

# ATAG Technical Guide 2008

## Solar Water Heating

## Contents



## About the ATAG Technical Guide

The ATAG Technical Guide is your comprehensive reference to installing solar water heating systems. In this archive you will find installation manuals, operation manuals, schematics and CAD drawings amongst other documents that should cover all aspects of the installation and operation of the ATAG solar heating system.


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## 1.0 Introduction

ATAG solar panel technology is being used in over 55 countries throughout the world, spanning a wide spectrum of applications; including domestic water heating, space heating, industrial and agricultural heating processes as well as for heating swimming pools of all shapes and sizes.

Using the limitless energy contained in natural light, ATAG is empowering consumers and businesses to use a non polluting way of creating energy without harmful emissions. ATAG solar panel technology has been certified to meet all applicable standards in the European Union, the United States of America and Canada.

Every year an ATAG solar heating system will save a home owner thousands of tonnes of carbon dioxide emissions.

### Converting light into usable energy

As the absorber panel collects light it causes an electro-magnetic stimulation of particles in the absorber plate. This causes light energy to be transferred into heat energy. The heat is transferred to the copper tubes behind the absorber plate by conduction and then, by the same process into the heat transfer fluid comprising a closed circuit inside the copper tubes. From there the heat will be drawn as required into a hot water cylinder, and or a heat exchanger for a swimming pool and/or a heat sink for a central heating system.

The light can strike our collectors in the form of direct radiation (direct sunshine) or diffusion radiation - the kind of light that you get on a cloudy day. The light is collected on the absorber plate of the collector, which is selectively coated with a substance to ensure the maximum absorption of light.

### Tips on communicating technology with your customer

- ATAG solar panels represent the latest generation of solar panel design, incorporating an advanced selective coating and patented connection clamps to ensure maximum efficency and minimal heat loss.
- The selective coating is made of 'microscopic canyons' to increase maximum surface area, which increases the potential to capture heat.
- The raw materials used to make an ATAG solar panel are mostly recyclable and can be recycled when the solar panel reaches it's end of life.
- The manufacturing process and facilities have been optimised to reduce the cabon emissions produced during manufacture. This increases the carbon efficency of the ATAG solar panel.
- ATAG solar heating offer long term financial savings, as long as 35 years.
- ATAG solar panels are high quality, light but robust designs. Constructed from a stamped aluminum sheet, the solar panel trough is built to be as strong as a roof and contrast greatly to cheaper, imported solar panels which often use plastics and corrosive materials to save money in manufacture.

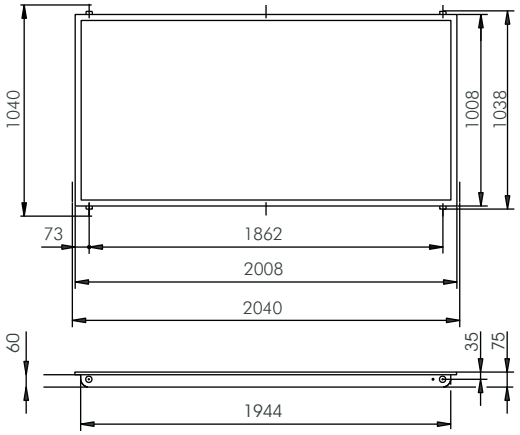
## 2.0 Technical datasheets

The technical datasheets offer you a convenient collection of specifications and operational quotas you should be aware of when commisioning or installing ATAG solar water heating.

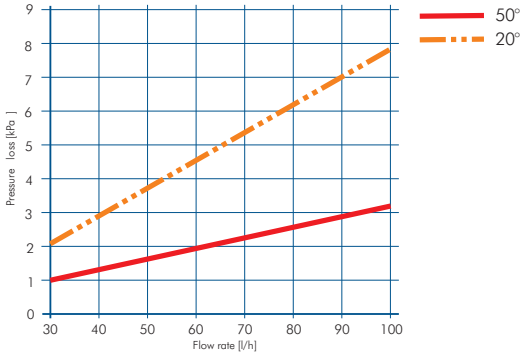
For your reference, a selection of vital statistics have been noted below. Please turn the page for the full colour datasheet.

### *ATAG solar panel specifications*

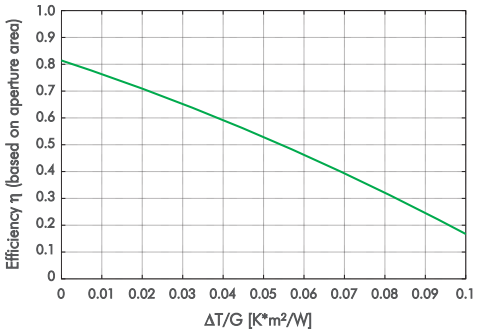
| | |
|---|---|
| **Gross area:** | 2.027 m² |
| **Absorber area:** | 1.778 m² |
| **Linkage dimension:** | 1040 x 2040mm |
| **Weight empty:** | 36.10kg |
| **Heat transfer fluid volume:** | 1.57 litres |
| **Absorbtance: α** | 94% |
| **Glass emittence: ε** | 12% |
| **Max. operating pressure:** | 6 bar |
| **Stagnation temperature:** | 170°C |
| **Max. operation temperature of heat transfer fluid:** | 100°C |
| **Recommended flow rate of heat transfer fluid:** | 60 L/h |
| **Cover glass:** | Safety solar glass 4mm thick. |
| **Connection:** | Patented connection clamp. |
| **Casing:** | Stamping from non-corrosive Al-Mg sheet. |
| **Thermowell:** | To accommodate Ø 4mm or Ø 6mm sensor. |




*Pressure Loss of ATAG solar with Anti-Freeze Liquid*




*Efficiency curve for the determined coefficients and for an assumed irradiation of 800 W/m² based on aperture area*



## Solar Panel Datasheet

## Contents

*For Architects, Engineers, Specifiers, Surveyors and Installers.*

## Contents (continued)

*For Architects, Engineers, Specifiers, Surveyors and Installers.*



## 3.1 Introduction

ATAG thermal solar systems are high quality thermal solar water heating systems. They are usually used for domestic water heating but also have industrial applications where hot water is required. ATAG systems are indirect, pressurised and pumped.

They produce hot water without creating any carbon dioxide or any other greenhouse gas and create no pollution. They produce energy without using scarce fossil fuels and are cost effective.

Its associated company, Genersys Plc, manufactures ATAG systems. Genersys have around 100,000 systems actively in use in Europe and other countries in the world. Altogether Genersys systems are used in over 44 countries.

ATAG is an ISO 9001 company and its product is manufactured in a fully qualified ISO 9806 parts 1 & 2 factory. The panels and systems are certified to BS EN 12975 (parts 1&2). This is the highest standard of certification for the United Kingdom and the whole European Community. Very few other systems have this standard. Detailed test results are available on request.

Some systems are tested to ISO 9806. EN 12975 tests measures efficiency using the difference between the mean collector fluid temperature and ambient temperature. In the ISO test the difference measured is between input temperature and ambient temperature so efficiency measured under the EN test is measuring something different than efficiency under the ISO test, so do not make direct comparisons because the measures are different.

This document is not intended to be a substitute for an installation guide or for the experience and know how of a qualified thermal solar engineer. It is intended to make installers aware of some of the issues that ATAG regards as important and which may not be widely known. These issues cover all aspects of thermal solar installations that commonly arise, including environmental issues.

## 3.2 About Genersys Plc

Genersys Plc is a public company formed to promote all types of renewable energy. Our thermal solar panels (under the Genersys brand or under the ThermoSolar brand are exported to over 44 countries in the world). Genersys has developed joint ventures in Denmark, Mexico, Ireland and Chile. Its core business is the manufacture and marketing of high quality thermal solar flat plate panels.

Genersys is not an installation company but works with installers and their businesses and to develop the thermal solar market in partnership with installers, specifiers, architects, local authorities, government agencies and those concerned with energy. Genersys seeks to learn from them and develop products that they need and can develop with confidence.

## 3.3 Flat plate panels or vacuum tubes?

There has been some debate in the United Kingdom that has centred upon whether flat panels or vacuum tubes are better for our domestic water. Both systems have their supporters and both systems have been around for a number of years, so it is possible to utilise case studies and experience in making a comparison, rather than theoretically based assumptions. Every engineer knows that what may be predicated in theory can often prove to be very different when the theory is put to practical applications.

Both flat plate panels and tubes work in the same way; radiated light is used to heat up a surface usually selectively coated with a substance and in a way to collect light and convert it into heat efficiently. The surface is called an absorber or blackbody. The blackbody transmits heat to a pipe, which carries a heat exchange fluid and the fluid delivers the heat where it is needed. Both types of collectors come in various designs with comparable efficiency. The ability to provide useful hot water in both cases is limited by the laws of physics and the demand requirement of domestic hot water.

In the case of vacuum tubes blackbody is enclosed within a glass tube, which is then evacuated. Light can travel through a vacuum but heat cannot, so in effect the vacuum is used to insulate the system and prevent virtually all heat loss. The glass tube, when evacuated, is connected to a metal condenser and the heat is directed to the condenser, which fits into a manifold. The vacuum seal is located where the glass tubing meets the manifold.

In the case of flat plate panels the heat exchange fluid serpentines in pipes connected to the absorber plate. The Genersys 1000-10 and the Genersys 1450 panels are constructed so that the absorber plate wraps around the heat pipe, enabling almost complete contact between the two. Other panels have the pipes welded or soldered to the absorber plate.

## 3.3 Flat plate panels or vacuum tubes?

Vacuum tubes were first developed by the aerospace industry with the help of copious grants from the German Government and various international organisations. They are manufactured in many countries but the highest concentration of manufacturers is in China where the products are used quite extensively. Flat panels have been developed in many countries but the leading product design and development is also German.

It may be thought by a layman that solar collectors are designed to collect as much light as possible and covert it to heat. This is actually not the case. When designing domestic water systems engineers know that in fact what you need is a compatibly designed system of collectors. There is no point in overheating the system because the hot water usage and storage capacity is finite and the way in which people use hot water and the times at which they use it have also to be taken into account.

At Genersys, we use ThermoSolar AG designed manufactured selective coating rather than other products, which get hotter, because we have to bear in mind that we are not making collectors to create more heat than can be usefully used because the higher the stagnation temperature and the more frequently the system reaches stagnation temperature the quicker is the aging process of the whole system.

We stress that both vacuum tubes and flat plate panels are viable and suitable systems for heating domestic water. If they are properly manufactured they should both give many years of useful production. In larger installations a competent engineer should make an evolution that takes into account all the factors that apply in the particular circumstances of the user and the location.

Some people look at the efficiency of the thermal solar system in terms of measuring its conversion of light into heat. In our view this is usually no more than an academic exercise; efficiency is usually irrelevant because the source of the energy, the light, is free.

Flat plate panels may be covered with glass or acrylic. Of those covered with glass, those using ferroginous glass (that is to say window quality glass that contains iron) the transmission properties of the glass is relatively poor when compared with those made with non-iron glass. Some flat panels are covered with acrylic domes. Generally, experience in Germany has shown that regardless of the collector, many acrylic coverings developed cracks at the points where they are attached to the collector frame. It is believed that these cracks occur as a result of the acrylic becoming brittle after long use; there is stress caused by the great changes in temperature; the hairline cracks do not generally impede collector performance in the short term.

Glass does fracture, although long tests in Germany show that this is a very rare phenomenon. *(continued...)*

## 3.3 Flat plate panels or vacuum tubes?

The very design of vacuum tubes inevitably creates certain advantages and disadvantages.

### Reason to install vacuum tubes:

- They are quite easy to fit as the manifold can be mounted on the roof and the tubes carried up to the roof by two people. Flat plate panels can be heavy. The Genersys panels weight is around 40 kilograms and therefore two people are needed to lift them to the roof.
- Tubes perform slightly better in relation to their size; generally a vacuum installation needs around 10-12% less roof space than an equivalent flat plate system.
- If an individual tube fails it can be replaced; the whole manifold of tubes does not need replacement. There is a relatively much higher failure rate of individual tubes (compared to the failure rate of well engineered individual panels). A tube failure can be diagnosed either when fogging is apparent or frost is not visible on a tube when it is visible on other tubes in the same manifold.

### Reason to install vacuum panels:

- Tubes are prone to overheating because it is difficult to design tube systems in a way that avoids overheating. Some tube systems try to overcome heating issues by incor porating automatic valves in the manifold. Flat plate panels, like Genersys panels, never suffer from overheating that can damage the panels or the system components because the panel is designed specially to avoid this, as the BS EN 12975 testing demonstrates. System components (other than panels) can take temperatures in ex cess of 120°C.
- Overheating reduces the life of the whole system and therefore panels systems tend to last much longer than tube systems.
- Well engineered panels, like Genersys range are much more robust than tubes.
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- Well engineered panels, like Genersys range are much more robust than tubes.
- The stresses caused by the expansion and contraction of the glass in tube systems (the coefficient of expansion of glass and metal are not identical) can lead to stress where the glass is joined to the condenser and sometimes stress fractures are caused, which means that the vacuum fails. The whole of the heat systems in panels is made of metal; glass covers the absorber plate but rests on a special washer which allows of differentials in expansion and contraction.
- The vacuum seal, located as it is in tubes where the glass tubing meets the manifold is actually located upon the hottest part of the collector. This causes stress upon the seal. In the case of the 1450 Genersys vacuum panel the seal between the glass and the metal is not part of the heat pipe and never exceeds 100°C.

## 3.3 Flat plate panels or vacuum tubes?

### Reason to install vacuum panels (continued):

- The systems of holding the tubes in a manifold and securing tubes to a roof means that in windy conditions minor tube movement can create glass fractures, which lead to vacuum failure. Panels do not suffer from this inconvenience.
- In snowy conditions snow tends to remain in the gaps between the tubes, reducing efficiency, whereas it tends to slide off panels much sooner than it clears from tubes.
- Panels can be roof integrated and are actually generally cheaper to install in new build situations. It is not possible to integrate tubes into the roof.
- Installations with vacuum tubes usually require more service calls than installations with panels owing to the more fragile construction of tubes

You will observe that we have not touched upon the aesthetics of tubes and panels. This is a matter of personal taste. Some people like an array of futuristic looking tubes on the roof whereas others prefer the flexibility that panels bring; panels can be fitted on roof, in the way that tubes are, but unlike tubes, panels can be roof integrated, which makes them look more pleasing and fits in better with architectural designs. A large array of panels can be made to look interesting by contrasting the roof tile colouring with them or could be made to blend by using blacks and dark blues as a roof tile colouring.

Finally the proof of this particular pudding is in the eating. In Germany, where both types of solar systems have been used in large volumes for over twenty years the market originally favoured tubes and panels were considered as a second best choice. Today vacuum tubes comprise of only 18% of the market, with flat plate panels taking a massive 82%. The end users found panels just as efficient, more aesthetically pleasing but also longer lasting with fewer faults and service calls required.

If you really want vacuum technology or have limited roof space then Genersys can offer a solution with its 1450 panel. This is a flat plate panel that is evacuated on site. It, being a panel, does not have overheating issues and the differentials in expansion and contraction are not relevant as there is no condenser glass connection. The vacuum is likely to need re-evacuation every five to ten years but this is a simple job that can be done from inside the building.

Whichever the market chooses, it is important to remember that these products need excellent and careful installation by trained professionals. The technology is designed to deliver heat where and when it is required and years of design and technology can easily be wasted if the installer adopts poor practice.

## 3.4 Drain back solar systems or pressurised solar systems

There has been some debate in the UK recently about the advantages and disadvantages of "drain back" solar water heating systems compared with the "sealed system" that Genersys manufactures. Genersys hopes the following information will help people to make an informed decision.

Due to the Dutch Water Board's preference of not using any chemicals including edible glycol in the Netherlands  the drain back was adopted. This is the main reason why Drainback systems are popular in the Netherlands but the Dutch have substantially less experience with thermal solar than Germans and Austrians.

### 3.4.1 How drain back systems work

The system is configured in the usual way – except that the water in some cases, the domestic water – flows thorough the panel. However, when the pump switches off (because the solar is not heating the water) the water inside the solar panel will drain back into a small drain back bottle. The system is thus protected against damage due to boiling and freezing in a simple way.

Drain back systems do not need glycol, because the water that is used as part of the drain back operation should never remain in the panel – it should all drain away.

Some drain back systems pump domestic water through the panel which can lead to scale build up and a steady decline in performance. No drain back system can be truly sealed or pressurised.

### 3.4.2 The rationale behind drain back systems

"Drain backs are good because they remove some of the installation and maintenance problems of pressurised systems."  Experience in other countries has proved otherwise.

## 3.4 Drain back solar systems or pressurised solar systems

### 3.4.3 Practical experience

To allay fears that we could be biased Genersys have manufactured a drain back panel using exactly the same materials as its 1000 range and 1450 range, which externally appears the same. Genersys can supply the market with both types of systems.

The experience of our European customers in Germany, Austria and in a smaller way in over 35 other countries has led us to believe that drain back systems are now old fashioned technology. In Germany our customers take the view that sealed pressurised systems are better, more robust and more efficient.

Allegations that there are installation and maintenance problems with sealed pressurised systems have been countered by the substantial European experience that we have had.

1. There are no “installation problems” with sealed pressurised systems although there is a requirement for high quality methodical workmanship during installation which can increase installation costs.
2. As sealed systems get hotter than drain back systems the plumbing must be of higher quality and hard soldered, not soft soldered.
3. Overheating is not an issue with Genersys systems because we use own ThermoSolar designed and manufactured sealed system able to sustain “stall” temperatures as our
4. BS EN 12975 testing confirms.
5. Boiling is not a problem, as our systems, as with any well-designed solar system the expansion vessel is designed to absorb any vapour created at high temperatures.
6. Freezing is the big issue, drain back systems are designed to drain all the water inside the panel away to avoid freezing. Our systems use edible glycol to avoid freezing, with a gel point of -30°C. With drain back it is imperative that there is a continuous fall back to the pump on all the pipe work to stop air locks and the failure of the drain back action.
7. To ensure that drain back panels do actually drain back all the fluid they must be mounted at a precisely designed angle and their operation carefully controlled. Not only can this lead at times to more pipe work for the installer but also if the panels are not mounted correctly there will be residual fluid which does not drain back and which will cause freeze damage to the panels. It is essential to ensure that all air is forced out of the system. If the pipe work has not been very carefully designed and constructed the installation will not work, either due to air pockets or due to frost damage. Because of this difficulty, some installers of indirect “drainback” system use glycol and not water.
8. If, after standstill in a drain back system, the circulation in the solar circuit has to be refilled, then the height of the lift of the water in the solar circuit means that you have to use noisier, less efficient pumps, such as gear pumps instead of centrifugal pumps.

*(continued...)*

## 3.4 Drain back solar systems or pressurised solar systems

### 3.4.3 Practical experience (continued)

9. There are, in their experience, more maintenance issues with drain back systems. Drain back systems have no corrosion inhibitors added, as this will drop the heat capacity of the transfer fluid. When the domestic water is used directly through the panel in areas with high mineral content water, scaling and impurities will generally cause damage that will require the panel and pipes to be descaled with strong acids regularly. Our glycol solution has corrosion inhibitors and is made with distilled water and that ensures Genersys panel lasts much longer
10. There are no maintenance problems with pressurised systems if the system has been correctly installed. Our recommended maintenance schedule for our pressurised systems is as modest as that of a drain back system.
11. Drain back systems cannot work below freezing point, whereas pressurised systems are designed to work below freezing conditions, such as those experienced every winter in central Europe.

Of course, it should be a matter for each individual system engineer to decide upon the best type of system according to the requirements and usage but generally we think all of these points are highly relevant to standard domestic hot water installations.

## 3.5 Comparisons between drain back and sealed systems

### 3.5.1 Advantages & disadvantages of Drain Back systems

**Advantages**

- Simple design and faster installations with lower grade pipe work can be used, as the system is not under pressure.
- No chemicals in the system (sometimes).
- Water carries a little more energy than glycol.

**Disadvantages**

- Drain backs are often not suitable to adapt to exiting DWH system's placements. Every house that is suitable for a solar system can be fitted with the pressurised system.
- The cylinder must be in an easy line from the panels so the pipe can fall correctly.
- The pipe work must have a continuous fall to avoid air locks. Special attention is needed to make sure soft drawn pipe is straight and fully supported with no undulations.
- Failure of the drain back action for any reason can result in costly damage to the solar panel.
- The control system has a long start up time as the water has to travel to the panel before energy can be absorbed.

*(continued...)*

## 3.5 Comparisons between drain back and sealed systems

### 3.5.1 Advantages & disadvantages of Drain Back systems

**Disadvantages (continued)**

- Measuring the amount of energy falling on the panel usually starts the system. The cylinder could be at a higher temperature than the panel so energy can be lost back to the atmosphere. A good sealed solar system starts transferring energy as soon as there is enough useful energy in the panels above the cylinder.
- Drain back systems cannot modulate in low radiation conditions. The Genersys sys tem modulates the pump to absorb as much energy as possible.
- The system needs to be checked regularly by the homeowner that the system is not low on water.
- System needs to stop at high temperatures to stop boiling.
- If for any reason the system boils the liquid will be lost.
- Bigger less efficient pumps.
- Difficulties in ensuring reliable drain back and refilling when several collectors used.

### 3.5.2 Advantages & disadvantages of Sealed systems

**Advantages**

- If the house is suitable for solar a sealed system can be installed regardless of cylin der location etc.
- Systems can be run more efficiently as the system can be run on the temperature differential.
- System can modulate up and down to gain the most from the solar gain available.
- There is no size limit to sealed systems while drain back is limited.
- No freezing problems.
- System designed to cope with vaporisation of the liquid in the system.
- Pipe work is to a higher standard to cope with higher pressure.
- No “start up” times as the glycol is heated as soon as any radiation hits the panel.
- Systems with long pipe runs are possible, with a diverter loop to stop cooling of the cylinder.
- Systems usually carry longer guarantees as all components are supplied by the manufacturer and so little change of contamination.
- Longer life expectancy.

**Advantages**

- Sometimes but not always longer installation times.
- Glycol has a slightly lower heat capacity than water.

## 3.6 Absorber

### The absorber surface

The absorber surface will not corrode but there are two matters that should be considered in relation to it.

- The absorber surface is by its nature when viewed microscopically uneven to expose a greater surface area to daylight. Virtually all flat plate panels are vented to allow the escape of condensation and the expansion and contraction of air as the absorber surface heats up. The venting means that dirt can adhere to the surface marginally interfering with the efficiency of the absorber plate. At locations where unusual conditions can occur, such as close to the sea, or in cities where a thermal inversion effect takes place (Mexico City, Santiago and Bath for example) polution can enter the panel and adhere to the absorber surface substantially shortening its useful efficient working life. As the Genersys 1450 is evacuated to 100 Pa, the absorber surface is cased within a sealed casing, thereby preventing any salt or other chemical entry thus enabling the absorber surface to be unaffected.
- The absorber surface is selectively coated with a thin layer based on colloidal nickel pigmented alumina. As the surface expands and contracts there is some effective wear and tear on it and there is a risk, after a lengthy period of time that the surface will in part become detached from its coating. The surface will still be able to absorb heat well, but not the same solar absorbivity ≃M 1.5 minimum 0.94 . Genersys believes that any detachment is extremely unlikely and in any event will not occur for at least 25 years but we feel that the possibility should be pointed out.

## 3.7 Insulation

Having gone to a great deal of effort to capture the energy, equal care must be taken during installation to minimize heat energy losses by conduction.

The use of the correct insulation is critical. Normal central heating insulation will melt and become brittle at the very high solar generated temperatures in the system.

Insulation materials must endure the highest occurring temperature, which will be more than 170◦C near the collector. Where the insulation is outdoors then it must be resistant to air pollution, UV radiation and pests, such as mice and birds that may eat it. In some countries the activities of insects require insulation to be “armoured”. Insulation should be externally sealed to prevent it carrying moisture.

If insulation is sheathed then care must be taken to seal lap joints ideally with aluminium foil allowing for proper overlap. If zinc coated sheathing is used there is likely to be high corrosion in the sheathing particularly on the hot pipe where it is located outdoors and unshielded from weather. Care must be taken not to impair the integrity of the coating by drilling holes in the zinc coated sheathing. *(continued...)*

## 3.7 Insulation (continued)

In these circumstances we recommend using only aluminium metallic sheathing and not galvanised steel in outdoor insulation piping. This is likely to provide a life of at least 25 years.

Moisture is unlikely to be an issue in indoor insulated piping. If the insulation is robust enough sheathing is not required; otherwise thin plastic sheathing works well.

## 3.8 Glass

The glass employed in Genersys collectors is special solar quality low reflection transparent hardened white glass. It is pre-stressed and hardened. It is rigorous enough to withstand hailstones the size of golf balls under TUV tests.

There will be no significant degradation in the glass over a thirty-five-year life span.

## 3.9 Hard or soft solder and brazing

We cannot recommend the use of soft solder and we believe that using it will cause problems for the installer. If the installer wants to check with the manufacturers of soft solder they will find that manufacturers themselves do not recommend the use of soft solder in solar installations because of the very high temperatures that can be experienced – well in excess of 100°C.

What should be borne in mind is that soft solder has a melting point of around 200°C. Genersys collectors have a stagnation temperature of 170°C so when the pump starts in the exchange system you can get bursts of temperature well in excess of 200°C albeit for short periods which might melt or weaken the joints. Hard solder has a much higher melting point and will result in no service calls for weeps and leaks.

Fernox, who make a good quality soft solder (Fry 99C lead-free wire) has a melting point of 227-228°C and this is not quite high enough.

The only possibility of a chemical reaction between the solder and the glycol arises if a solder has high zinc content in it, so no zinc, or very low zinc content hard solder must be used.

Whatever solder they use they should, in order to protect themselves, get the manufacturer to confirm its suitability for high pressure, high performing solar systems.

## 3.10 The collectors & roof fixings

There are three materials used in the manufacture of our flat plate collectors; a manganese aluminium one-piece shell and an aluminium absorber plate, a copper meandering tube and a protective glass cover. We shall set out scientific expectations for the life cycle of each constituent. We shall then deal with the life cycle of the product as a whole. Roof fixings are made of aluminium.

## 3.11 Aluminum

Aluminium is the third most abundant element on this planet. It can be produced cheaply from bauxite ore. Its properties (relevant to solar collector production) include:

- A low density. Aluminium is only one-third the weight of steel.
- Aluminium and most of its alloys is highly resistant to most forms of corrosion. The metal's natural coating of aluminium oxide provides a highly effective barrier to the ravages of air, temperature, moisture and chemical attack.
- Aluminium is non-toxic and impervious and has been used in the food and packaging industries for many years.

Genersys makes its collectors in its ThermoSolar factory in Ziar, Slovakia. The factory is actually located close to an aluminium plant. Slovakia and Ziar in particular has a long history of high quality engineering. The manufactured process is strictly quality controlled and the plant has ISO 9006 certification. As part of this process, each individual collector bears a unique serial number so that its production history can be traced.

Currently world production of refined aluminium is in excess of 18,000,000 metric tonnes.

### 3.11.1 The environmental impact

As a producer of an environmentally critical product we must appreciate the effects of what we use in our product on the environment. An important quality of aluminium, which makes up the shell into which the heat transfer equipment is housed, is the ease and viability of recycling aluminium, so that when the product reaches the end of its useful life, it can be recycled viably and commercially without adversely impacting on the environment; the recycling in the case of aluminium, is an important "green" justification for its use.

There are many secondary refiners that convert aluminium scrap into foundry ingot, deoxidiser for the steel industry and into master alloys. There are very good commercial reasons why this recycling has always taken place. The high intrinsic value of aluminium makes recycling economically attractive.
*(continued...)*

## 3.11 Aluminum

### 3.11.1 The environmental impact (continued)

Aluminium and its alloys can be melted and recast without loss in quality with today's technology. The recycling of aluminium back into new ingot takes place with an energy saving of 95% of the energy required to produce the same weight of aluminium through the primary smelter route. Thus, recycling saves raw materials and energy and also reduces the demand on landfill sites.

The Aluminium Federation claims that aluminium is an "energy-bank". It is unique in storing the energy used for its production, as its products can be re-cycled indefinitely.

### 3.11.2 The public health aspect

We should touch upon the public health aspects of the use of aluminium. It is important to state that at no time does aluminium ever come into contact with any drinking water supplies or any washing water. The aluminium in the collector is used as a frame to hold the heat transfer mechanism, the sealed copper tube containing glycol. There is no possibility of the aluminium accidentally coming into contact with drinking water in a Genersys solar system.

### 3.11.3 Corrosion & Degradation

Although aluminium is a very reactive metal with a high affinity for oxygen, the metal is highly resistant to most environments and to a great variety of chemical agents. This resistance is due to the inert and protective character of the aluminium oxide film which forms on the metal surface. In most environments the rate of corrosion of aluminium decreases rapidly with time. In only a few cases, e.g. caustic soda, does the corrosion rate approximate to the linear.[3]

Galvanic corrosion occurs when two conducting metals are joined and exposed to conducting of the short path through the electrolyte is low. Brazing and welding provide junctions at which galvanic corrosion can develop. In Genersys collectors, the one-piece shell construction of the collector means that there is no welding or brazing or similar process in which galvanic corrosion can occur. In addition, the evacuation of the internal part of the collector inhibits any corrosion by interaction between copper and aluminium. There should be no performance loss due to galvanic corrosion.[4] *(continued...)*

[3] Although the oxide film is extremely thin, between 50 and 100 Angstroms, it forms a protective barrier between the metal and the surrounding medium as soon as the metal comes into contact with an oxidising environment, such as water. The physical-chemical stability of the oxide film determines the corrosion resistance of the aluminium. This stability is dependent upon the pH value of the environment, since the oxide film is stable within the pH range of about 4 to 8. Below and above these values, acid dissolution yields Al3+ ions and the alkaline dissolution leads to the formation of Al02 ions.

[4] Weathering tests lasting more than ten years, carried out by The Association of Light Alloy Refiners, confirm that there is little difference in the resistance to atmospheric attack of the casting alloys LM2, LM4, LM5, LM6.

## 3.11 Aluminum

### 3.11.3 Corrosion & Degradation (continued)

Thermodynamically, aluminium is capable of reacting with a wide range of chemical substances. Free energy considerations make the reactions with oxygen and water particularly favourable. However, aluminium shows a high resistance to reactions, which would result in corrosion in most neutral solutions. This is due to the rapid growth of the oxide films or adsorbed oxygen on its surface. The oxide film forms within seconds, is self-healing, has a slow thickening rate and is very compact and adherent. This acts as a barrier between the metal surfaces.

The durability of aluminium enables its use in many applications and in doing so it may come into contact with aggressive environments. To achieve strength, aluminium is alloyed with other elements. Not only are the mechanical properties affected but also the corrosion properties change.

