Hamworthy Trigon

Solar Thermal Hot Water Systems

Trigon flat-plate solar collectors
Solar transfer stations and controllers

Modular arrays up to 60 m^2

Solar

2 Yr Warranty

CE

Hamworthy

Heating *at work.*

Trigon

Solar Thermal Hot Water Systems

Trigon solar hot water systems offer choice to building services engineers who are integrating solar energy into commercial hot water systems.

Commonly, solar thermal energy is used via calorifiers with high efficiency coils, to transfer the heat into stored water for distribution around the building. The solar energy can be supplemented through heat from a boiler system, or by using an electric immersion heater or other auxiliary sources.

Alternatively, solar thermal energy may be used to pre-heat storage tanks which are used to feed the water supply to conventional direct fired storage water heaters. This retains the seasonal efficiency benefits of separating the hot water generation from the heating system, and often enables the hot water generation to be located closer to the point of use, further reducing heat losses associated with hot water distribution systems.

Finally, solar thermal energy can be used with direct fired waters heaters, without the need for additional storage tanks, combining Trigon solar collectors with a Hamworthy Dorchester DR-TC solar water heater, with built in modulating gas burner to supplement the solar energy, and integrated control to prioritise use of solar energy, optimising the solar contribution.

The synergy achieved with Hamworthy Trigon solar hot water apparatus and Hamworthy's other hot water systems delivers effective hot water solutions to meet sustainable energy challenges with the most appropriate solution tailored for each project.

Options

- **Horizontal or vertical collectors**
- **Single or dual aspect fields**
- **Modular array mounting kits**
- **Solar transfer stations with standard or advanced controllers**
- **Heat metering**
- **Datalogger**
- **Powerstock calorifiers**
- **Powerstock storage tanks**
- **Dorchester direct-fired water heaters**

BENEFITS

- **Designed for commercial solar applications**
- **Optimised use of solar energy**
- **Full integration with hot water systems**
- **Pre-programmed schemes for easy set-up**
- **Intelligent power-saving controllers**
- **Impressive build quality**
- **Proven low-carbon solution**
- **Extensive technical sales support**

Trigon solar water heating apparatus from Hamworthy integrates highly efficient solar thermal energy into traditional heating and hot water systems for commercial applications.

High quality, highly efficient Trigon solar collectors

Trigon

Solar Equipment and Schemes

Trigon solar hot water systems are designed for integration with the Hamworthy Powerstock twin-coil calorifiers to provide solar duty domestic hot water (DHW). In such a system one coil in a Powerstock calorifier is fed by the Trigon solar circuit and one is fed by hot water from a boiler. Trigon solar systems can also be used in two–stage DHW systems where, in the first stage, the solar circuit feeds both calorifier coils (with both coils linked in series) to produce the solar pre-heated cold water feed for input to a second stage of DHW heaters. These can be either Dorchester water heaters or further Powerstock calorifiers, and they generate the duty DHW output.

Trigon solar systems are an attractive proposition as they profit from "free" solar energy whenever feasible. The more the calorifier is heated by solar energy, the less energy from other means is required to satisfy the heat demand at the DHW output, and so the greater the saving in fossil fuel, and the greater the carbon reduction.

Trigon solar systems become even more attractive when combined with Hamworthy high efficiency gas or oil boilers for top-up, night time and anti-legionella purge cycle heating; creating highly cost effective solutions while, at the same time, reducing CO_2 emissions.

The Trigon solar system includes high efficiency Trigon collectors and Trigon solar transfer stations with industry-leading controls, all sized for optimum performance to suit even the most demanding application. A range of modular collector array fixing kits for different roof types and A-frame mounts are available for rapid erection of Trigon collectors in arrays and fields. The Hamworthy Trigon solar system is scalable up to 60 m^2 area (30 collectors) for a single collector field.

Solar transfer stations for single collector field use are designated ST1, ST2 or ST3 according to pump size and size of collector field supported, and increasing in size from ST1 to ST3. The solar transfer station for dual-field use is designated ST1 DUAL, and is made up of an ST1 and an ST1 extension piece with additional pump and gauges.

The Trigon solar transfer station and solar controller are ordered together as one part. The transfer station name is appended with STD if supplied with the standard controller (DeltaSol BS/2), or ADV if supplied with the advanced controller (DeltaSol M) e.g. ST2 ADV.

Note that only transfer stations with an advanced controller can be specified for the dual-field option e.g. ST1 DUAL ADV, as the basic controller is designed to manage only one solar pump whereas the advanced can manage a single pump or control two pumps independently.

Nine pre-defined solar hot water design schemes are included in this brochure to aid design implementation using Trigon collectors and related equipment.

Trigon solar hot water apparatus is recommended for use with Hamworthy Powerstock calorifiers and/or water tanks, Dorchester water heaters, and auxiliary condensing gas boilers from the extensive Hamworthy range.

Trigon Solar Equipment and Associated Fittings

Trigon flat-plate collectors:

- Trigon 2.3V, vertical
- Trigon 2.3H, horizontal

Collector mounting kits (includes flexible connectors between adjacent panel connections) to mount arrays of between 1 and 10 collectors on:

- flat roofs/ground (A-frames)
- sloping slate, tile or corrugated steel roofs

Array hydraulic fittings kits (one required per array); includes balancing valve, hydraulic hardware and sensors

System balancing and equalisation valve for overall system hydraulic flow balancing

System safety relief valve for use between collector arrays and any isolation valves on the collector field manifold

All necessary temperature and light sensors

4 Trigon solar transfer stations with standard or advanced controllers:

- 3 for use with single field of collectors
- 1 for dual-field use (advanced controller only)

Optional heat metering equipment to measure solar heating contribution separately

System filling pump

Heat transfer fluid

Sensor lightning protection box

Expansion vessel (solar side)

Powerstock twin coil calorifier

The overview and descriptive sections that follow present the Hamworthy Trigon system, and the information is organised to reflect the functional block diagram on page 5. The block diagram also shows the Dorchester DR-TC system for comparison, although this system is fully described separately in brochure 500002598.

Trigon Solar DHW Schemes

The block diagram on page 5 references nine pre-defined design schemes that Hamworthy support for solar DHW production, organised in two functional groups:

Solar duty DHW schemes

Solar pre-heated cold water feed DHW schemes

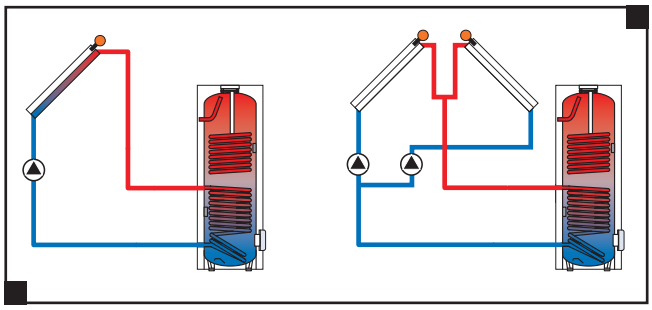
The schemes are presented from page 24 and offer a range of solar DHW solutions that can be scaled for a variety of applications. Hamworthy can offer design guidance, and technical support alongside these schemes, to assist in producing optimally sized, highly efficient solar DHW systems to suit location and DHW demand.

Please contact Hamworthy sales to discuss your specific solar DHW requirements on 0845 450 2865.

Hamworthy Solar Systems

Trigon and Dorchester DR-TC Systems Overview

The Trigon solar hot water and Dorchester DR-TC (combined solar and direct fired) systems both use a single pressurised closed-loop solar circuit (or two circuits in the case of the Trigon ST1 DUAL ADV) to capture solar energy and convert this into heat for commercial solar Domestic Hot Water (DHW) production: either for duty solar DHW systems, or for pre-heating the cold water supply to other duty DHW systems.



Single collector field and store (left), and dual-collector field and store (right) solar circuits

Each system operates using a generic solar heating cycle where a heat transfer medium (solar fluid) circulates between effectively two heat exchangers—one a Trigon solar collector field, the other a coil in a water store—taking in solar heat at the first heat exchanger and giving out thermal heat at the second, to heat water in the store. The two heat exchangers are coupled via a solar transfer station, which houses the solar pump (or pumps) on the return line to the collector. The pump (or pumps), together with temperature sensors at each collector field and water store, are electrically connected to the solar controller, to facilitate control of the pump (or pumps) and hence the fluid flow between the two heat exchangers.

Solar fluid heats up as it passes through the solar absorber pipework in the collector field and continues around the circuit to the coil in the storage device. In the Trigon system, the storage device is typically a Powerstock calorifier—a twin-coil storage tank, heated by solar fluid passing through one coil, with additional heat provided by a second coil fed with hot water from an auxiliary boiler, or an immersion heater. In the Dorchester DR-TC system, the storage device is the Dorchester DR-TC solar water heater with integral gas burner—again heated by solar fluid passing through its solar coil, but with additional heat provided by combustion gases from its integral burner passing through the water heater's condensing coil heat exchanger.

As the solar fluid passes through a calorifier or water heater coil, it gives up heat to the stored water and at the same time, cools down. It continues round the circuit to the collector where it is heated again by solar energy. The controller runs the pump, ensuring that the solar fluid is pumped around the circuit from collector field to coil and back at the appropriate flow rate. It operates the pump whenever feasible to profit from any available solar energy, i.e. whenever the solar fluid temperature at the collector field is a few degrees hotter than that of the stored water.

The controller automatically adjusts the solar fluid flow rate as necessary, under differential temperature feedback control, so that it responds to available solar conditions, DHW heat demand and draw off etc. to maintain efficient and effective operating performance and safety.

Hamworthy's Trigon and Dorchester DR-TC closed-loop solar hot water systems are summarised in the block diagram on page 5. Trigon systems offer single or dual collector field operation, whereas the Dorchester DR-TC system offers only single collector field operation, but has the advantage of not requiring any auxiliary boiler for topping-up heat or for anti-legionella cycling, so can be used in more space-limited applications. The equipment is organised by function as follows:

Solar (Energy Input) Collectors

- Trigon collectors with fixing equipment *(also for use with the Dorchester DR-TC system)*

Solar Energy Transfer and Control

Trigon System:

- 3 x Trigon transfer stations (with standard or advanced controllers) for single-field use
- 1 x Trigon transfer station (with advanced controller) for dual-field use
- Optional heat metering and datalogger

Dorchester DR-TC System:

- 2 x Dorchester DR-TC transfer stations, (with dedicated controller integrated in the water heater)
- Dorchester DR-TC optional monitoring equipment

Thermal Energy Output:

- Duty DHW systems *(Trigon and Dorchester DR-TC)*
- Heat Energy Output: Solar pre-heated cold water feed systems *(Trigon only)*

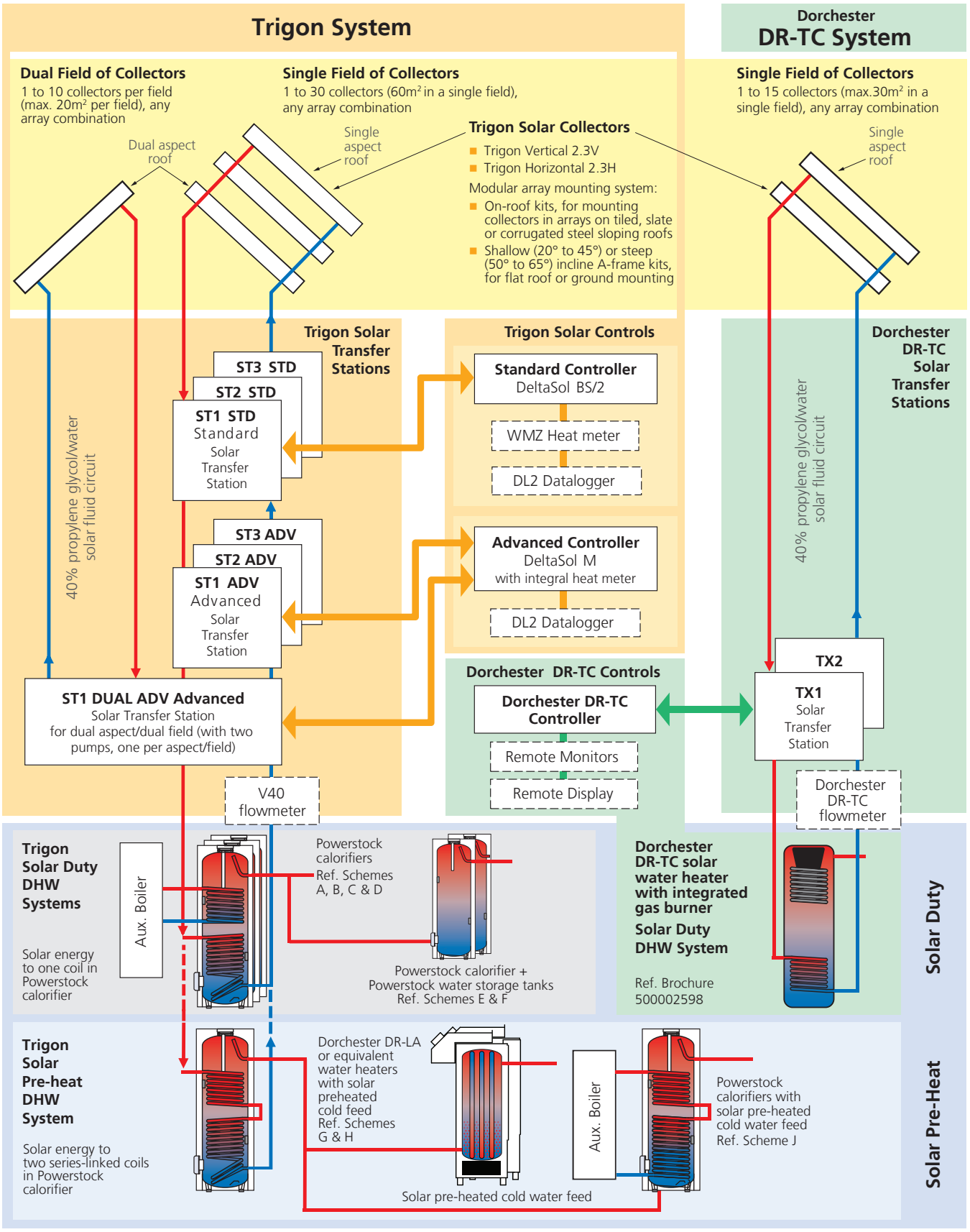
Additional equipment not shown in the diagram but necessary to complete either solar system includes: an expansion vessel to manage solar fluid expansion, a solar pump to load and pressurise the solar system, balancing and equalisation valves to adjust flow rates across arrays, and additional pressure relief valves to ensure the safety and integrity of the system.

Solar Collectors

In both Trigon and Dorchester DR-TC systems, the heat input to the solar circuit is via the Trigon collector field(s). A collector field comprises one or more flat-plate Trigon collectors connected together in single or multiple arrays, under control of a single pump.

Within each collector there is an absorber—a long meandering copper pipe welded to a specially coated sheet—which captures solar energy and transfers this to the solar fluid that flows through the copper pipe. Connecting several collectors together in arrays to form a single field creates effectively one very long solar energy absorbing pipe heat exchanger.

Trigon (and Dorchester DR-TC) Solar Systems



For details of hydraulic schemes, please refer to pages 24-27.

