INSTALLATION, COMMISSIONING

& MAINTENANCE INSTRUCTIONS

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1. General Data

1.1. Delivery & Handling

All solar components are supplied from the factory packaged in cardboard cartons. The solar collector should be handled with care. Always store the collector in its original packaging and in the indicated upright position. Placing anything on the front or back of the collector may cause damage. Proprietary lifting equipment should be considered where the collector is to be installed in generally less accessible positions.

1.2. Inspection

Before beginning the installation of this system examine the contents and determine that all components are correct and present. The McCallum solar system includes: –

1) High efficiency, lightweight solar collector with fixing brackets.
2) Purpose built solar cylinder.
3) Differential temperature controller.
4) Circulating pump and two pump isolating valves.
5) Solar rated expansion vessel.
6) Solar rated circuit components comprising automatic air vent & ball valve, fill valve & gauge, flow setter, non-return valve and pressure safety valve – alternatively a solar pump station complete with circuit components.
7) Approved solar premixed antifreeze solution.

1.3. Important Installer Information

- Only competent person(s) should undertake the installation of the solar water heating system. Necessary skills are required in plumbing, electrical, roof work and access work. Installers should have a high level of technical knowledge, be familiar with tools of the trade and have experience in current best practice. Items required by the installer to complete the installation include: –

1) Copper tube (under no circumstances should plastic pipework be used).
2) Compression fittings (under no circumstances should normal soft solder be used).

3) High temperature, interior and exterior quality pipe insulation.
4) 5 amp fused switch and electric wiring.
5) High quality roofing sealant or lead weathering slates for running pipe work through the roof.

- Temperatures within the solar circuit can be in excess of 100ºC, therefore suitable pipework, supports, fittings and insulation should be used. Under no circumstances should plastic pipes or pipe clips, soft solder fittings or standard insulation be employed.

- Insulation of the DHW cylinder should be at least equivalent to current best practice. All pipework should be insulated with high temperature insulation (e.g. Armaflex HT).

- The solar collector can reach very high temperatures when exposed to sunlight. Cover the collector whilst installing the system. Do not remove covering until commissioning the system.

- The solar system should have adequate frost protection. Fill the system with a suitable solar antifreeze fluid. Always read the solar antifreeze fluid label. Under no circumstances should water be added to premixed antifreeze fluid. The closed loop solar circuit should not be connected to the mains water supply.

- In hard water areas the high temperatures experienced in solar cylinders can result in the accumulation of limescale. As a means of control, the differential controller can be set with a maximum store temperature of 60ºC. Limescale build-up will not occur within the closed loop of an indirect solar circuit.

- At temperatures between 20ºC and 46ºC there is an increased risk of legionella bacteria growth within the DHW system. Solar water heating systems must have an auxiliary means of raising the temperature to at least 60ºC during winter months or days with little solar availability.

- The solar water heating system should meet the requirements for electrical earthing and bonding in accordance with IEE Wiring Regulations.

1.4. Health & Safety

Always assess risks prior to commencement of any work on the solar system. Take all necessary precautions to eliminate, or minimise to a safe level, any potential risks. Potential hazards can result from high temperatures of solar components (including escaping steam), working at height / roof work, electrical work, manual handling and working in confined spaces. Keep the solar collector covered during any works. Wear appropriate PPE at all times. All works should be carried out in accordance to current health and safety regulations and recommendations. The following Standards and Regulations are relevant to the design, installation, commissioning and maintenance of a solar water heating system.

- Solar standards: –

BS 853 - Calorifiers & Cylinders for Industrial purposes
BS 7431 – Method for assessing solar water heaters. Elastomeric materials for absorbers, connecting pipes and fittings
BS 5918 – Solar heating for domestic hot water
BS 6785 – Code of practice for solar heating systems for swimming pools
BS EN 12975 – Thermal solar systems and components – Solar collectors
BS EN 12976 – Thermal solar systems and components – Factory made systems
DD ENV 12977 – Thermal solar systems and components – Custom built systems

- Other relevant standards: -

BS 1566 – Copper indirect cylinders for domestic purposes
BS 4814 – Specifications for expansion vessels using an internal diagraph for sealed hot water heating systems
BS 5422 – Methods of specifying thermal insulation materials on pipes, ductwork and equipment in the temperature range of -40ºC to 700ºC
BS 5449 – Specification of forced circulation hot water central heating systems for domestic premises
BS 5534 – Code of practice for roofing and tiling – Design.
BS 5546 – Specification for installation of hot water supplies for domestic purposes, using gas-fired appliances of rated input not exceeding 70 kW
BS 5970 – Code of practice for thermal insulation of pipes and equipment
BS 6399 – Loading for buildings