Aluminium-magnesium of the kind used in the manufacture of Genersys panels has even better corrosion resistance than most metals; it can be used in marine conditions where total immersion in seawater is required.

Most aluminium casting alloys are classified as having good corrosion resistance and if used for purposes involving exposure out-of-doors, they will suffer no appreciable loss of strength as a result of corrosion.

Genersys 1450 panels are supplied with a 20 years anti-corrosion guarantee.

## 3.12 Copper

Copper has been used extensively in the construction for many years. Its properties are very well known. There are complex issues of corrosion of copper water pipes, which generally relate to manufacturing processes, modes of installation of copper pipe and water quality. Genersys assumes that in all installations high quality well-made pipe is used throughout. For those parts of the installations that Genersys undertakes this assumption is accurate.

Generally copper lasts for decades, but we should consider the effect of copper in Genersys systems and whether the copper will degrade as a result of the specific applications.

### 3.12.1 The environmental impact

Copper is completely recyclable and indeed there is a vigorous and active used copper market where material is recycled either by the granular process, or by a newer extrusion process. Copper and copper alloy scrap is recycled relatively cheaply, with low power consumption and with minimal losses. [5]

### 3.12.2 The public health aspect

Copper is well known as a safe metal. It is used worldwide for potable water supplies in preference to any other material. It does not absorb bacteria and is not dissolved in water. Copper gives excellent protection against contaminants to the domestic water supply. Copper does not absorb organic substances and cannot be softened by them in service.

[5] Copper is one of the few metals that are fully sustainable.

## 3.12 Copper

### 3.12.3 Corrosion & Degradation

Genersys systems that have copper piping in two separate areas which should be separately considered:

**Area 1: Within the Collector Body**

The copper heat transfer pipe within the collector body is partially wrapped by the aluminium absorber plate. This is made up of compression proof copper. As the whole of the heat transfer pipe is enclosed within the panel, it is contained within a rough vacuum. In these circumstances little or no oxidation or corrosion of the copper will take place. Indeed, the absorber plate, made from aluminium, should also be proof from any corrosion.

**Area 2: Outside the Collector Body**

Copper piping is used as a heat transfer conduit that carries glycol as a heat transfer medium. The Copper pipe connects to the meandering pipe within the Collector Body at one end and to the copper coil within the hot water cylinder at the other end.

This copper pipe is almost wholly enclosed by high quality aluminium covered special high temperature proof solar insulation. This protects the copper to a large degree from external corrosion. Because of its long use in building there should be no difficulty with the external surface of the copper pipe outside the collector body lasting for 35 years or more but regard must be had to the internal surface of the copper pipe both within and without the collector body.
This pipe will be filled with glycol and pressurised to between 4 and 5 barometers of pressure. The glycol will be pre mixed with water and diluted to a 45% solution. The dilution is factory controlled so that high alkaline and high sulphur water is not used. There will be no difficulty in the glycol solution forming the thin p-type films, which under most circumstances perform well and protect the surface against corrosion. We have asked our German partners, ThermoSolar AG for case studies that they know of where the copper pipes have failed. ThermoSolar have reported that they know of none.

It is well known that glycol has no adverse effect upon copper either at very high or very low temperatures.

## 3.12 Copper

### 3.12.4 Stress upon copper as a result of solar performance

The copper heat exchange pipe in Genersys panels contain glycol, pressurised and heated to temperatures in excess of 170° C when exposed to direct sunlight where the rays are striking the absorber plate at roughly a right angle very quickly. Similar temperatures will be reached in winter, but more slowly due to the lower levels of insulation. In winter at night the system is designed to be safe up to temperatures of minus 30° C or lower. It will perform in winter in the right insulation conditions and in below freezing temperatures.

Copper piping is used because copper is highly efficient in heat exchange operations because the thermal conductivity is so high. [6]

The copper piping will be exposed to high and low heat, including high variable heat. Three points should be made:-

- Copper does not become brittle at low temperatures.
- The melting point of copper is 1083°C.
- The grade of copper used by Genersys will not become hard (like steel) if it is cooled rapidly after heating.

Internally, the collector heat pipe, as folded into the absorber tray is one continuous tube which is hard soldered in two places only as part of the connective pipe.

### 3.12.5 The jointing of copper

Genersys systems are either "hard" soldered or preferably connected by press fittings, which allow fast, safe and efficient joints to be made. We recommend the use of press tools powered by a rechargeable battery to achieve a sound joint without the need for solder, flux or any other jointing materials. This creates extremely sound pressure proof joints without soldering or brazing.

This is particularly important as the glycol solution has a much lower surface tension than water and will find cracks and crevices in pipe work and jointing that water will not find. The fact that the heat transfer system is pressurised also confirms that the integrity of the pipe work is paramount.

The Genersys system uses thick-walled copper or gunmetal fittings that have a machined bead – similar to a solder ring fitting – containing an 0-ring. This is pressed onto copper tube using the tool fitted with the appropriate clamp.

In addition the Genersys installation will eliminate as many joints as possible by using continuous reels of high quality pre solar insulated pipe.

[6] Copper is 23 times better than stainless steel or titanium and 1.6 times better than aluminium.

## 3.13 Glycol

All our experience in Europe of hundreds of thousands of installations leads us to understand that the glycol is far more important than most installers appreciate as an integral part of a good solar system. Our engineers have spent a lot of time working with the glycol producer until they have found a satisfactory product.

Some installers may be using something like Fernox Protector Alphi-11, which contains mono-propylene glycol. If they use it in 25% concentration they will protect down to -11 degrees Celsius.

There are several reasons why we want them to use our own glycol which has been specially designed for solar installations.

- Our research and experience shows that if you mix glycol yourself you do not tend to mix it with distilled water so you introduce some impurities into the solution.
- Our experience shows that if you mix it yourself you rarely mix it thoroughly and you can get crystals forming in solar systems with the high differential of temperatures that can be experienced. These formations, of course, weaken the anti-freeze properties of the gly col and you can get freeze damage to the heat exchange pipes and to the pipes in the collectors. Factory mixed solutions should be used.
- Our solutions protect down to -30°C. Over a ten or fifteen year period all glycol loses its anti-freeze properties to some extent. Our glycol will after 10 years still protect down to -11°C.
- We do not use mono propylene glycol but polypropylene glycol, which is much more suitable because it is approved for use in the food industry and in the tobacco industry and is an ingredient in proprietary hair growing preparations. It is safe and edible.
- Under no circumstances should any ethylene based glycol be used in solar systems.

## 3.14 The pumping station

The pumping station is made up of various high quality components which have been factory assembled to ensure high quality control standards and save installation time and mistakes. Each component is "modular" in that it can be readily and easily replaced. Each particular component has the following estimated life span:

| | |
|---|---|
| • Pressure Vessel [7] | 5 years |
| • Flexible steel reinforced pipe to pressure vessel | 35 years |
| • Pressure gauge | 15 years |
| • Grunfos modulating pump type UPS 25/80 | 5 years |
| • Temperature gauge | 15 years |
| • Quarter turn valves | 35 years |
| • Flow rate controller | 35 years |
| • Non return valve | 35 years |
| • Station insulation | 35 years |

## 3.15 The hot water cylinder

Our cylinders are built to the following minimum specification:

- Vented (tank fed)
- Manufacturer: Copperform (RMC Group)
- Indirect cylinder Grade 3 copper
- Standard Applicable: BS699/1566 – 2002
- Maximum working head is 10 meters
- Pure copper complying to BS1654 used throughout
- Solar Coil tested to 7 bar

The insulation heat-losses of this cylinder are compliant within the specified 2.891 kWh per 24hrs of BS699/1566-2002. The bosses fitted to this cylinder comply with BS2779 (Parallel threads). Storage capacity is from 200 to whatever capacity is suitable.

The life cycle of cylinders is not affected by solar. Precisely the same heat exchange operations take place within the cylinder whether it is fitted with a solar coil or not. The ultimate life of the cylinder depends largely on the quality of the water flowing through it.

**It is important that in pressurised systems the solar coil inside the cylinder can withstand the pressures experienced. System designers should check that the cylinder that they intend to specify does measure up to this requirement by contacting the cylinder manufacturer.**

[7] This actually depends on its size.

## 3.16 The hydraulic heat exchange system insulation (where specified)

The hydraulic system is specially manufactured "Twinway" flexible solar annular pipe made from stainless steel, material AISI 316L straight seam welded, without braid. It beds to a radius of 100 mm and has a maximum operating pressure of 10 Bar and a burst pressure of 100 Bar. It is 3 mm thick and is un-jointed for lengths of 25 meters.

It is factory insulated with a highly flexible closed cell insulating material made from synthetic rubber based foam (elastomer) with 25 mm insulation.

It is free of CFCs, fulfils DIN 1988 parts 1 & 2 and is resistant to UV radiation.

The insulation can typically cope with the very high temperatures that solar applications create, including above 175 degrees Celsius. Its heat conductivity at 0 degrees Celsius is 0.040W/(m+K+) and at 40 degrees Celsius 0.045W/(m+K+).

The insulation is tested in conformity to DIN 52 615 for diffusion of vapour. The insulation material is tested for behaviour in faire and conforms to DIN 4102 Part 1 and BS 476 Part 7. In fire the material is self-extinguishing, non dripping and does not spread the fire. The system is also factory fitted with two silicon coated 4 strand wire for connection to the control system.

## 3.14 The digital controller

This is a robust electronic controller with no moving parts. It receives information from sensors and controls the flow of the hydraulic system according to need and availability of energy. It is programmable but is not intended to be user programmable. Generally we have excellent experience with these products and are accordingly able to offer a five-year unconditional warranty. We estimate that their working life should exceed this substantially, but account has to be taken of power surges and spikes that may damage the controller. These arise from matters outside the control of Genersys plc.

## 3.18 Safety controls in genersys thermal solar water heating systems

### 3.18.1 Safety

Safety is central to Genersys; we are not aware of any safety issues or claims or proceedings involving our systems anywhere in the world. Genersys Systems are designed to high degrees of safety but account must be taken of the differing safety regulations that apply throughout the world.

The thermal solar market in the United Kingdom is very small. There are various types of systems available (such as drain back, direct and evacuated tubes) and many of the system types have specific disadvantages. It is important that specifiers may distinguish between Genersys systems and other systems on the market and to understand that safety issues that may arise with other manufacturer's thermal solar systems do not arise in Genersys solar systems.

In this context "Safety" includes

- Safety to the Installer when installing a System.
- Safety to the Consumer when using a system.
- Water Safety Issues.

### 3.18.2 System overview

A typical Genersys system will include two or more panels mounted on a south facing roof area; the panels contain a sealed heat transfer pipe which directs heat to a coil in a hot water cylinder. The heat exchange is indirect.

### 3.18.3 Safety to the installer when installing the system

Genersys Systems are not marketed towards or intended to be installed by do it yourself, unskilled or untrained installers. Every installer authorised to install Genersys panels has been trained by Genersys. Installers usually have many plumbing qualifications.

Installers are trained to use scaffolding and proper up to date safety equipment and in the dangers of working at heights.

We have several training installers; they are all fully qualified plumbing and heating engineers, members of the Institute of Plumbing and Heating Engineering and some are members of the Water Industry Approved Plumber Scheme (WIAPS) duly certificated.

## 3.18 Safety controls in genersys thermal solar water heating systems

### 3.18.4 Safety to the consumer when using a system

There are many safety controls built into every Genersys system. Genersys relies on a number of safety strategies and in our view a properly engineered thermal solar system, like Genersys is safer to the consumer than the consumer using a fossil fuel central heating system in the home to heat water.

### 3.18.5 Overheating issues

These are traditionally associated with thermal solar installations. Genersys panels have a stagnation temperature of 170°C, the system has a minimum of an 18 litres expansion vessel and a pressure relief valve, set to 6 bar, the system is pressurized to 3 Bar but tested independently to still remain viable at 10 Bar.

The system is designed so that when the Glycol vaporises in the panels (which takes place at about 140oC) the vapour volume is pushed into the expansion vessel. Even on the hottest days the pressure relief valve should not relieve.

The system has a built in solar pressure relief valve rated for temperatures in excess of 180oC. All other components used in the system are temperature and pressure rated well over their expected operating temperatures and pressures on the system. We recommend, if there is room, that the discharge from the expansion relief valve is run to a container within the vicinity of the pump station. This container is twice the size of the volume of glycol above the valve.

All the Genersys controllers control the temperature of the cylinder and will shut the pump off when the desired predetermined temperature (set by the installer) is reached. As can be imagined, the heat exchange pipe work gets very hot. Heat exchange piping must be insulated by using solar quality insulation, so that there is no pipe exposed inside the house that can be touched by the homeowner. This prevents contact burns.

If an unvented cylinder is used, we install an additional two port valve wired to spring shut the flow from the solar, if overheating should arise, in accordance with building regulation G3. The over-heat thermostat is wired through the solar and heating controls so all solar thermal operations stop and is an easy visual indicator to the home owner if something is wrong. It must be manually reset as an additional safety measure.

### 3.18.6 Water safety issues

The solar system is a sealed system, so the heat transfer fluid does not at any time come into contact with the domestic hot water. We require the pipe work on the sealed system to be brazed or else to be joined using recommended

## 3.18 Safety controls in genersys thermal solar water heating systems

### 3.18.6 Water safety issues (continued)

compression joints with approved solar quality press fit joints ensuring that pipes have the right support sleeves in place. The cylinder has to be designed with a separate solar coil. The risk of cross contamination is slightly lower than that occurring in coiled cylinders connected to a boiler which covers both space heating and water heating as we demand a higher specification of the cylinder coils.

Gas central heating that connects to a coil in the boiler has chemical additives to protect pipe work. Thermal solar has anti-freeze properties to prevent frost damage. However, in order to ensure the safety of the consumer we use only polypropylene glycol, which is approved throughout the world for use in food and consumer products. We refuse to approve the use of mono-propylene glycol.

Our research and experience shows that installer mixed glycol is rarely mixed thoroughly and never with distilled water. Poorly mixed glycol allows crystals to form in solar systems with the high differential of temperatures that can be experienced. These formations, of course, weaken the anti-freeze properties of the glycol and freeze damage can occur to the heat exchange pipes and to the pipes in the collectors. Factory mixed solutions should be used.

To overcome the use of incorrectly mixed glycol or the wrong type of glycol, Genersys recommends its own ready mixed glycol solution which it sells with complete solar kits or separately.
Genersys solutions protect down to -30°C. The constant heating and cooling of glycol eventual after a 10 year period tends to reduce its anti-freeze properties to around -15°C. The exact state of the glycol can be tested by drawing off a small sample from within the home.

### 3.18.7 Installer safety issues

When inspecting or servicing any part of the equipment care must be exercised (1) not to turn any valves or change any digital controller settings and (2) not to touch any part of the collector or heat transfer system with bare hands. Very high temperatures can arise in the heat transfer system, which, if touched, will cause severe burn and the shock of which may cause the operative to slip or fall.

## 3.19 System using PhotoVoltaic panels to drive the pump

There are systems on the market today, which comprises a plastic thermal panel and a small PV cell. In this system the domestic hot water is pumped through the panel and then into the cylinder. The system requires very little plumbing. It does not have freeze protection because the plastic pipes it uses are designed to freeze without damage being caused.

The PV panel drives a small dc motor, which is all that is required. These systems do not provide a good solar fraction – rarely do they achieve more than 50%, and they are incapable of providing very hot water, although they can make a valuable contribution to a domestic hot water system.

They have the advantage of saving electricity and being able to function in a power cut. In our view these systems are really "hobby" systems. The electricity savings of not having a controller and pump hard wired to the mains are only in monetary terms around £6 per annum. The additional cost of the PV panel is such that it cannot be justified on economic terms, in our view.

Also it is our experience that long term electrical power cuts most often occur when a thermal system would not be experiencing any solar gain – normally at night in winter when peak demand is high.

If power cuts are caused by adverse weather conditions then in daylight these systems will still function, provided that the adverse weather conditions has not interfered with the water supply.

## 3.20 The estimated life cycle costs of genersys solar system

The specific components of Genersys solar hot water systems that we are covering:

- Genersys series 1000-4, 1000-10 or 1450 Solar Collector Panels.[8]
- An insulated pressurised hydraulic heat exchange system.
- An insulated hot water cylinder manufactured to Part L standards.[9]
- A Genersys pumping station.[10]
- *A Genersys DC11 digital controller.*[11]

In these circumstances we set out a short explanation of the components of the collectors which will enable a view to be formed.

There are only minimal performance differences between well made collectors and poorly made collectors. The technology is such that a tremendous amount of research is needed to produce a very modest performance increase in all existing types of collectors. The important differentials are quality of construction and materials used in the construction. There is no advantage in using a technology that purports to be "green" if it does not have a long working life. Accordingly, we have designed our products to provide the maximum durability consistent with reasonable performance and pricing structures.

## 3.21 Environmental savings as a result of using solar collectors

The average environmental savings for a household of two adults and a two children family using a Genersys thermal solar system with a 200m litre which uses oil as its main source of fuel.

| Pollutant | Annual aggregate saving | 35 year savings |
|---|---|---|
| Carbon dioxide | Three quarters of a tonne | 26.25 tonnes |
| Black smoke | If oil is used | If oil is used |
| Carbon monoxide | Depeneds on boiler efficiency | Depeneds on boiler efficiency |
| Acidic rain | Depeneds on boiler efficiency | Depeneds on boiler efficiency |
| Soot | Depeneds on boiler efficiency | Depeneds on boiler efficiency |

*Sustainability*: the energy taken to produce our solar collectors is recovered in two years or less.consistent with reasonable performance and pricing structures.

8 Data sheets are available.
9 Data sheets are available.
10 *This is factory assembled from a number of other components and drives the hydraulic heat exchange system.*
11 *In certain cases we shall supply the Genersys DC3 controller so that water usage can be monitored, if desired. The data sheet for the DC11 is produced as Appendix 3.*

## 3.22 Service requirements

Cleaning is sometimes an issue with some collector types. Exterior dirt accumulates on flat plate collectors but on long term tests it was found that without cleaning, at various locations, the optical efficiency is reduced by somewhere between .3% to 1 % after 8 to 16 years. With acrylic domes it was found that complete cleaning could not be achieved because the dirt tends to be "burnt on" and this reduces the optical efficiency more significantly.

With glass collectors the rain washes dirt away easily and cleaning is not recommended unless the collector is installed in an exceptionally dry polluted place which experiences high dust conditions.

The glass that covers vacuum tubes also allows dirt to be washed away easily but in some places moss accumulates on the underside of tubes which tends to affect the radiation transmission through the side of the tubes and in some tests was observed to reduce efficiency by 15% (when compared with new).

Many flat plate panels collect dirt on the interior of the glass. Usually this dirt looks worse than it actually is; in tests which compared the efficiency of dirty glass with clean glass in glazed collectors a drop in efficiency of only 0.4% was noted.

Both glass and acrylic "age" and aging tends to diminish the optical transparency. The transmission is best preserved by non ferrous white glass and 10% worse for acrylic coverings. For glass fibre reinforced plastic the transmission is 50% less efficient.

There is a simple regime of inspection and servicing that we recommend is carried out to ensure that the collectors are operating at their optimum efficiency, presented on the following page.

## 3.22 Service requirements

Recommended inspection regime for small systems (less than 3 solar panels):

| Interval | Category of inspection<br>Personnel and time needed to carry out work per system | Action to be taken |
|---|---|---|
| Monthly | Unqualified<br><br>Time: 1 minute | Check Pressure gauge; if it falls below 3 bar for long periods call for service; Note: it is normal to view large fluctuations, particularly when the collectors are engaging. |
| Three monthly | Unqualified<br><br>Time: 5 minutes | Visual inspection of internal system for weeps and leaks; report any that are viewed |
| Annual | Unqualified<br><br>Time: 10 minutes for testing, 1 hour for any necessary refilling | Visual inspection of internal system for weeps and leaks; report any that are viewed |
| Five yearly | Qualified; work is carried out from inside home; re-evacuation may take several hours; Glycol tests takes ten minutes; refilling or topping up glycol takes less than an hour | Re evacuate the panels if necessary (if 1450 panels are fitted)<br><br>Test glycol |
| Very rarely | Unqualified | The glass is self-cleaning (with rainfall) and surface dirt will not significantly impair performance. In the very unlikely event of any matter substantially adhering to the glass occurring, the glass can be cleaned like a normal window. |

## 3.23 Maintenance requirements in large scale systems (more than 3 collectors)

### 3.23.1 Maintenance Checks

A system of preventative maintenance should be adopted for solar installations and fossil fuelled installations.

The following specific checks are for large scale installations and should be carried out at least once every sixty days between October and March and at least once every ninety days between April and September.

- Visual inspection for weeps, leaks and fluid escapes and visual in spection of the pressure vessel.
- Manually operate all valves and pumps to ensure that they are working correctly.
- Visual inspection that system pressure has not dropped into red zone.
- Visual inspection that flow gauges indicate correct flow levels.
- Visual inspection that there is no damage to panels or fixing; this can be done from ground floor level provided some form of magni fication is used.
- If there is pre heating used, regular checks of the heating system for the final heated cylinder should be made.

### 3.23.2 Annual checks for large scale installations

- Check operation of active anodes.
- Check operation of non active anodes.

This maintenance regime can be adopted for smaller scale domestic water heating installations on an annual basis.

### 3.23.3 Additional Checks

The following additional checks must by carried out every three years

- Check the pre-charge of the expansion vessel(s).
- Check the whole system for signs of corrosion.
- Test glycol with approved testing kit.
- Visual inspection that all insulation is in good condition and not be coming brittle or cracked.
- Visual inspection that any pre heat cylinders are free from corrosion.

If vacuum panels are used, check that the vacuum gauge shows that there is still sufficient vacuum. The pointer should be in the green zone.

## 3.24 Planning issues

Planning permutation is not usually needed for Genersys Thermal Solar systems. As the systems do not protrude above or beyond the roof line, permission is not normally required for their installation. However, if the property to which the solar system is to be fitted is within a conservation area or within a National Park then enquiry of the local planners should always be made, to ascertain the position. The more forward thinking local authorities often have a way of fast tracking applications for planning permission for renewable systems.

In case of a listed building special listed building consent should be obtained. It is unlikely to be granted unless the solar panels are not visible from any elevation.

## 3.25 Building Regulations issues

On 1st April 2005 the new revision to Part L of the Building regulations came into force and these new regulations affect all new building work, including extensions to homes and boiler replacements.

The new building regulations make it essential for house builders to consider solar thermal installations and in most cases will install solar thermal systems as a result.

The most important change in the regulations is to require a 25% improvement in carbon saving in dwellings which is measured by a SAP rating methodology. If the building concerned is relatively small, such as a small terraced house on mains gas, the correct SAP rating can probably be achieved with a class A SEDBUK condensing boiler. However, for larger buildings, such as a four bedroomed detached home, it will be virtually impossible to obtain a legal SAP rating without a good thermal solar system.

The regulations actually provide "Where technically, environmentally, and economically feasible, new dwellings shall incorporate renewable and/or decentralised energy supply systems."

The regulations will also make it necessary for most homes built with oil or LPG heating to have thermal solar. Other technologies (such as heat pumps) also qualify but solar thermal will usually be the most cost effective as well as the most carbon efficient.

The overall effect of the regulations will be to raise energy performance in new buildings by 27%, or so the government believes. Some of this will come from structural efficiencies but some will inevitably have to come from renewables like solar thermal. Properly specified and fitted Genersys systems should, de facto, reduce carbon emissions by nearly a tonne a year by themselves.

The present legislation in the United Kingdom will allow the government to re-

## 3.25 Building Regulations issues (continued)

vise the SAP requirements (obviously on an upward only basis) in 2007 without having to put the revised proposals before Parliament. However, Part L will probably be substantively revised again in 2010 and 2015 when each revision will seek a further 20% to 30% improvement.

The government rightly believes that there is little scope for improving condensing boilers. The top of the range product is very efficient and only tiny efficiency improvements will be made. Insulations standards will be raised but that brings with it the spectre of trying to cope with over-insulated homes and treating the condensation and ventilation issues that will arise.

However, when high insulation standards are applied, and with the development of lower energy efficient appliances the biggest household energy load will fall on water heating. In these circumstances solar thermal technology will play an increasingly important part in the statutory strategies for reducing dependence on fossil fuel energy and improving sustainability and efficiency.

## 4.0 Installing the ATAG solar panel



Instruction manual for the installation of ATAG thermal solar panels.

*For use by trained, qualified staff only.*

## Contents

## 4.1 Health & Safety Information



Genersys 1000-10 panel is high quality thermal solar panel using selective coating technology to convert light into heat. Genersys panels should only be fitted by authorised, trained and qualified personnel. They are not intended to be a “do it yourself” product. Panels are also sometimes called “solar collectors”.

When fitting the panels installers should comply with all health and safety regulations and recommendations. Proper safety and protective clothing should be worn, including hard hats, boots, gloves and where appropriate eye protection. Subject to this we should point out some important matters.

- When handling the collectors remember that they have been de signed to convert light into heat and accordingly parts of them will get very hot if left out in the sun even for short periods of time. If you touch parts of the collectors after this exposure you may get se vere burns because temperatures may well exceed boiling.
- When working at heights always use proper scaffolding and safety harnesses
- Always assess the risks before you start work.
- Take care when carrying the collectors to a roof. Carrying and ma nipulating heavy weights and large frames onto a roof is difficult and can cause you to slip.
- Always make sure you have sufficient people to help you in your work
- Always comply with all wiring and electrical instructions and regula tions, including bonding rules when installing the pump station and digital controller.
- Do not open or attempt to service the panels. There are no user serviceable parts inside.

Unpack the panels carefully so that they are not damaged. The packaging is recyclable so please dispose of it in an environmentally friendly way.

Genersys systems are designed from high quality components intended for a long system life of working together as a thermal solar system. If you use any component that Genersys has not approved all warranties will be void.

## 4.2 Important installer tips



Always:-

- Use only solar quality O rings if you are using press fittings
- Do not install the panels upside down; they will only work the right way up.
- Use support sleeves (pipes inserts)
- Never use plastic pipes for the thermal circuit
- Join copper pipes by brazing, not with soft solder
- The glycol is ready mixed; do not add water or any other ingredient
- If you are not buying our pressure vessel, make sure the one you use has a glycol resistant Membrane
- Pressure test the panels before you connect up the circuit, especially if you are fitting them inside the roof

## 4.3 Storing, unpacking and moving the panels

Storing the panels:

- ATAG Panels must be stored vertically against a wall or kept on the pallet until you are ready to install them.
- ATAG Panels must not be stored on their horizontal sides be cause their pipes or clamps might be damaged
- ATAG "H" Panels must be stored horizontally against a wall or kept on the pallet until you are ready to install them.
- ATAG "H" Panels must not be stored on their vertical sides because their pipes or clamps might be damaged

Unpacking the panels:

- Unpack panels carefully so they are not damaged. The packaging is designed to be recyclable. Dispose of all packaging in an environ mental friendly way by taking it to recycling centres
- Take care when carrying the panels to the roof. Carrying and ma nipulating heavy weights and large frames on the roof is difficult and can cause you to slip. Make sure that you have all necessary supports harnesses and help for the job.

Moving the panels:

- Take care when the panels are exposed to the sun. The absorber plate and heat transfer reach ultra high temperatures in excess of 200°C and should not be touched whether the system is in opera tion or not otherwise severe burns will be suffered. In very hot condi tions shield the absorber parts of the panels from direct sunlight until the installation is complete.

## 4.4 The ATAG solar panel

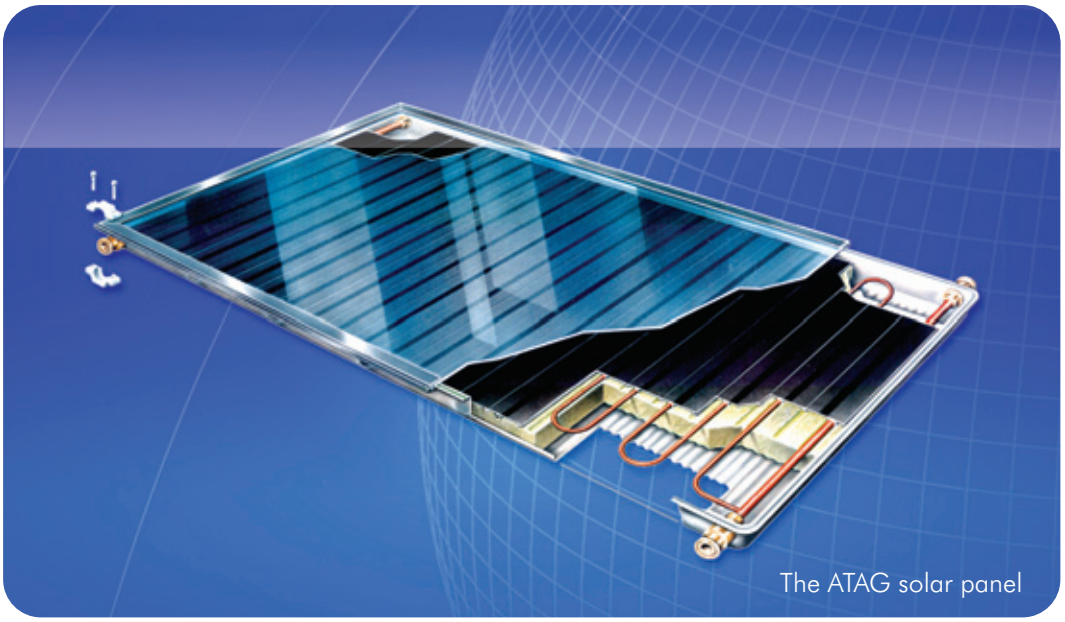


The ATAG solar panel is a vertically mounted glazed collector without collection pipes, intended for applications in systems equipped with circulating pumps.

The panels have an integrated connection system enabling pressure sealed linkage with adjacent panels

The ATAG panel is constructed with a single meander system piping without using soldering or welding and is folded into the absorber plate; a single piece tray folded into the frame holding the glazing.

The ATAG panel is not intended to be used in drain-back systems.



The ATAG solar panel

**Certification:**

Tested to EN 12975 (parts 1 & 2) and to Solar Rating & Certification Corporation Standards for the United States of America and to all applicable Canadian test standards

**Maintenance:**

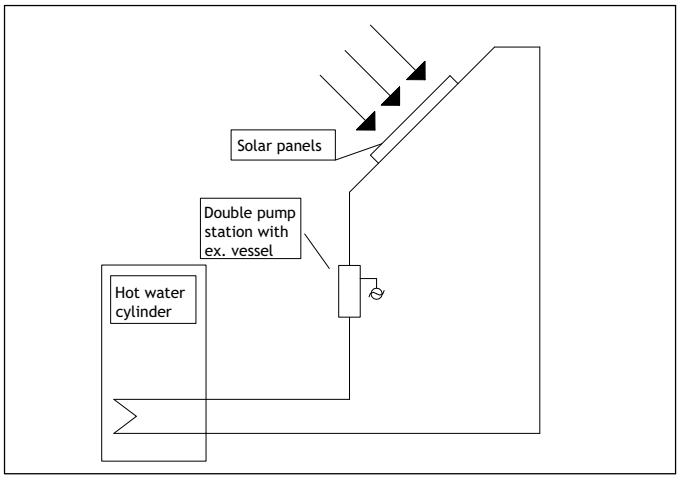
ATAG panels do not require any maintenance. The panels have been designed to withstand high temperatures; the glass does not require cleaning. There are no user serviceable parts inside and due to the heat exchange process the panel does not contact potable water or water to be heated.

