# MODUSOL Solar Heating

**Solar Heating Equipment For**
**Commercial Hot Water Installations.**

## Installation, Commissioning and Servicing Instructions

**IMPORTANT NOTE**

**THESE INSTRUCTIONS MUST BE READ AND UNDERSTOOD BEFORE INSTALLING, COMMISSIONING, OPERATING OR SERVICING EQUIPMENT**

Hamworthy

Heating *at work.*

# Customer After Sales Services

Telephone: **0845 450 2866** E-mail: **aftersales@hamworthy-heating.com** Fax: **01202 662522**

### Technical Enquiries

To supplement the detailed technical brochures, technical advice on the application and use of products in the Hamworthy Heating range is available from our technical team in Poole and our accredited agents.

### Site Assembly

Hamworthy offer a service of site assembly for many of our products in instances where plant room area is restricted. Using our trained staff we offer a higher quality of build and assurance of a boiler built and tested by the manufacturer.

### Commissioning

Commissioning of equipment by our own engineers, accredited agents or specialist sub – contractors will ensure the equipment is operating safely and efficiently.

### Maintenance Agreements

Regular routine servicing of equipment by Hamworthy service engineers inspects the safety and integrity of the plant, reducing the risk of failure and improving performance and efficiency. Maintenance agreements enable our customers to plan and budget more efficiently.

### Breakdown service, repair, replacement

Hamworthy provide a rapid response breakdown, repair or replacement service through head office at Poole and accredited agents throughout the UK.

### Spare Parts

A comprehensive spare parts service is operated from our factory in Poole, providing replacement parts for both current and discontinued products. Delivery of parts and components is normally from stock within seven days. However, a next day delivery service is available for breakdowns and emergencies.

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**COUNTRY OF DESTINATION : UNITED KINGDOM & REPUBLIC OF IRELAND**

THE EQUIPMENT COMPLIES WITH ALL RELEVANT UK BYLAWS & EUROPEAN DIRECTIVES.

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## 1.0 INTRODUCTION

**1.1** A competent person holding a BEPEC qualification or equivalent must install this solar equipment. All installations **MUST** conform to the relevant Electrical Safety and Building Regulations. Health & Safety requirements must also be taken into account when installing any equipment. Failure to comply with the above may lead to prosecution.

**1.2** The MODUSOL range is based round the MODUSOL flat plate Solar collector, which is available in bundles of 2, 3, 4 & 5 collectors connected in series. These are supplied in kits for either A-frame mounting; installation on a flat roof, or with the fixtures and fittings for "On-Roof" or "In-Roof" installation. Multiples of each kit can be selected depending on the total number of collectors required. See table 1.1 below.

**1.2.1** The pictures shown below (& right) demonstrate the different types of collector arrangements available.

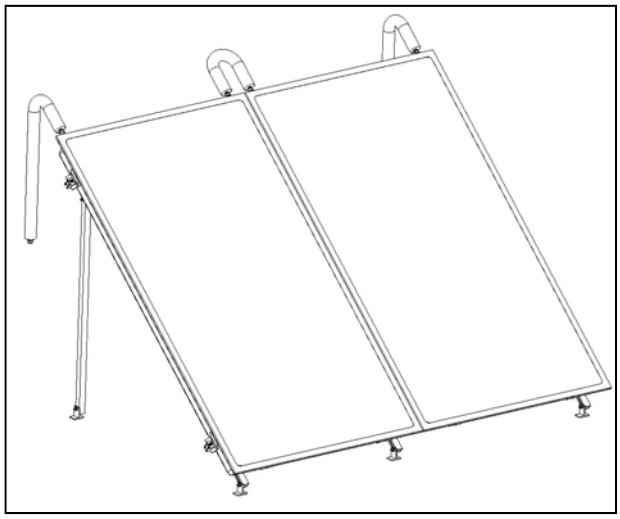


**Figure 1.1** A -Frame Assembly

**Figure 1.2** On Roof Assembly

**Figure 1.3** In Roof Assembly

| | Installation Type | ' On Roof ' | | 'A-Frame' | 'In Roof' |
|---|---|---|---|---|---|
| | Collector Orientation | Horizontal | Vertical | Vertical | Vertical |
| Number Of Collectors | 2 | 564300001 | 564300011 | 564300021 | 564300041 |
| | 3 | 564300002 | 564300012 | 564300022 | 564300042 |
| | 4 | 564300003 | 564300013 | 564300023 | 564300043 |
| | 5 | 564300004 | 564300014 | 564300024 | 564300044 |

Table 1.1 Collector Kits Available

## 2.0 The Modusol Solar Heating System

2.1 Refer to figure 2.0 below.

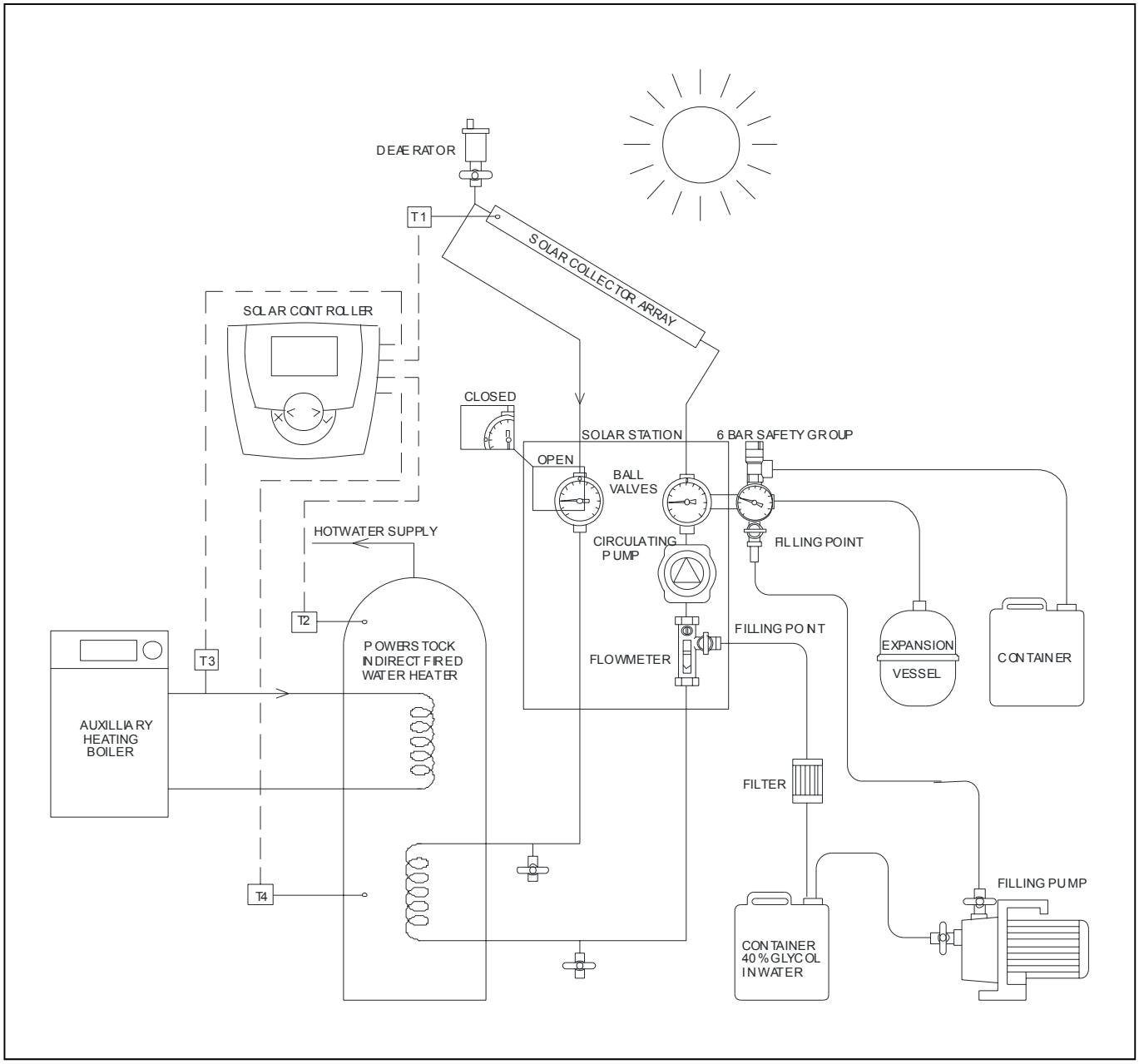



Figure 2.0—Simple Modusol Potable Water Heating Circuit

2.2 Operation Of Simple Modusol Heating Circuit

2.2.1 Infrared radiation from the sun warms the solar fluid contained in the solar collectors (collector array). The temperature of the fluid in the collectors is sensed by a 5kΩ NTC sensor (T1) connected to an electronic solar controller.

2.2.2 The minimum set temperature in the collectors to operate the circulating pump is 20$^{o}$C.

2.2.3 On reaching a predefined temperature measured in the collector array the solar controller switches the circulation pump on and fluid circulates through the collector array where it heats up due to the sun's radiation.

2.2.4 The heated fluid flows through the bottom coil of the Indirect fired water heater where it transfers it's heat to the potable water contained in the water heater.

2.2.5 On sensing the set point temperature (usually 60°C) for the indirect fired water heater from the 5kΩ NTC sensor (T2) the solar controller switches the circulating pump off.

2.2.6 The flow-rate through the circuit is set by either adjusting the speed of the pump on the solar-controller or restricting the flow using the valve in the flow-meter.

2.2.7 The rule of thumb for flow through the collector circuit is 0.5 litres / minute per m$^2$ of Net Collector Area.

2.2.8 Where the energy from the sun is insufficient to supply the heat necessary to raise the potable water in the indirect fired water heater to 60°C an auxiliary gas/oil/biomass fired boiler can be connected to the top coil of the indirect fired heater.

2.2.9 Alternatively an immersion heater in the clean-out flange of the indirect fired water heater can also be used.

2.2.10 For applications using thermal storage please refer to appendix B & C for details on the Powerstock calorifer & storage tank ranges.

2.2.11 The temperature of fluid in the flow & return pipework can be observed from the dial thermometers in the isolating ball valves of the Solar Station

2.2.12 A safety group is attached to the solar station & comprises :-
A) 6bar pressure relief valve, with R3/4 outlet.
B) D60mm 0-10 bar range manometer.
C) Isolating ball valve with R3/4" connection acting as a filling point.
D) R3/4" connection to an expansion vessel.

2.2.13 The expansion vessel and safety group can be connected using a 1.5m DN16 Stainless Steel corrugated hose. HHL. Part No. 564300051.

2.2.14 The solar circuit is filled with solar fluid made from 40% propylene Glycol and 60% water by volume.

2.2.15 A filling pump (HHL Part No. 564300050) supplied with hoses and filter is connected as shown in figure 2.0.

2.2.16 To fill or pressurise the solar circuit, open the fill point isolating valves. Ensure the ball valve directly above the pump is closed ( pip on the handle of the valve horizontal).

2.2.17 During filling, the isolating ball valve fitted below the de-aeration pot at the collector array is kept open.

2.2.18 A container is placed on the outlet of the pressure relief valve to collect the glycol / water mix discharge. The glycol water mix should not be discharged to drain.

3.0 Modusol Solar System Components

3.1. The solar collector is constructed of copper tube ultrasonically welded to selectively coated absorber plates. This is housed in an aluminium & UV resistant polycarbonate case and insulated at the rear of the absorber plate using a thick layer of rock-wool to prevent heat loss. The safety glass cover is coated in a self cleaning film, that ensures optimum performance.

3.2 Each Modusol kit comes supplied with brackets and fasteners; tubing to link the collectors & seals; solar transfer station (complete with integral or stand alone solar controller); three 5k Ohm NTC temperature sensors (with cables of varying length); solar circuit expansion vessel & containers of glycol solution to be mixed with water to give a concentration of 40% glycol/ 60% water.

3.3 Modusol flat solar collectors are suitable for retrofitting to existing hot water installations, refurbishment and new build.

3.4 Hamworthy Heating's range of Powerstock Indirect fired hot water calorifiers & storage tanks are sized specifically for each application and are supplied separately.

3.5 These vessels are available in storage capacities of :- 160L, 200L, 300L, 400L, 500L, 750L & 1000L.

Where larger storage capacities can be made up using multiple vessels.

3.6 Roof terminals (HHL Part no. 553000330) are used for entry of pipework & cables to the roof space.

Figure 3.1 Example Of A Tile Type Roof Terminal

3.7 The MODUSOL Solar Heating package come with a solar transfer station, suitable for a maximum of 12 Collectors. For larger collector arrays two or more solar stations can be installed in parallel.

3.7.1 The MODUSOL Solar Station comprises of a solar controller, circulation pump, flow-meter, pressure relief valve & manifold for connection to a suitably sized expansion vessel.

See Section 15.2 To 15.4 for expansion vessel sizing.

3.7.2 Of the three 5kΩ NTC temperature sensors supplied, the brown cabled temperature sensor is always installed in the return side of the collector array. The other two grey cabled sensors are installed in the solar thermal store. The location of these sensors depends on the location defined by the hydraulic scheme selected on the solar controller.

3.7.3 The controls philosophy is based on 9 commonly used designs of hydraulic scheme for solar heating. See section 16.1. Selection of the most appropriate hydraulic scheme on the controller matched to the application allows the installer to set the parameters relevant to control that particular solar heating installation.

3.7.4 The station mounted solar controller can control 1 variable speed circulating pump, one fixed speed pump and or a diverting valve depending on the design of the solar heating installation and hydraulic selected on the controller. The wall mounted controller can control 2 variable speed pumps.

3.8 Solar thermal storage is provided by the Powerstock range of un-vented hot water calorifiers and storage tanks.

3.8.1 The control panel supplied with the Powerstock tank range contains both a control and safety limit thermostat. The safety limit thermostat should be wired back to the main control panel to isolate the electrical supply to the solar station should the safety limit thermostat be activated.

3.8.2 Containers of 25L, 10L & 5L are provided partially filled with Propylene Glycol. The content is then topped-up with water to make a solution of 40% Glycol in water. The glycol mix is then pumped into the solar circuit.

3.9 Hamworthy Heating advises the use of AAV's within the fabric of the building and sited in an accessible location.

3.10 Where it is necessary to have an AAV, an isolating ball valve must be installed between the AAV and the system to prevent venting of steam during conditions of collector stagnation. The ball valves must be kept shut during normal operation.

3.11 A pressurisation unit HHL Part Number 553000800 designed specifically for Solar thermal heating, is also available. This incorporates a low level water switch that protects the pressurisation pump(s) and is provided with a relay to directly or indirectly shut down ancillary equipment such as an auxiliary boiler or give an alarm signal. Care must be taken to ensure all extra safety requirements are met and that the relevant interlocks will shut down the boiler(s) should a high or low pressure fault occur.

3.12 Where more than 5 collectors in series are required, it will be necessary to connect collector Kits in Parallel, where possible using kits of equal numbers of collectors to allow for a balanced flow across the collector array.

3.13 Alternatively a reverse return arrangement where each collector is connected in parallel to a common header is also a common method of connection.

3.14 When using a series / parallel arrangement for balancing of the array it is not necessary that balancing valves be used, provided that :-

A. The same number of collectors in series is used on each row of the array.

B. The same number, type of fitting and pipe lengths used on flow pipework mirror those on the return.

The combined dynamic resistance from each collector row must be at least 3 times more than that of the header pipes. This is called the Tichelmann principle.

3.15 If necessary balancing may be done using balancing valves (not HHL supply), such as where there is a combination of odd & even numbers of collectors in each row.

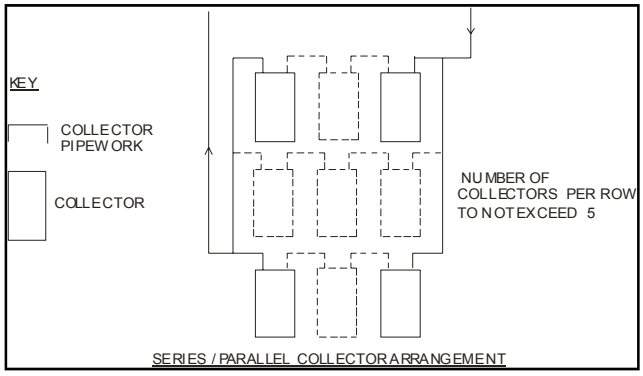



Figure 3.15 - Collector Array Balancing

3.16 If there is a combination of odd and even collectors use of a reverse return header arrangement may be expedient. See Figure 3.16.

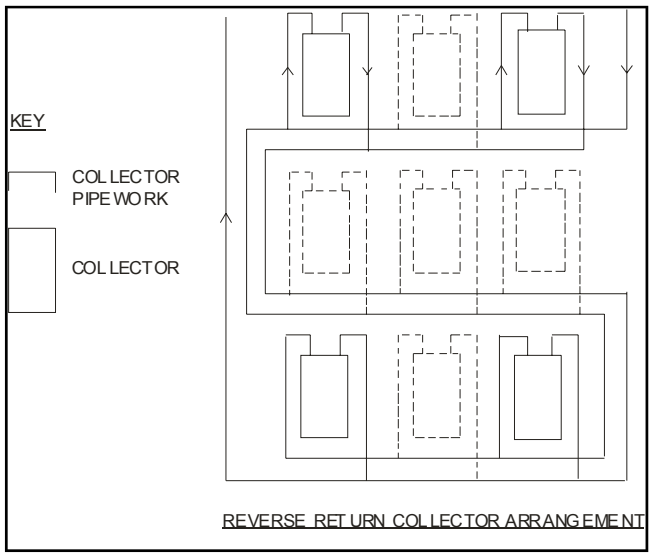



Figure 3.16 - Reverse Return Header Arrangement

Note in this arrangement the “Tichelmann principle” applies.

3.17 The comparison table 3.17 describes the advantages / disadvantages of both Series/Parallel and Reverse Return Header connection.

| Collector Arrangement | Advantages | Disadvantages |
|---|---|---|
| Series / Parallel | 1) Easy To Install.<br>2) Low Installation & Material Costs.<br>3) Easy To Balance (Using The Tichelmann Principle). | 1) Limited to a maximum number of 5 collectors per row.<br>2) High pressure drop across the collector array compared with Reverse Return Arrangement.<br>3) Lower efficiency compared with Reverse Return arrangement. |
| Reverse Return Arrangement | 1) No need to balance the array.<br>2) Reverse Return Header can be made off site. | 1) Higher Installation & material costs compared with Series / Parallel array. |

Table 3.17 - Table Of Advantages & Disadvantages Of Series / Parallel Collector and Reverse Return Connection

3.18 Hamworthy Heatings Modusol Collector kits are supplied for Series/Parallel installation at present.

Please consult Hamworthy Heating for further assistance.

3.20 Specification of Modusol components.

| | |
|---|---|
| Dimensions | 2100 x 1200 x 109 mm |
| Weight | 43 kg |
| Net Collector Area | 2.275 $m^2$ |
| Fluid Capacity | 1,46 l |
| Flow Through Collector Per Collector Area | 0.5l/min/$m^2$ |
| Pressure Drop across 2 collectors in series @ 2.3 l/min flow (40% Glycol / 60% Water) | 12.7 mbar |
| Pressure Drop across 5 collectors in series @ 5.75 l/min flow (40% Glycol / 60% Water) | 54.9 mbar |
| Absorption | 95% |
| Thermal Emission | 5% |
| Collector Yield, per annum | >525kWh/$m^2$a |
| Maximum Operating Pressure | 15bar |
| Collector Connection / Sealing | R½" / Flat Seal |
| Solar Sensor | D6mm 5k Ohm NTC |
| Absorber Plate | Selective Coating |
| Thermal Insulation | 60mm Glass Fibre |
| Glass Cover | Low iron solar safety glass |
| Glass Transmittance | 91% |
| Collector Stagnation Temperature @ 1000W/$m^2$ & 30°C ambient | 240°C |
| Collector Power Output @ 1000W/$m^2$ Solar Irradiance | 1.7kW |
| Rear Casing | Thick Walled Polycarbonate |

Table 3.19 – Solar collector Specification

| No. Collectors | Recommended Flowrate l/min | Pressure Drop mbar |
|---|---|---|
| 1 | 1.15 | 6.3 |
| 2 | 2.30 | 12.7 |
| 3 | 3.45 | 22.9 |
| 4 | 4.60 | 36.9 |
| 5 | 5.75 | 54.9 |

Table 3.20 - Table Of Resistance Of Collectors In Series With 40% Gycol / 60% Water Mix (By Volume)

| | |
|---|---|
| Dimensions | 454 x 248 x 203 |
| Weight | 7 kg |
| Volume Contents | 0.5 litres |
| Maximum Operating Pressure | 6 bar |
| Maximum Operating Temperature | 120 $^{o}$C, 160$^{o}$C Short Term |
| Safety Valve | 6 bar |
| Gravity Brake Opening Pressure | 20mbar |
| Flowmeter Measuring Range | 2-15 l/min |
| Thermometer Measuring Range | 0-120$^{o}$C |
| Circulation Pump | Biral MXS 13-1 |
| Supply Voltage | 230V AC +/-10% (50-60Hz) |
| Fuse Rating | 3.15A |
| Max Power Input | 2.3VA |
| Maximum Pump Head | 2.75m |
| Max Pump Capacity | 3.74m$^{3}$/h |
| Flow Measuring Device | 2-15l/min |
| Max No. Of Collectors Per Transfer Station | 12 |

Table 3.21 – Solar Transfer Station Specification

| Controller Type | Integral To Transfer Station | Wall Mounted |
|---|---|---|
| HHL Part Number | 553000500 | 553000520 |
| Max. Relay Switching Current | 2A | 1A |
| No. Of Relays | 2 | |
| Supply Voltage | 230V AC +/-10% (50-60Hz) | |
| Maximum Power Input | 2.3A | |
| Over Current Fuse Protection | 3.15A | |
| Number Of Sensor Inputs | 4 | |
| Sensor Type | 5 k Ohm NTC (D6mm) | |
| Display | Back Lit LCD Display | |
| Temperature Measuring Range | -20 To 250$^{o}$C | |
| Operating Temperature Of Electronics | 0-50$^{o}$C | |
| Ingress Protection | IP40-EN60529 | |
| Protective Class | II – EN60730 | |
| Controller Complies With | EMC Guideline 89/336/EWG To 90/68/EWG<br>Low Voltage Guideline 70/23/EWG | |
| Dimensions Of Plastic Enclosure | 154 x 135 x 49 mm | |

Table 3.22 —Solar Controller Specification

## 4.0 Standards And Safety Instructions

The following standards and health and safety documents apply : -

4.1 Solar System Design

EN ISO 9488
Thermal solar systems and components, terminology (ISO/DIS 9488; 1995)

EN12975-1
Thermal solar systems and components Part 1: General requirements.

EN12975-2
Thermal solar systems and components Part 2: Test Methods.

ENV 1991-2-3
Eurocode 1—Basis of design and actions on structures—Part 2-3: Actions on structures—Snow loads.

EN12976-1
Thermal solar systems and components—factory made systems—Part 1 : General requirements.

EN12976-1
Thermal solar systems and components—factory made systems—Part 2 : Test Methods.

EBV 12977-1
Thermal solar systems and components—custom built systems—Part 2: Testing Methods

ISO 9459-1:1993
Solar Heating—Domestic Water Heating Systems—Part 1; Performance rating procedure using indoor test methods.

ISO/TR 10217
Solar Energy— Water Heating Systems— Guide to Material selection with regard to internal corrosion.

4.2 Collectors and collector assembly

ENV 1991-2-4
Eurocode 1—Basic of design and actions on structures—Part 2-4: Actions on structures—wind actions.

4.3 Lightening protection

ENV 61024-1
Protection of structures against lightening—Part 1: General principles (IEC 1024-1:1990; modified)
Building Regulations 1991 (England & Wales. Requirements G3,L1 and Regulation 7.

BS7671
Requirements for electrical installations.
(IEE Wiring Regulations, 16th Edition)

4.4 COSHH

Applicable to storage and use of heat transfer fluid and water treatment chemicals.

## 5.0 Planning Permission

Seeking the opinion of the local authority on planning matters prior to starting work on the solar installation is advised. However planning permission is generally only required if you are in a conservation area or you are installing a solar system on a listed building.

## 6.0 Installation Requirements

6.1 Installation of the solar system must be carried out in accordance with the relevant requirements of the following statutory regulations:-

BS 5918:1989

The health & safety at work act 1974

The management of Health and Safety at work Regulations 1999.

The construction (Health, Safety and Welfare) Regulations 1996.

The construction design and management Regulations 1994.

The lifting Operations and Lifting Equipment Regulations 1998.

6.2 Electrical Installation

All wiring must be performed in accordance with BS7671: IEE Wiring Regulations

The controller must be earthed.

Primary flow & return circuit pipework must be electrically cross-bonded in accordance with BS7676.

## 7.0 Product Warrantee

The Modusol thermal solar heating system is covered by a 10 year warranty on the solar collectors and 2 years cover on the pump station, controller and all other components.

Where the installation has been installed by a third Party other than Hamworthy Heating Ltd, or one of it's approved solar heating installers this cover relates only to materials.

Contact Hamworthy Heating Ltd on 01202 662500 for an approved solar heating installer in your area.

## 8.0 SUPPLY AND DELIVERY

Your Modusol Solar Heating package is dispatched to site as a boxed kit. When taking delivery please ensure that you have received the correct number of packages to fulfill your order. If any item is missing please contact our after sales service team. Please provide details of your order such as order number and contract number as well as a detailed description of the missing item. Refer to the table below.
Do not store collectors on top of one another without their packaging or lay anything on the glass.

Table 8.0 - Schedule Of Modusol Kits

| Array Type | HHL Kit No. | Collectors | HHL Part No | Description | No. Of Boxes |
|---|---|---|---|---|---|
| On Roof Horizontal Collectors | 564300001 | 2 | 553000100 | 252 Solar Collector | 2 |
| | | | 553000202 | On Roof Basic Kit | 1 |
| | | | 553000303 | Anchor Set - 2 collectors | 1 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| | 564300002 | 3 | 553000100 | 252 Solar Collector | 3 |
| | | | 553000202 | On Roof Basic Kit | 1 |
| | | | 553000203 | On Roof Extension Kit | 1 |
| | | | 553000303 | Anchor set - 2 collectors | 1 |
| | | | 553000304 | Anchor set - Extra collector | 1 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| | 564300003 | 4 | 553000100 | 252 Solar Collector | 4 |
| | | | 553000202 | On Roof Basic Kit | 1 |
| | | | 553000203 | Extra Collector Kit | 2 |
| | | | 553000303 | Anchor set - 2 collectors | 1 |
| | | | 553000304 | Anchor set - Extra collector | 2 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| | 564300004 | 5 | 553000100 | 252 Solar Collector | 5 |
| | | | 553000202 | On Roof Basic Kit | 1 |
| | | | 553000203 | Extra Collector Kit | 3 |
| | | | 553000303 | Anchor set - 2 collectors | 1 |
| | | | 553000304 | Anchor set - Extra collector | 3 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| On Roof Vertical Collectors | 564300011 | 2 | 553000100 | 252 Solar Collector | 2 |
| | | | 553000200 | On Roof Basic Kit | 1 |
| | | | 553000300 | Anchor set - 2 collectors | 1 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| | 564300012 | 3 | 553000100 | Solar Collector 252 | 3 |
| | | | 553000200 | On Roof Basic Kit | 1 |
| | | | 553000201 | Extra Collector Kit | 1 |
| | | | 553000300 | Anchor set - 2 collectors | 1 |
| | | | 553000301 | Anchor set - Extra collector | 1 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| | 564300013 | 4 | 553000100 | 252 Solar Collector | 4 |
| | | | 553000200 | On Roof Basic Kit | 1 |
| | | | 553000201 | Extra Collector Kit | 2 |
| | | | 553000300 | Anchor set - 2 collectors | 1 |
| | | | 553000301 | Anchor set - Extra collector | 2 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |
| | 564300014 | 5 | 553000100 | 252 Solar Collector | 5 |
| | | | 553000200 | On Roof Basic Kit | 1 |
| | | | 553000201 | Extra Collector Kit | 3 |
| | | | 553000300 | Anchor set - 2 collectors | 1 |
| | | | 553000301 | Anchor set - Extra collector | 3 |
| | | | 553000330 | Pair Of Roof Terminals | 1 |

Table 8.0 - Schedule Of Modusol Kits (Continued)

| Collector Array Type | HHL Kit No. | Collectors | HHL Part No | Description | No. Of Boxes |
|---|---|---|---|---|---|
| A-Frame Mounted Vertical Collectors | 564300021 | 2 | 553000100 | Heliostar Collector 252 | 2 |
| | | | 553000309 | A-Frame Kit Basic | 1 |
| | | | 553000310 | Extra Collector Kit | 1 |
| | | | 553000715 | D12 x 500 Tube | 1 |
| | | | 553000716 | D12 x 1000 Tube | 2 |
| | | | 553000718 | R1/2" Brass Nipple | 2 |
| | | | 553000711 | x 10, 1/2" Flat Ring Seals | 1 |
| | 564300022 | 3 | 553000100 | Heliostar Collector 252 | 3 |
| | | | 553000309 | A-Frame Kit Basic | 1 |
| | | | 553000310 | Extra Collector Kit | 2 |
| | | | 553000715 | D12 x 500 Tube | 2 |
| | | | 553000716 | D12 x 1000 Tube | 2 |
| | | | 553000718 | R1/2" Brass Nipple | 2 |
| | | | 553000711 | x 10, 1/2" Flat Ring Seals | 1 |
| | 564300023 | 4 | 553000100 | Heliostar Collector 252 | 4 |
| | | | 553000309 | A-Frame Kit Basic | 1 |
| | | | 553000310 | Extra Collector Kit | 3 |
| | | | 553000715 | D12 x 500 Tube | 3 |
| | | | 553000716 | D12 x 1000 Tube | 2 |
| | | | 553000718 | R1/2" Brass Nipple | 2 |
| | | | 553000711 | x 10, 1/2" Flat Ring Seals | 1 |
| | 564300024 | 5 | 553000100 | Heliostar Collector 252 | 5 |
| | | | 553000309 | A-Frame Kit Basic | 1 |
| | | | 553000310 | Extra Collector Kit | 4 |
| | | | 553000715 | D12 x 500 Tube | 4 |
| | | | 553000716 | D12 x 1000 Tube | 2 |
| | | | 553000718 | R1/2" Brass Nipple | 2 |
| | | | 553000711 | x 10, 1/2" Flat Ring Seals | 2 |
| In Roof Vertical Collectors | 564300041 | 2 | 553000100 | 252 Solar Collector | 2 |
| | | | 553000306 | In Roof Basic Kit | 1 |
| | 564300042 | 3 | 553000100 | 252 Solar Collector | 3 |
| | | | 553000306 | In Roof Basic Kit | 1 |
| | | | 553000307 | Extra Collector Kit | 2 |
| | 564300043 | 4 | 553000100 | 252 Solar Collector | 4 |
| | | | 553000306 | In Roof Basic Kit | 1 |
| | | | 553000307 | Extra Collector Kit | 3 |
| | 564300044 | 5 | 553000100 | Heliostar Collector 252 | 5 |
| | | | 553000306 | In Roof Basic Kit | 1 |
| | | | 553000307 | Extra Collector Kit | 4 |

Table 8.1—Schedule Of Ancillary / Spare Parts

| HHL Part No. | Description | No. Of Boxes |
|---|---|---|
| 553000719 | Filling Pump | 1 |
| 553000330 | Pair Of Roof Terminals | 1 |
| 553000400 | 10L Container Glycol | N/A |
| 553000401 | 25L Container Glycol | N/A |
| 553000402 | 5L Container Glycol | N/A |
| 553000490 | Pump Station + 3 Off Temp Sensors | 1 |
| 553000510 | MXS13-1 Pump & Controller | 1 |
| 553000520 | ES5910S Electronic Controller | 1 |
| 553000800 | Solar PU | 1 |

**9.0 SIZE AND SPACE REQUIREMENTS**

9.1 The Modusol Solar heating kits have been designed for ease of installation on site. The overall dimensions of the collector and assembly arrangements are shown in the following figures.

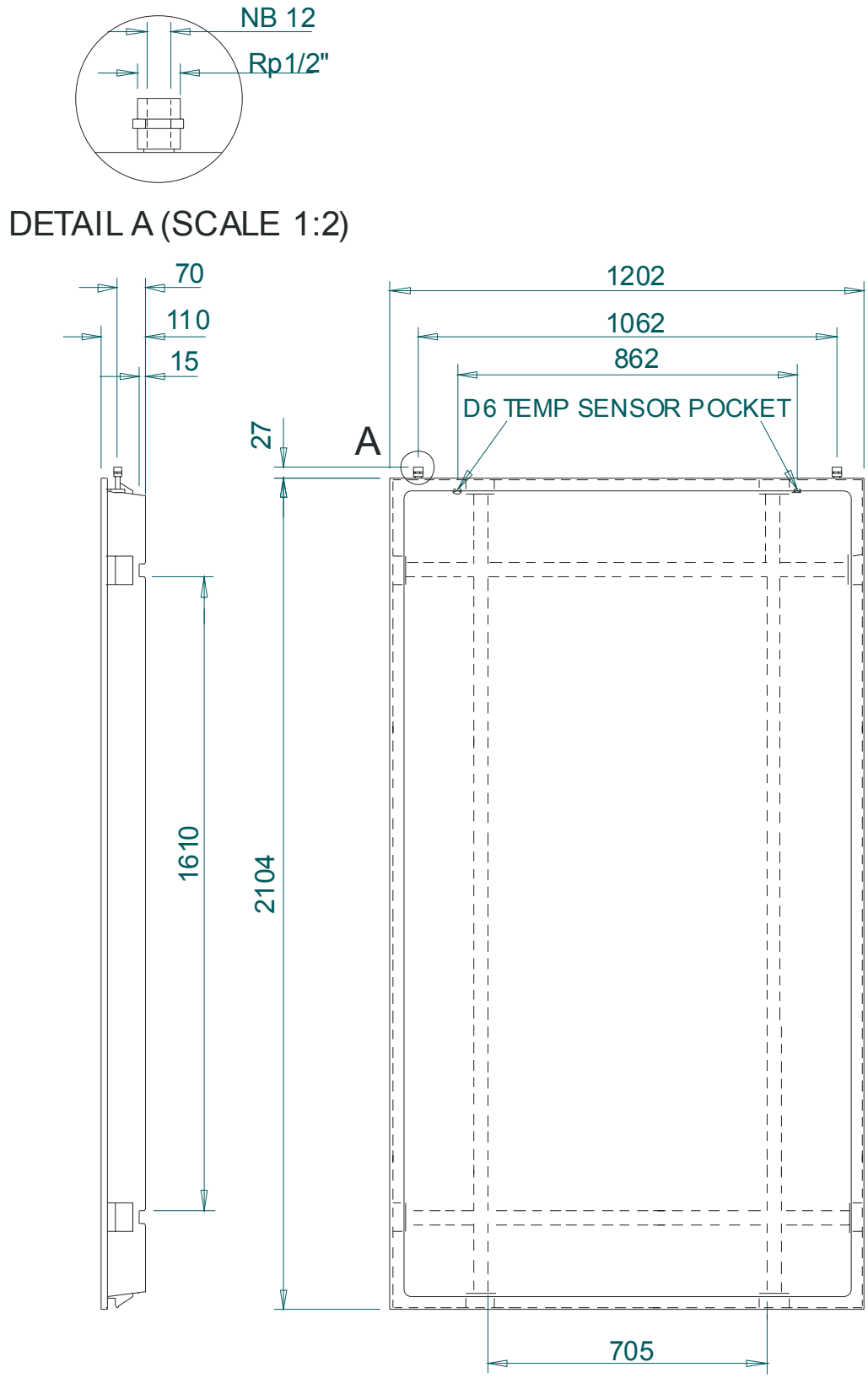



Figure 9.1— Dimensions Modusol Solar Collector (Part Number 553000100)

| Number Of Collectors | Length L (mm) |
|---|---|
| 2 | 2404 |
| 3 | 3606 |
| 4 | 4808 |
| 5 | 6010 |

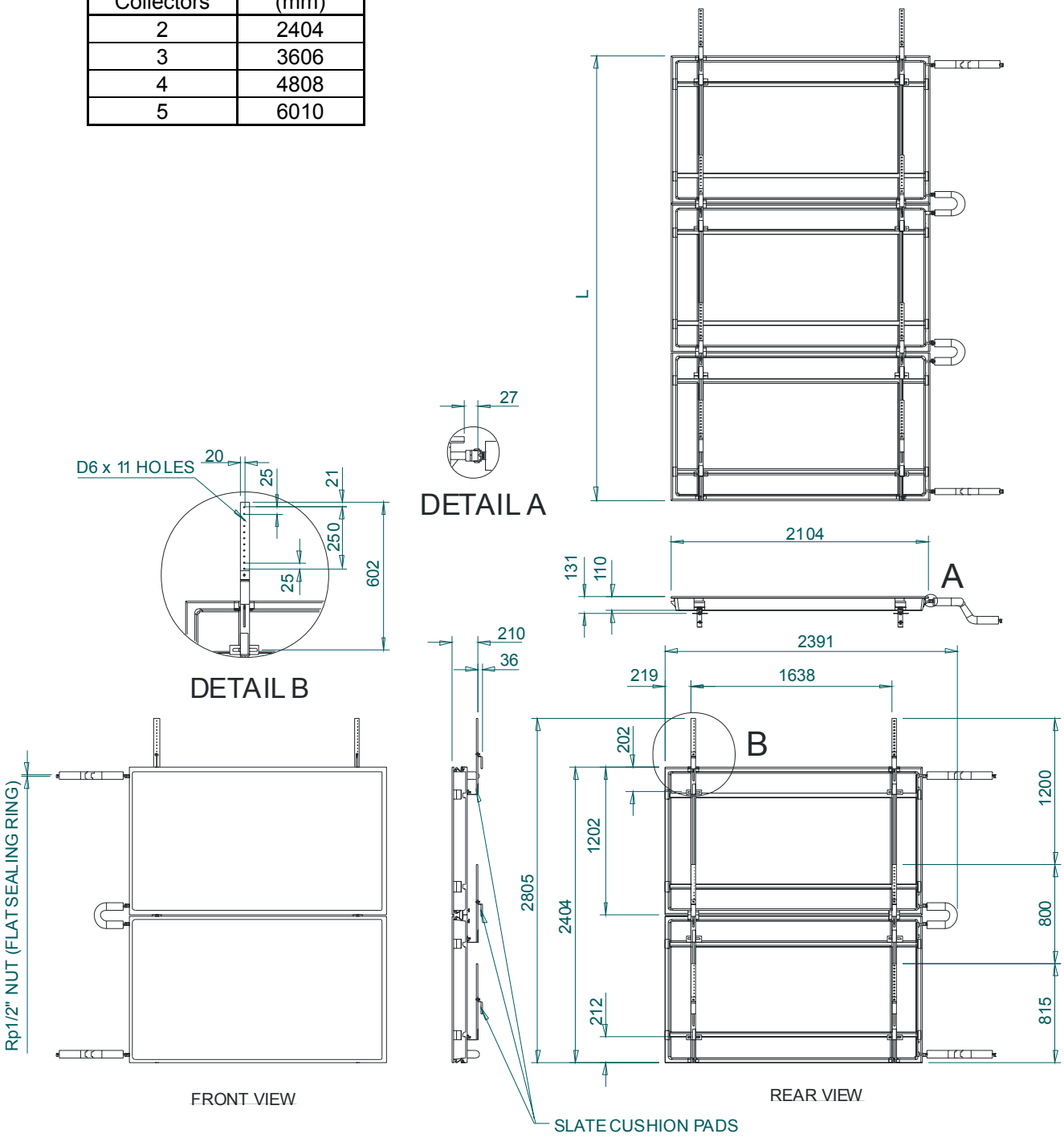



Figure 9.2 - Dimensions Of On-Roof Horizontal Collector Assembly (Part No's 64300001 To 564300004)

| Number Of Collectors | Length L (mm) |
|---|---|
| 2 | 2404 |
| 3 | 3606 |
| 4 | 4808 |
| 5 | 6010 |