BS 6651 – Lightning Protection – Code of practice for protection of structures against lightning
BS 6700 – Specification and design, installation, testing and maintenance of services supplying water for domestic uses within buildings and their curtilages
BS 6701 – Telecommunications equipment and telecommunications cabling
BS 6920 – Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water
BS 7074 – Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems
BS 7206 – Specification for unvented hot water storage units and packages
BS 7671 – Requirements for electrical installations
BS 8000 – Workmanship on building sites.
BS EN 12828 – Heating systems in buildings – Design for water-based heating systems
BS EN 12831 – Heating systems in buildings – Method for calculation of the design heat load

- Regulations: -

Confined Spaces Regulations 1997
Construction (Design and Management) Regulations 1994
Construction (Health, Safety & Welfare) Regulations 1996
Construction Regulations (Head Protection) 1989
Control of Substances Hazardous to Health Regulations 1994
Electricity at Work Regulations 1989
Health & Safety at Work Act 1974
Health and Safety (First Aid) Regulations 1981
Lifting Operations and Lifting Equipment Regulations 1998
Local Building Regulations
Local Water Bylaws
Management Health & Safety at Work Regulations 1999
Manual Handling Operations Regulations 1992
Noise at Work Regulations 1989
Personal Protective Equipment at Work Regulations 1992
Provision and Use of Work Equipment Regulations 1998
Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995

The Pressure Equipment Regulations

The Workplace (Health, Safety and Welfare) Regulations 1992

Water Supply (Water Fittings) Regulations

Work at Height Regulations 2005

2. Technical Specification

Dimensions & Weights (Serp. Landscape Collector)		
Size	Length, mm	Weight, kg
1.7m^2	1500	14
2.2m^2	1945	18
2.5m^2	2130	20
3.3m^2	2880	23
4.4m^2	3770	32
All collectors – 1175mm height, 100mm deep (Note: H&R Portrait Collector – length and height reversed)		

Collector type:	Model A, B, C, D, E, F, G, H, I, J, K, L
Test pressure:	15bar
Operating pressure:	1.5bar
Max. operating pressure:	10bar
Pressure drop:	10 kPa at 0.03 litre/sec/m^2 of collector area
Fluid content:	Maximum 1 litre per 1m^2 of collector area
Transfer fluid:	Premixed high temperature antifreeze fluid
Absorber insulation:	Rigid PIR foam, manufactured with zero ODP
Connections:	15mm copper (Serpentine) 22mm copper (H&R)
Max. stagnation temp.:	192.2ºC

3. Above Roof Work

Determine the position of the collectors on the roof, having regard for appearance and any potential shading. The preferred angle for fixing the collectors is in the range of 25 to 65 degrees, within the orientation of Southeast to Southwest. Installations outside these parameters are possible. Contact McCallum's for advice.

Each collector is supplied complete with fixing brackets (flat bar as standard). The number of fixings varies according to the size of the collector.

Collector Type	Flat Bracket Kit	A-frames (Flat Roofs / Wall Mounted)	L-Bracket Kit
1.7, 2.2, 2.5	4 brackets	2 frames	4 brackets
3.3	6 brackets	2 frames	4 brackets
4.4	8 brackets	3 frames	6 brackets

3.1. Flat Bar Brackets - Pitched tiled / slated roofs without sarking

Refer to diagram 1.

Captive nuts are located on the top and bottom edges of the collector. These nuts are moveable along the length of the collector, which means brackets can be spaced to suit. Chalk mark the position of each fixing bracket on the roof. Starting with the lower fixings, slide back the tile above the mark to expose the tile lathe. Measure the distance between the mark and the back of the tile lathe (A) and note the height between the lowest part of the tile and the fixing channel on the side of the collector (B). At ground level, using a mallet and block of wood, carefully form the pre-drilled end of the fixing brackets through 90° to give dimension (B). Measure back and mark off dimension (A). Using a block of wood of the same depth as the tile lathe, carefully form the bracket round the block to form a “U” shape. All the lower brackets will be of the same dimensions and may be similarly formed. Hook each bracket over the tile lathe, taking great care not to damage the weatherproof membrane and slide the upper tile back into place. The process may now be repeated with the upper fixings. The collector should now be lifted on to the roof, placed between the fixing brackets and fixed in place by means of the set-screws and captive nuts provided.