## 4.5 Positioning the solar panels



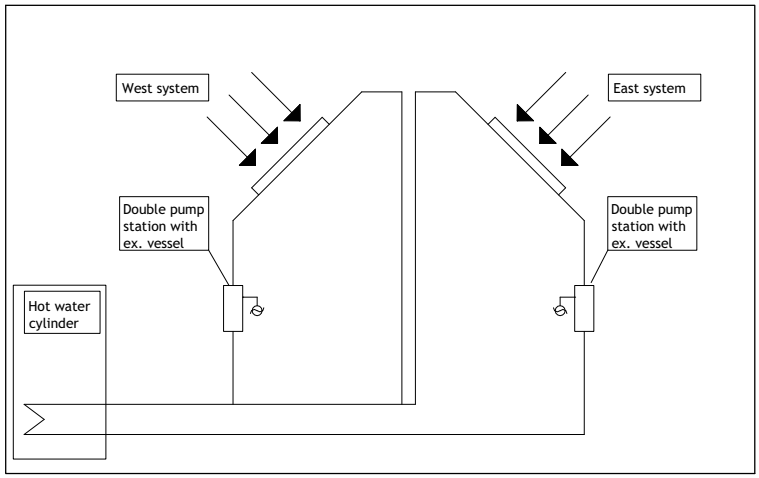
### 4.5.1 South facing roofs

Positioning the collectors is important for optimum performance. Collectors should ideally be mounted at an angle of between 30 degrees and 60 degrees on a south facing that is not shaded by overhanging trees buildings or structures. Good results can be obtained by positioning the panels facing anywhere in an arc between south west and south east but due south facing provides optimum performance in the Northern Hemisphere.




### 5.2 East/West facing roofs

Good results can be obtained by splitting the collector array on East/West elevations but this should only be used when it is not possible to have a mainly southerly position for the collectors. If you are installing a split East/West system you have to double it number of the panels, e.g. 2 panels system requires 2 panels on East and 2 panels on West; each set of panels will behave as an independent system. A split system is not suitable for every East/West facing roofs. In some cases (for example where the roof pitches vary or lack of space the installer may get good results installing an additional panel on either the east or on the west orientation.



## 4.5 Positioning the solar panels



### 4.5.3 North facing roofs

It is not generally recommended that you install the panels on North facing roof in the Northern Hemisphere. South of the equator, north facing will provide optimum performance and south facing will provide the worse performance.

## 4.6 Frame mounting

ATAG offer three types of on–roof panel mountings and two types of in–roof solar panel mounting.

On-roof installations:

- On–roof kit hook, suitable for medium and large tiles
- On–roof kit shark tail, suitable for small tiles
- On–roof kit slate, suitable for slate roofs

In-roof installations:

- Flashing kit for slate roofs
- Flashing kit for tile roofs

Flat roof or ground level installations:

- Use the “A” frame

## 4.6.1 On-roof Hook frame mounting

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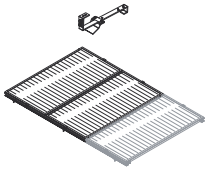
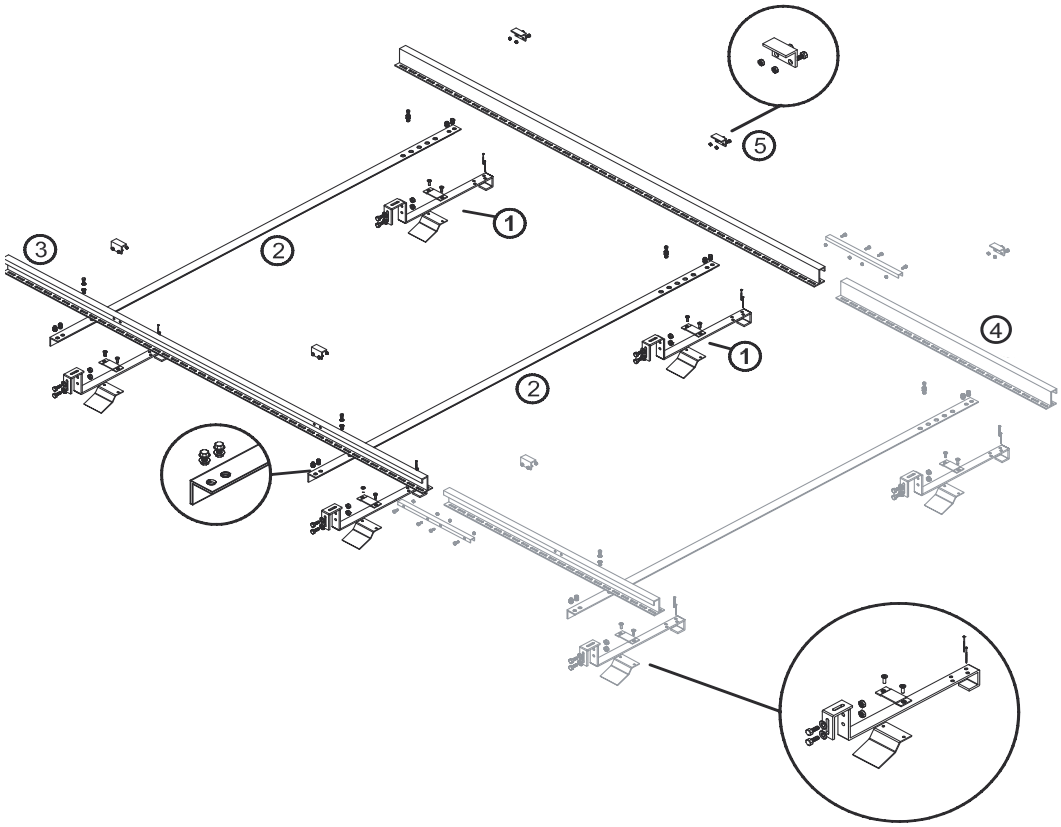


The on-roof hook installation is suitable for roofs which have a good wooden roof structure where the battens are sound. It will normally be the default fitting for on-roof installations.

**4.6.1.1** When you unpack the on-roof frame packaging please check if any pieces are missing, the package should contain:

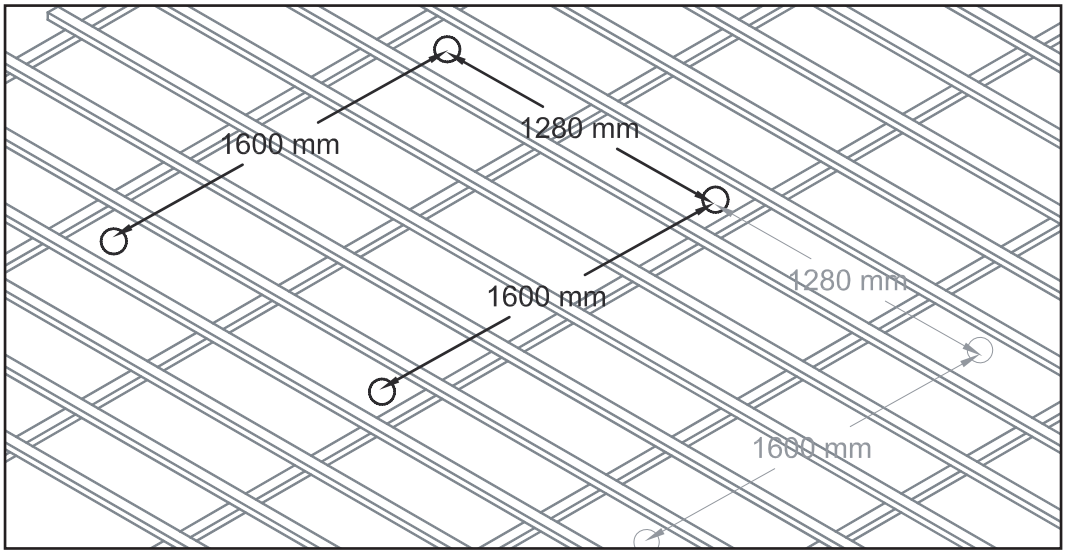



| Part No. | On-roof HOOK kit for a 2 panel system | Quantity |
|---|---|---|
| 1 | Roof hook | 4 |
| 2 | L-Rail | 2 |
| 3 | Z-Rail 2000mm | 2 |
| 5 | Wind clamp | 4 |
| | Bolt kit (bolt, nut, washer) M6x16 | 20 |
| | Long wood screw | 8 |
| | **On-roof HOOK Extension Kits** | |
| 1 | Roof hook | 2 |
| 2 | L-Rail | 1 |
| 4 | Z-Rail 2000mm | 1 |
| 5 | Wind clamp | 2 |
| | Frame connector (K 1141GB) | 2 |
| | Bolt kit (bolt, nut, washer) M6x16 | 12 |

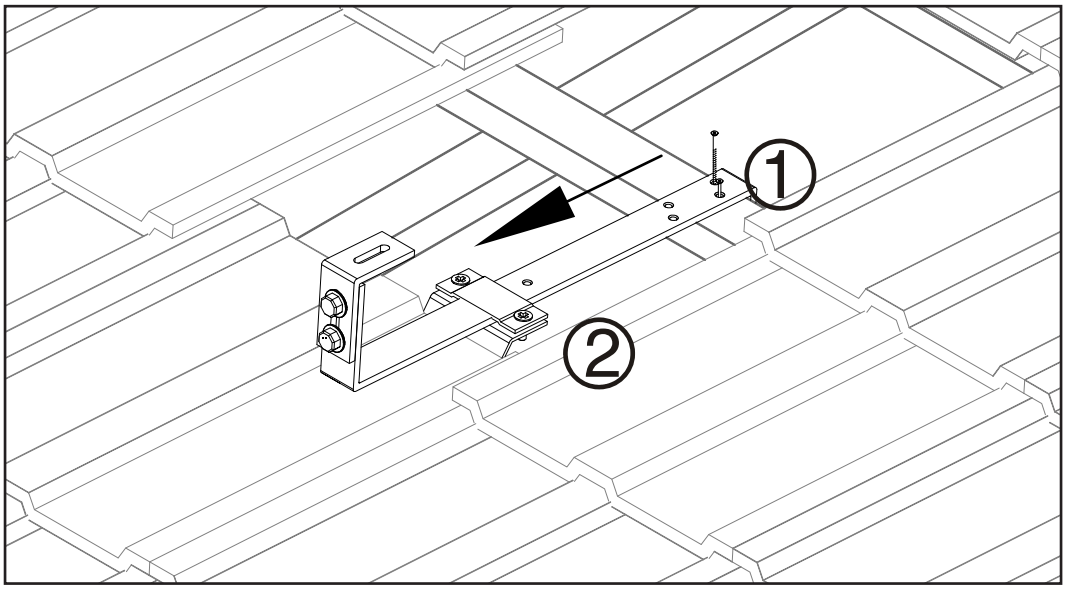
## 4.6.1 On-roof Hook frame mounting



**4.6.1.2** Check the roof battens for stability. The battens must not show any sign of deterioration. If the battens to be used are smaller than 30 x 50 mm you give them additional strength by fixing additional wood screws (not supplied).



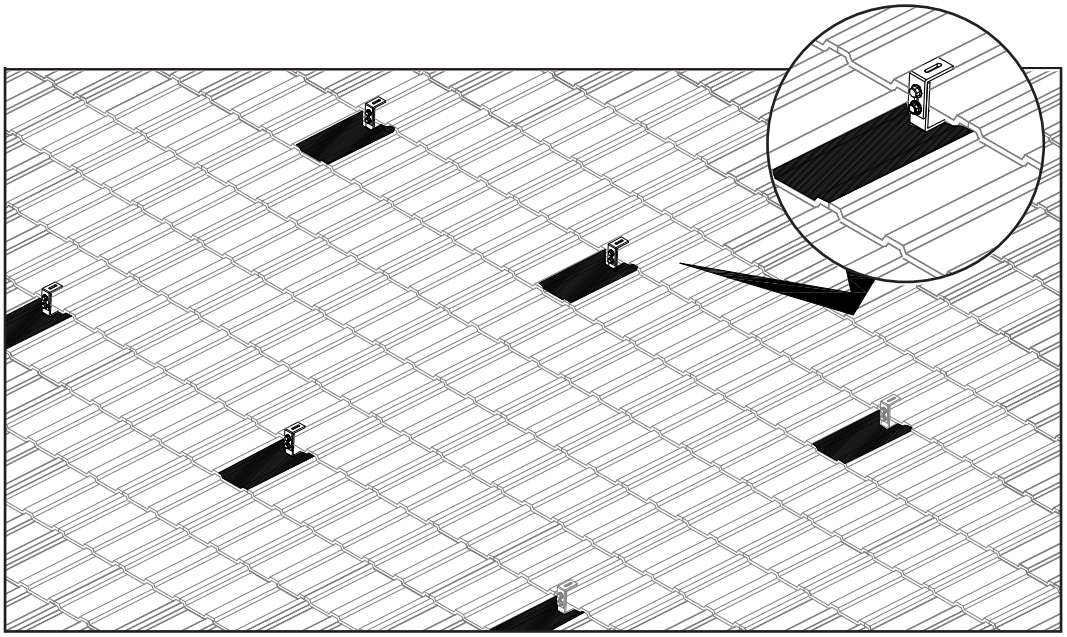

**4.6.1.3** Place the roof hooks (1) as shown using 2 wood screws (4 x 30 mm). Fix the tile (2) under the lower roof batten. In case of roof tiles which are unusually thick you should carefully bend the blade of the hook, in order to fit under the batten and not just under the roof tile. The length of the roof hook should then be adjusted so that the hook part of it is the only part protruding after the roof tile is fitted over the hook. If necessary, file or grind part of the roof tile so that that the hook does not have contact with the tile.



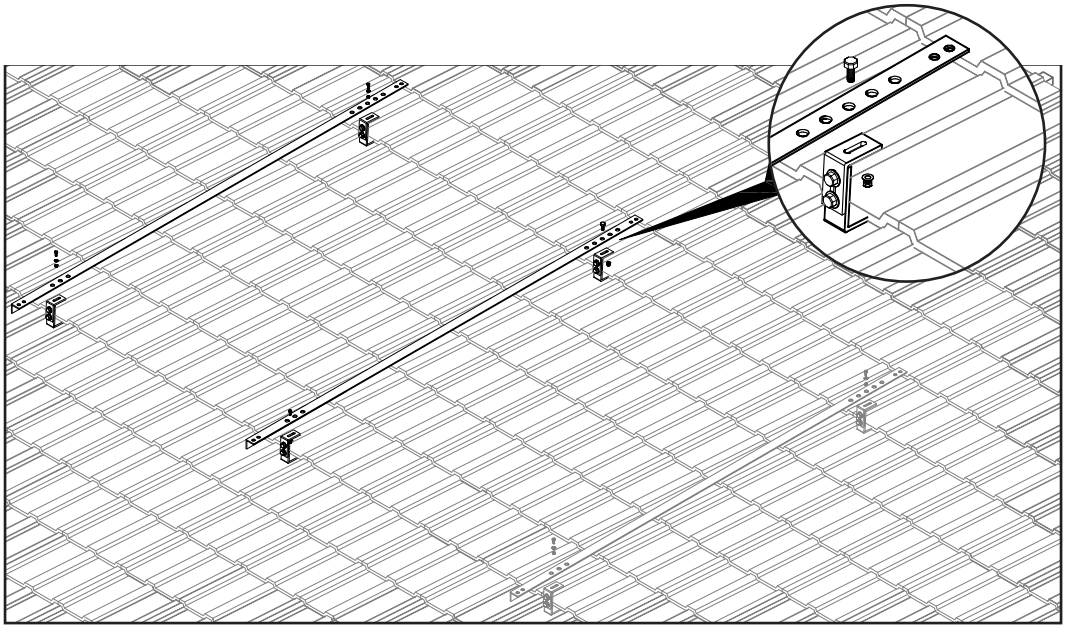
## 4.6.1 On-roof Hook frame mounting



**4.6.1.4** WARNING: In areas of where heavy snowfalls are experienced you should replace each roof tile that covers a roof hook with a metal tile. If you do not do this the roof tile might break under heavy snow loads.



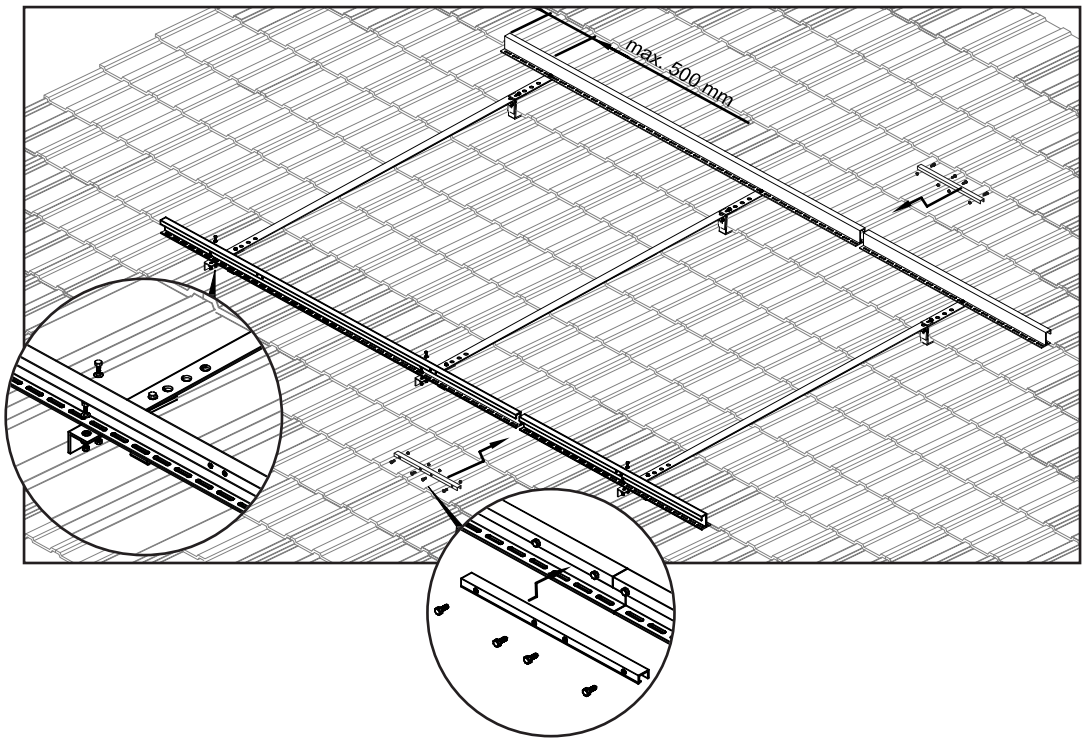
**4.6.1.5** Use screw kit M8 x 20 to connect the L-rails to the roof hooks. BE CAREFUL that the frame rails are mounted with the five holes (8.5 mm) positioned at the highest part of the roof.



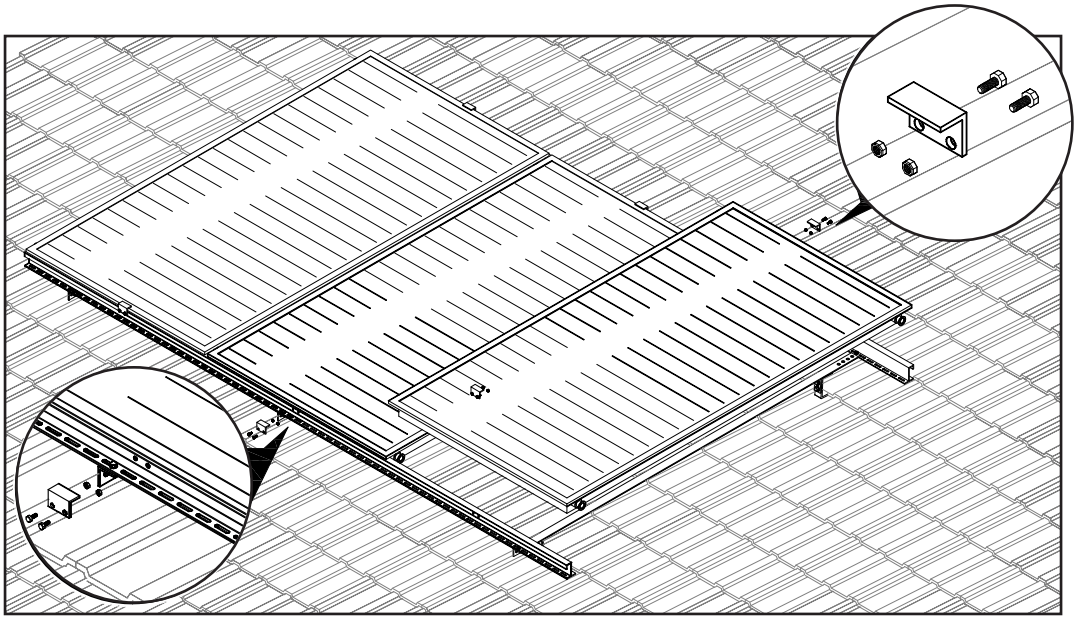
## 4.6.1 On-roof Hook frame mounting



**4.6.1.6** The Z-profile must next be fixed on to the L-rails, using the bolt kit M6. The maximum distance from a roof hook to the end tof the Z-rail must not be more than 500 mm. If necessary, use an on- roof extension kit, following the same procedure.




**4.6.1.7** Place the panels in position in the centre of the completed frame. In case of systems with more than two panels, mount the middle panel first. Mount the wind clamps to protect the panels using the nuts and bolts provided.



## 4.6.1 On-roof Hook frame mounting

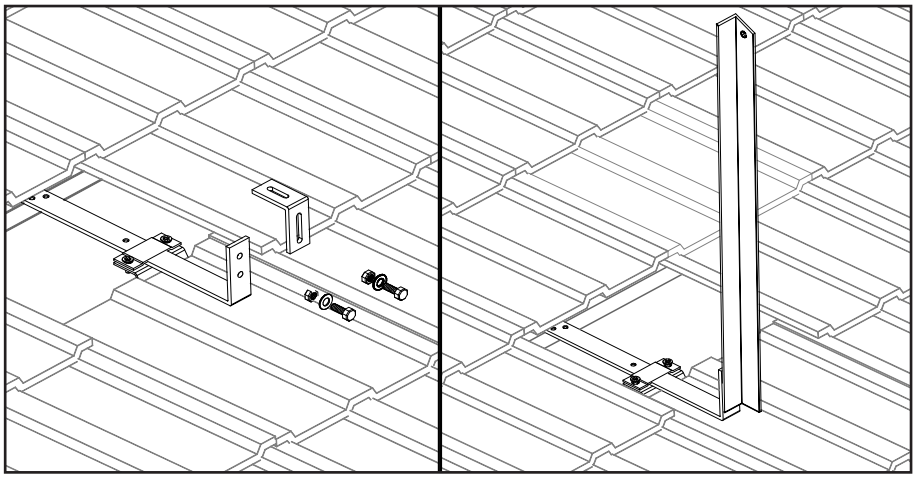


**4.6.1.8** Raising the panel pitch for a better incline than the roof allows:

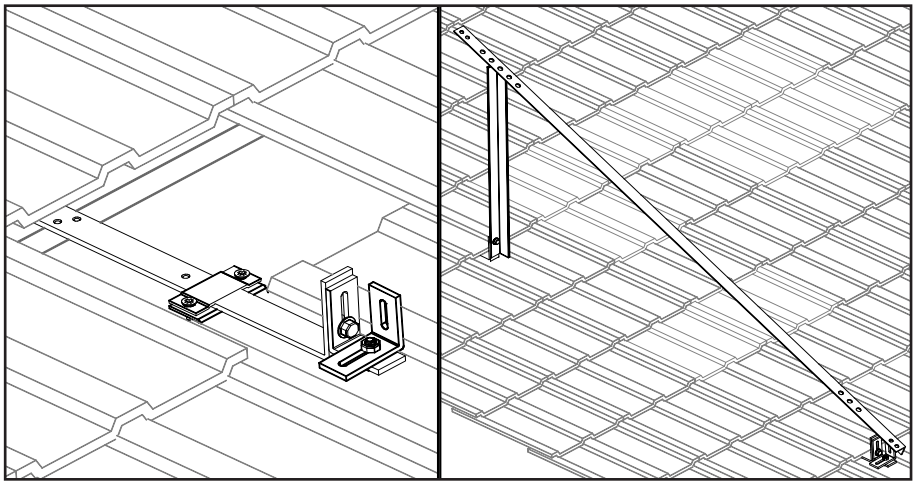
- 500mm Raises the pitch by about 15°
- 750mm Raises the pitch by about 21°
- 1000mm Raises the pitch by about 27°

**4.6.1.9** Installing the pitch extension frame:

- Remove the adjustable angle from the upper roof hooks.
- Fit the extension rails on to the upper roof hooks using the nuts and bolts provided.



- Mount the adjustable angles as shown.
- Connect the L-rails on the lower side of the roof hook and on the upper side of the extension rails. If necessary, drill appropriate holes into the rails.



## 4.6.2 On-roof Slate Mounting Kit

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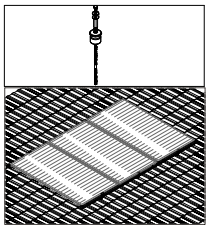
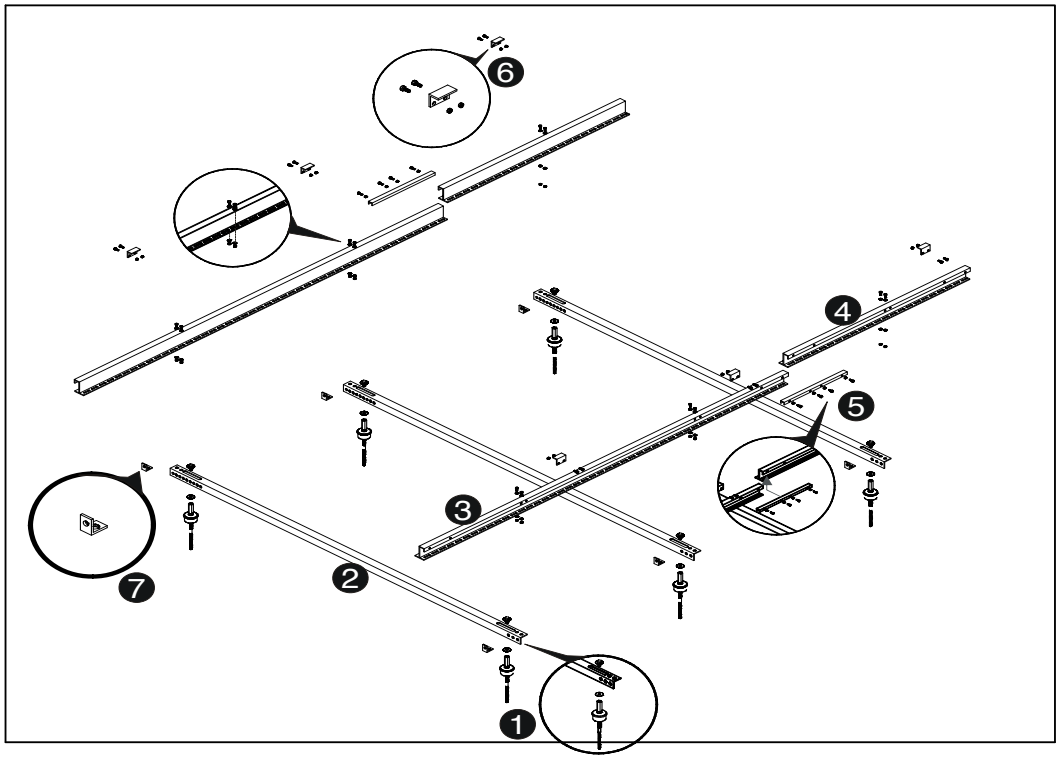


The slate roof mounting kit is suitable for of slate roofs, concrete roofs and in windy areas. It is also suitable for roofs which have the roof tiles cemented permanently on to the roof structure.

**4.6.2.1** When you unpack the slate roof frame packaging please check if any pieces are missing. The package should contain:

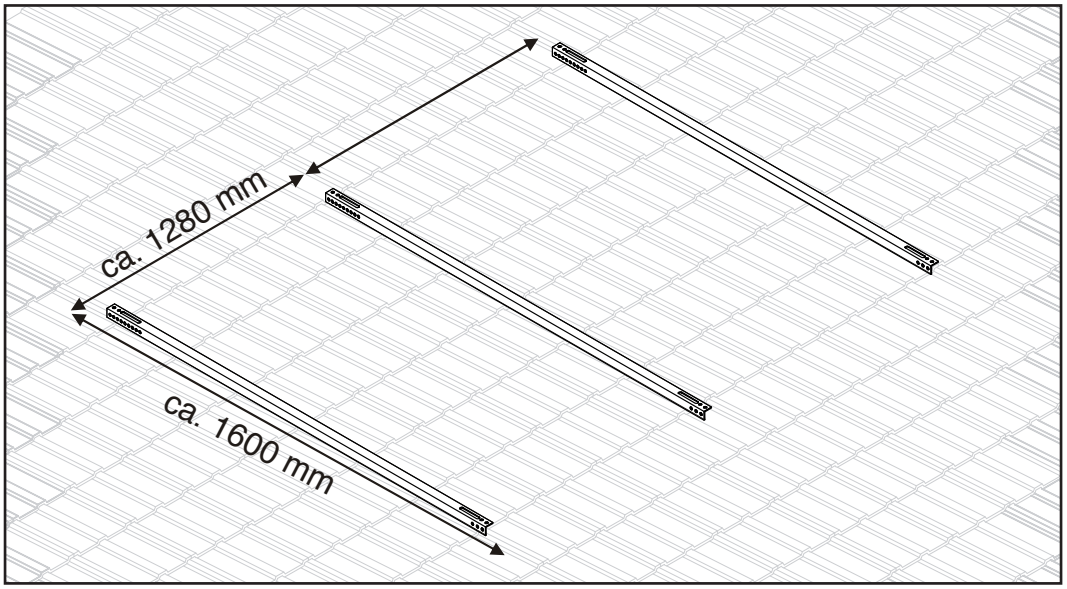



| Part No. | On-roof SLATE kit for a 2 panel system | Quantity |
|---|---|---|
| 1 | Self sealing bolt fitting | 4 |
| 2 | L-rail | 2 |
| 3 | Z-rail 2000 mm | 2 |
| 7 | Right angle connector | 4 |
| | Bolt kit M6x16 | 30 |
| | **On-roof SLATE Extension Kits** | |
| 1 | Self sealing screw fitting | 2 |
| 2 | L-rail | 1 |
| 4 | Z-rail 1000 mm | 1 |
| 5 | Frame connector (K1141GB) | 2 |
| 6 | Wind clamp | 2 |
| 7 | Right angle connector | 2 |
| | Screws kit M6 x 16 | 20 |

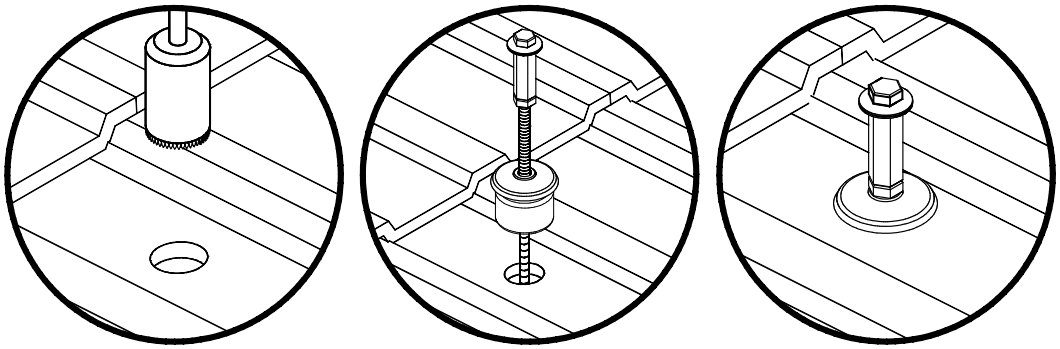
## 4.6.2 On-roof Slate Mounting Kit



**4.6.2.2** Locate the rafters under the slates. Mark the slates where the holes should be drilled so that the hole penetrates the centre of a rafter. Use the angle rail as a template. NOTE: The distance from the roof screw to the end of the Z-rail should not be more than 500mm on each side.




