Flat Plate Solar Collector

Installation, commissioning and maintenance instructions

Models:

LSP20+

LSP20+H

installation manual_flat plate collector_december2017

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

CONTENTS

1 INTRODUCTION

1.1 PRELIMINARY INFORMATION

Reproduction, storage or transmission of any part of this publication in any form, without the prior written consent of the Lochinvar Limited, is prohibited.

The collector, to which these instructions refer, is designed to be used for the purposes described and to be operated in accordance with these instructions.

Lochinvar Limited will not be liable for claims for damage caused to persons, animals, material goods or property caused by improper installation, adjustment and maintenance or improper use. Any use not specified in this manual is prohibited.

This document is intended to provide information only and does not form a contract with third parties.

Lochinvar Limited pursues a policy of constant improvement and development of its products and therefore reserves the right to change the specifications and the documentation at any time, without notice and without obligation to update existing equipment.

1.2 AIM AND CONTENT OF THE MANUAL

These instructions are intended to provide the information required for the selection, installation, use and maintenance of the collector.

They have been prepared in accordance with the European Union laws and with the technical standards in force at the date of issue of the instructions.

1.3 HOW TO STORE THE MANUAL

The manual must be kept in a suitable place with easy access for users and operators, protected from dust and damp.

The manual must always accompany the unit during the entire life cycle of the same and therefore must be transferred to any subsequent user.

1.4 MANUAL UPDATES

It is recommended that the manual is updated to the latest revision available.

If updates are sent to the customer, they must be added to this manual.

The latest information regarding the use of its products is available by contacting Lochinvar Limited.

2 GENERAL DESCRIPTION OF SYMBOLS USED

Symbols used within this document

PROHIBITED (YOU MUST NOT)

A black symbol inside a red circle with a red diagonal indicates an action that should not be performed

WARNING

A black symbol added to a yellow triangle with black edges indicates a hazard or danger

ACTION REQUIRED

A white symbol inserted in a blue circle indicates an action that must be taken to avoid risk

READ AND UNDERSTAND THE INSTRUCTIONS

Read and fully understand all instructions before attempting to operate maintain or install the unit.

ELECTRICAL HAZARD

Observe all signs placed next to the pictogram. the symbol indicates components of the unit and actions described in this manual that could create an electrical hazard.

HOT SURFACES

The symbol indicates those components with a high surface temperature that could create a risk.

This symbol shows essential information which is not safety related

Recover or recycle material

3 HOW TO USE THIS MANUAL

The manual is an integral part of the unit.
Users or operators must consult the manual before performing any operation and especially so when transporting, handling, installing, maintaining, or dismantling the unit in order to eliminate uncertainty and reduce risk.
In these instructions symbols have been used (described in the following paragraphs) to draw the attention of operators and users to the operations that have a higher risk and which must be performed safely.

3.1 POTENTIAL RISKS

Whilst the manual has been designed to minimise any risk posed to the safety of people working with the equipment, it has not been technically possible to eliminate all risk. **Please ensure suitable PPE is worn** whilst working on the equipment, taking note of all safety precautions within the document.

This equipment is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the equipment by a person responsible for their safety. Children should be supervised to ensure that they do not play with the equipment.

3.2 LIMITATIONS AND PROHIBITED USE

The collector is designed and built exclusively for the uses described in “Limitations of use” of the technical manual. Any other use is prohibited because it may pose a potential risk to the health of operators and users.

The collector is not suitable for use in environments with:

- **Excessively dusty or potentially explosive atmospheres**
- **Where there are aggressive atmospheres**

See section 8 regarding location

3.3 UNIT IDENTIFICATION

Each collector has an identification plate that provides key information regarding the collector. The key information includes

- Serial number
- The correct top and bottom position of the collector
- Collector weight
- Maximum stagnation temperature

The product label must never be removed from the unit

4 SAFETY

CAUTION BURN HAZARD

When handling the collectors remember that they have been designed to convert light into heat and accordingly parts of them will get very hot if left out in the sun even for a short period of time.

When working at heights always assess the risks before you start work.

Always assess the risks before you start work.

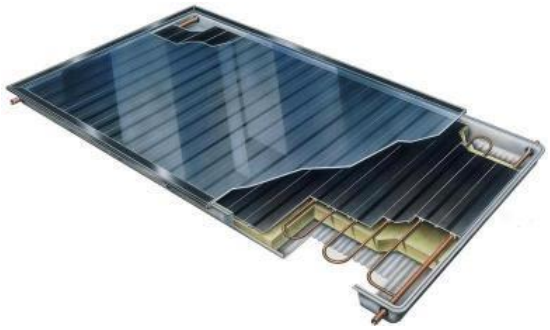
Take care when carrying the collectors to a roof. Carrying and manipulating heavy weights and large frames onto a roof are difficult and can cause you to slip. Do not lift beyond your safe carrying capacity and remove trip hazards.

5 TECHNICAL CHARACTERISTICS LSP20+

5.1 COLLECTOR DESCRIPTION

The Lochinvar LSP20+ flat plate solar collector is a vertically mounted glazed collector. The collector has an integrated connection system enabling pressure sealed linkage with adjacent collectors.

The LSP20+ is constructed with a single meander system piping that is folded into the absorber plate creating a better thermal contact than found when soldering or welding to the absorber plate. The only soldered connection is when the meandering pipe connects onto the flow and return manifolds at each end of the collector. The glazing is held in place with a single piece aluminium folded tray that houses the absorber and pipe work; this in turn is insulated on the back to reduce heat loss from the collector.



5.2 TECHNICAL DATA TABLE

Efficiency η_o (Aperture)	%	81
a_{1a} with wind, in relation to aperture	W/(m²K)	3.63
a_{2a} with wind, in relation to aperture	W/(m²K²)	0.011
Grid dimensions (length x width x depth)	mm	2008 x 1008 x 75
Gross surface area	m²	2.03
Aperture area	m²	1.79
Collector contents	litres	1.6
Weight	kg	36
Max. working pressure	bar	6
Max. stagnation temperature	°C	196
Min / max inclination	°	15/90 *
Recommended flow of heat transfer fluid		1ltr/min per collector
Maximum number of collectors per bank		10
Maximum number of banks		No limit
Glass material		4mm Safety solar glass
Collector material		Copper, Al alloys, brass, glass and mineral wool
Test and approvals		EN 12975, Solar Keymark ISO 9001
RHI ready		Yes

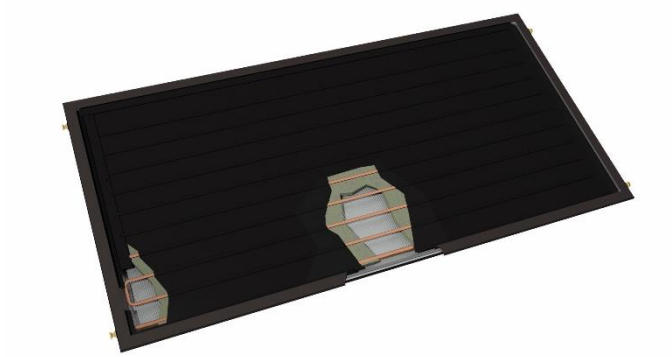
*Minimum angle on In-Roof kits is 27^0

6 TECHNICAL CHARACTERISTICS LSP20+H

6.1 COLLECTOR DESCRIPTION

For installations whereby the height of a vertical collector (LSP20+) may cause a visual impact, the collector is also available in a horizontal position (LSP20+H), thus greatly reducing its height. The installation of this collector is the same as the LSP20+ vertical collector with the main difference being the hydraulic connections are located on the short edge of the collector. The maximum number of collectors in a bank is also reduced down from 10 for the LSP20+ to 5 on the LSP20+H.

The LSP20+H is constructed with a single meander system piping that is folded into the absorber plate creating a better thermal contact than found when soldering or welding to the absorber plate. The only soldered connection is when the meandering pipe connects onto the flow and return manifolds at each end of the collector. The glazing is held in place with a single piece aluminium folded tray that houses the absorber and pipe work; this in turn is insulated on the back to reduce heat loss from the collector.



6.2 TECHNICAL DATA TABLE

Efficiency η_o (Aperture)	%	81
a_{1a} with wind, in relation to aperture	W/(m²K)	3.73
a_{2a} with wind, in relation to aperture	W/(m²K²)	0.014
Grid dimensions (length x width x depth)	mm	1008 x 2008 x 75
Gross surface area	m²	2.03
Aperture area	m²	1.78
Collector contents	litres	1.6
Weight	kg	36
Max. working pressure	bar	6
Max. stagnation temperature	°C	189
Min / max inclination	°	15/90 *
Recommended flow of heat transfer fluid		1ltr/min per collector
Maximum number of collectors per bank		5
Maximum number of banks		No limit
Glass material		4mm Safety solar glass
Collector material		Copper, Al alloys, brass, glass and mineral wool
Test and approvals		EN 12975, Solar Keymark ISO 9001
RHI ready		Yes

*Minimum angle on In-Roof kits is 27°

7 WORKING WITH THE COLLECTORS

7.1 STORING THE COLLECTORS

To prevent damage to the collectors during storage, the collector must be kept on the pallet or stored vertically against a wall until they are ready to be installed. The collector must not be stored on the side which has the hydraulic connections (long side for the LSP20+ and short side for the LSP20+H), as this may cause damage to the hydraulic connections. The collectors must also be covered to prevent them from absorbing light thus generating heat until they are ready to be commissioned.

If storing the collectors on a roof, ensure they are sufficiently secure to prevent them falling from the roof during high winds. Do not store collectors on a fragile roof.

Collectors must be covered until they are commissioned – this will prevent the collectors from absorbing light and generating heat – failure to do this may result in damage to the collectors which would not be covered under warranty.

7.2 UNPACKING COLLECTORS

Unpack the collectors carefully to prevent damage to the hydraulic connections or the special glazing on the collector.

The packaging is designed to be recyclable. Dispose of all packaging in an environmentally friendly way by taking it to a recycling centre.

7.3 MOVING THE COLLECTORS

Take care when carrying the collectors; make sure that all necessary supports and harnesses are available to help with this job. The collectors should be transported carefully to prevent damage to the hydraulic connections – do not carry or support the collector by these connections.

CAUTION BURN HAZARD

The absorber plate, hydraulic connections and any connected pipe work may become very hot when exposed to sunlight (even on dull days). Exercise extreme caution when working on or near the collectors.

Do not attempt to carry the collectors in windy conditions as the collectors may catch the wind and cause injury to the person carrying the collector.

8 INSTALLING THE COLLECTORS

8.1 LOCATING THE COLLECTOR

Positioning the collector is important for optimum performance. Ideally the collectors should be mounted –

- **South Facing** when installed in the northern hemisphere
- Between angles of 30º to 60º - lower angles will perform better in the summer and a steeper angle will perform better in the winter. An angle of 45º will give a good middle position to cover all the seasons within the year.

If a south facing position isn't available then good results can still be achieved by positioning the collectors facing anywhere in an arc south west to south east.

Good results can also be achieved by installing on an east/west split. This is when half the collectors face east and half the collectors face west, this way you will receive energy onto the collectors as the sun rises in the east and then energy will slowly move over to the west facing collectors as it sets. You may need to increase the number of collectors as half the collectors may not be receiving any energy at any one time.

On an east west split you may need to increase the number of collectors by 30%. Splitting the array becomes more expensive and creates a more complex system. West facing roofs perform better than east – if possible fit as many onto the west facing roof as possible.

Do not install the collectors facing north as performance will be greatly reduced.

When positioning the collectors ensure they are fully clear from any products of combustion from nearby flue terminals. Any flue products should clear the top of the collectors by 2 meters. If flue products are allowed to condense against the collectors the corrosive action of the flue products may damage the collectors and void and manufacturer or installers warranties.

Avoid positioning the collectors in areas of shade such caused by buildings or trees. If surveying an area during the winter consider that deciduous trees will have no leaves, during the spring/summer they may cast shadows when the leaves grow back.

The collectors have a top and bottom indicated by labels on the side of the collector. It is important that the collectors are fitted in the correct orientation. The yellow sticker indicates the top of the collector and the red sticker the bottom.

Top of collector


Bottom of collector

9 ROOF TYPES

The fixing method will be dependent on your roof type. There are generally three roof types for which different fixing kits are available. See separate roof fixing manual, available from www.lochinvar.ltd.uk

9.1 FLAT ROOF

Flat roofs can be made of many different materials such as concrete or metal, generally collectors installed on flat roofs will use an A frame to ensure the collectors sit at the correct angle, A-Frames are available in 3 angles 30º , 45º or 60º .

9.2 SLOPING

This could be slate, tile or metal, there are in addition specialist roof coverings, which are generally not suited to installing solar thermal. For sloping roofs first determine the roof finish such as tile, slate or metal and then select the correct roof fixing kit.

9.3 IN-ROOF

It is possible to install the LSP20+ and LSP20+H flat plate solar collector directly into the roof, this give a flush finish to the roof.

10 ROOF FIXINGS

10.1 FLAT ROOF

When installing on a flat roof the collectors are mounted on an A-Frame.

The angle of the A-Frame is fixed and is available in 3 set angles - 30º, 45º or 60º. Please make sure you have ordered the correct frame before installing the collectors.