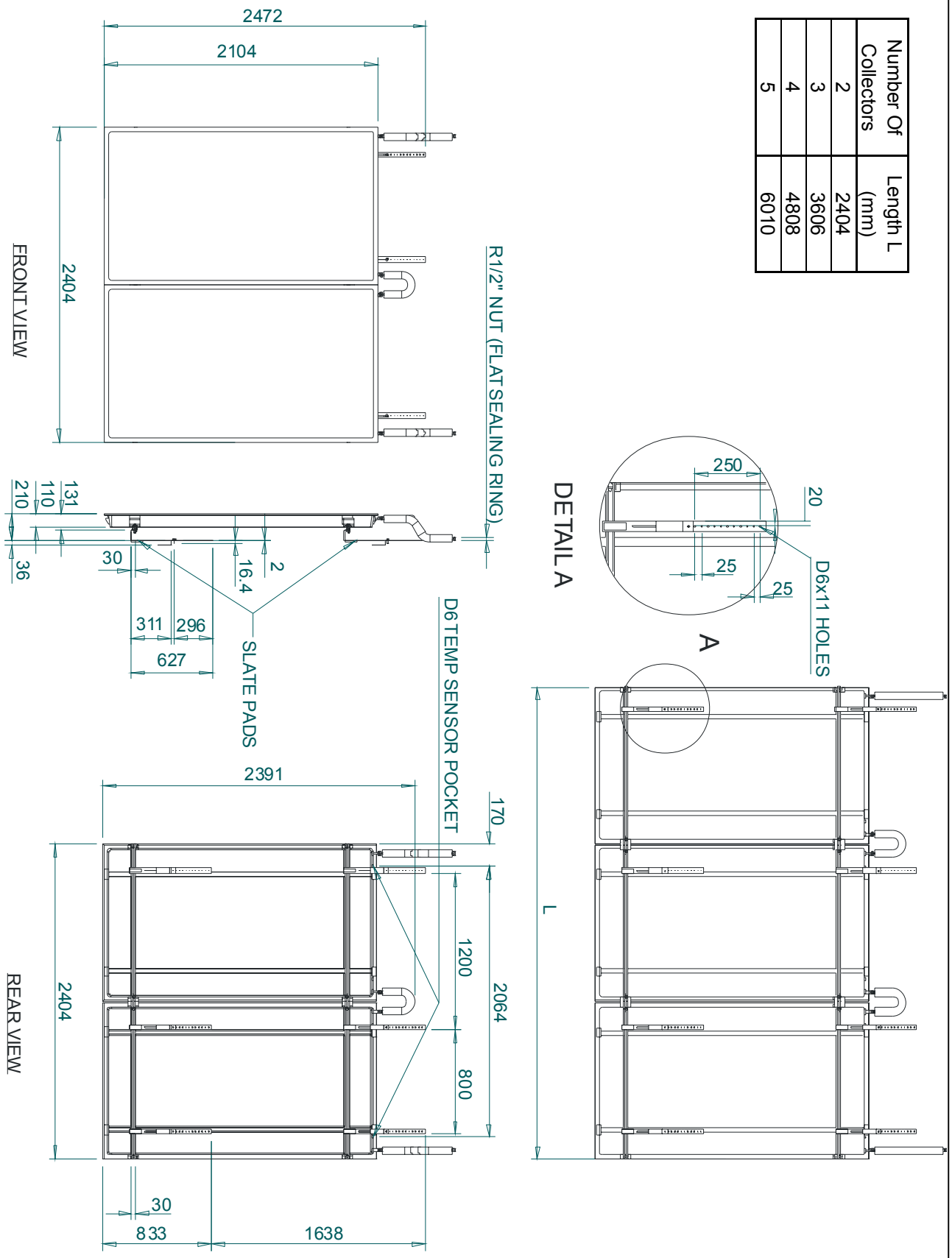
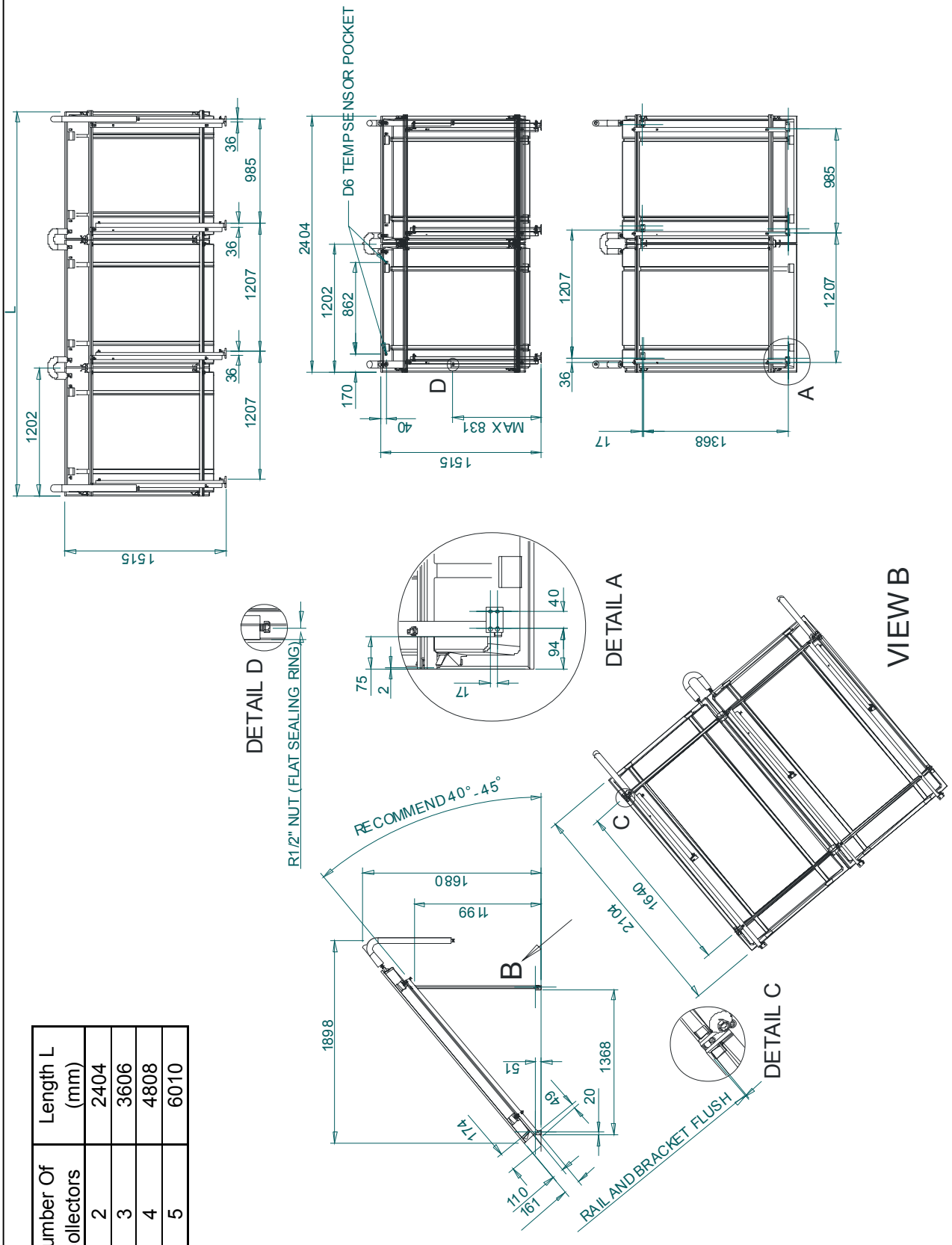
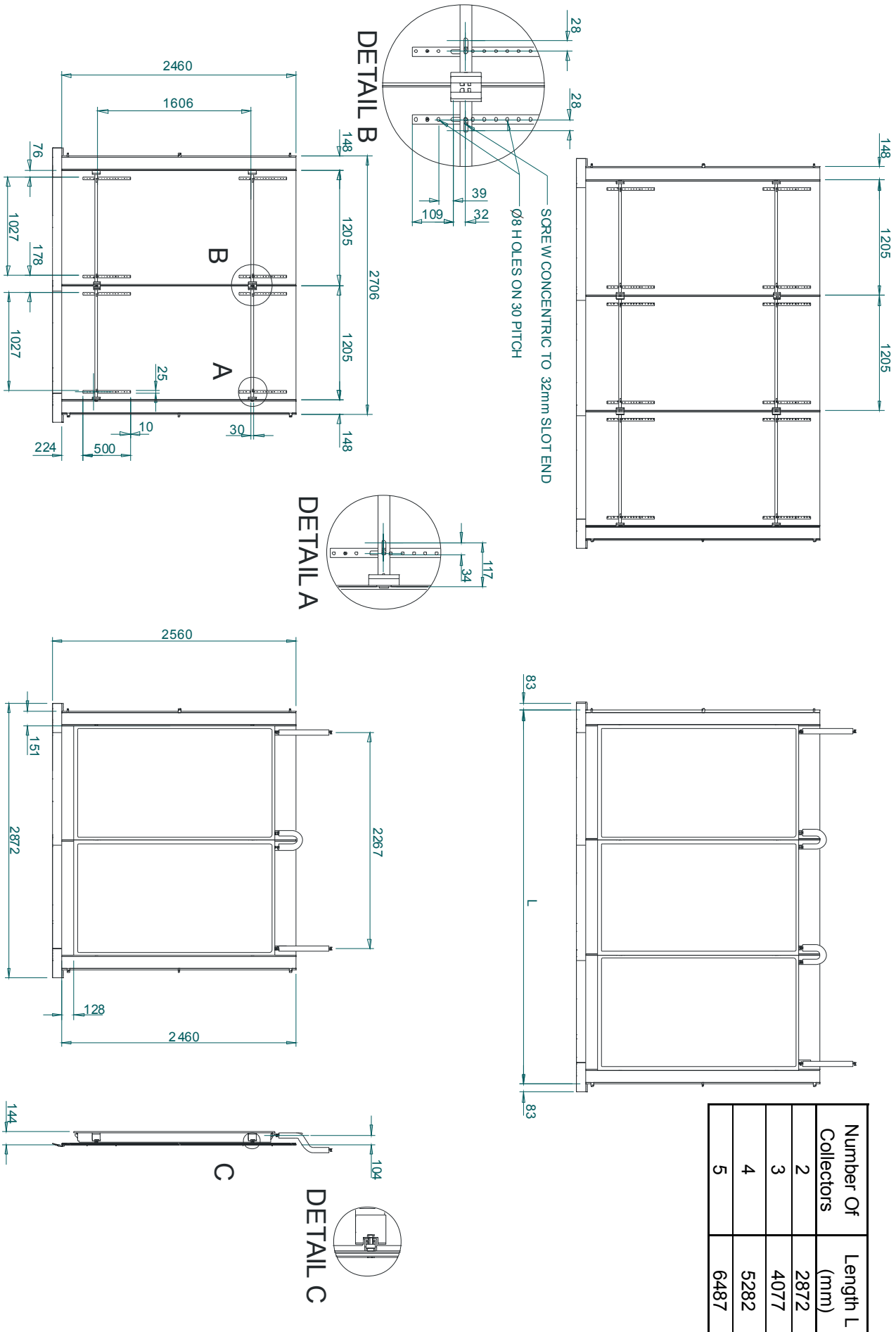



Figure 9.3 - Dimensions Of On Roof Vertical Collector Assembly (HHL P/No's 64300011 To 64300014)



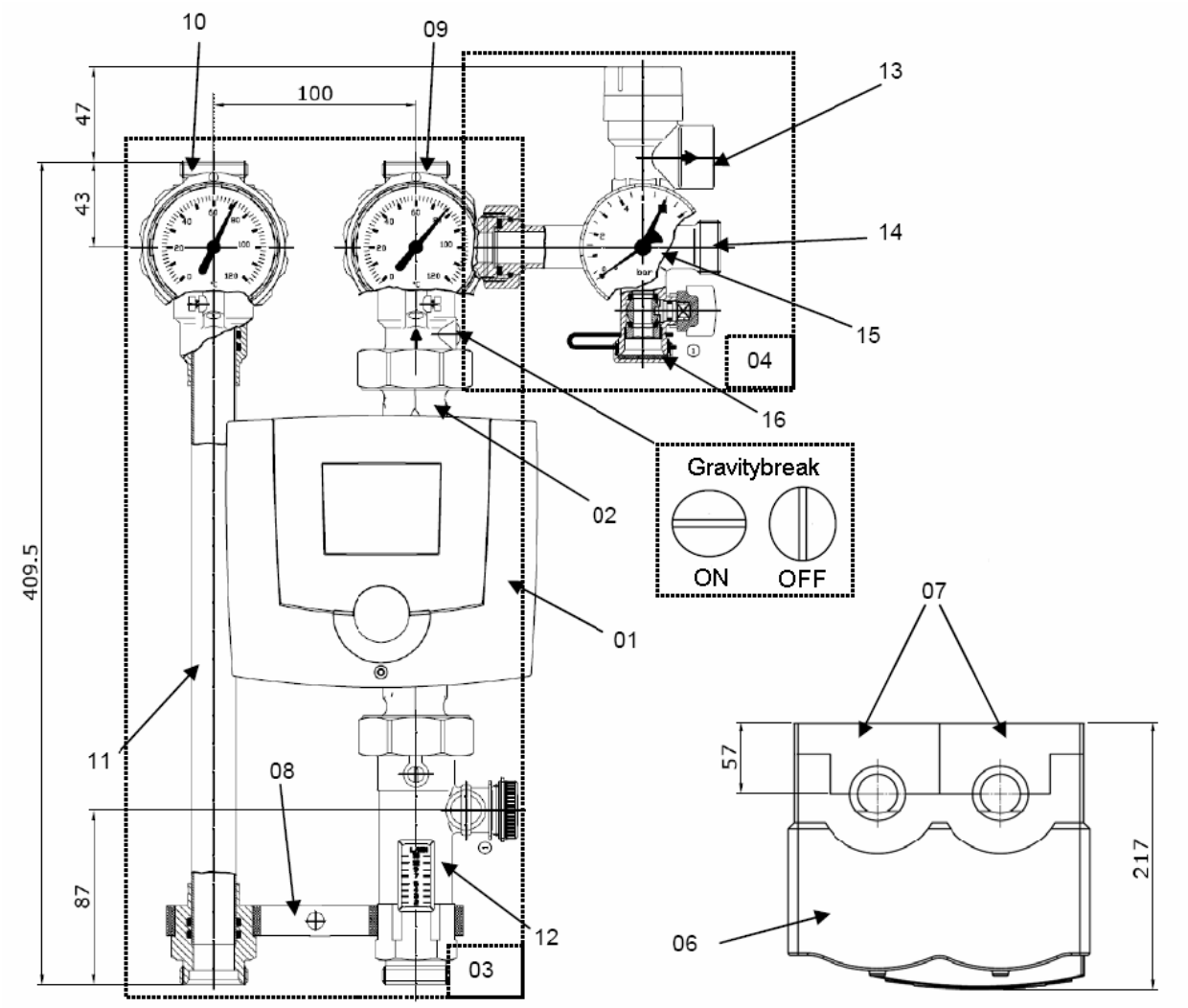

| Number Of Collectors | Length L (mm) |
|---|---|
| 2 | 2404 |
| 3 | 3606 |
| 4 | 4808 |
| 5 | 6010 |

Figure 9.4 - Dimensions Of Collector Assembly On A-Frame (HHL P/No's 64300021 To 564300024)




| Number Of Collectors | Length L (mm) |
|---|---|
| 2 | 2872 |
| 3 | 4077 |
| 4 | 5282 |
| 5 | 6487 |

Figure 9.5 - Dimensions Of In Roof Vertical Collector Assembly (Part Numbers 564300041 To 564300044)




| Amount | Description | | Pos |
|---|---|---|---|
| 1 | Solar control ES 5910 P | | 01 |
| 1 | Pump MXS 13-1 | | 02 |
| 1 | Hydraulic group | Composed off | 03 |
| | | Insulation hull front | 06 |
| | | Insulation hull back | 07 |
| | | Wall bracket | 08 |
| | | Return - ball valve | 09 |
| | | - Check valve | |
| | | - Thermometer | |
| | | - Gravity break | |
| | | - Safety group connection | |
| | | Feed – ball valve | 10 |
| | | - Stop valve | |
| | | - Thermometer | |
| | | - Gravity break | |
| | | Flange pipe | 11 |
| | | Flow meter 2 – 15 l/min | 12 |
| | | - Shut-off | |
| | | - Adjuster | |
| | | - lateral fill and flushing valve | |
| 1 | Safety group | Composed off | 04 |
| | | 6 bar safety valve ½ " x Rp ¾" | 13 |
| | | Outlet G ¾" outside thread | 14 |
| | | Manometer 10 bar | 15 |
| | | Lateral fill and flushing valve | 16 |
| 1 | Mounting parts | Composed off | 05 |
| | | Fixing materials | 17 |
| | | Cable fitting traps - set | 18 |

Figure 9.6 - Dimensions Of Solar Pump Station (Part No. 553000490)

## 10.0 SITE LOCATION AND PREPARATION

### 10.1 Site Location.

- **It is the installers responsibility to ensure that the roof be sufficiently strong to support :-**
  **A) The weight of the collectors, brackets, fittings, frames, and concrete plinth used to mount the collectors.**
  **B) The wind and snow loads on the roof due to the presence of the collectors.**

- **Where collectors are assembled to an A-Frame at ground level the A-Frame and Collectors must be securely anchored to the ground to withstand loading by the wind. See section 13.1 for wind loadings.**

- **For existing buildings Hamworthy Heating advise that a structural survey be conducted to determine permissible roof loading.**

- **The pertinent standards and guidelines apply, in particular BS6399 in terms of minimum anchoring loads with various building heights.**

- **Additional materials may be required for installation such as a concrete plinth, roof sealing compound, sheet metal flashing, wood for cross bracing between rafters & padding out under the rafter anchor, or sheet metal flashing (when using plain tiles). Roof entry terminals will also be required. These are available from Hamworthy Heating or specialist roofing & builders merchants.**

### 10.2 Site safety

- **Carry out all installation work using a minimum of 2 people.**

- **Do a risk assessment of the likelihood of injury to personnel prior to commencing any work.**

- **Provide appropriate personal protective equipment to ensure the safety of personnel.**

- **Use temporary roof edge protection systems to BS13374 : 2004 where full scaffolding is not possible.**

- **Wear a harness & safety line. The safety line must be securely attached to a part of the building that can take the weight of the person to whom it is attached. The line is not to be fastened to a ladder hook.**

- **The use of ladders for heights above 5m is not advised. A ladder should be set to lean at angle of between 65-75$^{o}$ from the horizontal. It is advised that the ladder should be set so that a minimum of 1m of it's length be between the location it is supported by the building & the ladder end.**

## 10.3 Safety Of Others

- **Prior to commencing any work an assessment must be carried out to the risk of injury to passers-by at ground level or people resident in the building who are in the vicinity of the working location.**

- **Provide warning of the danger from falling objects at ground level.**

- **Block off access to roads, footpaths & working places in the immediate vicinity below the installation area, to prevent injury from falling objects.**

- **Where possible it is advised that netting be used to capture falling objects.**

- **Installations on roofs must be carried out by companies employing professional tilers working to:-**

  **BS5534 : 2003 Code Of Practice For Slating & Tiling .**
  **BS8217 : 2005 Code Of Practice For Bitumen Membranes.**

- **Lifting equipment is necessary to transport the collectors onto the roof.**

## 10.4 Lightening protection

- **The solar installation must be protected against lightening to prevent physical damage or life hazard.**

- **Solar circuit piping must be earth bonded using a copper conductor of minimum diameter of 8mm with Green / Yellow insulation and terminated at a bonding bar of 50mm2 cross sectional area. For lightening protection piping should be connected to a deep earth electrode; the grounding cable must be external to the building, and the earth electrode must be connected to a bonding bar of with a cable of the same diameter.**

- **Lightening boxes (Part No. 553000632) can be provided for protection of the collector sensor cables.**

## 10.5 Location For Mounting Of Solar Pump Station

- **The pump station must be securely fixed to a brick or breeze block wall in an easily accessible location of approximately 1.5M off the ground. Do not secure to a plaster board partition wall, as the sound of the solar circulating pump could be amplified.**

## 10.6 ELECTRICAL SUPPLY

**WARNING! THIS APPLIANCE MUST BE EARTHED IN ACCORDANCE WITH IEE REGULATIONS**

- **The solar pump station is suitable for 230Volt, 50Hz supply.**
- **External fuses should be rated for 6 amps.**
- **Mains wiring must be completed in heat resistant cable size 0.75mm$^2$ csa.**
- **For multiple stations each station should have individual means of isolation.**
- **Electrical isolators must facilitate complete electrical isolation.**
- **Electrical isolators must have contact separation of minimum 3mm in all poles.**
- **Electrical isolators must be installed in readily accessible locations.**
- **An electrical supply to a pump station should only serve the pump station.**
- **Where volt free contacts are used, these too must be individually isolatable.**
- **Control of external devices from the controller via the 230V A.C switched outputs of T1 /N & T2/N should be via an external relay.**
- **Contacts connected to the Remote On/Off of an auxiliary boiler <u>MUST</u> be volt free.**

**ADDITIONAL INFORMATION REGARDING ELECTRICAL SUPPLIES IS GIVEN IN BS EN60335, Part 1.**

**NOTE: The appliance MUST be isolated from the electrical supply if electric arc welding is carried out on connecting pipework.**

**FOR DETAILED WIRING INSTRUCTIONS SEE SECTION 16.3.1 & APPENDIX D.1**

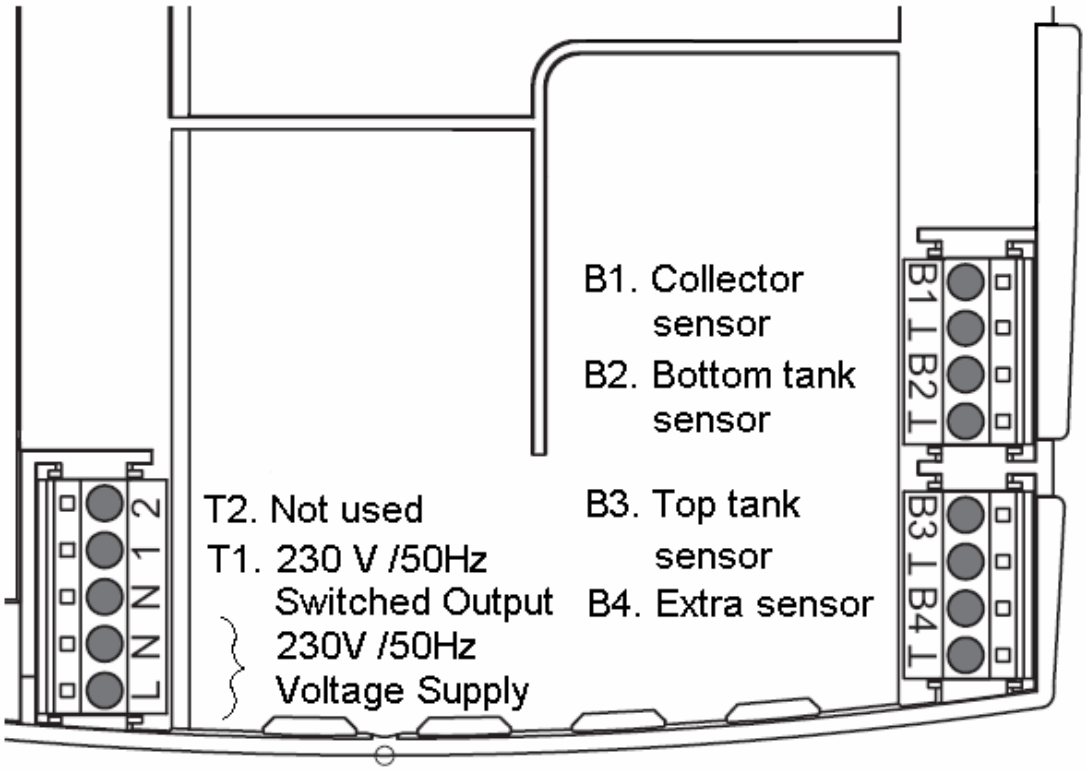



**Figure 10.6 - Solar Controller Wiring Schematic**

## 11.0 SOLAR HEATING SYSTEM ASSEMBLY

The components for the solar heating system are despatched to site as a kit of parts. The solar collector array , pipework, solar transfer station, indirect fired water heater, additional thermal store, and expansion vessel all need assembling together to form the solar system. See Appendix D for common examples.

An electrical supply needs to be provided for the solar station and or the solar controller if remotely mounted. A 230V / 50Hz switched output from T1 & N can be used to drive a external pump or valve. The electronic solar controller and external electrical components may be independent of or integrated within the building's heating control system.

It is the responsibility of the installer to follow the installation instructions within this installers guide.

Due to the large number of different arrangements of thermal solar heating system possible, the most common being used for potable hot water heating and combinations of hot-water and central heating, the hydraulic schemes in the solar controller See section 16.3.1— 16.3.10 have been standardised.

For advise on which of the controllers hydraulic circuit is pertinent to your application please contact the Technical support desk on 01202 662528.

## 12.0 ON-ROOF STYLE COLLECTOR ASSEMBLY

The table below lists the components shown in Figure 12.1 on page 22, that shows an exploded view of a horizontal on-roof kit.

| | | Quantity | |
|---|---|---|---|
| Position | Material | Basic Set For 2 Collectors HHL No. 564300001 | Extension Set For Each Extra Collector |
| 1 | Aluminium Installation Rail, Length 1205mm | 2 | 2 |
| 2 | Aluminium Installation Rail, Length 1205mm | 2 | - |
| 3 | Profile rail connection set (2 connection pro-files, 4 hexagonal screws M12x20 with nut & spring washer). | 1 | 1 |
| 4 | Single Attachment Clamp, 4 U profiles, 4xM12x20 with nut and spring washer | 1 | - |
| 5 | Double Attachment Clamp, 4 U profiles, 4 hex screws M12 x 20 with nut and spring washer | 2 | 2 |
| 6 | M10 x 30 Hex Screws, U-profile washer & nut | 6 | 6 |
| 7 | Aluminium Installation Rail, Length 900mm | 2 | - |
| 8 | L300mm Corrugated hose with R1/2" union nut, OD60xID20mm Insulation & R1/2" Seal-ing ring. | 1 | 1 |
| 9 | L900mm Corrugated hose with 60xID20mm Insulation & R1/2" Sealing ring. | 2 | - |
| 10 | Horizontal Attachment Anchor Bracket | 6 | 2 |
| 11 | Modusol Solar Collector | 2 | 1 |

Table 12.1 - Components Of Horizontal On-Roof Collector Kit

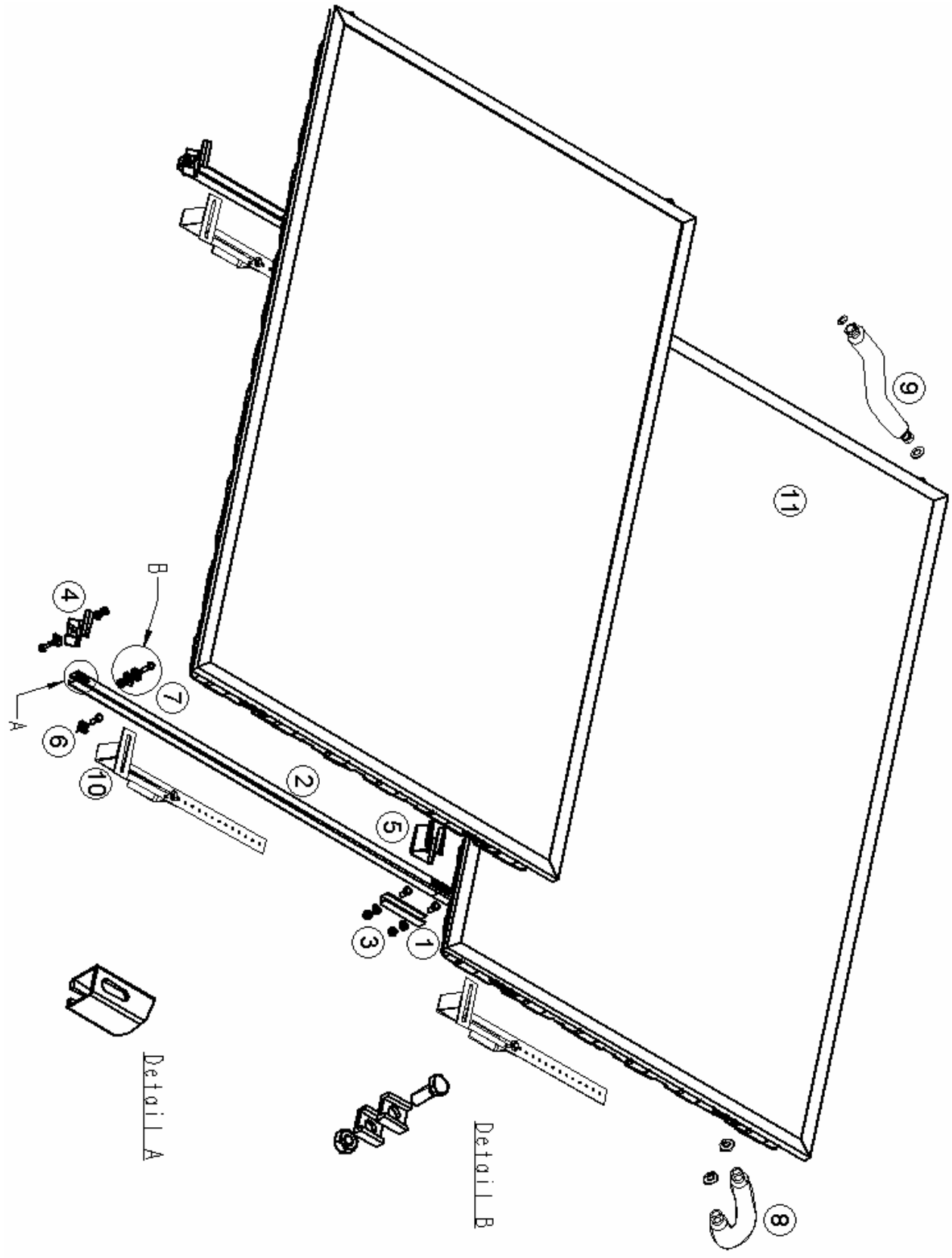



Figure 12.1—Exploded View Of Horizontal Collector Arrangement

| Position | Material | Quantity | |
|---|---|---|---|
| | | Basic Set For 2 Collectors HHL No. 564300011 | Extension Set For Each Extra Collector |
| 1 | Aluminium Installation Rail, Length 1205mm | 4 | 2 |
| 2 | Profile rail connection set (2 connection profiles, 4 hexagonal screws M12x20 with nut & spring washer). | 1 | 1 |
| 3 | Double Attachment Clamp, 4 U Profiles, 4 Hexagonal Screws M12 x 20 with nut and spring washer. | 2 | 2 |
| 4 | Single Attachment Clamp, 4 U-Profiles, 4 Hexagonal Screws M12 x 20 with nut and spring washer. | 1 | - |
| 5 | M10 x 30 Hex Screws, U-profile washer & nut | 6 | 2 |
| 6 | L300mm Corrugated hose with R1/2" union nut, OD60xID20mm Insulation & R1/2" Sealing ring. | 1 | 1 |
| 7 | L900mm Corrugated hose with OD60xID20mm Insulation & R1/2" Sealing ring. | 2 | - |
| 8 | Vertical Attachment Anchor Bracket | 6 | 2 |
| 9 | Modusol Solar Collector | 2 | 1 |

Table 12.2 - Components Of Vertical On-Roof Collector Kit

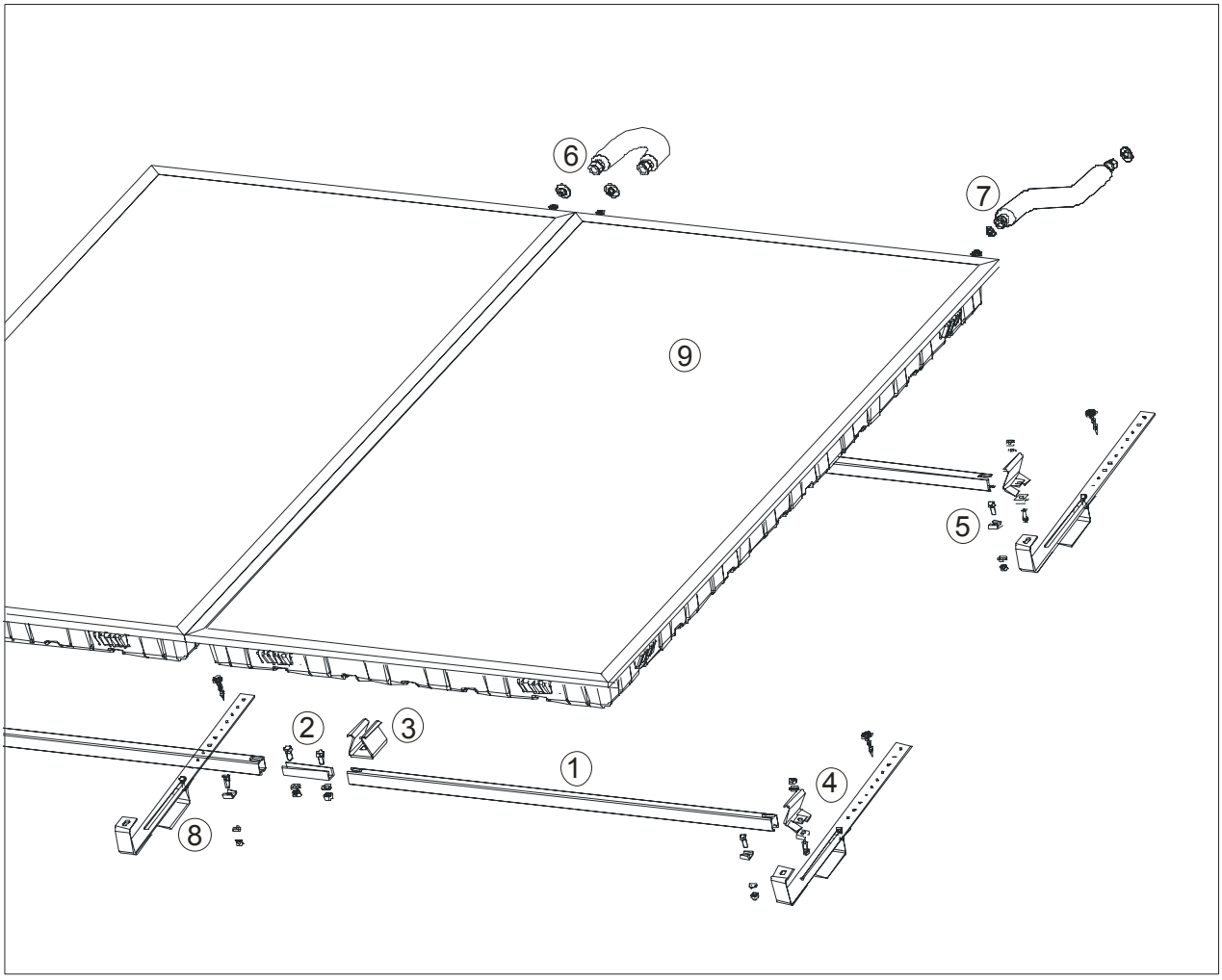



Figure 12.2 - Exploded View Of Vertical On-Roof Collector Arrangement

12.1 General Requirements On Roof Kits

The 'On-roof' kits are suitable for roofs with slopes of angle greater than 22 degrees & constructed from pan-tiles, roofing tiles, slates as well as plain tiles & fibre-cement corrugated plates.

Additional materials may be needed such as wood for cross bracing between rafters, or padding out the base under the attachment anchor bracket & sheet-metal flashing for sealing the rafter anchor when using plain tiles.

Additional equipment could be necessary to transport the collector to the roof.

12..2 Tools Required for Installation

13AF/17AF/19AF/20AF/22AF Spanners
Hand Drill
Medium Philips Bit
Angle Grinder
Hammer
String (10m Approx), measuring tape, rope
Pencil

12.3 Installation Instructions

12.3.1 Define Collector Array Position On Roof.

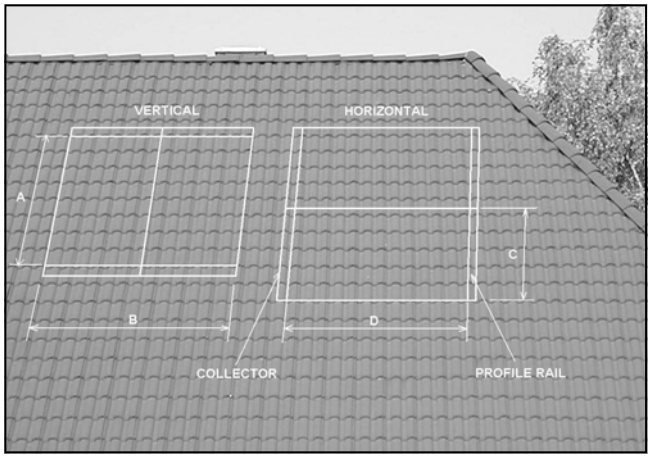



Figure 12.3 - Collector Position On Roof

12.3.2 For Vertical Installation.

- Measure A: 1610mm
- Measure B: Depends on distance between rafters & quantity of anchor brackets.

12.3.3 For horizontal Installation

- Measure C: 1202mm. The overall height depends on the number of collectors.
- Measure D: 1610mm.

12.3.4 **FOR YOUR SAFETY** When working on a roof ensure personnel wear personal protective equip-ment such as a harness & safety line.

Figure 12.4 - Always Wear A Safety Harness and use a safety line.

The safety line must be securely attached to a part of the building that can take the weight of the person to whom it is fastened. The line is not to be fastened to a ladder hook.

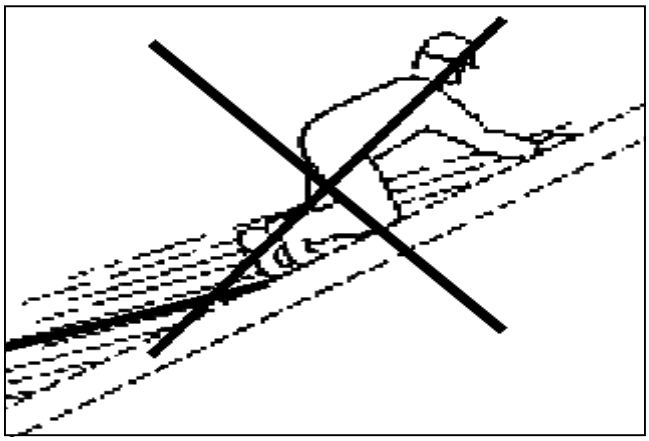


Figure 12.5 - For safety do not step on attachment rail

| Anchor Bracket Type | HHL Kit Part No. | |
|---|---|---|
| | 2 Collectors | Additional |
| Vertically Installed Collectors | 553000300 | 553000301 |
| Horizontally Installed Collectors | 553000303 | 553000304 |

Table 12.3.1 - Anchor Bracket Types.

12.3.5 Remove roof tiles within the predefined roof location to install the attachment anchor (2 to 3 roof tiles per attachment anchor).

12.3.6 Fix the anchor brackets to the roof using 3 of the 6x80mm screws to the roof lat. See Figures 9.2 & 9.3 as a guide to suggested distances between brackets. Depending on actual roof timbers these distances will need to be adjusted.

Figure 12.6 - Assembly Of Attachment Anchor Bracket.

The bracket must be positioned in the deepest part of the tile. Ensure the bracket does not impose pressure upon the roof tile.

12.3.7 Preassemble the profile rails on the ground. The screws for the connection of the aluminium rails & anchor bracket must be inserted before joining the individual rails.

For this purpose measure the position of the anchor bracket on the roof and mark the position on the rail.

Insert a M10x30 screw & U-profile washer into the rail (Figure 12.7 - A) and selo-tape these to the rail to locate them in position where this mark has been made.

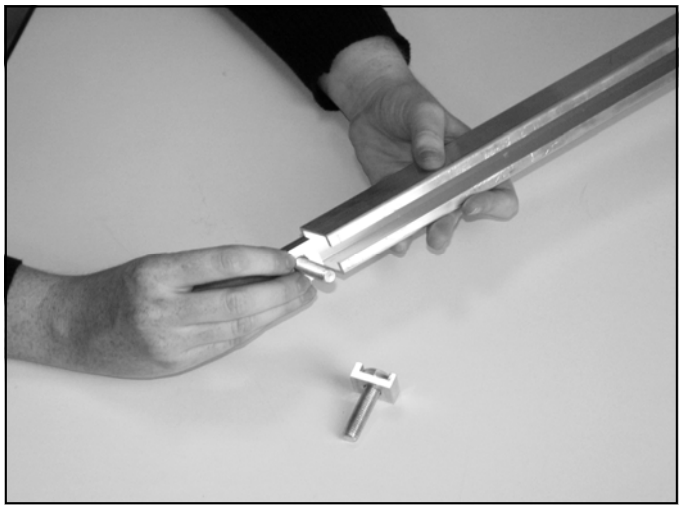


Figure 12.7 - A

12.3.8 Assemble M12x20 bolt into holes in the U-profile washers with the head of the screw in the U as in Figure above. To rear of U-profile place M12 washer over each bolt and screw on the M12 loc-nut.

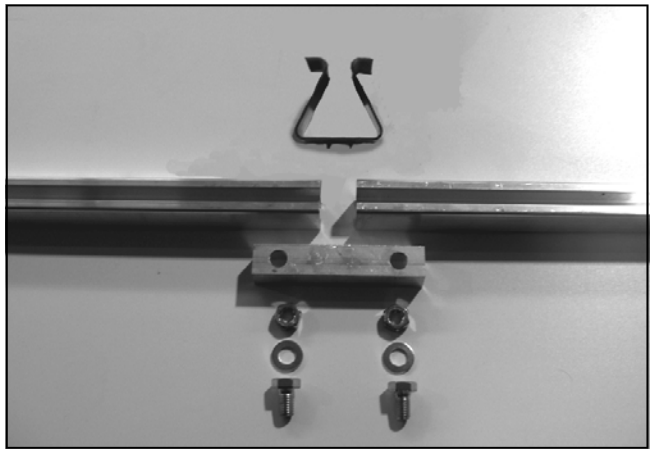


Figure 12.7 - B

12.3.9 Slide one 900mm Long C-profile aluminium rail over the U-profile at about the middle of the U-profile as shown in Figure 12.7 - C. Screw loc-nut to clamp C-profile to U-profile between washer and the back of the U-profile.

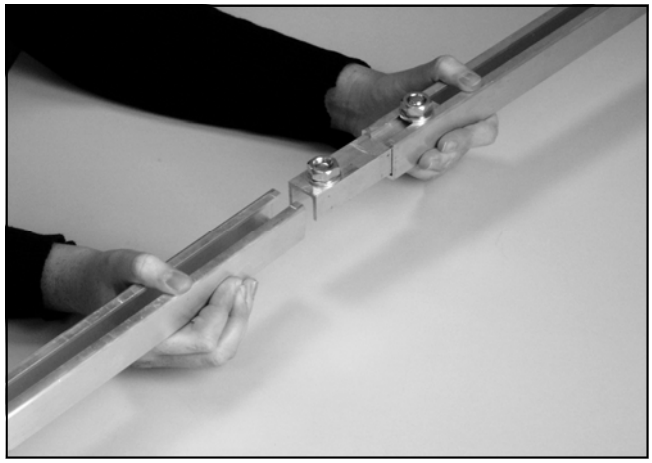


Figure 12.7 - C

12.3.10 Place double attachment clamp in end slot of C-profile rail. Slide another C-profile rail over U-profile & clamp to U-profile as before as in Figure 12.7 - D.

Figure 12.7 - D

12.3.11 Secure the rails to the anchor brackets on the roof by placing the M10x30 bolts through the slotted hole in the anchor bracket and secure using a washer & M10 Loc-nut as shown in Figure 12.8 below.

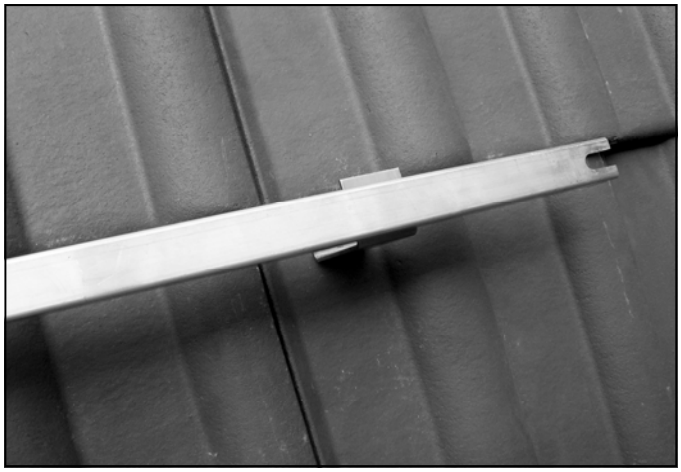


Figure 12.8 - Assembly Of Anchor Bracket To Rail

12.3.12 For Horizontal kits only secure the attachment rail using the double U-shaped washer arrangement shown in Detail B of Figure 12.1 .

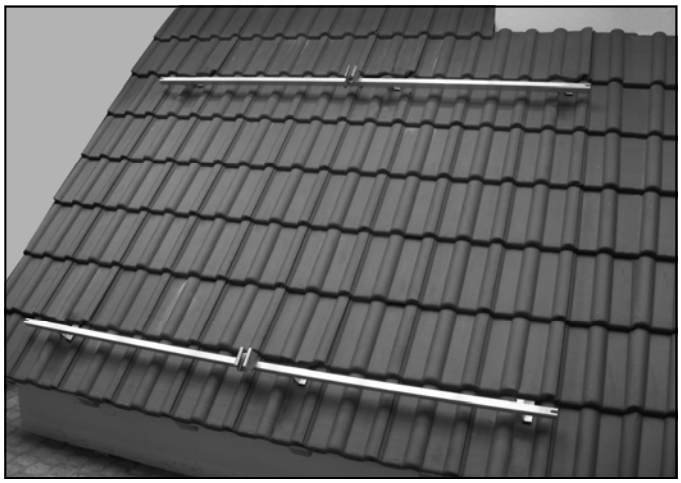


Figure 12.9 Assembly Of Upper & Lower Rails On Roof

12.3.13 Check the rails are parallel by measuring the length of diagonals of opposing rails from end to end so distances B & C are the same. If not adjust the rails.

This can be done using string or tape measure.

Make sure that Distance A between the rails is maintained. Check that the rails installed are horizontal or vertical using a builders level.

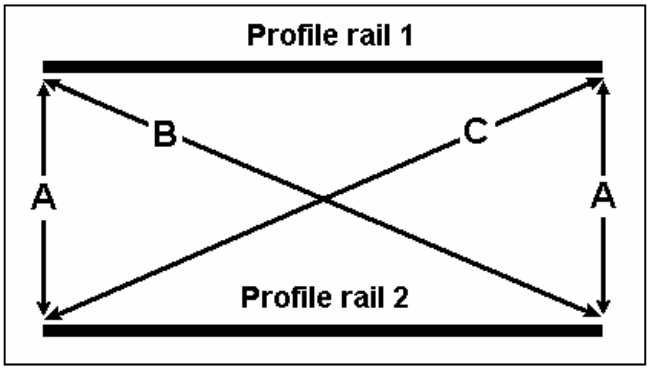



Figure 12.10 —Definition Of Parallelism

12.3.14 There are 2 slots at the back of the collector which run the width of the collector for horizontal or vertical installation.