**4.6.2.3** Drill the holes on each marked position with a high quality 25 mm masonry bit. Make sure the drill does not spin too fast or you may break the tile. Do not penetrate beyond the slate. After drilling the holes into the slates, use an 8mm wood bit to make a hole through the rafters at each position. Bolt the bottom part of the self sealing bolt fitting into each drilled hole.



## 4.6.2 On-roof Slate Mounting Kit

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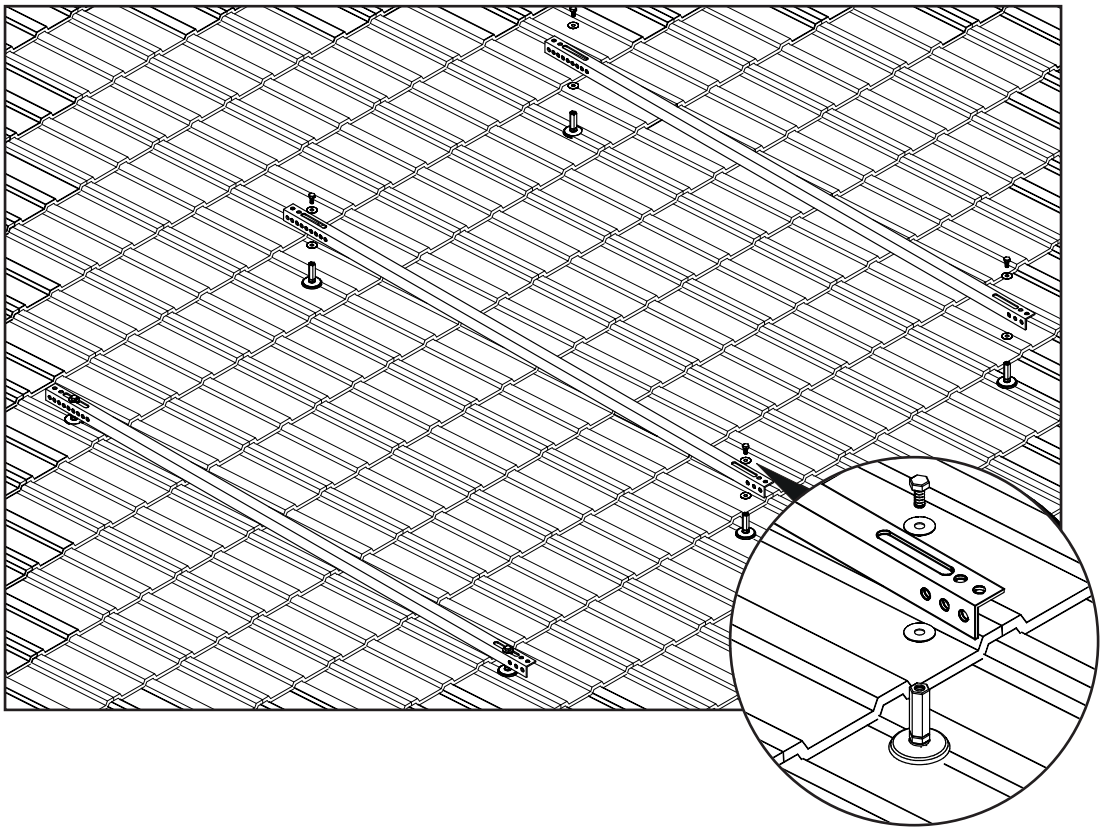
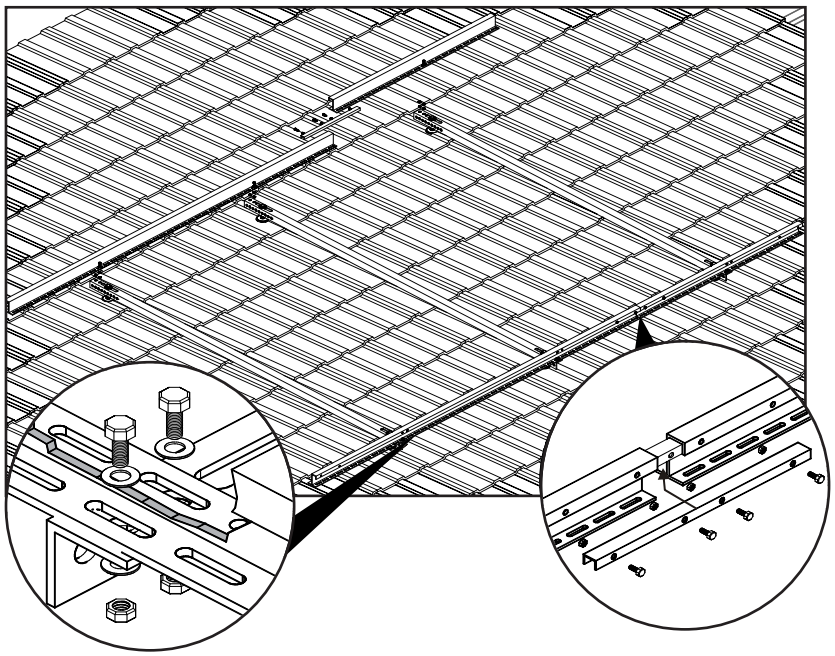
**4.6.2.4** Use the bolt kit M6x 6 to connect the L-rails to the self sealing bolt fitting. TAKE CARE: The L-rails must be mounted into the long adjustable slot.



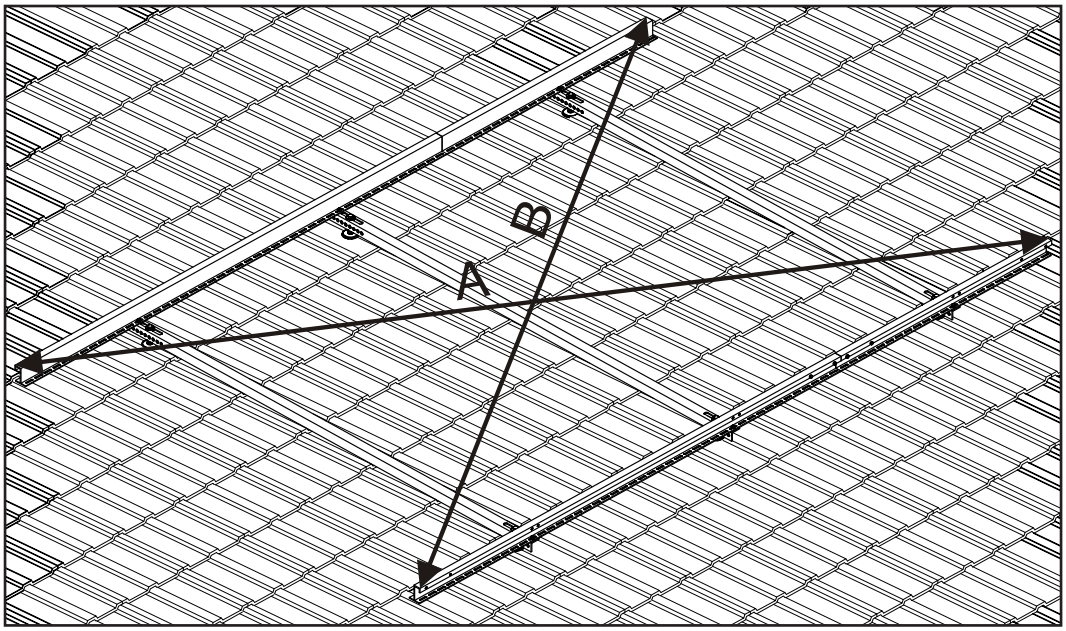
**4.6.2.5** The Z-profile must be fitted to the L-rail using the bottom two holes that are below the long adjustable slot. Do not tighten fully. TAKE CARE: Make sure frame connector is fitted into the Z-profile properly.



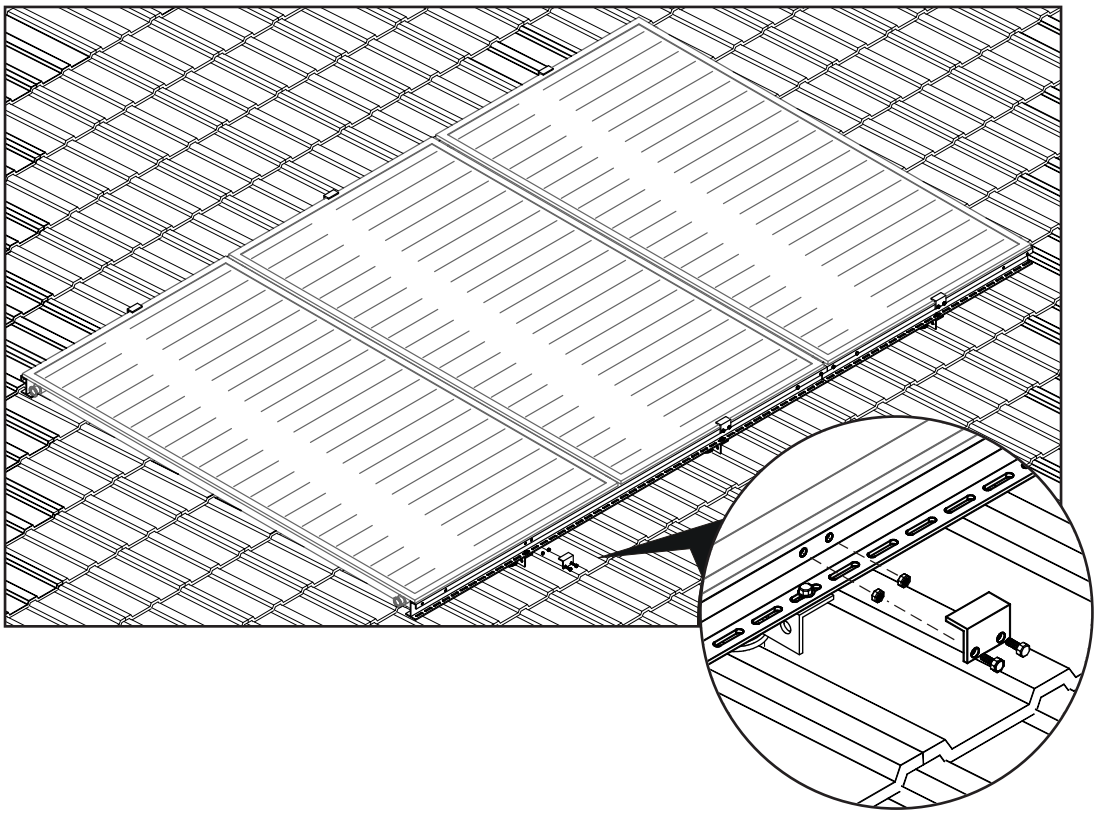
## 4.6.2 On-roof Slate Mounting Kit



**4.6.2.6** Cross measure along the diagonals and check that they are equal. Once you are satisfied that each distance (A and B) on the drawing are equal, tighten fully.




**4.6.2.7** After you place the panels into the frame, fit the wind clamps to the frame using the nuts and bolts provided.



## 4.6.2 On-roof Slate Mounting Kit

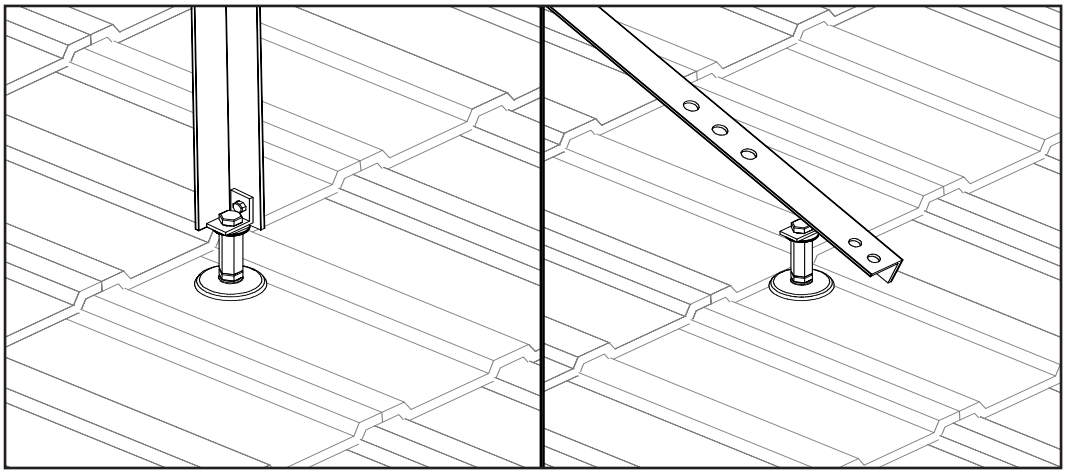


**4.6.2.8** Raising the panel pitch for a better incline than the roof allows:

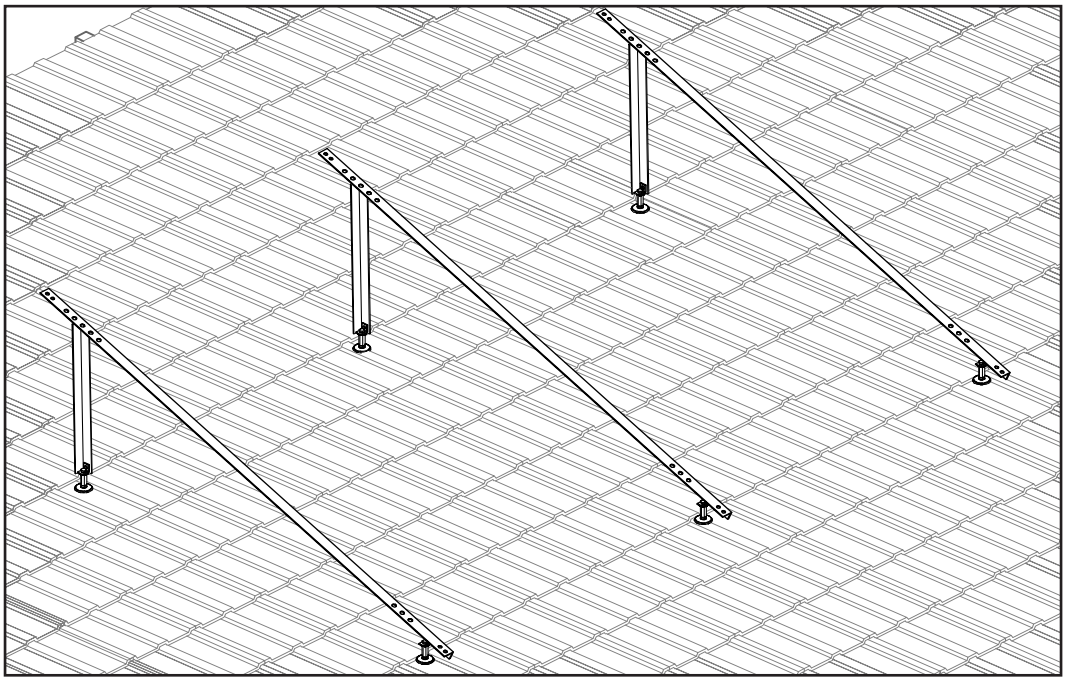
- 500mm Raises the pitch by about 15°
- 750mm Raises the pitch by about 21°
- 1000mm Raises the pitch by about 27°

**4.6.2.9** Installing the pitch extension frame:

- Fit the right angle connector on the top of the self sealing bolt fitting on the upper side screw extension rails.
- Fit the right angle connector to the top of the self sealing bolt fitting on the lower L-rail.



- Fit the L-rail to the top of the extension rail and to the bottom of the right angle connection.



## 4.6.3 On-roof Shark Tail Mounting Kit

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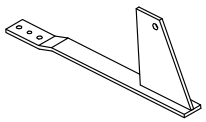
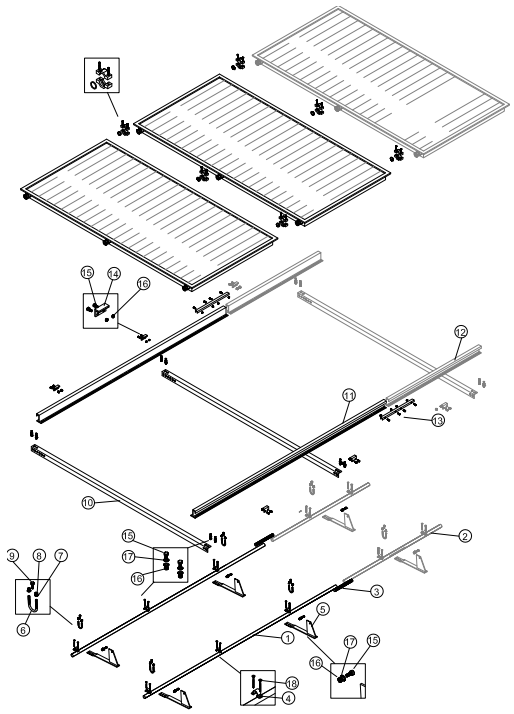


The on – roof shark tail mounting is suitable for thick and thin tiled roofs and where it is not possible to use the on – roof hook mounting.



**4.6.3.1** When you unpack the shark tail on-roof frame packaging please check if any piece is missing. The package should contain:

| Part No. | On-roof **SHARK TAIL** kit for 2 panel systems | Quantity |
|---|---|---|
| 1 | Support pipe ½" L = 2040 mm | 2 |
| 4 | Pipe clamp | 6 |
| 5 | Shark Tail | 4 |
| 6 | U- bolt M8 | 4 |
| 7 | Washer Ø8.4 | 8 |
| 8 | Nut M8 | 8 |
| 9 | Bolt M8x20 | 5 |
| 10 | L – rail L = 2010 mm | 2 |
| 11 | Z – rail L = 2080 mm | 2 |
| 14 | Wind clamps | 4 |
| 15 | Bolt M6x16 | 22 |
| 16 | Nut M6x16 | 22 |
| 17 | Washer M6x16 | 22 |
| 18 | Long screw Ø5x80/50 | 14 |
| | On – roof shark tail extension kit | |
| 2 | Support pipe ½" L = 1040 mm | 2 |
| 3 | Pipe connection | 2 |
| 10 | L – rail L = 2010 mm | 1 |
| 12 | Z – rail L = 1040 mm | 2 |
| 14 | Wind clamps | 2 |
| 15 | Bolt M6x16 | 8 |
| 16 | Nut M6x16 | 8 |
| 17 | Washer M6x16 | 8 |
| 13 | Frame connection (K1141 A) | 2 |

## 4.6.3 On-roof Shark Tail Mounting Kit

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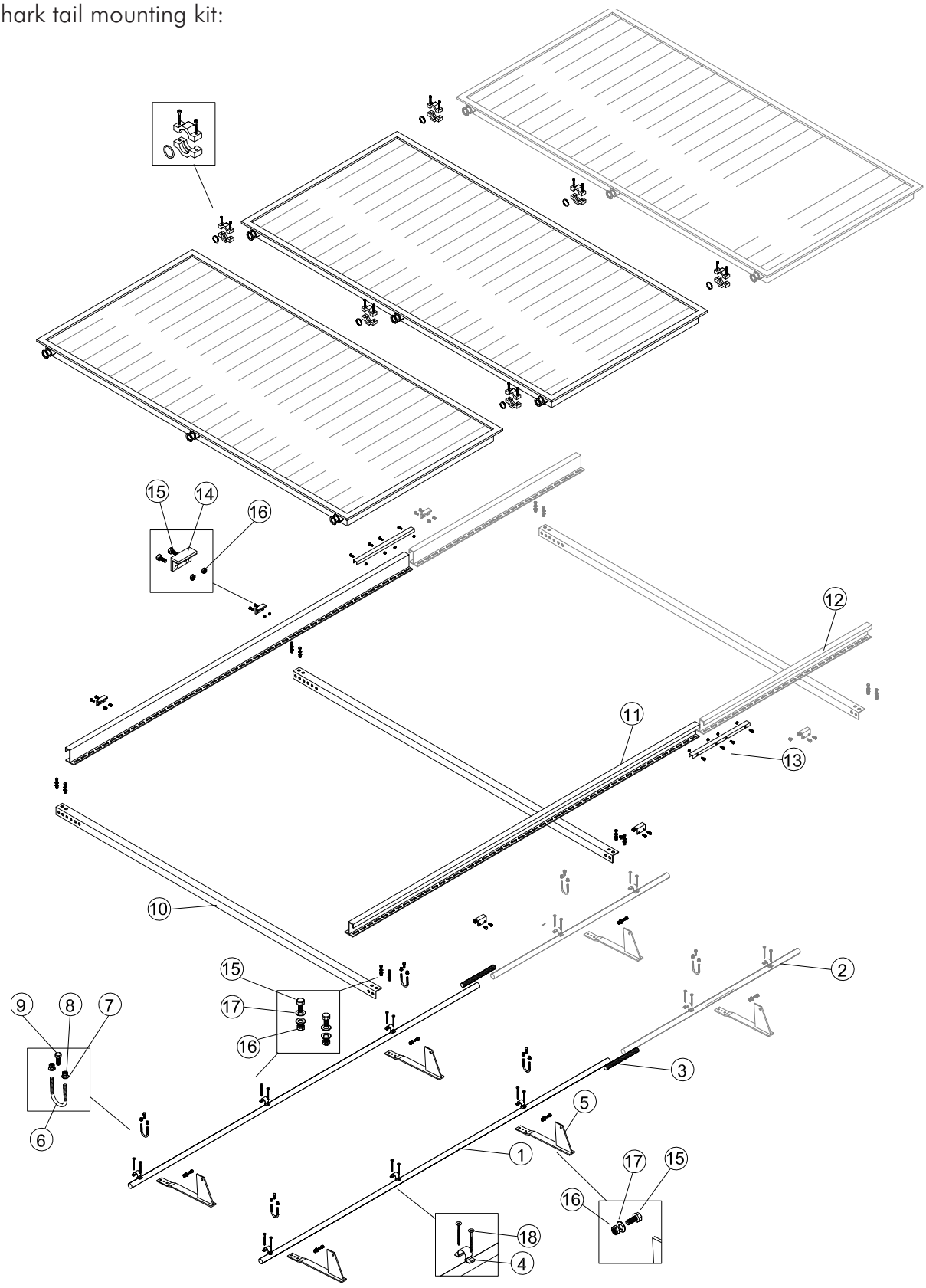
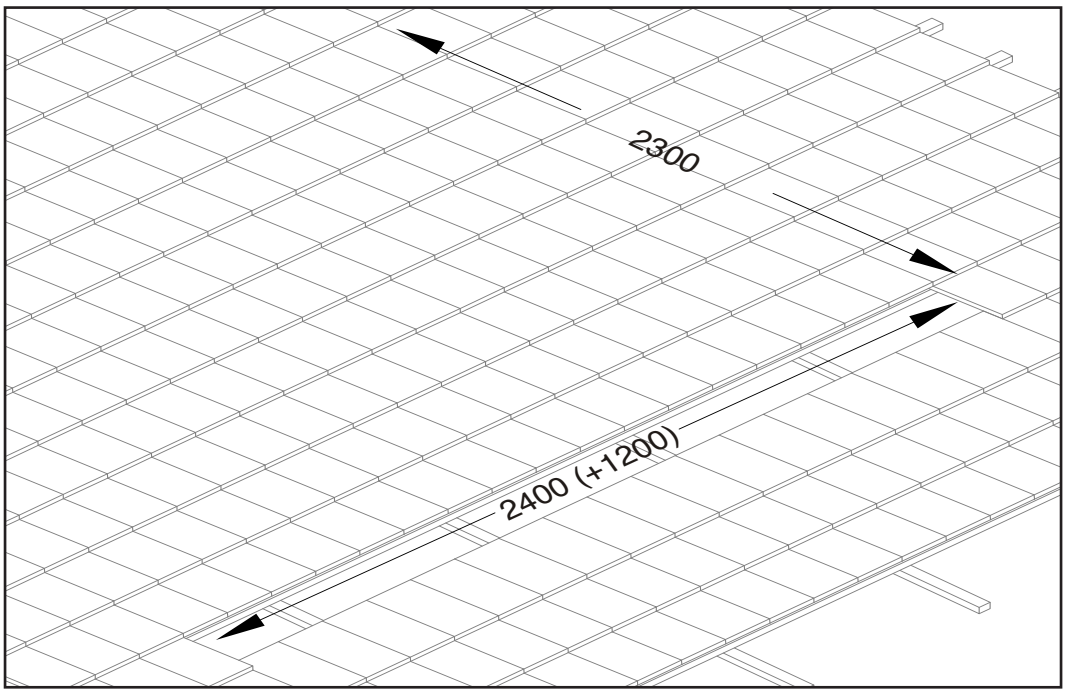
The shark tail mounting kit:



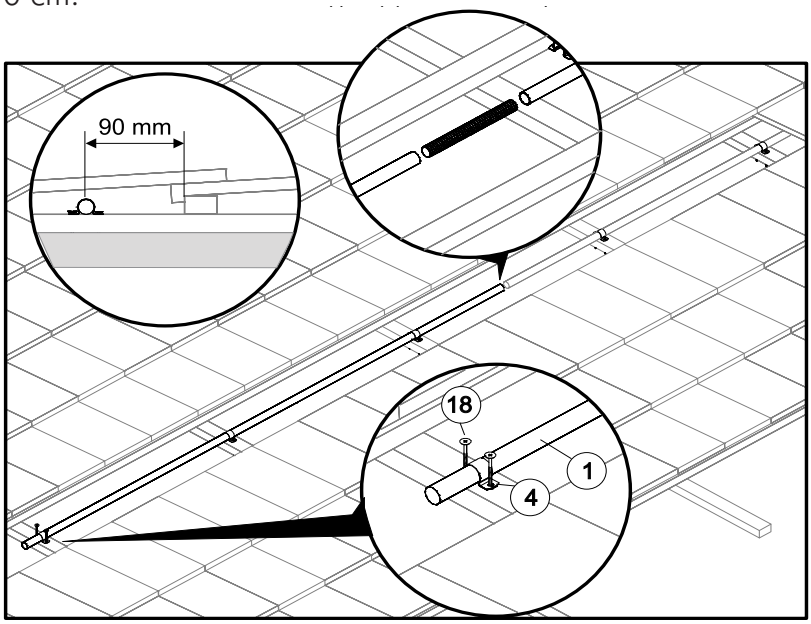
## 4.6.3 On-roof Shark Tail Mounting Kit



**4.6.3.2** Check the battens for stability. The battens must not show any signs of deterioration. Remove sufficient tiles to enable you to fit the shark tail.




**4.6.3.3** Fit the lower fittings first. Screw the support pipe with help of the pipe clamps. The distance between support pipe and nearest top batten should be around 90 cm.



