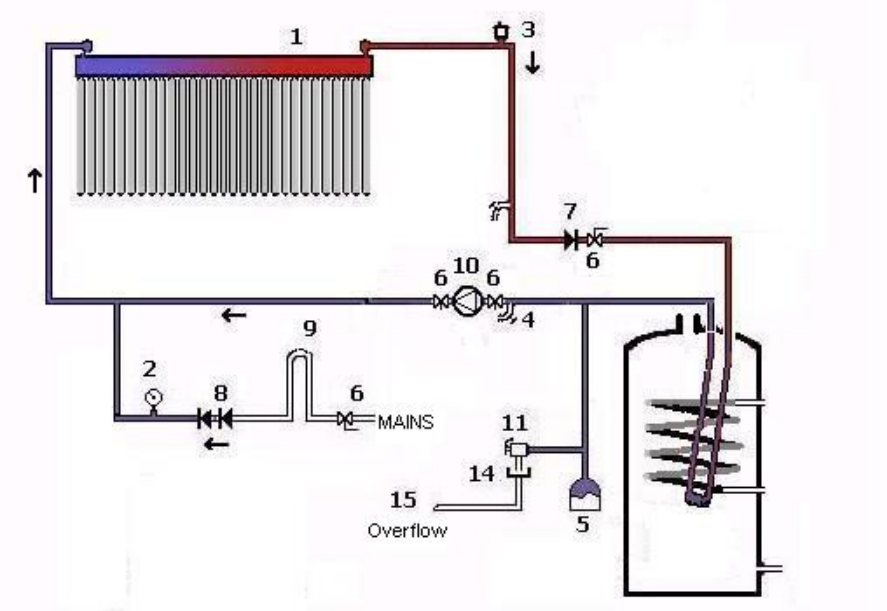
Expansion vessel and pressurized system kit

Swimming pool kit (Direct Heat)
Navitron Solar manifold with 20 Vacuum Solar Heater Tubes
Stainless Steel Heat Exchanger (required if you add chlorine to your water – this is because the chlorine will corrode the copper inside the solar collector's header)
Electronic Controller
Pump

Sample Schematics:

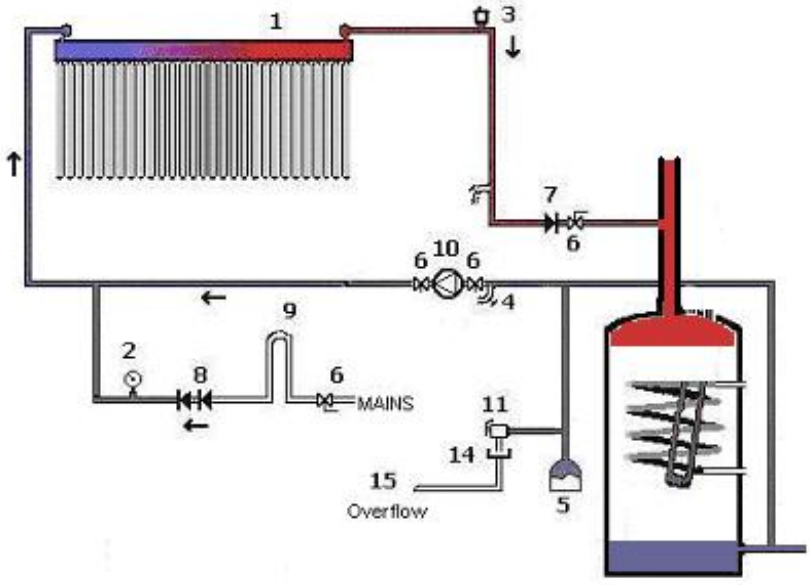
1. ‘Hot Tube’ coil screwed into immersion heater flange

Cheap and easy to install. Ideally requires immersion heater flange to be located in the lower part of the cylinder. Unfortunately, most modern hot water cylinders have top-mounted immersion heaters, which will not allow high efficiency when used to facilitate solar heating



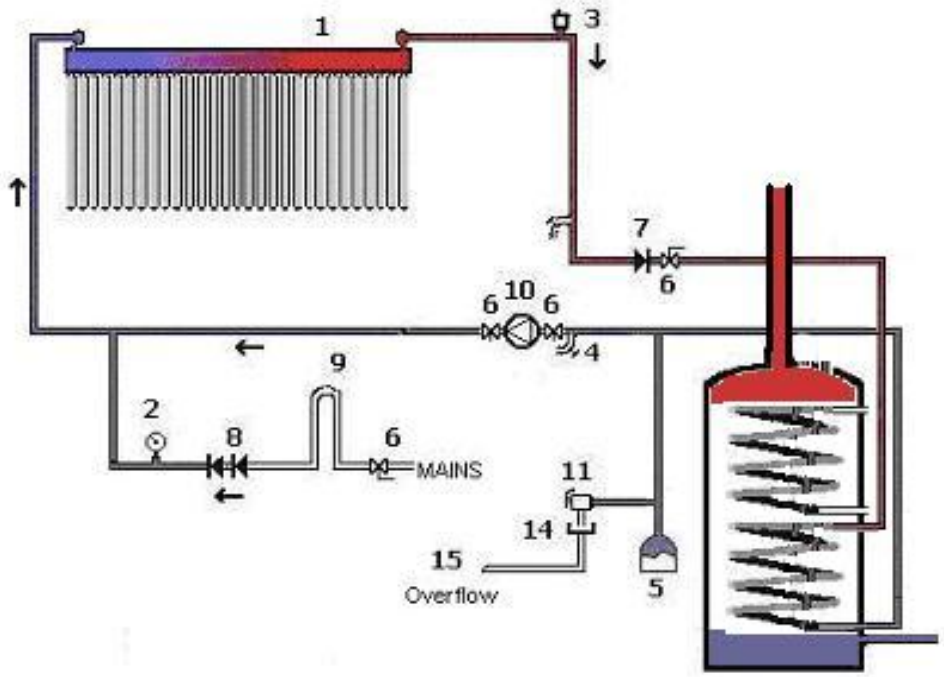
2. Direct heating(simplest method)

Simplest method. Quite efficient, but in areas of hard water, eventually, the solar collector will get ‘furred up’ with limescale, which will reduce efficiency. Easy to retro-fit to an existing direct or indirect hot water cylinder.



3. Twin coil hot water tank

This is the best method, but requires the added cost of a twin coil water cylinder. We can supply these at attractive prices, with the added advantage of a double layer of insulation(50mm), keeping heat losses to a minimum. Please contact for details



Key to Diagrams:

1. *Navitron Solar manifold with 20 Vacuum Solar Heater Tubes*
2. *Pressure Gauge*
3. *Automatic Air Bleed*
4. *Drain Cock*
5. *Expansion Tank*
6. *Gate Valve*
7. *Single Check Valve*
8. *Double Check Valve*
9. *Filling Loop*
10. *Circulating Pump*
11. *Pressure Relief Valve*
12. *Overflow*