Figure 12.11—Slots In Rear Of Collector

12.3.15 Place collector over the rails & allow the rear slots in collector to drop onto the rails.
Slide collector onto double attachment clamp.

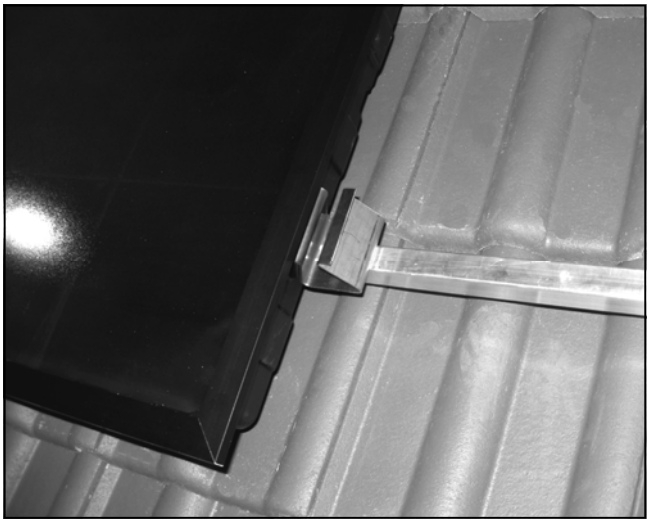


Figure 12.12— Collector Assembled To Rails

12.3.16 Fix single attachment clamps on outer edge of collector and clamp down on collector location lugs.

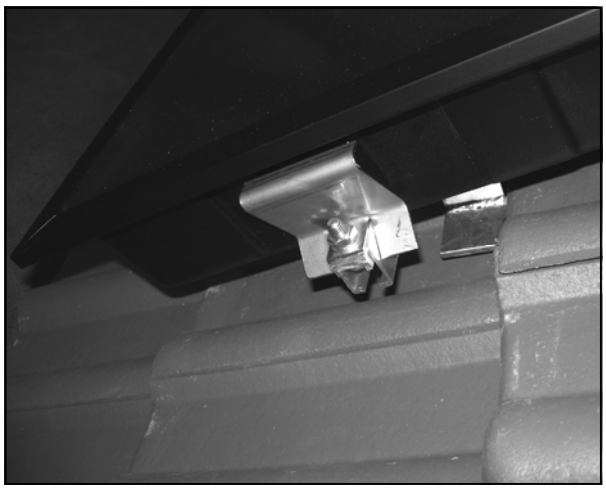


Figure 12.13-Outer Attachment Clamp Assembly Detail

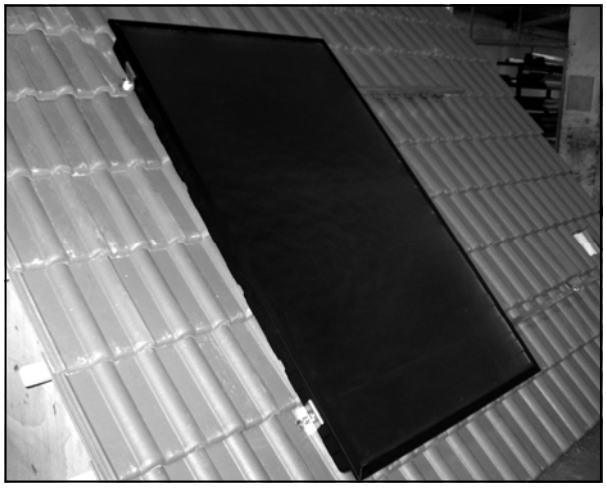


Figure 12.14 Outer Attachment Clamp Assembly Overview

12.3.17 Before installing additional collectors, remove the protective film packaging on the sides where the collectors touch.

12.3.18 To Install Temperature Sensor In Collector Array

The sensor with the brown cable must be installed in the sensor pocket at one collector on the end of one row in the array. Use the pocket closest to the flow connection i.e. the hottest point of the collector array.

To do this remove the rubber grommet in the top of the collector & put a hole in it. Thread the temperature sensor through the hole. Push aside the rockwool inside of the collector using a screwdriver so that the bore of the immersion sensor pocket is accessible.

Place some heat conducting paste on the tip of the temperature sensor & insert it as far as possible into the immersion pocket within the collector.

Push the rubber grommet back into position making sure the grommet is securely sealed in the frame of the collector.

To extend the sensor cable up to 50m to the solar station (page 17) use armoured cable of 2 x 0.75 mm. For cable lengths of above 50m use cables of 2 x 1.5 mm.

To protect the sensors against over-voltage it is advised the sensors are connected to a lightening box. Hamworthy Heating P/No. 553000632.

Figure 12.15 Assembly Of Sensor In Collector

12.3.19 Assemble a R1/2" washer between the hydraulic connection on the collector and the flange of the corrugated hydraulic tube used to link between collectors.

Figure 12.16 Assembling Hydraulic Sealing Ring

12.3.20 Ensure that a spanner holds the hydraulic fittings of the collector whilst tightening the nut of the corrugated tube to avoid the risk of damaging the copper tube of the collector which goes into the fitting. Non compliance can damage the collector.

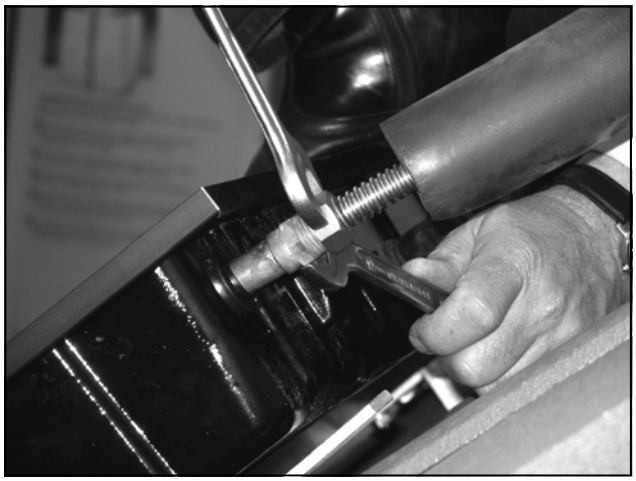


Figure 12.17 - Assembling the hydraulic tube

12.3.21 Repeat this to connect the corrugated tube on the flow & return connections of the collector array.

12.3.22 Cut a hole in the ventilation tile for entry into the roof space of the hydraulic connection tubing and collector sensor cable. Roof entry slates are available from Hamworthy Heating under Part No. 553000330.

If necessary separate available sarking membrane & fix in raised position. Open a hole in the roof and push the flow/return tubing from the array & the temperature sensor cabling through. Observe rising corrugated tube positioning.

Figure 12.18 - Tube Entry Into Roof Space

13.0 A-FRAME STYLE COLLECTOR ASSEMBLY

The A-Frame kits are suitable for flat roof and inclined flat roofs.

It is the installer who erects the A-frame responsibility to securely anchor the collector to the roof or ground to withstand loading by wind.

Where entry through the roof has been made the installer must also ensure the roof is weather proof on completion of the installation.

For existing buildings Hamworthy Heating advise that a survey be conducted to determine permissible roof loading.

Hamworthy Heating Ltd assumes no public liability whatsoever in cases of damage to the installation, building, personal property or personal injury resulting from overloading of the roof or from faulty installation of their products. The warranty in accordance with the conditions of guarantee that apply to the materials supplied by Hamworthy Heating Ltd remain unaffected by this.

Additional materials may be required for installation such as a concrete plinth, roof sealing compound, sheet metal flashing & roof entry terminals into the roof space for pipe work & cabling. These are available from specialist roofing & builders merchants.

13.1 Wind Loading On A-Frame

Prior to installation, the gust wind loading on the collector array must be calculated in accordance with BSEN6399 Part 2. Upon calculation of the resultant drag and lifting force on the array, the roof structure must be assessed to determine whether it is strong enough to support these loads when :-

A) Directly fixing the array to the roof trusses using the screws provided.
B) Mounting the array to a purpose built concrete plinth. Assessment must be carried out to determine whether the roof is able to withstand the static loading from the weight of the plinth necessary to ground the array under the applied gust wind load.

Hamworthy heating Ltd advises using the services of a structural engineer or technician for this assessment.

13.2 Tools required for installation of A-Frame

17AF/19AF Spanners
Hammer
Electric/Cordless Drill
Flat Blade Terminal Screwdriver
D12mm Masonry Drill
Pipe Wrench
Tape Measure,
Pencil or Pen

### 13.3 DEFINITION OF COMPONENTS USED IN A-FRAME KIT

Table 13.3 Definition of components used in the A-Frame Kit detailed in the exploded assembly on page 30.

| | | Quantity | |
|---|---|---|---|
| Position | Material | Basic Kit For 2 Collectors HHL No. 564300021 | Extension Kit For Each Extra Collector |
| 1 | C-Shaped Installation Rail 36x30x2235mm | 3 | 1 |
| 2 | C-Shaped Installation Rail 36x30x1640mm | 7 | 3 |
| 3 | U-Profile Rail 25x25x130mm | 3 | 1 |
| 4 | Attachment Clamp Single | 4 | - |
| 5 | Attachment Clamp Double | 2 | 2 |
| 6 | T-Piece 60x60x6 I:40 | 6 | 2 |
| 7 | M10x30 SKT-Screw | 10 | 2 |
| 8 | M10x60 SKT-Screw | 9 | 3 |
| 9 | M10 SKT-Nut | 19 | 5 |
| 10 | M10 Washer | 19 | 5 |
| 11 | Square U-Profile Washers D10.5mm | 19 | 5 |
| 12 | 8x60 SKT-Woodscrew | 12 | 4 |
| 13 | Rawl Plug S12x60 | 12 | 4 |
| 14 | M12x20 SKT-Screw | 4 | 4 |
| 15 | M12 Nut | 4 | 4 |
| 16 | R1/2” Insulated S.Steel Corrugated Hose. Length = 500mm | 1 | 1 |
| 17 | R1/2” Insulated S.Steel Corrugated Hose. Length = 1500mm | 2 | - |
| 18 | R1/2” Sealing Washers | 4 | 2 |
| 19 | Modusol Solar Collector | 2 | 1 |

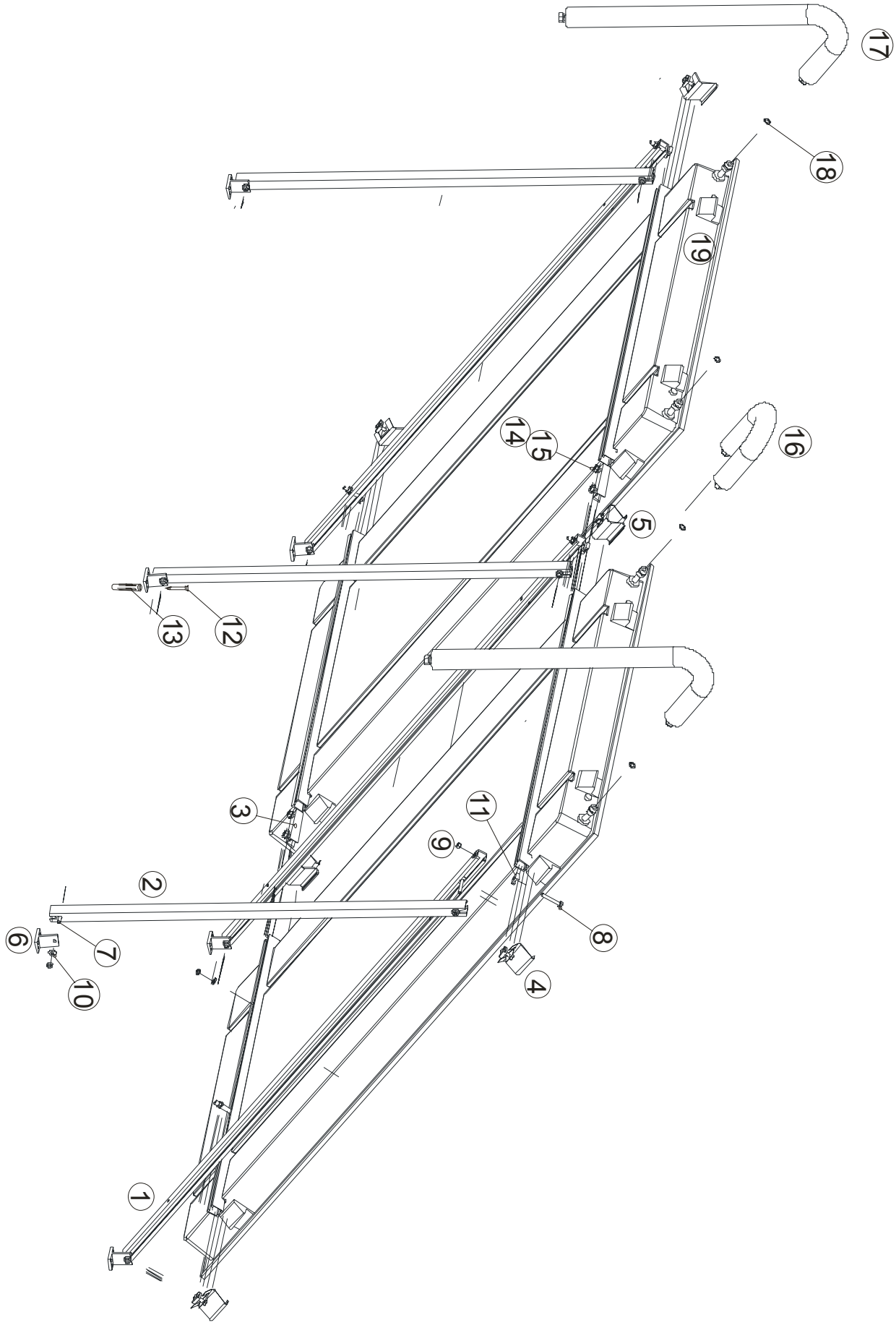



Figure 13.3 - A Frame Kit Explosion

13.4 Installation Instructions

13.4.1 Put M10x60 Screw through Square U-Shaped washer so the head of the screw sits in the recess of the washer. Assemble M10 washer & nut to end of screw as per figure below.

Figure 13.4.1 —Assembly M10 Screw & “U” Washer

13.4.2 Slide square U-shaped washer, M10 screw etc.. into end of 2235mm long C-Shaped installation rail. And drop the shank of the screw into the end slot of a 1640 mm length of rail.

Figure 13.4.2 - Assembly Of 2235mm & 1640mm Long Rails Together.

13.4.3 Tighten nut and with 1640mm rail vertically position rail like shown in Figure 13.4.3. The angle of the 2235 rail to horizontal can be set later. Secure the rails together by tightening the M10 nut and lay the rail on it’s side on the ground for the next step.

Figure 13.4.3 - Assembled 2235 & 1640mm Rails

13.4.4 Make-up two assemblies as shown in the figure below using a M10x30 Screw, Washer & Nut together with the square U-profile washer and T-Bracket.

Figure 13.4.4 - Foot Bracket Assembly

13.4.5 Slide the U-profile washer of the assembly into each end of the 1640mm and 2235mm rail as in figure 13.4.5. Tighten the nuts of the each assembly.

Figure 13.4.5 - Foot and rail assembly

13.4.6 Set the inclined rail at the desired angle of inclination usually between 30° & 45° to the horizontal.

13.4.7 Repeat steps 13.4.1 to 13.4.6 for each additional assembly of the 2235 & 1640mm rails depending on the number of collectors. See table below.

| No. Of Collectors | No. Of 2235 & 1640mm Rail Sets Required |
|---|---|
| 2 | 3 |
| 3 | 4 |
| 4 | 5 |
| 5 | 6 |

Table 13.4.1- No Of Rail Sets Required For Each Kit

13.4.8 Stand two of the rail sets upright next to one another as shown.

Figure 13.4.6—Triangular uprights

13.4.9 Two 1640mm rails are to be installed horizontally via the holes in the top & bottom of the 2235mm inclined rails to join the two Triangular assemblies.

Figure 13.4.7 - Horizontal rail assembly

13.4.10 Assemble together a M10x60 Screw and U-washer, and insert the assembly into the end of a 1640mm long rail. Push the shank of the screw through the top hole in the inclined 2235mm long rail. The distance of the outer edge of the inclined rail to the outer edge of the horizontal rail should be 75mm.

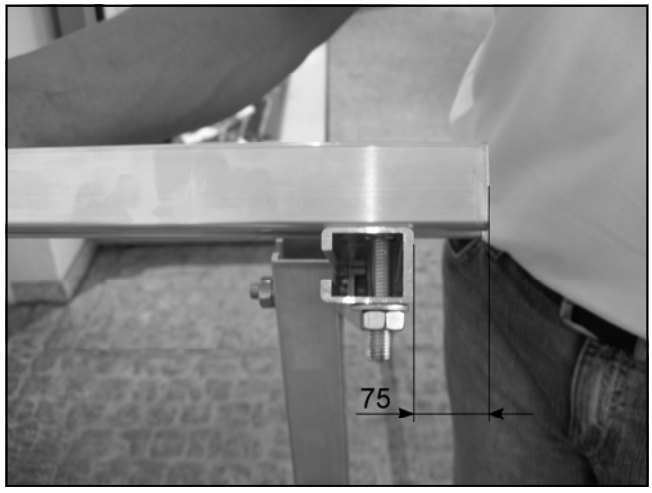



Figure 13.4.8 - Set Rail Edge To Be 75mm

13.4.11 Repeat on other side to fix the upper horizontal rail.

Figure 13.4.9 - Assembly Of Upper Horizontal Rail

13.4.12 Repeat the previous steps to assemble the lower horizontal rail.

Figure 13.4.10 - Assembly Of Lower Horizontal Rail

13.4.13 To be sure that the frame is not twisted measure across the diagonals of the frame.

Figure 13.4.11 Checking For A Twisted Frame

13.4.14 Drop an M12 x 20 screw through both the holes of the 25x25x130mm U-Profile Rail with the hex head of the screws nestled in the U of the profile.

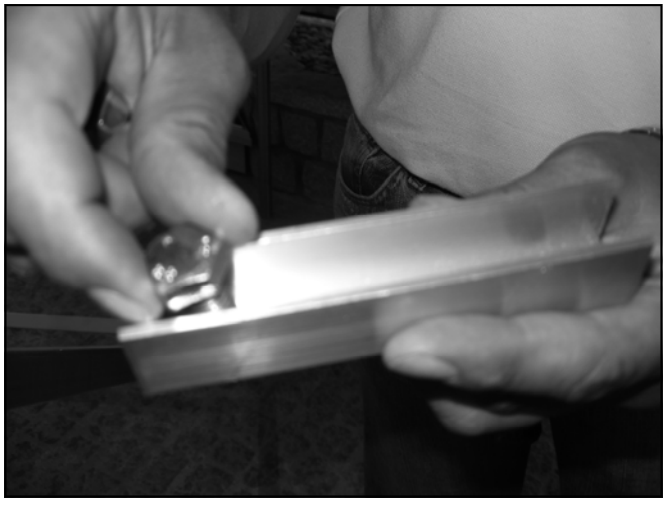


Figure 13.4.12 Assembly Of U-Profile & M12 Screws

13.4.15 On the opposite side assemble a washer and nut to each screw.

Figure 13.4.13 - Assembly Of Washer And Nut

13.4.16 Repeat the previous two steps on a second U-profile rail.

13.4.17 Insert a U-Profile assembly into the left hand side end of the top and bottom horizontal rails as shown in the figure below. Insert the U-profile rail to half it's length and tighten the nut between the U & horizontal rails to secure.

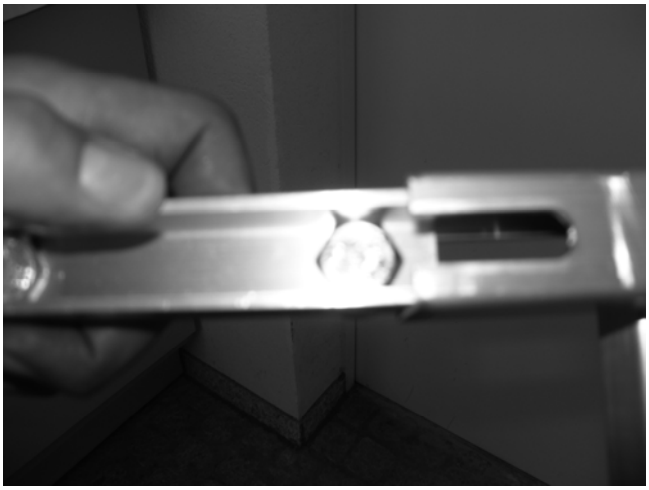


Figure 13.4.14 - U-Profile Rail Assembly To Horizontal Rails

13.4.18 Slide the tabs of the double attachment clamp down inside the U of the U-profile and into the end slot of the horizontal rail. Do this for top and bottom horizontal rails. See Figure 13.4.15 on page 34.

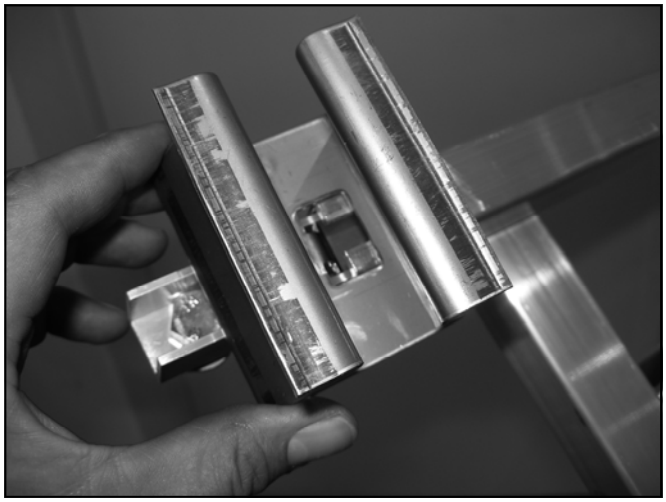


Figure 13.4.15—Double Attachment Clamp Assembly

13.4.19 Lie a third triangular up-right on it's side and assemble a 1640mm rail at the top and bottom of the inclined 2235mm rail to repeat steps 13.4.9 to 13.4.13. Tighten the nuts securing the horizontal rails to ensure this sub-frame is rigid for assembly to the frame already assembled in figure 13.4.11.

13.4.20 Stand the sub-frame up-right and move into position so that the upper and lower rails slide over the upper and lower U-Profile rail of the frame already built and so the washer and nut of U-Profile assembly are external to the horizontal rail. Tighten the top and bottom nut and washer to make the total assembly rigid.

Figure 13.4.16 - Assembly of third triangle with second upper and lower horizontal rail.

13.4.21 Add a second U-Profile assembly top and bottom of the L.H.Side of the newly added horizontal rail.

13.4.22 Repeat steps 13.4.14 To 13.4.20 depending on the number of solar panels required (up to 5 panels).

13.4.23. Using a builders level check that the vertical legs of the frame are vertical. Adjustment of these "legs" will be required. After adjusting the frame ensure all the nuts maintaining the rigidity of the frame are tight.

13.4.24 Slide the middle 2 pairs of double attachment clamps of the frame so that the L.H.S pair abut the left hand end of their respective slots in the horizontal rail and the R.H.S double attachment clamps abut the R.H.S of the slot.

13.4.25 Lift the first solar collector onto the frame so the top and bottom slots at the back of the collector locate over the horizontal rails top and bottom of the frame. Locate centrally to the frame. Note this is a two person job.

13.4.26 Using a tape measure make sure the collector is located centrally. If slightly out nudge the collector slightly along the rail.

13.4.27 Push the double attachment clamps either side of the first collector onto the corresponding collector lug.

13.4.28 Slide the next free pair of double attachment clamps along the frame (to the R.H.S of the first collector) away from the first collector, so each goes to the end of its slot. This is to make sufficient space to allow a second collector to be lifted onto the frame on the right of the first collector.

13.4.29 Push the second collector to the left so that the L.H.S lugs of the second collector now engage with the double attachment clamps engaged on the first collector. See figure 13.4.17 below.

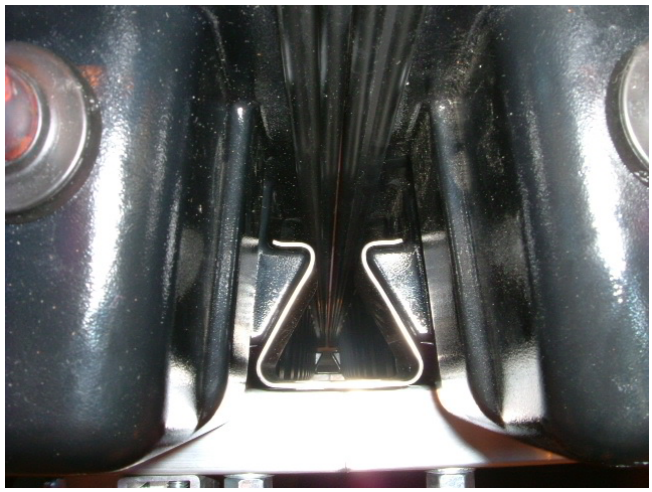


Figure 13.4.17 - Engagement of Double Attachment Clamp With Two Collectors

13.4.30 If a double attachment clamp has been installed to the right of the second collector push these clamps to the left over the R.H.S lugs of the second collector.

13.4.31 The repetition of steps 13.4.24 to 13.4.27 on the left hand side of the first collector depends on the number of solar panels in the array.

13.4.32 The solar panels are fixed to the outer ends of the frame using a single attachment clamp assembled to the top and bottom horizontal rails. A single attachment clamp, M10 x 30 screw, square shaped U-profile washer and M10 nut are assembled together. The U-profile washer slides down the channel of the horizontal rail. The clamp is then secured to the collector lug by tightening the M10 nut.

Figure 13.4.18 Assembly Of Single Attachment Clamp

13.4.33 To fix the frame to a concrete plinth mark off the holes in each foot bracket using a pen and move the frame back so that the holes can be drilled with a 12mm masonry drill. Insert a 12mm rawl-plug provided in each hole and position the frame so the holes in the feet align with the rawl-plugs. Fix the feet using the 8x60mm screws provided.


Figure 13.4.19—Marking The Foot Bracket Holes

13.4.34 Install the 5 kΩ collector temperature sensor (brown cable) provided in the sensor pocket in the last collector in the array next to the flow connection (from the collector array).

Remove the rubber grommet protecting this sensor pocket and push the sensor through the grommet to half the length of the sensor. Clear the sensor pocket of rock wool using a terminal screwdriver & apply heat conductive paste to the tip of the sensor.

Insert the sensor into the pocket until it bottoms out on the bottom of the pocket and re secure the rubber grommet in the collector frame.

Run the temperature sensor cable to a lightening box where an extension cable of 2 x 0.75mm2 is suitable for cable lengths of up to 50m between the solar pump station or wall mounted solar controller and the lightening box. Beyond 50m a cross section of 2 x 1.5mm2 must to be used.

Figure 13.4.20 Assembly Of Collector Sensor

13.4.35 The collectors are connected to one another and to flow / return pipework by the lengths of corrugated tube provided. Sealing rings are included.

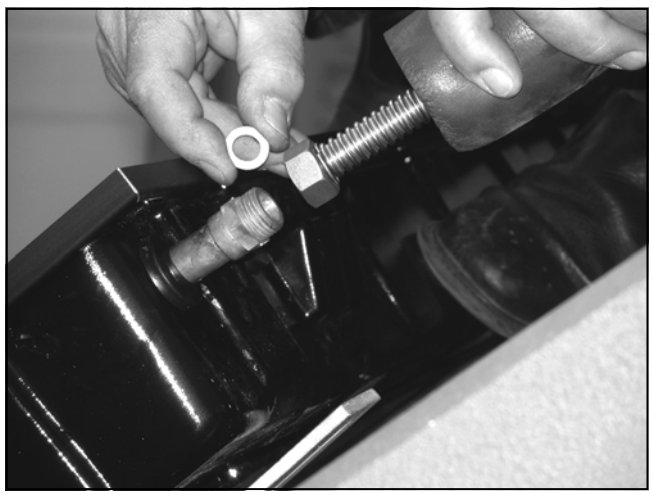


Figure 13.4.21 - Hydraulic Tube Assembly

## 14.0 IN-ROOF STYLE COLLECTOR ASSEMBLY

The 'In-roof' kits are suitable for roofs with slopes greater than 27° constructed from pantiles, roofing tiles, slates as well as plain tiles & fibre-cement corrugated plates.

Additional materials may be required such as ventilation roofing tiles for entry into the roof space for supply & return tubing. These are available from specialist roofing & builders merchants. Wood for cross bracing between rafters; padding out under the rafter anchor, or sheet metal flashing for sealing the rafter anchor when using plain tiles may also be required.

### 14.1 Tools required for installation

Tools required for installation
13AF/22AF/24AF Spanners
Hammer
Electric/Cordless Drill
Philips Screwdriver
D5mm Drill – For Metal
String (10m Approx), Tape Measure, Rope
Pencil

### 14.2 Overview Of Components In Kit

| | | Quantity | |
|---|---|---|---|
| Position | Material | Basic Set For 2 Collectors HHL No. 563400041 | Extension Set For Each Extra Collector |
| 1 | Lateral plate left with flashing<br>Lateral plate right with flashing | 1<br>1 | -<br>- |
| 2 | Collector Plate | 2 | 1 |
| 3 | Rubber connection profile 2425mm | 3 | 1 |
| 4 | Plate holder and nails | 6 | - |
| 5 | D5 x 40 Countersunk Spax Screws | 20 | 10 |
| 6 | Blue Polyamide Sealing Washer | 20 | 10 |
| 7 | Hex Screws M12 x 20, galvanised | 4 | 4 |
| 8 | Hex Nut M12, galvanised | 4 | 4 |
| 9 | Self Adhesive Foam Snow Wedge | 6 | 1 |
| 10 | Insulated Stainless Steel Corrugated Hose, R1/2", Length 1000mm. | 2 | - |
| 11 | Insulated Stainless Steel Corrugated Hose, R1/2" Length 300mm. | 1 | 1 |
| 12 | Flat Seal R1/2" | 6 | 2 |
| 13 | C-Shaped Installation Rail. Length = 1205mm | 4 | 2 |
| 14 | Attachment Rail Length 500mm | 8 | 4 |
| 15 | U-Connection Profile 25 x 25 x 3 Length 130mm | 2 | 2 |
| 16 | Attachment Clamp Single | 4 | - |
| 17 | Attachment Clamp Double | 2 | 2 |
| 18 | Hex Socket Head Bolt M10x30 | 8 | 4 |

Table 14.1 Definition of components used in the In-Roof Kit detailed in the exploded assembly on page 37.

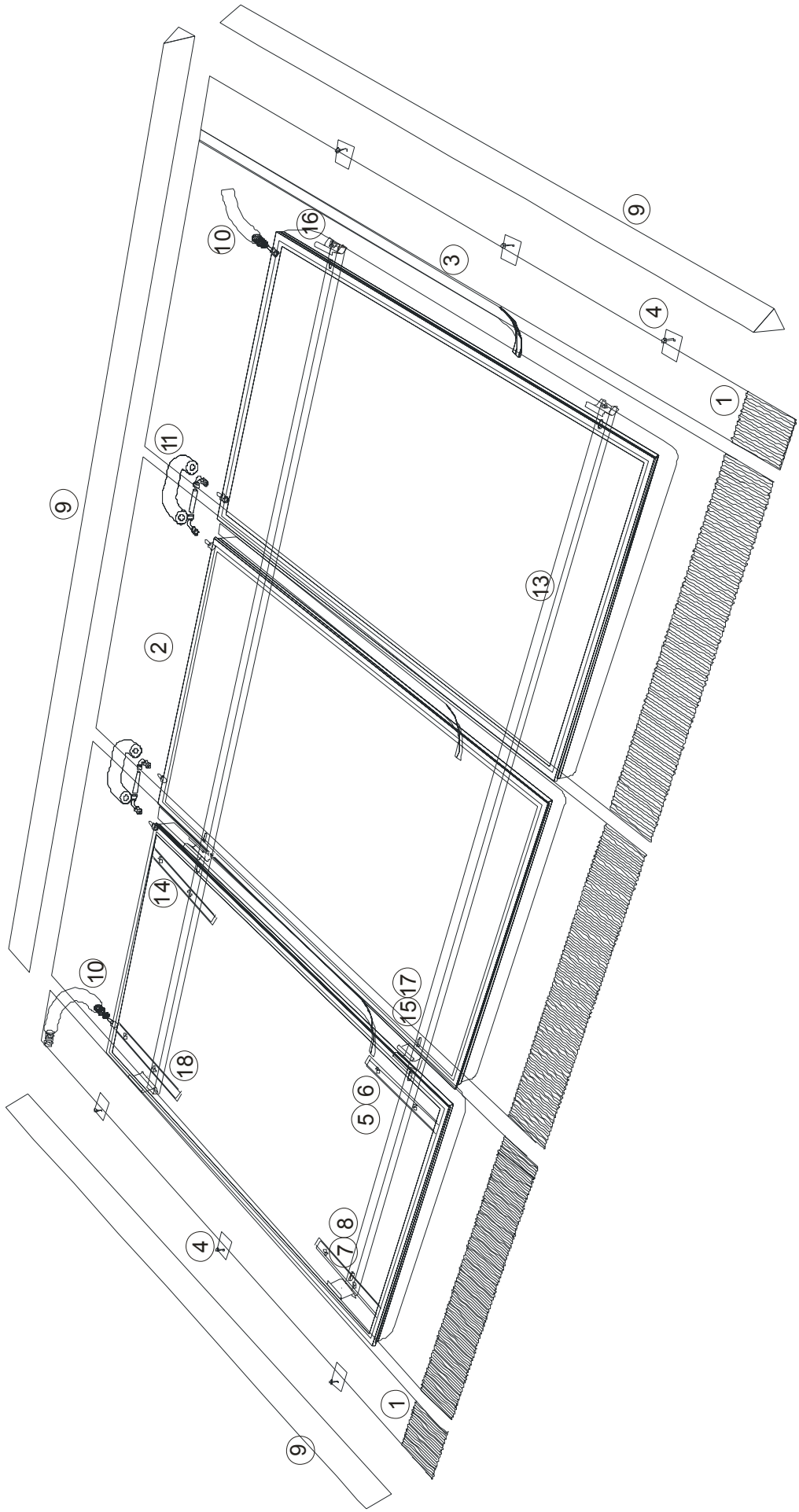



Figure 14.1—In Roof Kit Exploded Assembly

14.3 Installation Instructions

14.3.1 Before installing the collector array install the solar station and expansion vessel. After the collector array has been installed run the connecting pipework between the array and the solar station. Pressure test the entire solar circuit before recovering the roof.

14.3.2 When selecting the position of the collector array on the roof always leave 3 rows of tiles or slates under the ridge of the roof to protect this from damage.

14.3.3 Define collector array position on roof.

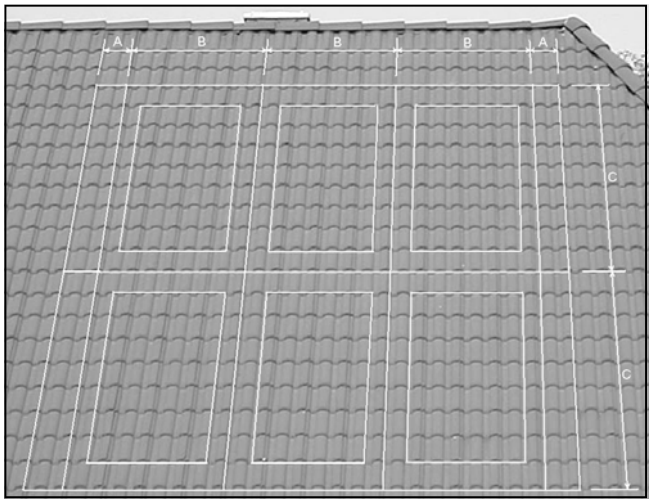



Figure 14.2—Collector Array Location

A : Measure 150mm
B : Measure 1205mm
C : Measure 2460mm (Without Flashing)

14.3.4 **FOR YOUR SAFETY** When working on a roof ensure personnel wear personal protective equipment such as a harness & safety line.

The safety line must be securely attached to a part of the building that can take the weight of the person to whom it is fastened. The line is not to be fastened to a ladder hook.

Figure 14.3 - Always Wear A Safety Harness and use a safety line.

14.3.5 After working out the dimensions of the collector field area required, remove the roof tiles in that area. Ensure the roof laths are not removed.

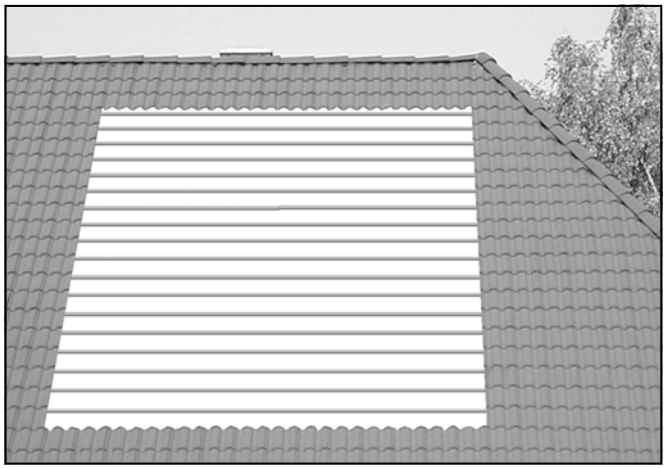


Figure 14.4 - Removal Of Tiles

14.3.6 Remove the collector plates from the packaging. Lie each one on the ground & mark the positions of the attachment flat on the collector plate referring to the positions shown in figure 9.5.

14.3.7 Position one M10 nut in each recessed slot of each attachment flat. Lay the attachment flats on the collector plate in position. The smaller slot should be face up so the nut is trapped between the collector plate and attachment flat.

14.3.8 Using the 5mm drill put a hole in the collector plate using one hole either side of the slot in the attachment flat as a guide.

14.3.9 Insert the self tapping screws with blue sealing washers through the attachment flat and screw to the collector plate.

14.3.10 Lift the right hand lateral plate(s) on the cleared roof area. Leave a gap of circa 25mm between the lower edge of the bottom collector / lateral plates and upper edge of the lath below it.

14.3.11 On the sides the distance ‘D’ in Figure 14.5 between the plate edge & un-removed tile should be selected so when the tiles are replaced on the side the tile bridges over the lip on the edge of the lateral plate. Manhandling / installation of the collector plates onto the roof is a two person job.

14.3.12 Fix the collector plates to the laths by selecting the holes in the attachment flat located above each lath and using these holes drill through the collector plate into the lath. Secure the collector plate to the laths using the self tapping screws with sealing washer.

14.3.13 When fixing the plates consider that these are horizontally aligned and jointly positioned next to one another.

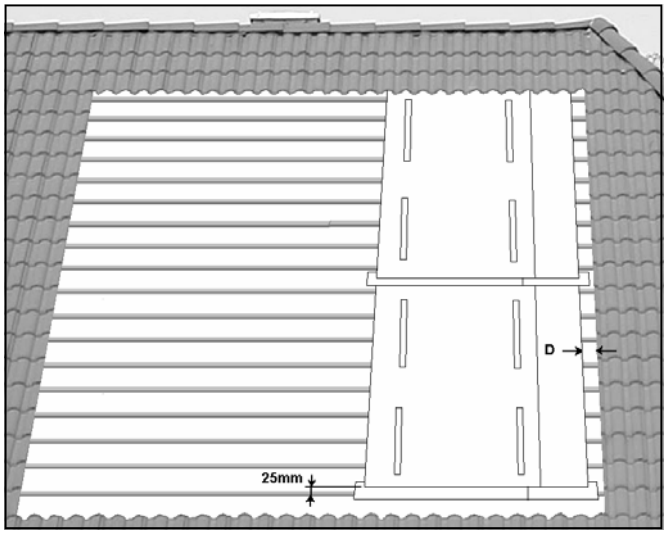



Figure 14.5 - Assembly Of Collector Plates

14.3.14 Fix the lateral plate using 3 plate holders assembled to the outer edges of the plate. The plates are placed side by side. In between 2 plates there are no plate holders.

Figure 14.6 – Plate Holder Assembly

14.3.15 Between the edges of each plate assemble the rubber connection profile. The rubber profile must be placed where plate edges meet.

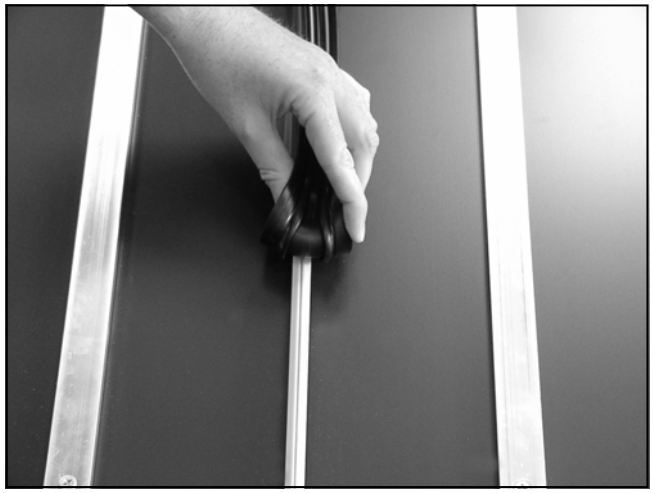


Figure 14.7 Rubber Connection Profile assembly

14.3.16 Place M12x20 hex head screws in the 25 x 25 x 130 U-connection profile with the screw head sitting between the U of the profile and M12 nut and washer on the other side of the profile.

14.3.17 Assemble top and bottom installation rails together at ground level before lifting to the roof.

14.3.18 To assemble the installation rails together secure the U-profile assembly in 14.3.16 between each installation rail by tightening M12 nuts. The central slot of the profile when slid down the installation rail must face down to straddle the profiled edge of the plates when once assembled.

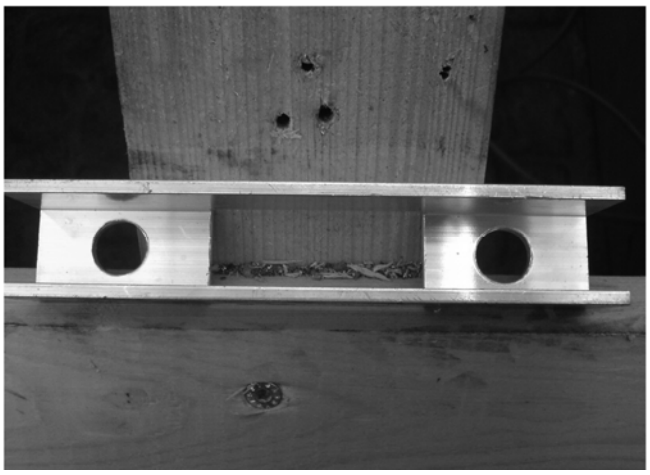
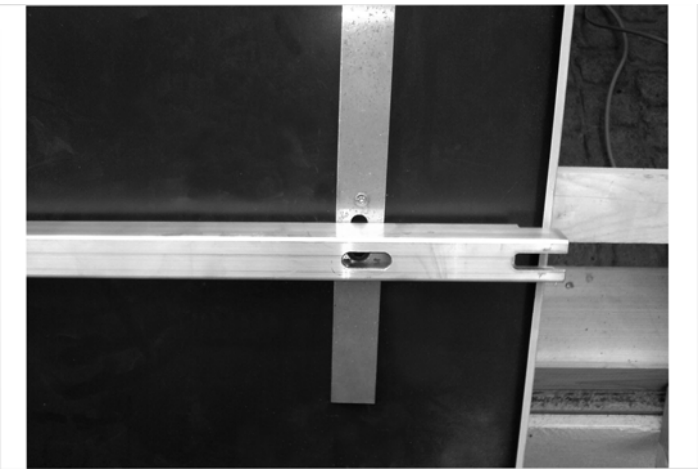


Figure 14.8 - 25x25x130 U-Connection Profile

14.3.19 When connecting two installation rails together slide the tab of the double attachment clamp within the end slot of one of the rails so that when the ends of the rail butt together the double attachment clamp is free to slide along the end slot of both left and right hand side rail.