Trigon (and Dorchester DR-TC) Solar Systems

The Trigon solar system can be sized to a maximum of 30 collectors and the Dorchester DR-TC system can be sized to a maximum of 20 collectors. Hamworthy offer a sizing service using T*SOL software to help the system designer to predict the solar contribution to a DHW system, to ensure solar efficiency is maximised for the location, collector arrangement and DHW demand. It takes into account, amongst many other factors, roof orientation and collector mounting angles, at any given UK location. It is important that the solar system collector field is correctly scaled and positioned to be neither too large nor too small, in order to satisfy the DHW output requirements alongside any auxiliary heating, while being designed to operate safely, effectively and efficiently throughout the heating year.

Solar Energy Transfer and Control

Solar energy is transferred from input collector field to output heat exchanger via the solar fluid pumped around the circuit. The solar fluid is pumped via a pump (or pumps) in the transfer station, which has an associated controller deciding when to turn on the pump, and if on, how fast it should pump the solar fluid round the circuit. In addition to the correctly sized pump or pumps, each transfer station includes safety valves, isolation and non-return valves, pressure and temperature gauges, fill and drain points, connection for expansion vessel etc., housed together in a compact unit and well insulated to prevent any risk of injury to personnel.

The Trigon and Dorchester DR-TC systems have separate solar transfer stations and controls system, and neither the Trigon transfer stations nor their solar controls can be interchanged with those of the Dorchester DR-TC system.

The Trigon system offers a choice of three solar transfer stations (ST1, ST2, ST3) with standard (STD) or advanced (ADV) controllers for single field installations, each covering a range of collector field sizes, based on the number of collectors or collector area, and each with a choice of standard or advanced controller.

ST1 (STD or ADV), for 2 m^2 to 20 m^2 of collector area (1 to 10 collectors) single field installations

ST2 (STD or ADV), for 22 m^2 to 40 m^2 collector area (11 to 20 collectors) single field installations

ST3 (STD or ADV), for 42 m^2 to 60 m^2 collector area (21 to 30 collectors) single field installations

A fourth transfer station is available for use in dual-field installations (ST1 DUAL ADV) which uses the advanced controller only - it includes two ST1 pumps.

ST1 DUAL ADV, for two collector field installations, each field with 2 m^2 to 20 m^2 of collector area (1 to 10 collectors). Total collector area range 4 m^2 to 20 m^2 (2 to 20 collectors).

Two electronic controllers are available for the Trigon solar transfer station for pump control and system monitoring, the standard controller (Resol DeltaSol BS/2) and an advanced controller (Resol DeltaSol M). Although both have comprehensive functionality, which is described later, the key points to note are that they are easy to set up, require very little maintenance, and provide accurate system monitoring. Once set-up, they run the solar circuit(s) completely automatically, optimising the pump operation and speed for the most efficient transfer of solar energy, and taking advantage of any available solar energy whenever the temperature differential between collector and store is deemed sufficient.

The block diagram on page 5 shows optional equipment as boxes with dashed lines. Included in the Trigon solar controls is the optional heat meter (WMZ) for the standard controller (this function is included in the advanced controller) which can be used to demonstrate the solar heat contribution, and a data logger (DL2) to log and store this, and other important data for up to two years. An optional UV sensor kit (not shown) can also be connected to the datalogger to record sunlight data alongside the solar performance.

For comparison, the Dorchester DR-TC system offers a choice of two solar transfer stations. The controller on the front of the Dorchester DR-TC water heater manages the solar and hot water systems together, controlling both the solar transfer station pump via a bus-connected solar termination panel (not shown), and the water heater's integral gas burner. The termination panel provides the power and control signal for the solar pump and also receives inputs from all temperature and flow sensors relating to the solar circuit.

The controller includes a heat metering function which requires an optional Q/T sensor to be connected to the solar termination panel. The bus system can be extended to include optional system monitoring and display equipment. For details of the Dorchester DR-TC system refer to brochure 500002598.

Thermal Energy Output

In the Trigon solar system the water storage device comprises one or more calorifiers from the highly efficient Powerstock range, with storage volume extendable using one or more Powerstock water tanks and loading circuits. The Powerstock calorifier(s) can be used with an auxiliary boiler or immersion heater to provide top-up heat whenever the solar circuit alone cannot satisfy the output demand, and for anti-legionella cycle heating.

In the Dorchester DR-TC system, water storage is provided by the solar water heater itself, with top-up/anti-legionella auxiliary heating delivered by its integral gas burner rather than by an external boiler. A range of Dorchester DR-TC solar water heaters with integral gas burners are available.

Hamworthy provide nine useful pre-defined schemes to demonstrate the Trigon solar DHW offer *(see pages 24-27)*, with single or dual field systems supplying solar heat to the following Hamworthy (or equivalent) output systems and equipment:

Trigon solar output: Duty DHW system schemes

One, two or three Powerstock calorifiers generating duty hot water, with auxiliary boiler/immersion heater providing back up heat, and one or two Powerstock water tanks for additional storage capacity.

Trigon solar output: Pre-heat DHW system schemes

A single Powerstock calorifier generating pre-heated cold water feed to supply a secondary DHW generation system; examples include solar pre-heat supply to one or two Dorchester (non-solar), direct-fired water heaters e.g. Dorchester DR-LA, and to one or two Powerstock calorifiers.

Specification

Trigon Solar Collectors

Collector Overview

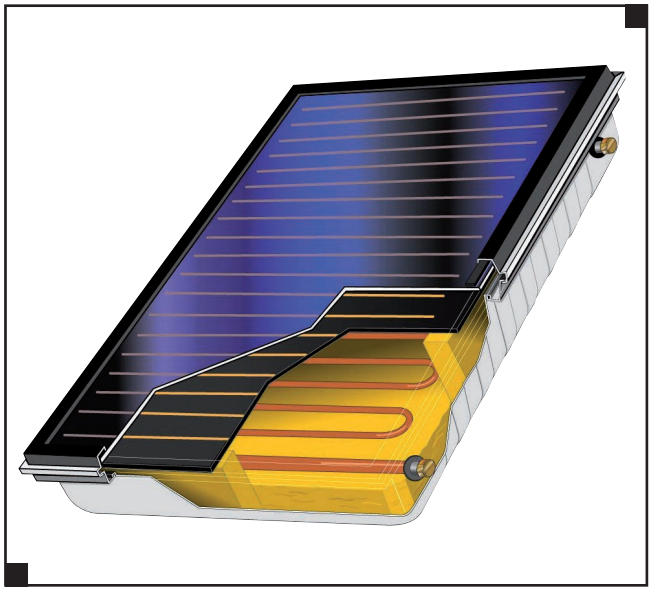
Hamworthy offers two precision engineered, flat plate solar collectors, the Trigon 2.3V vertical (portrait orientation) and Trigon 2.3H horizontal (landscape orientation) collectors. Trigon collectors are suitable for both new build and retrofit installation, and can be mounted on different types of sloping roofs, flat roofs, or can be ground-mounted, with collector orientation chosen to suit location and available space. All Trigon collectors come with a 5 year guarantee.

They come with scalable, easy-to-fit, mounting kits for rapid assembly in arrays up to 10 collectors wide, to make a single or multi- array collector field of up to 30 collectors. With an effective absorber surface area of 2.0 m^2 they each can provide around 1.57kW instantaneous thermal output with 1 kWhr/m^2 solar irradiance, and at a nominal flow rate of 20 litres/hour/m^2.

These collectors are of a simple but very effective and well-proven design and can operate even on cloudy days because they convert short wavelength ultraviolet light in to heat energy via their specially coated absorbers.

Designed for use in harsher climates than in Britain, and guaranteed hail/snow resistant to BS EN12975, these rugged units will give years of free solar energy, with little or no maintenance, when used with the recommended environmentally friendly and inherently safe solar fluid solution.

Trigon collectors can be rapidly installed in arrays using the modular rail-mounting system which can be scaled for arrays of up to 10 collectors at a time. The rail-mounting system is offered in sloping on-roof mounting kits suitable for tile, slate or corrugated steel pitched-roof mounting, or flat roof A-frames mounting kits for on-ground or flat-roof mounting of Trigon collector arrays, with either shallow or steep angle options on the A-frame for vertical collectors.



Cutaway of Trigon 2.3V, vertical, flat-plate collector

Collector Features

- 5 year guarantee
- Optical efficiency 80.4% (2.3V), 79.4% (2.3H)
- Up to 60mm Rockwool insulation
- Absorber with "meander" pipe layout for even heat distribution
- Flexible connectors between collectors in an array
- Rapid assembly of collector arrays—no brazing
- Maximum of 10 collectors per array, if feed and return are at opposite ends of the array
- Maximum of 5 collectors per array, if feed and return connect at same end of the array
- Left or right side connections
- Absorber with extremely high yield
- 3.2 mm safety glass, thermally pre-stressed
- Class 1 hail resistant to EN 12975
- Single weatherproof EPDM seal, using single machine-crimped retaining strip
- Precision engineered and tested.
- Tough, yet lightweight
- Sloping or flat roof mounting options for a range of roofing materials

Options

Collector on-roof mounting kits for sloping roofs:

- Tiled roofs (2.3V or 2.3H)
- Slate roofs (2.3V or 2.3H)
- Steel roofs (2.3V only)

Collector A-frame mounting kits:

- Shallow adjustable 20°, 30° or 45° inclination (2.3V or 2.3H)
- Steep adjustable 50°, 60° or 65° inclination (2.3V only)

Collector lifting straps

Specification

Trigon Solar Collectors

Collector Construction

The Trigon collector has a selective coated full area absorber which produces exceptional energy absorption performance. The absorber sheet is laser-welded to meandering narrow diameter copper pipe, to ensure maximum heat transfer to the solar fluid that flows through the absorber pipework. The narrow copper pipe is joined to two larger diameter copper pipes which act as the collector's flow and return manifolds. The piping arrangement offers consistent heating across the whole area of the collector and across an array of several collectors joined together.

The absorber is housed in a thermally efficient and fully weather-tight, deep-drawn aluminium casing, and behind a 3.2 mm thermally toughened soda lime silicate safety glass to EN 12150, which enables the maximum solar energy to reach the absorber, as well as providing a structurally tough protection against strong wind, hail and snow loadings. The tempered glass cover acts like glass in a greenhouse, retaining heat within the collector and reflecting light back to the absorber. The combined result is a collector which absorbs approximately 95% of the incident solar energy while only radiating approximately 5% of the energy back out.

The collector's efficiency is enhanced by minimising heat loss by convection between the absorber and the casing through the use of Rockwool insulation to a depth of up to 60mm behind the absorber, and to 13 mm to the side of the absorber. The casing also has a small vent at the rear to prevent condensation which might otherwise affect the optical performance of the glass cover.

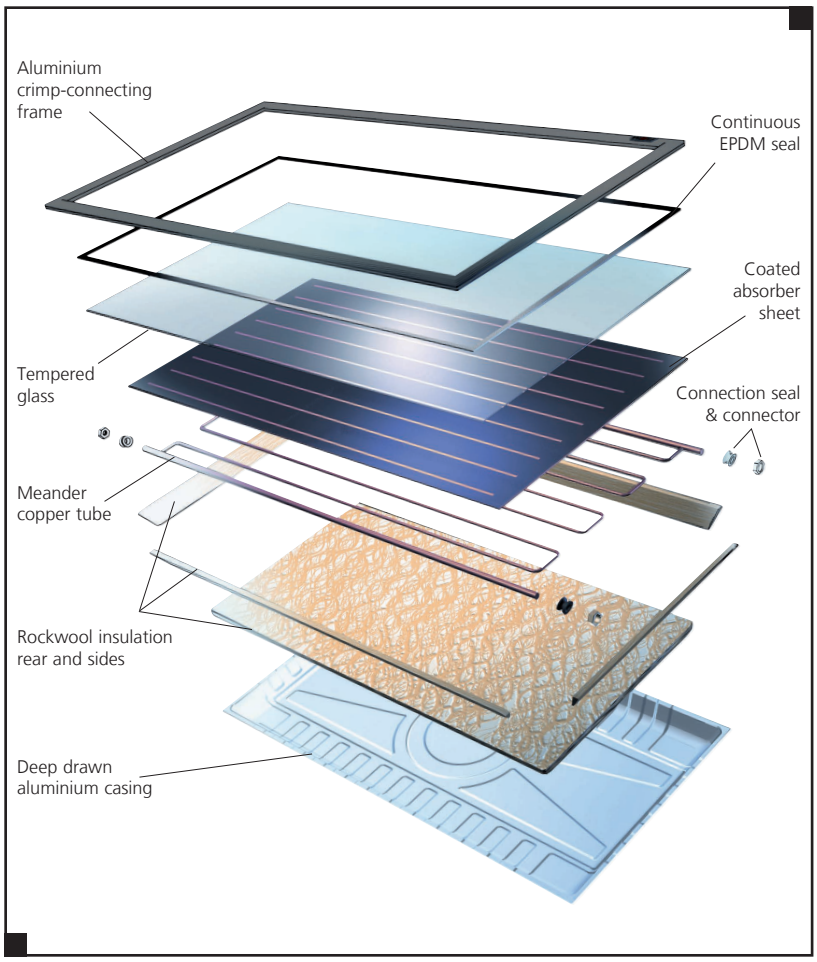
A one-piece continuous EPDM seal is used between the glass and the collector body, held in place by a machine crimped extruded aluminium frame, making a strong and dependable, weatherproof unit which is hail and snow resistant to BS EN12975. The collector is sealed for life unit, with no user-maintainable parts inside.

The collector has curved sides and four threaded sockets for positive location into the Trigon modular mounting kits. Two lower sockets are for threaded studs, which help to line up the collector initially on the lower fixing rail, and the upper sockets accept bolts that located and fix the collector to the upper rail. The sockets can also be used to attach optional lifting straps to aid hoisting to position on a roof.

Hydraulic flow and return connections at each end of the collector are via G¾" brass female, flat sealing threaded captive nuts, with high temperature sealing washers, for connection to flow and return pipework or to join to other collectors via flexible connectors that additionally accommodate expansion resulting from temperature gain.

The Trigon collector materials have been chosen with low weight in mind for ease of installation and for use on a greater variety of roof types without any additional structural support. A structural engineer should always check the intended location for suitability. The dry vertical collector weighs in at 40 kg, and the horizontal at 41 kg which equates to around 17.4 kg and 17.8 kg per square metre respectively. These offer a much lower per-square-metre roof loading than the equivalent sized evacuated tube collector, an important factor to consider when selecting the type of collector, especially if the existing roof structure design is limited in its ability to carry additional loading from the solar system. To help with loading calculations, a table has been included on page 14 showing the dry weights of vertical or horizontal collector arrays sized from one to 10 collectors, together with the weights of all associated fittings and fixtures.

For wind/snow loading calculations, the cross-sectional surface area of either collector is 2.3 m^2.