The A-Frame needs to be attached to the flat roof and there are 2 options for achieving this:

Fixing Points

The **preferred** fixing method is for the roof structure to have suitable fixing points or steels installed which allow the A frames to be bolted down to the roof structure.

The fixing points are then used to mount channels of unistrut that the A-Frame can be attached.

Ballast

If suitable fixing points have not been included within the roof structure or the roof type doesn't allow such fixings then the A –Frame will need to be secured down using ballast. When this method is used then an additional H-Frame is required. The H-Frame should be designed for sitting on a flat roof, it should be fitted with support feet to spread the load of the solar collector(s), the H-Frame will require a channel to insert the required ballast to hold down the frame. When in position the A-Frame is simply secured to the H-Frame.

Lochinvar do not provide ballast calculations, the amount of ballast required is subject to site conditions and will be influenced by location, height, type of collector used amongst other considerations. Due to each project location being unique each project should have the ballast requirements calculated by a suitable qualified person such as a structural engineer. Support frame suppliers may also provide this service.

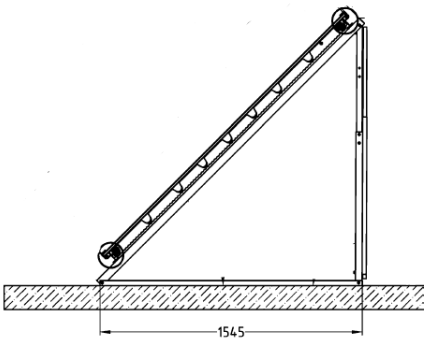
Images showing A-Frame supported by H-Frame and A-Frame supported by roof fixings and unistrut

In areas where there may be heavy snow fall please ensure the bottom of the collectors are at least 150mm above ground level.

Lochinvar do not provide the H-FRAME, this will need to be sourced independently. Please make sure you have sufficient distance between the front and rear legs to attach A-Frame to the H-Frame. Refer to 10.2

10.2 A-FRAME DIMENSION

The dimension of the A-Frame base is 1545mm on all 3 available A-Frame's covering angles 30º, 45º or 60º.



See separate roof fixing manual for further details fitting the A-Frame.

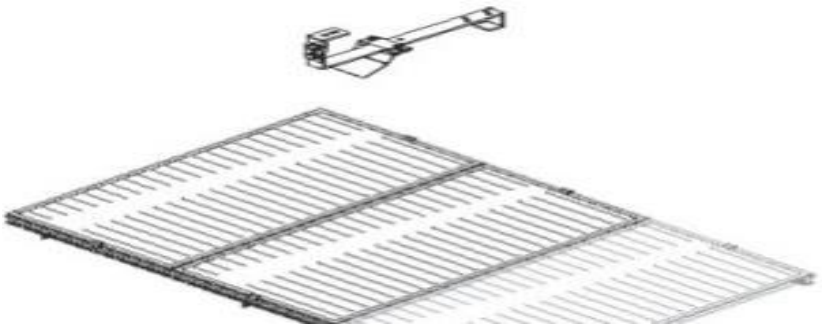
10.3 SLOPING ROOF

Depending on the roof finish this will determine the correct roof fixing. **Please refer to the separate roof fixing manual for fitting instructions**. The following roof fixings are available

The collectors must not be fitted at an angle of less than 15º, failure to meet the minimum angle may cause damage to the collectors which would not be covered under the collector warranty

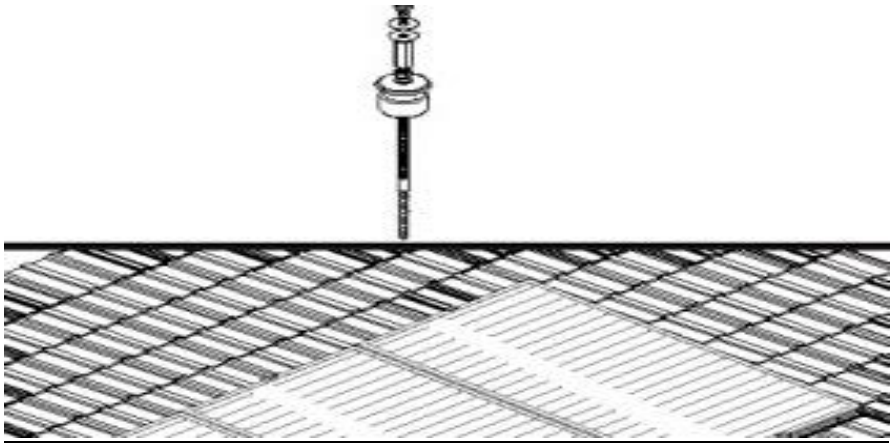
The collectors must be positioned at a minimum angle of 15º. If the roof pitch doesn't meet this angle then up- stands must be fitted to the relevant fixing kits to achieve the minimum angle.
See separate roof fixing manual for further detail. NOTE THE MINIMUM PANEL ANGLE FOR IN-ROOF KITS IS 27º.

ON ROOF TILE KIT



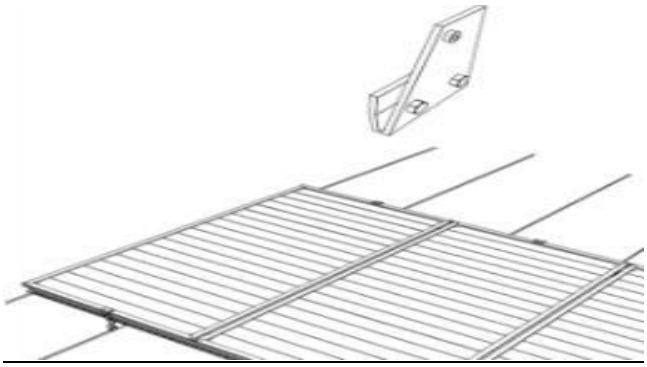
This allows fixing to a pitched tile roof – the fixing kit has hooks that fit onto the rafters and the frame will then mount to this.

ON ROOF SLATE KIT



This allows fixing to a pitched slate roof – the fixing kit has self-sealing screws that fix directly through the slate tiles thus securing the frame to the roof.

ON ROOF METAL KIT



This allows fixing to a standing seam metal roof – the fixing kit has clamps that secure onto the standing seam of the roof, the frame then fixes to these clamps.

Before fixing to a standing seam the roofing contractor/manufacturer must be consulted to ensure the clamps will not cause contact corrosion or affect the roof warranty

IN ROOF KIT

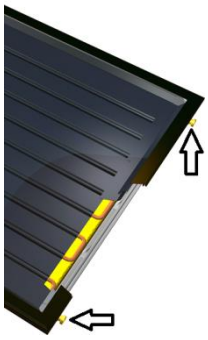
This allows installation of the collectors to be flush with the roof, the in-roof kit is available for both slate and tiled roof finishes.

IN ROOF KIT (note minimum collector angle of 27º required)

11 CONNECTING THE COLLECTORS

Collectors must be covered until they are commissioned – this will prevent the collectors from absorbing light and generating heat – failure to do this may result in damage to the collectors and this would not be covered by the manufacturer warranty.

The following fitting details apply to both the LSP20+ (vertical collector) and LSP20+H (horizontal collector); however the images shown are for the LSP20+ (vertical collector). Note that on the LSP20+H (horizontal collector) the connections are on the short edge of the collector – see below image.



LSP20+H Side Connections

11.1 ARRAYS AND BANKS

The complete installation of the solar collectors is called the solar array, the solar array may comprise separate groups of collectors, and these groups of collectors are called collector banks. There are two separate kits for hydraulically connecting the collectors; the installation kit is used for connecting the bank to the system and the extension kit is used for connecting each individual collector together in the bank.

The flow must be balanced to each bank, the flow may also vary to each individual bank depending on the number of collectors fitted, and as such flow setters may need to be fitted as to regulate the individual flow rates.

The maximum number of LSP20+ collectors in a single bank is 10. The maximum number of LSP20+H collectors in a single bank is 5.

11.2 EXTENSION KIT

The extension kit connects each collector in the bank together; this must be done first before fitting the Installation kit. The collectors join together using clamps and O-Rings as per the following instructions.

Extension Clamps

11.3 FITTING EXTENSION KIT

1) Apply a smear of silicone to the socket end of the connector located on the collector and then insert the O-Ring into this socket.

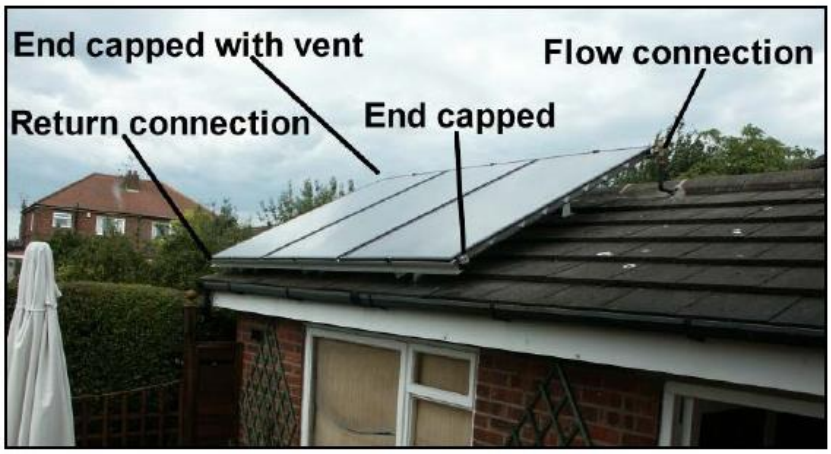
2) Pull up the collectors together so that the connections are exactly opposite each other.

3) Secure the clamps over the collector connectors and apply a smear of silicon to the bolt threads. Tighten the bolts using the supplied Allen key.

11.4 INSTALLATION KIT

The installation kit connects the system flow and return to each individual bank. The installation kit is fitted to the two end collectors of a bank, as shown below. NOTE LSP20+H have the connections on the short side of the collector – component position remains the same.

Installation Kit Components



Installation kit components along with location on the collector bank

Note LSP20+H will have connection on the short side of the collector

11.5 FITTING THE INSTALLATION KIT

1) On the flow connection attach the brass T-Piece with air vent using clamps and O-Ring as in the extension kit.

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

3) Fit the brass M cap with screw air vent to the top connection opposite the flow connection using the clamps and O-Ring as before.

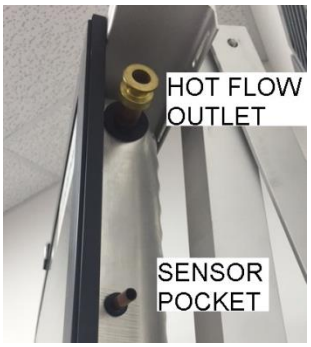
4) Fit the brass blank W cap to the remaining bottom connection using the clamps and O-Ring as before.

11.6 FITTING THE COLLECTOR SENSOR

The collector sensor should be fitted to the end collector on the array, this should be on the hot flow side of the array, if there are multiple banks then it should be fitted to the end collector of the array likely to receive the greatest solar energy.

If the collectors have been installed on an east/west split or a similar type of split arrangement then 2 sensors should be fitted, one to the end collector in each relevant array. If using 2 sensors then please ensure a suitable solar controller is used that accommodates multiple sensors. The Lochinvar solar controller allows for multiple sensors and the use of split systems.

The pocket for the sensor is located on the right hand side of the collector near the top – see below image



It is advisable to apply heat transfer paste to the sensor before inserting into the sensor pocket – this will ensure good thermal conductivity.

The sensor cable provided with the Lochinvar solar controller is around one meter long; this will need to be extended to reach the solar controller in the plant room. To extend the cable then a 2 core shielded cable (0.75mm²) should be used.

It is advisable to use a 4 core cable, this way if any issues occur with one of the cores supplying the sensor it will be easy to change onto one of the spare cores.

11.7 FINAL CHECKS

- Ensure that no more than 10 collectors are connected in any single bank
- Make sure the relevant roof fixing kit is correct, if using A-Frame ballast ensure correct ballast has been used.

Make sure the wind clamps have been fitted to the collectors and fixing frames – see below image of wind clamp. Failure to correctly fit the wind clamps may result in the collectors lifting in heavy wind.

Wind Clamp

- Make sure the installation kit is fitted correctly – the inlet is always on the bottom left side of the bank and the outlet is on the top right side.
- The solar sensor is installed in the pocket below the top right hand connection – only a single sensor is required for the complete array, unless a split system is being used such as an east/west split.

Collectors must be covered until they are commissioned, this will prevent the collectors from absorbing light and generating heat, failure to do this may result in damage to the collectors and would not be covered by the manufacturer warranty.

12 PIPE WORK

12.1 PIPE SIZING

When selecting the correct pipe work size it is important to have the following information;

- Required flow rate of the heat medium (Glycol)
- Balancing the flow
- Head available from the pump
- Total pipe work distance – including number and type of fittings

12.2 FLOW RATE

The flow rate when using the LSP20+ collector is calculated as follows –

For optimum performance of the collector we recommend a flow rate of 1ltrs/minute per collector when the pump speed is at 100%. The solar controller will modulate the pump speed down as the temperature difference between the collectors and the storage vessel becomes less.