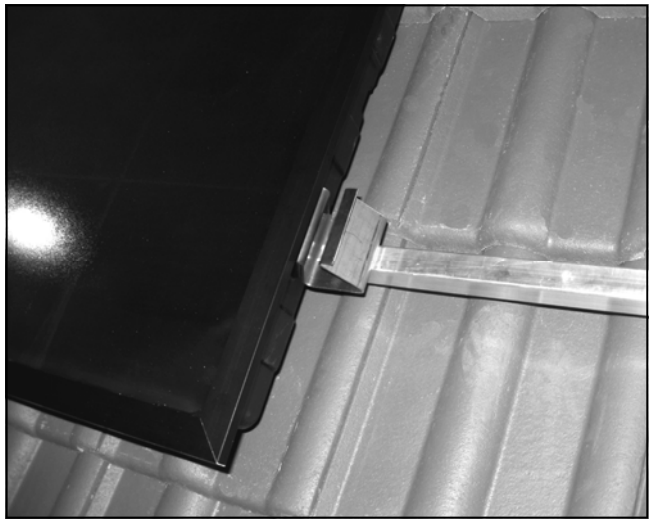
Figure 14.9 Double Attachment Clamp Assembly

14.3.20 Fix the “C” profile installation rails to the attachment rail, using M10 x 30 socket head bolts by screwing into the M10 nuts between the attachment flat and plates. See figure 14.10 below.



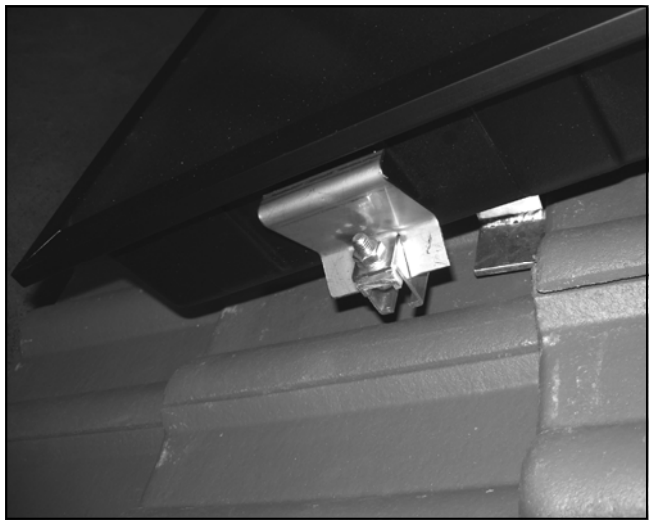
14.10 - Installation Rail Assembly

14.3.21 Assemble collectors on installation rails and slide double attachment clamps from the side. Before installing the second and any additional collector remove the protection film from the sides where the collectors touch



14.11—Assembly Of Collector to Double Attachment Clamp (on roof view)

14.3.22 Fix end attachment clamps with the U-profile washer, M12x20 Hex bolt & M12 nut. Before installing the second and any additional collector remove the protection film from the sides where the collectors touch.



14.12 - Assembly Of End Attachment Clamp

14.3.23 Connect collectors together using the 300mm long insulated corrugated tube, with sealing washer assembled between the collector & sealing face of the tube. The foam insulation of the tube can be pushed along the tube to reveal the end nut. Once connected the insulation can be pushed back to cover the nut.

14.3.24 Repeat this to connect the corrugated tube on the flow & return connections of the collector array. See figure 14.13.

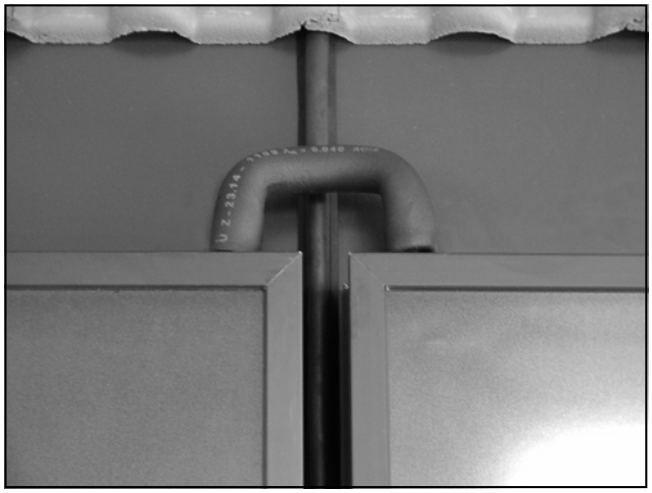


Figure 14.13—Assembly Of Connection Hose

14.3.25 Fix foam snow wedges on left, right & upper edge of the completed collector field. The surrounding roof tiles should be arranged in such a way that the snow wedge is located between the plate & roof tile. As shown in figure 14.1.

14.3.26 Assemble the row of tiles underneath the collector array so the tiles are under the flashing. Mould the flashing to the form of the roofing tiles.

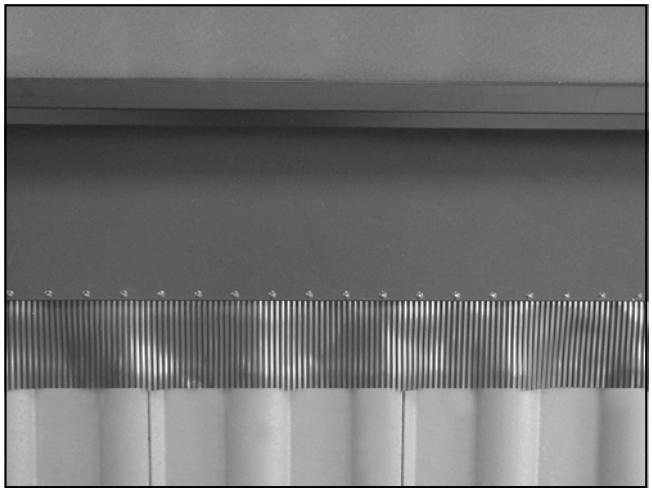


Figure 14.14 - Roof Flashing

14.3.27 To install the temperature sensor in the array remove the rubber grommet on the outlet side of the last collector in the top row of the array (hottest point in array). Using a screw driver put a hole in the grommet & push the temperature sensor through the hole. Apply heat conducting paste onto the tip of the sensor and insert as far as possible into the immersion sleeve. Push the grommet back into the collector to seal.

Figure 14.15—Assembly Of Collector Sensor

14.3.28 Cut a hole in the ventilation tile for entry into the roof space of the hydraulic connection tubing, Alternatively roof entry slates are available from Hamworthy Heating under P/No. 553000330. If necessary separate available sarking membrane & fix in raised position. Open a hole in the roof and push the hydraulic tubing through. Observe rising corrugated hose positioning.

Figure 14.16—Tile Type Roof Terminal Assembly

## 15.0 PRE-COMMISSIONING

## 15.1 PRE-COMMISSIONING CHECKLIST PRIOR TO SITE ATTENDANCE

**15.1.1 Has a hydraulic schematic for the solar heating system been sent to Hamworthy Heating Ltd together with the site reference for forwarding to the commissioning engineer ?**

**15.1.2 Has there been communication with the Heating System Controls Engineer about the electrical services to the solar controller or any auxiliary gas fired hot water heating and it's integration within any BMS.**

**15.1.3 Is there a dedicated manually Isolated/Fused 230V-50Hz (6Amp) electrical supply installed local to the Solar station. This supply should be wired so that if the high limit thermostat on the "Lead" indirect fired water heater (Powerstock Calorifer) is activated, the supply to the solar station is disabled.**

**15.1.4 Has there been a cable provided from the electrical supply to the solar controller of the solar pump station.**

**15.1.5 Has the brown coloured 5kΩ NTC temperature sensor, supplied with the pump station, been installed in the sensor pocket in the solar collector nearest to the flow pipe-work of the collector array.**

**15.1.6 Has there been a junction box supplied local to the collector array with sensor cable run to the box and an extension cable wired all the way back to the solar controller from the junction box.**

**15.1.7 Have the grey coloured cabled temperature sensors supplied with the pump station been installed in the correct top and bottom pockets of the indirect fired water heater that is connected to the solar circuit.**

**15.1.8 If the cable length of the grey cabled temperature sensors, are too short to terminate at the solar station, due to it's distance with the indirect fired water heater, have there been junction boxes installed with sufficient length of extension cable run back to the solar station to terminate at the solar controller.**

**15.1.9 Has the control and limit thermostat bulbs been installed in the top sensor pocket of the indirect fired water heater, together with the correct grey cabled solar temperature sensors?**

**15.1.10 Where extra sensors are required to connect with additional heating plant have these been installed with a junction box and have the extension sensor cables been run back to the controller. Note 1 brown sensor is supplied with the solar pump station & 3 grey sensors.**

**15.1.11 Has the Powerstock control panel been sited so that adjustment to the temperature setting on the controls stat can be effected, as instructed in the Powerstock installers guide.**

**15.1.12 Has the solar circuit been filled and pressure tested to 6 bar working pressure (so that the relief valve of the solar station activates) and the solar circuit been checked for leakage ?**

**15.1.13 Have the water contents of the circuit from the leakage test been drained prior to the glycol mix being put in ?**

**15.1.14 Was the solar circuit subsequently filled to a pressure of 2 bar with the solution of 40% Propylene Glycol / 60% water ?**

**15.1.15 Has the concentration of Glycol in water been tested ?**

**If No to Question 15.1.12/13/14 then this will involve additional work at the commissioning visit to which there will be an extra charge.**

**15.1.16 Has the correct expansion vessel gas pressure been set ?**

**15.1.17 When is the Plant Handover to take place ?**

**Suggestion would be to allow for this at time of commissioning visit.**

**15.1.18 If not a further visit will need to be planned of which there may be an additional charge.**

**15.1.19 Has the contact details of the site representative with whom the plant handover is to take place – including instructions on plant operation - been forwarded to HHL ?**

**15.1.20 Has the customer confirmed the following working temperatures of the solar system ?**

**A) Storage temperature set point (Solar Controller Parameter 08-62) in °C.**
**B) Legionella protection temperature (Parameter 05-04) to be set at 70 °C.**
**C) Legionella protection function (Parameter 05-14) usually set at raising to a minimum of 60°C once a day.**
**D) Strategy for solar charging (Parameter 08-50). Usually 0 = Parallel charging.**
**E) Are each solar store to be charged to the set point (Parameter 08-62), in turn ie.one at a time (presuming more than 1 solar storage vessel) ?**
**F) Over run time Auxiliary boiler pump in minutes, if controlled from the solar controller (Parameter 09-00).**

Fill in the information in the space provided under each question quoting site reference and fax back to Hamworthy Heating's Service Department On **Fax Number (01202) 662552**.

15.2 Expansion vessel sizing for solar system

15.2.1 As with any heating system, the solar primary fluid will expand when heated. Unlike conventional heating systems, the temperature can reach up to 130°C, The effect of a mixture of 40% glycol in water at this temperature gives an expansion of around 8%.

15.2.2 Even greater expansion occurs in the event that the circulation ceases under strong sunlight conditions (called stagnation). In this case, any fluid in the collector will vaporise creating steam that pushes out the fluid remaining in the collector. Under these conditions the temperature in the collector can reach over 150°C.

15.2.3 Ordinary expansion vessels are not normally rated to operate at these temperatures. Special expansion vessels for solar are available and are usually rated to 120°C. These vessels are still insufficient to withstand the temperatures found in stagnation. To overcome this the following is advised :-

- The vessel is to be located in the return line to the collectors and after the ball valve above the pump.
- Vessel orientation is with fluid side up, gas side down.
- Location is far enough away from the collector array to ensure that the working volume is less than 50% of that of the fluid between the collector and the vessel.

If the latter cannot be met by suitable pipe sizing, an intermediate auxiliary vessel must be placed in the return side of the collector array to prevent the possibility that vaporised fluid might strike the vessel membrane.

15.2.4 An alternative to an auxiliary vessel is to use large un-insulated diameter pipe on the return line to the collector array or in the expansion vessel branch. Proprietary corrugated stainless steel pipe used in the expansion vessel branch will also assist cooling.

See appendix E.5 for details of this pipe.

15.2.5 Figure 2.0 defined the location of the expansion vessel in the solar circuit recommended by Hamworthy Heating.

This location allows for un restricted flow back to the expansion vessel under conditions of stagnation. Labelling warning of the danger of scalding will be required on exposed surfaces.

15.2.6 The expansion vessel and pump station are designed for interior location only. If proprietary mixtures of anti-freeze are purchased, other than that supplied by Hamworthy Heating Ltd, compatible anti-corrosion inhibitors must be used to prevent corrosion within the expansion vessel.

15.2.7 The pre-charge of the vessel is set as a minimum to the equivalent static height of the system ie from the top of the collector to the vessel, prior to filling the system. The system pressure is then set to this value plus sufficient over-charge to stop sub-atmospheric pressure at the top of the circuit that could lead to air ingress or premature boiling.

15.2.8 The filling pressure in pre-commissioning is likely to be substantially greater than the system will fall to on the coldest days & therefore a suitable over-pressure is required on filling.

15.2.9 When measuring the vessel pre-charge, with a hand held pressure gauge or tyre pump, the vessel must be disconnected from the system.

15.2.10 The point at which the water in the primary transfer fluid evaporates ($t_s$) is dependent on the pressure in the collectors and taken from steam tables. See Figure 15.1. below.

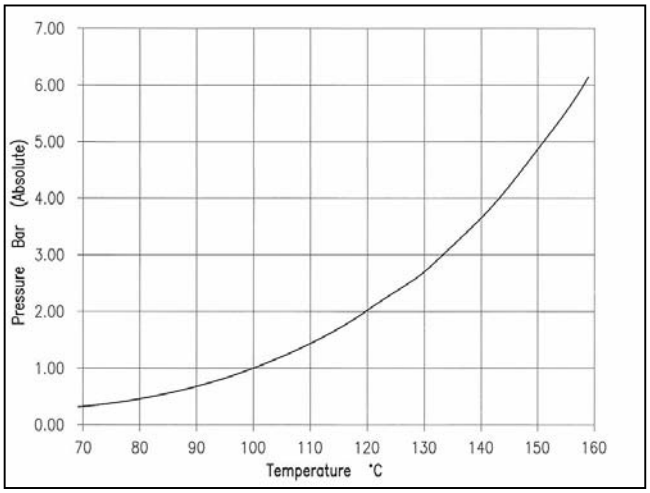



Figure 15.1 Relationship of boiling point elevation of water with pressure.

15.2.11 It is not usual to use a high filling pressure to permit liquid circulation at times of high temperatures, as it is preferable to increase the longevity of the antifreeze by allowing an early water evaporation typically no greater than 130°C.

15.2.12 Under these conditions the water in the collector evaporates out and the antifreeze is displaced as fluid into the expansion vessel away from the hottest parts of the collector. Both the filling pressure, pre-charge and pump controller setting effect this.

15.2.13 The solar controller should be set so the pump does not come back on until the temperature in the collector has dropped below the saturation temperature of water at the system pressure, so the fluid in the collector condenses back into a liquid.

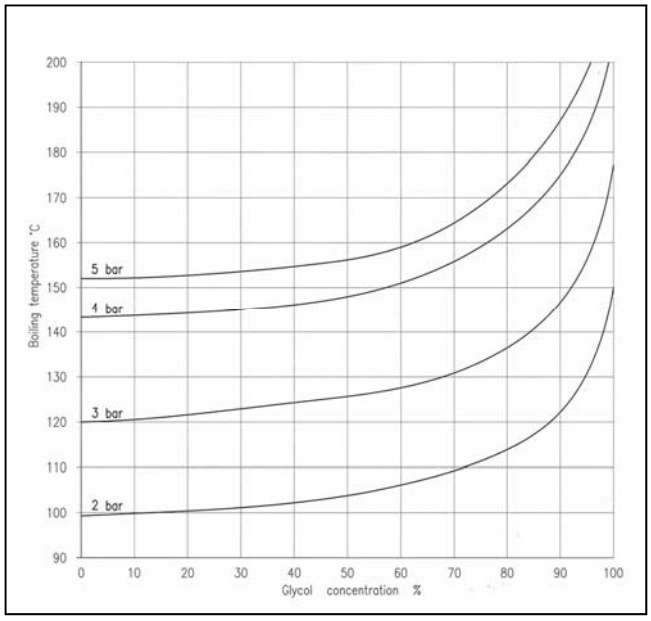



Figure 15.2 - Relationship Between Boiling Point & Aqueous Glycol Concentration

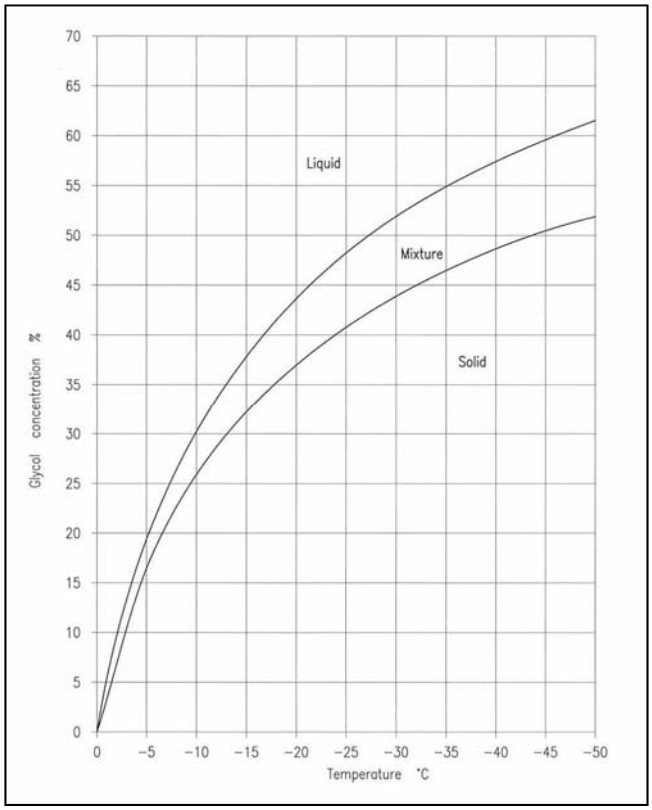



Figure 15.3—Relationship Between Freeze Point & Aqueous Glycol Concentration

15.2.14 Glycol decays under the action of heat, oxygen and bacteria so the solar fluid's concentration and acidity should be checked every 12 months.

15.2.15 To avoid under-sizing the expansion vessel and over pressure of the system, resulting in an elevation of the boiling point, Table 15.2 indicates suggested sizes for the expansion vessel and pressure settings to avoid safety valve discharge.

15.2.16 Where there is doubt follow the calculations procedure in section 15.4 to work out the vessel size, gas pre-charge and cold fill system pressure.

| System Height (m) | 2.5 | 5 | 10 |
|---|---|---|---|
| System Volume (Litres) | *Vessel Size* / ***Gas Pre-Charge*** / Initial Fill Pressure<br>*Litres* / ***Bar*** / Bar | | |
| <10 | *18* / ***1.3*** / 1.6 | *18* / ***1.5*** / 1.8 | *18* / ***2.0*** / 2.3 |
| 20 | *25* / ***1.3*** / 1.6 | *25* / ***1.5*** / 1.8 | *35* / ***2.0*** / 2.3 |
| 30 | *35* / ***1.3*** / 1.6 | *35* / ***1.5*** / 1.8 | *40* / ***2.0*** / 2.3 |
| 40 | *40* / ***1.3*** / 1.6 | *50* / ***1.5*** / 1.8 | *50* / ***2.0*** / 2.3 |
| 50 | *50* / ***1.3*** / 1.6 | *50* / ***1.5*** / 1.8 | *60* / ***2.0*** / 2.3 |

Table 15.2 Vessel Settings With 6 bar Safety Valve & 1.0 bar Overpressure.

15.3 Testing Glycol Concentration Of Solar Fluid

15.3.1 The method described to determine the concentration of Propylene glycol in water is based on the antifreeze tester sold under RS part number 196-8193.

15.3.2 Assemble weighted glass float labelled propylene glycol within the outer glass pipette of the antifreeze tester as shown.

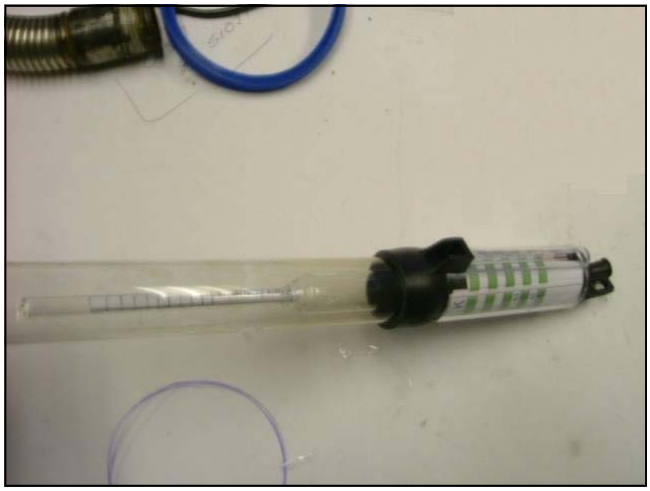


Figure 15.4—Assembly Of Glass Float

15.3.3 Fit rubber bellows to end of outer glass case.

15.3.4 Depress rubber bellows and immerse tip of pipette within the aqueous glycol solution being assessed.

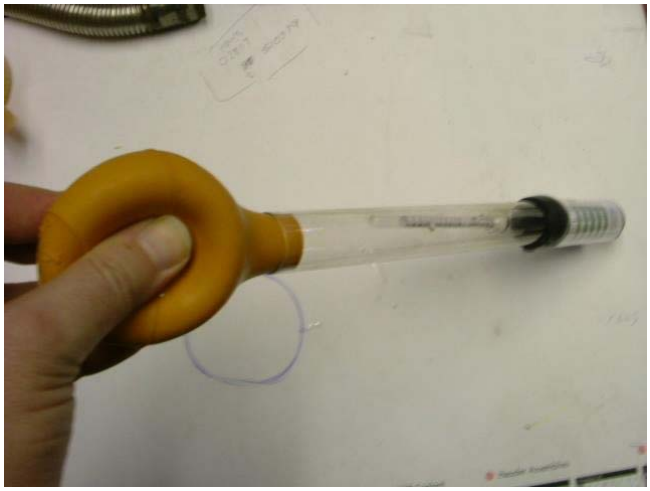


Figure 15.5 - Depress Rubber Bellows

15.3.5 Remove pressure on rubber bellows and draw the solution into the pipette so that the solution fills 2/3 of the pipette, & so the float is suspended in the solution.

15.3.6 Look at where the top film of the solution in the pipette comes in relation to the markings on the stem of the float and read off the corresponding letter on the float stem.

Figure 15.6 - Draw Glycol / Water Solution In Pipette

15.3.7 Observe the height of the red alcohol column on the bulb of the pipette and select the corresponding row in the table (on the sticker of the bulb) where the alcohol column ends.


Figure 15.7 - Read Off Concentration From Table

15.3.8 Select the column in the table which corresponds to the letter on the float stem and read off the concentration of glycol in the solution.

## 15.4 Method Of Calculation Of Expansion Vessel Size, Gas Pre-charge & Initial Fill Pressure

STEP 1 Calculate V expanded. Where V expanded = System Volume x Fluid Expansion Coefficient

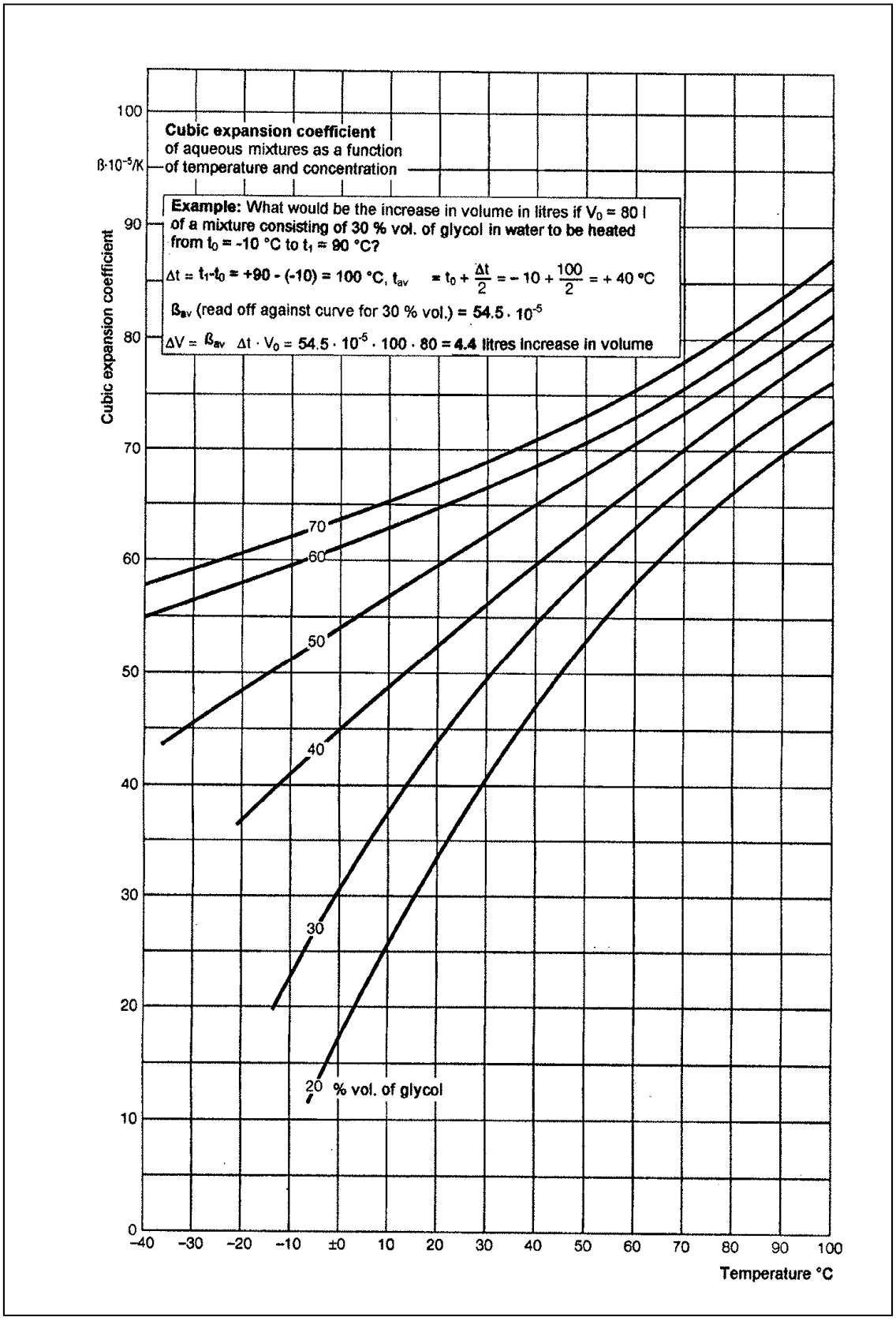



Figure 15.8 - Determine Expansion Coefficient Of Particular Concentration Of Glycol From Graph

STEP 2 Calculate Volume Of Extra Fluid For Protection Against Steam & For Small System Leaks ( V seal).

Where V seal = V total x 0.000654 x (T fill - T min)

For very small systems the minimum V seal must not be less than 3 litres.

STEP 3 Calculate Volume In Collector Array & Adjacent Pipework That May Vaporise At Stagnation (V vapour)

Where the volume in each collector is 1.46 Litres

STEP 4 Calculate Working Volume Of Expansion Vessel (V working)

Where V working = V expansion + V seal + V vapour

STEP 5 Calculate Final System Pressure During Stagnation (P final)

P final is used to set the intended vaporisation point of the antifreeze.

Where P sv = Rated Safety Valve Relief Pressure
P margin = A margin set on the Rated Safety Relief Valve Pressure so no discharge occurs in stagnation
= 0.1 x P sv & P margin > 0.5 bar
P final = P sv - P margin

STEP 6 Calculate Gas Pre-charge Pressure (P gas)

Where H geo = Height difference between the vessel inlet and the highest point of the collector array.
P geo = H geo x 1 bar / 10 m
P op = Over pressure of the collector at the highest point in the circuit.
P gas = P op + P geo

P op provides a means to prevent the pressure in the system becoming sub—atmospheric, which could lead to suction of air into the circuit or cause pump cavitation.

STEP 7 Set P wseal = 0.3 bar Where P wseal ensures the expansion vessel contains V seal.

STEP 8 Calculate the cold fill pressure for the solar circuit (P initial)

Where $P\ initial = \frac{P\ wseal + P\ gas}{P\ wseal + (P\ op + Pgeo)}$

STEP 9 Calculate the Pressure Factor for the vessel Pf

Where P pump = 0.3 bar

$$P\ f = \frac{P\ final + 1\ bar}{P\ final - (P\ gas + P\ pump)}$$

STEP 10 Calculate Nominal Expansion Vessel Volume (V nominal)

Where V nominal = Pf x V working x 1.1

Worked Example

A solar hot water system consists of 3 solar collectors, a circuit of 36m of D22mm copper pipe connected to the lower coil of a Powerstock 400l calorifier. The static height between the collector array and the expansion vessel is 8 meters. The ambient temperature during filling is 15°C and the minimum external temperature has been specified as –10°C. The solar circuit is filled with an aqueous solution of 40% glycol in water. The pressure relief valve is rated for 6 bar. An over pressure in the collector array (pump head on stagnation) has been specified as 1.1 bar.

| | | | Units | Formulae |
|---|---|---|---|---|
| Total number of solar collectors | | 3.0 | each | |
| Pipe run from plantroom to collector field | | 18.0 | metres | |
| Solar system static height | | 8.0 | metres | |
| Pipe diameter from plantroom to collectors | | 0.02 | m | |
| Safety relief valve setting | P sv | 6.0 | barg | |
| Maximum ambient temp during initial cold fill | | 15.0 | °C | |
| Lowest potential operating outside air temperature | | -10.0 | °C | |
| | | | | |
| **System volume** | | | | |
| Collector Array Volume | | 4.4 | litres | Internal volume per collector = 1.46 litres |
| Calorifier lower coil | | 12.2 | litres | PS300 = 10.4 litres<br>PS400 = 12.2 litres<br>PS500 = 13.15 litres<br>PS750 = 13.5 litres<br>PS1000 = 17.1 litres |
| Pipe volume plantroom to collector field | | 11.3 | litres | |
| Header volume behind collectors | | 3 | litres | Guess |
| Flexible connections volume | | 1 | litres | |
| **Total system volume** | **V total** | **31.9** | **litres** | |
| | | | | |
| **Expansion volume** | **V expanded** | **2.6** | **litres** | **0.08 x V total** |
| | | | | |
| Vessel water seal volume | V seal | 3.0 | litres | V total x 0.000654 x (filling temp + minimum external air temp) |
| Vapour volume (steam volume) | V vapour | 5.4 | litres | |
| Working volume expansion vessel | V working | 10.9 | litres | V expanded + V wseal + V vapour |
| Building static pressure | P geo | 0.8 | barg | Building height (metres) / 10.2 |
| Collector minimum pressure | P op | 1.1 | barg | Constant |
| Expansion vessel cushion pressure | P gas | 1.9 | barg | P geo + P op |
| Pressure margin for safe operation | P margin | 0.5 | barg | P sv x 10% **Must not be less than 0.5** |
| Maximum operating pressure | P final | 5.4 | barg | P sv - P margin |
| Water seal equivalent pressure | P wseal | 0.3 | barg | Constant |
| Pressure factor | P f | 2.5 | factor | ((P final + 1 barg) / P final - (P gas + P pump)) / 1.25 |
| Required nominal expansion vessel volume | V nominal | 25 | litres | P f x V working |
| Cold fill pressure | P initial | 2.2 | barg | P gas + 0.3 |

Table 15.3 - Results From Worked Example On Page 48

| | | | Units | Formulae |
|---|---|---|---|---|
| Total number of solar collectors | | | each | |
| Pipe run from plantroom to collector field | | | metres | |
| Solar system static height | | | metres | |
| Pipe diameter from plantroom to collectors | | | m | |
| Safety relief valve setting | P sv | | barg | |
| Maximum ambient temp during initial cold fill | | | °C | |
| Lowest potential operating outside air temperature | | | °C | |
| | | | | |
| **System volume** | | | | |
| Collector Array Volume | | | litres | Internal volume per collector = 1.46 litres |
| Calorifier lower coil | | | litres | PS300 = 10.4 litres<br>PS400 = 12.2 litres<br>PS500 = 13.15 litres<br>PS750 = 13.5 litres<br>PS1000 = 17.1 litres |
| Pipe volume plantroom to collector field | | | litres | |
| Header volume behind collectors | | | litres | Guess |
| Flexible connections volume | | | litres | |
| **Total system volume** | **V total** | | **litres** | |
| | | | | |
| **Expansion volume** | **V expanded** | | **litres** | **0.08 x V total** |
| | | | | |
| Vessel water seal volume | V seal | | litres | V total x 0.000654 x (filling temp + minimum external air temp) |
| Vapour volume (steam volume) | V vapour | | litres | |
| Working volume expansion vessel | V working | | litres | V expanded + V wseal + V vapour |
| Building static pressure | P geo | | barg | Building height (metres) / 10.2 |
| Collector minimum pressure | P op | | barg | Constant |
| Expansion vessel cushion pressure | P gas | | barg | P geo + P op |
| Pressure margin for safe operation | P margin | | barg | P sv x 10% **Must not be less than 0.5** |
| Maximum operating pressure | P final | | barg | P sv - P margin |
| Water seal equivalent pressure | P wseal | | barg | Constant |
| Pressure factor | P f | | factor | ((P final + 1 barg) / P final - (P gas + P pump)) / 1.25 |
| Required nominal expansion vessel volume | V nominal | | litres | P f x V working |
| Cold fill pressure | P initial | | barg | P gas + 0.3 |

Table 15.4 Empty Calculations Table For Expansion Vessel Sizing

15.5 Procedure For Filling / Draining / Pressurizing The Solar Circuit

15.5.1 Priming the filling pump.

Refer to Figure 15.9

A) Connect the green ribbed hydraulic hose over the hose tail of valve (1) and assemble using a Jubilee-clip.
B) Assemble the other end of this hose to valve (18) on the pump outlet.
C) Connect the hose with in line filter attached to valve (8) and submerge the end of the hose into the container of Glycol/water solution.
D) If the hose tail at (1) has been lost, a washing machine water supply hose can be connected between the pump and filling point (1).
E) Seal hose to hose-tail connections using Jubilee-clips.
F) Connect a length of hose to the inlet of valve (17) and submerge the end of the hose into a container of premixed solution of Glycol / water.
G) Close valve (6) so that the 20 & 100 Degree C graduations on the face of the dial thermometer in handle of valve are horizontal.
H) Open valves (5) so that the 20 & 100 Degree C graduations on the face of the dial thermometer in handle of valve are vertical.
I) Also open valves (1), (8) (18) & (17).
J) Cut off the continental moulded plug on the pump (19) and wire a 3-pinned UK plug to pump's flying lead.
K) Plug the pump into electrical supply and turn the pump on.
L) Run the pump at maximum speed and bleed the air in the pump head using the bronze screw at the front of the pump.
M) Turn the pump on & off several times in order to accelerate air extraction.

15.5.2 To fill the solar circuit.

A) Refer to figure 15.9.
B) Where possible cover the glass face of the collectors from direct sunlight using a tarpaulin, because with a high level of solar radiation it is possible that vapour could be generated in the collectors.
C) Open valves (1), (3), (6), (8) & (11).
D) Close ball valve (5).
E) Submerge the end of the inlet hose of the pump in the container (15) of premixed glycol/water.
F) Switch the pump on.
G) Allow the glycol/water mix to circulated back to the container, so that all air is purged from the solar circuit.

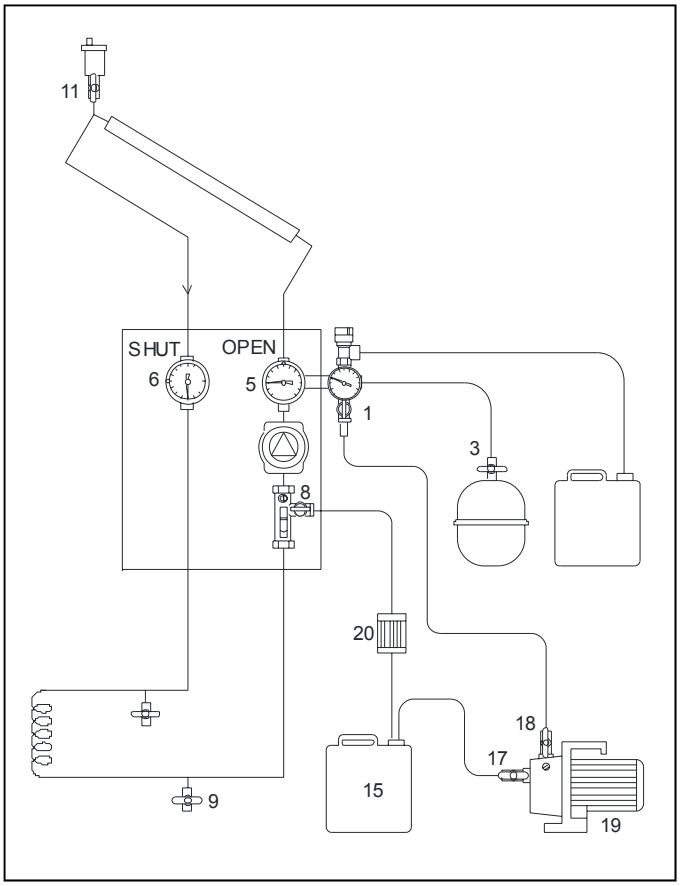



Figure 15.9 - Hydraulic Circuit For Priming Filling Pump

15.5.3 Pressurising the solar circuit

Refer to Figure 15.9

A) Ensure that valves (8), (9) & (11) are shut.
B) That valves (1), (3), (5), (6), (17) & (18) are open.
C) The end of the inlet hose to the pressurisation pump is submerged in the container.
D) Expansion vessel cold fill pressure has been calculated and the gas pre-charge been set.
E) Switch the pump on and fill the system until the pressure in the solar circuit reaches that of the cold fill pressure.
F) Shut valve 1 & switch off the pump simultaneously.
G) Shut valve 3 to isolate the expansion vessel (which has been correctly filled).
H) Raise the pressure in the circuit to 5 bar.
I) Check each joint in the circuit for leakage and tighten where necessary.
J) Drain & re-pressurise if necessary.
K) With a stable static circuit pressure reduce the internal pressure to the cold fill pressure by opening valve 8.
L) Re-pressurise to cold fill pressure with pump if necessary.
M) Close valve 1.
N) Open valve 3.
O) Remove the tarpaulin cover over the collectors.
P) The pressure should be set at 0.1-0.2 bar higher than the values given in Table 15.5 overleaf.

| Height To Top Of Collectors (m) | Cold Fill Pressure (bar) |
|---|---|
| 5 | 0.7-0.8 |
| 8 | 1.0-1.2 |
| 10 | 1.2-1.3 |
| 15 | 1.7-1.8 |
| 20 | 2.3-2.5 |

Table 15.5 - Guide For Cold Fill Pressures Where Installation Not Covered By Table 15.2 or calculated using Table 15.4

15.5.4 To flush an already filled solar circuit.

Refer to Figure 15.10

A) When flushing already filled circuits, such as when the glycol/water mix has been identified to be in poor condition, if possible cover the glass face of the collector array and set the solar controller to run the solar circulating pump in manual.
B) Ensure the temperature in the solar circuit is below 55 Degrees C. This reduces the risk of scalding when removing fluid from the circuit.
C) Connect the hose with in line water filter (from the filling pump kit 553000719) to valve (8). The end of this hose should be placed in an empty container.
D) Connect the outlet hose of the pump to valve (1) and submerge the end of the inlet hose to the pump (19), in the container of new glycol/water mix.
E) Open valves (6), (8), (17) & (18).
F) Close valve (3) & (5).
G) Simultaneously switch the pump on and open valve (1).
H) Depending on the solar circuit volume a number of containers of new glycol/water mix may be required.

15.5.5 To drain the solar circuit.

Refer to Figure 15.10

A) Connect a hose at valve (9) or valve (8) if (9) not present, and place the end of the hose into an empty container (21).
B) Open valves (5) & (6).
C) Slowly open valve (9) to reduce the pressure to atmosphere.
D) Open valve (11) or the plastic cap of the de-aeration pot to allow the contents of the circuit to collect in the container.
E) Depending on the circuit volume it may be necessary from time to time to change the container.
F) Where the system has neither a de-aeration pot or valve (11) the expansion vessel should be either disconnected from the circuit and it's connection to the circuit be temporarily plugged. Where fitted shut valve (3).

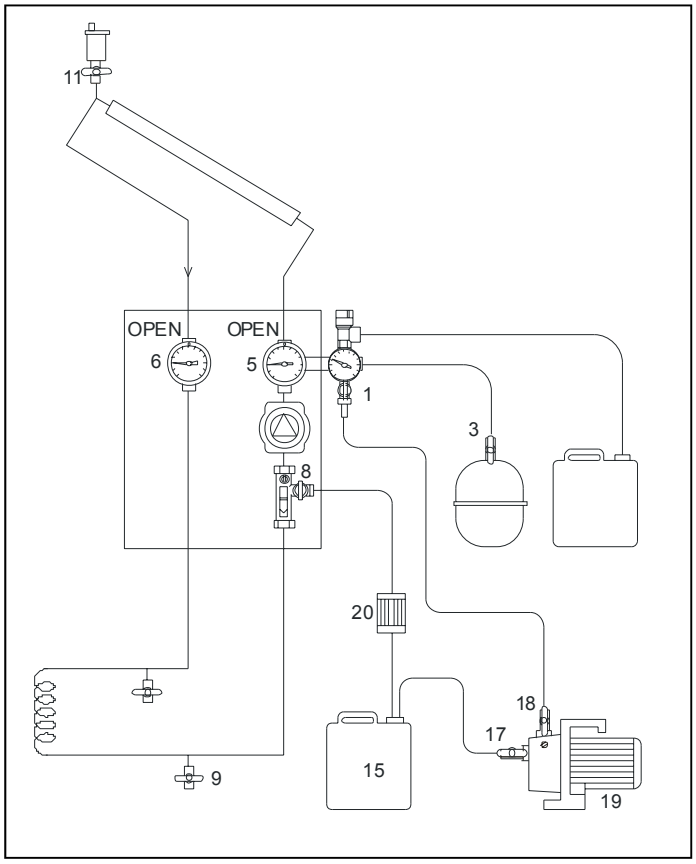



Figure 15.10 - Hydraulic Circuit For Pressurisation

G) Connect Valve (1) to a compressed air supply and apply an air pressure of maximum 3 bar to purge the fluid from the circuit.
H) Before carrying out this procedure undertake a risk assessment to those carrying out the work as well as to occupants and passers-by. Whilst carrying out this procedure wear appropriate personal protective equipment & restrict access to those in the vicinity of the installation. Remember the collectors will be sited on the roof so it may be necessary to cordon-off at ground level a suitable area underneath the collector installation.

15.6 Setting the solar circulation pump flowrate once the system has been filled with Gylcol / water mix.

15.6.1 Select the appropriate hydraulic variant for the application. See pages 73 to 84.
15.6.2 Ensure the controller is isolated from it's power supply at the wall.
15.6.3 Remove the front cover of the controller using the fixing screw in the front cover. Refer to page 71. figure 16.2.5.
15.6.4 Using a screwdriver prize the PCB away from the rear housing.
15.6.5 Based on the most appropriate hydraulic circuit to that of the application, wire the system components to the terminals as shown in the electrical schematic. See pages 73 to 84.
15.6.6 Replace the controller PCB and re-assemble the controller front cover.