Exploded view of Trigon 2.3H, horizontal, flat plate collector

Specification

Trigon Collector Arrays and Fields

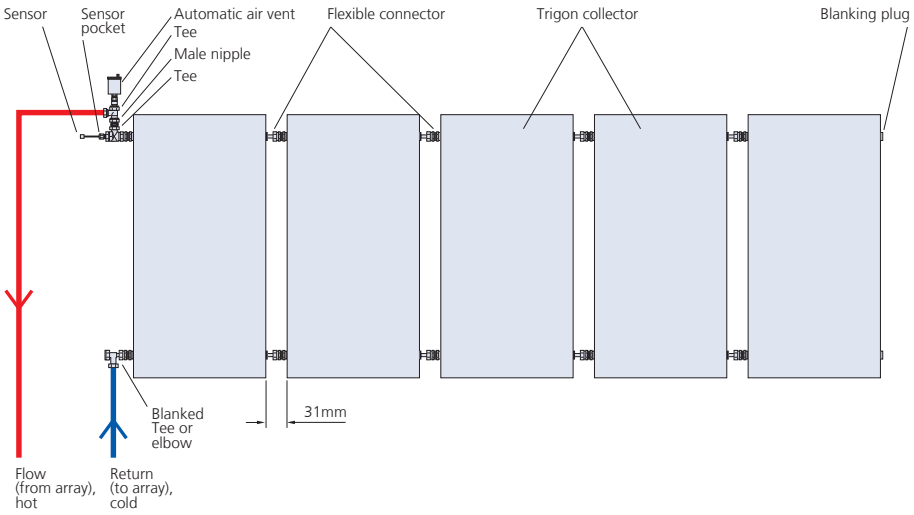
Solar collectors can be used individually, or connected in parallel in arrays of two, three, four or five collectors if flow and return hydraulic connections are made at one end (left or right), see Fig 1. Solar collectors can also be used individually or connected in parallel in single arrays of between 1 and 10 collectors if these connections are made at opposite ends of the array, see Fig 2. Hydraulic connections can be left or right side, but if two or more arrays are used then balancing valves (not shown) must be fitted on each return line, and if there is more than one array, a system balancing and equalisation valve is also required, to balance the whole solar field to match the pump maximum flow.

In the Trigon system, a solar field is defined as an arrangement of one or more collectors, grouped in single or multiple arrays that belong to the same closed solar circuit, and with the solar fluid flowing through it individually controlled by a single pump. A dual field system therefore has two pumps, one per field, and each under separate differential temperature control.

The maximum sized single field Trigon system is 30 collectors, arranged in any parallel array permutation. E.g.: 3 arrays of 10 collectors or 2 arrays of 7 collectors plus 2 arrays of 8 collectors etc.

Note: No single array can have more than 10 collectors. In dual-field systems, each field can have no more than 10 collectors.

Fig 1 – Single collector array, flow and return same end.
Maximum 5 x Trigon collectors (10m²)/array



Note: The collectors have connections that extend further from the collector's body on one side than the other.

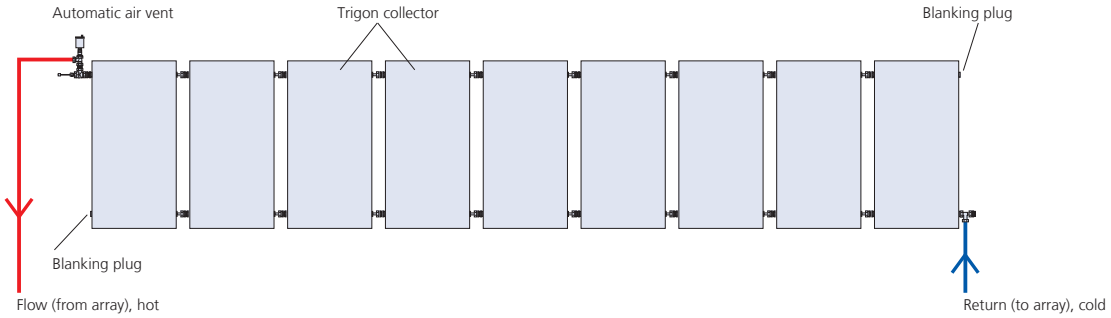
Orientate all collectors so that their extended pipe connections are on the left for left side flow pipe and AAV connections, as shown.

For flow pipe and AAV connections to the right side of the array, rotate each collector through 180 degrees so that their extended pipe connections are on the right.

Frame rails are pre-drilled to place collectors 31 mm apart.

Join collectors together with flexible connector (captive nuts), max torque 20 Nm.

Fig 2 – Single collector array, flow and return opposite ends.
Maximum 10 x Trigon collectors (20 m²)/array



Collector array arrangements complete with hydraulic fittings kit: temperature sensor pocket and sensor, balancing valve for the collector array, automatic air vent (AAV), 3 x Tee connectors (1 capped, 1 with sensor pocket, 1 with AAV and connection nipple), 2 x blanking plugs. Each collector is supplied complete with captive unions and high temperature sealing washers.
The appropriate number of flexible connectors are supplied as part of the selected collector mounting kit.

Specification

Trigon Solar Collector Equipment

Flexible Connectors

Collectors are supplied fitted with flexibly mounted female captive unions and high temperature sealing washers, and are simply joined together using flexible connectors with male captive union nuts (Maximum tightening torque 20 Nm). The flexible connectors allow for movement in the assembly and roof structure due to thermal expansion and contraction, while maintaining a strong hydraulic connection. The appropriate number of flexible connectors are supplied with the specific array mounting kit that is for a given number of collectors and specific roof type.

Balancing and Equalisation Valves

The Trigon system supports unequal arrays, by the provision of a balancing valve (DN15) in each array hydraulic fittings kit, for use on return line for each array, so that, on commissioning, pressures across the arrays can be manually balanced. This can be very useful in a system where the available roof space will not allow for an equal number of collectors in each array. It also means that without having to match pipe run lengths, such as in a Tichelmann arrangement, less overall piping should be required. Even so, it is still good practice to use an equal number of collectors in each array where possible, to roughly balance the pressure drop across each array, with balancing valves used for fine flow adjustment.

In multiple array installations an overall system balancing and equalisation valve should always be fitted to the main return to the collector arrays to adjust the flow rate to required level at the maximum selected pump speed. As a single balancing valve (DN15) is included in each first array hydraulic fittings kit, this will suffice as the equalisation valve when there is only one array of collectors.

Collector Temperature Sensors

A single aspect solar field requires one temperature sensor for the first array only, whilst a dual aspect solar field requires one temperature sensor for the first array, in each aspect.

Hamworthy provide appropriate temperature sensors and sensor pockets for use in the collector at the output of the collector field, with a single sensor and pocket included in the first array hydraulic fittings kit.

The sensor included in the hydraulics fittings kit is a PT1000 high temperature, (rated -50°C to 200°C) platinum sensor, 45 mm x 6 mm diameter, with 1.5 metre twisted pair black cable (rated -5° to 180°C), for measuring solar fluid temperature in collector flow.

Note: A spare collector temperature sensor is also supplied with each solar transfer station.

UV Sensor Kit (optional)

An optional "twilight" sensor is available, (Ultraviolet photocell CS10), for use with the advanced controller only, to record sunlight data (requires a DL2 Datalogger). Maximum cable length 100 m, not HHL supply.

Tank Temperature Sensor (Immersion Type)

A single calorifier (cylinder) immersion type temperature sensor is supplied with each solar transfer station. Additional optional sensors can be supplied for multiple calorifiers or storage tanks.

The Immersion sensor includes a ½" BSPP pocket, PT1000 high temperature (rated -50°C to 200°C) platinum sensor 45 mm long x 6mm diameter, with 2.5 m long twisted pair grey cable (rated -5°C to 80°C) for measuring stored DHW temperature in the calorifier.

Tank Temperature Sensor (Strap-on type)

An optional strap-on sensor is available, supplied to attach to the surface of the flow pipe, or preferably the surface of the tank below the insulation where possible, instead of using a sensor pocket. It is a PT1000 sensor (rated -50°C to 200°C) and cable (rated -5° to 80°C) with 2.5 m long twisted pair.

Note: use of immersion sensors is strongly recommended for more accurate temperature measurement.

Solar Fluid

Trigon systems are designed for use with a propylene glycol-based solar fluid. Tyfocor L solar fluid is recommended as it offers excellent heat transfer properties, antifreeze protection to -19°C at 40% concentration with clean water, and corrosion protection. For the initial fill, Hamworthy can supply 10 litres of solar fluid concentrate in 25 litre capacity part-filled containers for dilution with water on site, to save weight. To obtain the 40% glycol/water mix, the container is simply filled with clean water (i.e. add 15 litres). Top-up solar fluid concentrate can be supplied in 5 litre containers. For accurate heat metering, it is essential that the percentage glycol mixture matches the controller's glycol mix parameter settings. This should be tested on commissioning and the fluid or controller adjusted as necessary.

Note: Where use of a Renewable Heat Incentive (RHI) approved heat meter is specified, then the mix of solar fluid is of further significance. The RHI approved heat meter is calibrated for 40% glycol/water concentration at the factory, and supplied with compliance certification.

Sensor Lightning Protection Box

A sensor lightning protection box is optionally available to protect electronic equipment connected to the solar collector temperature sensor.

Note: This protection does not replace the need for pipework and fittings to be earthed for lightning protection in accordance with regulations.

Collector Lifting Straps

For ease of installation and lifting collectors to roof level, Hamworthy can supply an optional set of four short straps with securing bolts which screw into the collector fixing sockets.

Specification

Array Mounting Kits for Trigon Collectors

Rail-Mounting System

Hamworthy offers a quick-to-install modular rail-mounting system for rapid assembly of Trigon collectors into arrays and fields, and comes in sloping on-roof or A-frame for flat roof array mounting kits to suit the number, orientation and location of the collectors. It is a parallel, horizontal, two-rail system, where in sloping on-roof array mounting kits the two rails are fastened via appropriate fixings to a sloping roof, or in flat roof array mounting kits, are integral structural members in an A-frame assembly. Once the A-frame is assembled and anchored, or the rails are fixed to the sloping roof, the collectors simply fit onto the predrilled rails and are quickly located and secured at four points each with stainless steel bolts/studs and nuts, to make up a structurally sound array, with interconnections between adjoining panels made using bolt-on flexible connectors.

Array mounting kits are supplied as complete kits, suitable for the selected number of collectors, from one, up to ten, multiple mounting kits may be ordered. The array mounting kits include all rail extension pieces, flexible connectors, and necessary fixings for the on-roof type or A-frame specified.

Sloping On-roof Array Mounting Kits

Using the sloping on-roof mounting kits, Trigon collector arrays can be fixed to inclined roofs of an angle greater than, or equal to, 15° (27%). Sloping on-roof mounting kits have specific fittings for the type of roof material, with kits available for vertical or horizontal collectors, to suit:

- Interlocking ceramic, concrete or terracotta tiled roofs (tile depth must not exceed 40 mm)
- Slate roofs
- Corrugated steel roofs (vertical collectors only)

Roof type should be specified at the time of ordering.

Each collector can be positively located and bolted securely to the mounting rails.

Single field array of three Trigon 2.3V vertical collectors, rail-mounted on a tiled sloping roof

Trigon 2.3V collector array, flat roof mounted using a shallow A-Frame array fixing kit

A-Frame Array Mounting Kits

Trigon collectors can also be mounted on the ground or on flat roofs using A-frame mounting kits, which uses A-frames made from extruded aluminium for strength, low-weight and corrosion resistance.

Two A-frame types are available:

- Shallow A-frame, adjustable to allow 20°, 30°, or 45° inclination (vertical and horizontal collector variants available)
- Steep A-frame, adjustable to allow 50°, 60°, or 65° inclination (vertical collectors only)

Note: A-frames must be securely anchored to the ground or to a flat roof using bolts and/or steel cables as required (not HHL supply).

A-frames enable collectors to be mounted at an appropriate angle for use on flat roofs, roof terraces or at ground level. In most applications the solar collectors are arranged vertically, however, in A-frame installations, the horizontal layout helps to reduce shadowing, allowing multiple arrays of collectors to be aligned in rows closer together.

Roof Penetration Slates (Quick Slate)

Hamworthy can provide optional quick slates (roof penetration slates) for use where the pipework to and from the collectors needs to pass through the sloping roof. These obviate the need to cut existing tiles at the pipe/tile intersection. The optional quick slates are available in pairs and provides access to roof space for pipework and cables.

On a sloping roof, it is common practice to penetrate the roof close to each array using a quick slate, so multiple quick slates may be required. The pipework and cabling between collector array(s) and transfer station is the responsibility of others. Not HHL supply.

Performance and Technical Data

Trigon Solar Collectors

		Units	Collector Model	
			Trigon 2.3V	Trigon 2.3H
Energy	Collector output @ irradiance 1000 W/m² and 20 l/hr/m² solar fluid flow rate	kW	1.57	
	Collector yield per annum per m² absorber area @ irradiance 1000 W/m² and 20 l/hr/m² collector flow	kWh/m²	785	
	Optical Efficiency*	%	80.4	79.4
	Heat loss coefficient a_1 * (Thermal Transmittance, linear K_1)	W/(m²K)	3.235	3.494
	Heat loss coefficient a_2 *(Thermal Transmittance, quadratic (K_2) W/m/°C)	W/(m²K)	0.0117	0.015
	Maximum idle temperature	°C	194	198
	Irradiation angle correction factor IAM-50	%	94.0	95.4
	Specific thermal capacity C*	kJ/(m²K)	5.85	6.3 (8.073)
	Effective thermal capacity	kJ/K	11.75	12.6
	Maximum operating pressure	bar	10	
Solar Fluid	Recommended Max flow rate per collector	litres/hr.	20	
	Recommended solar fluid	-	Propylene glycol e.g. Tyfocor L (diluted 40% Tyfocor /60% water)	
	Maximum solar fluid pressure	bar	10	
	Maximum stagnation temperature at 1000 W/m² and 30°C	°C	194	198
	Solar fluid content	litres	1.7	1.9
Collector	Surface area of collector, gross	m²	2.3	
	Aperture surface area	m²	2.0	
	Effective absorber surface area	m²	2.0	
	Tempered solar safety glass, resistant to hail (EN12150, EN12975) thickness	mm	3.2	
	Mechanical strength of the glass cover to climatic loads (wind lift and snow loading)	Pa	3200	
	Depth of Rockwool Insulation in base of housing	mm	55	60
	Angle of installation	degrees	From 15° to 90° depending on fixings	

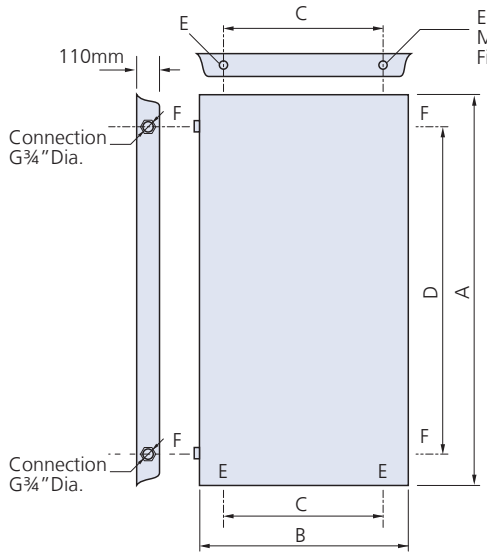
**Values to EN 12975*

Pressure Loss across Collector Arrays @20l/h/m² Collector Absorber Area

Pressure Loss/mbar, with Flow & Return Connection at:	Number of Collectors									
	1	2	3	4	5	6	7	8	9	10
Opposite Ends/2.3 V	31.93	32.23	32.99	34.02	35.73	38.04	41.04	45.09	49.72	55.98
Same Ends/2.3 V	32.07	32.56	33.55	34.88	36.89	N/A	N/A	N/A	N/A	N/A
Opposite Ends/2.3 H	32.36	34.03	36.75	40.42	45.85	53.19	62.28	74.57	87.86	105.85
Same Ends/2.3 H	31.99	33.15	35.30	38.22	42.49	N/A	N/A	N/A	N/A	N/A

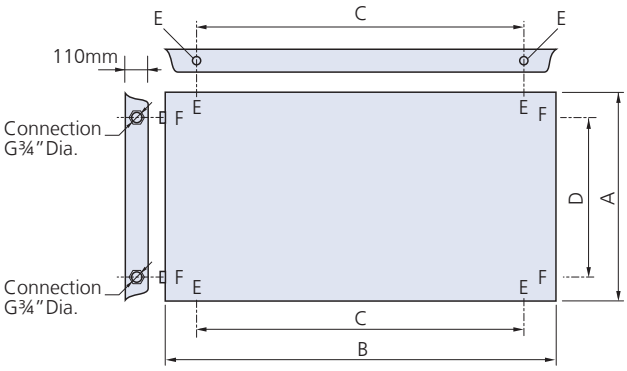
Dimensional Details

Trigon Solar Collectors



Trigon 2.3V Collector

Note: Collector flow output (hot) is from either upper connection. Collector return input (cooler) is from either lower connection.