## 4.6.3 On-roof Shark Tail Mounting Kit

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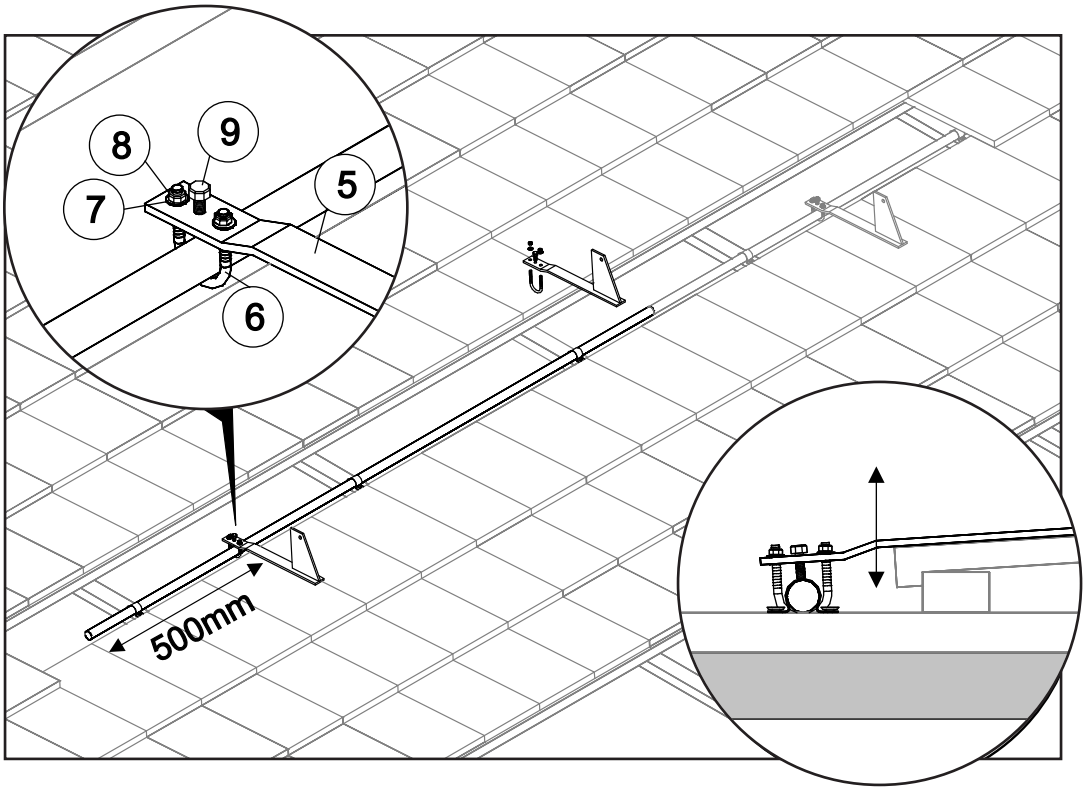
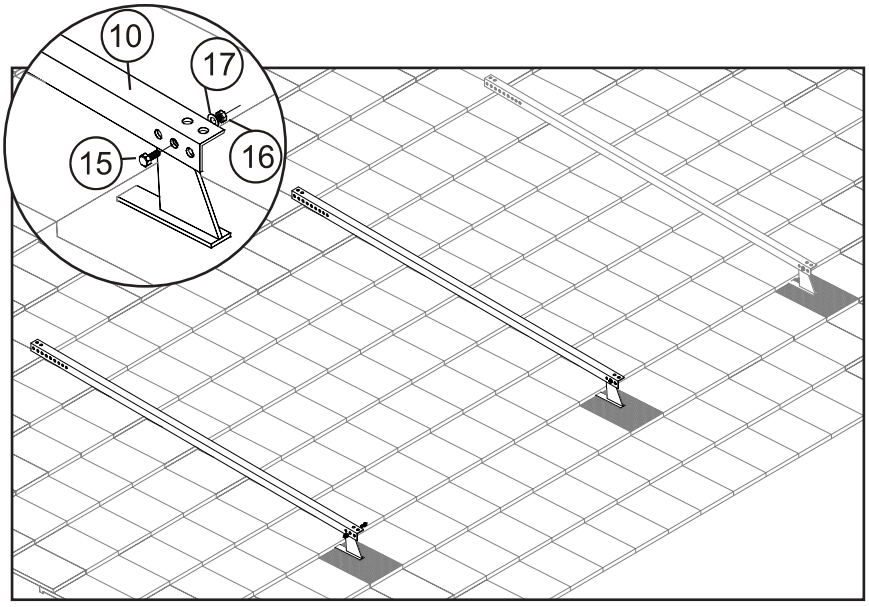
**4.6.3.4** Fit the U – bolt on the support pipe and on the top part of the shark tail. The shark tail should be placed no more than 500 mm from the end of the pipe.



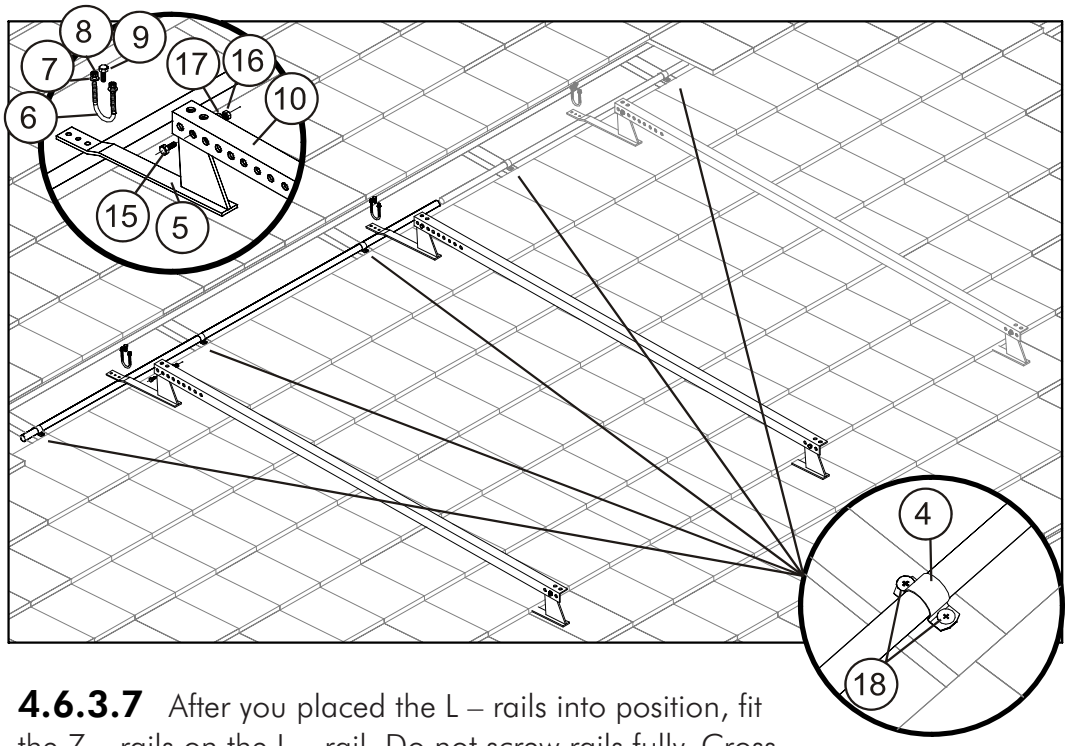

**4.6.3.5** Fit the L – rail on to the shark tail. The top of the L – rail indicates where you should place the top support pipe and shark tails.



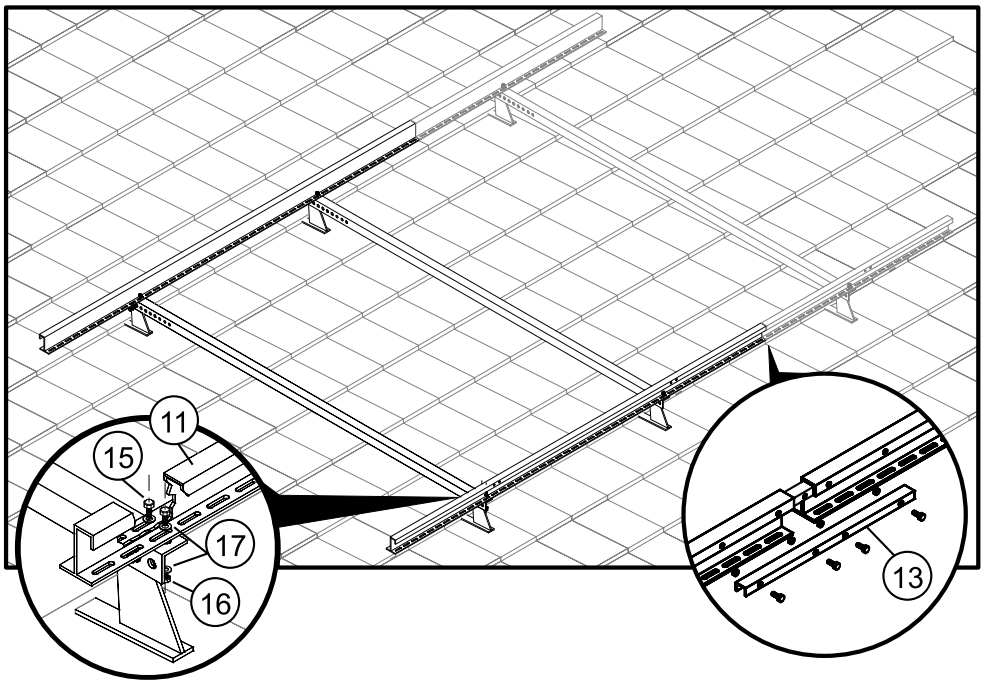
## 4.6.3 On-roof Shark Tail Mounting Kit



**4.6.3.6** Fit the support pipe to the top of the L –rail, screwing in the shark tails. The shark tail must be upright. Then fit the shark tails and support pipe together with U-bolts.




**4.6.3.7** After you placed the L – rails into position, fit the Z – rails on the L – rail. Do not screw rails fully. Cross measure along the diagonals and check that they are equal. Once you are satisfied that each diagonal (A and B on the drawing) are equal, tighten fully.

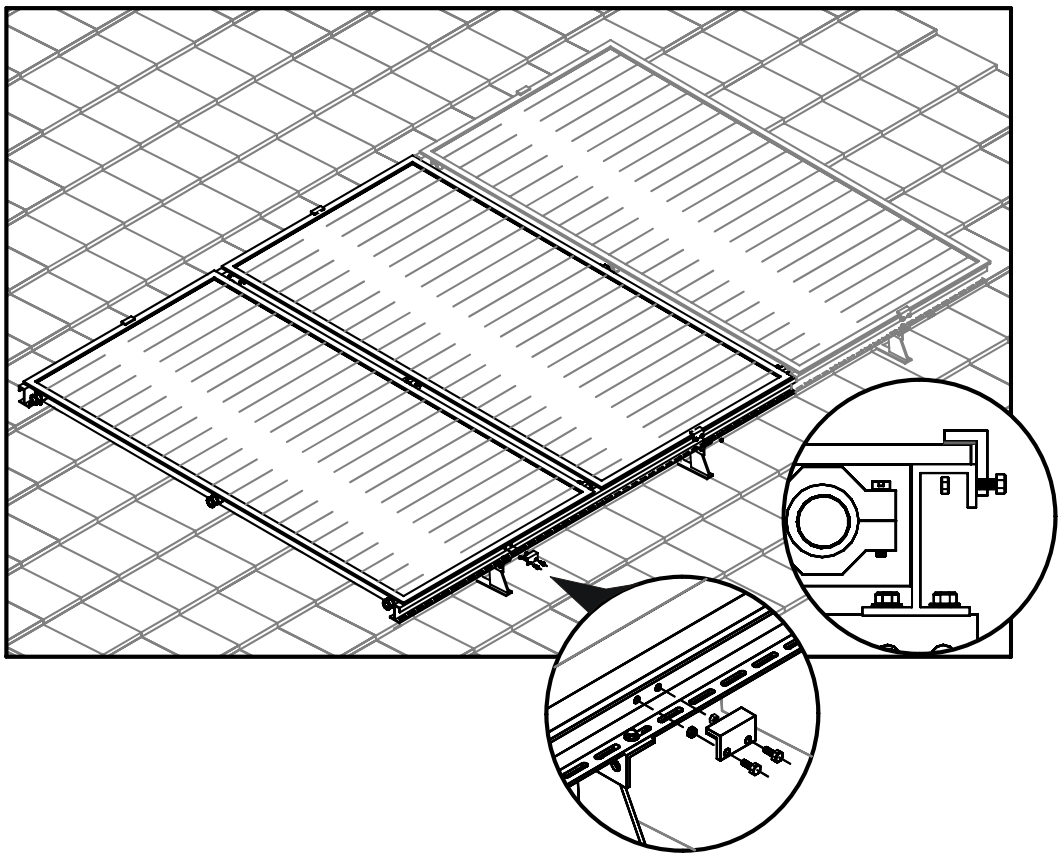


## 4.6.3 On-roof Shark Tail Mounting Kit



**4.6.3.8** If you are installing more than two panels always install middle panel first.

**4.6.3.9** Do not forget to fit the wind clamps in place.

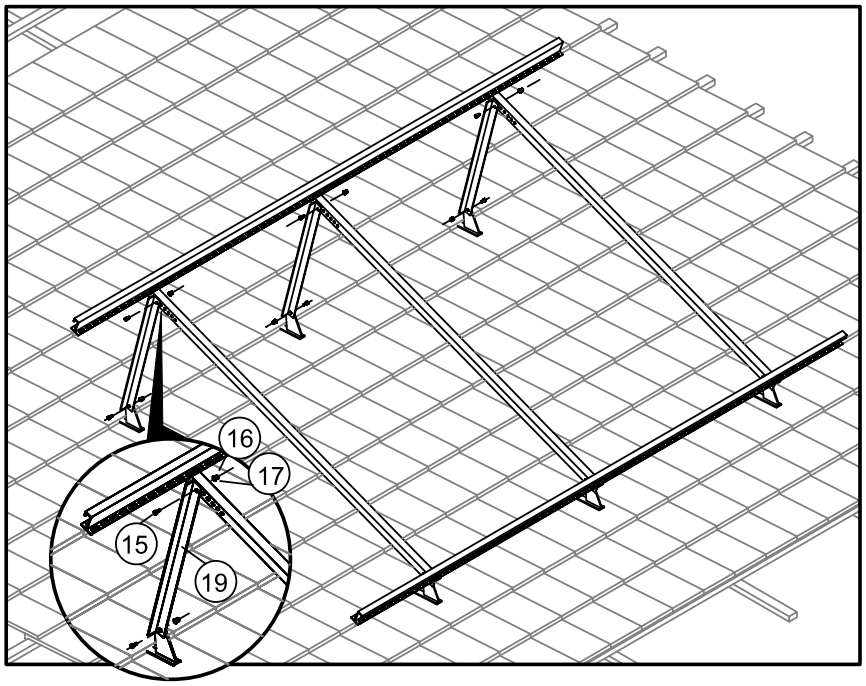


## 4.6.3 On-roof Shark Tail Mounting Kit



**4.6.3.10** Raising the panel pitch for a better incline than the roof allows:

- 500mm Raises the pitch by about 15°
- 750mm Raises the pitch by about 21°
- 1000mm Raises the pitch by about 27°




**4.6.3.11** Installing the pitch extension frame:

- Fit the right angle connector on the top of the fitting on the upper side screw extension rails.
- Fit the extension rails on to the upper roof hooks using the nuts and bolts provided.

## 4.6.4 In-roof tiled roof fittings

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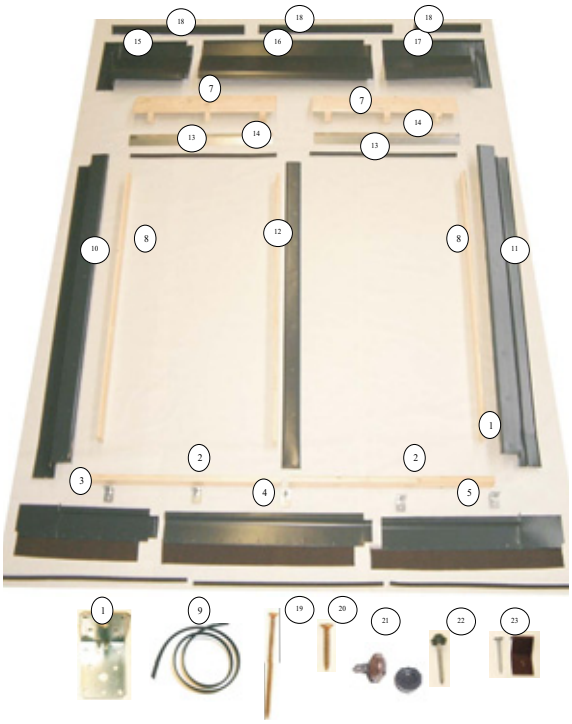
The standard in roof mounting kit is designed to accommodate 2 or 3 panel systems and is suitable for most types of roof tiles except slate roofs.

**4.6.4.1** When you unpack the in-roof frame kit from its packaging, please check if any part is missing. The package should contain:

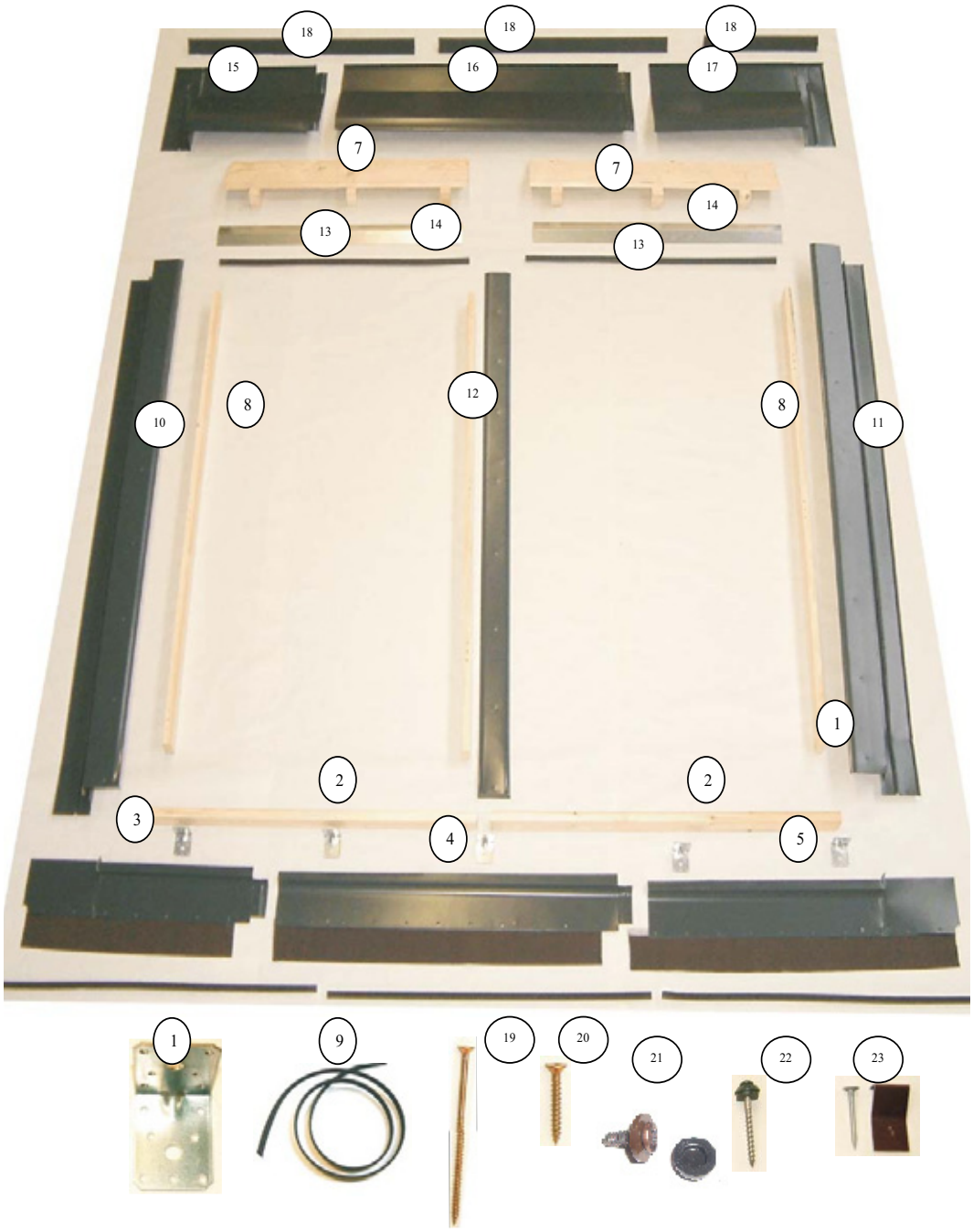


| Part No. | On-roof **SHARK TAIL** kit for 2 panel systems | Quantity |
|---|---|---|
| 1 | Angle Iron | 6 |
| 2 | Lower wooden slat | 2 |
| 3 | Lower left flashing | 1 |
| 4 | Lower centre flashing | 1 |
| 5 | Lower right flashing | 1 |
| 6 | Lower seals strip | 2m |
| 7 | Upper wedge | 2 |
| 8 | Side slat | 3 |
| 9 | Side seal strip | 8m |
| 10 | Left side flashing | 1 |
| 11 | Right side flashing | 1 |
| 12 | Centre flashing | 1 |
| 13 | Upper seal strip | 2m |
| 14 | Wind retaining rail | 2 |
| 15 | Upper left flashing | 1 |
| 16 | Upper centre flashing | 1 |
| 17 | Upper right flashing | 1 |
| 18 | Triangular seal | 2m |
| 19 | Wood screws (5x110) | 15 |
| 20 | Wood screws (4x30) | 57 |
| 21 | Screws with washer and seal small | 2 |
| 22 | Screws with washer and seal small | 26 |
| 23 | Nail straps | 15 |

## 4.6.4 In-roof tiled roof fittings



Contents of the ATAG In-roof Tile Kit:



## 4.6.4 In-roof tiled roof fittings

Installation Manual page 26

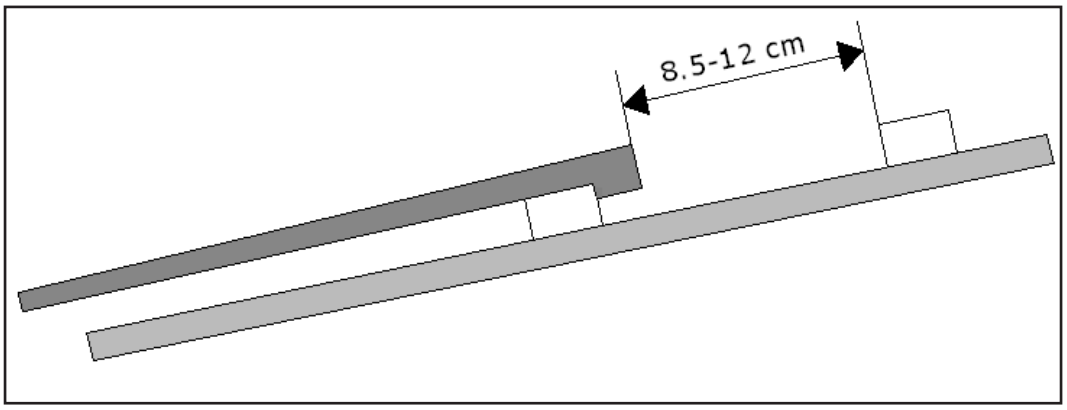
**4.6.4.2** Determine where the panels will be mounted and check the roof tile alignment:

**4.6.4.3** Remove the tiles from the roof according to the size of system you are fitting. For a two panel installation a tiled area is 2600 x 2600 should be removed. For every additional panel remove a further tiled area of 1100 x 2600.

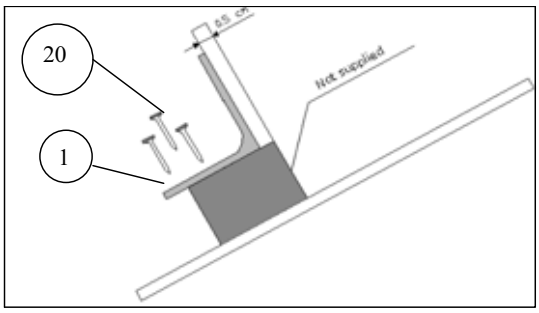
## 4.6.4 In-roof tiled roof fittings



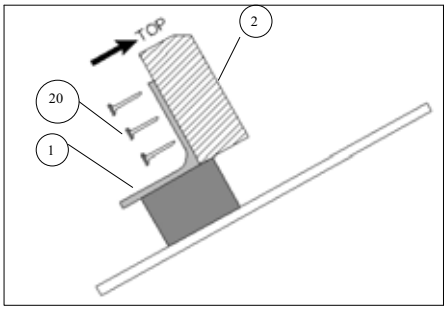
**4.6.4.4** Attach a lower support batten. Screw the lower support batten to the rafter along where the panels are going to be placed. Use wood screws (4.5 x 80). NOTE: These battens and screws are not supplied! Use good quality batten wood, preferably from sustainable sources.




**4.6.4.5** ***(Below)*** Attach the angle irons (1) to the lower support batten at equal distances using 3 screws, 4x30 (20). If more than two panels are to be installed, fit the first and the last angle, tighten a cord between them and place the rest of the angle irons along the cord.




**4.6.4.6** ***(Right)*** Attach the lower wooden slat (2) with the cut off edge placed toward the panel as shown. Use 4x30 (20) screws. NOTE: The slats in the in – roof installation set are longer than the ones in the extension set. The slats should be placed on the left and right side of the area.




**Note:** Before the side, middle and top flashing part is installed make sure that you have:

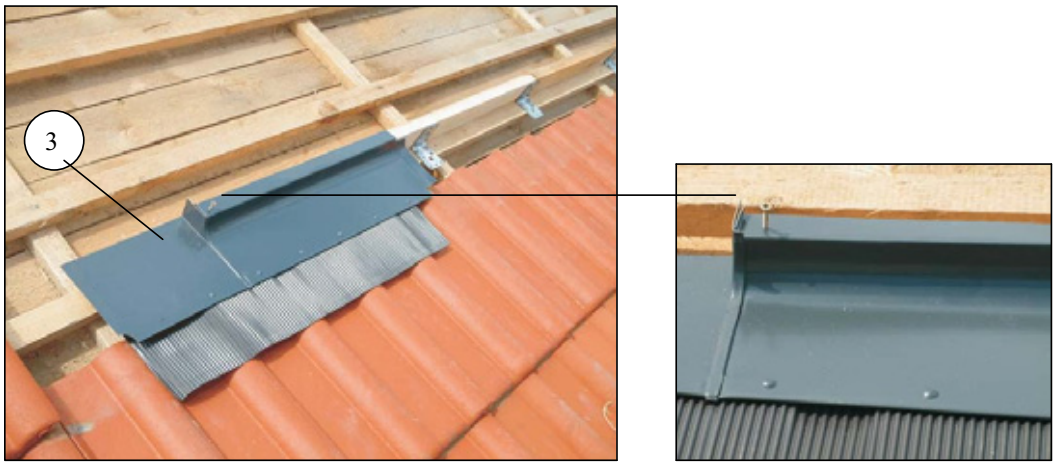
- pressure tested the connections of the panels **AND**
- placed the temperature sensor in the panel.

Once is the flashing kit finished you will either not be able to do these tasks, or be able to do them with great difficulty.

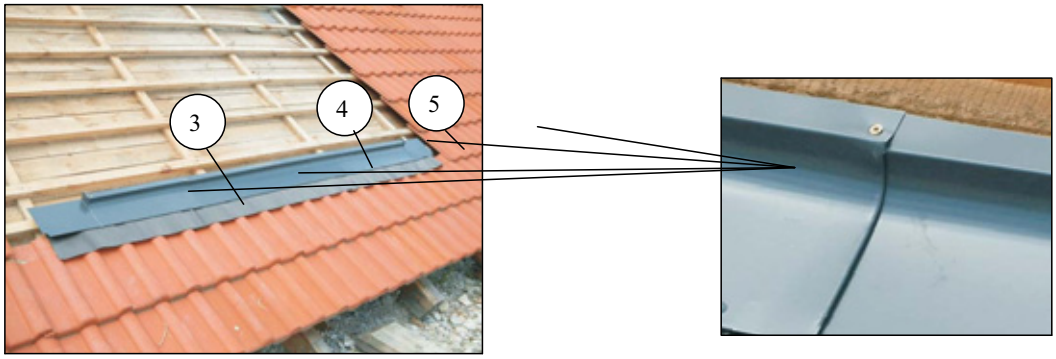
## 4.6.4 In-roof tiled roof fittings

Installation Manual page 28

**4.6.4.7** Fitting of the lower left flashing: Starting from the left side, place the lower left flashing (3) onto the slat and screw it 4x30 (20) at the top left corner as shown.



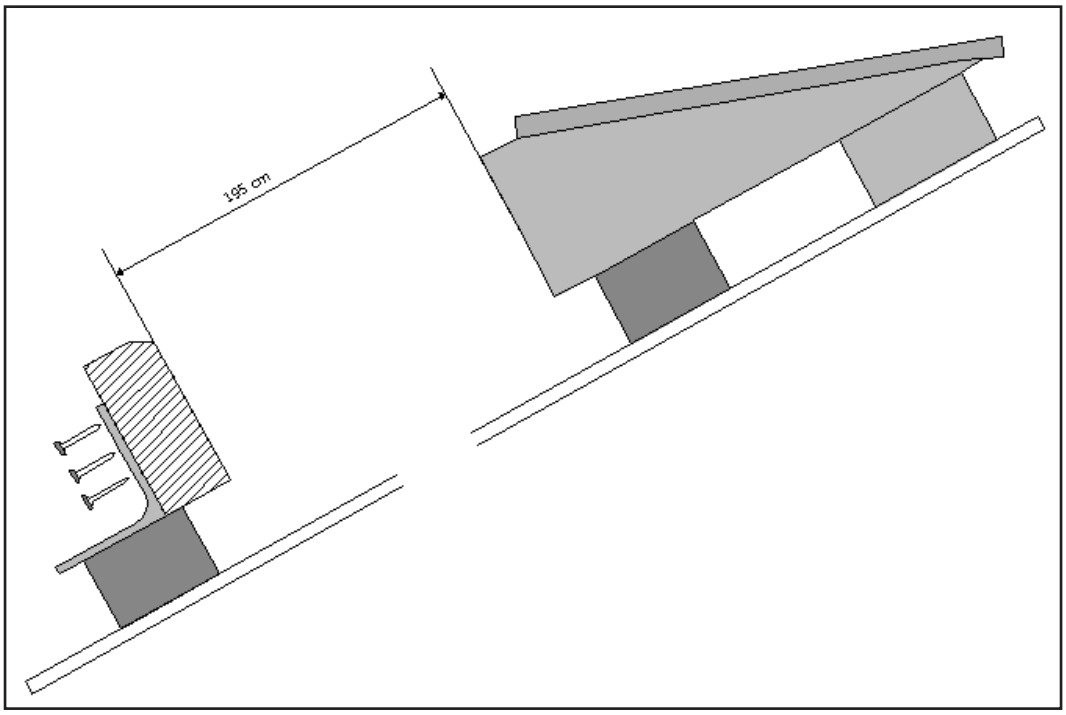

**4.6.4.8** Continuing from the left to the right side, place the lower flashings (4), (5) onto the slat by pushing them on the lap together and place a screw 4x30 (20) on each connection.



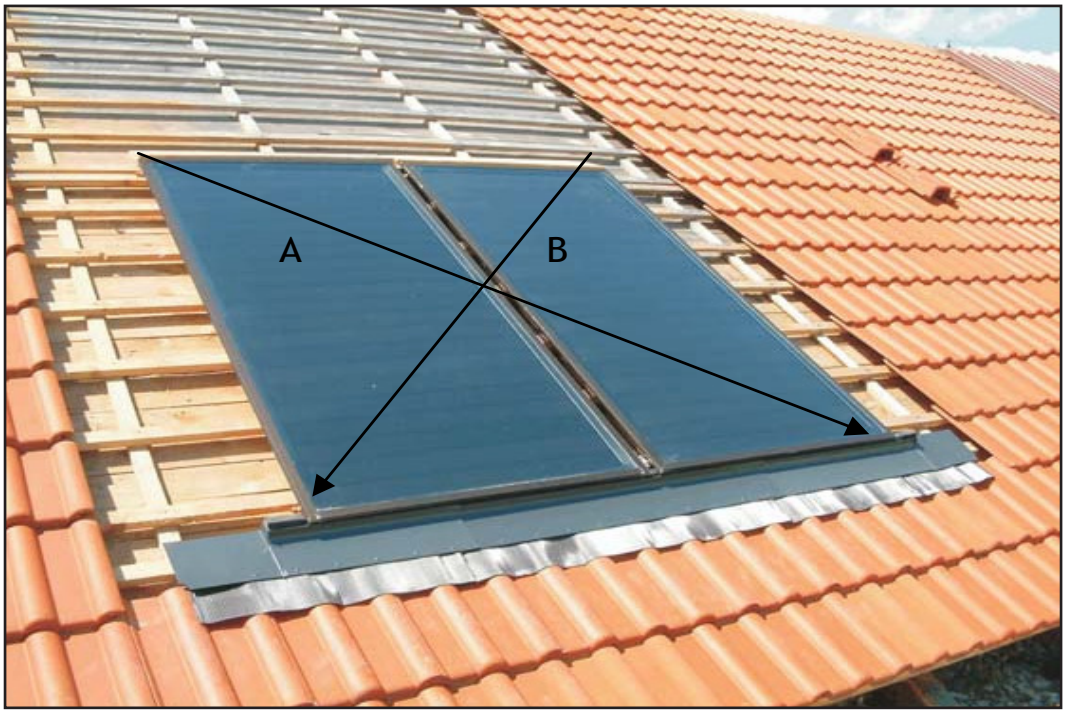
## 4.6.4 In-roof tiled roof fittings

Installation Manual page 29

**4.6.4.9** Attach the upper support batten so that the distance between the lower slat (2) and the upper wedge (7) is 1950 mm. The upper wedge must be supported by at least two battens.