15.6.7 Ensure valves 3, 5, 6 and the slot of the in-line ball valve setting screw of the flow-meter is set to vertical ie open. See figure 15.11 below.

Figure 15.11 Flowmeter Setting Valve

15.6.8 Switch the 230V mains Isolator back on.

15.6.9 The controller goes to automatic mode when switched on.

15.6.10 Press the √ key on the control panel.

15.6.11 The automatic symbol will begin to flash.

15.6.12 Press the > key once and the controller goes in to manual mode.

15.6.13 Press the √ key.

15.6.14 Using the > key, keep pressing this until you come to the “SET” mode.

15.6.15 Press the √ key to accept this mode.

15.6.16 Using the > again scroll through until you get the symbols Cod - - appear.

15.6.17 Enter the installers code. (contact HHL for code)

15.6.18 Using the > key scroll through the parameters until you reach parameter 4-06.

15.6.19 Press the √ key to alter this parameter.

15.6.20 Use the > key, select the desired hydraulic scheme 1 to 9 and press the √ to accept.

15.6.21 Re-enter the installers access code and scroll through until you reach parameter 8-37.

15.6.22 Increase the flowrate of the pump in l/min from 2 to 40l/min. You may need to adjust this flowrate at a later stage.

15.6.23 Accept the value using the √ key of the control panel.

15.6.24 Press the “X” key on the control panel to go back to manual mode.

15.6.25 Pressing the > key scroll down so the word “SET” displays on the control panel.

15.6.26 Press the √ key to accept.

15.6.27 Scroll through the parameters with the > key until you reach parameter 8-85.

15.6.28 Accept using the √ key and using the > keys increase the flowrate of the pump to 100%.

15.6.29 Press the √ key and observe the flowrate on the flowmeter.

15.6.30 Note : at this stage even though the pump may be running there may not be any flow.

To rectify this check the hydraulic circuit along it’s length for any closed valves and loosen off all internal / external Automatic Air Vent (AAV) caps.

If need be drop the system pressure temporarily as this may help the movement of any pipe work air locks to the AAV’s.

15.6.31 Refer to Table 3.20 (page 6) for recommended flowrates through the collector array.

15.6.32 Reduce the parameter 8-85 until the actual flowrate matches that of the desired flowrate.

15.6.33 Once the % flow on the basis of maximum flow from the pump has been defined go back into the installers menu and reduce parameter 8-37 from 40l/min to the desired flowrate and accept (√ key). Also adjust parameter 8-35 to 100% and accept.

15.6.34 Press the X key twice to get back to manual mode.

15.6.35 Press the √ key and press the > key to select automatic mode. Accept this mode using the √ key.

## 16.0 SOLAR HEATING SYSTEM COMMISSIONING

The following checks must be carried out before the solar heating system is commissioned.

For Solar Commissioning Sheet See Appendix F.

Ensure that;

- Pipework and valve arrangement is installed to Hamworthy Heating recommendations.
- Solar heating system is full of water/glycol solution, vented and pressurised appropriately.
- Solar circulation pump is working and interlocked where required.
- Pipework connections to the transfer station are fitted correctly.
- Temperature sensors are wired correctly to the solar controller and installed in the appropriate pockets in the indirect / direct fired water heater or storage tank; depending on the Hydraulic variant selected.
  See pages 73 to 84
- All isolation valves except for those fitted to AAV's are open.
- Safety valve is correctly sized and located.
- Electrical connections are correct and isolatable.
- External controls are operational.

When defining the operating parameters of the solar heating system by following the controller operating instructions on pages 55 to 88, it is important to ensure that the value of parameters selected meet the advise given in the Health and Safety Commission's publication L8—The control of legionella bacteria in water systems.

For this reason Hamworthy Heating recommends :-

A) Parameter 5-04 : The legionella protection temperature, is set to 70$^{o}$C.
B) Parameter 5-14 is set to value 8 = daily. This will mean the bottom of the storage vessel is heated to this temperature daily.
C) Parameter 8-20 must be set to 10 K. So that the water stored is at 60$^{o}$C.

For further advise on measures to sterilise against Legionella, Hamworthy Heating advises you to contact The Chartered institute Of Building Services Engineers.

## 16.1 OPERATING INSTRUCTIONS FOR ES5910 ELECTRONIC SOLAR CONTROLLER

TABLE 16.1 - OPERATING INSTRUCTIONS CONTENTS

Warning

The controller is electrically operated.
Improper installation or attempted repair can cause a life-threatening electric shock hazard. Installation and commissioning must be performed only by adequately qualified specialist personnel. It is forbidden to open the device or auxiliary components with the exception of the terminal cover. When the controller cover is removed, the printed circuit board must be handled with care. Mechanical damage and effects from tools must be avoided. Repairs may only be carried out by the manufacturer.

Instructions in the text that are marked by a warning symbol must be observed under all circumstances.

Attention danger by voltage.

Special reference, which is to be considered.

**Display & Controls**

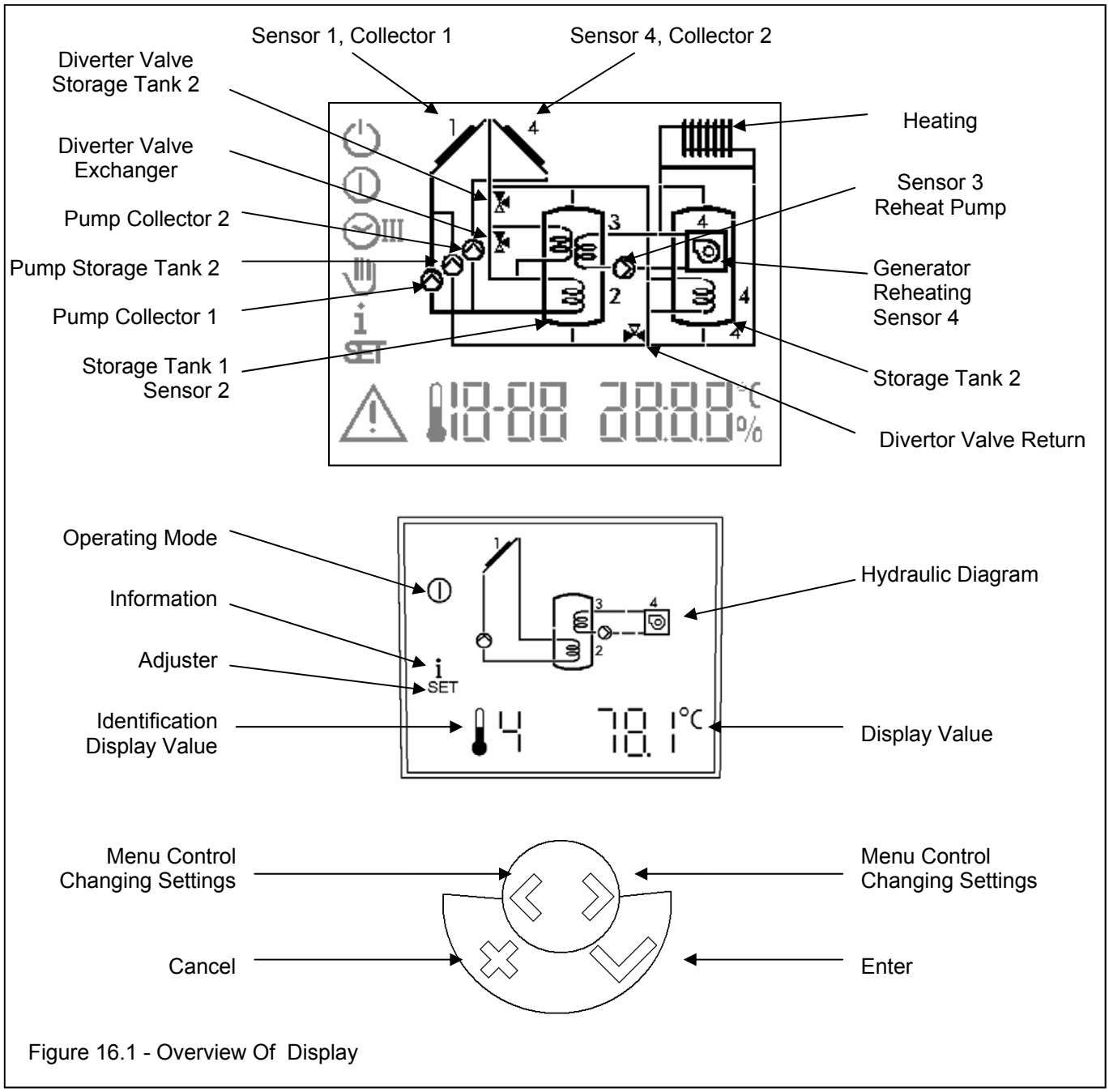



Figure 16.1 - Overview Of Display

16.1.0 Operation

16.1.1 Change operating mode

With the enter-key and the '<' & '>' setting-keys, the desired operating mode can be selected. The symbol on the left side of the display shows the active operating mode.

Example. Change the operating mode from **automatic** to **manual** ( which allows you to run the pump & set the flowrate round the solar circuit).

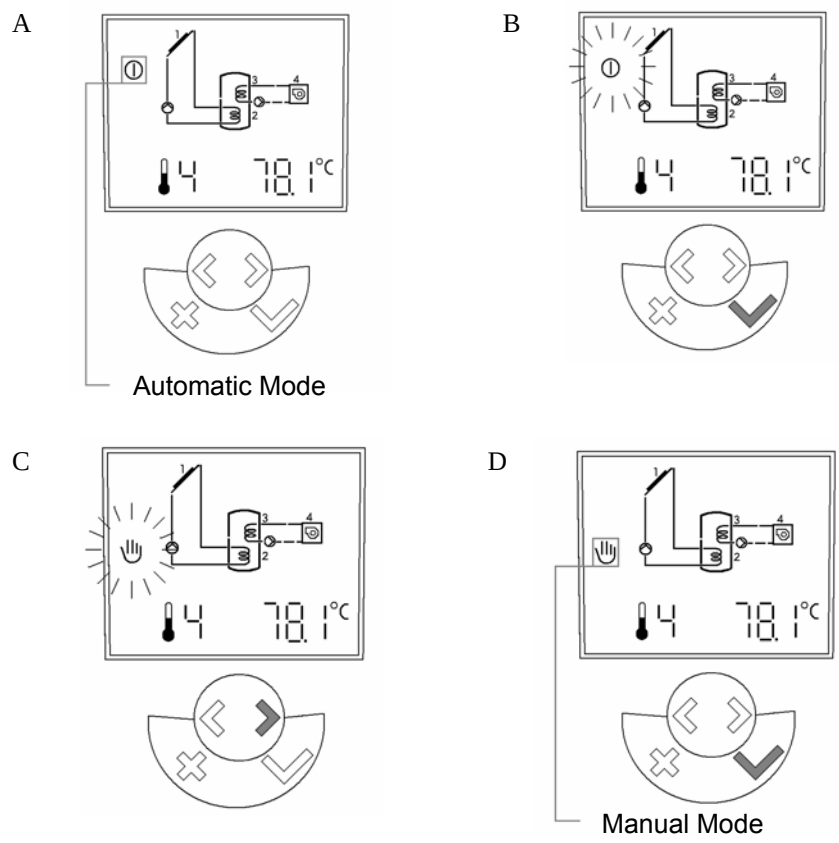



Figure 16.1.1 - Change Of Operating Mode

A) The operating mode **automatic mode** ⏻ is active.
B) To change into the operating mode **manual**, press the √ key .
The symbol of the operating mode blinks.
C) Press the > key to select the operating mode **manual**.
D) Press the > key to confirm.
E) The operating mode **manual** is activated.

| Symbol | Mode | Function |
|---|---|---|
| ⏻ | Standby | System off, protective functions active |
| ⏻ | Automatic mode | The controller function is active & dependent on the hydraulic scheme selected & parameter settings. |
| ✋ | Manual | The functions can be tested and adjusted manually. Used during system commissioning. |

**Table 16.1.1 - Operating modes**

**Note:**
With the 'X' key pressed a function can be interrupted, before it has been confirmed.
By using this key the controller turns back to it's previous operating mode.

16.1.2 Query of temperatures and operating data

At the information viewing level, the temperature values (measured and set point) as well as the operating data can be queried successively.

Example

A) To change to information level, press the > key. The symbol ' İ ' appears.

B) To query the values and data, press the √ key .
The first identification value blinks.

C) By pressing the > key, the temperature values (measured and set point) as well as the operating data can be queried successively. For set points, the symbol 'SET' appears on the display.

D) By querying of the data, the function symbol as well as the function-unit are blinking.

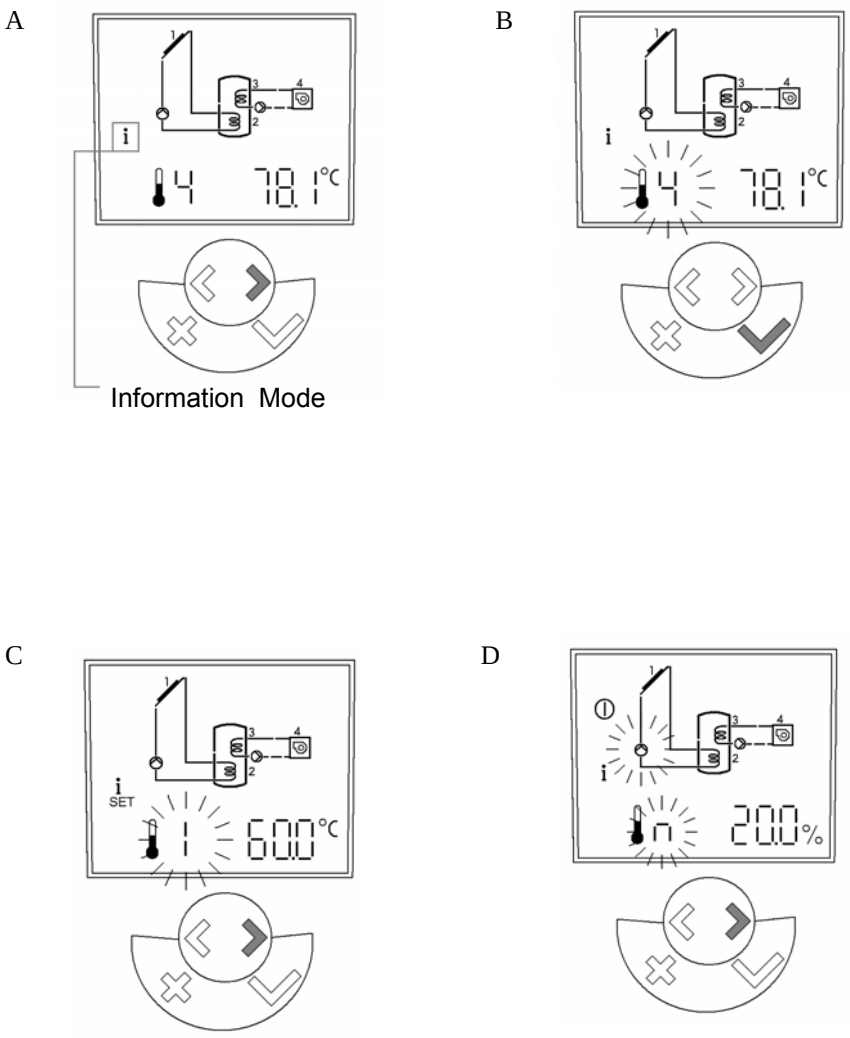



Figure 16.1.2 - Query temperatures & Operating Data

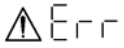
| Display | Description | Unit |
|---|---|---|
|  | Measured temperature value | oC |
|  | Set point of temperature | oC |
|  | Maximum collector temperature into 24 h | oC |
|  | Revolution collector pump | % |
|  | Relay of reheating pump, generator pump or diverter valve | - |
|  | Collector capacity | - |
|  | Collector yield since installation | kW |
|  | Information | - |

Table 16.1.2 - Display Symbols

Note:

After a timeout of 2 minutes, the controller turns back to the actual operating mode.

With the ‘X’ key the query of the temperature values and data can be interrupted. The controller turns back to the actual operating mode.

16.1.3 Settings at the user level

At the user level, the following controller parameters can be adjusted.

| Parameter | Description |
|---|---|
| 8-56 | Priority tank 1 |
| 8-62 | Set temperature tank 1, normal |
| 8-63 | Switching on hysteresis to set temperature tank 1. |
| 8-56 | Priority tank 2 |
| 8-62 | Set temperature tank 2, normal. |
| 8-63 | Switching on hysteresis to set temperature tank 2 in **Manual Operation.** |
| 8-85 | Flowrate Pump 1 as % of the maximum set flow available. **Manual Operation**. |
| 8-85 | Flowrate Pump 2 as % of the maximum set flow available. **Manual Operation**. |
| 8-86 | Set value of circulation pump in **Manual Operation.** |
| 8-87 | Set value of diverter valve in **Manual Operation.** |

Table 16.1.3 - User Level Controller Parameters

Example
A) To access the user level, press the > key a number of times, until the symbol SET appears.
B) To query the parameters, press the √ key. The first parameter and his function blinks.
C) By pressing the > key, parameters can be queried successively.
D) Press the √ key to adapt the parameter.
E) By pressing the < > keys the setting of the parameter can be adjusted.
F) Press the key √ to save the setting of the parameter.
G) With the 'X' key the adaptation of the parameter can be interrupted. By pressing once, the controller shows Figure 16.1.3.C & the set value stays like before. By pressing two times, the controller goes to Figure 16.1.3.A.

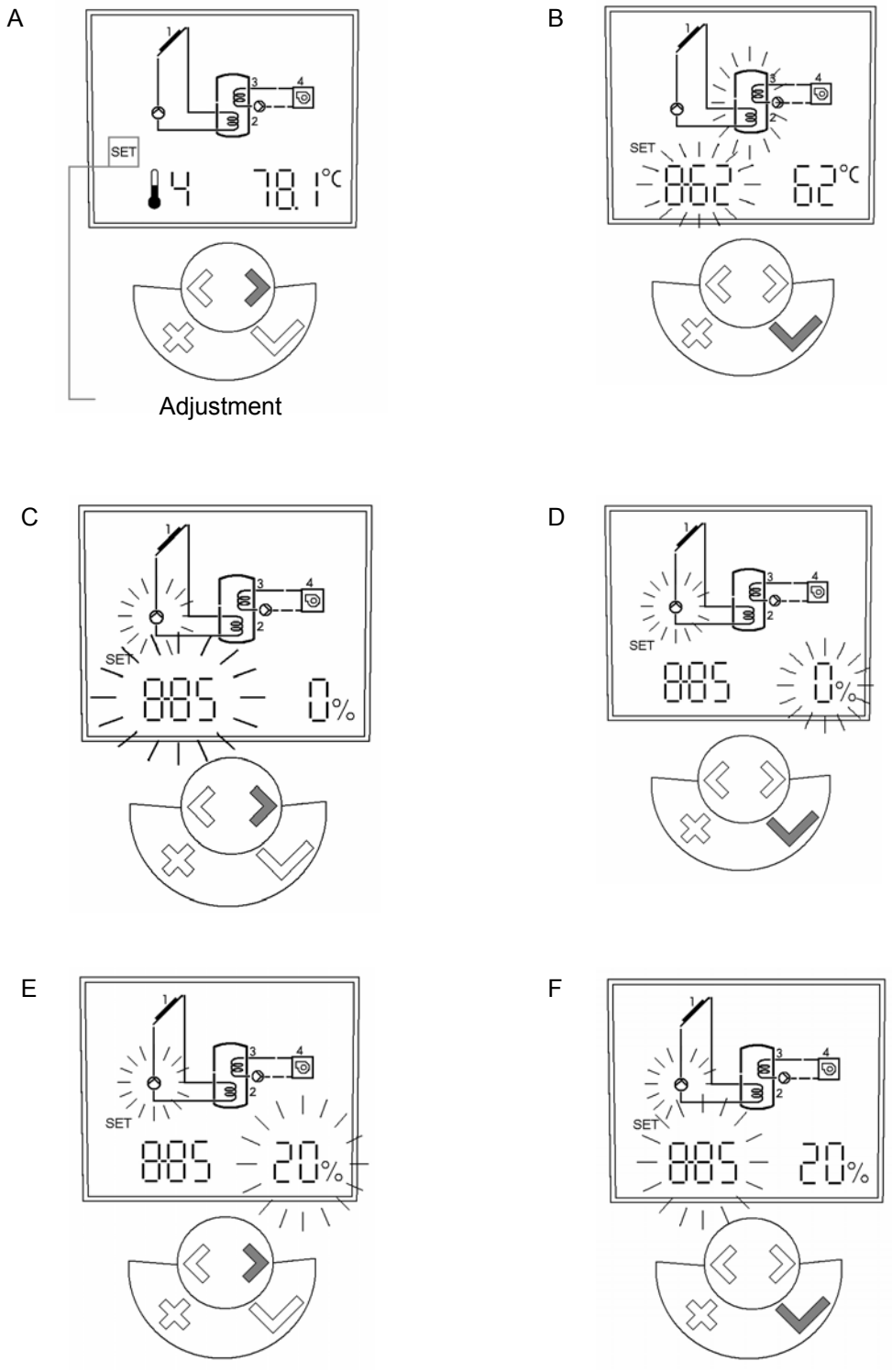



Figure 16.1.3 - User Level Parameter Adjustment

16.1.4 Parameters that can be adjusted at User Level.

| Parameter | Solar Scheme | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|---|
| 8-56 | 6,8 | Priority Tank 1 | 1÷2 | 1 | - | |
| | | If more than one tank is used the priority can be selected for each tank. Small value = high priority | | | | |
| 8-62 | All | Set temperature 1, normal | 0÷90 | 60 | °C | |
| | | Reference quantity for different functions of tank charging. If the value at the tank sensor is higher, the set value is reached. Switching point during charging is set value. Set value for recharging tank 1. Basic target value for calculation of the optimised over-increase of the number of revolutions during charging is set value. | | | | |
| 8-63 | All | Switching on hysteresis to set temperature tank 1 | 1÷30 | 2 | K | |
| | | Value 8-62 minus the set value gives a charging request | | | | |
| 8-56 | 6,7 | Priority tank 2 | 1÷2 | 2 | - | |
| | | As 08-56 tank 1 | | | | |
| 8-62 | 6,7 | Set temperature 2, normal | 0÷90 | 60 | °C | |
| | | As 08-56 tank 1 | | | | |
| 8-63 | 6,7 | Switching on hysteresis to set temperature tank 2 | 1÷30 | 2 | K | |
| 8-85 | All | Setting value collector pump 1, in manual operation | 0÷100 | 0 | % | |
| | | In manual operation the controller can be set | | | | |
| 8-85 | 6,9 | Setting value collector pump 2, in manual operation | 0÷100 | 0 | % | |
| | | In manual operation the controller can be set | | | | |
| 8-86 | 2,4,5 | Setting value circulation pump in manual operation | on/off | off | - | |
| | | In manual operation a setting value can be entered here. | | | | |
| 8-87 | 3,7,8 | Setting diverter valve in manual operation | on/off | off | | |
| | | In manual operation a setting value can be entered here. | | | | |

Table 16.1.4 Parameters That Can Be Adjusted At User Level

16.1.5 Parameters Available with Installers access code.

The parameters to be set by an Installer are protected by an access code. Please contact Hamworthy Heating to get the installers access code.

A) To enter into the user level, press the > key a number of times until the symbol SET appears.
B) To query the parameters, press the √ key. The first parameter and his function blinks.
C) Keep pressing the > key, until “COD—“ appears.
D) Press the key √ to enter the access code.
E) Using the < & > keys enter the code.
F) Confirm the code by pressing the √ key.

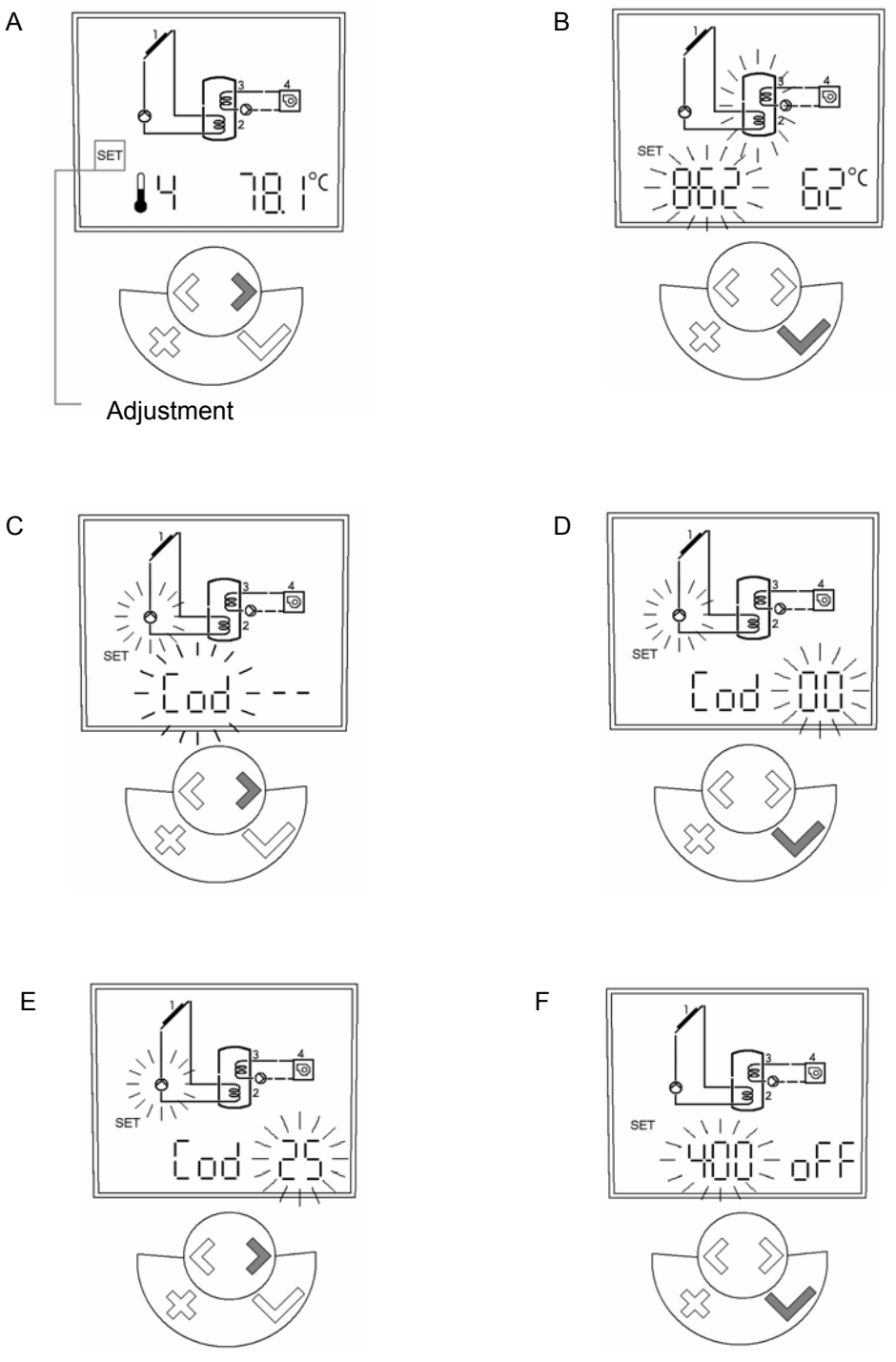



Figure 16.1.5 - Input Installers Level Access

16.1.6 Parameters that can be adjusted at Installers Level.

| Parameter | Solar Scheme | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|---|
| 04-06 | all | Hydraulic variants | 1÷9 | 1 | - | |
| | | Selection of Hydraulic Variant<br>1 = Speed (rpm) controlled collector pump on tank (SP)1<br>2 = Speed controlled collector pump on SP1, recharge / charge off/ to SP 2 with pump<br>3 = Speed controlled collector pump on SP1, reflow via divertor valve<br>4 = Speed controlled collector pump on SP1, recharge with boiler via pump without T.<br>5 = Speed controlled collector pump on SP1, recharge with boiler via pump with T.<br>6 = 2 Speed controlled collector pumps on tank SP1 and tank SP2.<br>7 = Speed controlled collector pump on SP1 and SP2 via diverter valve.<br>8 = Speed controlled collector pump on SP1 with 2 heat exchangers via diverter valve.<br>9 = 2 Speed controlled collector pumps for 2 collectors on tank 1.<br>Note: Settings 6 & 9 only for ES591xS.<br>Following a new selection, the controller will be restarted ! | | | | |
| 05-04 | All | Legionella protection temperature | 60÷80 | 60 | °C | |
| | | Set value for the thermal disinfection (legionella protection). Is valid during a released thermal disinfection. | | | | |
| 05-14 | all | Legionella protection function | 0÷9 | 0 | - | |
| | | The warm water is heated to the set Legionella protection temperature a set number of times (protective temperature as per Parameter 5-04).<br>0 = no function<br>1 = 1x each week<br>8 = daily<br>9 = permanently | | | | |
| 07-08 | 3 | Max. tank temp. for return flow increase | 30÷90 | 70 | °C | |
| | | If the temperature at sensor B3 rises above the set value, the return flow increase is disabled. | | | | |
| 08-01 | all | Increase collector tank for charging ON. | 0÷50 | 15 | K | |
| | | If the temp. at the collector sensor is higher than the temp. on the tank sensor + set value “08-01” solar charging is enabled | | | | |
| 08-02 | All | Increase collector tank for charging OFF. | 0÷50 | 5 | K | |
| | | If the temp. at the collector sensor is less than the temp. at the tank sensor + set value “08-02”, solar charging is disabled. | | | | |
| 08-15 | All | Start-up help pipe collector | on/off | on | - | |
| | | In systems with pipe collectors, the collector temp. is often only insufficiently recorded. In the “on” position a start up help for the solar pump is activated.<br>Due to the positive temperature increase at the collector sensor, the solar pump switches on for 30 seconds. After this time period the pump switches off. Now the temperature on the collector becomes measured . If the temperature difference to the storage tank is sufficient, the solar pump switches on again, after a variable timeout (min. 15 minutes to max. 100 minutes) for 30’s. the timeout period becomes set by the conditions of the actual collector temperature and the temperature change. | | | | |

Table 16.1.6 - Parameters That Can Be Adjusted At Installers Level

| Parameter | Solar Scheme | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|---|
| 08-20 | All | P range (Xp) collector controller pump steering | 10÷50 | 20 | K | |
| | | The collector controller has a PID control. The set P range determines at which set value deviation 100% adjusting command for the speed control is generated. | | | | |
| 08-21 | All | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | | The response time influences the speed with which the speed control adjusts a deviation between set actual values. The setting determines after how many minutes the double value of the difference from the minimum setting value (08-35) is demanded. | | | | |
| 08-22 | All | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | | With the derivative time, a differential share can be allocated to the speed control. The actual increase of the collector temp, multiplied by the derivative time gives the change in setting for the speed control.<br>Note: - With the derivative time, the controller makes a forecast of the deviation from the set temperature and corrects the expected deviation correspondingly, i.e. it makes the correction before the deviation from the set value has developed. Time horizon of the forecast = derivative time. | | | | |
| 08-30 | All | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | | Input of the installed collector performance which can be achieved under optimum running conditions. The performance must be corrected for alignment and angle of inclination of the collector area as per the manufacturers instructions. The value is used to calculate the relative solar performance. During solar charging the actual solar performance (n x c x V x T) is compared to the nominal performance.<br>If the factor is > than the set value (08-51), the charging strategy is switched over (higher charge).<br>Note: n = actual set value<br>c = heat capacity medium collector circuit (08-09)<br>V= Volume at 100% speed (08-37)<br>T= temperature difference collector B1/tank B2 | | | | |
| 08-30 | 9 | Solar nominal performance collector 2 | 1÷50 | 8 | kW | |
| | | As for parameter 08-30 collector 1 | | | | |
| 08-35 | All | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | | Minimum set value for the speed control of the collector pump 1 | | | | |
| 08-35 | 6,9 | Min. set value collector pump 2 | 1÷50 | 2 | l/min | |
| | | As for parameter 08-35 collector 1 | | | | |
| 08-37 | All | Volume flow coll. Pump 1 at 100% set value | 1÷50 | 2 | l/min | |
| | | The volume flow at 100% set value of the pump collector 1 and aligned hydraulic.<br>Note :- In manual operating mode set adjuster 08-85 to 100%. Read the through-flow at the floating body volume flow meter. | | | | |
| 08-37 | 6,9 | Volume flow collector Pump 2 at 100% set value | 1÷50 | 2 | l/min | |
| | | As for parameter above. | | | | |

Table 16.1.6 - Parameters That Can Be Adjusted At Installers Level

| Parameter | Solar Scheme | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|---|
| 08-50 | All | Strategy solar charging | 0÷4 | 3 | - | |
| | | A basic Strategy can be selected for solar charging:<br>Note: In the charging strategy it is attempted to charge the tank to the required set or maximum value with as few charging cycles as possible.<br>Based on the available solar energy, the controller attempts to maintain an even increase at the collector sensor throughout the whole charging time. This optimised increase has a lower limit. (Parameter 08-64).<br>In strategies 3 & 4 this calculation is only used with high solar energy levels. | | | | |
| | | 0 = Parallel charging | Charging in an alternating operation, the lowest tank is charged first. The set value for the speed control is determined from the temperature at the tank sensor + increase (Parameter 08-64). | | | |
| | | 1 = Set charging | Charging is carried out to the set value according to priority of the tank (Parameter 08-56). The tank with priority 1 is charged first to the set value (Parameter 08-62). The set value for the speed control is determined from the temperature at the tank sensor + optimised increase. | | | |
| | | 2 = maximum charging | Charging is carried out to the maximum value according to priority of the tank (parameter 08-56). The tank with priority 1 is charged first upto the maximum value (parameter 08-56). The set value for the speed control is determined by the maximum value + optimised increase (parameter 08-64). | | | |
| | | 3 = Set charging dependent on energy | Charging is carried out to the set value according to energy available (parameter 08-51) parallel in alternating operation or according to priority of the tank (parameter 08-56). The set value for the speed control is determined according to the active strategy. | | | |
| | | 4 = Maximum charging dependent on energy | Charging is carried out to the maximum value according to the energy available (parameter 08-51) parallel in alternating operation or according to priority of the tank (parameter 08-56). The set value for the speed control is determined according to the active strategy. | | | |
| 08-51 | All | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | | If the comparison of actual solar energy with the nominal performance gives a factor which lies above setting value, a change-over from parallel operation (alternating) to set value or maximum charging takes place.<br>Note :- The basic settings for the nominal solar performance (08-30) are directly linked and must be correctly set. | | | | |

Table 16.1.6 - Parameters That Can Be Adjusted At Installers Level

| Parameter | Solar Scheme | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|---|
| 08-55 | All | Tank type, tank 1 | 0÷4 | 0 | - | |
| | | 0 = Warm water tank | All charging strategies are possible. According to application, the settings for the change-over to alternating operation must be adjusted.<br>Parameter (08-65 & 08-66). | | | |
| | | 2 = Heating tank | If the tank set value is set below 20°C, this is understood to be summer operation. The tank set value will be lowered to the frost temperature of 10°C. | | | |
| | | 4 = Swimming Pool | Not included in alternating operation | | | |
| 08-59 | All | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | | If the temperature at the tank sensor rises above the set value, solar charging for this tank is disabled.<br>With active overheating protection (parameter 08-05) this limiting value is ignored. | | | | |
| 08-60 | All | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | | If the temperature at the tank sensor rises above the set value, solar charging is disabled, even if the overheating protection is active. | | | | |
| 08-64 | All | Set value charging temperature increase, tank 1 | 5÷50 | 20 | K | |
| | | Minimum increase which is demanded at the collector sensor for charging. This increase always refers to the tank sensor. | | | | |
| 08-65 | 6,7 | Switch-on threshold tank1 alternating operation | 0÷20 | 5 | K | |
| | | If the tank temperature setting is smaller than the temperature in the tank with the lowest priority, solar charging will be enabled for tank 1.<br>Note:- Setting of different on & off thresholds can optimise the alternating operations for tanks with large volumes or temperature levels. | | | | |
| 08-66 | 6,7 | Switch-off threshold tank 1 alternating operation. | 0÷20 | 5 | K | |
| | | If the tank temperature + setting value is larger than the temperature in the tank with the lowest priority, solar charging of tank 1 will be disabled. | | | | |
| 08-55 | 6,7 | Tank type, tank 2 | 0÷4 | 0 | - | |
| | | As for Adjuster 8-55 tank 1 | | | | |
| 08-59 | 6,7 | Maximum temperature, tank 2 | 10÷90 | 80 | °C | |
| | | As for adjuster 08-59 tank 1 | | | | |
| 08-60 | 6,7 | Protective temperature tank 2 | 10÷95 | 90 | °C | |
| | | As for adjuster 8-60 tank 1 | | | | |
| 08-64 | 6,7 | Set value charge temperature increase, tank 2 | 5÷50 | 20 | K | |
| | | As for adjuster 08-64 tank 1 | | | | |
| 08-65 | 6,7 | Switch-on threshold tank 2 alternating operation | 0÷20 | 5 | K | |
| | | If the tank set temperature is lower than the temperature in the tank with the lowest priority, solar charging for tank 2 will be enabled. | | | | |

Table 16.1.6 - Parameters That Can Be Adjusted At Installers Level

| Parame-ter | Solar Schem e | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|---|
| 08-70 | 2,4,5 | Switch-on threshold detec-tion of high solar energy | 0÷100 | 50 | % | |
| | | If the comparison of current solar performance with the nominal perform-ance results in a factor above the setting value and if the reduced tank set value (parameter 08-62 to adjuster 08-72) is exceeded, recharging with a conventional heat generator will only be allowed to the reduced set value.<br>If the factor is 10% (fix hysteresis) below the setting, the normal tank set value (parameter 08-62) will be reactivated except when the long-term dis-ablement prevents this (see parameter 08-71).<br>If the value is lower than the reduced set value, the normal tank set value (parameter 08-62) is immediately reactivated.<br>Note:- The basic setting for nominal solar performance (parameter 08-30) is directly linked and must be adjusted correctly. | | | | |
| 08-72 | 2,4,5 | Reduction of tank set value with high solar energy | 0÷40 | 15 | K | |
| | | If. According to setting Adjuster 08-70 or adjuster 08-71, high solar or daily energy is recognised, the normal tank set value (parameter 08-62) will be reduced by the set value for recharging with a conventional heat exchanger. | | | | |
| 08-75 | 2,5 | Switch-on increase for re-charging | 10÷50 | 20 | K | |
| | | If the temperature for a tank sensor is smaller than the active tank set value switch-on hysteresis (parameter 08-63), and if the temperature difference to the recharging sensor rises above the set value, recharging is enabled. | | | | |
| 08-76 | 2,5 | Switch-off increase for re-charging | 2÷20 | 5 | K | |
| | | If the temperature at the tank sensor is higher than the active tank set value, or if the temperature difference to the recharging sensor sinks below the set value, recharging is disabled. | | | | |
| 08-77 | 2 | Switch-on increase for dis-charging. | 5÷50 | 20 | K | |
| | | If the temperature at the tank sensor is higher than the active tank set value+2K, and if the temperature difference to the discharge sensor rises above the set value, discharge will be enabled. | | | | |
| 08-78 | 2 | Switch off increase for dis-charging | 2÷20 | 10 | K | |
| | | If the temperature at the tank sensor is smaller than the active tank set value or if the temperature difference to the discharge sensor sinks below the set value, discharge will be disabled. | | | | |
| 08-80 | 3 | Switch-on increase for return flow | 0÷50 | 10 | K | |
| | | If the temperature at tank sensor B3 rises above the heating circuit return flow temperature B4 + set value, the increase for return flow is enabled.<br>Note:- If the max tank temp. for return flow increase (parameter 07-08) is exceeded, the return flow increase is disabled. | | | | |
| 08-81 | 3 | Switch-off increase for return flow | 0÷50 | 5 | K | |
| | | If the temperature at the tank sensor B3 sinks below the heating circuit flow temperature B4+set value, the increase for return flow is enabled.<br>Note : -If the maximum tank temperature for return flow increase (parameter 07-08) is exceeded, the return flow increase is disabled. | | | | |
| 09-00 | 4,5 | Over-run time boiler pump | 0÷30 | 6 | min | |
| | | If recharging is complete, the pumps will continue to run for the set time. | | | | |