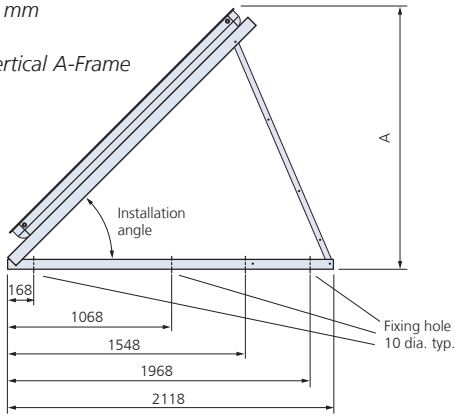


Trigon 2.3H Collector

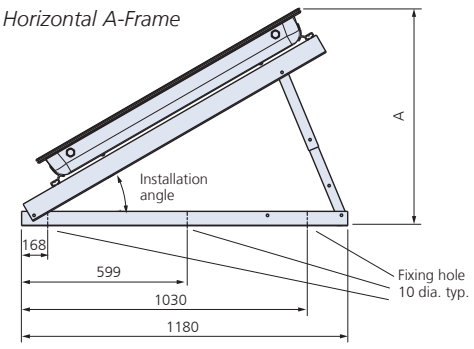
Dims.	Description	Units	Trigon 2.3V	Trigon 2.3H
A	Height	mm	2099	1099
B	Width	mm	1099	2099
	Depth	mm	110	
C	Rail Fixing Point centres	mm	167	
D	Flow/return centres		1900	900
E	Threaded hole, rail fixing point, for M8x20 coach bolt to upper rail, M8x30 hex socket stud and nut to lower rail.		M8	
F	Flow/return connections (flat sealing, threaded, with union nut)	inch	G□" female	
	Weight (dry)	kg	40	41

All dimensions in mm

Trigon 2.3V on Vertical A-Frame (shallow or steep)



Trigon 2.3H on Horizontal A-Frame (shallow)



Height Ref.	Vertical Collector Installation Angle					
	Shallow			Steep		
	20°	30°	45°	50°	60°	65°
A	951	1286	1716	1835	2032	2108

Height Ref.	Horizontal Collector Installation Angle		
	Shallow		
	20°	30°	45°
A	608	785	1008

Collector Field Equipment

Weights of Collector Field Equipment

When calculating the load on the roof or other supporting structure, in addition to snow and wind loadings, all equipment static loads should be taken into account, including the weight of solar fluid in the collectors and any pipework in the proximity of the collector field. A structural engineer can then ascertain the suitability of the structure to mount the solar fields for the suggested scheme and, if necessary, advise on any reinforcement work that may be required.

The dry weights of collectors and their modular on-roof array mounting kit, A-frame array mounting kits, and collector hydraulic fittings kits must also be considered in roof loading calculations. The table below summarises the weights for different equipment combinations for arrays of up to 10 vertical or horizontal collectors.

Collector Array Hydraulic Fittings Kits

A collector hydraulic fittings kit is required for every collector array. This has all the necessary fittings for the array. The pipework and sensor cabling from the array to connect to the solar transfer station is not included.

There are collector array hydraulic fittings kits for sloping on-roof or A-frame installations, and each has a 1st array kit and an extension array kit.

A single array installation, will simply need a 1st array hydraulic fittings kit, for either on-roof or A-frame.

Multiple arrays, will require a 1st array hydraulic fittings kit, and then an extension array kit for each subsequent array. For example, an installation with 15 collectors in 3 arrays of 5 collectors each, will need one 1st array kit and two extension array kits, for either on-roof or A-frame.

Every collector array hydraulic fittings kit includes a single balancing valve (DN15), an elbow/tee for the return connection, an automatic air vent for vertical connection via two tees and male nipple for the flow connection. Two metal blanking plugs are also included in the kit to seal the unused connections.

In addition, each 1st array hydraulic fittings kit includes a sensor pocket and insertion temperature sensor for the first collector flow connection.

Both types of sloping on-roof kits will each include two 1m lengths of insulated stainless steel flexible convoluted hose and fittings, for piping the collector flow and return lines through the roof space, for each array.

	Trigon Collector Quantity x Model	Array Width (m)	Dry Weight of Collectors only (kg)	Total weight with mounting kit and hydraulic fittings kit (kg)				
				Sloping on-roof mounting kits			A-frame mounting kits	
				Tile	Slate	Steel	Shallow, 20°/30°/45°	Steep, 50°/60°/65°
Vertical Collectors	1 x 2.3V	-	40	53	50	48	58	63
	2 x 2.3V	2.23	80	99	95	91	108.5	113
	3 x 2.3V	3.36	120	146	141	135	158.5	167
	4 x 2.3V	4.49	160	192.3	185.5	179.8	205	217
	5 x 2.3V	5.62	200	239.3	231.5	223.8	255	271
	6 x 2.3V	6.75	240	285.6	276.1	268.6	301.5	321
	7 x 2.3V	7.88	280	332.6	322.1	312.6	351.5	375
	8 x 2.3V	9.01	320	378.9	366.6	357.4	398	425
	9 x 2.3V	10.14	360	425.9	412.6	401.5	448	479
	10 x 2.3V	11.27	400	472.2	457.2	446.3	494.5	529
Horizontal Collectors	1 x 2.3H	2.1	41	57	54	N/A	58.5	N/A
	2 x 2.3H	4.23	82	108	104	N/A	111	N/A
	3 x 2.3H	6.36	123	159	154	N/A	163.5	N/A
	4 x 2.3H	8.49	164	210	204	N/A	216	N/A
	5 x 2.3H	10.62	205	261	254	N/A	268.5	N/A
	6 x 2.3H	12.75	246	312	304	N/A	321	N/A
	7 x 2.3H	14.88	287	363	354	N/A	373.5	N/A
	8 x 2.3H	17.01	328	414	404	N/A	426	N/A
	9 x 2.3H	19.14	369	465	454	N/A	478.5	N/A
	10 x 2.3H	21.27	410	516	504	N/A	531	N/A

Trigon Solar Transfer Stations

Solar Transfer Stations ST1, ST1 Dual, ST2 and ST3

ST1 solar transfer station

Solar Transfer Station Overview

Trigon solar transfer stations house the pump(s) which automatically control the flow of solar fluid in the closed solar circuit, under control from a standard or advanced electronic controller. The station physically couples the solar energy input part of the solar circuit (or circuits) to the solar thermal output part of the circuit. Each station is specifically designed and sized for optimum flow performance for a range of collector field sizes, and houses the pump(s), valves, safety equipment and fittings, together in a compact, wall mounted unit, which is well insulated for thermal efficiency and to minimise any risk of injury to personnel.

The Trigon system offers a choice of three solar transfer stations: ST1 (STD or ADV), ST2 (STD or ADV) and ST3 (STD or ADV), for single field installations and one solar transfer station: ST1 DUAL ADV, for dual field installations. Each covers a range of sizes of collector field area/number of collectors.

Options

Choice of 3 sizes of transfer station for single field use and 1 for dual field use:

- ST1: 2 m^2 to 20 m^2 / 1 to 10 collectors
- ST2: 22 m^2 to 40 m^2 / 11 to 20 collectors
- ST3: 42 m^2 to 60 m^2 / 21 to 30 collectors
- ST1 DUAL ADV: 4 m^2 to 40 m^2 / 2 fields: (1 to 10) plus (1 to 10) collectors

Standard or advanced controllers

Solar transfer stations are supplied with standard or advanced controllers as one unit and in the nomenclature, STD refers to those with the standard controller, ADV refers to those with the advanced controller.

Note: The standard controller is not available with the ST1 DUAL ADV as this is a two pump unit that requires the advanced controller to manage both pumps.

Solar Transfer Station Features

For accessibility and convenience, Trigon solar transfer stations pack all of the following necessary equipment into one compact unit:

Highly reliable and efficient Wilo Star stepped-variable speed solar pump (or pumps for ST1 DUAL ADV) on the return side, for long life /low maintenance, with:

- 3 manual pre-set maximum speed settings to aid system flow set-up; for use in conjunction with equalisation valve for setting optimum flow rates,

In-line, ¼-turn isolation valves with non-return valves to prevent thermosyphoning (one in each of the flow and return lines).

Push-fit dial temperature gauges, integral to the isolation valves, for clear and precise system temperature monitoring. These are colour-coded red for the flow from the collector (left side) and blue for the return (right side) for ease of identification.

Dial pressure gauge on the discharge side of the pump for clear and accurate indication of system pressure (return side).

Solar fluid fill and drain connections with isolation valves *(flow and/or return side depending on model - see details on pages 16 & 17).*

Connection for a necessary expansion vessel (return side).

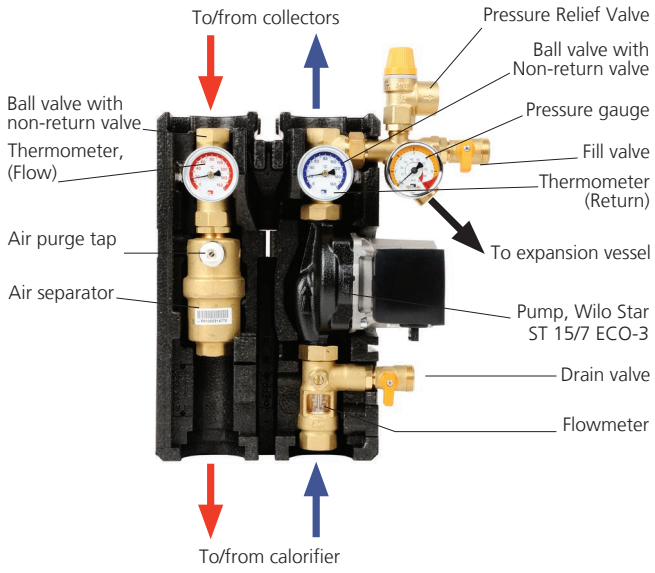
Visual inline flowmeter (ST1 and ST2 only) or flowmeters (ST1 DUAL ADV), for instant visual confirmation of fluid flow (no blockages) and condition as well as a mechanical measure of flow rate (return side). For the ST3, the visual flow meter is supplied with the solar transfer station, but is fitted outside of the transfer station on the return line.

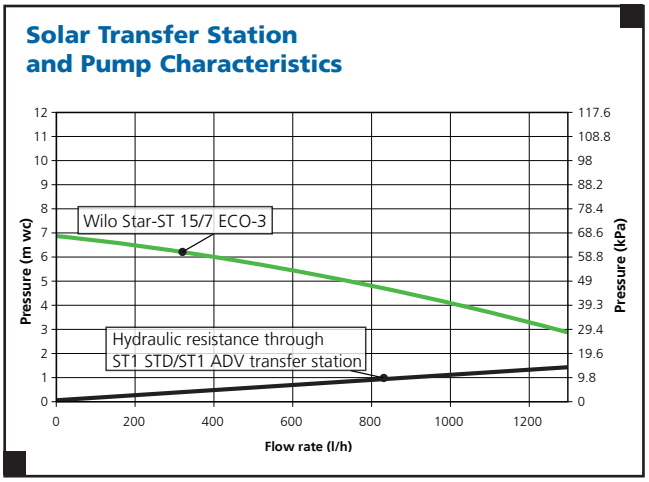
Automatic air separator with purge point on the flow line to continually purge any air from the system. For the ST3, the air separator is supplied with the transfer station, but is fitted outside of the solar transfer station.

Specifications

Trigon Solar Transfer Stations

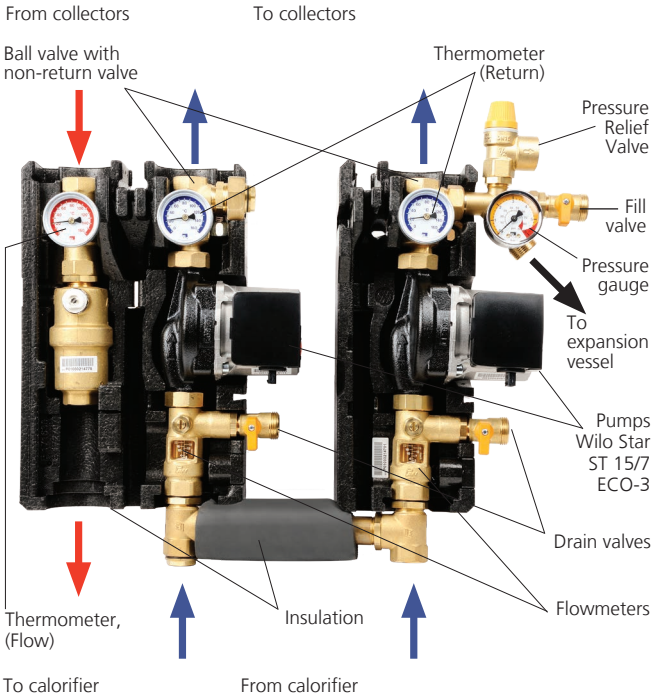
ST1 STD/ST1 ADV (insulation removed)

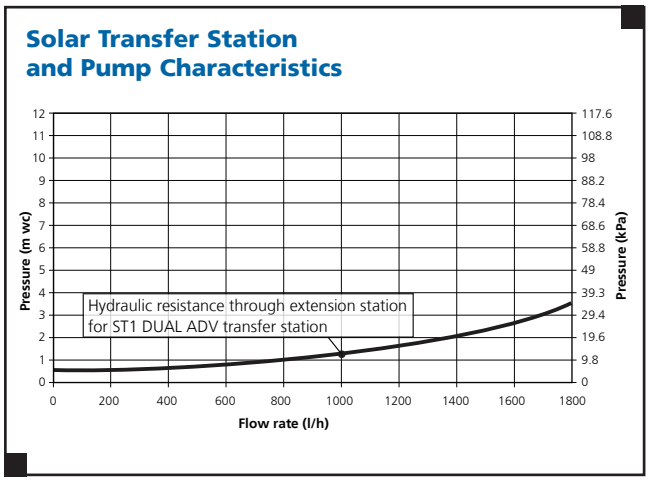




Trigon ST1 (STD or ADV) solar transfer station hydraulic resistance and Wilo Star ST15/7 ECO-3 pump flow characteristics