Example Setting;

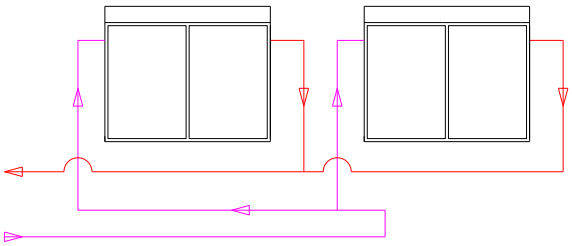
10 collectors = 10 ltrs/minute flow rate when the pump is at 100% speed setting.

12.3 BALANCING THE FLOW

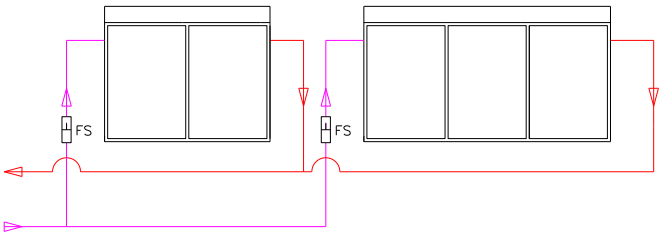
When installing the collector banks it is important to have the correct flow going to each bank see section 12.2. Banks may have a different amount of collectors per bank meaning different flow rates to each bank. To correctly balance the flow then it is recommended to fit solar approved flow setters on the flow side of the pipework feeding each bank.

To set the flow open all of the flow setters fully and set the main flow using the flow setter on the pump station see section 18.4. When the combined flow has been set next adjust the flow to each bank by adjusting the individual flow setters.

On systems with equal collectors in the banks, it is possible to balance the flow to the individual banks by balancing the pipework on a reverse flow or return (tichelmann principle). The flow rate would then be set as per section 18.4.



EQUAL PANELS IN BANKS, BANKS BALANCED USING TICHELMANN PRINCIPLE



UNEQUAL PANELS IN BANKS, FLOW SETTERS USED TO BALANCE BANKS

12.4 PIPE WORK DISTANCE

Measure the total distance of the pipe work in your solar loop, count the number of elbows and other fittings that will be installed on the loop. You will need this information to calculate your pipe work pressure drop.

12.5 PUMP HEAD

This is the head available following the pressure drop across the solar array and the coil or plate heat exchanger feeding the pre-heat vessel. The pressure drop from your collectors and pre-heat vessel will be available from the supplier. When you know the system head loss, excluding the pipe work, look at the pump curve at the required flow rate and this will give you the head available from the pump. Now deduct the system head loss and this will show you what you have available for your pipe work/fittings. Pressure drops for pipe lengths/fittings can be found in documents such as the institute of plumbing design guide – select a pipe size and calculate the pressure drop per metre, make sure that this combined pressure drop can be met by the available head from the pump.

If using a Lochinvar solar package and assuming the total pipe work length is no more than 100 metres (50 metres each way) then the following can be used as a guideline.

Number of LSP20+ Collectors	Pipe size
Up to 4	15mm
Up to 12	22mm
Up to 15	28mm

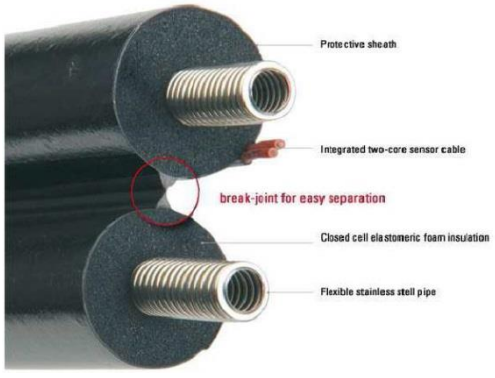
TABLE INDICATING TYPICAL **SMOOTH COPPER PIPE WORK** SIZE DEPENDENT ON COLLECTOR QUANTITY

Solar approved automatic air-vents should be used on all high sections of pipe work to prevent air-locks when filling the system. The automatic air-vents should be isolated by using a check valve fitted beneath the air vent when the system has been filled - if the vent is left open it can result in a loss of fluid as vapour when the system goes into stagnation.

12.6 PIPE MATERIALS

Only the following types of pipe are permitted on solar thermal installations

- Copper
- Stainless steel
- Mild steel
- continuous flexible stainless pipe, this is a corrugated type of pipe and is useful on small systems using short runs – this type of pipe work comes pre-insulated and has a 2 core cable running its entire length that can be used for connecting the solar collector sensor.



Flexible stainless steel pipe

Due to the high pressure drop of this type of pipe work, do not use on systems with large pipe work runs or high flow rates.

12.7 PIPE JOINTING METHODS

Due to potential high stagnation temperatures and the chemical properties of glycol, only the following pipe jointing methods are permitted

- Brazed
- Solar Press Fit (press fit with solar rated EPDM O-Rings)
- Compression

If using jointing compounds please ensure these are solar rated.

The following jointing methods must not be used

- Solder
- PEX
- Plastic
- PEX-ALU-PEX
- Galvanised pipe or fittings

12.8 EXPANSION VESSEL SIZING

Every solar thermal system will have a solar expansion vessel included within the equipment supplied. This has been based on an average system and as such as part of the installation/commissioning procedure the size must be checked to ensure the vessel is large enough and if required swapped for a larger vessel.

Failure to check and install a correctly sized expansion vessel will lead to overheating problems and premature component failure that will not be covered under the manufactures warranty

In order to accurately size a solar expansion vessel we need to use the following formulae:

$$V_N=((V_e + V_v + V_d) \times (P_{max}+1)) /(P_{max}-P_{prec})$$

Where

- V_N =nominal expansion vessel volume
- V_e =expansion volume of the solar fluid (expansion coefficient (0.09) x system volume)
- V_v =amount of fluid in the expansion vessel in litres (0.02 x system volume) **minimum must be 3 litres**
- V_d=volume of steam in litres (1.1 x system volume)
- P_{max}= maximum working pressure of the system in bar
- P_{prec}= pre-charge pressure of the expansion vessel

EXAMPLE SIZING

Solar collector volume=60 litres
Solar pipework and other components = 105 litres
Glycol 42%
Maximum working temperature of the system 130°C
Safety valve setting 6 bar
Minimum working pressure 0.7 bar
Static head on the system 20metre

- V_e = 0.09 x 105 +60 =14.85
- V_v = 0.02 x 105 + 60 =3.3 litres(**minimum must be 3 litres)**
- V_d= 1.1 x 25 + 60 =93.4
- P_{max}= 0.9 x 6 =5.4bar
- P_{prec} =2 + 0.7 =2.7 bar

$$V_N=((14.85 + 3.3 + 93.5) \times (5.4+1)) /(5.4-2.7)=$$
$$V_N= \quad 111.65 \quad \times \quad (6.4 / 2.7) =$$
$$V_N= \quad 111.65 \quad \times \quad 2.37 =$$
$$V_N= 264.6 \text{ litres}$$

The nearest equivalent or larger sized commercially available vessel should be chosen

The sizing of the solar expansion vessel is for guidance only, sizing should be checked and verified by a competent engineer

12.9 PIPE INSULATION

Pipe insulation in a solar thermal installation is very important; the heat energy gained by the collectors needs to be transferred to the vessel with minimum heat losses. When selecting insulation for the solar pipe work the following needs to be considered;

- Sufficient insulation thickness (see table)
- No gaps – ensure fittings, vessels and connections are also insulated)
- Insulation type is suitable – external pipe work should be UV protected, be suitable for all weather conditions and have a level of protection from birds and animals.
- The insulation should be suitable for high temperature use

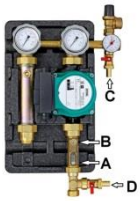
PIPE SIZE mm	INSULATION THICKNESS mm
Up to 22	22
Up to 42	32
>42	Equal to the nominal width of the pipe

TABLE SHOWING MINIMUM INSULATION THICKNESS

Do not insulate the section of pipe work between the solar expansion vessel and the system, this will allow heat to be dissipated from the glycol whilst expanding into the expansion vessel; this will increase the life expectancy of the expansion vessel.

13 SYSTEM COMPONENTS

In order for a solar thermal system to operate correctly and efficiently, certain key components are required. Component type and quantity will vary on each individual system design; however the following components are commonly used;

Solar controller	
Pump station	
Alarm module	
Flow sensor	
Solar expansion vessel	
Heat meter	
Collection vessel	
Heat transfer fluid	
Storage vessel - this may be a single or twin coil indirect vessel or a thermal store	

13.1 SOLAR CONTROLLER

The solar controller is the brains of the system, monitoring temperatures and system problems. The controller runs the solar pump station along with various other system components.

13.2 SOLAR PUMP STATION

A solar pump station transports the solar fluid (Glycol) through the solar system. The solar controller powers the pump station depending on the settings made within the controller.

13.3 ALARM MODULE

The AM1 alarm module connects directly to the solar controller. The alarm module has a volt free contact that will close in the event of a system fault. The module also flashes red – **NOTE under normal operation the module is illuminated red and only flashes red on fault.**

13.4 FLOW SENSOR

The solar controller uses the flow sensor to monitor the flow of glycol within the solar circuit. In the event of a no-flow situation, for example a pump failure, the controller will display a fault and close the contact on the AM1 module.

13.5 SOLAR EXPANSION VESSEL

An expansion vessel absorbs the expansion volume of the solar fluid within the solar system as it heats keeping the system at a semi constant pressure. These expansion vessels are factory set with a cushion pressure of 3bar (this pressure can be adjusted) and are available in five different sizes (24, 35, 50, 80 and 100 litres). **See section 12.8 expansion vessel sizing.**

13.6 HEAT METER

In order to claim the Renewable Heat Incentive (RHI) for eligible installations, a suitable heat meter is required. The HM1.5 is an MID Class 2 RHI compliant heat meter suitable for solar thermal systems.
The heat meter is mains powered and comes complete with a volt free contact, which closes each time the system generates 1 kWh of energy. The heat meter also has a MBUS connection.
The heat meter is calibrated on supply depending on the Glycol type used. The meter measures the temperature difference across the flow and return pipe work, along with the flow rate within the system. With this information, the heat meter calculates the energy transferred to the water and displays this in kWh.

13.7 COLLECTION VESSEL

If an over pressure situation occurs, such as a failure of the expansion vessel the pump station has a 6 bar pressure relief valve that will discharge the excess pressure. Rather than discharging Glycol onto the plant room floor or down a drain point, we collect the discharged glycol in a container for re-use. The container should be large enough to hold the full contents of the solar thermal collectors.

13.8 HEAT TRANSFER FLUID (GLYCOL)

Glycol is the solar fluid that circulates around the solar thermal system and transfers heat energy from the collectors to the storage vessel. This Glycol is a 40% mixed solution, is corrosion inhibited and has an anti-frost agent. Lochinvar uses the following glycol;

- **HGLHTF** - High Grade Lochinvar Heat Transfer Fluid – **THESOL** – 20ltr tubs

TECHNICAL SHEET

Date of issue: 17. 02. 2011
No of Page: 5

1. SUBSTANCE/PREPARATION AND COMPANY NAME :

1.1. Product name: Thesol
1.2. Use: Antifreeze/anticorossion fluid with low freezing point for clasic and vacuum solar systems with extended lifetime.
1.3. Producer : Thermo|Solar, s.r.o. Ziar nad Hronom

2. WORKING CONDITIONS :

Unfreezing temperature	-32°C
Working temperature	-32°C/+230°C (max. 2,5MPa)
Short term overheat temperature	300°C

3. LIFETIME :

Expected life time is 10 years in case of regularly revised systems. Recommended service of ZVA parameter and unfreezing point is every 2 years.

4. PHYSICAL AND CHEMICAL PROPERTIES:

4.1. General information

Appearance:	softly viscid
Colour:	green

4.2. Technical information

pH mixed with 33% distilled wate:	7,2 – 9,0
Boiling point:	105°C
Density at 20°C:	> 1 035 kg/m^3
Index of refraction by 20°C:	1,387 – 1,390

4.3. Corroding process

Material	ASTM D 3306 [mg/vz.]		TL 774 C [g/m2]	
	Achieved value	Desired value	Achieved value	Desired value
copper	<2	≤ 10	<0.7	≤ 4
soldering metal	<2	≤ 30	<0,7	≤ 4
brass	<1	≤ 10	<0.3	≤ 4
steel	<0,2	≤ 10	<0.1	≤ 4
iron	<0,2	≤ 10	<0,1	≤ 4

Technical data sheet for Lochinvar Heat Transfer Fluid - THESOL

To maintain the warranty on the collectors it is important that any future glycol replacement uses THESOL glycol (available from Lochinvar limited).

14 STORAGE VESSEL

The energy collected by the solar collectors is used to heat the cold water supply that feeds your primary heat source, such as a direct fired water heater. Sizing the storage vessel correctly is important to ensure that the solar thermal system operates efficiently for as long as possible to take advantage of the almost free limitless energy. Storage vessels are sized on both the storage volume and coil size.

14.1 STORAGE VOLUME

The vessel should be sufficiently sized to store the energy from the collectors, it is recommended to have 100ltrs of storage for every flat plat collector. For sites such as a hotel when the main peak demand may be in the evening, it is recommended to have even higher storage so as to capture as much free energy during the day as possible. Sites with higher demand throughout the day may have smaller storage as the pre-heat may never reach set point anyway.