**4.6.4.10** Attach the upper support batten so that the distance between the lower slat (2) and the upper wedge (7) is 1950 mm. The upper wedge must be supported by at least two battens.

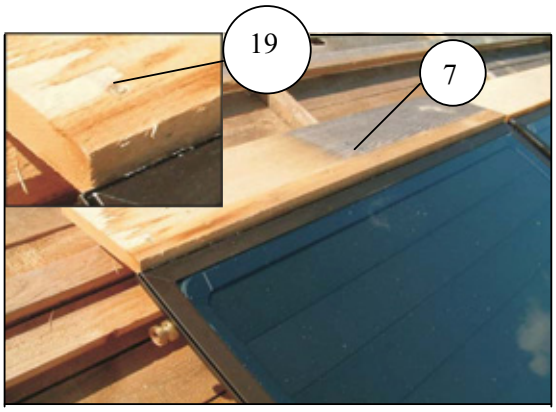


## 4.6.4 In-roof tiled roof fittings

Installation Manual page 30

**4.6.4.11** Panels should be 10 cm from the edge of bottom flashing.

**4.6.4.12** Mounting the upper wedge: Place the upper wedge (7) under the panels. Align them and use screws 5x10 (19), tighten them to the batten.




#reference
**Chapter 5**

**4.6.4.13** Connect the panels together and connect them with pipes (see Chapter 6 of the Installation Manual, 6.6 of the Technial Guide.)

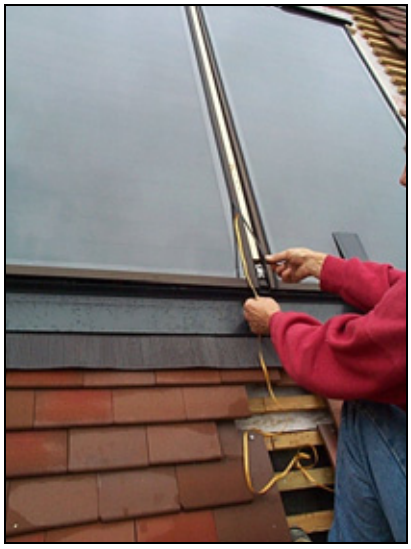
**4.6.4.14** ***(Right)*** Insert the panel temperature sensor (brown wire).

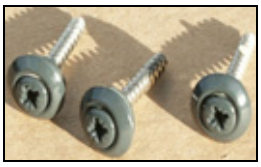
## 4.6.4 In-roof tiled roof fittings

Installation Manual page 31

**4.6.4.15** Mounting the middle and side wooden rafters.

**4.6.4.16** Paste the adhesive backed black strip to the side panel edge and fix the middle flashing kit on the middle wooden rafter using the coloured screws





**4.6.4.17** ***(Left)*** Next fix the left and right hand edge.

**4.6.4.18** Fixing the side flashing:

## 4.6.4 In-roof tiled roof fittings

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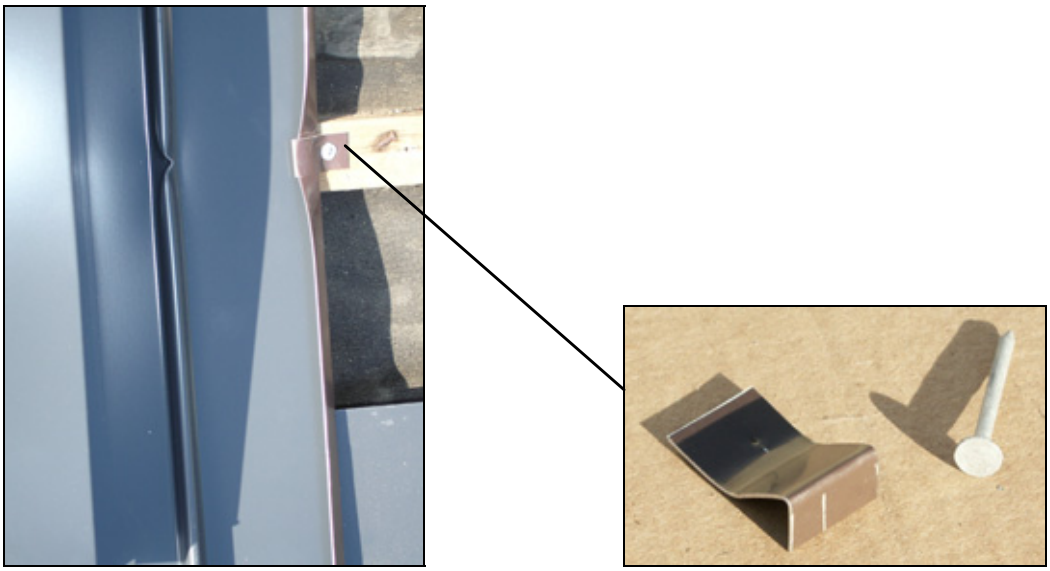
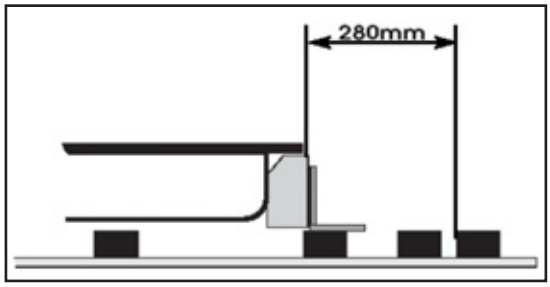
**4.6.4.19** Using the nails and clips shown below (1), secure the side flashings to the tile lathes by hooking the clips over the outside edge of the flashings and nailing into the lathe as shown below (2).

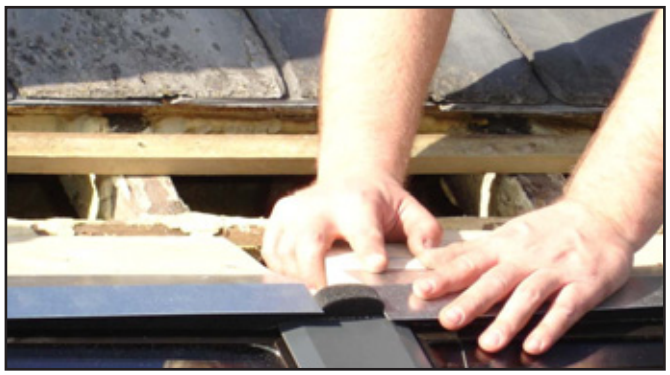


**4.6.4.20** Fix another timber rail (not supplied) across the top of the array, 280mm above the bib flashing support rail fixed earlier.




**4.6.4.21** ***(Right)*** Paste the adhesive backed black strip:

**4.6.4.22** Screw the wind retaining rail on the timber rail.



## 4.6.4 In-roof tiled roof fittings



**4.6.4.23** ***(Left)*** Fix the top flashing kit – starting with the left part.

**4.6.4.24** ***(Right)*** The middle part of the flashing kit side below the left part.

**4.6.4.25** ***(Below)*** Fix the right part of the top flashing kit.

**4.6.4.26** When you have firmly fixed all flashing the roof tiles can be replaced:

## 4.6.5 In-roof slate fittings

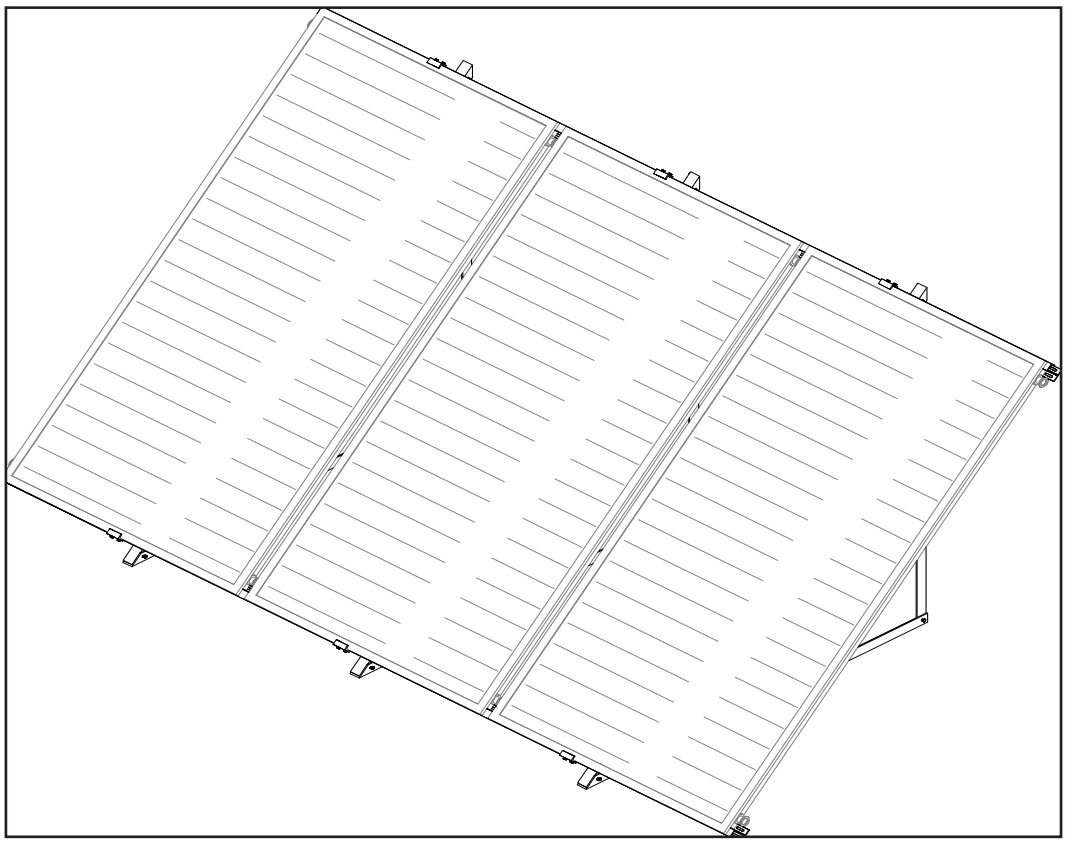
Installation Manual page **34**

Please refer to section **4.6.4** of the Installation Manual for instructions to install ATAG solar heating into In-roof slate roofs. There are no specific guidelines for In-roof slate fittings, the In-roof tiled instructions should be applied.

## 4.6.6 Flat roof and free standing

Installation Manual page 35

The A–frame is suitable for any kind of flat roof and it is also is suitable for ground installation.



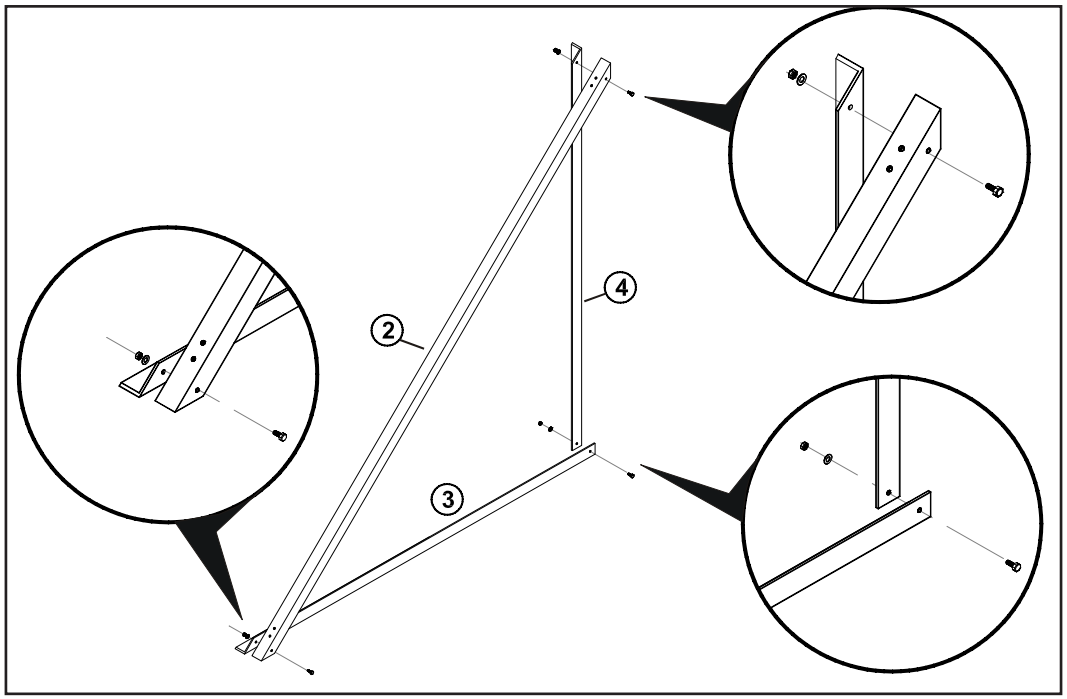
**4.6.6.1** When you unpack the A-frame kit packaging please check if any piece is missing. The package should contain:

| Part No. | A – frame kit for 2 panels | Quantity |
|---|---|---|
| 1 | Z-rail 2040 mm | 2 |
| 2 | L-rail | 2 |
| 3 | Basic rail | 2 |
| 4 | Support rail | 2 |
| 5 | Cross rail | 1 |
| 6 | Wind clamps | 4 |
| | Bolt kit (bolt, nut, washer) M6x16 | 30 |
| **Part No.** | **A – frame kit for Extension Kits** | **Quantity** |
| 2 | L-rail | 1 |
| 3 | Basic rail | 1 |
| 4 | Support rail | 1 |
| 6 | Wind clamp | 2 |
| 7 | Z – rail 1040 mm | 2 |
| 8 | Frame connection (K1141 GB) | 1 |
| | Bolt kit (bolt, nut, washer) M6x16 | 12 |

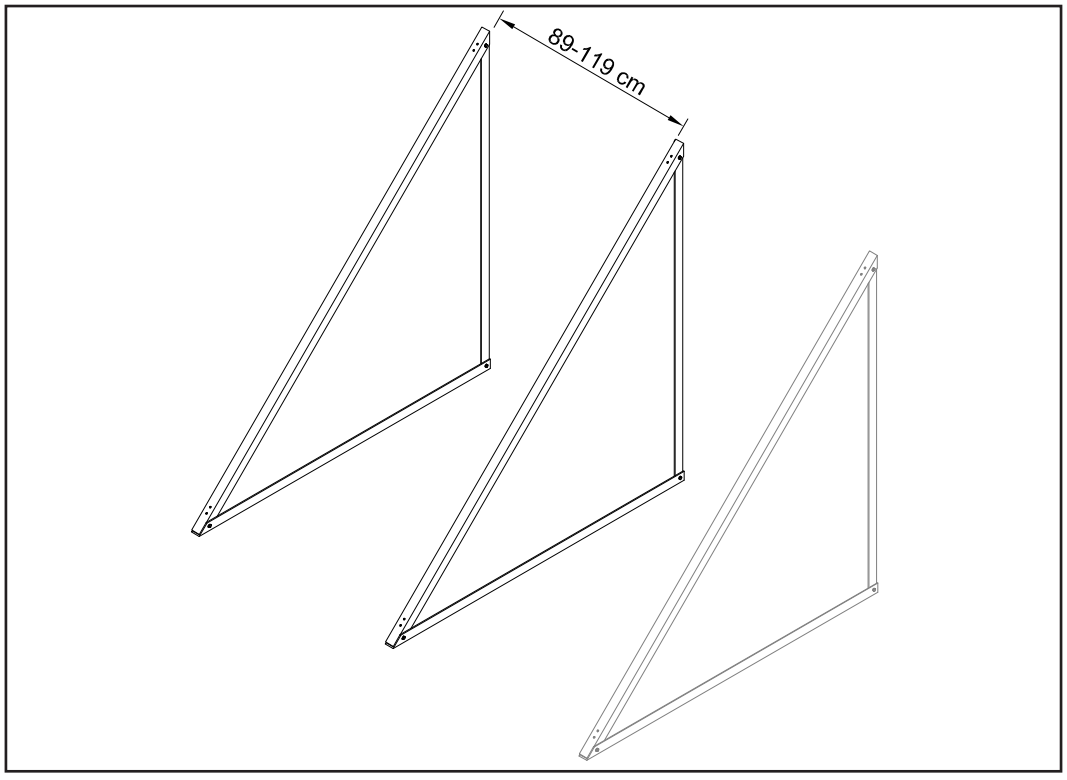
## 4.6.6 Flat roof and free standing

Installation Manual page 36

**4.6.6.2** Fit together the basic rail, support rail and L-rail using the nuts and bolts provided. You will create triangular structures as shown in the diagram.



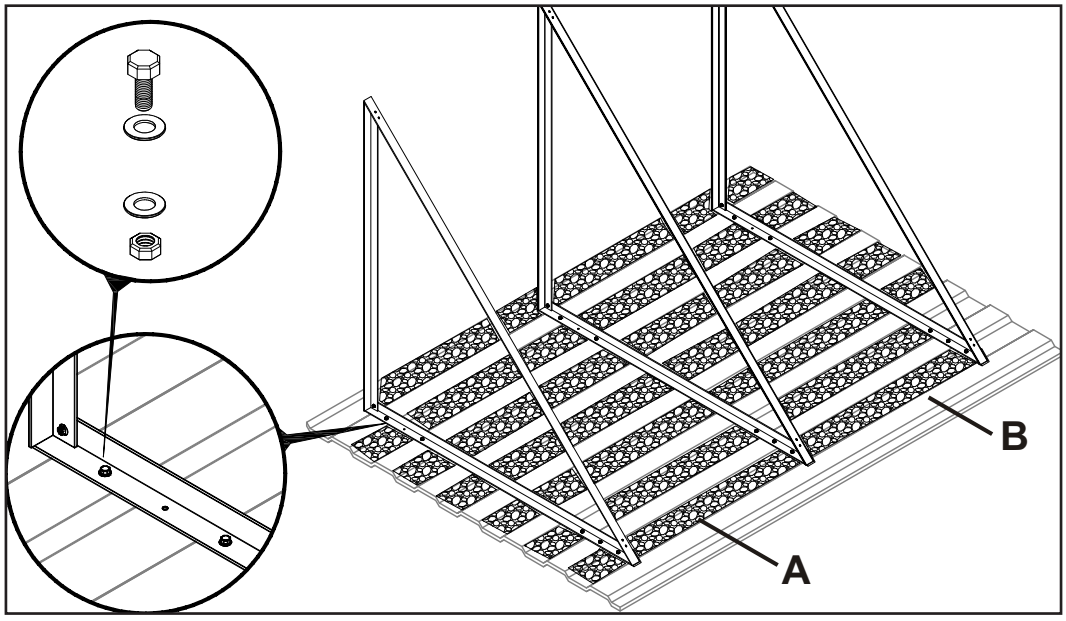

**4.6.6.3** The distance between each triangle should be between 89–119cm.



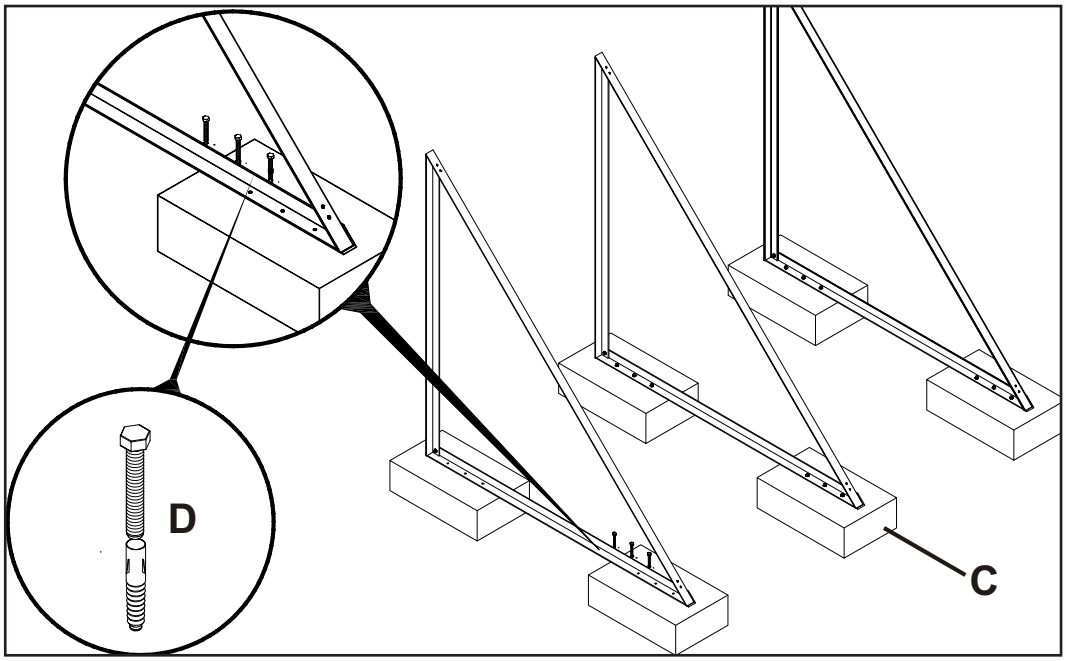
## 4.6.6 Flat roof and free standing



**4.6.6.4** First option for frame mounting: If it is not possible to screw the A – frame into the roof directly without affecting the integrity and water tightness of the roof structure you must use a special concrete-metal sheet. The A – frame must be fixed to the sheet placed on the roof and the frame and the sheet must be weighed down for security. CAUTION: the weight holding down each panel must be 350 kg to provide stability in high winds although installers should pay particular care in local conditions where very high wind speed occur.



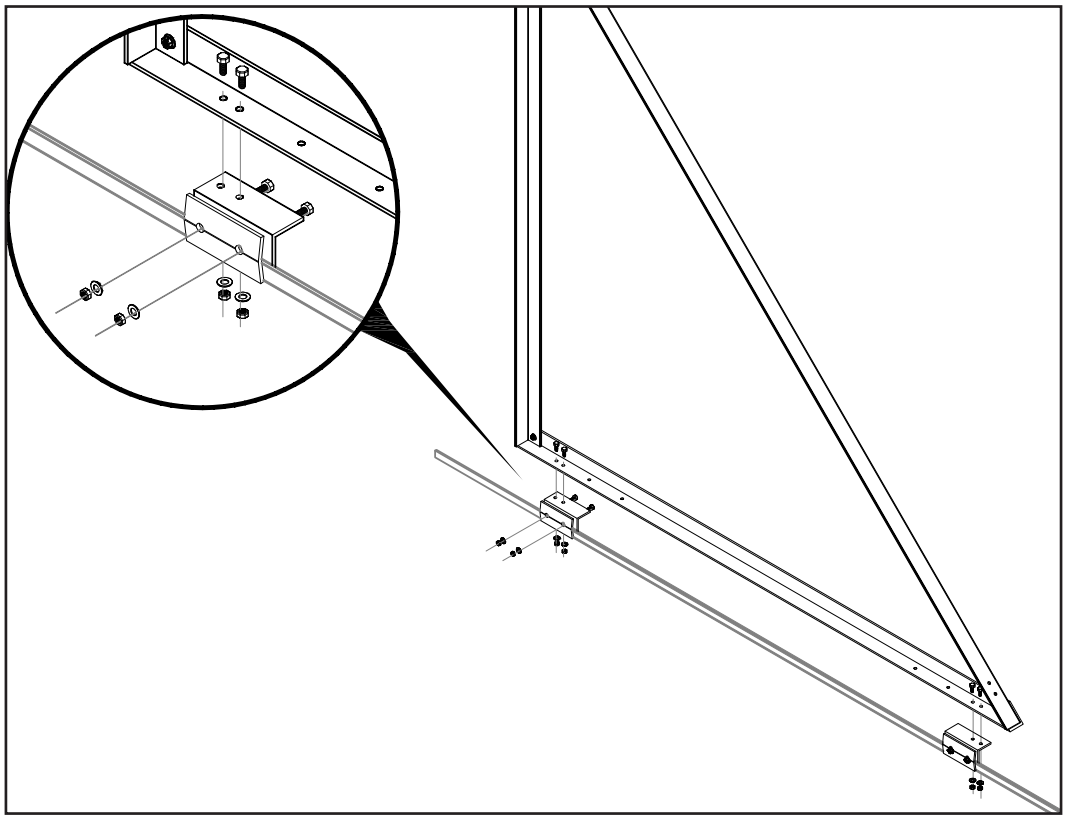

**4.6.6.5** Second option for frame mounting: If the roof is made from concrete use special fittings for concrete (not supplied).



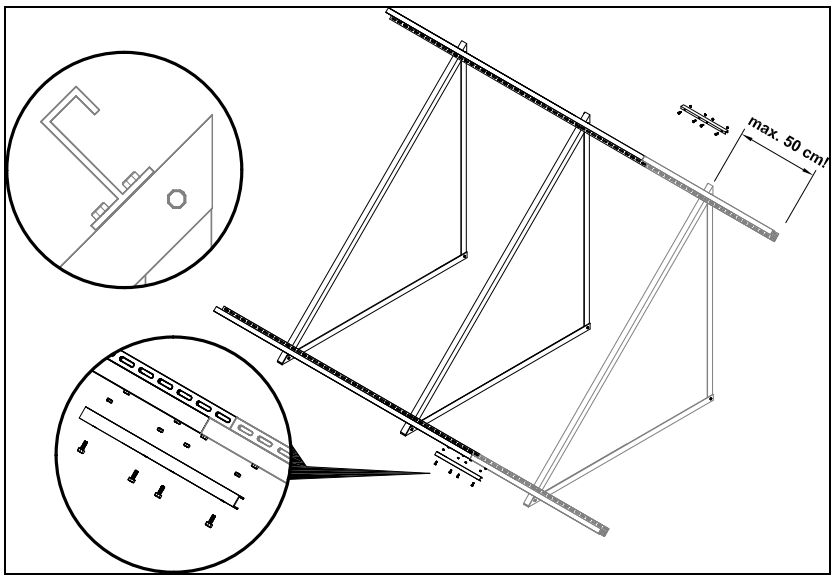
## 4.6.6 Flat roof and free standing

Installation Manual page 38

**4.6.6.6** Fit the Z – rail on to the triangles as shown below. To extend a two panel kit extension, fit the frame connection (K1141) to the bottom and to the top of Z-rails.



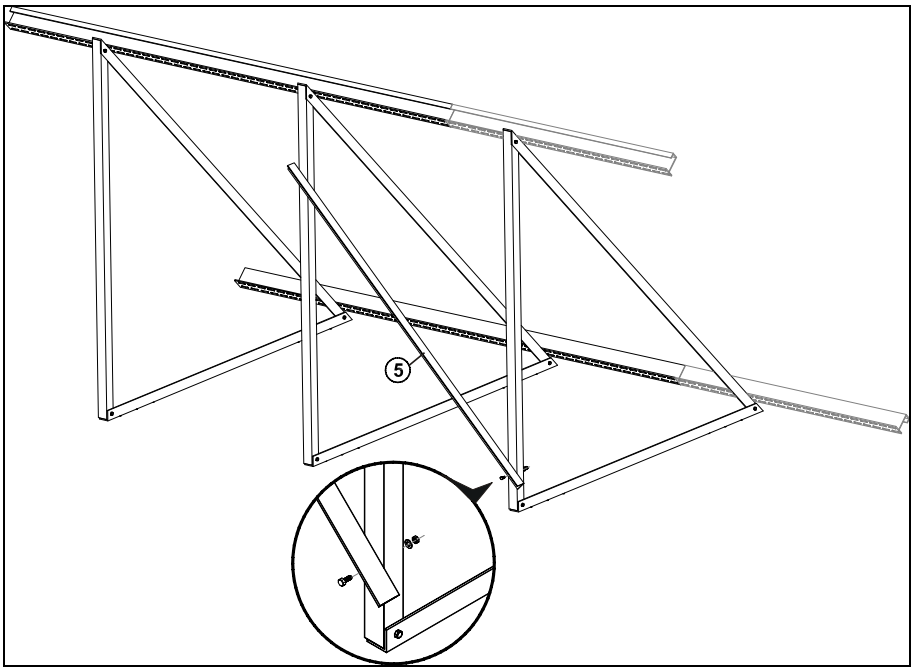
**4.6.6.7** When the Z – rail has been fitted to the triangle, bolt the cross rail on the back of the frame construction. NOTE: Drill Ø 8 mm holes into the support rail as necessary.



## 4.6.6 Flat roof and free standing

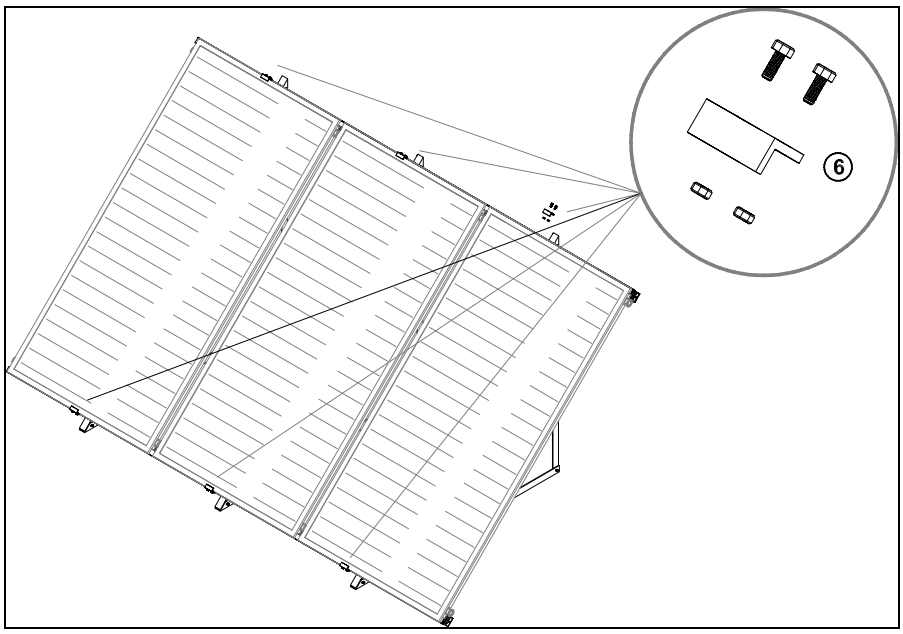


**4.6.6.8** When the Z – rail has been fitted to the triangle, bolt the cross rail on the back of the frame construction. NOTE: Drill Ø 8 mm holes into the support rail as necessary.




