

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 water 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**

- **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**

BENEFITS

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

5 YEAR
MANUFACTURER'S
WARRANTY



High quality, highly efficient Trigon solar collectors

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 to 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 m² to 20 m² of collector area (1 to 10 collectors) single field installations 25 m²
- ST2 (STD or ADV), for 22 m² to 40 m² collector area (11 to 20 collectors) single field installations
- ST3 (STD or ADV), for 42 m² to 60 m² 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 m² to 20 m² of collector area (1 to 10 collectors). Total collector area range 4 m² to 20 m² (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 2.0m² they each can provide around 1.57kW instantaneous thermal output with 1 kWhr/m² solar irradiance, and at a nominal flow rate of 20 litres/hour/m².

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.

Options

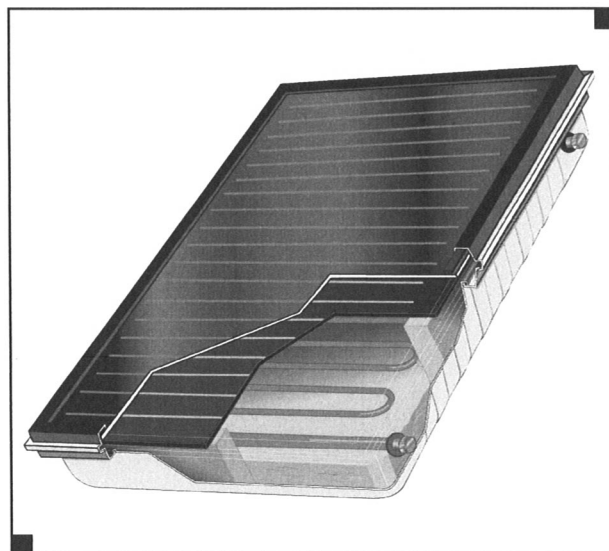
■ Collector on-roof mounting kits for sloping roofs:

- 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



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

Solar Collectors

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

Performance and Technical Data

Trigon Solar Collectors

		Units	Collector Model	
			Trigon 2.3V	Trigon 2.3H
Energy	Collector output @ irradiance 1000 W/m ² and 20 l/hr/m ² solar fluid flow rate	kW	1.57 × 10 = 15.7 kW.	
	Collector yield per annum per m ² absorber area @ irradiance 1000 W/m ² and 20 l/hr/m ² collector flow	kWh/m ²	785	
	Optical Efficiency*	%	80.4	79.4
	Heat loss coefficient a ₁ * (Thermal Transmittance, linear K ₁)	W/(m ² K)	3.235	3.494
	Heat loss coefficient a ₂ *(Thermal Transmittance, quadratic (K ₂) W/m ² °C)	W/(m ² K)	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/(m ² K)	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 1000W/m ² and 30°C	°C	194	198
	Solar fluid content	litres	1.7	1.9
Collector	Surface area of collector, gross	m ²	2.3	
	Aperture surface area	m ²	2.0	
	Effective absorber surface area	m ²	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

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	–	Wilco Star-ST 15/7 ECO-3	Wilco Star-ST 25/7 3C	Wilco Star Top-S 30/10	Wilco 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	Rp $\frac{3}{4}$ "	Rp1"	Rp1 $\frac{1}{4}$ "	Rp $\frac{3}{4}$ "
Fill and drain points	inch	Rp $\frac{1}{2}$ " int., G $\frac{3}{4}$ " ext. dual thread			
Pressure relief valve outlet	inch	Rp $\frac{3}{4}$ "		Rp1"	Rp $\frac{3}{4}$ "
Connection for expansion vessel	inch	G $\frac{3}{4}$ " flat faced Rp $\frac{3}{8}$ " dual thread		Rp $\frac{3}{4}$ "	G $\frac{3}{4}$ " Rp $\frac{3}{8}$ " 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.



Solar Hydraulic Schemes

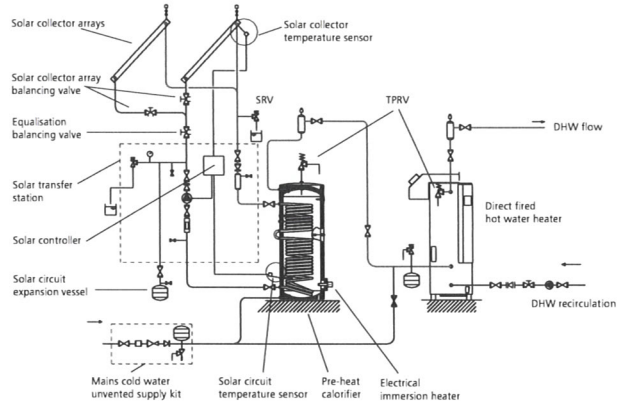
Solar Pre-heat DHW Control Strategies

Hydraulic Scheme G

Trigon solar system with single calorifier pre-heat, 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

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

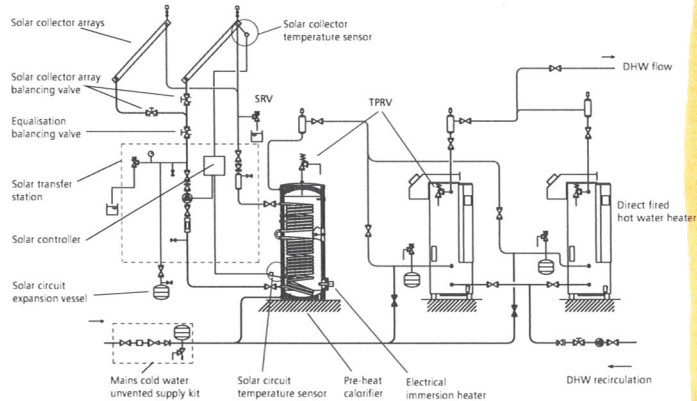


Hydraulic Scheme H

Trigon solar system with single calorifier pre-heat, 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

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

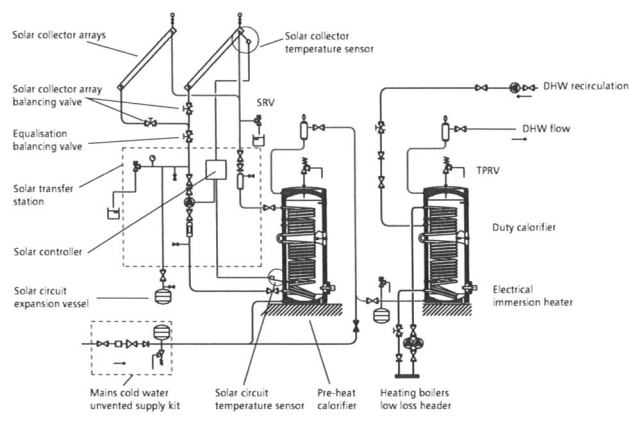


Hydraulic Scheme J

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



Thermal Energy Output