Number of collectors	Storage for High Demand System (litres)	Storage for Low Demand System (litres)
1	50	100
5	250	500
10	500	1000

TABLE SHOWING TYPICAL MINIMUM AND MAXIMUM STORAGE VESSELS DEPENDENT ON SYSTEM DEMAND

14.2 COIL SIZE – SINGLE COIL VESSEL

In order for the system to operate efficiently and without problems we suggest to have **0.2m²** of coil surface area for every **m²** of collector absorber area. Each flat plate collector has an absorber area of 1.79m², so multiply this by the number of collectors and multiply this figure with 0.2 to find out the minimum recommended coil surface area.

Example calculation (5 LSP20+ Flat plate collectors on a Low demand system) – see above

- LSP20+ Absorber area 1.79m²
- Recommended minimum coil surface area for 5 x LSP20+ = 5 x 1.79 = total absorber area **8.95m²**
  0.2 x 8.95 = 1.79 = minimum coil surface area of **1.79m²**
- Minimum storage vessel size required = 5 x 100 (see table above) =**500Litres**

Most standard hot water vessels will not have a coil large enough to operate correctly on a solar thermal system.

Do not use a vessel with an undersized coil; this will result in overheating of the solar thermal array, this could cause safety devices to operate and/or damage the glycol within the system.

14.3 TWIN COIL VESSELS

The lower coil is used to heat the cold feed on a twin coil vessel, the upper coil is heated by the primary heat source to provide the domestic hot water at the correct temperature. When selecting a twin coil vessel attention needs to be made to the upper and lower volumes fed by the coils – for example a 1000ltr twin coil will have typically 400ltrs available for your solar volume and 600ltrs available for your domestic hot water. The volume and coil sizes shown in sections 14.1 and 14.2 still need to be adhered to.

If the coil size on a single coil vessel for the required volume isn't adequate – it may be possible to use a twin coil vessel and connect the two coils in series, this way you may achieve a greater coil surface area.

14.4 THERMAL STORE

A thermal store is able to combine multiple heat sources for the generation of hot water. When used with a solar system it is typically only connected to the solar circuit. The thermal store comprises of a store of water that is heated by the solar collectors via an indirect coil, the water that is heated stays within the vessel as a thermal store. A large stainless steel domestic hot water coil is submerged within this thermal store and as cold water passes through this coil, heat energy is transferred indirectly from the thermal store to the cold water. Due to the fact the water inside the thermal store is separate from the domestic hot water there is a much lower legionella risk, thus a pasteurisation – (see section 17) may not be required. When connecting to the solar circuit sections 14.1 and 14.2 should still be adhered to, dependent on how many coils are being utilised by the solar circuit.

A risk assessment should be carried out on any installation to ascertain the individual legionella risk.

14.5 DIRECT VESSEL

Systems that have a large number of collectors may not have a suitable indirect vessel available due to the coil size. This may mean having multiple indirect vessels to increase the coil surface area available. An alternative is to use a direct vessel with a plate heat exchanger see schematic 15.3. The plate heat exchanger should be sized so its capacity matches that of the solar array in terms of power. The power of the array will vary depending on each installation, however if the following calculation is done this will assist in sizing the capacity of the plate.

The average solar radiation in the UK is 1000W/m² - the LSP20+ and LSP20+H have an absorber area of 1.79m² meaning the potential solar radiation hitting the absorber would be 1000W/m² x 1.79 = 1790W or 1.79kW. Due to the efficiency of the collector this will then be reduced – the efficiency of the LSP20+ and LSP20+H is at best 81% meaning the absorber could potentially receive 1790W x 0.81 = 1449W or we could say 1.5kW per collector.

Example – a 10 collector system would require a plate heat exchanger with a power capacity of –

10 (collectors) x 1.5kW (potential power of the collector) = **15kW (power of the plate heat exchanger)**.

Other considerations when sizing the plate heat exchanger would be;

- The flow rate on the primary side of the plate (the solar circuit side)
- Flow/Return temperatures on the primary side (the solar circuit side) of the plate, it's best to use poor performing temperatures when sizing the plate for example 50/30ºC
- The flow rate on the secondary side (this will normally be the same as the primary but would be supplied by the plate manufacturer)
- Flow/Return temperatures on the secondary side of the plate, it's best to use poor performing temperatures when sizing the plate for example 25/45ºC
- The medium used on the primary/secondary side, for example glycol on the primary and water on the secondary.
- Suitable pumps are selected for both the primary and secondary sides taking into account the flow rates and pressure drops.

Using the above information a suitable plate should then be able to be sized and selected from a plate manufacturer.

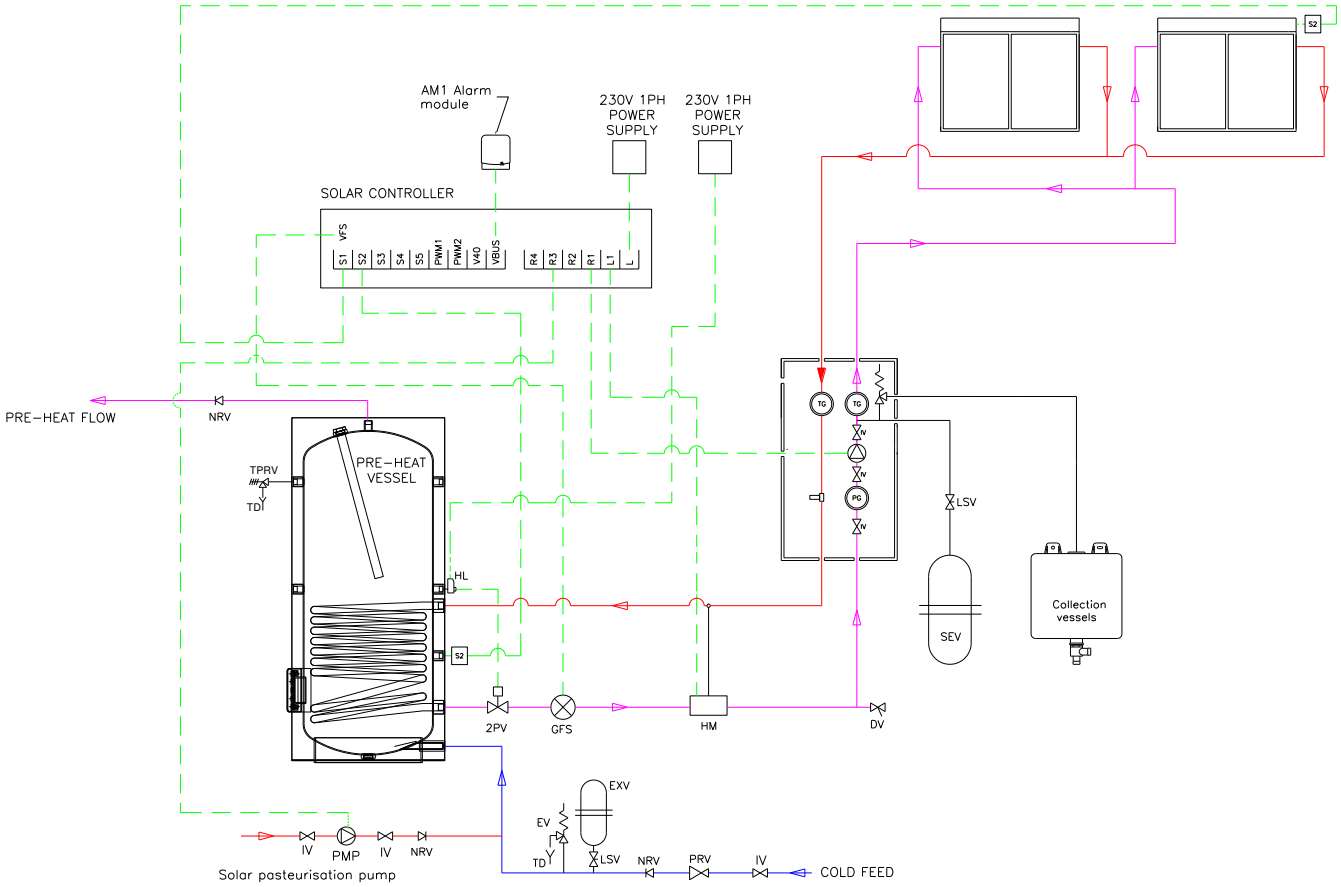
15 SCHEMATICS

Solar thermal systems tend to be bespoke in design; as such it is difficult to show schematics to cover every design. The schematics shown in sections 15.1, 15.2, 15.3, 15.4 are generic but typically all designs follow this principle.

Lochinvar limited may provide technical advice and guidance to assist with best practice, optimisation and installation of Lochinvar products; however, we will not be liable for any duties as designers under construction (design and management regulations 2015). In all cases where information is provided, the customer must assess and manage risks associated with the technical information and advice provided.

15.1 PRE-HEAT SYSTEM USING SINGLE COIL VESSEL

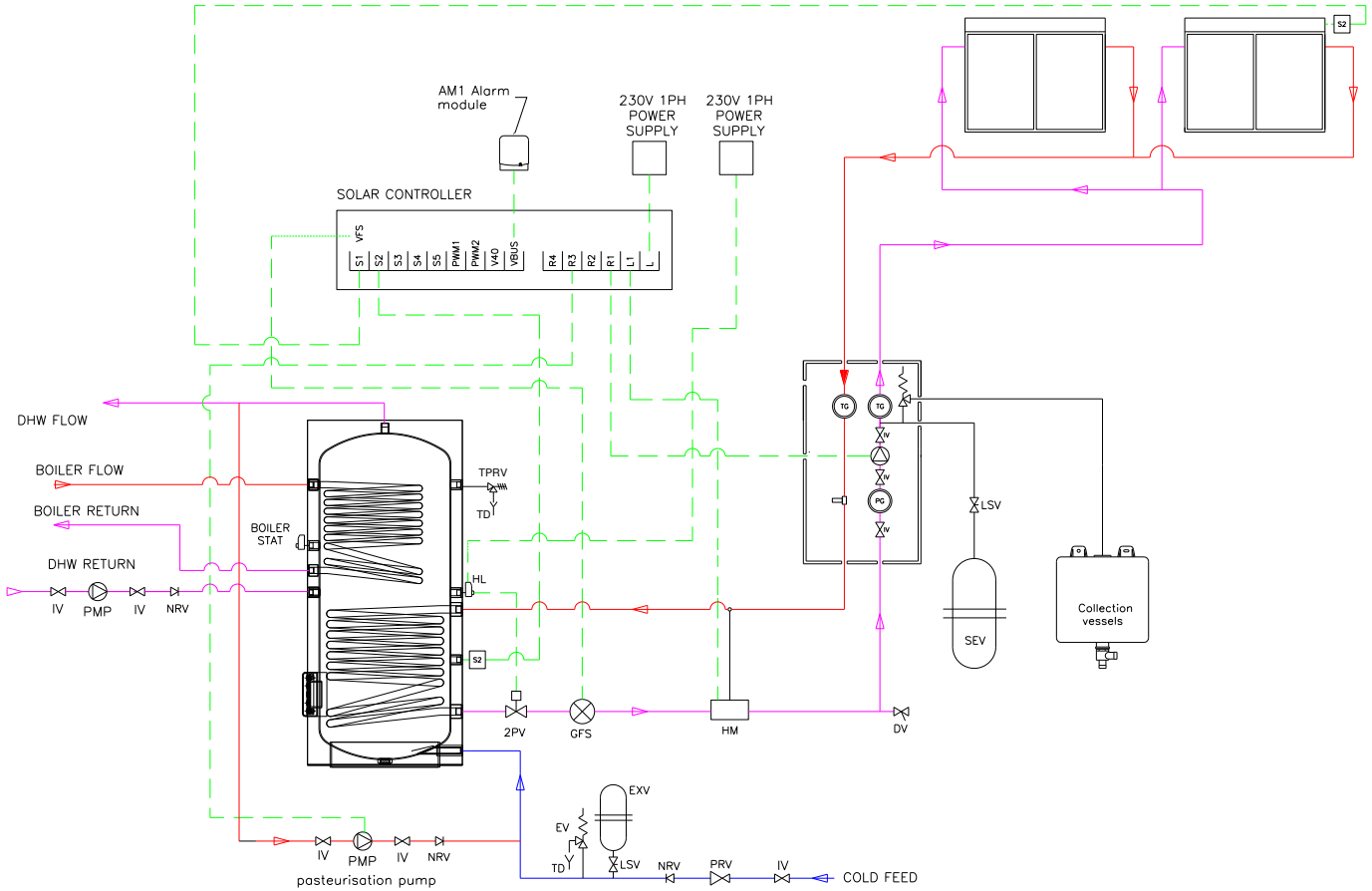
This is the most common type of solar pre-heat system. The solar collectors heat a pre-heat vessel which then feeds the primary water heater, such as a direct fired storage water heater. The vessel would be correctly sized in accordance with section 14. Due to the fact the pre-heat vessel may at times not fully reach 60ºC the vessel will need to be pasteurised as per section 17