Table 16.1.6 - Parameters That Can Be Adjusted At Installers Level

16.2 Dimensions and assembly

16.2.1 Dimensions Of ES5910S Solar Controller

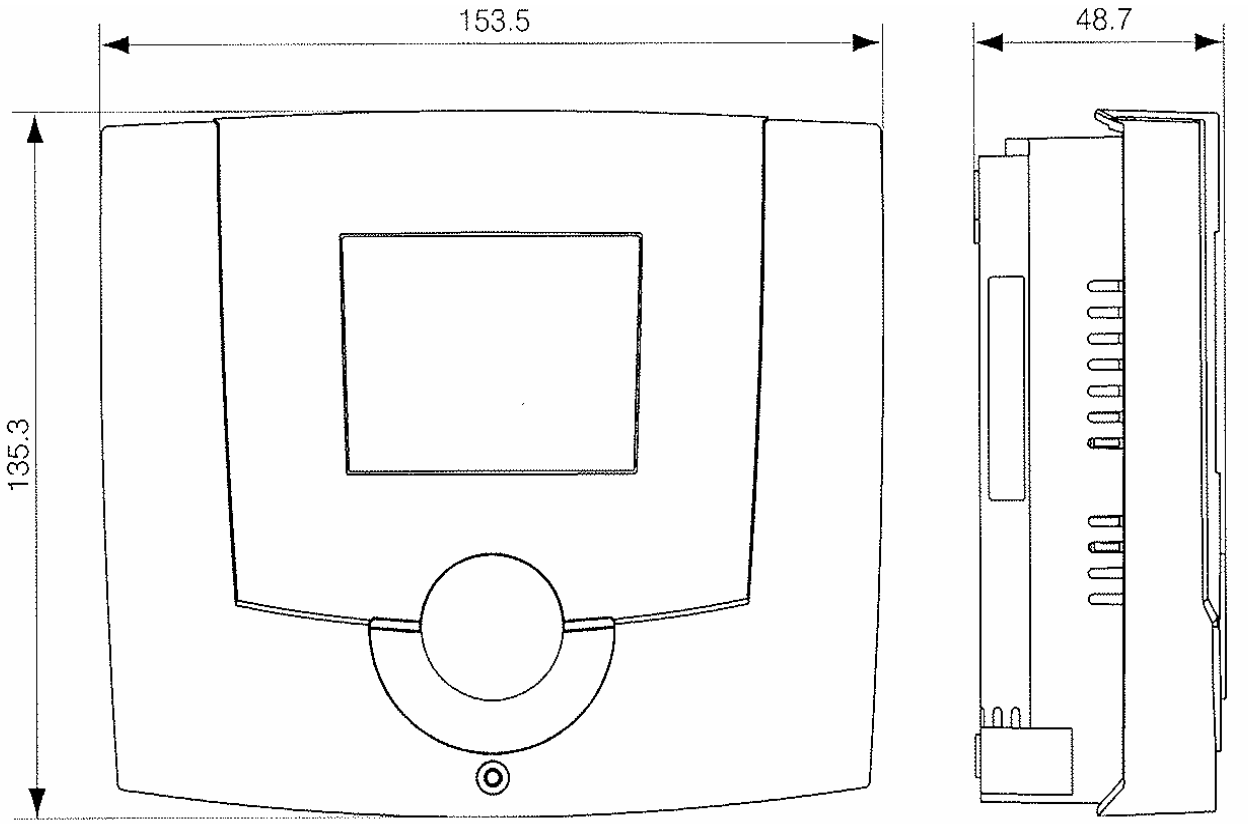



Figure 16.2.1 - Controller Dimensions

16.2.2 Dimensions of the basic housing ES591XS

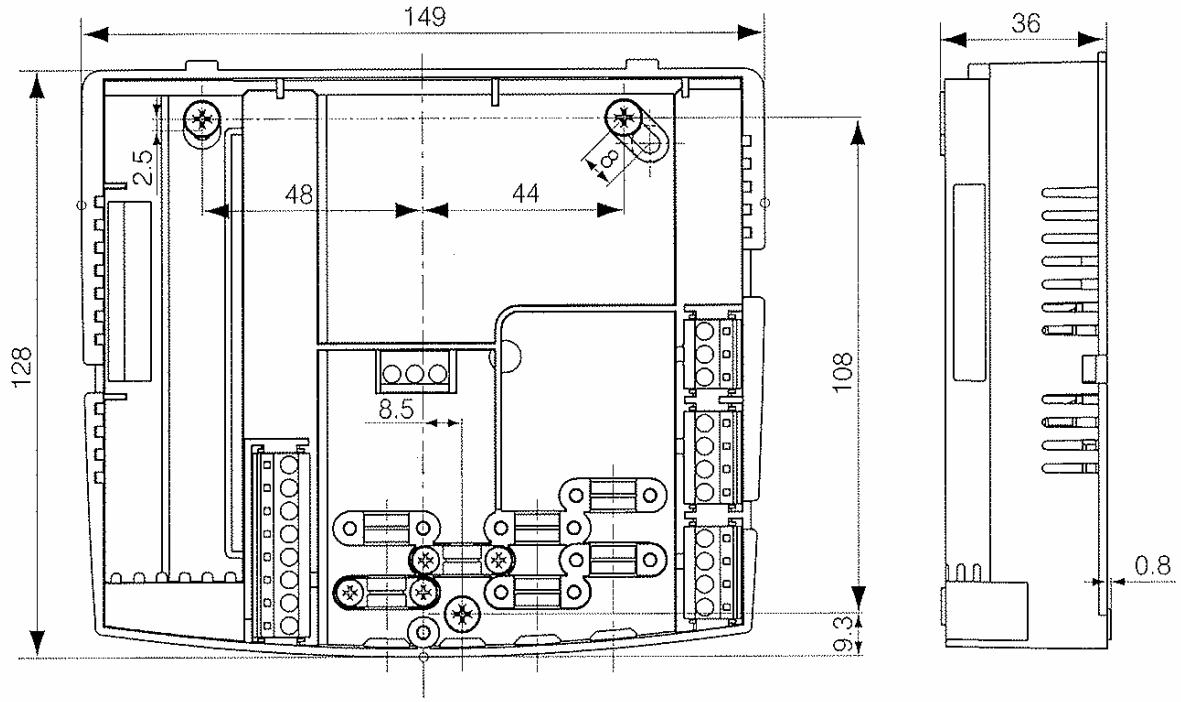



Figure 16.2.2 - Dimensions ES5910 Controller Housing

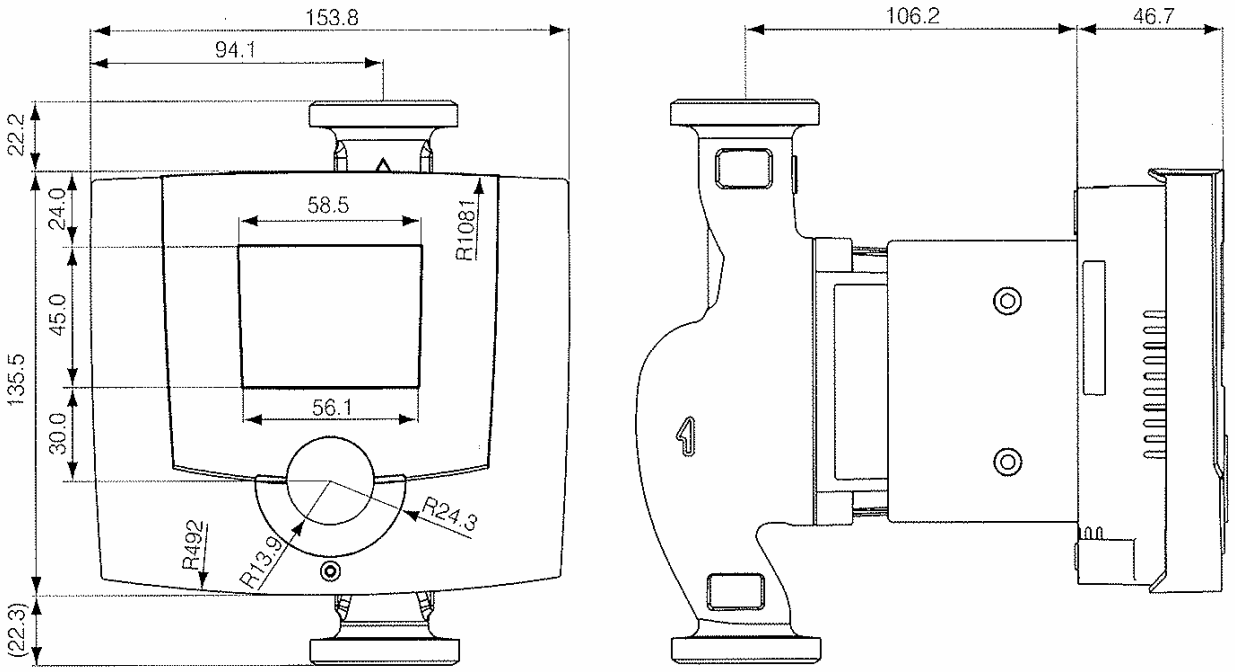



Figure 16.2.3 Dimensions ES5910P (MXS13-1 Pump Mounted Controller)

16.2.4 Dimensions SS5910

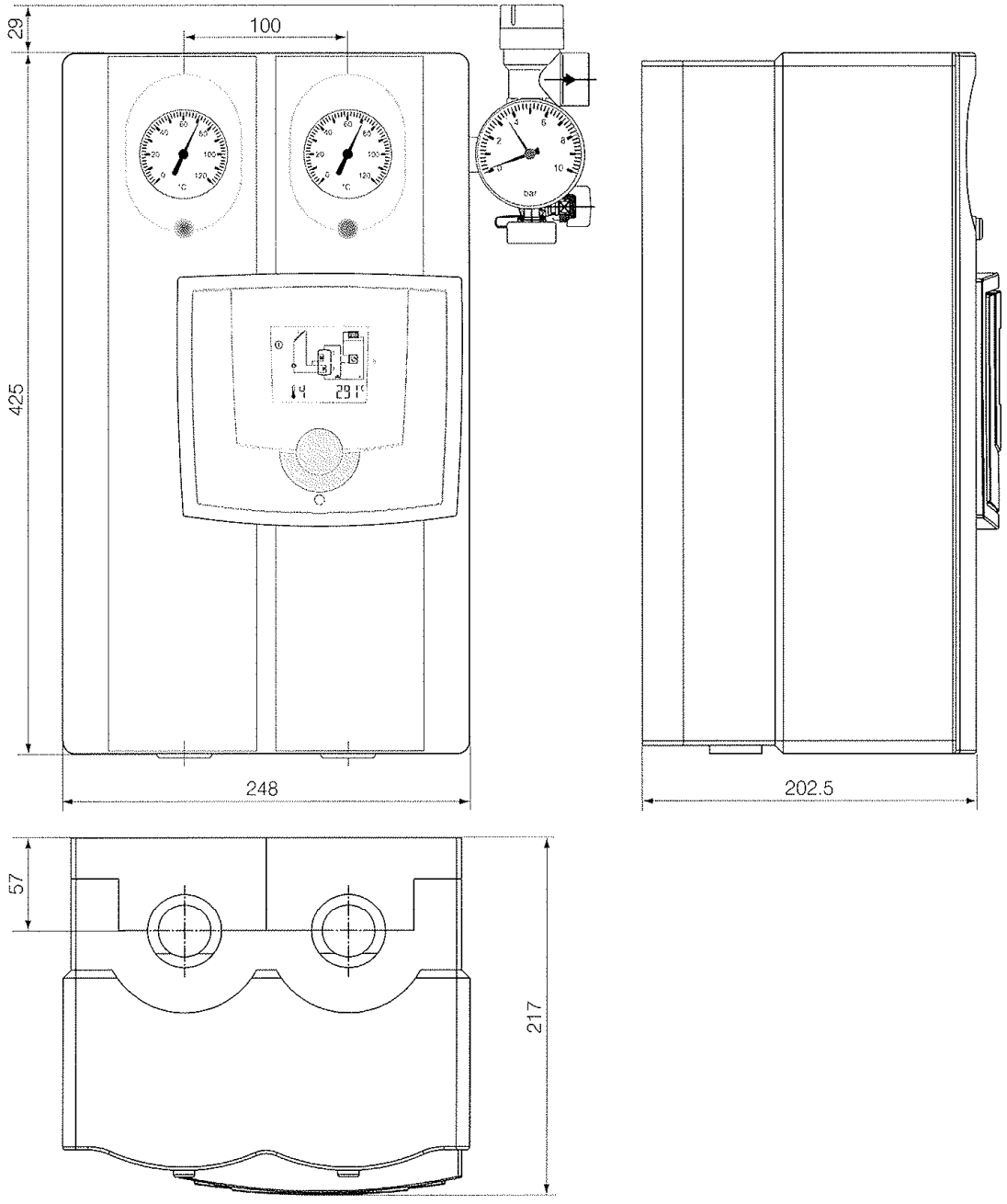



Figure 16.2.4 Dimensions SS5910 Solar Pump Station

16.2.5 To Mount The Solar Controller

Locate the solar controller ES5910/11S close to the solar circulating pump so that a short cable length is made possible.

15.2.5.1Open the front cover for the assembly and wiring .
Remove the controller's printed circuit board by lifting the PCB from the base moulding using a screwdriver. See Figure 16.2.5 below.

15.2.5.2 Mounting of the controller base
The controller base of the ES5910 has to be mounted with 3 screws.
A) Hold the controller base to the assembly place & mark with a pen through the mounting holes.
B) Drill the mounting holes and provide them with pegs.
C) Place the controller base, fit the screws (do not tighten), align the base, then drive the mounting screws fully home.

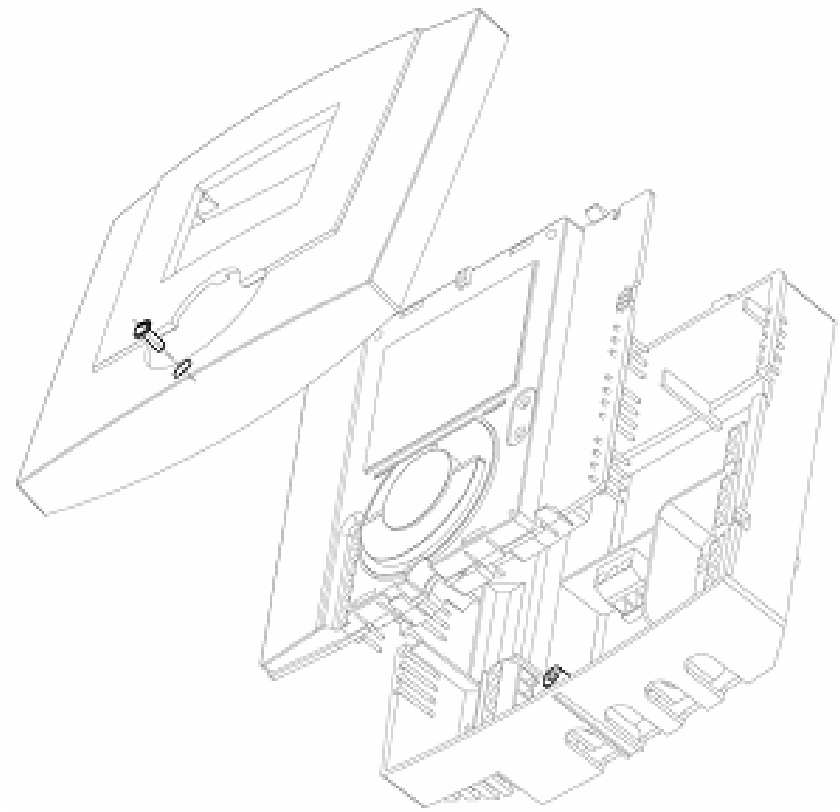


Figure 16.2.5 Removal Of Controller PCB From Housing

16.2.5.3 Now the controller can be wired electrically, to the pump, temperature sensors or valves.

16.2.5.4 Electrical installation and fuse protection must comply with local regulations.
16.2.5.5 The ES5910 must be powered continuously, to ensure operation at all times.
16.2.5.6 Upstream switchgear should therefore be limited to emergency or main switches that are permanently "on".
16.2.5.7 Before putting the controller into operation, check all electrical connections to the various system components.
16.2.5.8 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 an RC circuit directly to the coil terminals of the disturbing components.

Recommended RC circuit: 0.047 fEF 100, rated at 250VAC (eg Bosch, RIFA, etc).

16.2.6 Assembly ES5910P

16.2.6.1 Basic housing on the pump. See Figure 16.2.6 below.
The basic housing is screwed directly to the pump with the three 3 cross-recessed screws provided.

Screw 1 ensures that the earth connection between pump housing and controller exists. This screw must be secured against loosening using a lock washer.

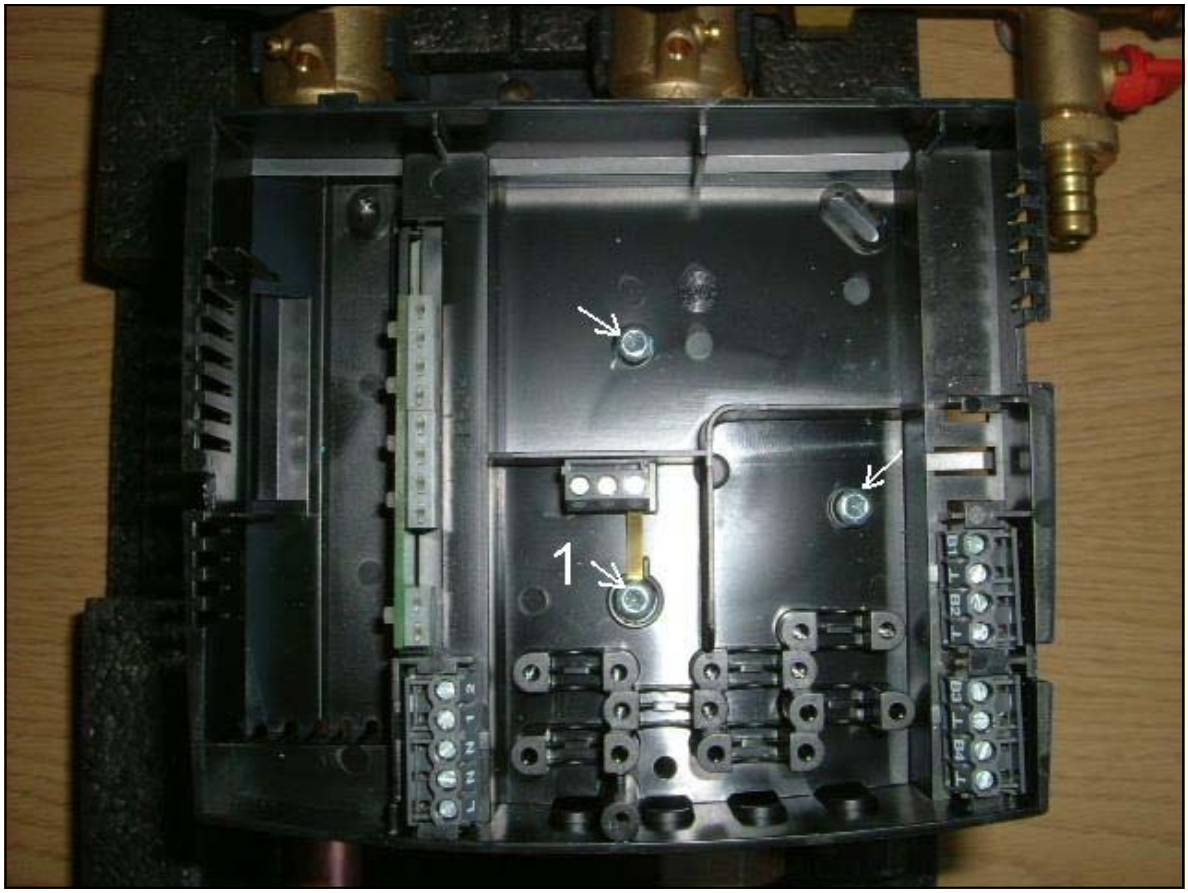



Figure 16.2.6 - Rear Of Controller Housing Assembled On Pump

16.2.6.2 Wiring connection

Make sure that the electrical supply to the controller is switched off, or that fuses of the supply are removed before beginning wiring work. Do not alter the existing wiring between the pump and terminals supplied with the controller.

16.2.6.3 Start up

**The voltage at the left hand side terminals No.1-3/LN are loaded with 230V. The controller housing may only be connected to when the supply is isolated, as there is the potential for mortal danger from electric shock.**

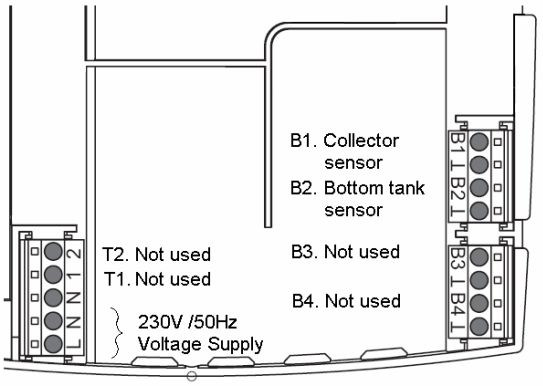
Checks before start up :-

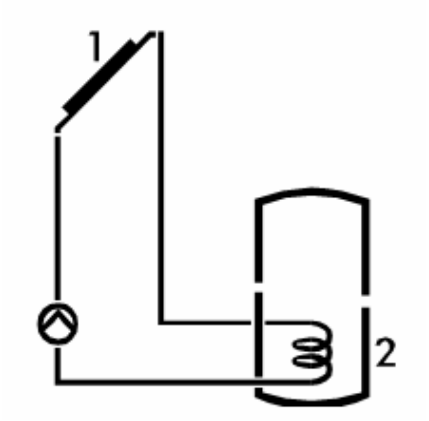
A) The electrical supply to the controller is on.
B) The controller is switched on.
C) All graphical segments of the LCD are displayed briefly.
D) The software number appears eg. p.e.SW1.5.
E) The controller display reverts to normal, the internal function test was complete.
F) The correct hydraulic circuit has been selected for that particular solar
Installation (Parameter 04-06).
G) The temperatures of the connected sensors are shown on the display, and the values shown are plausible.
H) The temperature set points are OK.

16.3.1 HYDRAULIC VARIANTS/ ELECTRICAL CONNECTION

16.3.2 Hydraulic variant 1 - Solar charging of tank 1.
(Tank type can be chosen, warm water/heating/swimming pool).

Connections hydraulic variant 1:



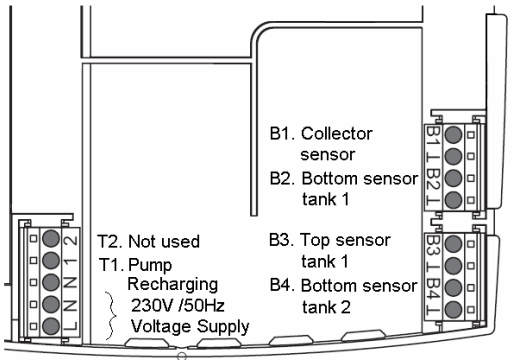



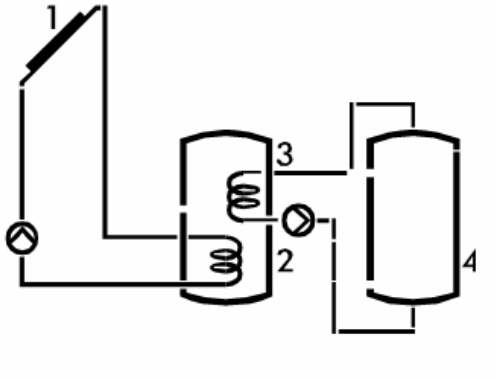

| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switching on hysteresis to set temperature tank 1 | 1÷30 | 2 | K | |
| | 8-85 | Setting value collector pump 1, in manual operation | 0÷100 | 0 | % | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) collector controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Volume Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temperature increase, tank1 | 5÷50 | 20 | K | |

16.3.3 Hydraulic Variant 2 - Solar charging of tank.
Conversion / recharging of tank 2 via temperature difference B3/B4.

Connections hydraulic variant 2 :



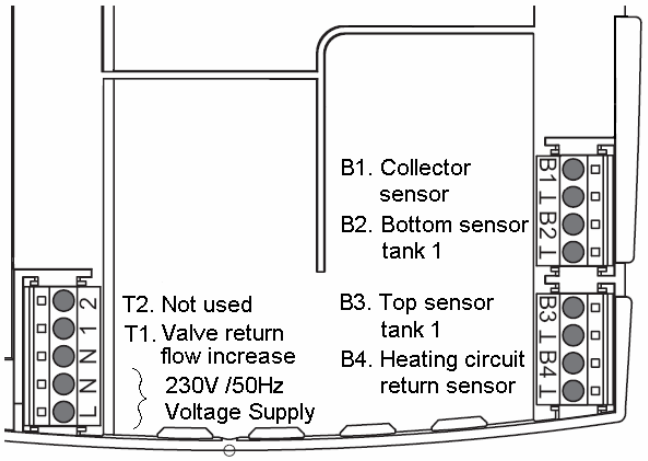



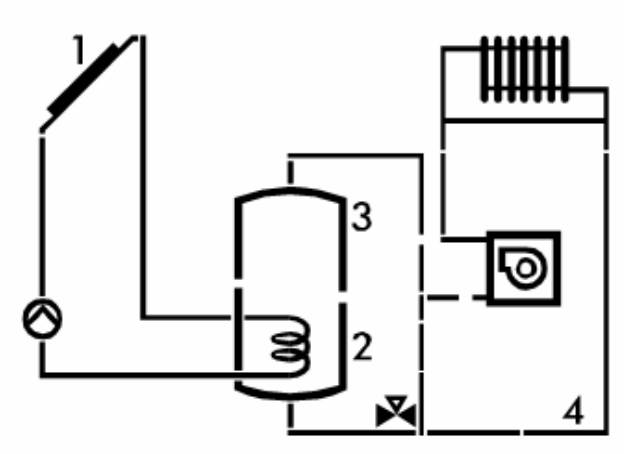

| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switching on hysteresis to set T1 | 1÷30 | 2 | K | |
| | 8-85 | Set value collector pump 1, in manual | 0÷100 | 0 | % | |
| | 8-86 | Set value circulation pump 2 in manual | On/off | off | - | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) collector controller pump | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Vol Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set value charging temp increase, tank1 | 5÷50 | 20 | K | |
| | 8-70 | Switch-on threshold detection of high solar energy | 0÷100 | 50 | % | |
| | 8-72 | Reduction of tank set Pt. with Hi energy | 0÷40 | 15 | K | |
| | 8-75 | Switch-on increase for recharging | 10÷50 | 20 | K | |
| | 8-76 | Switch-off increase for recharging | 2÷20 | 5 | K | |
| | 8-77 | Switch-on increase for discharging | 5÷50 | 20 | K | |
| | 8-78 | Switch-off increase for discharging | 2÷20 | 10 | K | |

16.3.4 Hydraulic variant 3 - Solar charging to tank. Heating support through return flow increase.

Connections hydraulic variant 3.



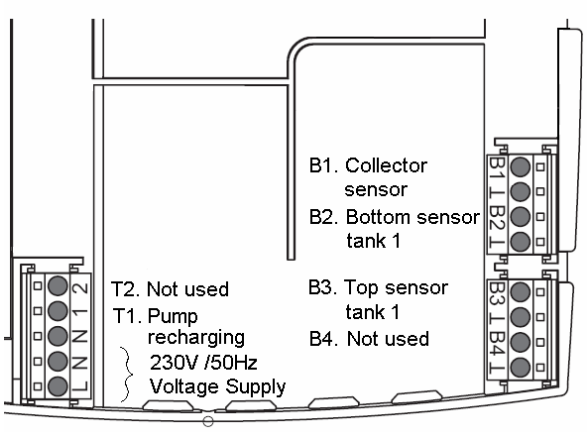

| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switch on hysteresis to set temp tank 1 | 1÷30 | 2 | K | |
| | 8-85 | Set value collector pump 1, in manual | 0÷100 | 0 | % | |
| | 8-87 | Set value diverter valve in manual | on/off | off | - | |

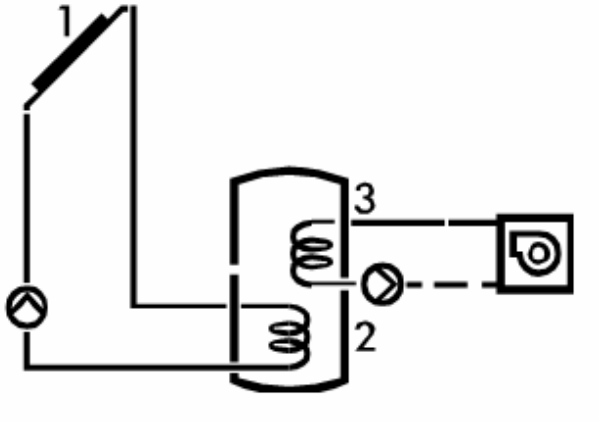
| | | | | | | |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 7-08 | Max. Tank temp. for return flow increase. | 30÷90 | 70 | °C | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) collector controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Vol Flow Coil Pump 1 @ 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temperature increase, tank1 | 5÷50 | 20 | K | |
| | 8-80 | Switch-on increase for return flow | 0÷50 | 10 | K | |
| | 8-81 | Switch-off increase for return flow | 0÷50 | 5 | K | |

16.3.5 Hydraulic Variant 4 - Solar charging to tank.

Recharging from a second heat generator if the temperature at sensor B3 is lower than the set value.

Connections hydraulic variant 4.



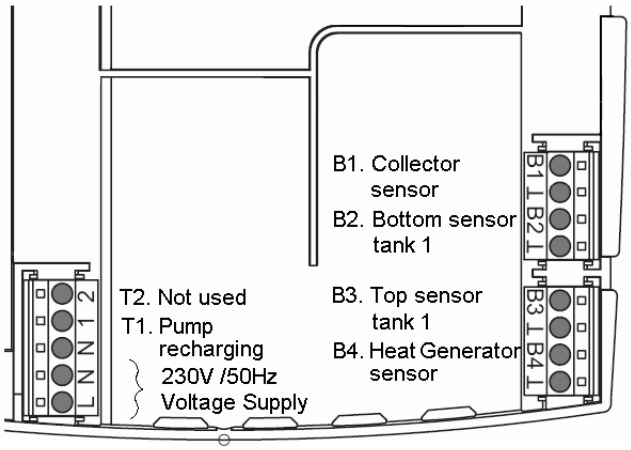

| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switch on hysteresis to set temp tank 1 | 1÷30 | 2 | K | |
| | 8-85 | Set value collector pump 1, in manual | 0÷100 | 0 | % | |
| | 8-86 | Set value circulation pump in manual | on/off | off | - | |

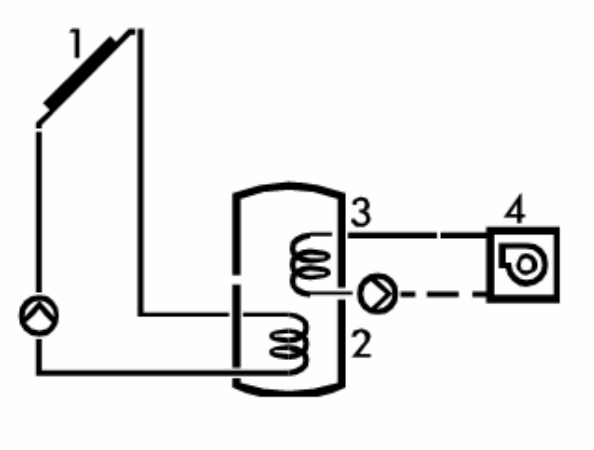
| | | | | | | |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Vol Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temp increase, tank1 | 5÷50 | 20 | K | |
| | 8-70 | Switch-on threshold detection of high solar energy | 0÷100 | 50 | % | |
| | 8-71 | Switch-on threshold detection recognition high daily energy | 0÷100 | 80 | % | |
| | 8-72 | Reduction of tank set value with high solar energy | 0÷40 | 15 | K | |
| | 9-00 | Over-run time boiler pump | 0÷30 | 6 | min | |

16.3.6 Hydraulic circuit 5

Solar charging to tank. Recharging from alternative heat generator via the temperature difference B3/B4.

Connections hydraulic variant 5



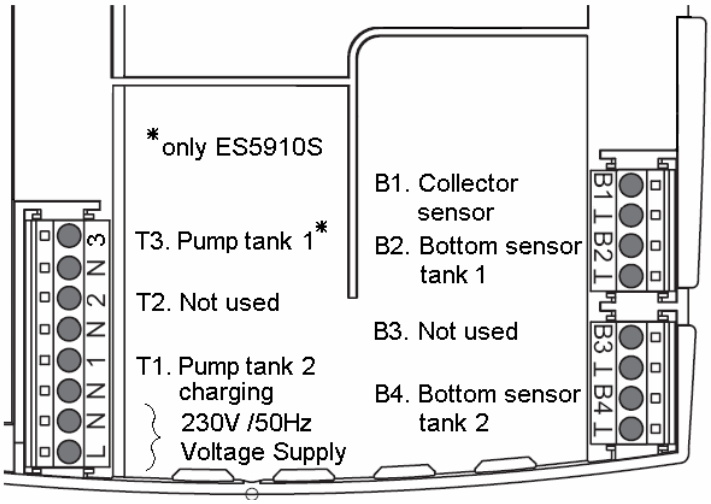

| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switch on hysteresis to set temp tank 1 | 1÷30 | 2 | K | |
| | 8-85 | Set value collector pump 1, in manual | 0÷100 | 0 | % | |
| | 8-86 | Set circulation pump in manual | on/off | off | - | |

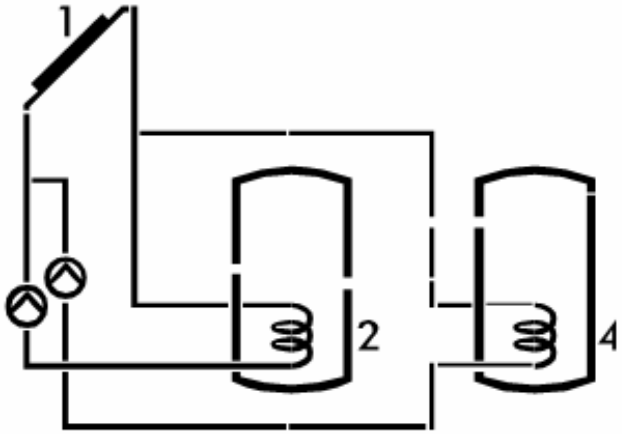
| | | | | | | |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) controller | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) controller | 0÷10 | 0 | Min | |
| | 8-30 | Nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Vol Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temp increase, tank1 | 5÷50 | 20 | K | |
| | 8-70 | Switch-on threshold detection of high solar energy | 0÷100 | 50 | % | |
| | 8-71 | Switch-on threshold detection recognition high daily energy | 0÷100 | 80 | % | |
| | 8-72 | Reduction of tank set value with high solar energy | 0÷40 | 15 | K | |
| | 8-75 | Switch-on increase for recharging | 10÷50 | 20 | K | |
| | 8-76 | Switch-of increase for re-charging | 2÷20 | 5 | K | |
| | 9-00 | Over-run time boiler pump | 0÷30 | 6 | min | |

16.3.7 Hydraulic variant 6 - Solar charging to tank cascade with 2 pumps

Note:- This hydraulic variant is only available with the wall mounted ES5910S controller only (HHL Part No. 553000520).

Connections hydraulic variant 6:




| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-56 | Priority tank 1 | 1÷2 | 1 | - | |
| | 8-56 | Priority tank 2 | 1÷2 | 2 | - | |
| | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-62 | Set temperature tank 2, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switch on hysteresis to set temperature tank 1 | 1÷30 | 2 | K | |
| | 8-63 | Switch on hysteresis to set temperature tank 2 | 1÷30 | 2 | K | |
| | 8-85 | Set value collector pump 1, in manual operation | 0÷100 | 0 | % | |
| | 8-85 | Set value collector pump 2, in manual operation | 0÷100 | 0 | % | |

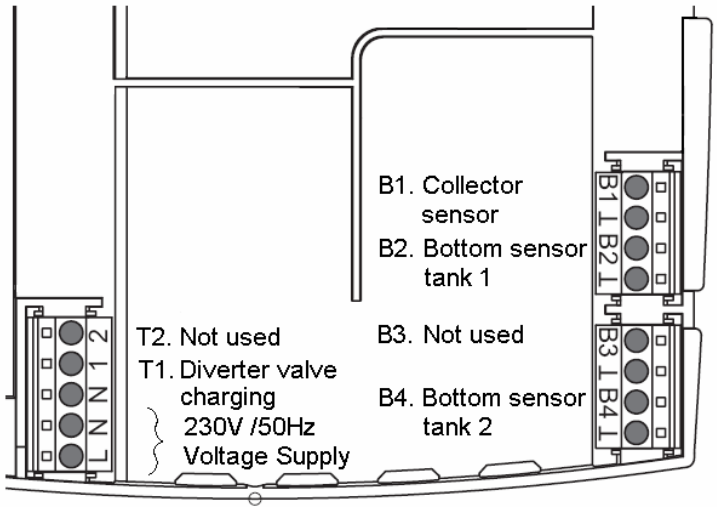
16.3.7 Hydraulic variant 6 Parameters Available With User Access Code

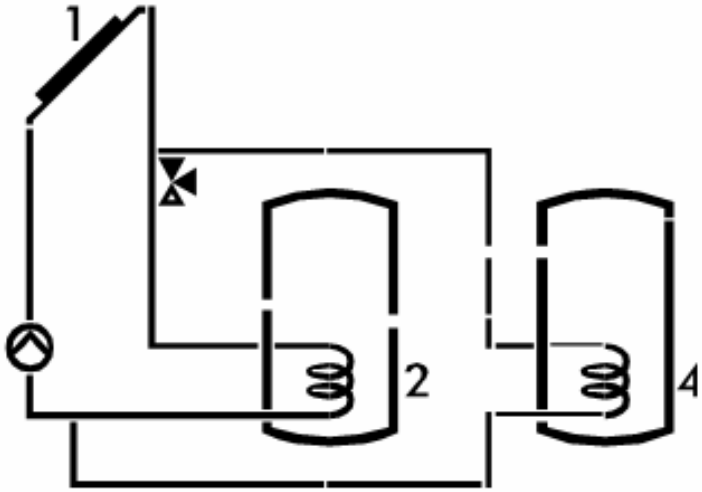
| Code | Pa-rameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) collector controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-35 | Min. set value collector pump 2 | 5÷100 | 50 | % | |
| | 8-37 | Volume Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-37 | Volume flow coil. Pump 2 at 100% set value | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temperature increase, tank1 | 5÷50 | 20 | K | |
| | 8-65 | Switch-on threshold tank 1 alternating operation | 0÷20 | 5 | K | |
| | 8-66 | Switch-off threshold tank 1 alternating operation | 0÷20 | 5 | K | |
| | 8-55 | Tank type, tank 2 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 2 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 2 | 10÷95 | 90 | °C | |
| | 8-64 | Set value charging temperature increase, tank 2 | 5÷50 | 20 | K | |
| | 8-65 | Switch-on threshold tank 2 alternating operation | 0÷20 | 5 | K | |
| | 8-66 | Switch-off threshold tank 2 alternating operation | 0÷20 | 5 | K | |

16.3.8 Hydraulic variant 7

Solar charging to tank cascade with diverter valve.

Connections hydraulic variant 7




| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-56 | Priority tank 1 | 1÷2 | 1 | - | |
| | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-62 | Set temperature tank 2, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switch on hysteresis to set temperature tank 1 | 1÷30 | 2 | K | |
| | 8-63 | Switch on hysteresis to set temperature tank 2 | 1÷30 | 2 | K | |
| | 8-85 | Set value pump 1, in manual operation | 0÷100 | 0 | % | |
| | 8-87 | Set value diverter valve in manual operation | On/off | Off | - | |

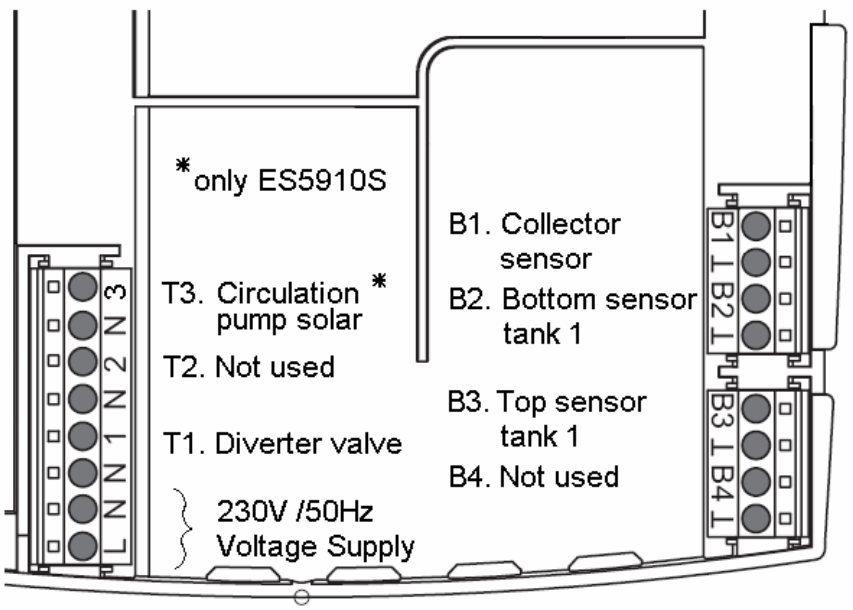
16.3.8 Hydraulic variant 7 Parameters Available With User Access Code

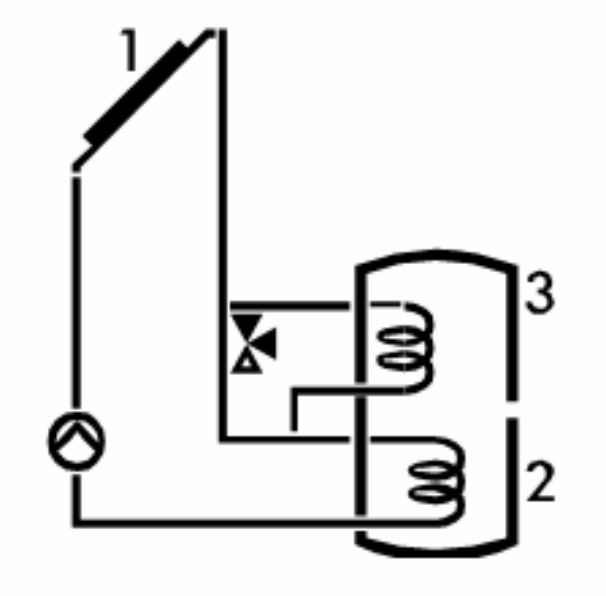
| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) collector controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Volume Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temperature increase, tank1 | 5÷50 | 20 | K | |
| | 8-65 | Switch-on threshold tank 1 alternating operation | 0÷20 | 5 | K | |
| | 8-66 | Switch-off threshold tank 1 alternating operation | 0÷20 | 5 | K | |
| | 8-55 | Tank type, tank 2 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 2 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 2 | 10÷95 | 90 | °C | |
| | 8-64 | Set value charging temperature increase, tank 2 | 5÷50 | 20 | K | |
| | 8-65 | Switch-on threshold tank 2 alternating operation | 0÷20 | 5 | K | |
| | 8-66 | Switch-off threshold tank 2 alternating operation | 0÷20 | 5 | K | |

16.3.9 Hydraulic variant 8 - Solar charging to tank with heat exchanger cascade and diverter valve.

Note:- This hydraulic variant is only available with the wall mounted ES5910S controller only (HHL Part No. 553000520).

Connections hydraulic variant 8:




| Code | Parame-ter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-56 | Priority tank 1 | 1÷2 | 1 | - | |
| | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switching on hysteresis to set temp tank 1 | 1÷30 | 2 | K | |
| | 8-85 | Setting value collector pump 1, in manual operation | 0÷100 | 0 | % | |
| | 8-87 | Setting value diverter valve in manual operation | On/off | off | - | |

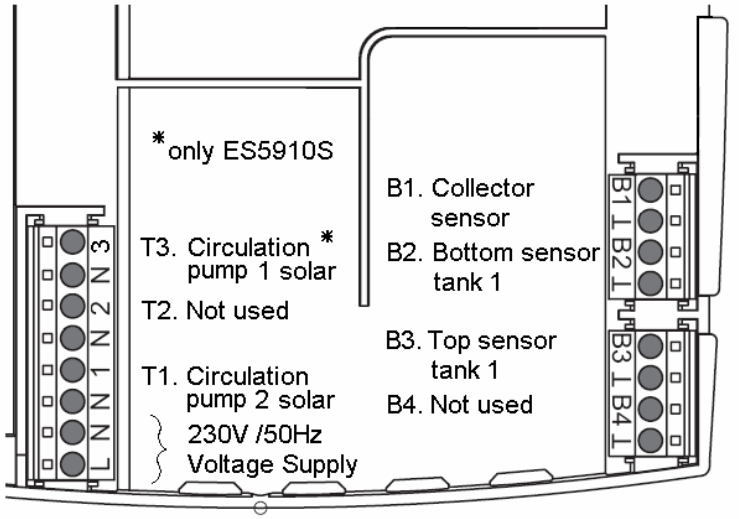
16.3.9 Hydraulic variant 8 Parameters Available With User Access Code

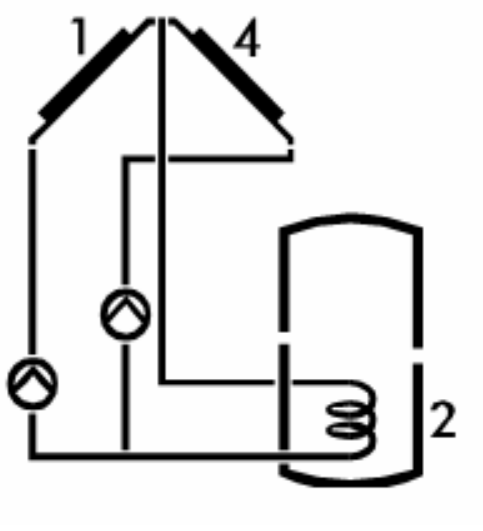
| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-37 | Volume Flow Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temp increase, tank1 | 5÷50 | 20 | K | |
| | 8-65 | Switch-on threshold tank 1 alternating operation | 0÷20 | 5 | K | |
| | 8-66 | Switch-off threshold tank 1 alternating operation | 0÷20 | 5 | K | |
| | 8-55 | Tank type, tank 2 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 2 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 2 | 10÷95 | 90 | °C | |
| | 8-64 | Set value charging temperature increase, tank 2 | 5÷50 | 20 | K | |
| | 8-65 | Switch-on threshold tank 2 alternating operation | 0÷20 | 5 | K | |
| | 8-66 | Switch-off threshold tank 2 alternating operation | 0÷20 | 5 | K | |

16.3.10 Hydraulic variant 9 - Solar charging to tank with East-West collector cascade and 2 pumps.

Note:- This hydraulic variant is only available with the wall mounted ES5910S controller only (HHL Part No. 553000520).