**4.6.6.9** **WARNING:** If the installation is more than 2 collectors, install the middle collector first.

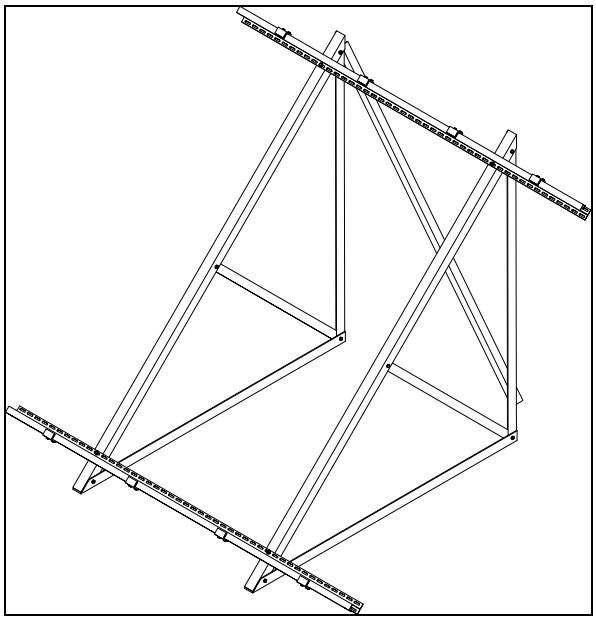
**4.6.6.10** When you have finished building the frame and fitting the panels, do not forget to fit the wind clamps:



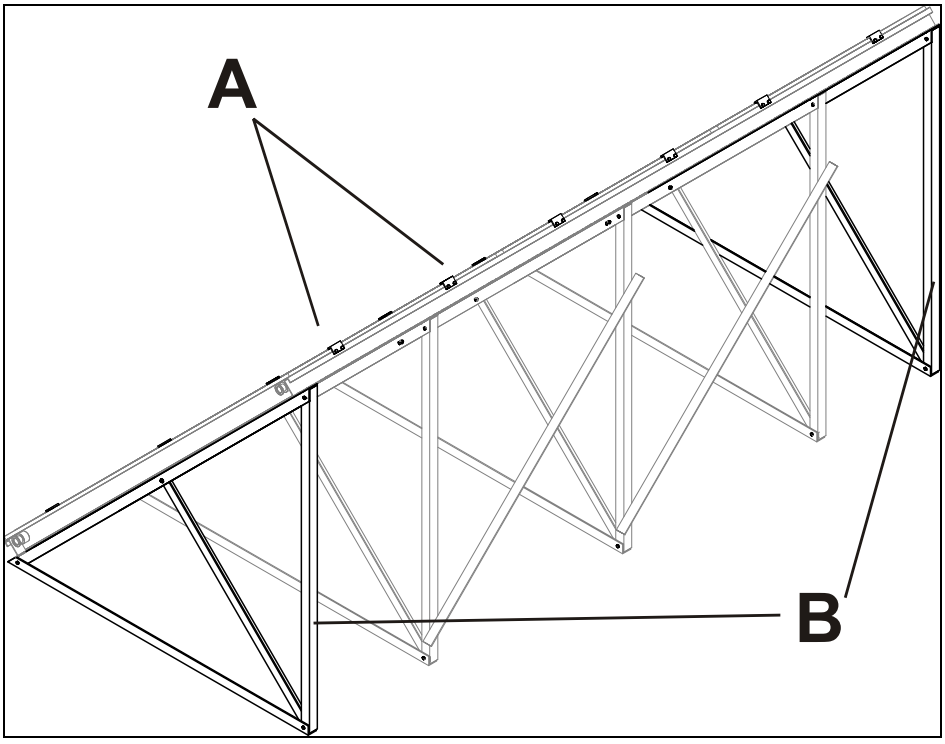
## 4.6.6 Flat roof and free standing



**4.6.6.11** If the overall length of the A frame is to be more than 8 metres the frame construction must be secured with another support rail as shown below:



**4.6.6.12** **WARNING:** In areas with strong wind you must take into account the possibility of wind resistance which may cause the whole frame and panel construction to vibrate. In these cases fit one more support triangles at the end of each side of the A frame as shown. This will make the whole construction stronger.



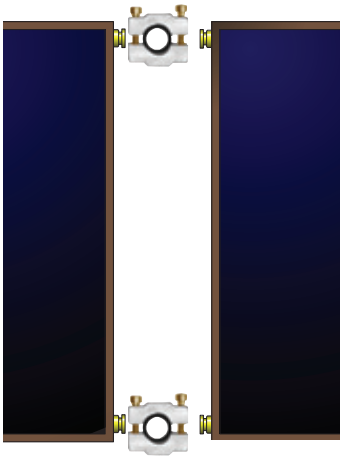
## 4.7 Panel connections and pressure testing

Installation Manual page 41

**4.7.1** There are two separate kits; the installation kit is used for connecting the panels to the heat exchange loop and the extension kit is used for connecting one panel to another. Both kits have special clamps that are connected by means of an alen key.

**Installation kit:**

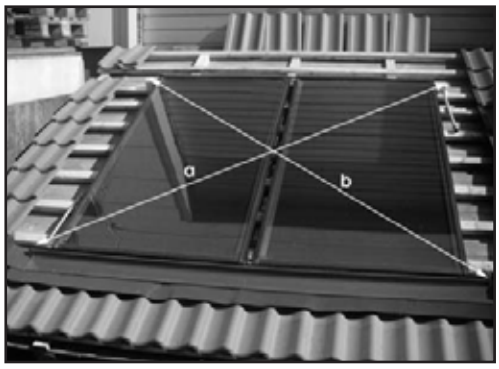
**Extension kit:**



**4.7.2** Before you place the panels on the frame and connect them check the diagonals to make sure the top and bottom rails are square.

**On roof installation:**

**In roof installation:**

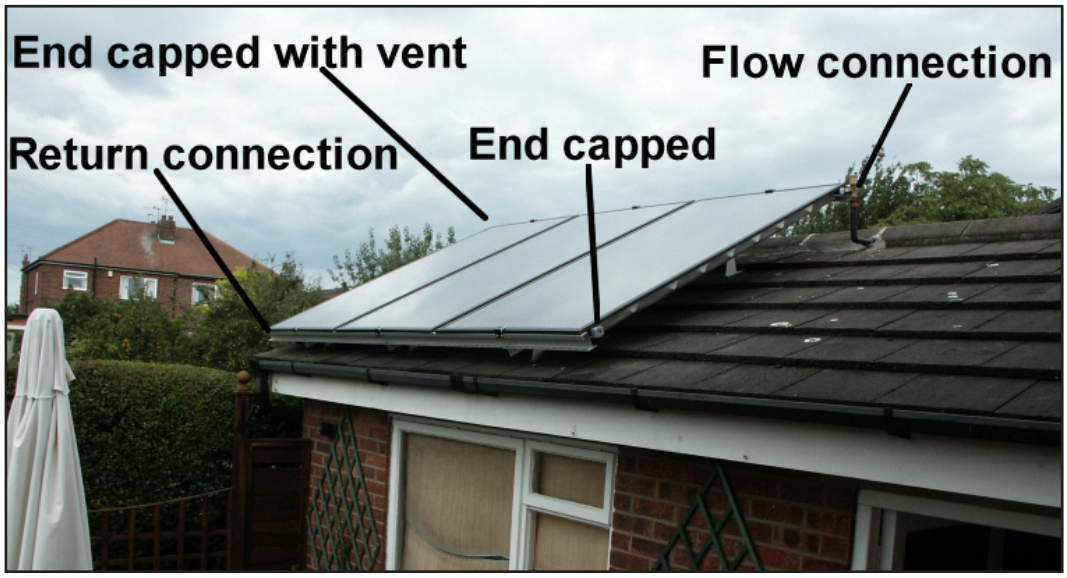



**4.7.3** Place the panels in position in the centre of the completed frame. In case of the systems with more than two panels, mount the middle panel first.

## 4.7 Panel connections and pressure testing

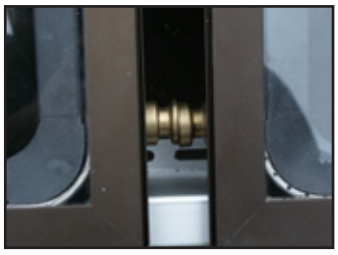
Installation Manual page 42

**4.7.4** The panels are connected in parallel. The inlet (return) is always on the bottom left side and the outlet (flow) is on the top right side.

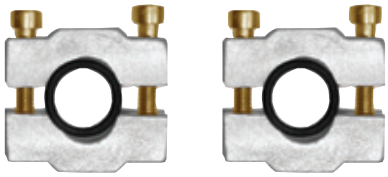



**4.7.5** Apply a smear of silicone to the socket end of the connector and insert the O-ring.

**4.7.6** Pull up the panels together, so that the connections are exactly opposite each other.

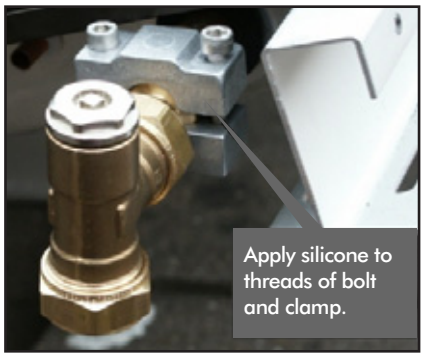


**4.7.7** Using the extension kit (clamps, bolts and O-rings - supplied, *below left*) apply a smear of the silicone to the bolt thread and fasten with Alen key T.



**Extension kit clamps**

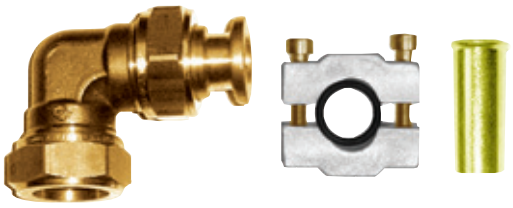
**4.7.8** ***(Below right)*** On the flow connection attach the brass T-piece with air vent supplied using the using clamps and O-ring as before



## 4.7 Panel connections and pressure testing

Installation Manual page 43

**4.7.9** On the return connection (always diagonally opposite the flow connection) connect the right-angled brass elbow using the clamps and O-ring as before.



**4.7.10** The brass M cap with screw air vent supplied must be fitted to the top connection opposite the flow connection using the clamps and O-ring as before.

**4.7.11** The brass blank W cap supplied must be fitted to the remaining bottom connection using clamp and O-ring as before.

**4.7.12** Finally the panels should be secured to the frame using the wind clamps. Position the wind clamps at the top and bottom in the centre of each panel.

**4.7.13** When the panels are connected together and the pipe work is complete the system should be filled with drinking water, vented, checked for leaks, flushed and re-filled with the water/glycol mix. If you are fitting an in roof system, do the pressure test before you fit the top and side flashings.

#reference
**Chapter 14**

For filling instructions see part 14 of these instructions.

**Note:**

- You can connect a maximum of 10 panels together.
- The inlet is always on the bottom left side and the outlet is on the top right side .
- The temperature sensor pocket is below the top right connection Once is the flashing kit finished you will either not be able to do these tasks, or be able to do them with great difficulty.

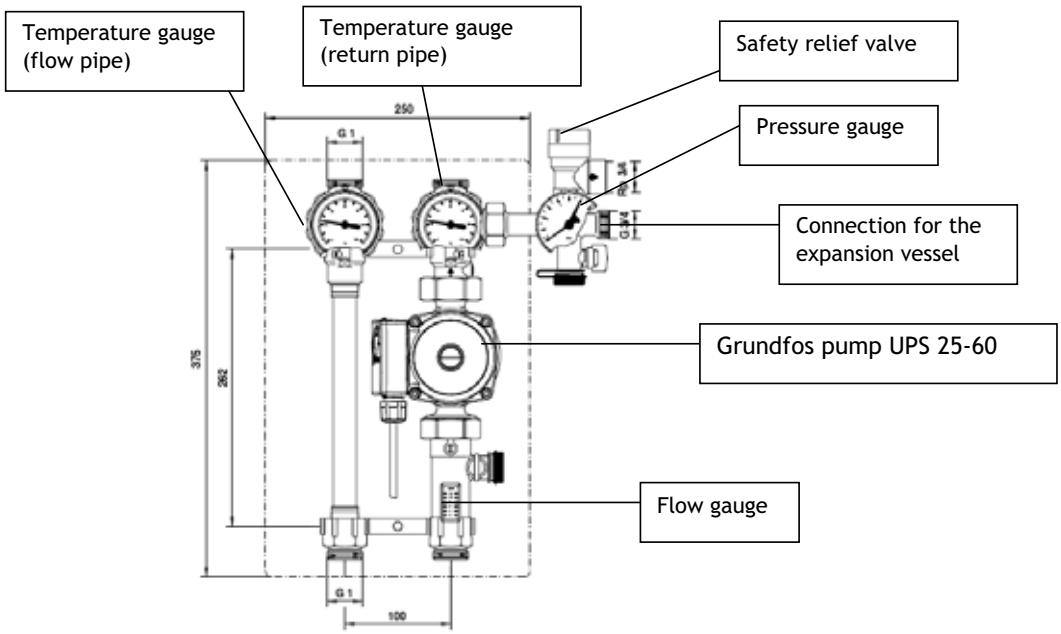
## 4.8 The double pump station



The double pump station ensures a continuous circulation of the glycol inside the closed solar loop when useful energy is available in the solar panels. The double pump station recommended by Genersys is constructed so as to be unaffected by the operating temperatures of the loop for many years.

### 4.8.1 Technical data

| | | |
|---|---|---|
| Maximum working excess pressure: | | 6 bar |
| Safety valve: | | 6 bar |
| Circulation pump: | | Grundfos UPS 25-60 |
| Nominal voltage: | | AC 230 V |
| Power consumption: | Phase 1 | 45 W |
| | Phase 2 | 65 W |
| | Phase 3 | 90 W |
| Maximum pump head: | | 6 m |
| Maximum pump capacity: | | 4.5 $m^3$ /h |




**4.8.2** The double pump station must always be mounted at a level that is lower than the panels so that no steam may penetrate the expansion tank in case of stagnation. Stagnation occurs when the solar panels have heat energy which is not needed by the system and the panels stagnate at around 180° Celsius. If the expansion vessel is mounted at the same level or at a higher lever than the double pump station, a thermal insulation loop must be installed.

**4.8.3** The double pump station is supplied with the two temperature gauges (flow pipe and return pipe) with pre-fitted flow gauge. On the return pipe is pre-fitted the safety pressure relieve valve with tapping (G 3/4'') for an expansion vessel.

## 4.6.8 The double pump station



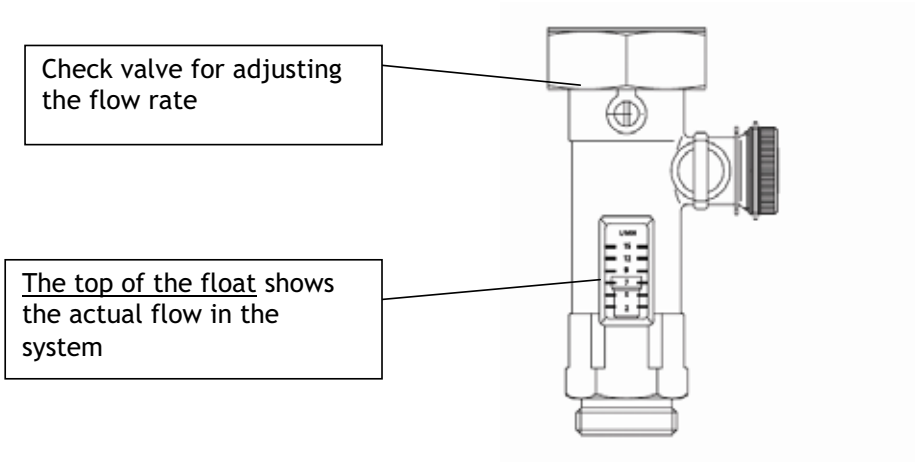
**4.8.4** The solar circuit has to be flushed with clean fresh water after each draining operation.

**4.8.5** The double pump station is not suitable for direct contact with swimming pool water.

### 4.8.6 Flow settings:

The flow regulator should be set to 1.0 litre per minute per panel. A three-panel installation is set to a flow rate of three litres per minute.

How to read the flow setter:




### 4.8.7 Pressure settings:

The maximum pressure is 6 bar. Once the system is pressurised keep the pressure between 3 – 4,5 bar. With higher pressure inside the system, the glycol/mix will not evaporate until temperatures of around 120°Clesius are reached. Pressurisation therefore helps to prevent glycol degradation and enables more useful heat energy to be applied.

### 4.8.8 Maintenance:

The double pump station does not require maintenance. It is fully controlled by the digital controller.

The customer should do a visual check every month for leaks, significant different readings on the temperature gauges and readings on digital controller, pressure drop below red line on the pressure gauge. The customer should be informed that fluctuations in pressure readings while the system is operating are perfectly normal.

**The customer must contact the installer immediately in the case of any unexpected changes.**

## 4.9 The expansion vessel
**(also known as the expansion tank or pressure vessel)**

Installation Manual page 46

### Function of the expansion vessel:

An expansion vessel protects the solar system during pressure changes and temperatures fluctuations. For example, in very hot conditions when energy is not being drawn off the system may overheat causing the heat exchanged glycol to expand.

### 4.9.1 Technical data:

| | |
|---|---|
| Maximum pressure: | 6 bar |
| Working pressure: | 3.5 – 4.0 bar (20°C) |
| Gas pressure: | 2.5 bar |
| Maximum working temperature: | 110°C |
| Membrane: | Nytril (butyl) rubber |
| Resistance: | 40 % glycol |

### 4.9.2 Expansion vessel sizing:

It is of critical importance to have the correct size of expansion vessel in your solar system. The volume of the expansion vessel is determined by the number of Genersys solar panels connected within the one solar heating system. For one collector 6 Litres of the expansion vessel volume is required. Please use the right size expansion vessel, and we set out a table below to help you chose the correct size:

| Number of solar collectors | Expansion vessel size in litres |
|---|---|
| 2 | 12 |
| 3 | 18 |
| 4 | 24 |
| 5 | 32 |
| 6 | 36 |
| 7 | 42 |
| 8 | 48 |
| 9 | 56 |
| 10 | 60 |

**Due to standard sizes of the vessels we have rounded the size up to standardised sizes of expansion vessels.**

## 4.9 The expansion vessel
**(also known as the expansion tank or pressure vessel)**



### 4.9.3 Location:

The pressure vessel should be located in a position where it can be easily accessed. It should be fitted with isolating valve for ease of replacement. The isolating valve should not be accessible without a tool so that an unqualified person cannot shut it off.

The expansion vessel should be fitted on the return run of the system.

### 4.9.4 Maintenance:

Once an expansion vessel is pressurised correctly it does not require maintenance, although we strongly recommend a visual inspection by a qualified person at least once a year. Monthly checking of the pressure gauge on the double pump station is also very important.

A pressure drop might indicate:

- A leak on the pipes connections or
- A leak on the panels connections or
- A faulty expansion vessel

**If case of any unexpected changes, the customer must contact the installer immediately and the installer should inform the customer of this when explaining the system.**

## 4.10 Piping and pipes connections



### 4.10.1 Piping

The copper heat exchange pipe in Genersys panels contain glycol, pressurised and heated to temperatures in excess of 170°C when exposed to direct sunlight where the rays are striking the absorber plate at roughly a right angle. This heating process takes place very quickly. Similar temperatures will be reached in winter, but more slowly due to the lower levels of insolation. In winter at night the system is designed to be safe up to temperatures of minus 30° C or lower. It will perform in winter in the right insolation conditions and in below freezing temperatures.

Copper piping is used because copper is highly efficient in heat exchange operations because the thermal conductivity is high. The copper piping will be exposed to high and low heat, including high variable heat. Three points should be made:-

- Copper does not become brittle at low temperatures.
- The melting point of copper is 1083°C.
- The grade of copper used by Genersys will not become hard (like steel) if it is cooled rapidly after heating.

Internally, the collector heat pipe, as folded into the absorber tray is one continuous tube which is hard soldered in two places only as part of the connective pipe.

We accordingly recommend that best quality copper pipe is used in the heat exchange loop, or stainless steel flexible pipe is used.

**NOTE: On an ATAG system you must not use plastic pipe in the heat exchange circuit due to very high temperatures the system generates. Using plastic pipes might cause major injuries in the almost certain event that the plastic will explode under the combination of temperatures and pressures generated.**

## 4.10 Piping and pipes connections



### 4.10.2 Pipes connections

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We accordingly recommend that best quality copper pipe is used in the heat exchange loop, or stainless steel flexible pipe is used.

### 4.10.3 O rings

If you use press fitting please remember to use solar quality O rings, rather than traditional plumbing O rings. Solar quality O rings will not melt at the temperatures experienced inside the thermal loop.

## 4.11 Insulation



The use of the correct insulation is critical. Normal central heating insulation will melt and become brittle at the very high solar generated temperatures in the system.

Insulation materials must endure the highest occurring temperature, which will be more than 170◦C near the collector.

If the insulation is outdoors then it must be:

- Resistant to temperatures up to 170°C
- Must have a flexibility in - 30°C conditions
- Resistant to air pollution
- Resistance to UV radiation
- Resistance to pests, such as mice and birds that may eat it. In some countries the activities of insects require insulation to be "armoured" or sheathed
- Externally sealed to prevent it carrying moisture.

## 4.12 Glycol

Glycol is heat exchanging fluid with a very low freezing point, already pre-mixed to a 40/60% concentration of Glycol/Water. Glycol supplied by ATAG has the following properties:

- Glycol 40% pre-mixed has an anti-freeze protection up to -40°C
- Contains anti-corrosion inhibitors for pipes protection
- Glycol is a food safe polypropylene product approved for use in solar systems by all major countries including the USA and EU
- The glycol contains a harmless pink dye so that if there is a failure of the water cylinder or storage tank, the dye will warn the con sumer of that fact and allow the consumer to call the installer
- Glycol has a notably more intensive creeping property than water
- Glycol is not compatible withy zinc. So pipes with internal zinc gal vanising should not be used
- Chemical nature: Propane 1.2 with corrosion inhibitors
- As with all chemicals, normal precautions should be taken in handling the glycol to prevent ingestion and delivery into the water system.

**NOTE: Under no circumstances should any ethylene based glycol be used in solar systems.**

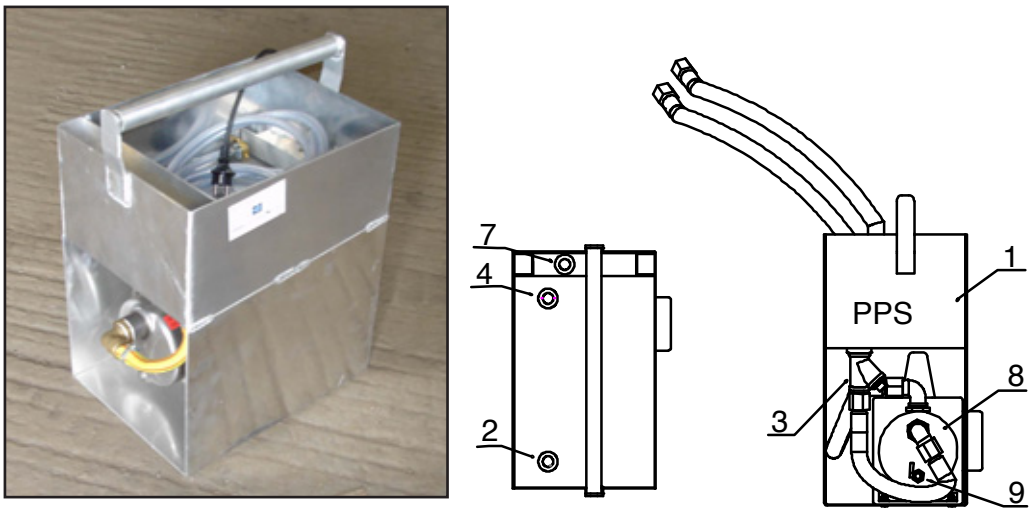
- The EU safety sheet for ATAG glycol is available on request.

## 4.13 Filling the system with Glycol

Installation Manual page 51

When the solar heating system is filled with heat exchange liquid (Glycol), the heat transfer medium displace the air. The correct system charging will ensure that the solar system will run without the pressure losses and with high performance.

However carefully you fill the system manually, small bubbles of air might be caught in 'air locks' inside the pipes and some of these air locks will be from air naturally dissolved in the water part of the glycol solution. Using the automatic filling pump station design by Genersys you will reduce the occurrence of air locks and save time bleeding the system.




**Legend:**

| | | | |
|---|---|---|---|
| 1. | Tray for the Glycol | 7. | Damper |
| 2. | Suction hole | 8. | Pump |
| 3. | Filter | 9. | Drain hole |
| 4. | Blow hole | 10. | High voltage cable |
| 5. | PVC pipe for the flow (2 m length) | 11. | Switcher ON/OFF |
| 6. | PVC pipe for the return (2m length) | | |

## 4.13 Filling the system with Glycol



### Connecting the filling pump to the Double Pump Station:

Step 1. Place the filling pump station on secure, horizontally clear place, close to the double pump station so the hoses of 2 m can connect to the double pump station

Step 2. Connect the hoses from filling pump station to the double pump station.

Step 3. The flow hose (5) connect on the part of the double pump station where the safety relieve valve (A) is located.

Step 4. The return hose (6) connects to the valve below the Grundfos pump next to flow setter (B).

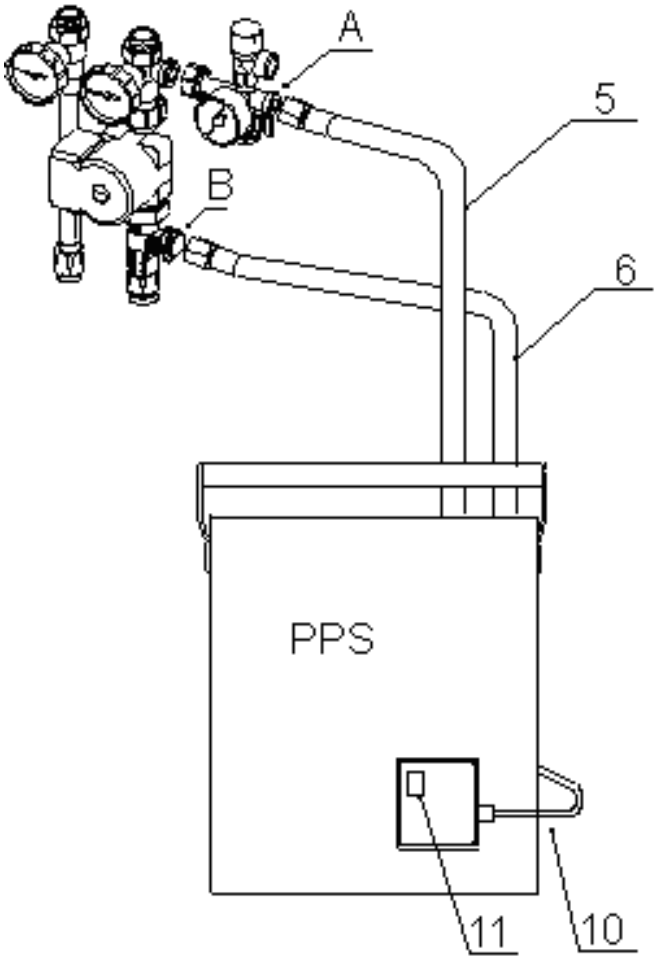
Step 5. Fill the tray with glyco.l

Step 6. Make sure the filling station switch is off and plug the pump into a convenient socket.

Step 7. Switch the filling pump station on and open the valves A and B.

Step 8. Be prepared to carefully add additional glycol as needed to the tray while it is operating.

### Double Pump Station:



## 4.14 The digital controller



This controller provides simple control of solar circulating pump based on adjustable (0-40K) temperature differential on and (0-40K) temperature differential off measured with sensors fitted to solar collector and hot water cylinder.

The controller is an electronic device for use in conjunction with a hydraulic circuit in accordance with the manufacturer's specifications. The device is not to be used for any other purpose.

The controller complies with the following EU guidelines:

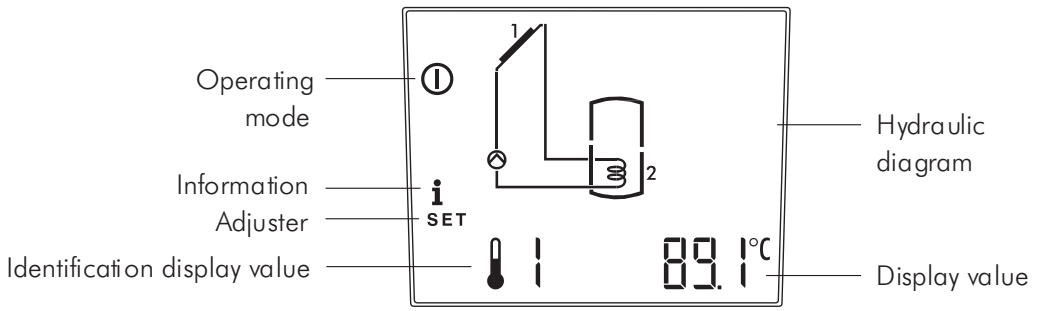
- 72/23/EWG "Low Voltage Guidelines"
- 89/336/EWG "EMC Guidelines", including amendment guideline 92/31/EWG

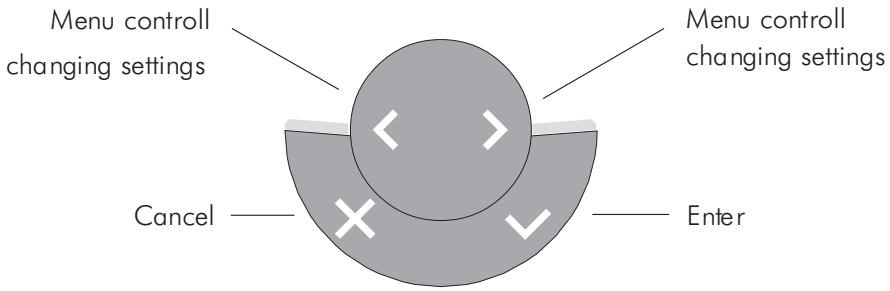
**DANGER:** The controller is electrically operated. Improper installation or attempted repair can cause a life-threatening electric shock hazard. Only adequately qualified specialist personnel must perform installation and commissioning. It is forbidden to open the device or ancillary components. Repairs are to be carried out only by the installer.