SINGLE COIL PRE-HEAT SYSTEM

15.2 PRE-HEAT SYSTEM USING TWIN COIL VESSEL

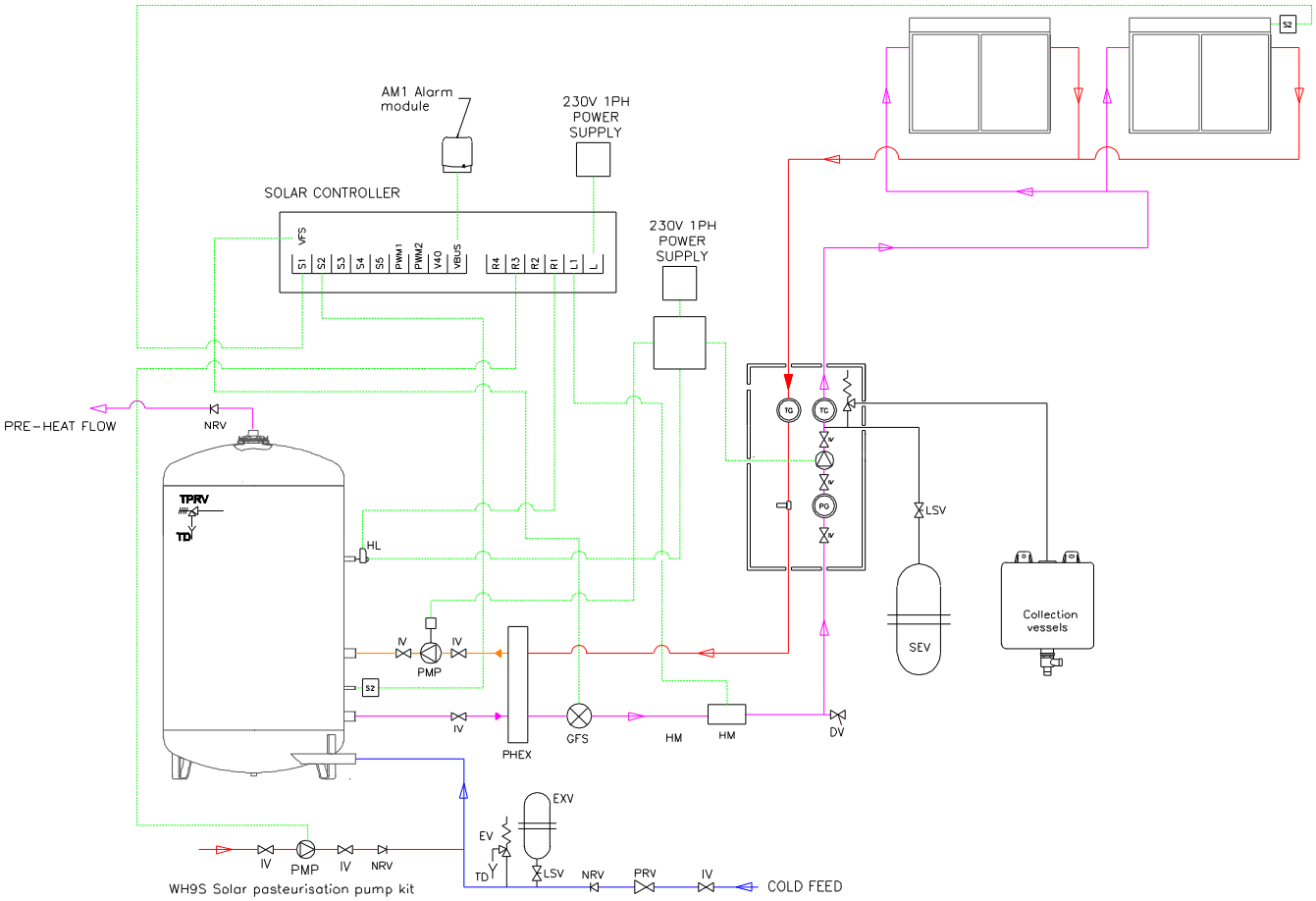
This section is similar to the single coil system; the difference being that instead of the pre-heat then feeding a separate water heater or indirect vessel, the upper coil is the primary heat source providing the DHW, the cold feed is simply pre-heated in the lower section of the vessel via the solar coil. The vessel should be sized in accordance to section 14. To pasteurise this type of vessel a pump should be fitted to the vessel to comply with section 17.



TWIN COIL PRE-HEAT SYSTEM

15.3 PRE-HEAT SYSTEM USING PLATE HEAT EXCHANGER

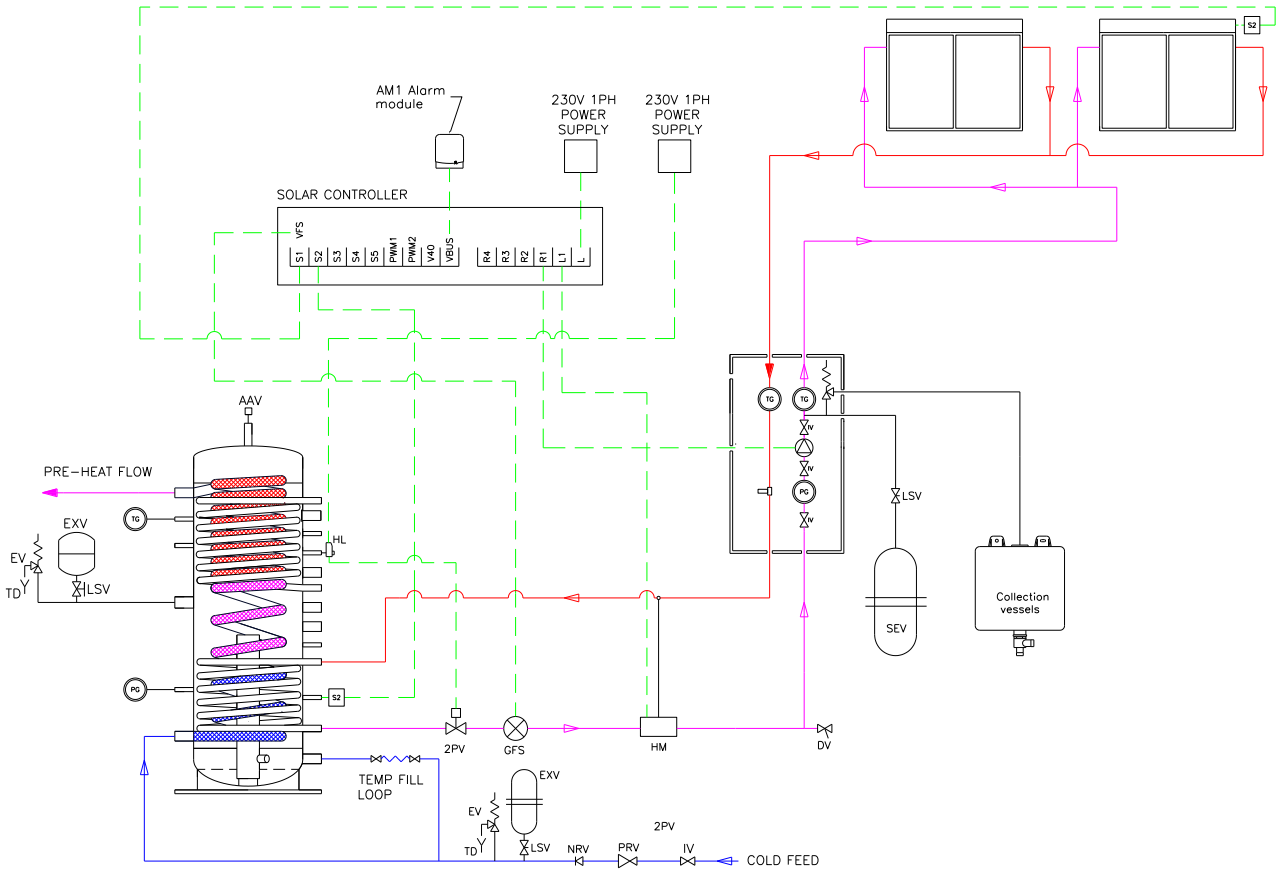
If a selected vessel doesn't have an adequate coil size as per section 14 then a plate heat exchanger should be sized and selected, this would then be connected to a direct storage vessel that would be heated via the plate. The pre-heat vessel will need to be pasteurised as per section 17.



PRE-HEAT SYSTEM USING A PLATE HEAT EXCHANGER

15.4 PRE-HEAT SYSTEM USING THERMAL STORE

A thermal store incorporates two internal coils and multiple connections. The main body of water within the HSV is heated via the indirect coil(s) and acts as the heat transfer to the high recovery stainless steel DHW coil which can be used to provide a pre-heated cold feed to a primary heat source. Due to the low volume of potable water within the DHW coil and when used under normal operating conditions the build up of legionella bacteria is greatly reduced, meaning that a pasteurisation regime is not usually required' however' a risk assessment should be made on each individual project to ascertain if such a regime is required. Details on sizing a thermal store can be found in section 14.4



PRE-HEAT SYSTEM USING THERMAL STORE

15.5 PRE-HEAT SYSTEM USING HYBRID WATER HEATERS

It is possible to install our flat plate solar collectors with our range of Hybrid water heaters – for further information on this please refer to our ICM instructions for the EcoCharger HWH or EcoCharger HWHC. www.lochinvar.ltd.uk

16 WIRING

16.1 SOLAR CONTROLLER (LPC)

The control of the system is provided by the solar controller; all other system components connect back to this unit. The controller has 4 individual relay outputs with a maximum 1A draw from each relay. These relays can be used to operate valves and pumps. There is also a permanent live output from the controller which can be used to power items such as the heat meter or a solar display, the maximum current draw from this output is shown on the below table.

LPC SOLAR CONTROLLER	
Power Supply	100...240VAC (50...60Hz)
Internal Fuse	4A
Power Consumption Standby	<1W
Total Switching Capacity	4A 240VAC
Relay 1 to 3 Type	Semiconductor relay – 1A max each
Relay 4	Electromechanical relay – 1A max
VBUS ® Current Supply	35 mA

Always disconnect the controller from the power supply before opening the housing.

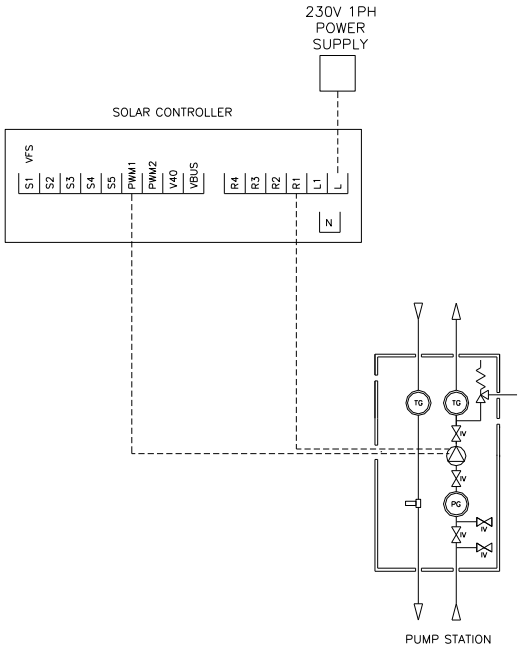
A separate manual is available for the solar controller which gives further installation details.

To access the wiring terminals on the solar controller make sure power is off to the unit and then remove the small screw in the centre of the controller, this will then give access to the terminals on the controller.

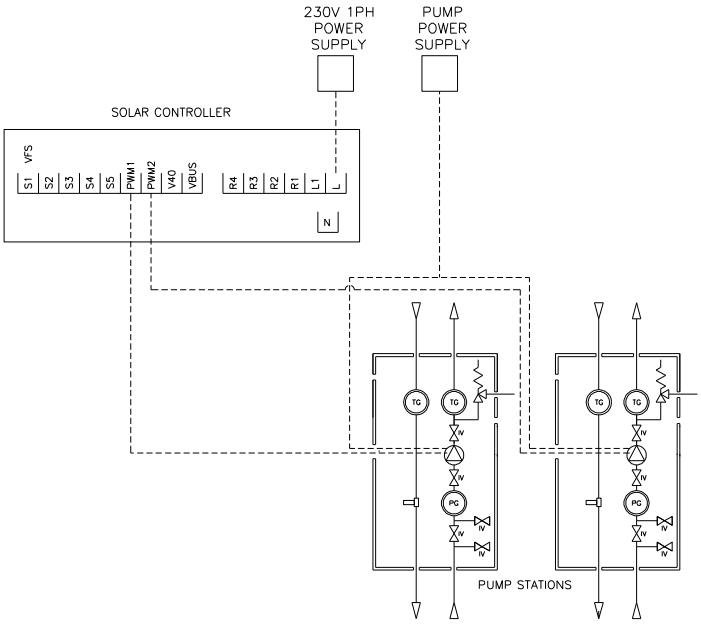
SOLAR CONTROLLER

16.2 PUMP

The pump is located within the solar pump station. All the pumps supplied by Lochinvar are of the high efficiency type with PWM control. The pump can be wired directly to the solar controller, the controller will provide the pump with a power supply and the control will be performed by the PWM connection. For full details on wiring the pump see section 16. For systems using multiple pumps on the same controller it may be required to fit a separate permanent power supply for the pumps and only wire the PWM controls back to the controller.