ST1 DUAL ADV as ST1 ADV + DUAL Extension Station (insulation removed)



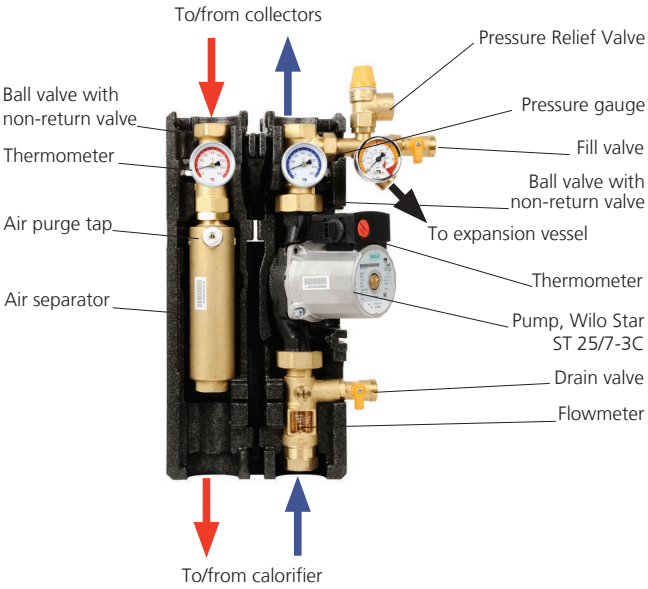


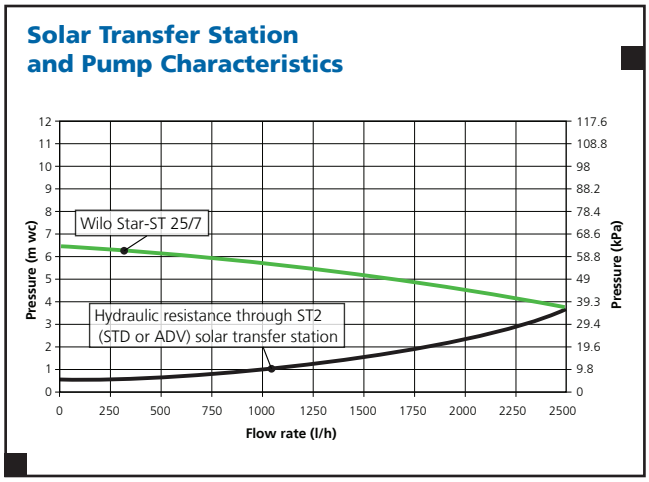
Trigon ST1 DUAL extension hydraulic resistance characteristics (For pump flow and ST1 characteristics see Wilo Star ST15/7 ECO-3 and ST1 above)

Specifications

Trigon Solar Transfer Stations

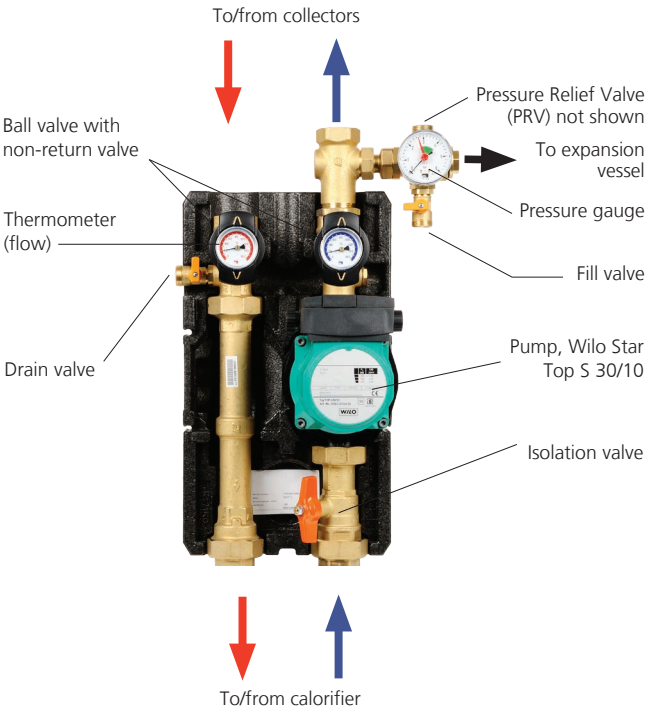
ST2 STD/ST2 ADV (insulation removed)

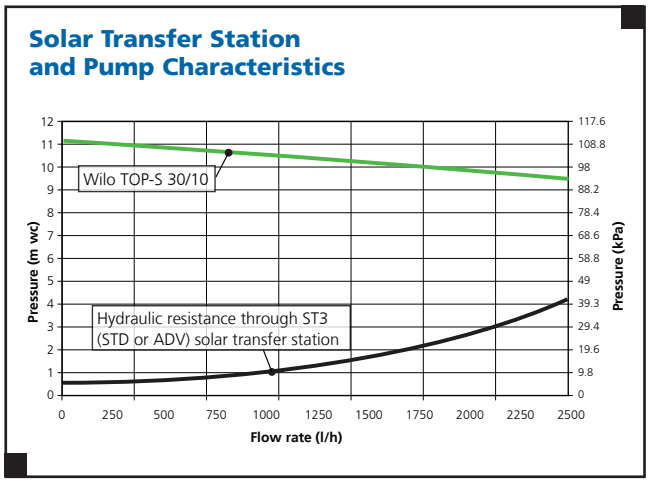




Trigon ST2 (STD or ADV) solar transfer station hydraulic resistance and Wilo Star ST-25/7-3C pump flow characteristics

ST3 STD/ST3 ADV (insulation removed)





Trigon ST3 (STD or ADV) solar transfer station hydraulic resistance and Wilo TOP-S 30/10 pump flow characteristics

Note: For the ST3 transfer station the visual flowmeter and air separator are larger in size, and so are supplied loose for fitting on site in the pipework adjacent to the solar transfer station.

Technical Data and Dimensional Details

Trigon Solar Transfer Stations

Transfer Station Technical Data

	Units	ST1 (STD or ADV)	ST2 (STD or ADV)	ST3 (STD or ADV)	ST1 DUAL Extension
Maximum pressure	Bar	10	6		10
Maximum continuous operating temperature	°C	120			
Maximum short term temperature, <15minutes	°C	160			
Percentage propylene glycol	%	45			
Pressure relief valve	bar	6			
Pressure gauge range	bar	0–6	0–6, with stop valve		0–6
Sightglass flowmeter range	l/min	1–20	5-40	Not fitted	1–20
Non-return valve, opening pressure in head of hot water	mm	200			
Dial thermometer temperature range	°C	0-160			
Circulation pump make/model	–	Wilo Star-ST 15/7 ECO-3	Wilo Star-ST 25/7 3C	Wilo Star Top-S 30/10	Wilo Star-ST 15/7 ECO-3
Insulation material/Lambda	W/(m.K)	EPP/ λ = 0.041			
Electrical power (3 settings per pump)	W	40/48/54	59/81/110	335/385/390	2 x 40/48/54
Electrical supply		230 V 1Ph / 50Hz			

Transfer Station Dimensions

	Units	ST1 (STD or ADV)	ST2 (STD or ADV)	ST3 (STD or ADV)	ST1 DUAL ADV
Height (with insulation)	mm	402	502	675	440
Width (with insulation)	mm	235	265	330	208
Depth (with insulation), *(Without pump head)	mm	~175		125*	204
Distance between flow and return centres	mm	100	125	125	100 and 310
Distance between wall and flow/return centres	mm	65	65	With mount bracket: 135 or 110	65
Pipe fittings (flow and return connections)	inch	Rp¾"	Rp1"	Rp1¼"	Rp¾"
Fill and drain points	inch	Rp½" int., G¾" ext. dual thread			
Pressure relief valve outlet	inch	Rp¾"		Rp1"	Rp¾"
Connection for expansion vessel	inch	G¾" flat faced Rp⅜" dual thread		Rp¾"	G¾" Rp⅜" dual thread

Automatic Air Vents (AAV)

Air Separator in Solar Transfer Station

An air separator with manual vent valve is used to vent automatically the solar circuit at the solar station. An air separator is integrated in all Trigon solar transfer stations except the ST3 (STD or ADV), where it is supplied with the transfer station for fitting external to the transfer station. To ensure correct de-aeration operation, the flow velocity must be at least 0.3 m/s in the flow line.

Collector-mounted AAV

The air separator in the solar transfer station works in conjunction with the collector-mounted AAV that is included in each 1st array hydraulic fittings kit. The AAV is fitted on the 1st collector flow output connection using elbows and tees included in the hydraulic fittings kit such that it sits vertically at the highest point in each array in the solar circuit. Any air not otherwise purged in the system will naturally rise to the highest points and be automatically removed by the collector AAV(s) to maintain an air-free solar circuit.

***Warning**: Only qualified persons should operate or maintain a live Trigon solar system due to the potential high operating temperatures and high pressures of the system, and special care must be taken to avoid any risk of scalding - for example when carrying out initial manual air purging at the air separator, where the escaping medium could be at more than 100°C and at a pressure of up to 6 bar.*

Trigon Solar Control and Monitoring

Standard and Advanced Solar Controllers

Controller Overview

Two user-friendly electronic controller options are available for the efficient and safe fully automatic control of the Trigon solar system, with accurate real-time monitoring of system parameters:

- Standard controller, for basic control of single collector field/single pump solar systems with a single DHW store (DeltaSol BS/2)
- Advanced controller, for single or dual collector field/ single or dual pump solar systems with single or multiple DHW stores (DeltaSol M)

They are used to power the pump(s) in the transfer station, via a semiconductor relay or relays, using differential temperature (ΔT) and rate of change of ΔT proportional control, within various programmed or measured temperature settings limits, and within optional timing schemes. PT1000 high temperature sensors are used to measure temperature differential, and rate of change of temperature, between the collector field and the store.

These compact wall mounted units are easy to configure, and once set up require no further intervention from the user under normal operation. With bright and clear displays, the user can select and monitor all key parameters. User access level protection is included in both controllers. The basic (default) level access allows adjustment of only a limited set of parameters, in order to protect a properly commissioned system from accidental maladjustment. The highest level access allows editing of all programmable parameters.

They both feature a timer-programmable legionella protection function to minimise any risk of infection. The other features of the two controllers are compared in the table on page 20.

The controllers use the proprietary two-wire Resol Vbus bus connection for easy plug-and-play connecting of optional heat metering and data storage equipment. It is also possible to use Resol software on a local or remote PC to manage data from the controllers, to modify controller settings, and to display near real-time system parameters in a web browser.

Options

Standard or advanced controller

Heat metering

Datalogger with software

Temperature sensors and pockets

V40 flow meter for heat metering

Remote alarm module

Advanced controller (left), standard controller (right)

General Controller Features

The standard and advanced solar controllers have a host of useful features and the main features common to both systems are listed below.

- Logical, easy to use, 3-button manual interface
- User access level protection to prevent accidental maladjustment
- Backlit screen for clear icon or menu display
- Warning LED lamp
- Clear display of selected parameter values
- Semiconductor relay control of transfer station pump(s)
- Differential temperature and rate of change of differential temperature proportional control of solar pump(s)
- Vbus system for plug and play connection of additional equipment
- Ultra-low power consumption

Heat Metering

The Trigon solar system offers a choice of heat metering capabilities, depending on the project requirements. The standard and advanced controllers can both provide heat metering with additional optioanal equipment. In addition, an optional datalogger is available to record information such as temperature and flow rates over a long period.

For details of heat metering options and the datalogger option, please refer to page 22.

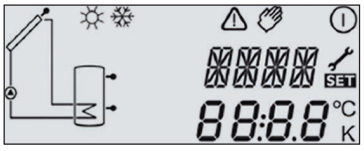
To claim the Renewable Heat Incentive (RHI) an approved heat meter must be deployed in addition to, or in place of, the above-mentioned heat meters.

Remote Alarm Module

The Remote Alarm Module provides an indication for common fault condition. Connected via the VBus to either the standard or advanced controller, on receiving a fault condition signal the Remote Alarm Module provides a visual indication via a red LED and energises a volt free contact rated up to 230 V with normally open contacts.

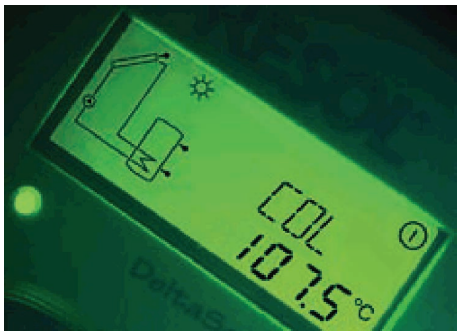
Trigon Solar Control and Monitoring

Controller Features Comparison

	Feature	Standard Solar Controller (DeltaSol BS/2)	Advanced Solar Controller (DeltaSol M)
Inputs/outputs	Associated Trigon Solar Transfer Station	ST1 STD, ST2 STD, ST3 STD	ST1 ADV, ST1 DUAL ADV, ST2 ADV, ST3 ADV
	Sensor inputs	Up to 4	Up to 15
	Temperature sensors	PT1000 (FKP6)	PT1000 (FKP6), RTA11-M
	Flowmeter input	Indirectly, via a WMZ with an attached V40 impulse flowmeter	V40 impulse flowmeter
	Ultraviolet detector	x	CS10 UV meter
	No. of relay outputs	1	9
	No. of relay output type/ maximum switching current	1 x semiconductor/1 A (for power/speed control of one pump)	4 x standard/4 A, 4 x semiconductor/1 A, 1 x potential free/4 A Total current all relays max. 6.3 A
	Bus connections	Vbus	Vbus and RS232
Functions	Pre programmed solar schemes	1	7
	Number of access protection levels	2	3
	Selectable temperature units, °C/°F	✓	✓
	Pump operating hours counter	✓	✓
	Differential temperature controls	1	2
	Ultraviolet detection (for DL2 use)	x	✓
	Pump speed controller	✓	✓
	Heat quantity measurement	✓if fitted with WMZ and V40 and two PT1000 temp sensors	✓if user programmes flow rate manually, or if fitted with V40 and two PT1000 temp sensors
	Maximum number of water stores	1	4
User Interface	Interface type	System monitor and display	Menu navigation text display
	User controls	Three pushbuttons, menu driven.	
	Display screen		
	Display details	System visualisation screen with segments which illuminate to reflect status of pump or sensor. 16 text and 7 numerical segment displays, additional 8 LED symbols for system status, and a bi-coloured LED operating control lamp	4-line illuminated liquid crystal display presents the first four menu options (scroll to access up to 8 menu options), and a bi-coloured LED operating control lamp
Other Technical	Installation	Wall–mounted or patch panel	
	Housing	PC-ABS and PMMA	
	Protection	IP 20/DIN 40050	
	Ambient temperature	0–40°C	
	Store temperature range	4–95°C	
	Power supply/ Fuse	230 V 1 PH 50 Hz / 4 A	230 V 1 PH 50 Hz / 6.3 A

Controller Operation

Trigon Solar Controllers



The Trigon standard and advanced solar controllers' principle function is very similar and relatively simple, i.e. it is the on/off and speed control of the solar pump in the solar transfer station under differential temperature (ΔT), thermostat and timer control. The generic functions common to both controllers are described here with default settings taken from the standard controller and parameter names shown in italics.
For full details of the operation of each controller, refer to the appropriate controller's user manual.