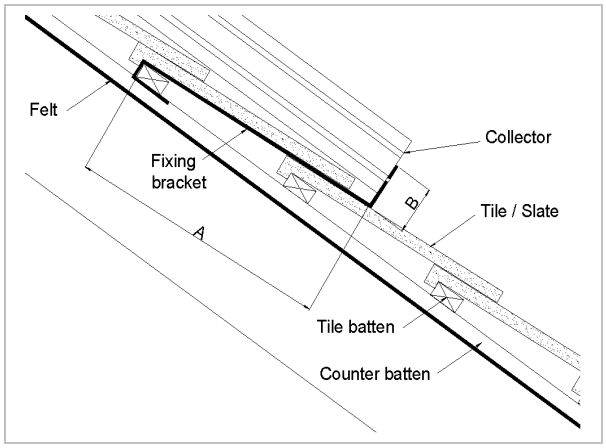


Diagram 1 – Fixing on a roof with no sarking

3.2. Flat Bar Brackets - Pitched tiled / slated roofs with sarking

Refer to diagram 2.

Mark off the roof as previously described and slide back the tile to expose the sarking. Measure the distance between the mark and the front of the tile lathe supporting the raised tile (A). Measure the height between the sarking and the top of the marked tile (C) and note the height between the lowest part of the marker tile and the fixing channel on the side of the collector (B). Offset the rear of the fixing bracket by the dimension (C) and form the pre-drilled end of the bracket over a wooden block through 90° to form dimension (B). All the lower brackets will be of the same dimensions and may be similarly formed. Screw the brackets into the sarking using 2 zinc plated woodscrews and slide the upper tile back into place. The process may now be repeated with the upper fixings. The collector should now be lifted on to the roof, placed between the fixing brackets and fixed in place by means of the M8 x 12 set screws and capture nuts provided.

3.3. A-frame

McCallum's can supply A-frame brackets suitable for tilting collectors that are to be located on flat roofs or on the side of buildings. The flat roof A-frame must be adequately weighted down or bolted. If the supporting frame is secured by weights rather than being screwed down permissible roof loads must not be exceeded under any circumstances, and if necessary a structural engineer must be consulted beforehand.

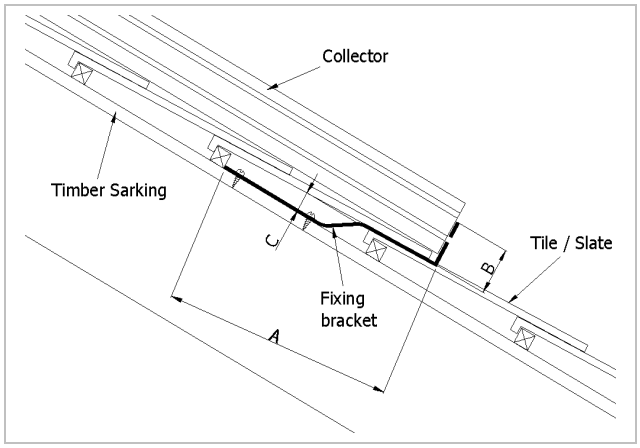


Diagram 2 – Fixing on a roof with sarking

3.4. Other Roof Types

For other roof types (e.g. Steel Profile) we can supply an L-Bracket fixing that can be bolted/screwed through the roof fabric. We can provide L-Bracket roof fixing instruction, please contact us. If the substructure has been penetrated, it must be carefully re-sealed in accordance with the roofing manufacturer's specification. Specialist roof manufacturers may have specific seam clips for their roof types, which can be bolted to the collector, contact the roof manufacturer direct.

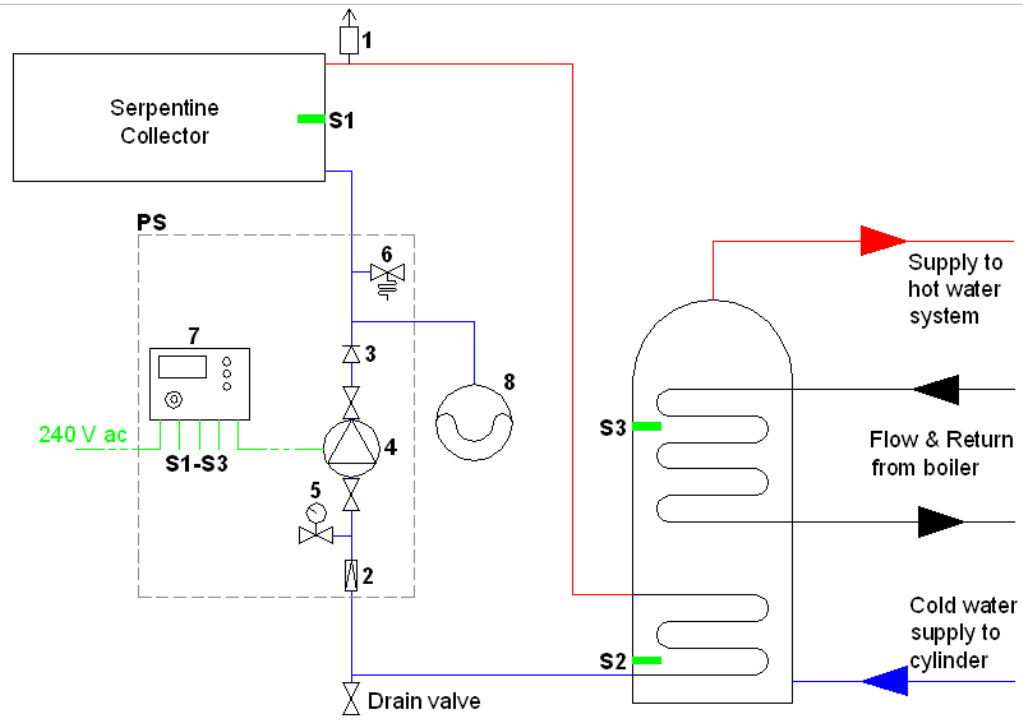
3.5. Running Pipework Through the Roof

Mark off the position on the tiles/slates through which you wish to run the pipework and sensor, remembering to leave sufficient room to fit a Tee for the automatic air vent at the top of the collector. Carefully drill through the roof. Alternatively lead-weathering slates may be used. Ensure when positioning that the top edge is lapped under the tile above and dress to shape.

Fit the temperature sensor into the housing in the collector, making sure that it is pushed fully home and the open end of housing sealed with sealant. Run the pipework and sensor cable through the holes in the roof and seal with quality roofing sealant. The internal primary circuit pipework may now be completed.

4. Solar System Installation

McCallum's systems are easily integrated with all kinds of conventional heating systems. Diagram 3 is a standard layout schematic. McCallum's can provide installers with schematics for various systems (e.g. swimming pool, multiple-store system, heat exchanger etc.), please contact us or visit our website to download information.



1. Automatic Air Vent & Ball Valve
2. Flow Setter
3. Non-Return Valve
4. Pump & Valves
5. Fill Valve & Gauge
6. Pressure Safety Valve
7. Differential Temperature Controller
8. Expansion Vessel

S1. Collector Temperature Sensor

S2. Store Temperature Sensor [Bottom]

S3. Store Temperature Sensor [Top]

PS. Pump Station (Containing items 2-7)

Diagram 3 – Pressurised solar thermal collector system with twin coil single cylinder

4.1. Sequence of Work

It is important when choosing the location of the equipment to keep the pipe runs as short as possible.

Temperatures within the solar circuit can exceed 100ºC. **Copper tube and compression fittings should be used throughout the solar circuit**.

1) Isolate the electrical supply to the boiler and turn off the cold water supply to the heating and hot water systems.
2) Partially drain down the central heating circuit, disconnect and remove the existing cylinder. Replace with the new unit.
3) Connect the boiler flow and return pipework to the upper coil connections.
4) Refill the central heating circuit and bleed off all air as necessary. Check for leaks.
5) Thoroughly flush out and refill the new cylinder, checking all connections for leaks.
6) Connect the solar primary circuit components in the order shown in the layout drawing. If necessary, the pump and expansion vessel may be located in the roof space. A 5-amp fused switch should be adjacent to the DTC.
7) Automatic air vents should be located at each high point on the system. No vent is required if filling with a solar pump filling station. Drain valves should be located at all low points.
8) The discharge port of the pressure safety valve should be piped to a place of safety.
9) All pipework should rise to vent and fall to drain and be adequately supported with pipe clips (do not use plastic clips).

4.2. Notes on Solar Circuit Components

- Automatic air vent & ball valve – To be fitted at the highest point on the solar circuit. More than one may be required.

- Cylinder – In open vented systems where less than 1m head is available the cold feed diameter should be increased to the next size up in order to avoid drawing air down the vent pipe. For unvented systems the instructions contained in the cylinder manufacturer's installation manual must be followed. In mains pressure applications it should be noted that a competent person must only undertake installation of the cylinder and it is a legal requirement that the relevant local authority be informed of the intention to install an unvented hot water storage system under 500ltrs and

46kw. In order to achieve satisfactory outlet flow rate for an unvented system it is essential to check the flow rate available from the incoming cold mains.

- Differential temperature controller - Choose a convenient location where the customer can easily see the display. The sensor cables carry low voltage only and polarity is not important. The sensor cables may be extended using twin core flex / bell wire. Refer to the manufacturers operating and installation instructions for wiring connections.

- Expansion Vessel – Refer to the manufacturer's instructions. Locate on a 0.5m uninsulated falling spur.

- Fill valve & gauge – Under no circumstances should this be connected to the mains water supply.

- Antifreeze – McCallum's can provide a suitable premixed solar fluid with adequate frost protection. **Do not dilute.**

- Flow setter – The recommended flow rate for a domestic hot water system is 1 litre/ min/1m^2 of collector absorber area. For swimming pool applications the recommended flow rate is 2 litre/min/1m^2 of collector absorber area.

- Pressure Safety Valve - Refer to the manufacturer's instructions.

- Pump Station – Refer to the manufacturer's instructions.

4.3. Collector Arrays

The following pipe diameters (mm) are outline guidelines only for pipe sizes for collector arrays.

Collector type	Number of Collectors				
	1	2	3	4	5
2.2m^2	15	15	22	22	22
2.5m^2	15	15	22	22	22
3.3m^2	15	22	22	22	28
4.4m^2	15	22	22	28	28

Collector arrays up to 6m^2 can be connected in series (diagram 4). For arrays greater than 6m^2, collectors should be connected in parallel (diagram 5). Automatic air vents should be fitted at the highest point on the solar circuit.

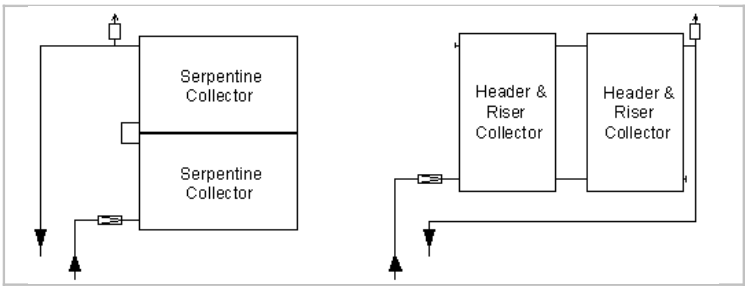


Diagram 4 – Schematic of collectors in series

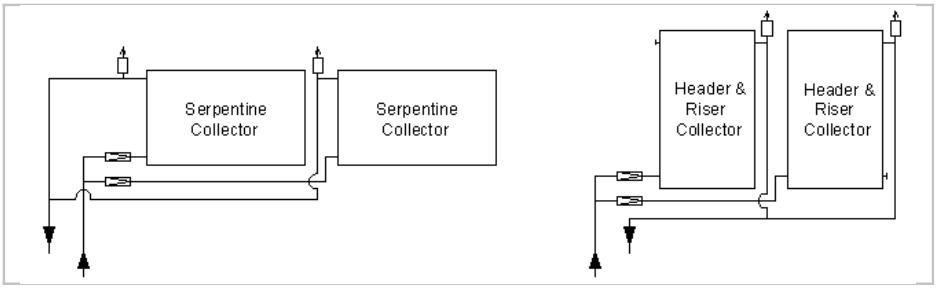


Diagram 5 – Schematic of collectors in parallel

5. Commissioning

1) On completion of the primary circuit pipework make sure of the following: -
   - All drain cocks are closed.
   - Pump isolating valves are fully open.
   - Caps on all automatic air vents are slackened one turn.
   - Ensure the pressure on the gas side of the expansion vessel is reduced to 1.5 bar.

2) Connect the inlet of the fill valve to a pump filled with fresh water. Unscrew the knurled knob on the underside of the fill valve and fill the system until a pressure of 1.5 bar is shown on the pressure gauge.
3) Check that all fittings are free from leaks.
4) Drain the system through the primary circuit drain valve.
5) Flush and back flush primary circuit until clean and clear.
6) Ensure all water is drained completely from the primary circuit (Note: It will be necessary to use a by-pass valve or additional drain valve to allow the system to drain completely around the non-return valve)
7) Refill the system as previously to 1.5 bar with antifreeze. Always read the solar antifreeze fluid label. Under no circumstances should water be added to premixed antifreeze fluid.
8) Switch on the electrical supply to activate the system. If there is insufficient solar energy the override switch on the controller should be activated. Any air in the primary circuit will now be dissipated through the automatic air vent.
9) The system should be re-pressurised to 1.5 bar.
10) The circulating pump should be set to operate at the lowest speed possible to achieve the required flow rate.
11) Once commissioned the DTC must be left on automatic operation and the automatic air vent isolated.
12) Pipework insulation may now be applied. It is essential to use only high temperature, exterior quality insulation. Secure in place with cable ties or insulation tape.

On completion of the solar water heating system the installer must explain the function and operation of the system to the end user. The installation, commissioning and maintenance instructions should be passed on to the end user.

(Note: If a by-pass valve is used for draining the system it should be normally closed when the system is in operation.)

AES can provide installers with a commissioning checklist, please contact us.

6. Maintenance

(To BS 5918 : 1989[1])

While a properly designed and installed heating system should be expected to give a service life comparable to that of other types of heating systems, some maintenance may be necessary to maintain the efficiency of the installation. A maintenance inspection should be carried out annually, the anti-freeze solution should be replaced at 5 year intervals. During a maintenance inspection the following items should be checked: -

1) That unions and glands are free from weeps.
2) That the glazing seals are weathertight and sound.
3) That the collector circuit is free from air.
4) That all air eliminators, non-return valves, solenoid valves and motorised valves are operating correctly.
5) That the correct solar fluid volume is maintained.
6) That the electrical controls are operating correctly to the manufacturer's instructions.
7) That circulating pump is operating without undue noise or vibration.
8) That all insulation is firmly attached.
9) That all covers are in place
10) That no condensation or damp spots are apparent, particularly around the pipes and fixings in the roof.
11) That the roof fixings are firm and the roof covering is free from cracks.
12) That the weathering is properly protecting the structure.
13) That the collector glazing is clean.
14) That there is no damage to the glazing.
15) That there is no evidence of serious corrosion.

1 Code of practice for SOLAR HEATING SYSTEMS FOR DOMESTIC HOT WATER British Standards Institution

16) That any paintwork is sound.

17) That all sensing devices are firmly and properly in place.

7. Notes for the User

You have just become a user of the most important energy source of the future – and yet the oldest one in existence. Correctly installed, it will provide many years of reliable service. The system revolves around the lightweight yet highly efficient collector. McCallum has many years of experience in this specialist field and selects only the highest quality components for their systems._The solar system contains a special solar fluid, which transfers heat from the solar collectors to the hot water storage cylinder. The pipework circuit is subject to a small pressure and should be fitted with all necessary safety features i.e. expansion vessel and pressure safety valve.

Fully automatic control is by a differential temperature controller (DTC). The DTC measures the temperature in the solar collector and, when this is (typically) 4ºC hotter than the temperature in the lower half of the cylinder switches on a circulating pump in order to transfer the heat. When the temperature difference has fallen to 2ºC the pump is switched off. The collectors are protected and solar benefit will be had all year round because the fluid in the system contains anti-freeze. The DTC automatically controls the operation of the circulating pump and, at the same time, provides a digital temperature read-out. For operation of the controller please refer to the DTC manufacturers instruction manual.

To ensure satisfactory operation of the system the following points should be observed: -

1) The system should always be left switched on even when the house is unoccupied. This will ensure that the fluid in the collectors does not boil and evaporate, possibly resulting in a service call.
2) If the property is to remain unoccupied for a lengthy period of time the solar panels should be covered.
3) Periodically check the pressure gauge. When installed, the system is pressurised to 1.5 bar. This will vary continually according to the temperature in the collectors. If the pressure falls below 0.5 bar, however, a service call may be required.
4) To maximise solar gain, it is advised auxiliary heating (e.g. gas boiler) be switched off during daylight hours.

8. Decommissioning

Please contact McCallum Water Heating for information on decommissioning.