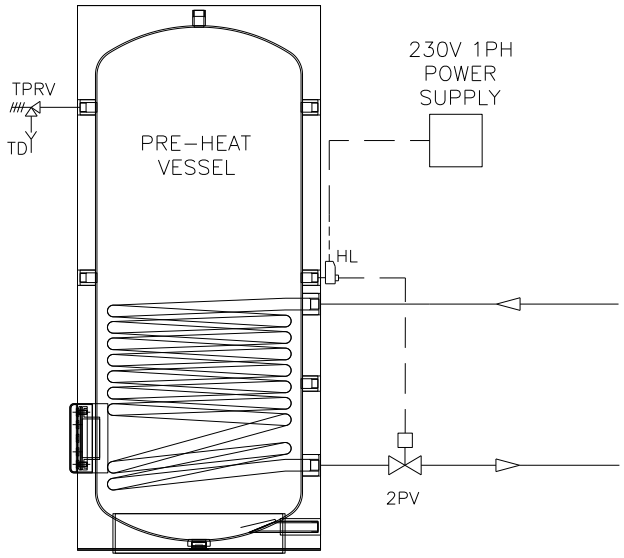
SINGLE PUMP CONNECTED TO SOLAR CONTROLLER



TWO PUMPS CONNECTED TO SOLAR CONTROLLER WITH SEPARATE POWER SUPPLY

16.3 HIGH LIMIT CONTROL

Solar thermal pre-heat systems must comply with regulations in terms of temperature control, Lochinvar recommends the use of a 2 port motorised valve connected via a high limit stat. The power supply that opens the 2 port valve is wired in series with the high limit stat, in the event that the stat detects a temperature above 82°C then the power supply to the 2 port valve is cut, this will close the valve and stop any further flow of energy into the vessel via the indirect coil. The solar thermal system has a flow sensor connected to the primary flow which will then detect a "no-flow" situation and alarm the system. When the cause of the over-heat has been found then the high limit stat can be reset allowing the 2 port valve to again open and normal flow on the primary circuit to resume.



2 PORT VALVE CONNECTED IN SERIES WITH HIGH LIMIT STAT

16.4 OTHER ANCILLARIES

The system may have solar Ancillary components these can be connected to and controlled by the solar controller; some items can take their power supply from the controller depending upon the Amps required.

Always check with the solar control ICM instructions before connecting any ancillary equipment.

The wiring diagram below shows connection for common system components, this wiring diagram may slightly differ depending on any particular system design.

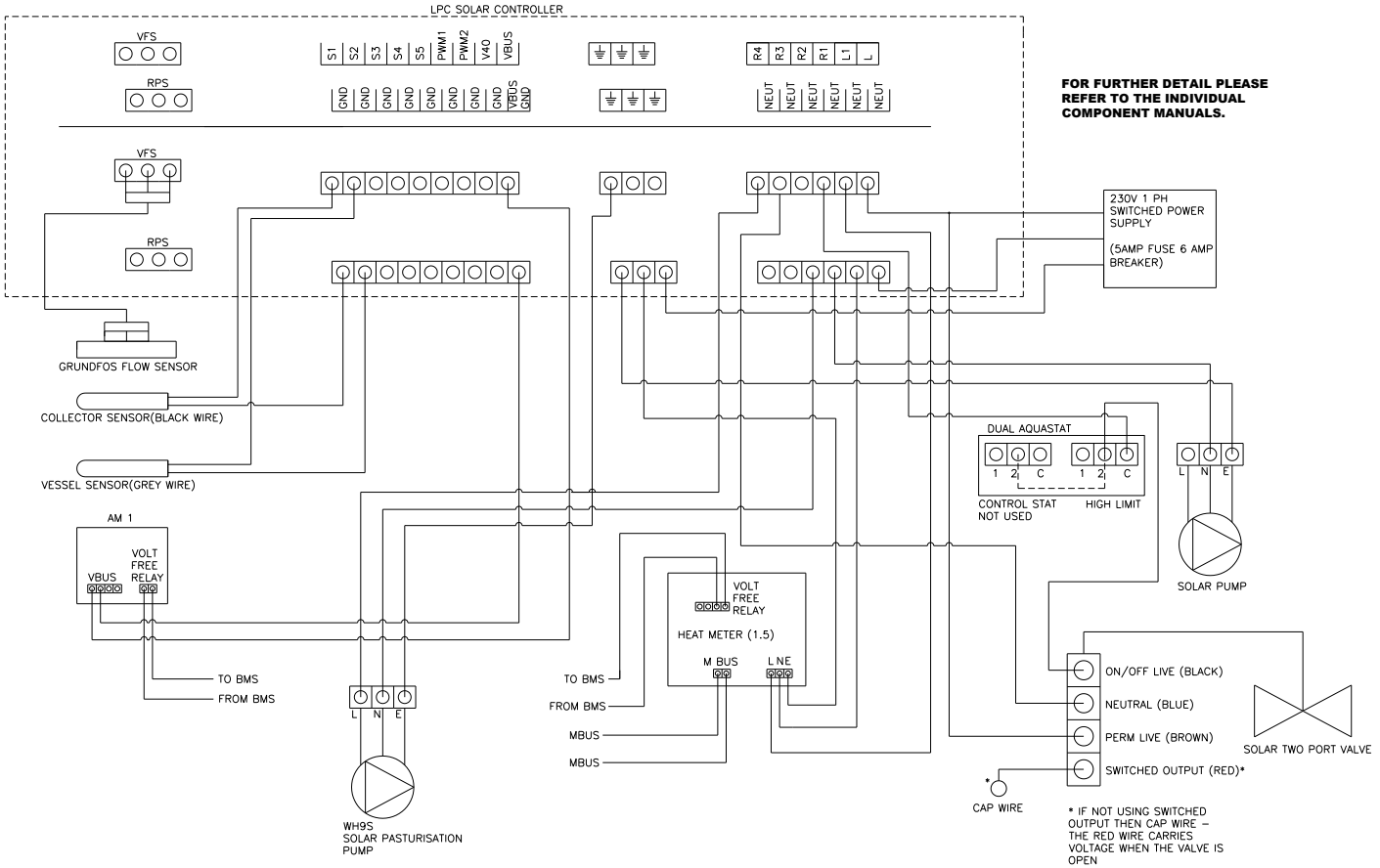
This is a list of the common system components that connect to the solar controller.

- Pump station – details shown in 16.2, can be controlled by the solar controller
- AM1 alarm module - details shown in 13.3, connected to the VBUS connection to the controller
- Heat meter – details shown in 13.6 – the heat meter requires a power supply, this can be taken from the solar controller.
- Flow sensor – details shown in 13.4 – the flow sensor connects to VFS or RPS depending on the type of flow sensor used.
- Pasteurisation pump – details shown in section 17 – the pump may be controlled by the solar controller
- Sensors – the collector and vessel sensors connect directly to the solar controller.

Various other components can be connected to the solar controller; this is all dependent on the individual design. For further details on this refer to the relevant manual for the system component or the separate manual for the solar controller.

16.5 WIRING DIAGRAM

The below wiring diagram only covers the LPC controller supplied by Lochinvar LTD – other controllers may be used please refer to the relevant manual.



TYPICAL WIRING DIAGRAM LAYOUT

17 PASTEURISATION

Legionella bacteria are commonly found in water. The bacteria multiply where temperatures are between 20-45°C and nutrients are available. The bacteria are dormant below 20°C and do not survive above 60°C. Legionella legislation requires any hot water storage vessel to raise the temperature of the stored water to 60°C for at least 60 minutes every day. Due to the intermittent energy input from solar thermal there may be days when this is not achieved, during winter months this period could be extended.

Solar pre-heat systems must comply with the ACOP and guidance on regulations covering L8 and HSG274 part 2 - Legionella control in water systems.

One method of control is thermal disinfection; this is achieved by lifting the pre-heat vessel to 60ºC and holding this temperature for one hour.

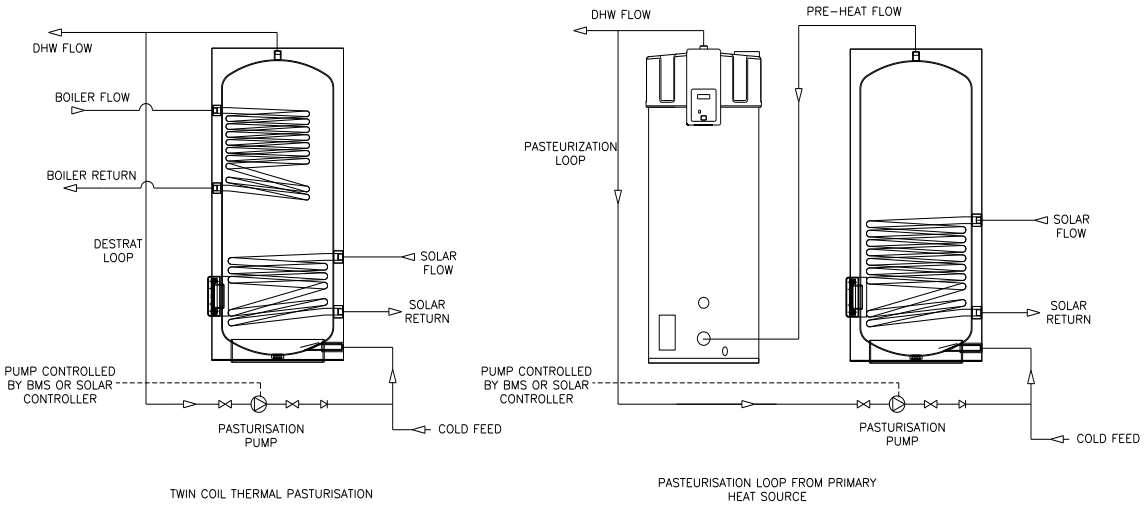
The solar controller can be programmed to run a thermal disinfection if required, it will do this by monitoring the pre-heat vessel, if the vessel fails to achieve 60ºC during its monitoring period it will use one of the below methods to lift the vessel temperature to 60ºC for one hour. The time this is done can also be programmed.

The thermal disinfection should be programmed to run at a time that will not affect any potential solar thermal gains into the storage vessel. This will be site dependent but with careful planning the potential loss of solar gains can be minimised.

Thermal disinfection can be achieved in one of the following ways, these can either be controlled by the BMS or the solar controller itself – Details on programming the solar controller can be found in the separate manual for the controller.

17.1 PASTEURISATION PUMP

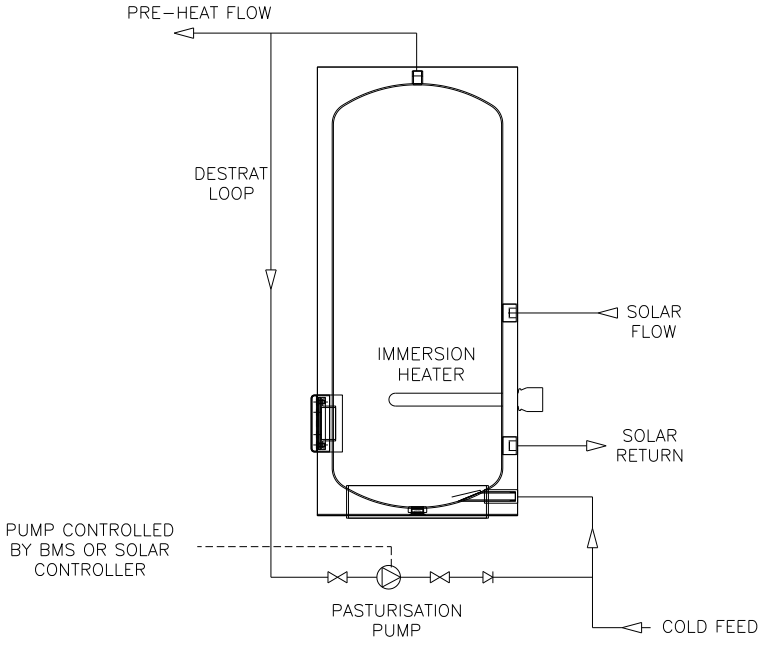
The pre-heat vessel can be heated by the primary heat source such as a storage water heater or boiler with indirect vessel, the hot DHW flow from the primary heat source will have a section of pipe work that feeds to the cold feed of the pre-heat vessel. When this pump is energised it will circulate the water from the pre-heat vessel to the primary heat source until the pre-heat vessel is heated to 60ºC



PASTEURISATION METHODS

17.2 IMMERSION HEATER

An immersion heater can be fitted to the pre-heat vessel and be powered to come on at a given time to lift the vessel to 60ºC.



IMMERSION HEATER AND DE-STRATIFICATION PUMP USED FOR PASTEURISATION

If the immersion heater is powered by the solar controller then this must be done via a separate volt free relay powered by the controller due to the high current draw from the immersion heater.

It may be advisable to also fit a de-stratification pump to the vessel to ensure the complete contents of the vessel are heated to 60ºC and not just the volume of water above the immersion heater, this pump could be energised to come on at the same time as the immersion heater.

17.3 DE-STRATIFICATION PUMP

When using a twin coil vessel, normally the primary heat source is used to heat the upper coil thus maintaining the top section of the vessel to 60ºC. A pump can be fitted to the pre-heat vessel to circulate the contents of the vessel so the top coil can heat the complete vessel to the required 60ºC.