Pump On/Off Control: Differential Temperature (ΔT, or DT in display)

The pump is switched on when the *Switch-on temperature differential* setting (difference between the temperature measured at the collector and the temperature measured in the water in the base of the tank) has been reached. This setting is adjustable from 1°C to 20°C in steps of 0.5°C, with default setting of 6°C.

The pump is switched off again when the *Switch-off temperature differential* setting is reached. This setting is adjustable from 0.5°C to 19.5°C in steps of 0.5°C, with default setting of 4°C.

Note that the *Switch-on temperature differential* setting must be at least 0.5°C higher than the *Switch-off temperature differential* setting.

Pump Speed Control

Under normal operation, when the *Switch-on temperature differential* setting is reached, the pump switches on at full power for 10 seconds and then drops to 30% speed, after which the speed is automatically adjusted in response to the temperature differential and rate of change of the temperature, in 10% steps up to 100% of the *set maximum speed*.

The control of the system is refined by controlling parameters that affect pump speed e.g. *minimum pump speed*, and *temperature rise rate* which effectively controls the speed of response of the system.

Pump On/Off Control: Thermostat/Timer

The pump is switched off once the maximum store temperature is reached (including 2°C fixed hysteresis). In addition, various thermostat and parameter settings will trigger the pump to start, stop or change speed accordingly when user-defined settings are reached (factory default values shown in brackets); these include:

Maximum store temperature (65°C)

Collector emergency shutdown temperature (140°C)

Maximum collector temperature (105°C)

Minimum collector temperature (20°C-if minimum collector function is selected)

Antifreeze temperature (4°C-if antifreeze function is selected)

Re-cooling function, (if selected, the maximum store temperature setting, used to prevent collector from overheating, is overridden, and the pump runs up until the *emergency store shutdown temperature* (95°C) is reached

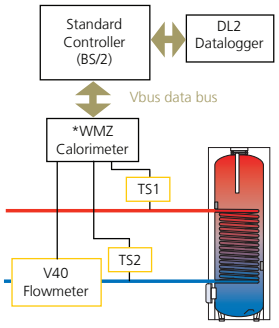
Relative minimum pump speed (30%)

Operating mode ON/OFF/AUTO (AUTO)

System Monitoring

By selecting the appropriate channel on either controller, current temperatures measured at various points in the solar circuit and other parameters such as pump speed and hours run can be displayed. Heat meter measurements may also be monitored at the controller, if appropriate optional heat metering equipment has been installed and powered on. Data available at the controller can be captured and stored using a DL2 Datalogger* *(see page 22)*.
**Not applicable for RHI heat meter.*

Standard controller heat metering option

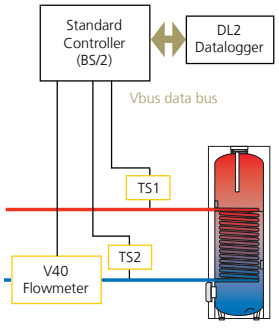


*WMZ unit required

TS1 = Flow temperature sensor

TS2 = Return temperature sensor

Advanced controller heat metering option



*WMZ unit not required

TS1 = Flow temperature sensor

TS2 = Return temperature sensor

Heat Metering & Data Capture

Heat Meter and Datalogger Options

The Trigon solar system offers a choice of heat metering options, depending on the project requirements. In all cases, the recommended glycol/water mix must be adhered to, for the heat meters to function effectively.

Heat Metering - Using Standard Controller

For heat metering with the standard controller, the flow meter and temperature sensors must be connected via a WMZ calorimeter. See *WMZ Calorimeter* below.

Heat Metering - Using Advanced Controller

The cumulative solar energy performance can be measured using either of the advanced controller's two internal calorimeters, with the addition of a V40 impulse flow meter in the return line, together with matched temperature sensors, to measure the solar fluid flow and return temperatures close to the input and output to the calorifier's solar coil.

RHI Approved Heat Metering

To claim the Renewable Heat Incentive (RHI) an approved heat meter must be deployed in addition to, or in place of, the above-mentioned heat meters.

Hamworthy can provide an independent, tamper resistant, RHI approved flow meter specifically for this purpose, which meets the requirements of European Guidelines MID-2004/22/EC and standard EN 1434 class 2.

This is a mains-powered heat meter comprising a static flow sensor with integrator unit, and matched pair of PT500 sensors. The RHI-approved heat meter operates independently of any other heat meter, storing up to 15 months of measurements internally. ModBus or RS232 bus connection options can permit data transmission to a BMS system for remote meter reading.

It is important to note that the RHI approved heat meters are calibrated for 40% glycol/water concentration at the factory, so the solar fluid must be mixed to that percentage concentration.

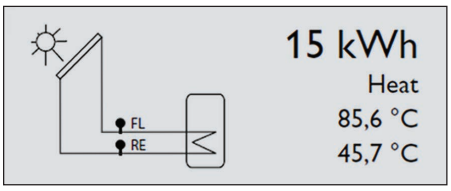
To discuss your heat metering requirements, please contact our customer service centre. Telephone 0845 450 2865.

WMZ Calorimeter

For use with the standard controller, to provide instant evaluation of the heat performance of the solar system, Hamworthy offer the WMZ heat meter, a universal calorimeter, which in conjunction with a V40 flowmeter measures heat energy. It takes into account the density (which is temperature dependent) and the specific heat capacity of the solar fluid, both of which vary according to the mixture ratio of water to glycol in the solar fluid.

The device is operated in a similar way to the controllers, i.e. via a 3-pushbutton navigation interface to access different menu levels and view or edit different parameters.

The first level is a graphic display showing the temperature at the selected measuring points, the heat gained and the actual power or the volumetric flow rate of the system.



The second level is used for parameter adjustments e.g. set/adjust the antifreeze type and percentage ratio mix of glycol to water of the solar fluid to reflect that of the solar fluid being used in the system.

The WMZ calorimeter runs at 230V AC. It includes a power failure protection system to guarantee that the adjusted system parameters and the calculated heat quantity are maintained in the case of power loss.

The V40 flowmeter is supplied with a pair of matched temperature sensors with pockets.

Connection to the controller is via the VBus connection. The VBus can also be used to transmit display values to a PC or DL2 Datalogger for longer term storage and data analysis. Up to 16 WMZ calorimeters may be connected to a single DL2 Datalogger.

DL2 Datalogger

The DL2 Datalogger is used to acquire and store large amounts of data, such as measured temperatures and flow rates over a long period of time using its 180MB internal memory. With a logging interval of 5 minutes, up to 120 months of data can be stored from a system with one Trigon solar advanced controller.

It has a useful stepped LED visual indicator showing the current level of used memory, and a clear plastic cover to prevent accidental pressing of the data reset button.

It can be directly connected to a PC or router for remote access, via an integrated web interface, and used for system monitoring, and fault diagnosis using Resol's ServiceCenter software. The software allows live data from the DL2 to be presented at different reference points on a schematic of the system, (requires a JPEG schematic of the system to be imported as a background) . Data can also be stored in tabular form for export to spreadsheets.

Connections include Vbus, Ethernet (LAN) and Auto MDIX 10/100 Base TX (standard or GSM modem connection). An optional SD Card can be used as a means to transfer bulk data manually from the internal memory to an external PC. The DL2 runs at 5V DC through a 230V 50 Hz AC transformer supplied with the unit.

Specifications & Dimensional Details

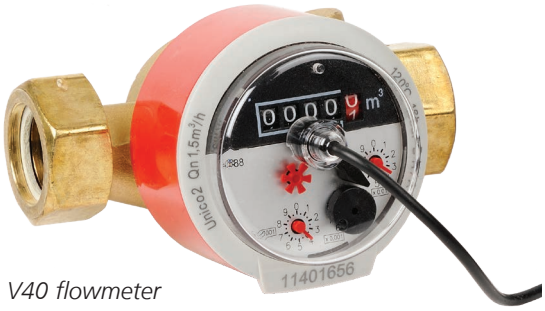
Heat Metering Equipment

DeltaSol Controllers, WMZ Calorimeter and DL2 Datalogger Dimensions

Dimensions/mm	Standard controller: DeltaSol BS/2	Advanced controller: DeltaSol M	WMZ Calorimeter	DL2 Datalogger
Width	110	260	110	130 diameter
Height	172	216	155	
Depth	47	64	47	45

V40 (0.6 and 1.5m³/h) Flowmeter Specifications

Description	Units	V40 Models	
		V40-06	V40-15
Nominal Flow Rate	m³/hr	0.6	1.5
Pulse rate	l/ impulse	1	10
Maximum pressure	bar	16	
Maximum temperature	°C	120	
Pressure drop at nominal flow rate	bar	0.25	
Maximum flow rate	m³/hr	1.2	3
Pressure drop at maximum flow rate	bar	1	
Flowrate limit, precision +/- 3%	l/hr	48	120
Horizontal minimum flow rate	l/hr	12	30
Vertical minimum flow rate	l/hr	24	60



V40 flowmeter

V40 (0.6 and 1.5m³/h) Flowmeter Dimensions

The V40-06 and V40-15 flow meters have the same external dimensions as shown in the figure (below right). The couplings (not shown) have a diameter of DN20 with an R□" thread. They can be mounted horizontally or vertically.

Resol ServiceCenter Software

ServiceCenter software requires Microsoft Windows 2000/XP and Java V1.6.0 or higher.

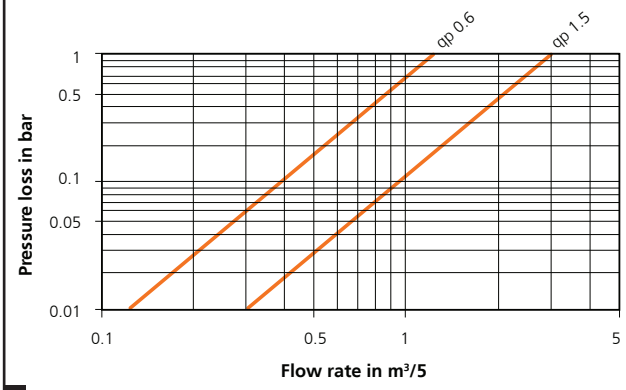
VBus record: Files all measuring and balance values received by VBus into a text file; this file can be processed by a standard spreadsheet program such as Excel.

Designer: Allows the positioning of the VBus values on a customised background graphic; in this way, system visualisations for any solar system can be presented in real-time.

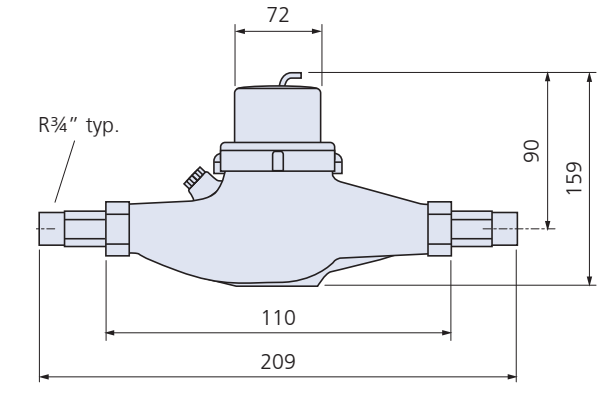
Datalogger: Manages any number of Dataloggers; the ServiceCenter establishes connection at the push of a button, reads out the data, if necessary, deletes data from the logger and converts data into a text file.

Parameterisation: DeltaSol BS/2 and M controllers can be easily configured via the PC; the parameter values are checked and possible overlaps are transferred by VBus to the controls.

V40 flowmeter, flow characteristic



V40 flowmeter, dimensions



Supplementary Equipment & Schemes

Supplementary Equipment for use with Trigon

Expansion Vessel

A solar expansion vessel is an essential safety component in the pressurised solar system, to absorb the additional volume of solar fluid that is generated due to the fluid expanding as it is heated. It should be installed at the designated connection in the solar station on the return (cooler) side. It must be capable of taking pressurised solar fluid up to 10 bar, and be resistant to high temperature (120°C).

Hamworthy can offer a range of suitable expansion vessels. The vessel must be sized to absorb the full expansion volume from cold to stagnation temperature whilst maintaining system operating pressure within safe design conditions. *Refer to page 30 for further information.*

Solar Filling Pump

The Trigon solar system operates as a pressurised system and can be pressurised on filling with solar fluid with the optional Hamworthy solar fluid filling pump to the designed system pressure for the ambient temperature. The operating pressure under maximum solar heating conditions must be less than 6 bar (the pressure relief valve setting in the solar stations). The solar pump includes flexible suction and discharge pipes and has a maximum filling head of approximately 35 m.

Safety Relief Valve

An additional safety relief valve (SRV) is required on the hot flow from the collector to the solar station upstream of the balancing valves, to prevent accidental hydraulic isolation, which could cause an overpressure situation and damage the system and/or present a potential risk of scalding. Any SRV discharge should be safely drained away in thermally insulated piping and sent to waste via a tundish. Appropriate hot fluid warnings should be displayed nearby.

Trigon Solar Hydraulic Schemes

To help the system designer, Hamworthy provide and support nine pre-defined Trigon solar schemes. These are summarised in the table below, and expanded upon from page 25. All schemes (except scheme B) have been described for a single field of collectors. However, all schemes can be used for dual-field applications (like scheme B) if the ST1 DUAL ADV solar transfer station and advanced controller are used. Note that, as the ST1 DUAL ADV is limited to a maximum of 10 collectors (20 m^2) per field and therefore may not be ideal for the largest DHW volume systems (schemes D and E) if the required collector area is greater than 40 m^2.

Hamworthy Heating Limited is not a heating systems designer and therefore accepts no responsibility for the design of the heating system or plant specification in the following schemes; they are for illustrative purposes only. Please refer to a competent heating system designer for a detailed design that is fit for the purpose required and is designed in accordance with current regulations.