Connections hydraulic variant 9:




| Code | Parameter | Function | Setting Range | Factory Setting | Unit | Set Data |
|---|---|---|---|---|---|---|
| User | 8-62 | Set temperature tank 1, normal | 0÷90 | 60 | °C | |
| | 8-63 | Switch on hysteresis to set temp tank 1 | 1÷30 | 2 | K | |
| | 8-85 | Setting value collector pump 1, in manual | 0÷100 | 0 | % | |
| | 8-85 | Setting value collector pump 2, in manual | 0÷100 | 0 | % | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Installer | 4-06 | Hydraulic variants | 1÷9 | 1 | - | |
| | 5-04 | Legionella protection temp. | 60÷80 | 60 | °C | |
| | 5-14 | Legionella protection function | 0÷9 | 0 | - | |
| | 8-01 | Increase collector tank for charging ON | 0÷50 | 15 | K | |
| | 8-02 | Increase collector tank for charging OFF | 0÷50 | 5 | K | |
| | 8-15 | Start-up help pipe collector | On/off | On | - | |
| | 8-20 | P range (Xp) controller pump steering | 10÷50 | 20 | K | |
| | 8-21 | Response time (Tn) collector controllers | 0÷30 | 10 | Min | |
| | 8-22 | Derivative time (Tv) collector controllers | 0÷10 | 0 | Min | |
| | 8-30 | Solar nominal performance collector 1 | 1÷50 | 8 | kW | |
| | 8-30 | Solar nominal performance collector 2 | 1÷50 | 8 | kW | |
| | 8-35 | Min. set value collector pump 1 | 5÷100 | 50 | % | |
| | 8-35 | Min. set value collector pump 2 | 5÷100 | 50 | % | |
| | 8-37 | Vol Flow Coil Pump 1 at 100% set value. | 1÷50 | 2 | l/min | |
| | 8-37 | Vol Flow coil. Pump 2 at 100% set value | 1÷50 | 2 | l/min | |
| | 8-50 | Basic strategy solar charging | 0÷4 | 3 | - | |
| | 8-51 | Change-over solar charging (high energy levels) | 30÷100 | 50 | % | |
| | 8-55 | Tank type, Tank 1 | 0÷4 | 0 | - | |
| | 8-59 | Maximum temperature, tank 1 | 10÷90 | 80 | °C | |
| | 8-60 | Protective temperature tank 1 | 10÷95 | 90 | °C | |
| | 8-64 | Set Value charging temp increase, tank1 | 5÷50 | 20 | K | |

16.3.11 Parameters Accessible With Engineers Access Code

The parameters below are valid for all hydraulic variants.

Please contact Hamworthy Heating to get the engineers access code.

Parameters that can be adjusted at Engineers Level are:

| Parameter | Function | Range | Factory Setting | Unit | Actual Setting Date: |
|---|---|---|---|---|---|
| 08-05 | Overheating protection | On/off | on | - | |
| | If the temperature at the collector rises above the set collector maximum temperature (parameter 08-11) with the overheating protection active, solar charging will be enabled independent of the set tank maximum temperature (parameter 08-59).<br>The set value for the speed control is determined by the temperature on the tank sensor + setting value 08-64.<br>If the collector protection temperature (parameter 08-10) or the tank protective temperature (08-60) is exceeded the solar charging is disabled. | | | | |
| 08-09 | Special heat capacity fluid | On/off | 4.1 | kJ/kgK | |
| | Special heat capacity of the collector fluid according to manufacturers specifications. | | | | |
| 08-10 | Collector protective temperature | 80÷130 | 130 | °C | |
| | If the temperature at the collector sensor rises above the set value, solar charging is disabled. | | | | |
| 08-11 | Collector maximum temperature | 80÷130 | 95 | °C | |
| | If the temperature at the collector sensor rises above the set values with the overheating protection active (parameter 08-05), solar charging is enabled. | | | | |
| 08-13 | Frost protection function | -50÷10 | -50 | °C | |
| | Deactivated if the setting is -50°C.<br>Solar pump is switched on if the temperature at the collector sensor < setting – hysteresis. | | | | |
| 08-90 | Error threshold for pump feedback signal | 0÷200 | 100 | % | |
| | Note : Option only available for controllers ES591XP<br>The pump can be controlled. The controller measures the phase displacement and compares it to the expected values.<br>0% = Only small deviations allowed<br>0÷199% = The larger the set value, the higher the allowed deviation<br>200% = Inactive, no pump error messages. | | | | |
| 08-91 | Maximum temperature difference collector – tank | 10÷80 | 50 | K | |
| | If the difference in temperature between the collector and the tank temperature rises above the set value when solar charging is active during the set time (Parameter 08-92), an error message (Error 61,62,63) is generated. | | | | |
| 08-92 | Waiting period error message ΔT Collector - Tank | 0÷180 | 30 | min | |
| | If the difference in temperature between the collector and the tank temperature is too high when solar charging is active and during the set time, the error message is generated according to 8-91.<br>Note: 0 = Error message disabled | | | | |

Table 16.3.11 - Parameters Accessible With Engineers Access code

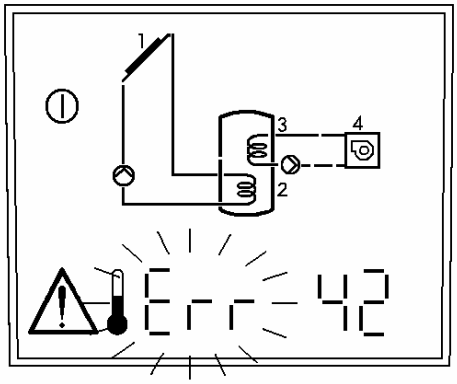
16.4 Troubleshooting

If after switching on, no display appears, or an error message appears, the clarification in the table below may be of use.

| Effect | Possible cause | Solution |
|---|---|---|
| Display does not appear | No Electrical Supply To Controller | Check fused isolator. If isolator on or isolator fuse ok. Isolate controller & remove front cover. Remove PCB from housing and check PCB fuse in holder at rear of PCB. |
| | Supply wiring incorrect | Open controller and examine wiring against connection schematic appropriate to the hydraulic scheme of the installation. |

16.4.1 Error Codes

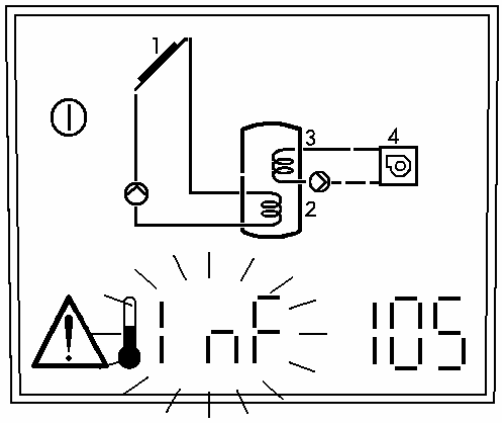
Error display. See figure below.




| Error Code | Hydraulic | Description | Possible Cause |
|---|---|---|---|
| 41 | All | Sensor 1 outside the measuring range.<br>Note: If the sensor is not required, sensor configuration (Parameter 4-0) tank. | Short circuit of sensor / cut out. |
| 42 | All | Sensor 2 outside the measuring range.<br>Note : If the sensor is not required, sensor configuration (Parameter 4-0) tank. | Short circuit of sensor / cut-out |
| 43 | 2,3,4 ,5,7 | Sensor 3 outside the measuring range.<br>Note: If the sensor is not required, sensor configuration (Parameter 4-0) tank. | Short circuit of sensor / cut-out |
| 44 | 2,3,5 ,6,8,9 | Sensor 4 outside the measuring range.<br>Note : If the sensor is not required, sensor configuration (Parameter 4-0) tank | Short circuit of sensor/ cutout |
| 53 | All | Speed (revs.) of the pump does not correspond to the controller given figure.<br>Note : With Parameter 08-90 = 200, control OFF. (Only in controller ES591xP) | Pump blocked ! |
| 61 | All | Error when charging from collector 1 to tank 1 lower zone (temp. diff. collector-tank remains high).<br>Note : With Parameter 08-92 = 0, control OFF | No heat transfer, air in charging circuit, no hydraulic adjustment, outlet, pump defect. |
| 62 | 2,6,7,8 | Error when charging from collector 1 to tank 2 lower zone or tank 1 top zone (temp. diff. collector – tank remains high).<br>Note: With Parameter 08-92 = 0, control OFF. | No heat transfer, air in charging circuit, no hydraulic adjustment , outlet pump defect. |
| 63 | 9 | Error when charging from collector 2 to tank 1 lower zone (temp. diff. collector – tank remains high).<br>Note: With Parameter 8-92 = 0, control OFF. | No heat transfer, air in charging circuit, no hydraulic adjustment, outlet, pump defect. |

16.4.2 Information about the plausibility check

Info-display
The controller checks the system status and signals errors. This is a plausibility check of the data and serves to provide information when malfunctioning occurs.




| Info Code | Hydraulic Schematic | Description | Possible Cause |
|---|---|---|---|
| 101 | All | Collector max.temp > as the collector protection temp. | Wrong basic settings (08-10 > 08-11) |
| 102 | all | Increase collector tank for charging OFF > increase collector tank for charging ON-2K | Wrong basic settings (8-02 > 8-01) 2K. |
| 104 | 6,8 | Priority tank 1 = priority tank 2 | Wrong basic settings (8-56) must, for SP1 + SP2 |
| 105 | All | Set temp. tank 1 norma l> max. temp. tank 1 | Wrong basic settings SP1 (8-62 > 8-59) |
| 106 | 4,5 | Legionella protection temp. > max. temp. tank 1 | Wrong basic settings (5-04 > 8-59) |
| 107 | All | Maximum temp. Tank 1 > protection temp. tank 1 | Wrong basic settings 8-59 > 8-60. |
| 108 | 2,5 | Switch-off increase for recharging > switch-on increase for recharging - 2K | Wrong basic settings 8-76 > (8-75 – 2K). |
| 109 | 2 | Switch-off increase for discharging > switch-on increase for discharging – 2K | Wrong basic settings 8-78 > (8-77 -2 K) |
| 110 | 3 | Switch-off increase for return flow increase > switch on increase for return return flow increase – 2K | Wrong basic settings (8-81) > (8-80 -2K). |
| 111 | 6,8 | Set temperature tank 2, normal > max. temp tank 2. | Wrong basic settings SP2 (8-62 > 8-59). |

16.5 TECHNICAL DATA

16.5.1 NTC Temperature Sensor Resistance

| Temperature °C | Resistance NTC 5kΩ |
|---|---|
| -10 | 27665 |
| -5 | 21165 |
| 0 | 16325 |
| 5 | 12695 |
| 10 | 9950 |
| 20 | 6245 |
| 30 | 4029 |
| 40 | 2663 |
| 50 | 1802 |
| 60 | 1244 |
| 70 | 876 |
| 80 | 628 |
| 90 | 458 |
| 100 | 339 |
| 110 | 255 |

16.5.2 Explanation of terms and abbreviations

| | |
|---|---|
| h | Hours |
| Actual Value | Measured Value/temperature by sensor, displayed on controller |
| K | Kelvin, temperature difference |
| Min | Minutes |
| Net | Mains Connection 230V VAC |
| Set point value | Temperature to be reached by controller |

## 17.0 FAULT FINDING

17.1 The main reasons why some solar heating systems perform poorly and malfunction are :

- Frost damage to the collector due to degradation of antifreeze.
- Temperature sensors have been displaced from their correct position.
- Circulation pump seizure
- Loss of fluid due to open vent evaporation, or slow leakage of liquid through an automatic air vent if not isolated using a ball valve.
- Sealed system expansion vessel incorrectly sized, positioned or adjusted.
- Sealed system expansion vessel has lost pre-charge.
- Safety valve damaged and relieving
- Residue from overheated antifreeze blocking pipes.
- Lime-scale blockage of the collector, pipes or heat exchanger.
- Temperature differential between storage tank and collector incorrectly set in solar controller.
- Pump control malfunctioning.
- Another heating appliance interfering with heat transfer within the DHW store.
- Missing or damaged insulation of pipes and store.
- Incorrect location or damage to temperature sensors.
- Inadequate air removal from pipes or collector.
- Incorrect pump speed.
- Flow & return pipes to cylinder and / or collector having the wrong orientation.

17.2 If there is significant drop in primary pressure or fluid level, suspect one or more of the following :

- Overheating may have occurred during periods of hot weather if the circulation in the circuit unintentionally fails or the system is designed incorrectly, resulting in the pressure relief valve lifting.
- There is a system leak requiring drain down & repair or replacement of the faulty component.

## 18.0 SERVICING

Servicing on the frequency listed below is recommended, preferably by a Hamworthy appointed person, and at least annually, to ensure trouble free operation.

When conducting servicing / maintenance great care should be taken during sunny conditions. Appropriate personal protective equipment must be worn.

18.1 Items requiring annual checks

- Pressure levels are checked against those specified.
- The circulating pump is operating without undue noise.
- The collector glass is checked for damage.
- Electrical controls and temperature sensors are operating correctly.
- There are no signs of condensation or damp around the pipe-work or fixings in the roof space.
- Pipework insulation is firmly in place.
- Check for lime scale build up in hot water calorifiers / thermal storage vessels within hard water areas every 3 months for the first year and yearly thereafter.

18.2 Items requiring 2 yearly checks

- De-scale the heat exchanger coil surface of any calorifiers found to be scaled up.
- Where solar is used in conjunction with direct fired water heaters, direct fired water heaters should be checked every 3 months in the first year to establish the frequency of maintenance required.
- Expansion vessel pre-charge checked against commissioned settings when the vessel has been isolated from the system and the system side of the vessel is at atmospheric.

18.3 Items requiring 5 year checks

- Collector array fixings & frames are firm & checked for corrosion where accessible.
- Roof coverings are satisfactory.
- Safety relief valves are operating correctly.
- Safety limit thermostats on vessels are operating correctly
- Glycol concentration and acidity tested using a glycol tester & PH indicator paper.

## 19.0 REPLACEMENT OF FAILED COMPONENTS

There are a number of components listed below which can be replaced by following the given procedure. In each case the operation of each replaced component must be checked by carrying out the appropriate part of the commissioning procedure.

19.1 Solar Controller

Isolate the 230V / 50hz controller at the mains. Unscrew the front cover and prize the PCB away from the rear housing using a screwdriver. Assemble the new PCB within the rear housing and assemble the plastic front cover back on and affix using the front securing screw. Commission the new PCB with the original parameters.

19.2 Circulating Pump

Isolate the solar station from it's electrical supply. Shut the isolating ball valve on the expansion vessel & drop the system pressure to atmospheric. Mark the position of the screwdriver slot of the flow control valve on the flow-meter below the pump. Close the ball valve above the pump and shut the flow control valve on the flow meter, so the screwdriver slot is horizontal. Uncouple the AF52 nuts immediately above & below the pump body and remove the pump. Place a new pump in position, with seals on the top and bottom face of the pump & retighten the AF52 nuts against the pump body. Make sure the arrow on the reinstalled pump points upwards. Open the expansion vessel isolating ball valve & re-pressurise the heating circuit. If supplied with a new solar controller mounted to the pump, reprogram this new controller with the original parameters. Re-pressurise and de-aerate circuit by running the pump with the automatic air vents in operation. Once all air has been de-aerated it will be necessary to top up to the commissioning pressure.

19.3 Pressure Relief Valve

Isolate the solar station from it's electrical supply. If the valve is letting by at the commission pressure drop the system pressure to atmospheric. The whole system pressure need not be dropped as the ball valve above the pump, isolating valve on the expansion vessel and flow control valve on the flow-meter below the pump can be shut so it can resume it's original position. Remember to mark the position of the screwdriver slot with a pen prior to closing this valve. Assemble a new valve in its place. Re-pressurise the circuit and raise the pressure in the circuit so the valve relieves. Drop the pressure in the circuit to the commission pressure.

19.4 Pressure gauge.

The replacement procedure is similar to the pressure relief valve except on replacement, the pressure can be reinstalled to the commission pressure.

19.5 Expansion vessel

On checking the gas pre-charge should the pressure have been reduced by 30% then it is likely that the membrane has suffered excessive use and requires replacement. This could imply that the vessel is undersized. Also if the system pressure has found to have dropped without any indication of leakage from pipework, or erratic flow observed through the circulating pump possibly with transport of air bubbles then it is likely that the expansion vessel membrane has ruptured.

To remove the vessel drop the system pressure to atmospheric. Close the isolating ball valve of the expansion vessel and remove the vessel. Set the gas pre-charge of the replacement vessel and assemble to the system at the isolating ball valve.

19.6 Dial thermometer integral with the handle of the ball valves of the solar pump station.

These are difficult to remove and it may be necessary to replace the entire valve, or pump station. In this case the system must be drained.

19.7 Flowmeter

Isolate the solar controller from the 230V / 50Hz electrical supply. Close both ball valves of the solar station. Drop the pressure at the indirect fired coil side of the circuit, through the 1/4" top-off valve in the side of the flow meter. Partially drain the circuit so the flow-meter is vacated. Disconnect the flow-meter from the attached pipework and loosen the AF52 nut attaching the flow-meter to the pump. Remove the flow-meter and replace. Assemble the new flow-meter to the pump and attach to pipe-work beneath flowmeter. Open ball valves and fill circuit to commissioning pressure. De-aerate the circuit and top the pressure up when necessary.

19.8 Non return valve integral to pump station ball valves.

If the storage vessel temperature falls significantly lower than that expected due to standing losses and light draw off over night, it may be necessary to change the pump station ball valves as the integral non-return valves in the body of the ball valve may be fouled in an open position. This could cause unwanted reverse heat flow from the thermal store to the collectors at night if the collector temperature falls below ambient. To do this the solar heating circuit will need to be drained. On replacement the circuit will need to be refilled, re-pressurised and de-aerated.

19.9 Collectors

If the collector glazing has become damaged replacement of the collector will require draining the solar heating circuit and disassembly from the collector of attached hydraulic tubing. Replacement may require the erection of scaffolding such as with an on-roof or in-roof collector array. In any case replacement of a collector in the middle of the array will require moving the collectors either side of the damaged collector sufficiently along the installation rail for replacement. Disassembly of tubing attached to surrounding collectors may also be required. On replacement the circuit will need to be refilled, re-pressurised and de-aerated.

19.10 Collector Temperature sensor

Isolate the controller from its 230V / 50Hz supply and disconnect the faulty sensor from the terminals in the junction box. Prize the rubber sealing grommet in which the collector sensor cable is inserted, from the collector. Retract the sensor from the pocket in the collector. Withdraw the faulty temperature sensor from the rubber grommet and insert the sensor head of the new sensor in the grommet. Place a small amount of heat conductive paste on the tip of the new sensor and insert into the sensor pocket of the collector. Reassemble the rubber grommet and attach the extension cable of the new sensor to the terminal in the junction box.

19.11 Heat store and auxiliary plant temperature sensors

Isolate the solar controller from it's 230V / 50Hz supply. Remove the screw in the front cover of the controller. Remove the front cover and retract the controller PCB from the rear housing to gain access to the terminals within the rear housing of the controller. Disconnect the faulty sensor (s) from the controller terminals and remove the sensor from the pocket in which it was installed. Connect the new sensor to the terminal in the rear housing of the controller and install in the appropriate sensor pocket. Note where these sensors are secured with W-shaped clips in the calorifier or storage tank pockets, use a pair of long nosed pliers to remove the W-shaped clips together with the sensor from the pocket.
Ensure that when the sensor is installed that the sensor tip is coated with heat conductive paste and inserted so the tip bottoms out on the bottom of the pocket in the tank/ pipework.

## 21.0 RECOMMENDED SPARES

| SPARES ITEM | PART No. |
|---|---|
| **ELECTRICAL ITEMS** | |
| ES 5910 S, Solar Controller | 553000520 |
| ES 5910 P, Pump With Solar Controller Mounted | 553000510 |
| MXS13-1 Circulating Pump | 553000530 |
| 5kOhm Tank Sensor x2.5 m Cable | 553000630 |
| 5k Ohm Collector Sensor x4 m Cable | 553000631 |
| Junction / Lightening Box | 553000632 |
| Modusol Pressurisation Unit | 553000800 |
| SS5910 Solar Transfer Station | 553000500 |
| Filling Pump Assembly | 564300050 |
| Safety Temperature Limit Thermostat | 533901179 |
| **MECHANICAL ITEMS** | |
| Modusol 252 Solar Collector | 553000100 |
| DN12 x 1/2" BSP Corrugated Insulated Connection Tube For Connecting Between Collectors | 553000715 |
| On-Roof Attachment Set For 1 Extra Vertical Collector | 553000201 |
| Attachment Anchor Extension Set For 1 Extra Vertical Collector | 553000301 |
| On-Roof Attachment Set For 1 Extra Horizontal Collector | 553000203 |
| Universal Bolt Anchor | 553000302 |
| Attachment Anchor Extension Set For 1 Extra Horizontal Collector | 553000304 |
| In-Roof Attachment Set For 1 Extra Collector | 553000307 |
| A-Frame Attachment Set For 1 Extra Collector | 553000310 |
| Solar Transfer Station Safety Group (6 bar Pressure Relief Valve / Manometer ) | 553000540 |
| Solar Transfer Station Flowmeter | 553000600 |
| Ball Valve With Integral Check Valve & Temperature Gauge | 553000610 |
| Solar Transfer Station Flushing / Filling Device | 553000601 |
| Expansion Vessel Connection Set For Solar Transfer Station | 553000550 |
| Expansion Vessel Quick Action Coupling | 553000560 |
| Solar Transfer Station Foam Insulation Covers | 553000602 |
| Olive Connection Set For x2 DN15 Copper Tube Connections | 553000620 |
| Olive Connection Set for x2 DN22 Copper Tube Connections | 553000621 |
| Pair Of Black Quick Slates | 553000330 |
| **CONSUMABLE ITEMS** | |
| 10L Container Propylene Glycol. Mixes To 25L Of 60% Water / 40% Glycol Solution. | 553000400 |
| 5L Refill –Container Of Propylene Glycol. | 553000402 |
| Box Of 10 Off NBR 1/2" Sealing Washers | 553000711 |

For service or spares please contact :-

**Hamworthy Heating Limited**
**Fleets Corner**
**Poole**
**Dorset BH17 0HH**

**Phone Number ..... 01202 662500**
**Fax Number..... 01202 665111**
**Service ..... 01202 662555**
**Spares ..... 01202 662525**
**Technical ..... 01202 662566**

## APPENDIX A - SOLAR CIRCULATION PUMP PERFORMANCE

| | |
|---|---|
| Installation Dimension | 1 ½" x 180mm |
| Permissible Operating Pressure | 10 bar |
| Permissible Operating Temperature | - 20°C To + 120°C |
| Operating Pressure Required At 500m a.s.l. | |
| - At 90°C Water Temperature | + 0,45 bar |
| - At 120°C Water Temperature | + 2,2 bar |
| - Per ± 100m Height | ± 0,01 bar |
| Voltage | 230V, 50Hz (Single Phase) |
| Speed | Max. 2700 revs/min |
| | Min. 1000 revs/min |
| Current | Max. 0.5A |
| | Min. 0.2A |
| Power | Max. 96W |
| | Min. 26W |

Table A1 - MXS 13-1 Pump Specification

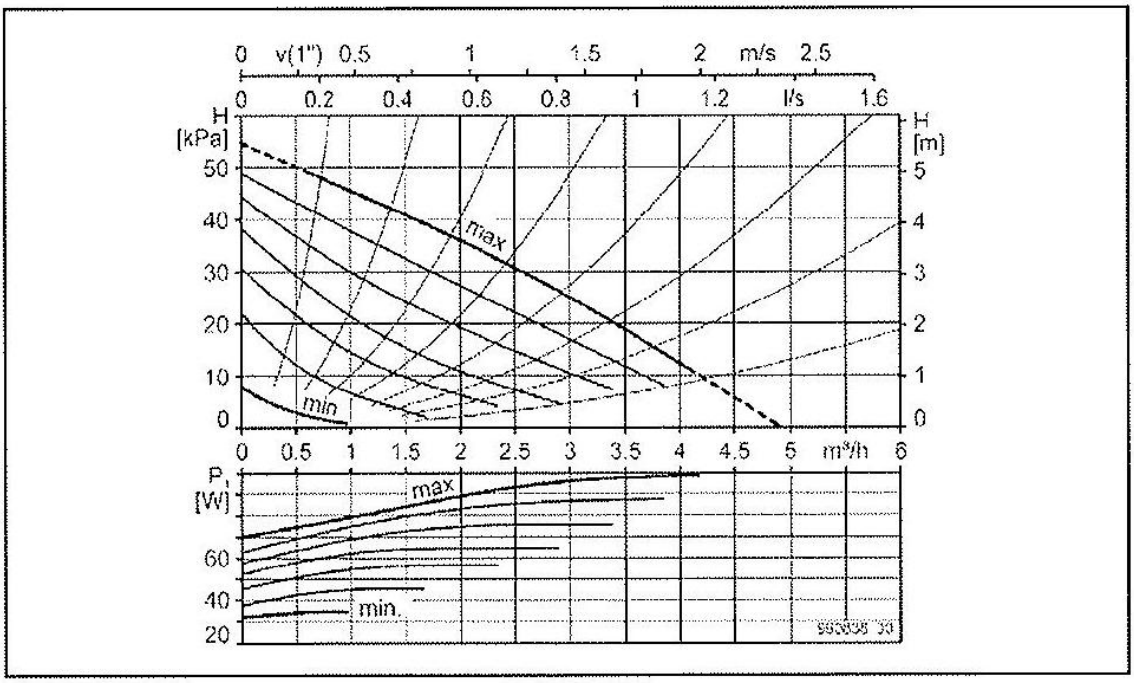


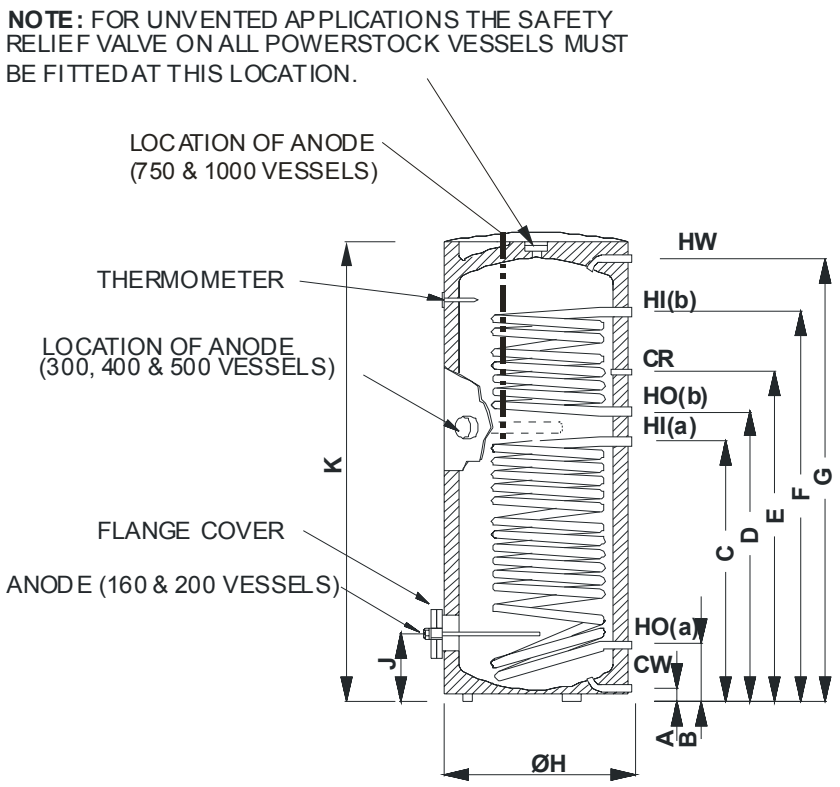

Figure A1 - Pump Characteristics Curve

APPENDIX B - OVERVIEW OF POWERSTOCK INDIRECT FIRED HOT WATER CALORIFIER VESSELS

For Detailed Installation Instructions Refer To Installers Guide 500001084

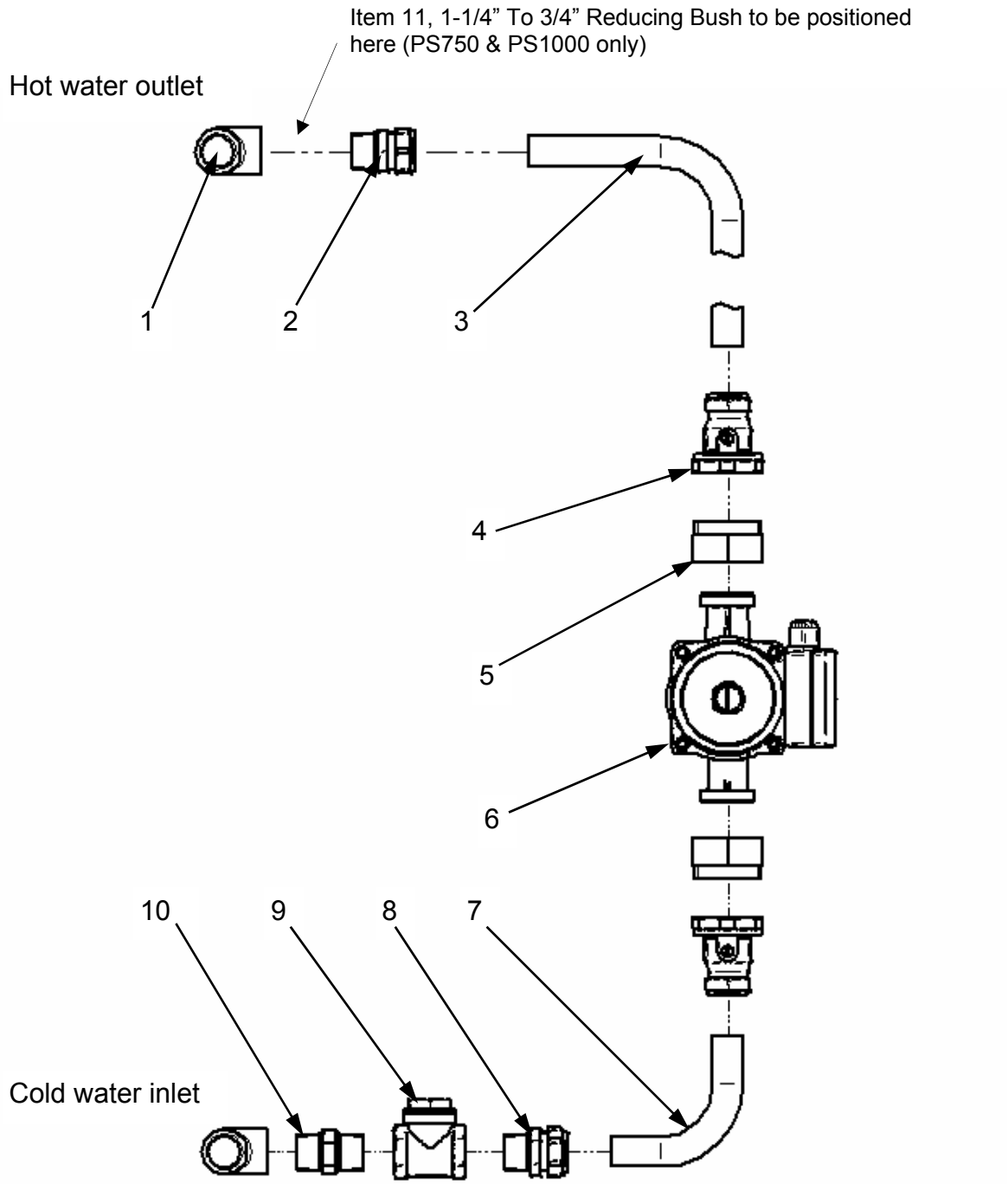
| Calorifier Model | **PS160** | **PS200** | **PS300** | **PS400** | **PS500** | **PS750** | **PS1000** |
|---|---|---|---|---|---|---|---|
| **General data.** | | | | | | | |
| Storage Capacity (litres) | 160 | 200 | 292 | 380 | 470 | 750 | 995 |
| Top Coil Surface Area (sq. metres) | N/A | N/A | 0.80 | 1.05 | 1.30 | 1.17 | 1.12 |
| Bottom Coil Surface Area (sq. metres) | 0.75 | 0.95 | 1.55 | 1.80 | 1.90 | 1.93 | 2.45 |
| Max Operating Pressure (Primary) (bar) | 10 | | | | | | |
| Max Operating Pressure (Secondary) (bar) | 10 | | | | | | |
| Max Operating Temp (°C) | Primary = 110°C<br>Stored water = 70°C | | | | | | |
| Weight Empty (kg) | 70 | 80 | 130 | 185 | 215 | 217 | 275 |
| Weight Full (kg) | 230 | 280 | 422 | 565 | 685 | 967 | 1270 |
| **Operational data: Bottom coil only in operation.** | | | | | | | |
| Primary Temperature (°C) | 80 | | | | | | |
| Stored water temperature (°C) | 60 | | | | | | |
| Continuous Output (l/h)<br>Secondary out = 60°C, Cold feed = 10°C | 501 | 600 | 816 | 976 | 1109 | 1062 | 1281 |
| Heat input (kW) | 29.2 | 35.6 | 48.4 | 57.9 | 65.7 | 63 | 76 |
| 10min Peak Output (litres) | 250 | 362 | 448 | 615 | 771 | 1100 | 1197 |
| Recovery time 10-60°C (minutes) | 20 | 20 | 22 | 24 | 26 | 42 | 46 |
| **Operational data: Top and bottom coils connected for series operation.** | | | | | | | |
| Primary Temperature (°C) | 80 | | | | | | |
| Stored water temperature (°C) | 60 | | | | | | |
| Continuous Output (l/h)<br>Secondary out = 60°C, Cold feed = 10°C | N/A | N/A | 1032 | 1285 | 1549 | 1432 | 1635 |
| Heat input (kW) | N/A | N/A | 61.2 | 76.2 | 91.8 | 85 | 97 |
| 10min Peak Output (litres) | N/A | N/A | 567 | 889 | 1077 | 1319 | 1483 |
| Recovery time 10-60°C (minutes) | N/A | N/A | 17 | 18 | 18 | 31 | 36 |

**Table B1 - Technical data for Powerstock indirect fired Hotwater Calorifier Vessels**




| MODEL | | PS160 | PS200 | PS300 | PS400 | PS500 | PS750 | PS1000 |
|---|---|---|---|---|---|---|---|---|
| DIMENSIONS (mm) | A | 55 | 55 | 90 | 55 | 55 | 103 | 103 |
| | B | 191 | 191 | 254 | 220 | 220 | 288 | 296 |
| | C | 596 | 686 | 964 | 909 | 965 | 830 | 884 |
| | D | N/A | N/A | 1064 | 1006 | 1114 | 1151 | 1153 |
| | E | 732 | 899 | 1179 | 1111 | 1264 | 1242 | 1243 |
| | F | N/A | N/A | 1424 | 1354 | 1604 | 1467 | 1423 |
| | G | 1106 | 1366 | 1725 | 1523 | 1853 | 1887 | 1905 |
| | H | 540 | 540 | 625 | 700 | 700 | 910 | 1010 |
| | J | 246 | 246 | 324 | 275 | 275 | 378 | 386 |
| | K | 1172 | 1432 | 1775 | 1591 | 1921 | 1998 | 2025 |
| CONNECTIONS | **HW** Hot water outlet. | R ¾" | R ¾" | R 1" | R 1" | R 1" | R 1¼" | R 1¼" |
| | **HO(b)** Upper primary coil outlet. | N/A | N/A | R 1" | R 1" | R 1" | R 1" | R 1" |
| | **CR** Circulation return. | R ¾" | R ¾" | R ¾" | R ¾" | R ¾" | R ¾" | R ¾" |
| | **HI(b)** Upper primary coil inlet. | N/A | N/A | R 1" | R 1" | R 1" | R 1" | R 1" |
| | **HO(a)** Lower primary coil outlet. | R 1" | R 1" | R 1" | R 1" | R 1" | R 1" | R 1" |
| | **HI(a)** Lower primary coil inlet. | R 1" | R 1" | R 1" | R 1" | R 1" | R 1" | R 1" |
| | **CW** Cold water feed. | R ¾" | R ¾" | R 1" | R 1" | R 1" | R 1¼" | R 1¼" |

**Figure B1 - Layout and dimensional data for Powerstock indirect fired Hotwater Calorifier Vessels**




| Item | Description | Qty | PS160 | PS200 | PS300 | PS400 | PS500 | PS750 | PS1000 |
|---|---|---|---|---|---|---|---|---|---|
| | Re-circulation kit | | 563605387 | 563605388 | 563605389 | 563605390 | 563605391 | 563605460 | 563605461 |
| 1 | Tee | 2 | 741654278 | 741654278 | 741654286 | 741654286 | 741654286 | 741654294 | 741654294 |
| 2 | Coupling | 1 | 530505002 | 530505002 | 530505128 | 530505128 | 530505128 | 530505128 | 530505128 |
| 3 | Pipe 22mm | 1 | 532403192 | 532403193 | 532403194 | 532403195 | 532403196 | 532403233 | 532403234 |
| 4 | Isolation valve | 2 | 531911002 | 531911002 | 531911002 | 531911002 | 531911002 | 531911002 | 531911002 |
| 5 | Pump adaptor | 2 | 530905047 | 530905047 | 530905047 | 530905047 | 530905047 | 530905047 | 530905047 |
| 6 | Pump Biral WX13 | 1 | 1154050150 | 1154050150 | 1154050150 | 1154050150 | 1154050150 | 530905050 | 530905050 |
| 7 | Elbow | 1 | 532403011 | 532403011 | 532403011 | 532403011 | 532403011 | 532403011 | 532403011 |
| 8 | Coupling | 1 | 530505002 | 530505002 | 530505002 | 530505002 | 530505002 | 530505002 | 530505002 |
| 9 | Check valve | 1 | 531911003 | 531911003 | 531911003 | 531911003 | 531911003 | 531911003 | 531911003 |
| 10 | Adaptor | 1 | 741614298 | 741614298 | 741614298 | 741617085 | 741614298 | 741617101 | 741617101 |
| 11 | Reducing Bush | 1 | - | - | - | - | - | 741627340 | 741627340 |

**Figure B2 - Top to bottom circulation Kits For Use With Powerstock Indirect Fired hotwater Calorifiers**

APPENDIX C - OVERVIEW OF POWERSTOCK STORAGE TANKS

For Detailed Installation Instructions Refer To Installers Guide 500001177

| | MODEL | ST300 | ST500 | ST750 | ST1000 |
|---|---|---|---|---|---|
| DATA | Storage Capacity (Litres) | 300 | 502 | 750 | 990 |
| | Weight Empty (kg) | 87 | 111 | 195 | 248 |
| | Weight Full (kg) | 387 | 613 | 945 | 1238 |
| | Standby Losses (kw/h) | 0.1 | 0.13 | 0.15 | 0.2 |
| | Max Operating Pressure (bar) | 10 | | | |
| | Max Operating Temperature ($^{o}$C) | 95 | | | |
| DIMENSIONS (mm) | A | 1836 | 1967 | 2040 | 2040 |
| | B | 1505 | 1686 | 1643 | 1671 |
| | C | | | 1473 | 1511 |
| | D | 325 | 276 | 378 | 386 |
| | E | DN110 | DN110 | DN180 | DN180 |
| | F - Anode | | | R1 1/4” | R1 1/4” |
| | G | | | 5 | 5 |
| | H | | | R1/2” | R1/2” |
| | I | 620 | 726 | 915 | 1010 |
| | J | | | 60 | 60 |
| | K (Hot Water Return Connection) | | | R2” | R2” |
| | L (Hot Water Outlet Connection) | R1 1/2” | R1 1/2” | R2” | R2” |
| | M | 16 | 16 | 60 | 60 |
| | N (Circulation/Control Panel Pocket Assembly) | R3/4” | R3/4” | R1 1/4” | R1 1/4” |
| | O (Sensor Pocket Connection) | | | R1/2” | R1/2” |
| | P (Sensor Pocket) | R1/2” | R1/2” | R1/2” | R1/2” |
| | Q (Cold Water Inlet Connection) | R1” | R1” | R2” | R2” |
| | Q’ (Secondary Cold Water Inlet Connection) | R1 1/2” | R1 1/2” | | |
| | S | 90 | 55 | 88 | 92 |
| | T | 272 | 238 | 290 | 297 |
| | U | | | 945 | 952 |
| | V | 1180 | 1265 | 1145 | 1154 |
| | W | 1546 | 1673 | 1640 | 1647 |
| | X | | | 1908 | 1911 |
| | Y | R1” | R1” | R1 1/4” | R1 1/4” |
| | Z | R1 1/4” | R1 1/4” | R1” | R1” |
| | 1 | 272 | 238 | | |
| | 2 - Anode | R3/4” | R3/4” | | |
| | 3 | 70 | 110 | | |