17.4 THERMAL STORES

Thermal stores such as the HSV range available from Lochinvar generally do not require a pasteurisation regime as they do not store domestic hot water but utilise a pre-heat coil to heat the cold water as it flows through the pre-heat coil. The use of a HSV thermal store will reduce the energy impact of pasteurising the pre-heat store daily which can during winter months negate any energy savings from the solar thermal system. Further details of the HSV thermal store can be found at www.lochinvar.ltd.uk or by contacting Lochinvar sales.

Any solution used must comply with the requirements of part G of the building regulations and a thorough risk assessment undertaken as required under legionella legislation.

18 COMMISSIONING

The following Commissioning regime must be followed along with the record sheet in section 22.This is a requirement under the solar thermal collector warranty. This should only be completed by a suitably competent person.

Commissioning should be carried out by a suitably competent engineer.

COLLECTORS SHOULD BE COVERED THE DAY BEFORE COMMISSIONING
Before starting check the collector temperature on the solar control, if this is higher than 30°C then commissioning cannot take place.

Prior to commissioning the following checks should be made

- All pipe work and wiring connections are correct
- The collectors are sufficiently cool prior to filling
- Pipe Work has been pressure tested – if not then start at section 18.1 – if pipe work has been pressure tested and a certificate is available to show this then start at section 18.2

18.1 PRESSURE TESTING PIPE WORK

Prior to filling the system it is advisable to check the integrity of the hydraulic circuit by pressure testing the pipe work.

To pressure test the hydraulic circuit, the circuit will need to be filled and held under pressure for a period of time, this time can be site specific but is typically for around 2 hours. To fill the circuit follow the instructions given in the relevant pump station manual with your system.

The system may be filled and pressure tested with either;

- GLYCOL (Only use glycol supplied BY Lochinvar see section 13.8) – **this is the preferred method.**
- Air – using compressed air and leak detect spray – air testing is more hazardous than using glycol, as such this manual doesn't cover this process and if this is the chosen method then the correct procedure in terms of safe working should be followed.

DO NOT USE WATER TO PRESSURE TEST THE PIPE WORK

It may not be possible to fully empty the contents of the collectors following a pressure test. If pressure testing during sub-zero temperatures it is advised to do this with GLYCOL, otherwise irreparable damage may occur to the collectors.

To pressure test the system with glycol then the following or a similar method should be followed and a test certificate signed and kept as a record this has been done. Please ensure any pressure gauges used are calibrated and have been serviced.

1. Start to fill the hydraulic circuit – **refer to the relevant solar pump station manual for details on filling the system.** Whilst filling it is advisable to walk the route to look for any obvious leaks. If caught early this may be heard as air leaking from the circuit.
2. Release air from all high sections in the pipe work, to ensure the complete circuit is full and there are no air locks. The use of solar approved Automatic Air-Vents should be used on all high points.
3. Once the system is full then raise the pressure into the system, this pressure varies depending on site but typically the pressure should be set to 3 bar and held for 2 hours – if the pressure gauge still reads 3 bar after the given time period then the test has passed – if there has been a significant drop in pressure then the leak will need to be detected and the test repeated.
4. When the test has been completed this should be witnessed and a test certificate signed and kept as a record of the test.

5. Drain the system by relieving the pressure – the air vents at the highest points may again need to be opened to allow air back into the system and allow the glycol to drain off.

The pressure relief valve on the solar pump station is factory set to 6 bar – if this is exceeded during the pressure test then the valve will discharge and may release hot liquid into the area.

If site requirements require a pressure test at higher pressures, the solar thermal collectors should be isolated before any high pressure testing is carried out to prevent damage which would not be covered under the collector warranty.

18.2 SETTING THE SOLAR EXPANSION VESSEL CUSHION PRESSURE

The cushion pressure on the expansion vessel should be set to 0.2 bar less the cold fill pressure; typically the fill pressure will be 2bar, as such set the cushion pressure on the expansion vessel to 1.8 bar.

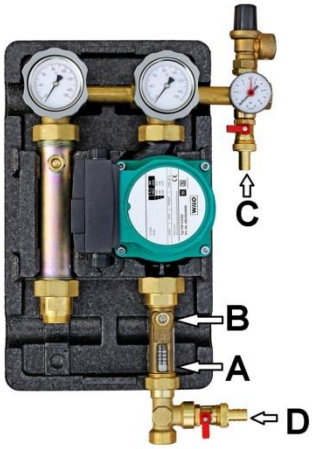
18.3 FILLING THE HYDRAULIC CIRCUIT

The system is filled via the solar pump station – for connection details please refer to the separate manual for your particular pump station.

Please make sure the pipe work is fully flushed of any potential debris prior to filling.

Filling the circuit is similar to the procedure when pressures testing the pipe work; however it is now important to make sure that all the air bubbles are removed from the circuit (even micro air bubbles) this can only be achieved by circulating the Glycol mix around the hydraulic circuit using a filling station.

TYPICAL FILLING STATION



TYPICAL PUMP STATION

1. Fill the filling station with Glycol – have further glycol available to top up.
2. Connect the filing station to the solar pump station, the flow from the filling station should connect to point (C) and the return to the filling station should connect to point (D) – full details of connection can be found in the separate pump station manual depending on the model used.
3. Close the isolating valve (B) located just above the flow setter (A) on the pump station; this will prevent glycol re-circulating just around the filling station.
4. Open the fill (C) and return valve (D), in the beginning only slightly open valve (D) on the pump station
5. Switch on the solar filling station, glycol will now be pumped into the solar loop and air will be seen pushing into the glycol stored in the filling station. Keep an eye on the level of glycol in the filling station and fill as necessary.

Any air vents on the pipe work may need to be open during the filling stage to allow the removal of any air-locks. Ensure these are then closed when the loop is full.

6. Continue circulating the glycol around the circuit adding more glycol into the filling station and the level stops dropping indicating the loop is full. Continue circulating for a period of time until no more air bubbles are seen in the filling station.

To assist with air removal from the circuit, try stopping and starting the filling station, the sudden changes in fluid motion can dislodge trapped air bubbles. Occasionally open the isolation valve on the flow meter to make sure no air is trapped in the sight glass.

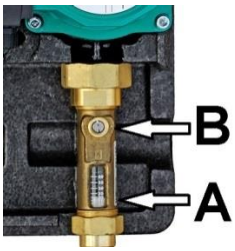
7. When satisfied all the air is removed from the solar loop, isolate the return valve (D) and fully open the isolation valve (B) just above the flow setter (A), continue pumping into the solar loop – this will cause the pressure in the loop to rise, continue to do this until the required pressure is set. This must be set to 2 bar minimum but may be higher depending upon site requirements.
8. When the pressure has been set switch off the filling station and isolate the fill loop connection (C).
9. Check the circuit for leaks and monitor the system pressure for drops.
10. The above procedure may need to be repeated if all the air hasn't been removed or the pressure drops with no signs of any leak.
11. If the plumbing is sound and no leaks are found then disconnect the filling station and drain back into the glycol containers any unused glycol. Cap the fill (C) and return points (D) on the solar pump station.

It is advisable to return and check the system 2 weeks after initial fill to ensure no air-locks have formed. If air-locks have formed then the above procedure should be repeated.

18.4 SETTING THE FLOW RATE

Setting the correct flow rate depending on the size of the array is important to ensure that all the energy is removed from the collectors and delivered to the pre-heat vessel as efficiently as possible. See section 12.2 for recommended flow rates. Check the individual manual for your pump station, however; most pump stations set their flows by the following method.

- If the solar pump has speed settings, set the pump to the lowest speed.
- Switch the pump to manual via the solar controller – see the individual manual for the solar controller for details on how to do this.
- Locate the adjusting screw (B) above the site glass and turn clockwise to decrease the flow. The flow rate will be shown on the site glass gauge (A), do this until the required flow is measured. If the required flow can't be met then change the pump speed up one level and try adjusting again.
- If the pump station does not have a flow setter then the flow must be balanced using flow setters to the individual banks see section 12.3



CLOSE UP VIEW OF FLOW SETTER

Pump stations may have modulating PWM pumps – for these pump stations the pump will find its own flow rate depending on the collector and vessel temperature. The pipework still needs to be balanced as per section 12.3.

18.5 CONTROLLER SETTINGS

When the system has been filled and the flow set then the controller should next be programmed. Full details for programming the controller can be found in the individual manual for the LPC controller.
Depending on the individual design of the system depends on the program that will be set on the controller, however, the key points to cover when programming the controller are as follows;

Vessel set point

The set point you would like to heat the pre-heat vessel to should be programmed – the standard set point is 60ºC but this can be adjusted to a higher temperature of 65ºC. If the maximum energy from the collectors is to be stored then you could increase the set point to 80ºC, however this is close to the high limit set point which is typically 82ºC.

If temperatures above 65ºc are stored in the pre-heat vessel it will be necessary to fit a tempering valve to ensure high temperatures are not supplied at the outlets.

Collector switch on set point

This is the temperature difference that needs to exist between the pre-heat vessel and the collectors. Typically this would be set to 10K meaning the collectors will need to be 10K hotter than the pre-heat vessel for the solar pump to switch on.

Collector switch off set point

This is what the temperature difference needs to drop between the collectors and the pre-heat vessel to for the solar pump to turn off. We recommend this is set to 5K.

Minimum collector switch on temperature

A minimum collector temperature can be set that the collector needs to reach before the solar pump will switch on, independent to the collector switch on point. This is to prevent the solar pump activating if the collectors are sat at a low temperature but still 6ºC above the pre-heat vessel. This is an optional setting however it is normally recommended to keep the system inactive unless the collectors reach a minimum temperature of around 25ºC.

Maximum collector temperature before lockout

During times when the pre-heat vessel is at set point and the solar pump has turned off, the collectors will still be receiving energy and their temperature will increase, this is called stagnation. If the collectors reach a certain temperature the glycol may begin to boil and vapour will form, when this happens the solar pump should be prevented from activating (as the pre-heat vessel drops in temperature) to prevent the circulation of steam which will damage system components. The factory set point for this is 130ºC.

Flow sensor

It is recommended to fit a flow sensor to the solar loop, Lochinvar supply a flow sensor with all their solar packages. When fitted the flow sensor connects to the solar controller and the controller needs to be programmed depending on the type of flow sensor fitted.

Pasteurisation settings

If the solar controller is used to run the pasteurisation cycle see section 17. The monitoring period, pasteurisation time and set points are all programmed into the controller. During the monitoring period, if the solar controller reads the pre-heat vessel has reached the minimum set point, say 60 ºC, and remained at that temperature for 1 hour during the monitoring period it will cancel the pasteurisation run for that particular day.

Depending on the system design many other parameters can be set – the above points are the main settings that need consideration on the majority of installations.

On completion fill in the Commissioning sheet

18.6 DRAINING THE HYDRAULIC CIRCUIT

CAUTION BURN RISK

Before draining the hydraulic circuit please make sure the system is at a safe temperature to discharge the glycol to prevent the risk of burns. It is highly advisable to cover the collectors or perform maintenance first thing in the morning to prevent there being high temperatures or pressures in the solar primary circuit.

To drain the hydraulic circuit of glycol complete the following

- Isolate the system electrically
- If possible cover the collectors
- Open any air valves (⚠ **only if the primary solar circuit is at a safe temperature and pressure)** at the highest point on the system, this may be the air valve located on the top left of each collector bank.
- Locate drain valves at the lowest point of the system
- Open drain points and collect glycol in suitable containers
- See glycol disposal in section 20
- To refill the circuit with Glycol following section 18.3

19 MAINTENANCE

The following maintenance regime must be followed to maintain an efficient operating system and is a requirement under the solar thermal collector warranty. This should only be completed by a suitably competent person.

If the electrical supply to the system is to be switched off then do this at a time of low solar gain or cover the collectors, this is to prevent the collectors reaching their maximum temperature – see maximum collector temperature in section 18.5

19.1 MONTHLY

- The solar controller should be checked to ensure the system is operating correctly, from the display you can view the collector and vessel temperatures. If the system is in fault then an error code will be displayed.
- Check for weeps/leaks from pipe work
- Check the system pressure, the system pressure should be within +/- 0.5 bar from the initial fill pressure. If the system has a pressure outside of the normal ranges report this to a service engineer.
- If no flow sensor is fitted to the system then ensure adequate flow is present when the pump is running
- Check the condition of the solar pre-heat vessel.
- Visual inspection that there is no damage to collectors or fixings

In addition to the above, every installation should have a specific anti-legionella regime in place and the details of this should be logged.

19.2 ANNUAL – CARRIED OUT BY COMPETENT SERVICE ENGINEER

- Speak with the customer to establish if they are happy with their system and to discuss anything they may have noticed during their weekly checks. Speaking with the customer can save valuable time in determining the correct operation of the system.
- Check for damage to the absorber or glass along with the integrity of the mounting frame. If roof access isn't available then a visual inspection from the ground is normally suffice.

Do not clean the collector glass, aggressive washing may cause damage to the surface of the collector and affect performance. If there is heavy debris such as bird droppings then this should be removed very carefully with warm water.