Description	Scheme	Transfer Station/ Controller	Aux Heating and Storage				Max. Collector Area/m^2	Max. DHW Storage/ litre
			Boiler	Calorifier	Tank	Water Heater		
Trigon solar low-volume DHW system	A	ST1 STD	1	1	-	-	6 to 20	1000
Trigon solar low-volume DHW system, dual-field of collectors	B	ST1 DUAL ADV only	1	1	-	-	6 to 20 per aspect	1000
Trigon solar medium-volume DHW system	C	ST2 ADV	1	2	-	-	12 to 40	2000
Trigon solar large-volume DHW system	D	ST3 ADV	1	3	-	-	18 to 60	3000
Trigon solar large volume/twin water tank DHW system	E	ST3 STD	1	1	2	-	18 to 60	3000
Trigon solar large-volume/ single water tank DHW system	F	ST2 STD	1	1	1	-	12 to 40	2000
Trigon solar system with single calorifier pre-heater, for single direct-fired water heater system	G	ST1 STD	-	1	-	1	8 to 30	1500
Trigon solar system with single calorifier pre-heater, for twin direct-fired water heater system	H	ST2 STD	-	1	-	2	12 to 40	2000
Trigon solar with single calorifier pre-heater, for a 2nd calorifier system	J	ST1 STD or ST2 STD	1	2	-	-	6 to 40	2000

Solar Hydraulic Schemes

Solar Duty DHW Control Strategies

The Trigon solar offer includes the following nine pre-defined hydraulic configurations for design flexibility. Schemes A to F are for solar duty DHW, schemes G to J are solar pre-heat DHW. *Please contact Hamworthy sales team on 0845 450 2865 to discuss your specific system requirements so we can help you select the most suitable system for your application.*

Hydraulic Scheme A

Trigon solar low-volume DHW System, single collector field with 1 x calorifier, 1 x aux. boiler and **standard** transfer station/ controller

- Max. storage: 1000 litres
- Collector single field area: 6 m^2 to 20 m^2
- Solar control: temperature differential of collector vs calorifier tank
- Aux boiler control: Powerstock stats or BMS
- Calorifier: PS300 to PS1000
- DeltaSol BS/2 scheme: System 1

Hydraulic Scheme B

Trigon solar low-volume DHW system, dual collector fields with 1 x calorifier, 1 x aux. boiler and **advanced** transfer station/ controller

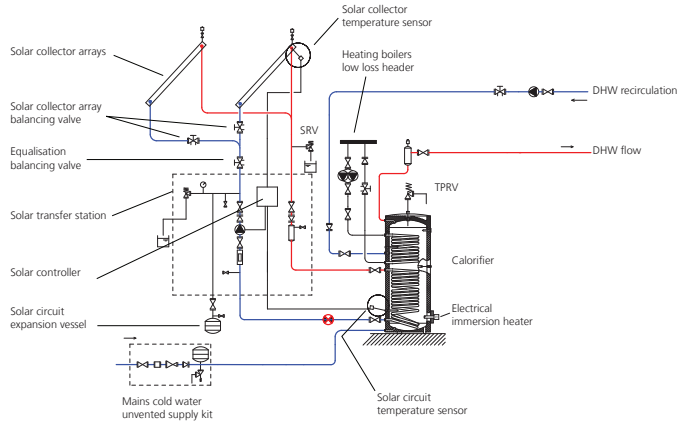
- Max. storage: 1000 litres
- Collector dual-field area: 12 m^2 to 40 m^2
- Solar control: Temperature differential of each collector field vs calorifier tank
- Aux boiler control: Powerstock stats or BMS
- Calorifier: PS300 to PS1000
- DeltaSol M preset scheme: System2/ Variant1

Hydraulic Scheme C

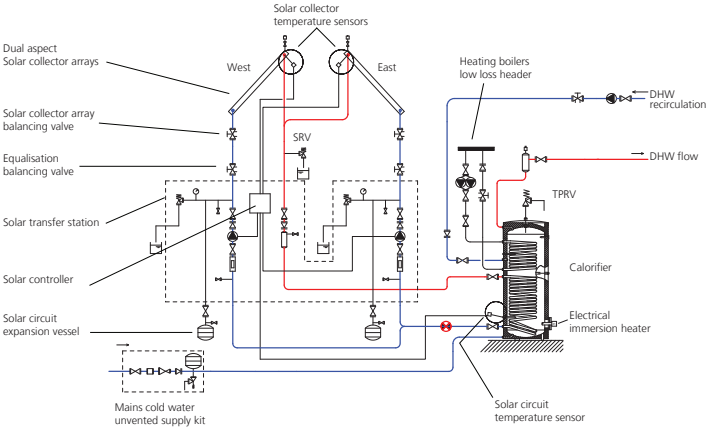
Trigon solar medium-volume DHW system with 2 x calorifiers, 1 x aux. boiler and **advanced** transfer station/controller

- Max. storage: 2000 litres
- Collector single field area: 12 m^2 to 40 m^2
- Solar control: Temperature differential of collector vs 2 x calorifier tanks with isolation valve (not HHL supply) control of each calorifier from the solar controller
- Aux boiler control: Powerstock stats or BMS
- Calorifier: 2 x PS300 to PS1000
- DeltaSol M preset scheme: System5/ Variant1

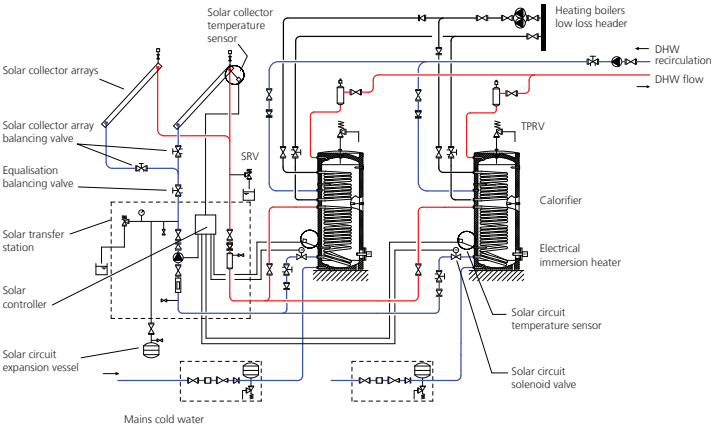
Scheme A Trigon solar low-volume DHW system, single collector field



Scheme B Trigon solar low-volume DHW system, dual collector field



Scheme C Trigon solar medium-volume DHW system



Solar Hydraulic Schemes

Solar Duty DHW Control Strategies

Hydraulic Scheme D

Trigon solar large-volume DHW system with 3 x calorifiers, 1 x aux. boiler, with **advanced** transfer station/controller

- Max. storage: 3000 litres
- Collector single field area: 18 m² to 60 m²
- Solar control: Temperature differential of collector vs 3 x calorifier tanks and valve control of isolation valves (not HHL supply) for individual cylinder charging
- Aux boiler control: Powerstock stats or BMS
- Calorifier: 3 x PS300 to PS1000
- DeltaSol M preset scheme: System5/ Variant1

Hydraulic Scheme E

Trigon solar large-volume DHW/twin tank system with 1 x calorifier, 1 x aux. boiler, 2 x storage tanks, and 3 x immersion heaters with **standard** transfer station/ controller

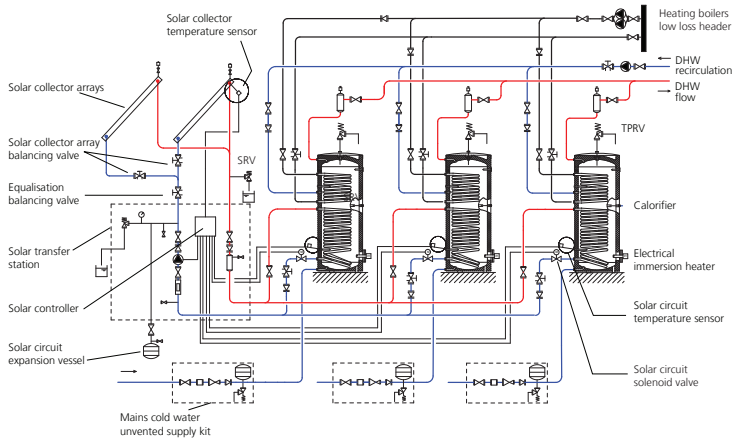
- Max. storage: 3000 litres
- Collector single field area: 18 m² to 60 m²
- Solar control: Temperature differential of collector vs 1 x calorifier tank. and loading pump circuit (not HHL supply)
- Aux boiler/immersion control: Powerstock stats or BMS
- Calorifier: 1 x PS300 to PS1000
- Tanks: 2 x ST1000 max.
- DeltaSol BS/2 scheme: System 1

Hydraulic Scheme F

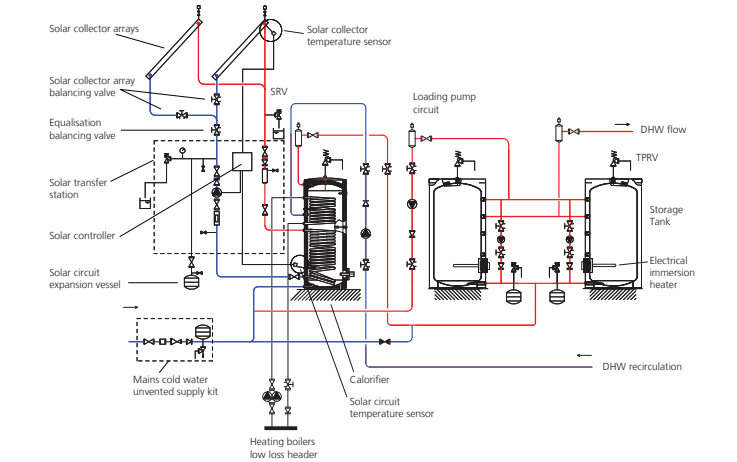
Trigon solar large-volume DHW/single tank system with 1 x calorifier, 1 x aux. boiler, 1 x storage tank, and 2 x immersion heaters with **standard** transfer station/ controller

- Max. storage: 2000 litres
- Collector single field area: 12 m² to 40 m²
- Solar control: Temperature differential of collector vs 1 x calorifier tank, with loading pump circuit (not HHL supply).
- Aux boiler/immersion control: Powerstock stats or BMS
- Calorifier: 1 x PS300 to PS1000
- Tank: 1 x ST1000 max
- DeltaSol BS/2 scheme: System 1

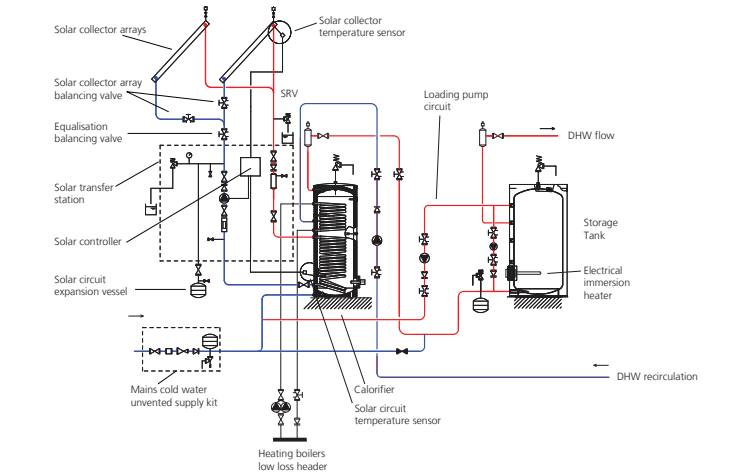
Scheme D Trigon solar large-volume DHW system



Scheme E Trigon solar large-volume DHW/twin tank system



Scheme F Trigon solar large-volume DHW/single tank system



Solar Hydraulic Schemes

Solar Pre-heat DHW Control Strategies

Hydraulic Scheme G

Trigon solar system with single calorifier pre-heater, for single direct-fired water heater, with 1 x calorifier, 1 x any direct-fired water heater, and **standard** transfer station/controller

- Max. storage: 1500 litres
- Collector single field area: 8 m² to 30 m²
- Solar control: Temperature differential of collector vs 1 x calorifier tank. Dorchester water heater self-controlled or under BMS control
- Immersion control: Powerstock stats or BMS
- Pre-heat calorifier: 1 x PS300 to PS1000
- Water heater: 227 to 504 litres
- DeltaSol BS/2 scheme: System 1

Hydraulic Scheme H

Trigon solar system with single calorifier pre-heater, for twin direct-fired water heaters, with 1 x calorifier, 2 x direct-fired water heaters, and **standard** transfer station/controller

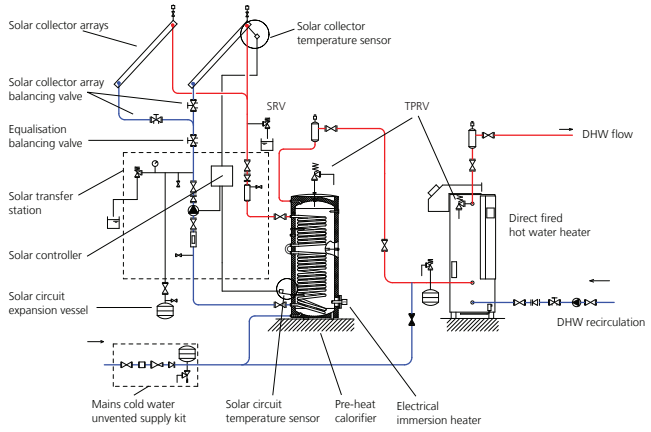
- Max. storage: 2000 litres
- Collector single field area: 12 m² to 40 m²
- Solar control: Temperature differential of collector vs 1 x calorifier tank. Dorchester water heaters self-controlled or under BMS control
- Immersion control: Powerstock stats or BMS
- Pre-heat calorifier: 1 x PS300 to PS1000
- Water heaters: 2x (227–504l)
- DeltaSol BS/2 scheme: System 1

Hydraulic Scheme J

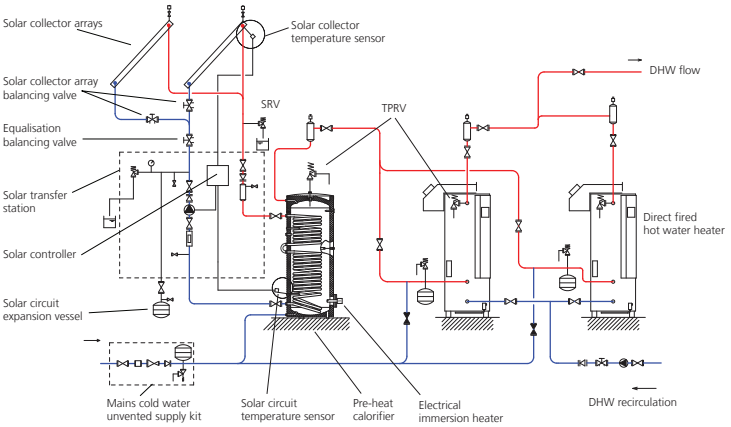
Trigon solar system with single calorifier pre-heat, for a second calorifier, with 2 x calorifiers, 1 aux. boiler, and a **standard** transfer station/controller

- Max. storage: 2000 litres
- Collector single field area: 6 m² to 40 m²
- Solar control: Temperature differential of collector vs 1 x calorifier tank. Aux calorifier/boiler under BMS or self-control
- Pre-heat calorifier: 1 x PS300 to PS1000
- Duty calorifier: 1 x PS300 to PS1000
- DeltaSol BS/2 scheme: System 1

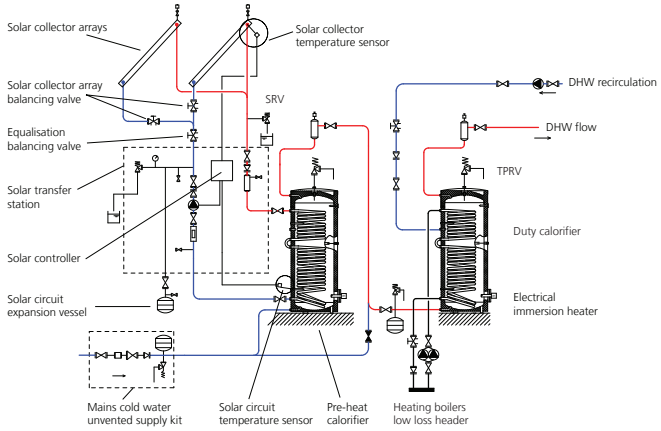
Scheme G Trigon solar system with single calorifier pre-heater, for single direct-fired water heater



Scheme H Trigon solar system with single calorifier pre-heater, for twin direct-fired water heaters



Scheme J Trigon solar system with single calorifier pre-heater, for a second calorifier



Powerstock Calorifiers and Tanks

Solar Thermal Hot Water Storage with Indirect-fired Auxiliary Heating

Integrating solar energy into a domestic hot water system using indirect-fired calorifiers or direct-fired water storage heaters and storage tanks can offer a wide variety of functional configurations for both duty solar DHW and solar preheating of cold water feeds to secondary DHW systems. Careful selection of such equipment is required to ensure that the thermal solar load is managed safely and efficiently.