## 4.14 The digital controller

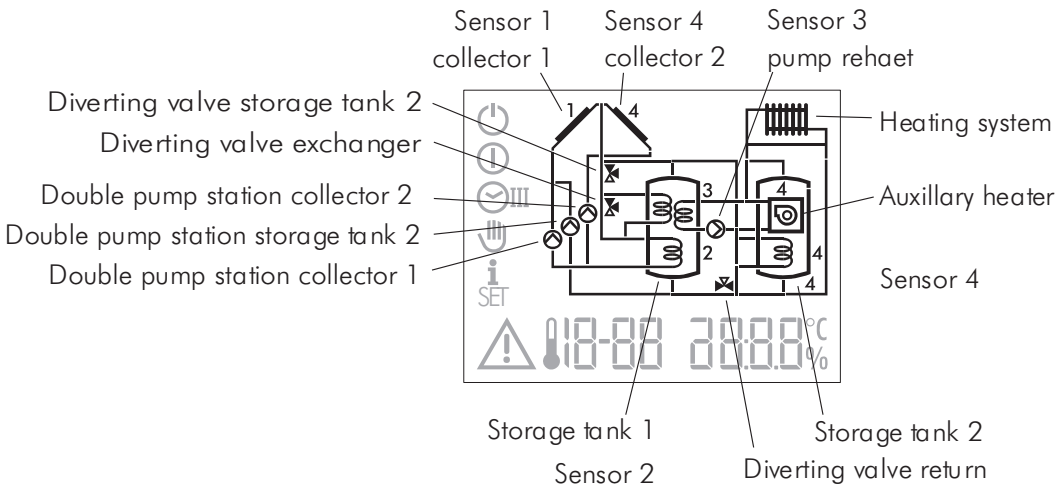
Installation Manual page 54

Overview of display



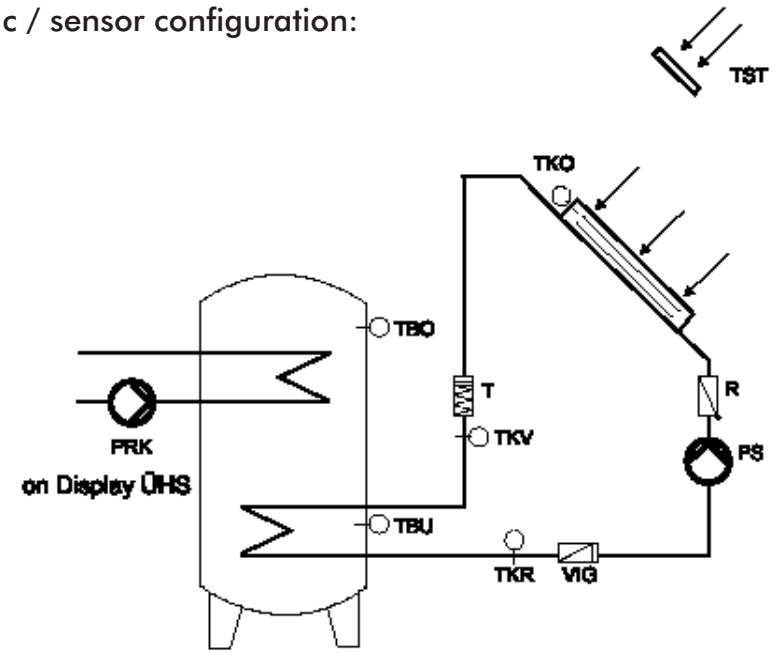

Display with all segments



## 4.14 The digital controller



Hydraulic / sensor configuration:




~~Legend:~~

| | | |
|---|---|---|
| 1. | PS | Solar pump |
| 2. | TBU | Domestic hot water (DHW) temperature/bottom sensor |
| 3. | TKO | Collector temperature/sensor |
| 4. | BW | Operating mode selector<br>Auto = automatic<br>On = pumps on at 100%<br>OFF = controller off, display only |
| 5. | TMA | Maximum hot water storage temperature (850C) |
| 6. | DT15K | Solar difference pump on 0-40K |
| 7. | DT5K | Solar difference pump off 0-40K |
| 8. | PH | Live connection |
| 9. | N | Neutral Connection |
| 10. | PE | Earth Connection |

**(Below)** PS5510 240v Input/output connector strip

| 5 | 4 | 3 | 2 | 1 | L | N | N | N | N | N | N | ⏚ | ⏚ | ⏚ | ⏚ | ⏚ | ⏚ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PS | Ph | N | | | | | | PE | | | | | |

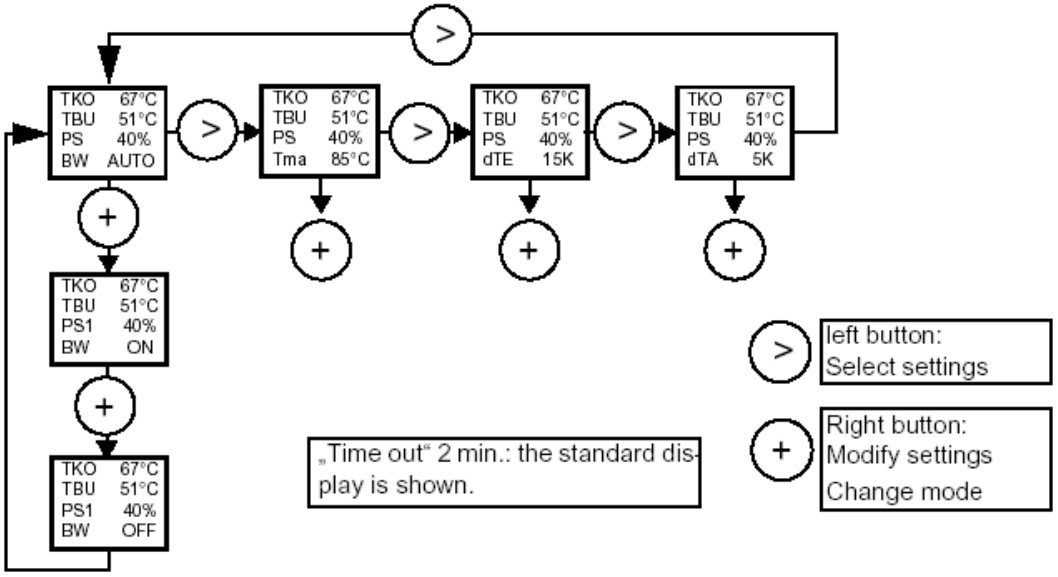
*(Below)* PS5510 Sensor connector strip

| 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | TBU | | TKO | | | |

## 4.14 The digital controller



Menu structure:




Menu structure:

The solar pump is switched on when the difference in temperature at the collector sensor TKO and the hot water sensor TBU is larger than the given set point dTE. The solar pump is switched off when the difference in temperature at the collector sensor TKO and the hot water sensor TBU is smaller than the given set point dTA. Using speed regulation of the pump, it is attempted to maintain a transfer temperature at the collector sensor TKO. The set point xs is given by the following formula:

*xs TKO-DHS-Tank = TBU + 1/2 x (dTE + dTA)*

If the temperature rises above the set "maximum storage temperature" Tma, the solar pump switches off. If a temperature of above 130°C is reached at the collector sensor, the solar pump is switched off.

## 4.14 The digital controller



### Installation

Electrical installation and safety regulations must comply with local regulations. The solar controller must be powered continuously in order to ensure operation at all times.

Before putting the controller into operation the electrical connections to all system components must be checked. It may be necessary to electrically suppress strongly inductive loads in the vicinity of the controller (contactors, solenoid-operated valves, etc.).

This can be done by connecting RC-links directly to the coil terminals of the offending components. Recommended RC-links: 0.047µF, 100W, rated at 250 VAC (e.g. Bosch, RIFA, etc.).

### Mounting instructions

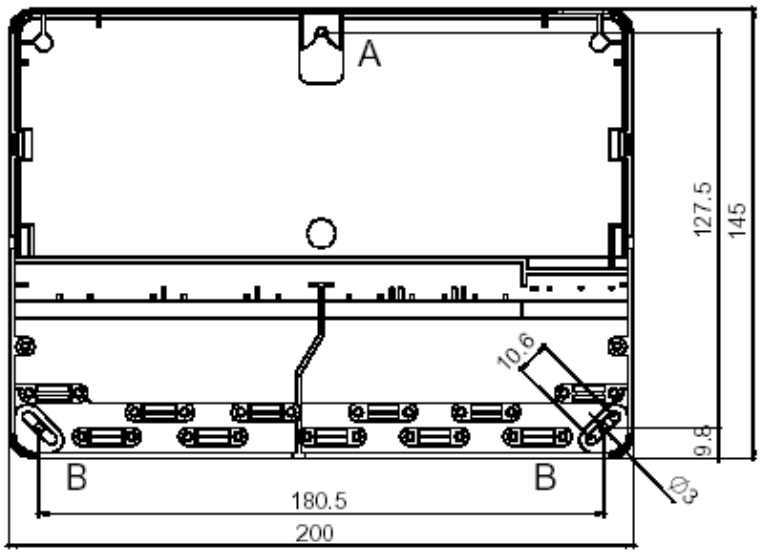
**Step 1.** After drilling the three mounting holes, screw in the top screw so that the controller can be hung from it.

**Step 2.** Remove the connector strip cover by loosening the securing screws.

**Step 3.** Screw the two lower mounting screws 'B'.

**Step 4.** The controller can now be wired up.

### Control dimensions:



## 4.14 The digital controller



### Technical specifications:

Supply voltage 230 VAC ±10 %, 50-60 Hz
Power consumption 7 VA
Sensor circuit voltage 12 V, insulation strength 4 KV
Ambient temperature 0 °C .....50 °C
Sensor cable length, cross-section max. 100 m; 0,75 mm2
Output switching capability 250 VAC, 1 A, 50 Hz
Certification -compliant
Protection category II EN 60730
Protection level IP40 EN 60529
EMV EN 50082-1
EMV-emission EN 50081-1
Protective fuse 6,3 A medium reaction 5x20 mm filled with extinguishing agent.

### Table of temperature sensors and resistances

Sensor NTC 5000 Ω at 25°C:

| Resistance Ω | Temperature °C | Resistance Ω | Temperature °C | Resistance Ω | Temperature °C | Resistance Ω |
|---|---|---|---|---|---|---|
| 48,536 | 2 | 14,479 | 24 | 5,225 | 75 | 740 |
| 43,247 | 4 | 13,342 | 26 | 4,787 | 80 | 628 |
| 38,592 | 6 | 12,085 | 30 | 4,029 | 85 | 535 |
| 34,489 | 8 | 10,959 | 35 | 3,266 | 90 | 458 |
| 30,866 | 10 | 9,950 | 40 | 2,663 | 95 | 393 |
| 27,663 | 12 | 9,045 | 45 | 2,184 | 100 | 339 |
| 24,827 | 14 | 8,231 | 50 | 1,801 | 105 | 294 |
| 22,313 | 16 | 7,499 | 55 | 1,493 | 110 | 255 |
| 20,079 | 18 | 6,840 | 60 | 1,244 | 120 | 195 |
| 18,094 | 20 | 6,246 | 65 | 1,042 | 130 | 150 |

**NOTE: The manual for the DC22 and DC32 controllers are available separately on request.**

## 4.15 Cylinders & hot water tanks

Installation Manual page 59

The ATAG solar heating system has been carefully designed for generating hot water. Choosing right solar hot water storage tank is very important. The goal is to store the available solar energy as completely as possible during the period of low power demand and later supply this energy as efficiently as possible when needed.

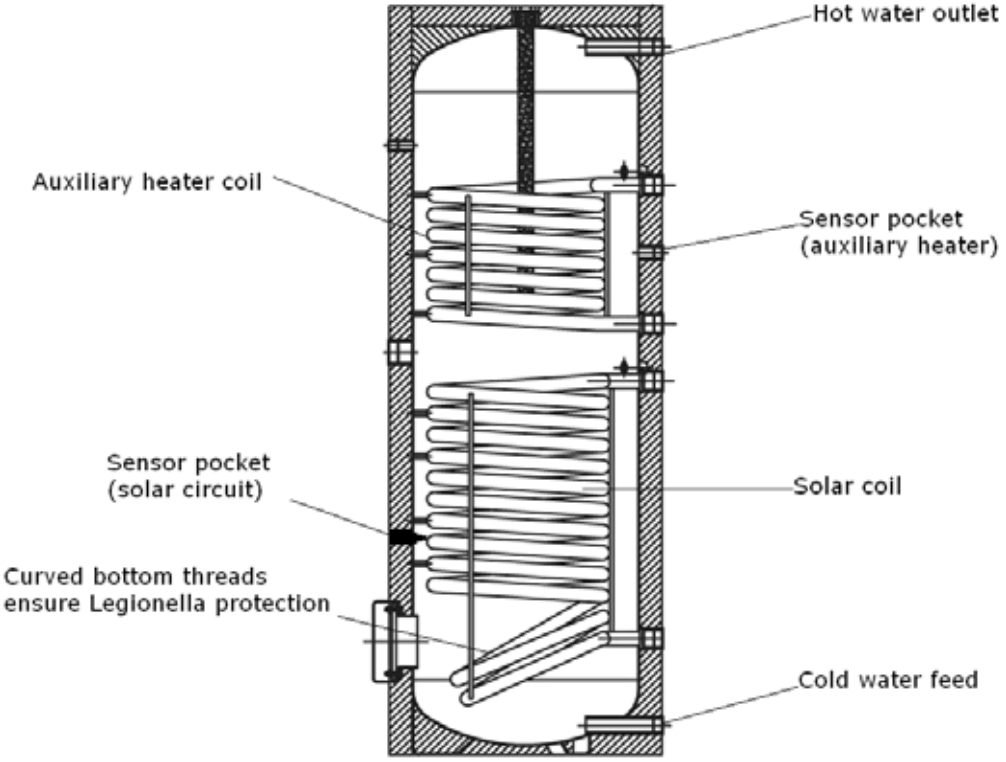
**In the order to maximize the performance of the ATAG thermal solar system we would highly recommend that the specification of the solar cylinder includes:**

- The solar cylinder should be slim and tall, ensure water stratification.
- The solar coil must be on the bottom of the cylinder.
- Bottom threads of the solar coil must be curved towards the bot tom of the cylinder if cylinder has a convex bottom (as shown on the following page).
- An electric coil (immersion heater) must be always above the solar coil. Ideally it should be located in the upper part of the cylinder.
- The coil for the auxiliary heater should be above the electric coil (immersion heater) in top part of the cylinder.
- A sensor pocket for the solar (primary) circuit in the middle part of the solar coil with internal diameter Ø 10 (Ø 8).
- A sensor pocket for the auxiliary heater in the middle part of the auxiliary coil with internal diameter Ø 10 (Ø 8).
- The cold water feed must be as low as possible, to prevent against mixing cold water with hot water in the upper part of the cylinder.
- Anti-corrosion protection.
- Insulation thickness minimum 80 mm without Freon (optimum 100-120 mm).
- The jacket of the cylinder should be made of leather or plastic.
- Maximum working pressure for the solar coil is 6 bar (600 kPa).
- Maximum working pressure for the auxiliary heater coil is 6 bar (600 kPa).
- The surface area of the coils and maximum working pressure to be those sized in accordance with cylinder size set out on the table – *Cylinder sizing specification*, following page.

## 4.15 Cylinders & hot water tanks

Installation Manual page 60

*A suitable cylinder for ATAG solar heating systems:*




*Cylinder sizing specification table:*

| Solar Cylinder | Objem | 200 | 300 | 400 | 500 | 750 | 1000 |
|---|---|---|---|---|---|---|---|
| *Total volume* | *L* | *200* | *300* | *400* | *500* | *750* | *1000* |
| *Max. working pressure* | *bar* | *6 - 10* | *6 - 10* | *10* | *10* | *10* | *10* |
| *Max. working temperature* | *°C* | *95* | *95* | *95* | *95* | *95* | *95* |
| *Max. working pressure of the coils* | *bar* | *10* | *10* | *10* | *10* | *10* | *10* |
| *Max. working temperature of the coils* | *°C* | *110* | *110* | *110* | *110* | *110* | *110* |
| *Surface of the upper coil* | *$m^2$* | *0.6 - 0.9* | *0.6 - 0.9* | *0.9 - 1.1* | *1.1 - 1.3* | *1.4* | *1.75 - 2.5* |
| *Surface of the lower coil* | *$m^2$* | *0.9 - 1.0* | *1.5 - 1.7* | *1.9 - 2.0* | *1.9 - 2.25* | *2.5 - 2.9* | *2.9 - 4.0* |
| *Number of the panels* | | *2* | *3* | *4* | *5* | *7-8* | *10* |

*A specific engineering calculation is required for cylinders with over a 1000 litre capacity.*

## 4.16 Explaining the system to the customer



Having completed the work and fully commissioned the system the installer should explain to the customer how the system works. The installer should familiarise the customer with the key components – the solar panels, the pump station, the pressure vessel and the digital controller.

**The customer should be informed:**

- Not to attempt to clean the panels, there will be no benefit in doing so.
- Not to adjust to re programme the digital controller
- What each reading on the digital controller means
- What the gauges on the pump station signify.

The customer should be provided with a copy of this installation manual and the customers own manual.

The customer should also be provided with the installer's telephone number and other details to enable the customer to call if there is any permanent drop in pressure (fluctuations in pressure when the system is working as normal) or if there are any leaks or weeps.

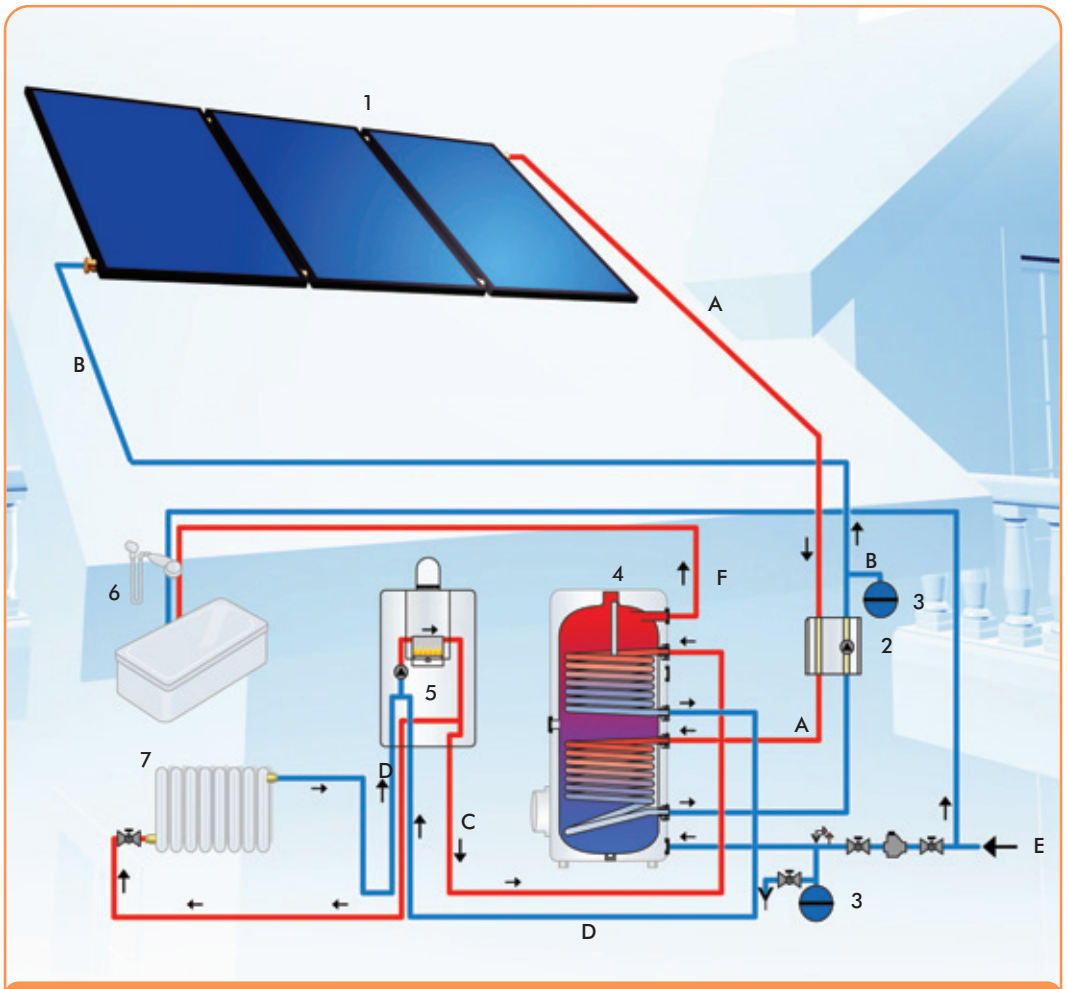
The customer should be reminded to ask the customer's central heating engineer to look at the pressure vessel every year when servicing the boiler (unless the installer offers this facility) and to have the glycol checked every five or ten years (for small DHW installations) or more frequently for larger installations.

If you have followed these instructions carefully you will have built a robust solar system which will provide years and years of trouble free performance.

## 4.17 The solar hot water domestic system

Installation Manual page 62

Overview of the ATAG solar water heating system for homes:




| | Legend: |
|---|---|
| 1 | 1000-10 Genersys solar panel |
| 2 | Double Pump Station |
| 3 | Expansion Vessel |
| 4 | Hot Water Cylinder |
| 5 | Auxillary Heater |
| 6 | Hot water domestic supply |
| 7 | Heating system |
| A | Flow pipe (hot Glycol) on solar system |
| B | Return pipe (cold Glycol) on solar system |
| C | Flow pipe from Auxillary Heater |
| D | Return pipe to Auxillary Heater |
| E | Cold water feed |
| F | Hot water supply to tap |

## 5.0 ATAG solar heating ticks all the right boxes for it's installers and their customers

- Building Regulation Compliance
- 10% Renewable energy targets for planning authorities
- 35 year life span
- 10 year performance guarantee
- 20 year anti corrosion guarantee
- Payback
- Aesthetically pleasing
- Low maintenance costs

ATAG solar thermal systems tick all the boxes for builders. A typical two panel system on a new three bedroom semi detached house will turn a SAP energy cost from £211 to £191 reducing 8,789kWh a year into 7,309 kWh a year, saving 1,440 kWh a year using the BRE's SAP worksheet 9.80, turning a "fail" into a "pass".[1]

A two panel system will provide around half a family's hot water from renewable sources (more in some cases, depending on lifestyle) reducing the home's carbon footprint by around half a tonne a year.[2]

If the home is built with oil or electricity as the main heat source the figures are even better.

The system has very low parasitic losses, and in an average newly built home pays for itself after seven to ten years. [3]

Maintenance costs are very low, usually requiring no more than visual inspections and glycol testing every ten years.[4]

[1] *Input data includes post 98 condensing boiler with room stats and TRVs; full details of SAP and energy requirements can be obtained from ATAG.*
[2] *Source: T-Sol software simulations based on the same sized house and normal family usage.*
[3] *Average costs for electricity for pump and controller are around £5 per year at current prices.*
[4] *Recommendations are visual inspections of the pressure gauge and pressure vessel; glycol testing can be done from inside the home.*

## 6.0 Safety controls in ATAG solar heating systems

SAFETY CONTROLS IN GENERSYS THERMAL SOLAR WATER HEATING SYSTEMS

Introduction

Genersys thermal solar systems are high quality thermal solar water heating systems. They are usually used for domestic water heating but also have industrial applications where hot water is required. Genersys systems are indirect water heating systems, pressurised and pumped.

They produce hot water without creating any carbon dioxide or any other greenhouse gas and create no pollution. They produce energy without using scarce fossil fuels and are cost effective.

Genersys systems are manufactured by its associated company, ThermoSolar AG. Genersys have around 100,000 systems actively in use in Europe and other countries in the world. Altogether Genersys systems are used in over 50 countries.

Genersys is an ISO 9001 company and its product is manufactured in a fully qualified ISO 9806 parts 1 & 2 factory.

Safety

Safety is central to Genersys; we are not aware of any safety issues or claims or proceedings involving our systems anywhere in the world. Genersys Systems are designed to high degrees of safety but account must be taken of the differing safety regulations that apply throughout the world.

The thermal solar market in the United Kingdom is very small. There are various types of systems available (such as drain back, direct, and evacuated tubes) and many of the system types have specific disadvantages. Genersys plc has produced this document in order that specifiers may distinguish between Genersys systems and other systems on the market and to inform specifiers that safety issues that may arise with other manufacturer's thermal solar systems do not arise in Genersys solar systems.

In this context "Safety" includes

- Safety to the Installer when installing a system
- Safety to the Consumer when using a system
- Water Safety Issues

System Overview

## 6.0 Safety controls in ATAG solar heating systems

A typical Genersys system will include two or more panels mounted on a south facing roof area; the panels contain a sealed heat transfer pipe which directs heat to a coil in a hot water cylinder. The heat exchange is indirect.

Safety to the Installer when installing a System

Genersys Systems are not marketed towards or intended to be installed by do it yourself unskilled or untrained installers. Every installer authorised to install Genersys panels has been fully trained. Installers usually have many plumbing qualifications.

Installers are trained to use scaffolding and proper up to date safety equipment and in the dangers of working at heights.

We have several training installers; they are all fully qualified plumbing and heating engineers, members of the Institute of Plumbing and Heating Engineering and some are members of the Water Industry Approved Plumber Scheme (WIAPS) duly certificated.

Safety to the Consumer when using a Genersys System

There are many safety controls built into every Genersys system. Genersys relies on a number of safety strategies and in our view a properly engineered thermal solar system, like Genersys', is as safe if not safer to the consumer than the consumer using a pressurised central heating system in the home to heat water.

Over Heating Issues

These are traditionally associated with thermal solar installations. Genersys panels have a stagnation temperature of 178°C, the system has a minimum of an 18 litre expansion vessel and a pressure relief valve, set to 6 bar, the system is pressurised to 3 bar but tested independently to still remain viable at 10 bar.

The system is designed so that when the Glycol vaporises in the panels (which takes place at about 140oC), the vapour volume is pushed into the expansion vessel. Even on the hottest days the pressure relief valve should not relieve.

The system has a built in solar pressure relief valve rated for temperatures in excess of 180oC. All other components used in the system are temperature and pressure rated well over there expected operating temperatures and pressures on the system. We recommend, if there is room, that the discharge from the expansion relief valve is run to a container within the vicinity of the pump station. This container is twice the size of the volume of glycol above the valve.

## 6.0 Safety controls in ATAG solar heating systems

All the Genersys controllers (DC11, 21, 31) control the temperature of the cylinder and will shut the pump off when the desired predetermined temperature (set by the installer) is reached. As can be imagined, the heat exchange pipe work gets very hot. All pipe work on the system is insulated by using solar quality insulation so that there is no pipe exposed inside the house that can be touched by the homeowner. This prevents contact burns.

If an unvented cylinder is used, we install an additional two port valve wired to spring shut the flow from the solar, if overheating should arise, in accordance with building regulation G3. The over-heat thermostat is wired though the solar and heating controls so all solar thermal operations stop and is an easy visual indicator to the home owner something is wrong. It must be manually reset as an additional safety measure.

Water Safety Issues

The solar system is a sealed system, so the heat transfer fluid does not at any time come into contact with the domestic hot water. We require the pipe work on the sealed system to be brazed or else to be joined using recommended compression joints with approved solar quality press fit joints. The cylinder has to be designed with a separate solar coil. The risk of cross contamination is slightly lower than that of central heating coiled cylinders as we demand a higher specification of the cylinder coils.

However, in order to ensure the safety of the consumer we use only polypropylene glycol which is approved throughout the world for use in food and consumer products. We refuse to approve the use of mono-propylene glycol. Under no circumstances should any ethylene based glycol be used in solar systems.

Our research and experience shows that installer mixed glycol is rarely mixed thoroughly and never with distilled water. Poorly mixed glycol allows crystals to form in solar systems with the high differential of temperatures that can be experienced. These formations, of course, weaken the anti-freeze properties of the glycol and freeze damage can occur to the heat exchange pipes and to the pipes in the collectors. Factory mixed solutions should be used.

To overcome the use of incorrectly mixed glycol or the wrong type of glycol, Genersys recommends its own ready mixed glycol solution which it sells with complete solar kits or separately.
Genersys solutions protect down to -30°C. The constant heating and cooling of glycol eventual after a ten year period tends to reduce its anti-freeze properties to around -15°C. The exact state of the glycol can be tested by drawing off a small sample from within the home.
MAINTENANCE REQUIREMENTS FOR SOLAR INSTALLATIONS

## 6.0 Safety controls in ATAG solar heating systems

Note:

These requirements are recommended by Genersys plc and must be adhered to and an appropriate written record of adherence must be kept. Any failure to do so will nullify any manufacturer's guarantees and is likely to nullify any installer's guarantee.

In addition these requirements are separate from any regime for the prevention of legionella formation. Genersys recommends that every installation should have a specific anti-legionella regime as the installing heating and ventilation engineers and/or the system designers propose. The anti-legionella regime should be recorded in writing and a written record of adherence thereto should be maintained.

Maintenance Checks

A system of preventative maintenance should be adopted for solar installations and fossil fuelled installations.

The following specific checks are for large scale installations and should be carried out at least once every sixty days between October and March and at least once every ninety days between April and September.

- Visual inspection for weeps, leaks and fluid escapes
- Manually operate all valves and pumps to ensure that they are working correctly
- Visual inspection that system pressure has not dropped into red zone
- Visual inspection that flow gauges indicate correct flow levels
- Visual inspection that there is no damage to panels or fixings; this can be done from ground floor level provided some form of magnification is used
- If there is pre heating used, regular checks of the heating system for the final heated cylinder should be made

Annual Checks for Large Scale Installations

- Check operation of active anodes
- Check operation of non active anodes

This maintenance regime can be adopted for smaller scale domestic water heating installations on an annual basis

## 6.0 Safety controls in ATAG solar heating systems

The following additional checks must be carried out every three years;

- Check the pre-charge of the expansion vessel(s)
- Check the whole system for signs of corrosion
- Test glycol with approved testing kit
- Visual inspection that all insulation is in good condition and not becoming brittle or cracked
- Visual inspection that any pre heat cylinders are free from corrosion
- If vacuum panels are used, check that the vacuum gauge shows that there is still sufficient vacuum. The pointer should be in the green zone.