**Table C1 - Data & Product Dimensions Detailed In Figures C2 & C3**

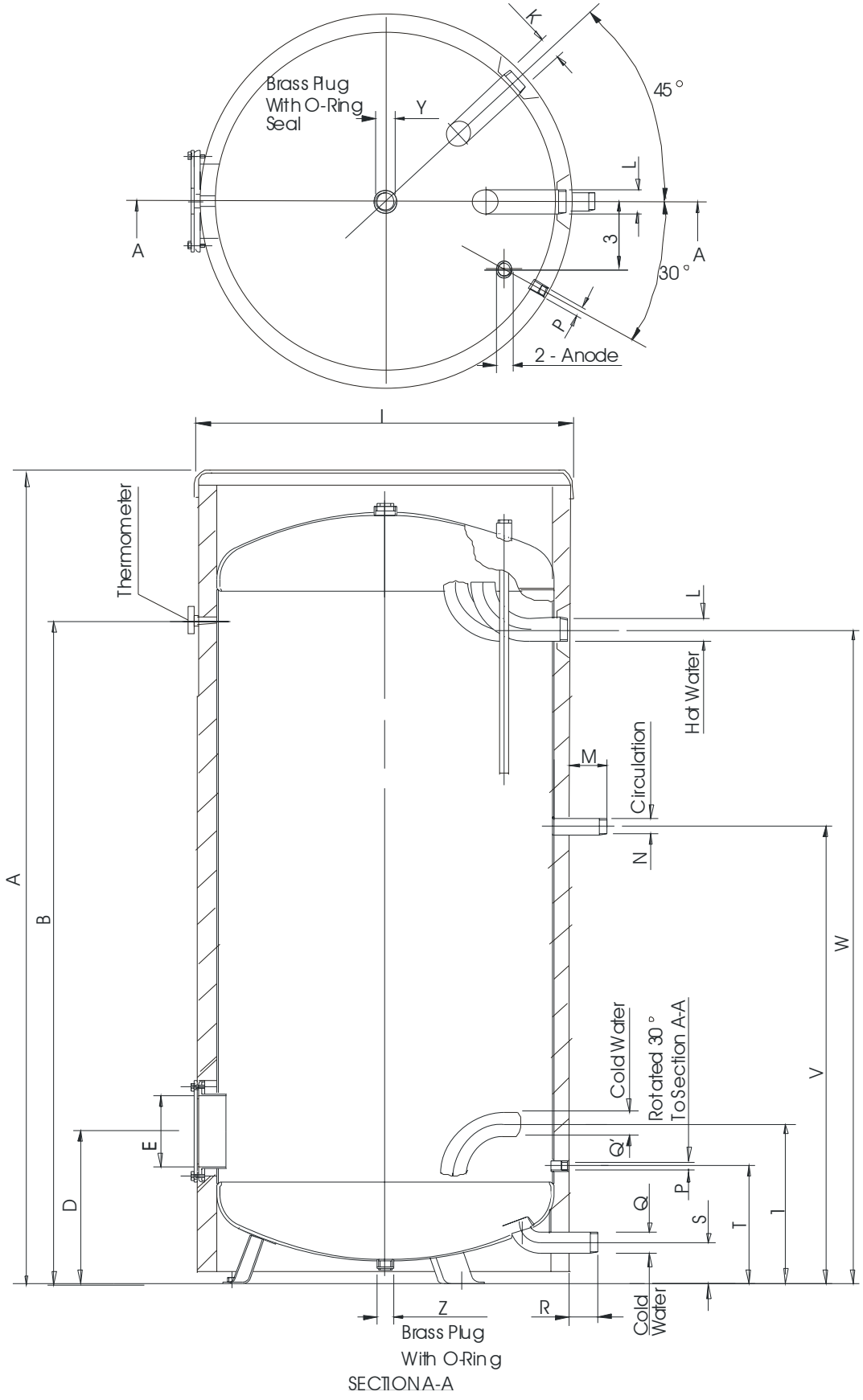



Figure C2 - General Arrangement Drawing Of ST300 / ST500

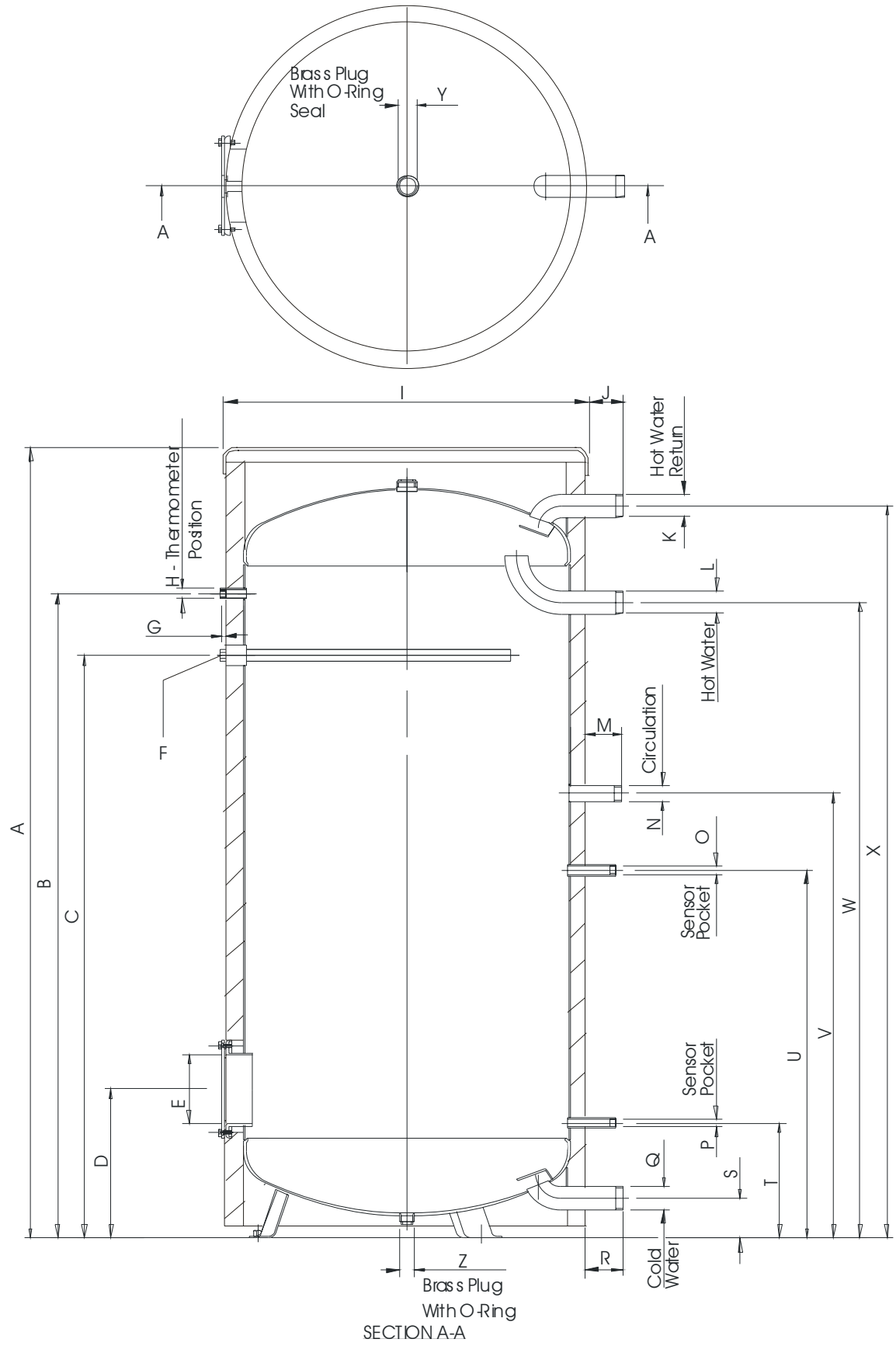
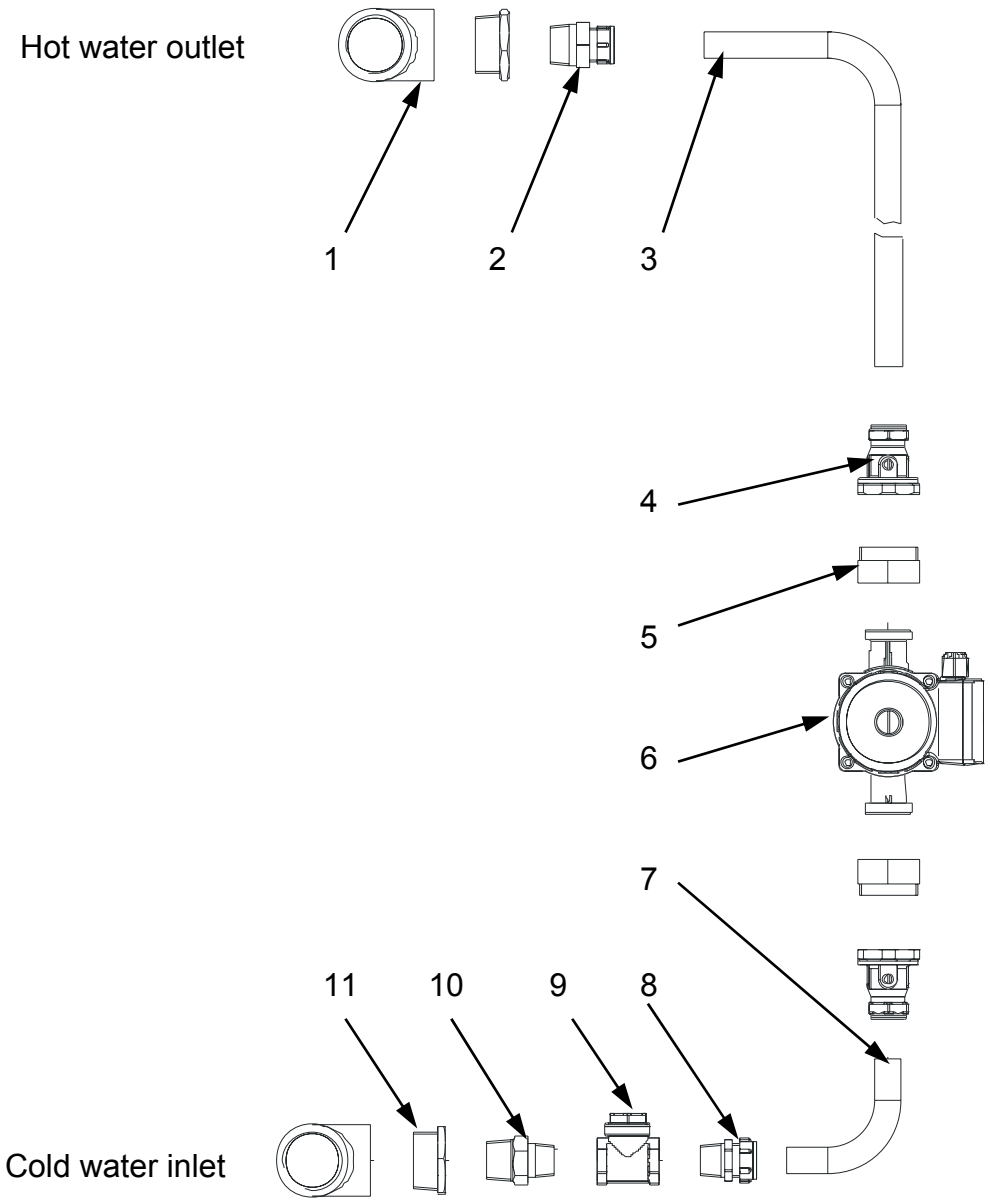



Figure C3 - General Arrangement Drawing Of ST750 / ST1000




| Item | Description | Qty | ST300 | ST500 | ST750 | ST1000 |
|---|---|---|---|---|---|---|
| | Re-circulation kit | | 563605481 | 563605482 | 563605483 | 563605461 |
| 1 | Tee | 2 | 741654302 | 741654302 | 741654310 | 741654310 |
| 2 | Coupling | 1 | 530505128 | 530505128 | 530505128 | 530505128 |
| 3 | Pipe 22mm | 1 | 532403235 | 532403236 | 532403237 | 532403237 |
| 4 | Isolation valve | 2 | 531911002 | 531911002 | 531911002 | 531911002 |
| 5 | Pump adaptor | 2 | 530905047 | 530905047 | 530905047 | 530905047 |
| 6 | Pump Biral WX13 | 1 | 1154050150 | 1154050150 | 1154050150 | 1154050150 |
| 7 | Elbow | 1 | 532403011 | 532403011 | 532403011 | 532403011 |
| 8 | Coupling | 1 | 530505002 | 530505002 | 530505002 | 530505002 |
| 9 | Check valve | 1 | 531911003 | 531911003 | 531911003 | 531911003 |
| 10 | Adaptor | 1 | 741614291 | 741614291 | 741614291 | 741614291 |
| 11 | Reducing Bush | 2 | 741627357 | 741627357 | 741627480 | 741627480 |

Figure - C4 : Top to bottom circulation kits for use with Powerstock thermal storage tanks

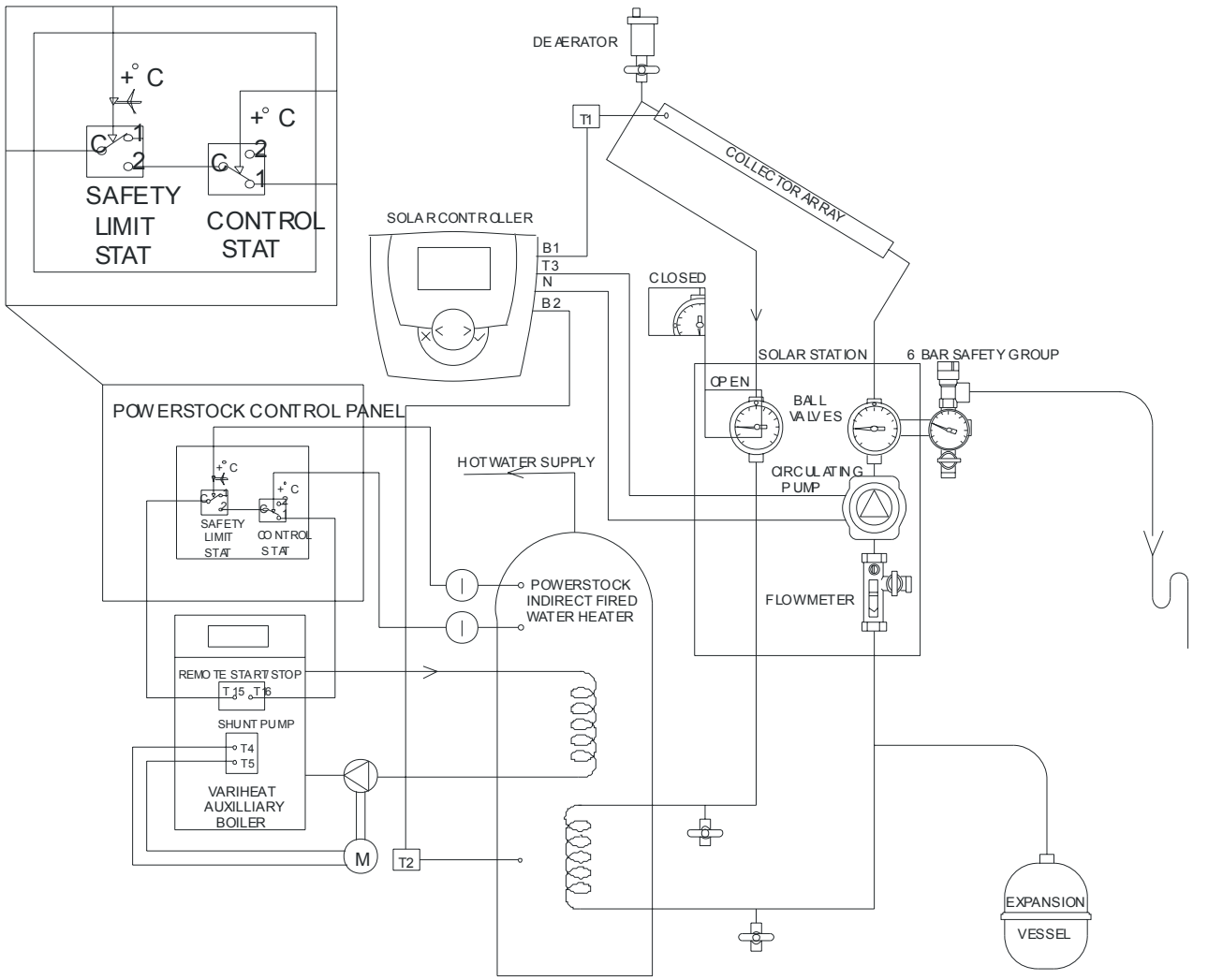
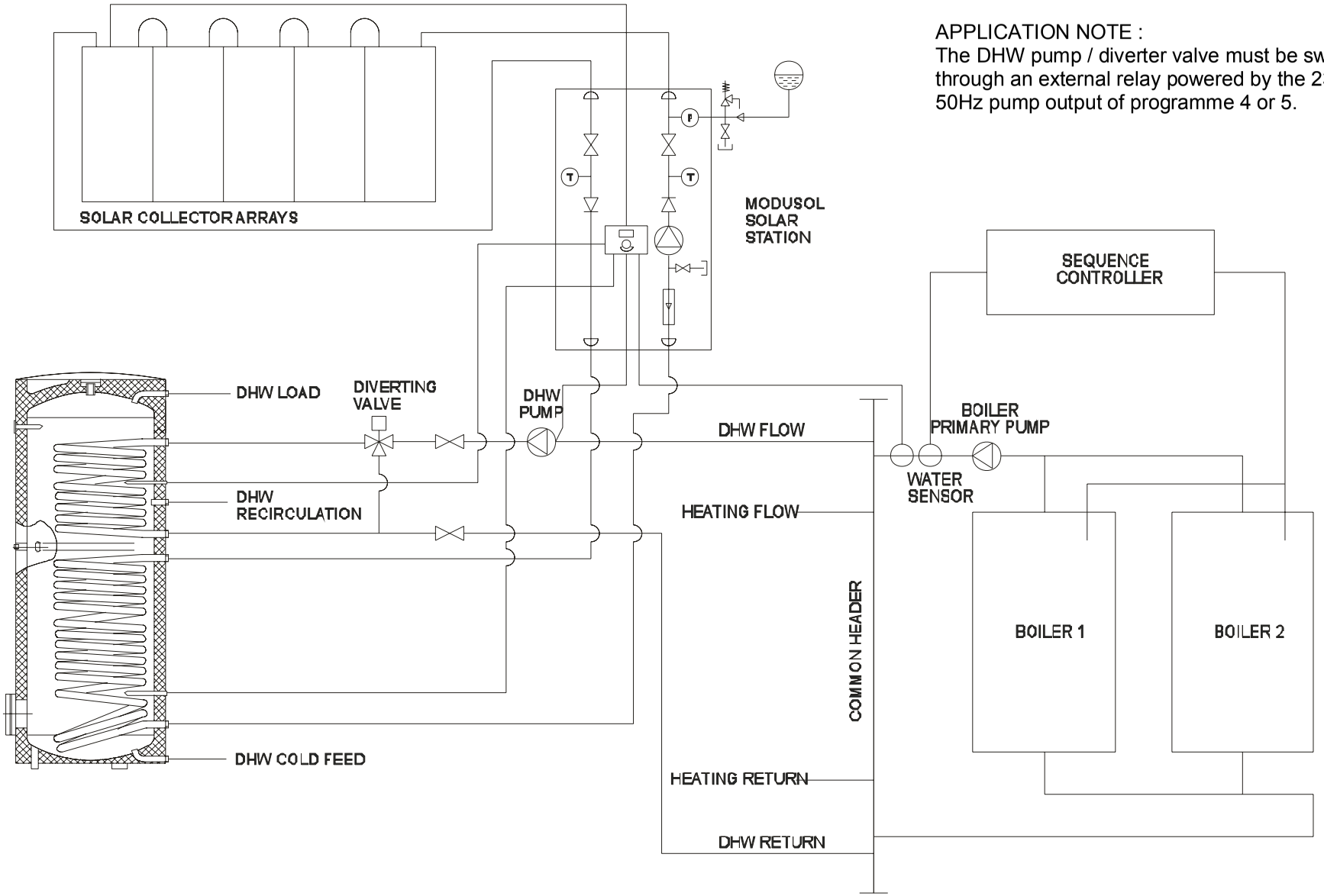



Figure D.1 - Single Powerstock twin coil hot water calorifier with auxiliary heat boiler. Solar controller Set To Hydraulic Variant 1.

# APPENDIX D - HAMWORTHY HEATING RECOMMENDED SOLAR SCHEMATICS

APPLICATION NOTE :
The DHW pump / diverter valve must be switched through an external relay powered by the 230V/ 50Hz pump output of programme 4 or 5.




D.2 Solar preheat to calorifier(s) with gas /oil or biomass fired auxiliary boilers. Controller Hydraulic 4 & 5

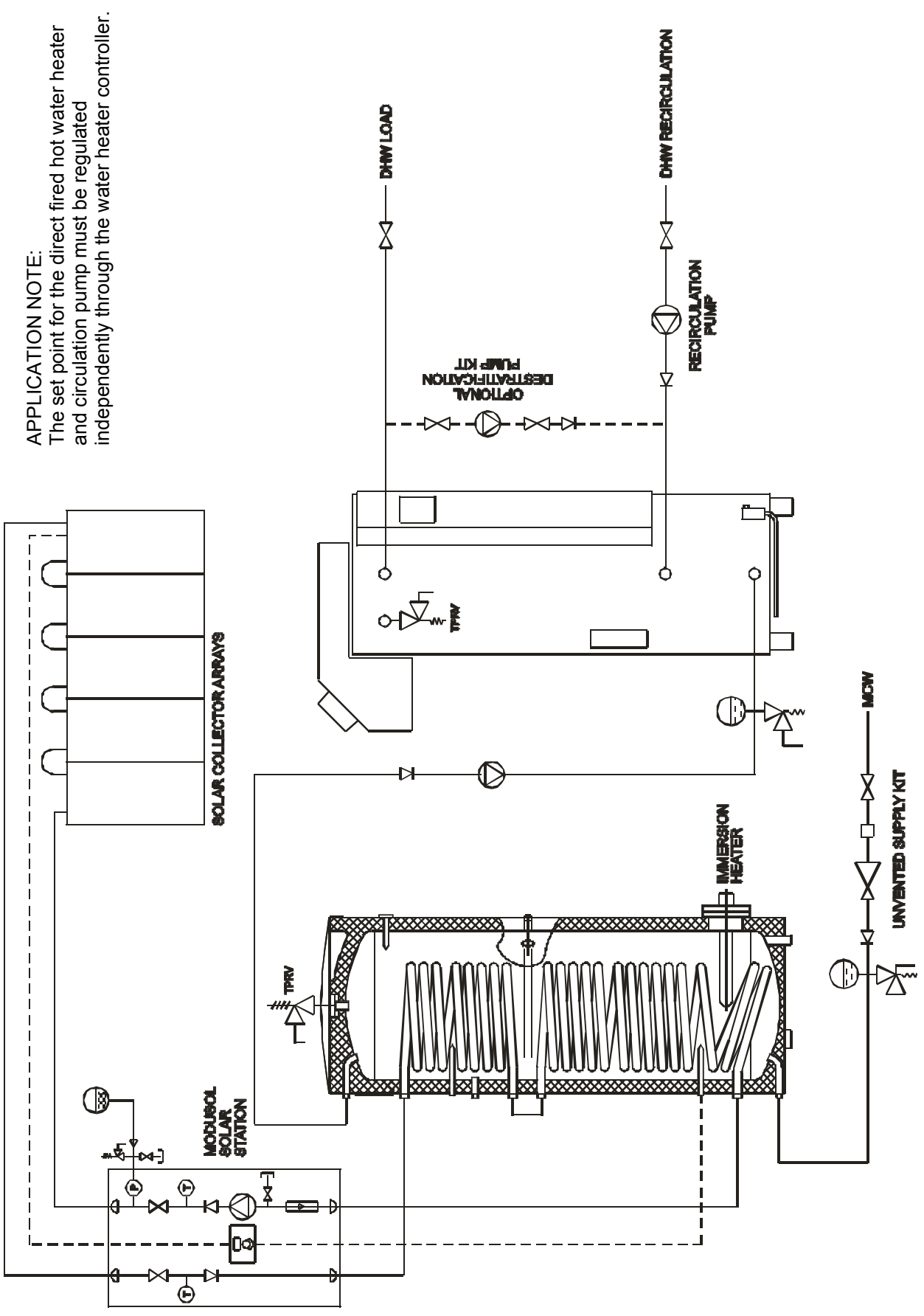



Figure D.3 - Solar Preheat Feeding At Direct Fired Water Heater. Controller Hydraulic Variant 2.

APPLICATION NOTE:
1) If Hydraulic Variant 2 is to be used the auxiliary heating control must be controlled independently.
2) If Hydraulic Variant 4 or 5 is used the loading / recirculation / de-stratification pumps must be controlled independently from the solar controller.

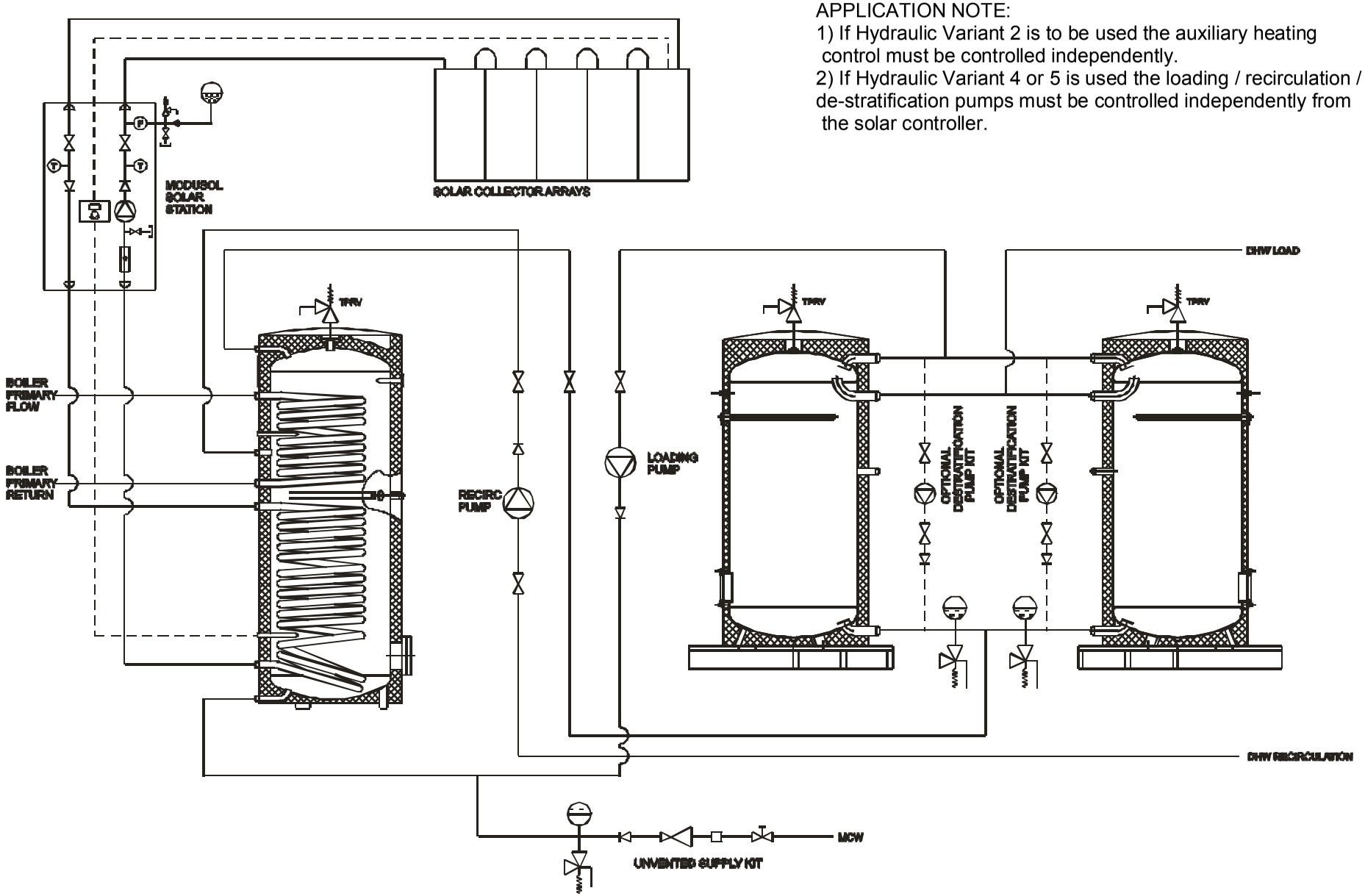



Figure D.4 - Solar Heating And Secondary Storage. Controller Hydraulic Variants 2,4,5

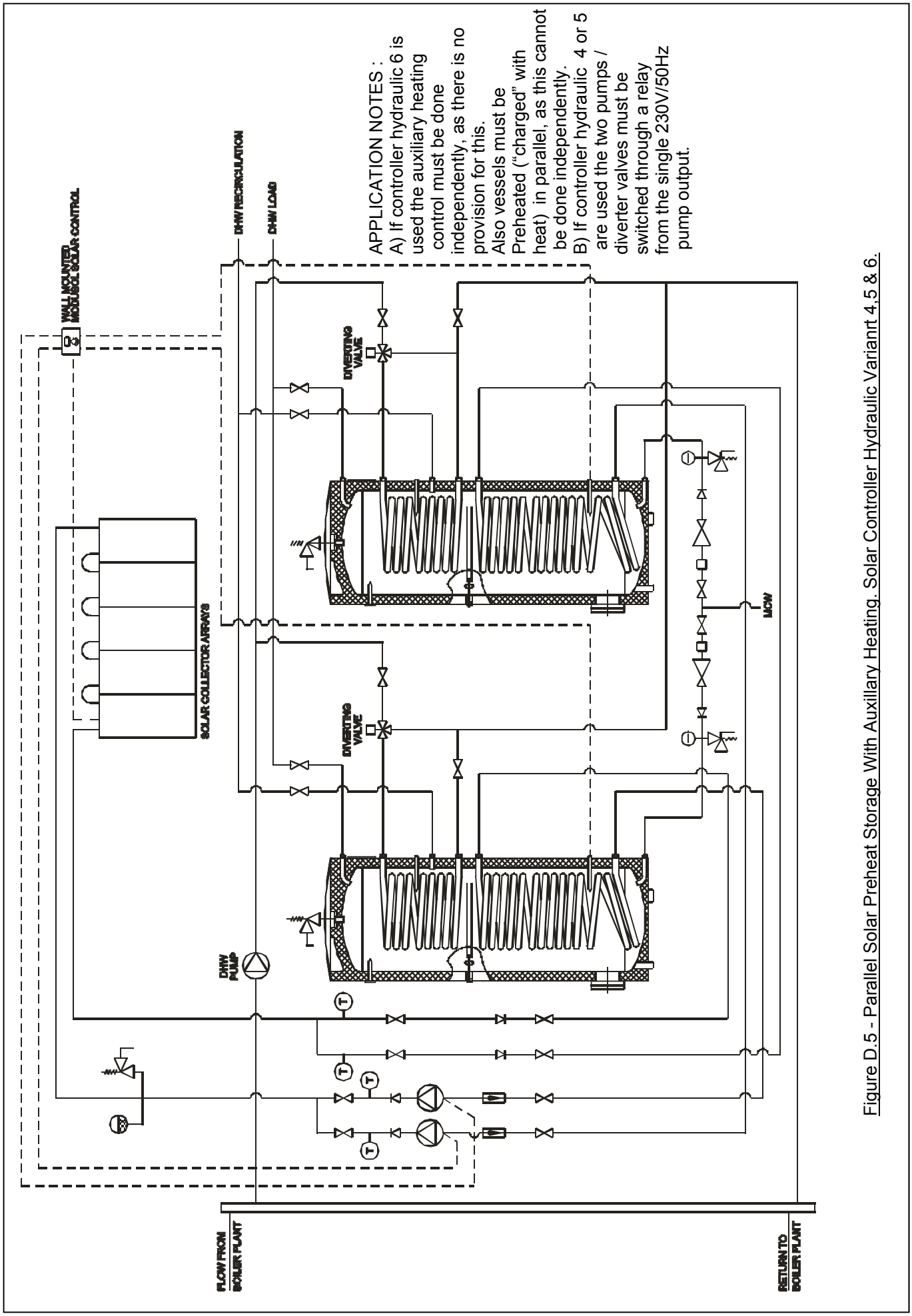



Figure D.5 - Parallel Solar Preheat Storage With Auxillary Heating. Solar Controller Hydraulic Variannt 4,5 & 6.

APPENDIX E - GUIDANCE NOTES ON SOLAR CIRCUIT PIPEWORK DESIGN AND USE

E.1 Temperature resistance of common hydraulic joints

The use of flat faced union joints with fibre faced washers, compression olives with support sleeves, threaded joints using hemp, high temperature o-rings with copper crimp fittings all have proven performance in solar systems. The use of soldered joints is however not recommended due to the limiting temperature of the solder material.

| Joint Type | Pressure Limit (bar) | Operating Temperature limit $^{o}$C | Softening point of materials $^{o}$C |
|---|---|---|---|
| Non-metal bodied joints and non-metal pipes | 6 | 95 | 110 |
| Lead based solder | 16 | 110 | 140 |
| Lead free solder | 16 | 110 | 160 |
| Silver solder | 16 | 110 | 200 |
| Copper Phosphorous Braze | 16 | 110 | 850 |
| Compression without support sleeves | 6 | 120 | N/A |
| High Temperature O-ring with copper crimp fitting | 10 | 110 | N/A |
| High Temperature O-Ring with high temperature metal case | 16 | 200 | N/A |

Table E.1 - Performance Of various types of Hydraulic Joint

Use of non-metallic tubing is also not recommended due to the risk of damage from rodent, birds & squirrels.

E.2 Pipe Insulation Materials Used Externally.

Pipe insulation should be selected for it's high temperature resistance, above 150$^{o}$C, such as foil-faced glass / mineral wool. Extra mechanical protection such as metal cladding or petroleum wrap should be used for resistance to rodent bird & squirrel damage.

E.3 Linear Expansion Of Copper Tubing

A minimum allowance of up to 3mm expansion per linear meter must be allowed for most copper pipes between the coldest days and stagnation temperature of circa 230$^{o}$C at the collector. Expansion legs should be incorporated into the pipework to accommodate for this.

Table E.2 below shows the elongation in softer copper types.

| Copper Tube Type | Hard (R290) | Half Hard (R250) | Annealed (220) |
|---|---|---|---|
| Elongation @ 230$^{o}$C | 3% | 20% | 40% |

Table E.2 - Effect Of Grades Of Copper Tube On Linear Expansion of copper Tube at Stagnation Temperature

E.4 A calculation of total system volume is necessary to determine primary fluid quantities such as antifreeze & the expansion of the fluid over the operating temperature range. Tables E.3 , E.4 define the internal volume of copper & steel tube where used.

| | Copper to BSEN1057 – R250 (Old Table X) Outside Diameter & Wall Thickness (mm) | | | | |
|---|---|---|---|---|---|
| Pipe size | 8 x 0.6 | 10 x 0.6 | 12 x 0.6 | 15 x 0.7 | 22 x 0.9 |
| Internal Volume per meter (litres) | 0.036 | 0.058 | 0.085 | 0.145 | 0.321 |

Table E.3 - Internal Volume Of Various Copper Tube Sizes Per Meter

| | Threaded Medium Weight Steel Pipe To BS1387 Nominal Diameter Shown | | | | |
|---|---|---|---|---|---|
| Pipe size | 3/8” | ½” | ¾” | 1” | 1 ¼” |
| Internal Volume Per meter (litres) | 0.12 | 0.2 | 0.37 | 0.58 | 1.02 |

Table E.4 - Internal Volume Of Various Steel Pipe Sizes Per Meter

E.5 Various size of corrugated flexible stainless-steel tube can be supplied instead of straight pipe. Coils of this tubing are available pre-insulated and un-insulated from Hamworthy Heating Ltd.

| Nominal Diameter (mm) | Description | Coil Length (m) | HHL Part No. |
|---|---|---|---|
| DN16 | Twin Tube - Insulated | 15 | 553000703 |
| DN16 | Twin Tube - Insulated | 25 | 553000704 |
| DN20 | Twin Tube - Insulated | 15 | 553000705 |
| DN20 | Twin Tube - Insulated | 25 | 553000706 |
| DN25 | Twin Tube - Insulated | 15 | 553000724 |
| DN12 | Single Tube ~ Un-insulated | 50 | 553000712 |
| DN16 | Single Tube ~ Un-insulated | 50 | 553000700 |
| DN25 | Single Tube ~ Un-insulated | 50 | 553000701 |

Table E.5 - Sizes Of Stainless Steel Corrugated Tube Available From Hamworthy Heating Ltd

Figure E.6 - Insulated Corrugated Stainless - Steel tubing

E.6 A flange crimping tool set HHL Part no. 553000801 is available to form a flange from the last 3 corrugations of each cut length of tube. Prior to the crimping operation the appropriate back nut needs to be applied. See Table E.6 Below.

| Back Nut / Washer Size | Nominal Corrugated Tube Size |
|---|---|
| ½" | DN12 |
| ¾" | DN16 |
| 1" | DN20 |
| 1 ¼" | DN25 |

Table E.6—Standard Brass Back Nut / NBR Stabilised Fibre Washer size Suitable For Use With Corrugated Tube

E.8 Pre-assembled insulated single corrugated tubes with R1/2" Nuts at both ends, are available in three lengths. See table E.8 below.

| Description | Tube Length (m) | HHL Part No. |
|---|---|---|
| DN12 Insulated Tube With R1/2" Nuts Both sides | 0.5 | 553000715 |
| | 1 | 553000716 |
| | 1.5 | 553000717 |

Table E.8 - Pre-assembled insulated single corrugated tubes available for connection to a solar collector

Figure E.8—Pre-assembled Insulated Single Corrugated Tube With R1/2" Nut & End Flange

E.9 Maximum continuous working temperature of tube is 200°C.
Pre-insulated with UV stable 13mm Thick EDPM
Doubled annealed ensuring pipework retains its shape when bent or straightened.

| DN | Inside Diameter (mm) | Outside Diameter (mm) | Bending Radius Static (mm) | Maximum Allowed Pressure (bar) | Weight/ Meter (g) | Burst Pressure (bar) |
|---|---|---|---|---|---|---|
| 8 | 8 | 11.4 | 25 | 10 | 100 | 100 |
| 12 | 12.6 | 16.0 | 80 | 10 | 190 | 90 |
| 16 | 15.6 | 20.2 | 100 | 10 | 260 | 70 |
| 20 | 19.8 | 25.5 | 125 | 10 | 350 | 60 |
| 25 | 26.8 | 31.7 | 150 | 10 | 410 | 50 |

Table E.9— Technical Specification Of Corrugated Stainless Steel Solar Tubing

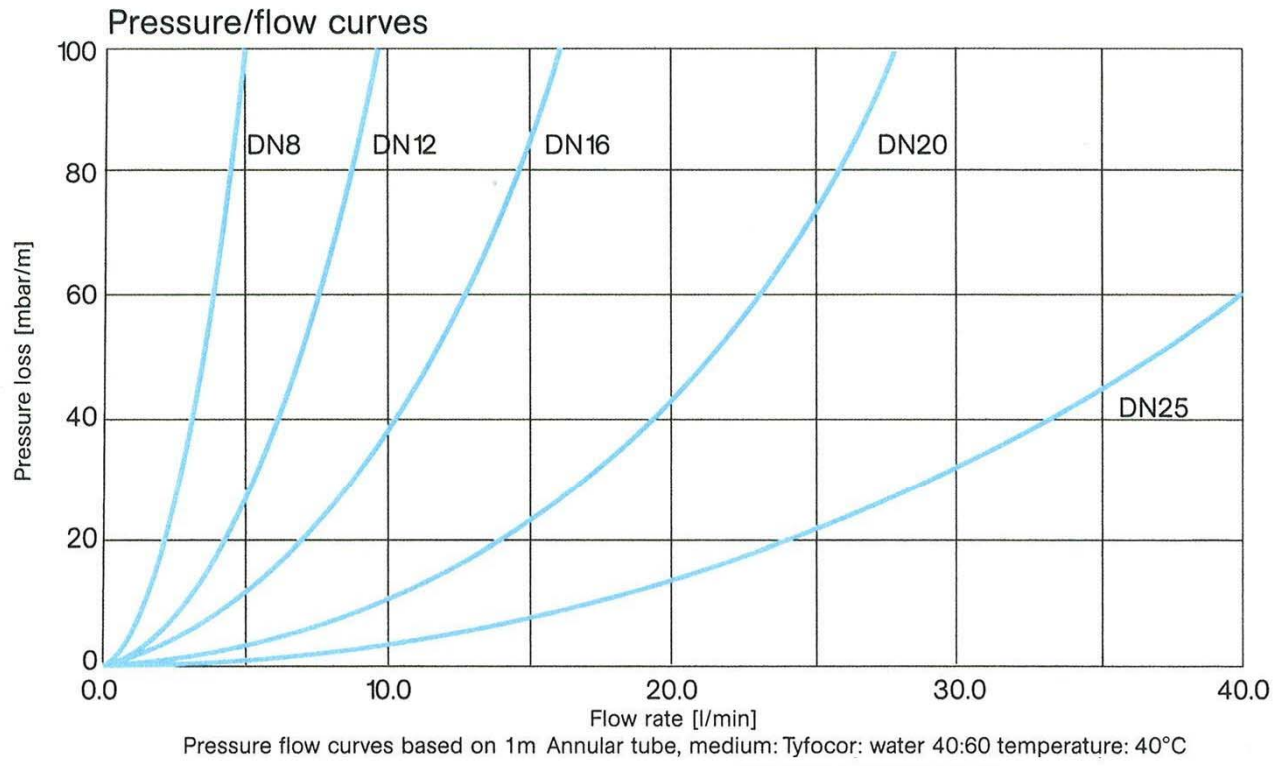



Figure E.10 Graph Of Flow / Pressure Loss Characteristics Of Stainless Steel Annular tube.

**HAMWORTHY HEATING LIMITED**

Fleets Corner, Poole, Dorset BH17 0HH. England

Heating *at work*.

www.hamworthy-heating.com
Telephone Hamworthy Heating Service Team On : + 44 (0)1202 66 2555

## Hamworthy Heating Ltd Contract Reference :
## Site :

COMMISSIONING SHEET F.1 (PAGE 1)

| | | |
|---|---|---|
| 1 | User Instructions Explained To Client & Handed Over | Yes / No |
| 2 | EU Certificates Of Conformity For Components Left On Site | Yes / No |
| 3 | Installation Instructions Handed Over | Yes / No |
| 4 | Location Where Documentation Left | |
| 5 | Total Net Absorber Area Array | $m^2$ |
| 6 | Serial Numbers Of Collectors Installed | |
| 7 | Maximum Design Pressure Of Pre-Heat Solar Store | bar |
| 8 | Maximum Design Pressure Of Solar System | 10 bar |
| 9 | System Pressure When Filled | bar |
| 10 | Date Filled | |
| 11 | Minimum Allowable Primary System Pressure Level Before User Action Required | 0.9 bar |
| 12 | Procedure For User To Follow If Solar System Pressure Below Level | 1) Check for Leakage.<br>2) If None Contact Hamworthy Heating Ltd. |
| 13 | Location Of Solar Station In Building | |
| 14 | Location Of Solar System Pressure Gauge If Different From 12 | |
| 15 | Location Of Pressure Relief Safety Device If Different From 12 | |
| 16 | Frequency Of Regular Test Of Pressure Safety Device | Yearly |
| 17 | Date Of Tests Of Pressure Safety Device | |
| 18 | Location Of Electrical Fused Isolation Switch For Solar Controller | As Point 12 |
| 19 | Fuse Rating Isolation Switch | Amps |
| 20 | Fuse Type / Rating Transfer Station Controller | 5x20mm (T) 3.15A |
| 21 | Electrical Controls & Temperature Sensors Operating Correctly | Yes / No |
| 22 | Back-Up DHW heating fitted With Thermostat Responding To Solar Preheat Store | Yes / No |
| 23 | DHW Thermostat Setting | 65 °C |
| 24 | Increase collector tank for charging ON (8-01) | 8 °C |

**HAMWORTHY HEATING LIMITED**

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Heating *at work*.

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**Hamworthy Heating Ltd Contract Reference :**
**Site :**

COMMISSIONING SHEET F.1 (PAGE 2)

| | | |
|---|---|---|
| 25 | Increase for collector tank for charging OFF (8-02) | 4 °C |
| 26 | Solar Expansion Vessel Rated Volume | Litres |
| 27 | Solar Expansion Vessel Pre-charge | bar |
| 28 | Type Of Solar Transfer Fluid | 40% HHL Supplied Propyl-ene Glycol / 60% Water |
| 29 | Corrosion Inhibitor Used | Yes |
| 30 | Actual Pump Circulation Rate Solar Circuit | L/min |
| 31 | Solar Preheat Store Type | |
| 32 | Volume Of Solar Preheat Store | Litres |
| 33 | Location Of DHW Isolation Valve | |
| 34 | Method Of Anti-Scalding In DHW Distribution | TMV |
| 35 | Limescale Risk In DHW Heat Exchanger | Medium |
| 36 | Limescale Control In Heat Exchanger | Cleanout Door |
| 37 | Expected Annual Delivered Solar Energy To Taps | kWh |
| 38 | Expected Annual Solar Fraction Of DHW | % |
| 39 | Method Of Performance Calculation | SAP2005/CIBSE Solar De-sign Guide/Other |
| 40 | Daily DHW Load Assumption | L/day @ °C |
| 41 | Date Of Visits For Bacterial, Water quality & Access Risk Assessments | Twice Yearly (Not Exceeding 6 Months) |
| 42 | System Commissioned By | |
| 43 | On Behalf Of | Hamworthy Heating Ltd |
| 44 | Date System Commissioned & Handed Over | |
| 45 | Signature Of Commissioning Engineer | |
| 46 | System Handed Over To | |
| 47 | On Behalf Of | |
| 48 | Signature Of Accepting Engineer | |
| 49 | 1 Copy Of Checklist Given To Client. One To HHL | Yes / No |

## USEFUL USER INFORMATION

| INSTALLER | SITE ADDRESS |
|---|---|
| | |

| BOILER TYPE | BOILER SIZE(S) | UNIT NO(S). | SERIAL NO(S). | FLUE |
|---|---|---|---|---|
| | | | | |

| NOTES |
|---|
| |

# Notes

# Hamworthy Heating Accredited Agents

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tel: **00 353 141 91919** fax: **00 353 145 84806**

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Hamworthy

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