Powerstock Calorifiers and Storage Tanks

A popular method of heating hot water with solar energy is to use Hamworthy Powerstock high performance rapid recovery calorifiers.

There are 7 models in the Powerstock calorifier range with continuous outputs, from 501 litres/hour to 1635 litres/hour. Storage capacities are from 160 litres to 995 litres. Using a traditional coil type design, twin coil models start from 816 litres/hour and storage capacities from 292 litres, allowing heat from solar and back up boilers to be connected independently. Calorifier performance is based on a hot water flow temperature of 60°C, with a cold water inlet temperature of 10°C and a primary inlet temperature of 80°C.

The Powerstock range also extends to storage tanks with capacities from 300 litres to 1000 litres, for a variety of applications either to maximise energy efficiency or increase system security.

Powerstock calorifiers are all approved by the Water Regulations Advisory Service (WRAS) to comply with the requirements of the UK Water Supply (Water Fittings) Regulations and Scottish Water Byelaws, when correctly installed.

Options

Powerstock calorifiers are available with single or twin coil configurations to suit the application, with or without optional immersion heaters for auxiliary electric heating. Other options include a top-to-bottom recirculation kit for effective legionella purging and an unvented supply kit.

For full details of the Hamworthy Powerstock range of calorifiers and storage tanks, please refer to publication 500002488.

Powerstock calorifiers from 160 litres to 995 litres capacity

Powerstock Calorifier Features

- Twin and single coil construction
- 10 bar pressure rated
- Vitreous enamel lining
- Inspection and clean out door
- Pressure and temperature relief valve
- Pre-wired control panel
- Unvented kit for mains supply (optional)
- Anode protection for soft water areas
- Polyurethane foam insulation

Designed for Safety

The Health and Safety Commission (HSC) approved code of practice and guidance document L8, makes it clear that if the risk of Legionella is to be minimised, then the recommendations must be observed in so far as they relate to hot & cold water systems. Powerstock calorifiers and storage tanks conform to these requirements as follows:

- Good access for cleaning
- Generous flow and return connections
- Adequately sized drain
- Base designed to avoid sludge traps
- Provision of anodes to reduce metal corrosion
- Number of tappings correctly positioned to facilitate recirculation, destratification, and to obviate stagnation areas
- Designed to meet unvented supply requirements
- Destratification pump kit (optional)

Trigon Solar with Dorchester Water Heaters

Solar Thermal Hot Water Storage – with Direct-fired Auxiliary Heating

Dorchester Direct-Fired Water Heaters (without solar coil)

An extensive range of compact and efficient direct fired-water heater options are available from Hamworthy for generating DHW, which can accept a solar pre-heated cold water feed from the Trigon solar system. Examples include the popular Dorchester DR-LA range of atmospheric water heaters, often chosen for upgrades to existing water heaters in refurbishment projects as existing flues can be reused, and the DR-FC Evo range of condensing direct-fired water heaters for maximum seasonal efficiency.

Each Dorchester water heater incudes an integral gas burner and heat exchanger arrangement, housed in a special glass–lined tank, and are manufactured to the highest standards using the latest production technology to ensure a high quality, long lasting finish.

Compliance is assured with stringent controls in accordance with the European Directives for CE marking, and all models are Water Regulations Advisory Scheme (WRAS) approved.

For full details of the Hamworthy Dorchester range of water heaters, please refer to publication 500002371.

Dorchester DR-LA Direct–fired water heater

Dorchester DR-TC Solar Water Heaters with Integral Gas Burner (with dedicated solar coil)

The Dorchester water heaters referred to in the previous section have no special solar coil heat exchanger for receiving solar fluid from a solar circuit. If a solar coil is required then the Hamworthy Dorchester DR-TC condensing solar water heater, with integrated gas burner, is available. Although one of the family of Dorchester water heaters, it is considered not as part of the Trigon solar DHW system, but as the entirely separate Dorchester DR-TC solar DHW system.

The highly efficient Dorchester DR-TC water heater comes with a dedicated integral controller, different from the solar-only controls used in Trigon solar systems, in that it manages together both the solar circuit and control of the integral gas burner.

The Dorchester DR-TC comes with a choice of two dedicated transfer stations, TX1 and TX2, and optional monitoring equipment, again all different from those of the Trigon solar system, but offering similar solar control functionality. The whole system is referred to as the Dorchester DR-TC solar DHW system, and is supplied without collectors, although it is recommended for use with Trigon collectors to provide its solar energy input. Using the larger flow rate solar transfer station (TX2), the Dorchester DR-TC water heater can be used with a single Trigon collector field of up to 15 collectors (30 m^2 collector area).

The Dorchester DR-TC condensing solar water heater with integrated gas burner, provides an ideal solution for DHW systems where there is no auxiliary boiler, or where DHW heating is to be kept completely separate from space heating systems. It is an excellent solution if there is a space limitation preventing the use of boilers and calorifiers together for DHW production.

For full details of the Dorchester DR-TC solar water heater and associated solar system, refer to brochure 500002598.

Dorchester DR-TC water heater with integral gas burner

General Application Information

Trigon Solar Thermal Hot Water

Suitability of Installation Location

Where solar collector arrays are being considered for positioning on any roof structure or in a ground position, a structural engineer should be consulted to assess the suitability of the structure and roof/ground fixing points to withstand the weight of the complete arrays including fittings, as well as wind loadings and snow loading effects, and to advise if any additional structures are required to secure the collector frames safely. Also to advise what, if any, measures may be needed to make good the watertight nature of the roof if the frame anchors have to pierce the roof membrane between the rafters and battens on sloping roofs or the external waterproof material of a flat roof.

Pipework and Insulation

Pipework may be sized to suit the flow requirements at the solar collectors. If multiple collectors are used in each collector array, then the pipe size may need to be larger to keep overall circuit resistance within the capacity of the chosen pump.

All pipework connections and insulation should be suitable for high temperatures and all pipes within the solar circuit must be insulated to BS476 Part 7. All external insulation should be such that it is protected from rodent/bird attack, and such that it sufficient to act as a thermal barrier both for effective system operation but also to guard against potential risks posed to people and animals from exposed high temperature surfaces.

Sloping on-roof 1st array hydraulic fittings kits include two 1m lengths of insulated stainless steel flexible convoluted hose and fittings, for piping the collector flow and return lines through the roof space. Hamworthy can provide optional quick slates (roof penetration slates) for use where the pipework to and from the collectors needs to pass through the sloping roof. The pipework and cabling between collector array(s) and transfer station and then to storage vessel(s) is the responsibility of others. Not HHL supply.

Where copper pipe is used, joints should be brazed; soft solder jointing is not permitted due to the possibility of elevated operating temperatures.

The solar circuit should be cleansed and flushed to remove any debris from brazing/pipe cutting prior to filling with solar fluid.

Expansion Vessels

Expansion vessels in solar systems are typically sized larger than for a typical pressurised gas-fired heating circuit, as the expansion coefficient of the fluid is greater than that of water alone. A qualified solar water system designer should calculate the appropriate expansion vessel size requirements based on CIBSE recommendations.

The vessel may also need to be protected from any risk of operating outside of the vessel's designed maximum operating temperature (120°C) by connecting the vessel to the system via an intermediate cooling tank or a suitable length of pipe of a much larger diameter than that of the normal flow and return pipes.

Total system solar fluid volume for expansion vessel sizing consists of the entire system volume when cold (including the collectors and local pipe work) plus a small reserve of fluid that remains in the expansion vessel when the solar circuit is cold, e.g. 5 litres. As a rule-of-thumb, calculate for approximately 10% expansion in solar fluid volume between cold and normal operation. Hamworthy can provide correctly sized expansion vessels for any Trigon solar circuit. *Contact our technical team for further assistance. Tel 01202 662500.*

Secondary Circuit Considerations

Stored hot water temperatures will at times be higher than with traditional DHW systems. It is therefore important that exposed pipework is insulated to prevent the risk of personal injury to people or animals.

With higher stored hot water temperatures it is essential that thermostatic mixing valves are fitted at hot water outlets to ensure that the risk of scalding is reduced.
Further information relating to application requirements can be found at the Thermostatic Mixing Valve Manufacturers Association web site, www.beama.org.uk.

Anti-legionella

To help reduce stagnation within the collector circuit, whilst maintaining hot water close to outlets and complying with anti-legionella requirements, the secondary circuit should deploy pumped recirculation. Stagnation probability is reduced by mixing the storage tank contents to a lower mean temperature thus prolonging the heating cycle.

Where the solar circuit is used as a pre-heat system for a direct fired water heater, consideration must be given for the prevention of Legionellae within the pre-heat cylinder. This is most important for prolonged periods of low solar energy when the pre-heat cylinder temperature may not rise to temperatures suitable for killing bacteria. Suitable anti-legionella precautions would include;

- Using a time-controlled immersion heater to raise the calorifier contents to a suitable temperature.
- Applying auxiliary heat to the second coil of the calorifier on a time basis.
- Use a time controlled de-stratification pump to ensure the entire contents of the calorifier are raised to the required temperature.

For further information on the control of legionella bacteria in water systems, please refer to HSC Document L8, Approved Code of Practice & Guidance.

Heating and Sustainable Hot Water

Trigon Solar Thermal Hot Water

Why Choose Hamworthy?

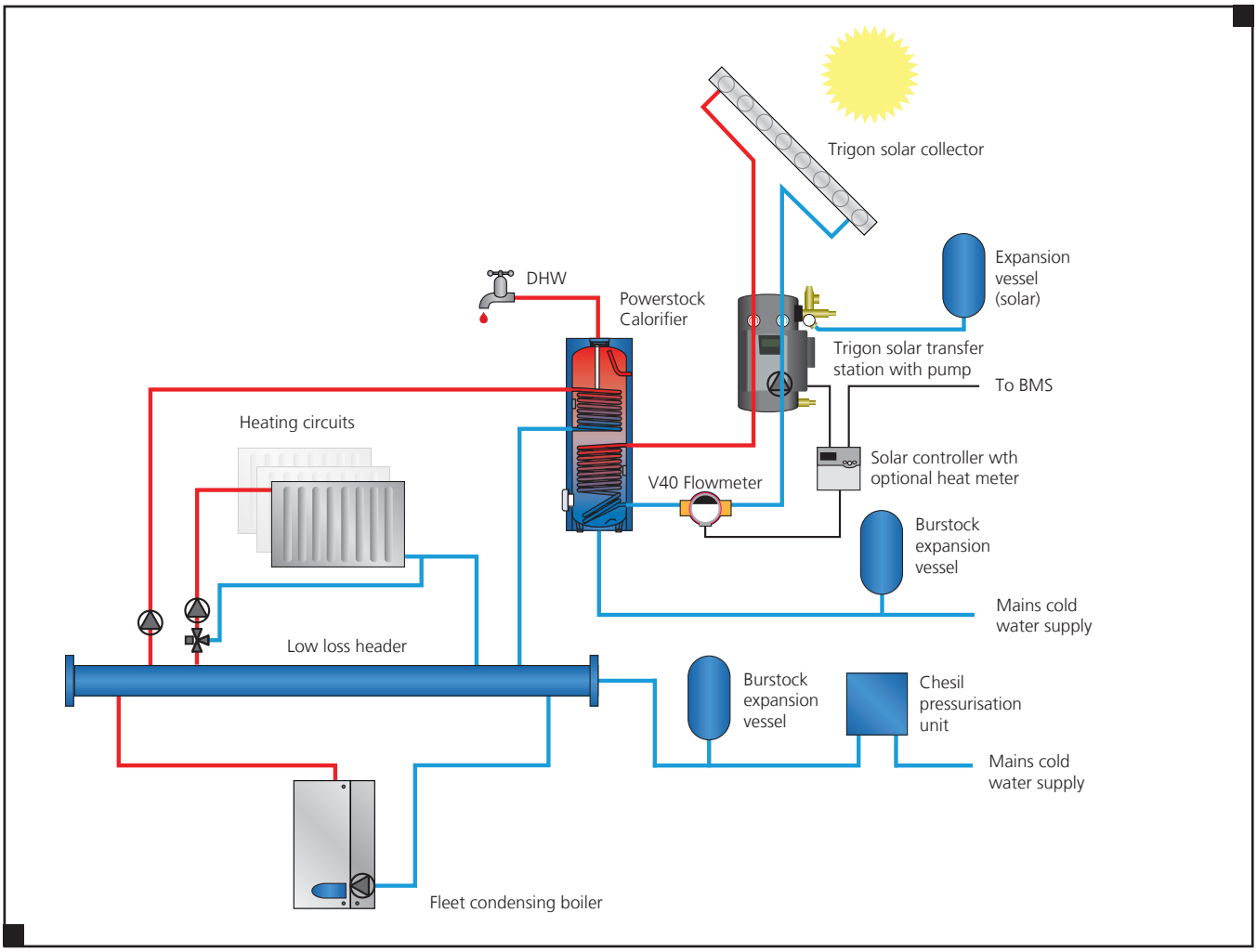
Hamworthy has extensive knowledge and over 40 years of experience of heating and hot water systems for commercial buildings, including supply of gas fired boilers for peak-load delivery alongside solar hot water systems. We can advise on the optimum boiler, water heater and solar thermal equipment selection for each project .

Whether it's for a new build, or for a refurbishment project, and whatever level of solar thermal integration is required for the building, we have the knowledge and expertise to help guide you through every stage of the process, from site survey to completed installation and on-going support.

For advice on making the right choice for your heating and hot water systems, talk to Hamworthy.

Tel: 0845 450 2865

Email: sales@hamworthy-heating.com



Hamworthy renewable capability with combined heating and DHW systems.

A typical Hamworthy combined traditional and renewable solution for heating and DHW is shown above in simplified form, and includes the following main items of equipment:

Heating System: Fleet condensing boiler, low loss header, Chesil pressurisation unit and Burstock expansion vessel.

Renewable and/or Indirect-fired DHW System: Field of solar collectors feeding a twin-coil calorifier via a solar transfer station and controller, with flowmeter and separate expansion vessels for the solar and DHW circuits.

Additional valves and safety equipment required for the unvented Fleet and Powerstock hydraulic circuits are not shown for clarity. An unvented kit is available for the Powerstock which includes a Burstock expansion vessel and the necessary valves.

For Hamworthy boilers and direct-fired water heaters, Hamworthy can supply a comprehensive range of flue solutions to complete the package.

Your local contact is:

British engineering excellence from Hamworthy Heating; the commercial heating and hot water specialists.

Hamworthy

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