- Check the system pressure, the system pressure should be within +/- 0.5 bar from the initial fill pressure. If there is a major drop in the pressure, check for glycol in the discharge container. If no glycol is found in the discharge container then this may indicate a leak on the pipe work that needs to be located. If the pressure is higher than expected then follow the next step.
- Isolate the expansion vessel from the solar circuit and use a manometer to check the cushion pressure on the expansion vessel; this should be 0.2 bar less than the cold fill pressure of the solar circuit (this pressure should have been recorded on the initial commissioning sheet).
- Manually operate the pump and check that there is correct circulation in terms of flow rate around the solar circuit. See section 18.4. If the flow rate can't be adjusted then check the integrity of the pump or for any blockages around in-line filters, items such as heat meters have in-line filters built into the unit. If everything is clear then the blockage may be down to degraded glycol.
- Drain off a small amount of glycol and place into a small container. Take a sample of this glycol and place it onto a refractometer, this will allow you to view the antifreeze level of the glycol. Check the data sheet for the glycol used and this will allow you to determine if the glycol is still protecting from freezing to a sufficient level.
- Now dip a pH test strip into the glycol, the target value for the glycol should be approx. 7.5. As glycol breaks down it becomes more acidic and this may cause damage to the pipe work and system components, as such if the pH level drops less than pH7 replace the glycol. See section 18.6

CAUTION BURN RISK

If replacing the glycol please make sure the system is at a safe temperature to discharge the glycol to prevent the risk of burns.

- Run a visual inspection of the pre-heat vessel for signs of leaks or damage to its insulation. Check the vessel for scale formation and remove as necessary, also check the condition of any sacrificial anodes or that any impressed current system such as the Correx® system is working correctly.
- Check the settings in the solar to ensure that they are set to provide optimal performance of the system. Following the conversation with the customer, as mentioned in the first step, you may find you wish to make certain setting adjustments. See section 18.5 and the individual manual for the solar controller for moiré detail.

20 DECOMMISSIONING

Due to the pressure and potential temperatures found within a solar thermal system, decommissioning should only be conducted by a suitable competent engineer.

CAUTION BURN RISK
Cover the collectors or complete the works during a time of low solar gain such as early morning to reduce the possibility of high temperatures.

The decommissioning of a system will be completed in 5 steps as follows;

20.1 ELECTRICAL ISOLATION

- Isolate the solar controller from the mains
- Remove all electrical connections to the controller from sensors, valves and other ancillary components such as the heat meter
- Remove all earth cables from pipe work

20.2 REMOVAL OF THE HEAT TRANSFER FLUID, GLYCOL

- Drain the system – see section 18.6

20.3 REMOVAL OF THE SOLAR PIPE WORK LOOP

- Remove all pipe work between collectors and pump station
- Remove all pipe work in the plant room
- Remove all system components connected to the solar loop such as the solar expansion vessel
- Disconnect pipe work to the solar pre-heat vessel

Depending on the position of drain valves, fully removing all the glycol from the circuit is difficult, please note that when removing pipe work at the lowest levels of the circuit then glycol my still be present in the pipe work and fittings.

20.4 DISMANTLE AND REMOVAL OF THE COLLECTORS

- Remove the collectors and all related fixing frames.
- Remove any ballast that may have been used to support the frames
- Any roof penetrations should be made weather tight

CAUTION BURN RISK

The collectors may still be hot even if they have been drained of all their contents.

20.5 DISPOSAL

- All components such as the collectors, solar pump station and other solar ancillaries may be stored and used again.
- Glycol –

  The glycol used in solar thermal systems is called propylene glycol; propylene glycol is non-volatile but is miscible with water. Propylene glycol is not subject to registration as a hazardous material according to EEC directives; the solution should be disposed of taking into consideration local environmental and health and safety legislation. Although glycol is not harmful to marine life and is fully biodegradable we recommend you contact your local authority to find out if any special landfill points will accept the solution. There are also a number of specialist companies that will remove substances such as glycol.

  If the glycol is to be stored and used on a future project then please check its suitability, see check glycol in **section 19.2**. Any stored glycol must be stored in a suitable container and clearly labelled to show the glycol stored, any relevant COSH data should also be made available when storing the glycol.

- Remove any debris left over from the decommissioning and leave the area the system was installed Clean and tidy.

Following decommissioning any waste materials should be recycled responsibly.

21 FAULT FINDING

For faults relating to individual components please refer to the relevant component ICM instructions; below details a number of situations and items to check.

In the event of a fault on the solar thermal system – leave the system switched on as other features may still be active to protect the system.

Issue	Remedy
Solar Pump not running	The solar display shows the solar pump, if the pump is flashing then the pump should be active, if the pump is static then follow the below. 1. Is there sufficient temperature difference between the solar collectors and the storage vessel? For the system to transfer heat energy from the collectors to the vessel there needs to be a temperature difference of 10K. 2. Is the Storage vessel already at set-point? If the storage vessel is already at set-point then the pump will stop transferring heat energy from the collectors to the vessel. 3. Have the collectors reached lock-out temperature? If the collectors reach a temperature of 130°C then the controller disables the pump until the collectors cool down, this is to prevent the pump circulating glycol that may have gone through a phase change from liquid to steam. 4. Has the High-Limit stat tripped? If the storage vessel has reached 82°C then it may be that the high limit stat has tripped, this will close a 2 port valve and prevent the pump from flowing. Most systems will have a flow sensor fitted and the controller will detect no flow and alarm the system. The display should read "EFLOW" if this is the case. 5. Pump failed – it may be the pump has seized or failed, repair or replace. 6. Air lock – it is possible for air bubbles to form in the solar circuit, if allowed to build up this may cause an air lock and prevent flow, again the controller should detect this and alarm the system with an "EFLOW" error code. 7. Blocked filter – it is possible on older systems that any components such as the heat meter which have filters fitted have become blocked thus reducing or stopping the flow – Clean or replace filters as necessary.

Issue	Remedy
Pressure Low or Lost in the solar circuit	1. Check the pressure gauge against the pressure recorded during commissioning of the system – it is normal to have +/- 0.5 bar difference due to fluctuations in temperature. 2. Air in circuit – if the system is a new installation or recently had new glycol fitted, it is possible that when the initial system pressure was set that there was air in the circuit, after a few days this air is removed thus dropping the pressure. If no leaks are found then top up the system again. 3. Has the glycol discharged from the circuit – check the glycol discharge container for glycol – **TAKE CARE AS THE GLYCOL MAY STILL BE HOT** – If glycol has discharged then check what has caused the over pressure in the circuit, most likely cause is a failure or incorrect cushion pressure on the solar expansion vessel. 4. Leaks on the circuit – if the glycol hasn't discharged into the storage container then it may be a leak on the system. Check pipe work/fittings for leaks and repair as necessary.
Poor Temperature in the storage vessel	1. Check that the system is actually running and that there is sufficient temperature difference between the collectors and the storage vessel. For the transfer of heat energy there needs to be a temperature difference of 6K between the solar collectors and the storage vessel. The higher the temperature difference the greater the transfer of heat. 2. Has there been a recent demand on the system? If there has been a recent demand on the system it is possible for the pre-heat vessel to sit at a lower temperature whilst the collectors re-heat the vessel. 3. Poor flow rate – check that the flow rate on the circuit matches the flow rate set during commissioning of the system. As a rule the flow rate should be 1ltr/min per collector.
Collector temperature very high – above 130°C and vessel cold. Exclamation mark shown in warning triangle on the solar display.	1. If the collectors exceed their maximum operating temperature typically 130°C, the system will be locked out. Temperatures above 130°C means there is likely to be glycol vapour in the circuit, this would cause issues if the pump tried to circulate the glycol, as such the pump is disabled and the system locks out. As the collector temperature cools back below 130°C the system will return to normal.
Solar display blank	1. Check power has not been switched off to the controller. 2. Check the main fuse hasn't tripped or the 4 amp fuse within the controller hasn't blown – refer to separate manual for the solar controller.

22 COMMISSIONING RECORD

		YES	NO	N/A
SOLAR CIRCUIT				
	Solar collectors installed as per manufacturer's instructions – Flow balanced to individual banks using flow setters or similar			
	Solar flow/return pipework installed using brazed, compression or specialist high temperature press-fit system			
	Pipework pressure tested and certificate supplied to Lochinvar			
	Glycol checked and at the correct levels, record PH and freeze temperature protection temperature			
	Isolatable high temperature AAV's fitted to all high points on pipework			
	Solar safety valve discharge to collection facility			
	All pipework insulated with suitable high temperature insulation			
	System Flow rate set? Record figure in box			
SOLAR CYLINDER				
	Water to the DHW circuit			
	Solar vessel and main DHW unit (such as water heater) are full and flushed			
	Solar vessel T&P valve fitted in accordance with G3			
	2 Port valve fitted to solar circuit and wired to high limit stat on solar vessel			
	Pasteurisation pump fitted and wired back to solar controller or BMS			
ELECTRICAL COMPONENTS				
	240V supply wired to solar control unit			
	All interconnecting wires completed between control and pump station			
	All interconnecting wires completed between solar controller and ancillary items such as flow meter, heat meter and alarm module			
	All sensor fitted and wired back to solar controller (solar array and vessel)			
	240V supply wired to collector cooling fan via supplied control unit (if fitted)			
	240V supply wired to solar display panel if fitted			

Installation/Commissioning company	
MCS Installer?	
Signature of engineer	
Print Name	
Date	

23 MAINTENANCE RECORDS

The following maintenance regime must be followed to maintain an efficient operating system and is a requirement under the solar thermal collector warranty. This should only be completed by a suitably competent person.

It is important to maintain maintenance records for the solar thermal system – failure to produce maintenance records will invalidate any manufacturer's warranty

Please copy this page and complete the two tables below on both a monthly and annual basis – place a tick in each check box upon completion.

23.1 MONTHLY RECORD

CHECK	MONTH – TICK WHEN COMPLETE											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Solar Controller												
Check For Leaks												
System Pressure												
System Flow												
Storage Vessel												
Collector/Frame Inspection												
Signature												
Print Name												
Date												

23.2 ANNUAL RECORD

CHECK	YEAR – TICK WHEN COMPLETE									
	01	02	03	04	05	06	07	08	09	10
Speak To Customer to Discuss Any Issues										
Inspect Full solar Array Including Mounting System										
Check Glycol PH and Antifreeze Properties, record results below										
Glycol antifreeze protection temperature **see 19.2**										
Glycol PH level **see 19.2**										
Check Cushion Pressure Of Solar Expansion Vessel										
Check System Pressure										
Check Storage Vessel for Leaks/Corrosion										
Check Any Corrosion Devices Such As Anodes On Vessel										
Check Solar Pipe Work For Leaks/Weeps										
Signature										
Print Name										
Date										

24 WARRANTY

A separate copy of the warranty terms and conditions is available from www.lochinvar.ltd.uk

Model	Warranty Period		Warranty Conditions
LSP20+ **LSP20+H**	Supply Only	10 Years	• Equipment must be installed/operated in line with ICM Instructions • Full service history as detailed in ICM Instructions • Heat transfer fluid (Glycol) must be supplied by Lochinvar Ltd

Components Warranty

Our warranty is to provide a replacement component in exchange for the return of the defective component and is subject to an audit upon receipt of the faulty component. Replacement components must be paid for in full prior to dispatch unless we agree otherwise. The warranty does not include any labour costs or carriage of the returned component.

LSP20+ Flat Plate Collector Warranty

The LSP20+ flat plate collectors have a manufacturing defect warranty. This provides coverage to the end user via Lochinvar. If the collector becomes unserviceable due to a material or workmanship defect it will be replaced. Damage to the collector due to the following, is not a defect in the material or workmanship of the collector and is therefore not covered by the warranty.

- Lack of maintenance regime as stated in the ICM instructions to the solar thermal system.
- Not installed as per manufacturers ICM instructions and MCS guidelines, along with the relevant British standards.
- Severe damage from foreign objects.
- Cleaning the glass on the collector – this damages the special glazing.

Warranty Procedures

If a claim is to be made under the terms of our warranty, the original purchaser of the appliance should place a purchase order for the required component and obtain a Sales Return Order (SRO) number for the return of the defective component.

To process any warranty claim, we require the following information:

- **Product model number**
- **Date and proof of purchase**
- **Brief description of fault**

Upon receipt of the defective component, it will be tested and if the component is found to be faulty, a credit will be raised against the relevant invoice.

The warranty period starts from the date of delivery of the original appliance unless the equipment is commissioned by Lochinvar, in which case the warranty period will begin from the completion date of the initial commissioning. Warranties are subject to the equipment being installed and maintained in accordance with the relevant Installation Commissioning and Maintenance Instructions and do not cover failures due to deliberate misuse, malicious damage, neglect, unauthorised alterations or repairs, accidental damage or third party damage. The warranty is held by the company/organisation that has placed the purchase order with us and is only valid if the equipment supplied has been paid for in full.

Lochinvar's total liability is limited to the value of the warranted product or component and it shall not be responsible for any loss of income, profits (actual or anticipated), and contracts or for any other business related loss, indirect or consequential losses arising in connection with the warranted product or component.

We retain the exclusive right to replace the product or offer a refund at our sole discretion. Such remedy shall be your sole and exclusive remedy for any breach of warranty.

Lochinvar's standard terms and conditions apply to this warranty and in the event of any inconsistency between the two, the wording in this warranty shall prevail.

IMPORTANT INFORMATION

These instructions must be read and understood before installing, commissioning, operating or maintaining the equipment.

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS