TECHNICAL DATASHEET:
Design of Large Scale and Pool Systems

100% Solar Solutions

The Imagination Solar System can be used for large scale applications as well as the standard one and two-panel domestic scale systems. This may be for a commercial building, swimming pool, hospital, communally heated apartments, sheltered accommodation or a domestic property with a large hot water demand. We have 'off the shelf' systems up to 16.2m2 but can provide bespoke solutions for any size of system.

Large Scale Options

There are two main stages when designing a large-scale system. Firstly, how large the system needs to be (collector area and storage volume) to provide the required hot water demand. Secondly, whether the system will be made up of readily available ISL components ('off-the-shelf') or whether a bespoke drainback system will be used.

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1. General Design Guidelines

There are no hard and fast rules when designing and specifying a solar system, but several 'rules of thumb' can be used.

It is unrealistic to try and design a solar system that will provide 100% of a building's annual domestic hot water (DHW) demand. Therefore a good starting point for most large-scale systems is to aim for 50% of the DHW demand. This may provide upwards of 80% of the summer load and a useful contribution in the winter months.

In general, either an annual volume of hot water consumption figure or annual energy load needed to heat the hot water will denote the DHW load.

Sizing based on DHW volume

To size a system based on hot water consumption assumptions will have to be made about the persons residing or working in the building. For a residential building the British Gas formula below is useful for calculating hot water consumption:

Hot water demand (litres/day) = 38 + 25 N

Where N is the number of occupants.

Persons in working environments use far less water per day for sinks and basins.

Estimates will also have to be provided for hot water use in washing machines and dishwashers. Depending on their efficiency and the temperature of the wash they may use anything from 5-25 litres of water (at 60°C) per cycle.

Sizing from energy demand

Some clients will provide DHW usage figures in energy needed to heat the water. This will normally be in the units kWh. A single panel ISL system delivers 1112kWh per year 'at the taps', although the energy collected by the solar system is much higher than this. This figure can be used to extrapolate the energy produced from multi-panel systems in DHW situations.

Rest of the system

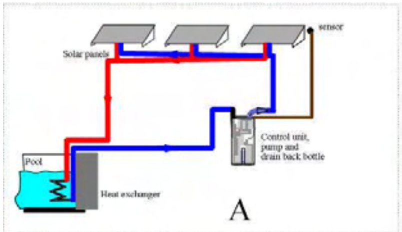
Once either the size of storage has been estimated then the area of collector can be determined on the basis that 50 litres of storage per square metre of collector. This is a happy medium between efficiency and hotter water temperatures, as increasing the storage\collector ratio will increase efficiency, whilst decreasing it will increase useful hot water temperature.

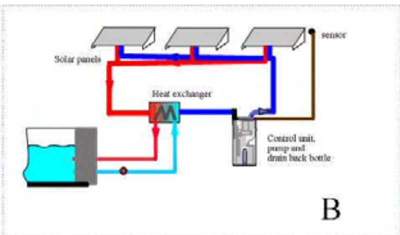
Other factors

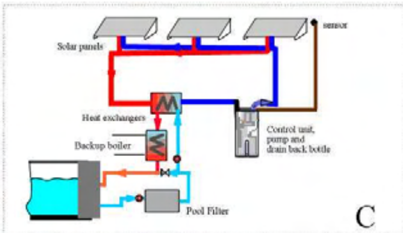
A number of other factors may influence the size of the system or the number of collectors used. This will include; angle or orientation, tilt angle, potential shading and geographical location.

Swimming pools

Swimming pool systems are large scale systems using to heat pool water, in most cases via a heat exchanger, as in diagrams B&C below. We would normally recommend a solar panel area equivalent to 25-50% of the pool area. Hot water for showers can also be provided.







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2. System type

'Off-the-Shelf' Systems

An 'off-the-shelf' system is a complete system made up of a number of smaller ISL systems. For example, the installation on the right is an eight-panel system divided up into two four-panel systems. This utilises two four-panel pump units and two solar coils in the cylinder. The advantage of this is that a large system can be made from a combination of standard pump units designed for 1,2,4 and 6 panels that carry guarantees and are tried and tested.

Whilst this makes design and commissioning relatively straightforward it can potentially make for a more expensive solar system. For a single cylinder the maximum limit is around 18 panels (48.6m^2) comprising three 6 panel systems with three solar coils. However if more than one storage vessel was used then 'off-the-shelf' system design is virtually unlimited.

Pipe Sizing

It is important with all ISL systems to get the pipe sizing and hydraulic conductivity right. Details on both these can be found in the Drainback Unit Technical Datasheet and Installation Guide 2 respectively.

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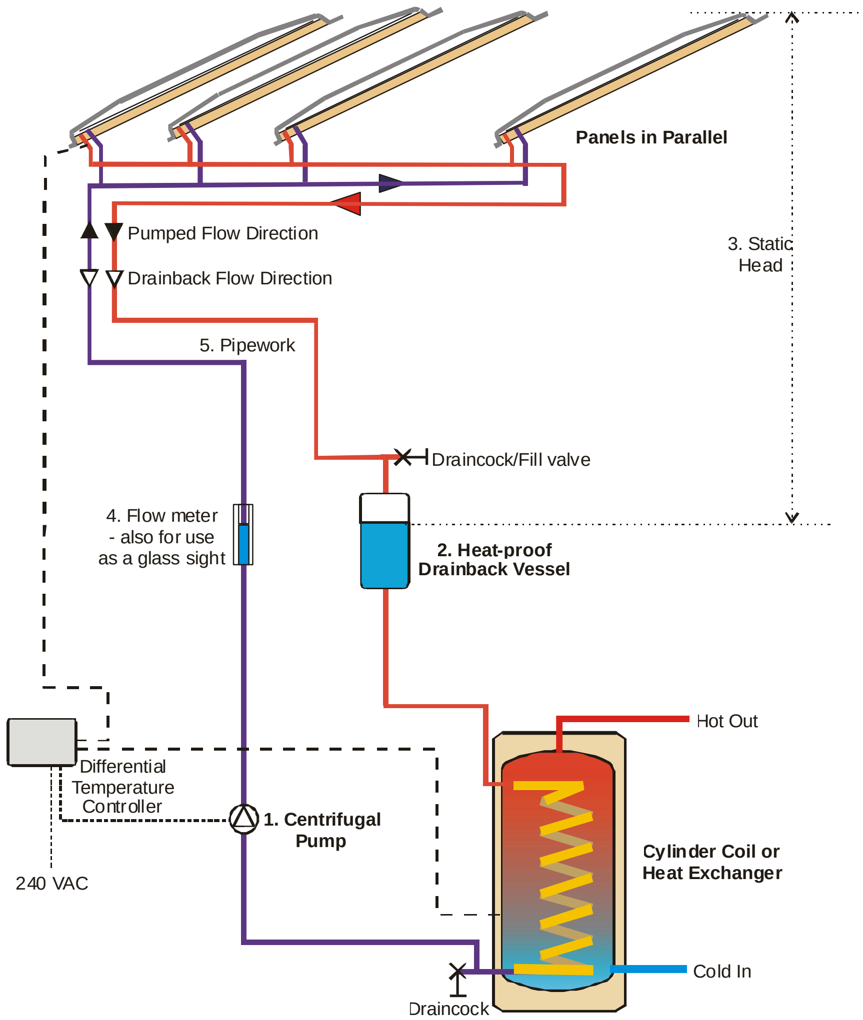
Bespoke Systems
Above 16.2m^2 the other option is to use a number of ISL panels in a conventional drainback design. In this case the system would be designed from first principles using piping, drainback vessel, pumps and valves, designed to suit the particular application. A typical sealed system will be as per the schematic below.



Notes:

1. Centrifugal Pump

A centrifugal pump is used so that drainback can occur both ways around the system. The pump needs to be a high static head AC pump that can overcome frictional forces and also the initial lift needed for the water to reach the highest point on the collectors (static head).

Position the pump a minimum of 1m below the lowest water level in the drainback vessel to ensure that air cannot be sucked into the pump. In best practice the pump will be mounted on the exit from the cylinder and will sit vertically on the feed side to help eliminate airlock problems.

2. Drainback Vessel

Position the drainback vessel in a heated space at any point above the cylinder height. Placing the drainback vessel closer to the height of the panels reduces the static head and therefore the required lift from the pump. Plumbing a couple of elbows in just above the reservoir can help reduce the noise of water falling.

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Sizing
Allow 1l of water for every ISL panel used; plus 4l for every 10m of 15mm pipe or 6.5l for every 10m of 22mm pipe. Allow an additional 15l to prevent water being sucked up.

3. Static Head
The static head is the vertical distance from water level in the drainback vessel to the highest point of the collector. The pump must have enough kick to overcome the static head plus a 1.5m safety margin.

4. Flow meters
A low pressure drop flow meter positioned at the exact height of the top part of the drainback reservoir can be used as a flow meter and as a site glass to measure the level of water in the drainback vessel. This way when the system is filled the top of the flow meter can be used as maximum fill level. It must allow back flow when the pump turns off for drainback.

5. Pipework
All pipes must have a minimum downwards gradient of 10°, increasing to 15° for pipes in unheated spaces. For large drainback systems use a minimum of 15mm pipes to ensure gravitational drainback. Furthermore, its best practise to use two 45° elbows instead of one 90 when running exterior pipes.

If the return pipework from the panels falls in a direct line downwards for more than 6m the water may fall faster than it is being pumped. Add a couple of 90° elbows in a heated space to prevent the pipework and drainback vessel from making excessive noise.

Sizing
Use 15mm pipe for up to six panels in parallel, 22mm for up to 10 panels in parallel and 28mm for system larger than this.

6. Antifreeze
Use a water/antifreeze ratio according to the manufacturers instructions.

7. Sealed versus Vented System
It is possible to design either a sealed or a vented system for large scale drainback. A sealed system will not require the addition of more heat transfer fluid at a later date, but will require the drainback vessel will also act as an expansion vessel or a separate expansion vessel to be included.

Disclaimer
These design notes are intended as a brief introduction and not as definitive guidance to be used for specification purposes. Please consult a building services engineer or experienced solar installer for final design and quotation.

References:
Some data and facts in this publication have been taken from the following sources:
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