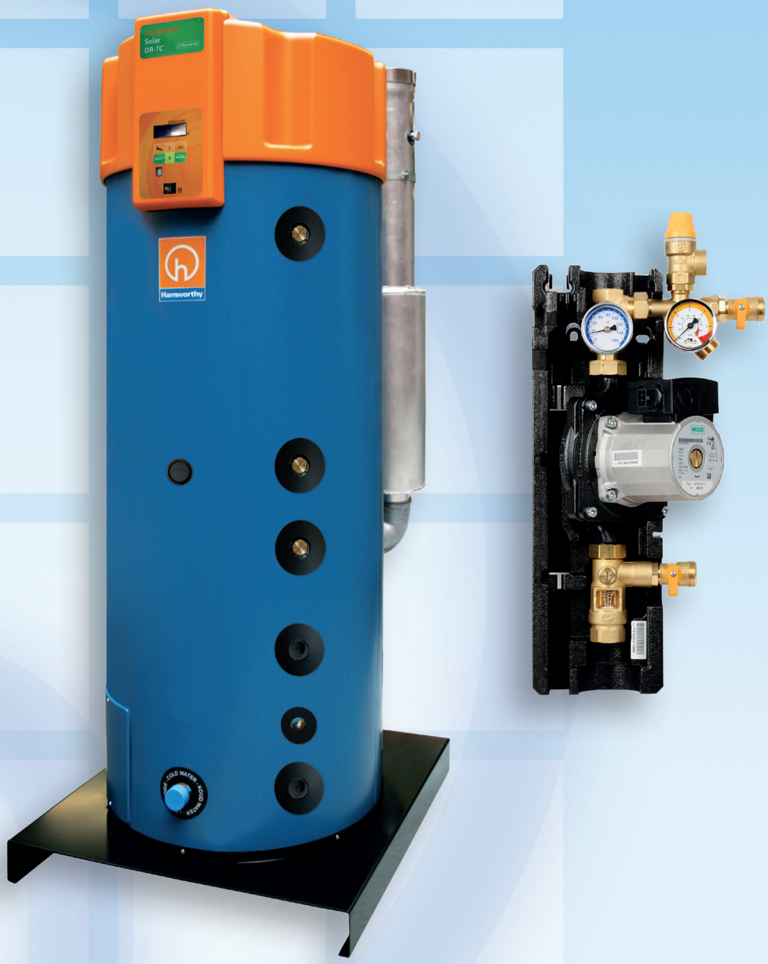


Hamworthy Dorchester
DR-TC 40 & DR-TC 60

Fully Automatic Solar Water Heaters
30kW Solar with
40kW or 60kW Natural Gas or LPG
Continuous outputs 820l/h to 1200l/h

CE

Hamworthy

Heating *at work.*

Dorchester DR-TC

Solar Water Heater with Integral Gas Burner

The innovative Dorchester DR-TC solar water heater combines the use of solar energy with condensing gas fired capability within a single storage unit, saving space and retaining all the benefits of direct fired water heating solutions.

Designed for commercial hot water applications, the Dorchester DR-TC range of solar water heaters features an intelligent control system to maximise the solar contribution whenever available, whilst at the same time delivering the assurance of a reliable hot water supply at all times, through the integrated gas fired system.

There are two models in the Dorchester DR-TC range, with a choice of natural gas or LPG fuel, and burner inputs rated at 40kW or 60kW. Both models have a storage capacity of 388 litres, and can deliver continuous outputs up to 820 and 1200 litres/hour respectively, based on a 44°C temperature rise.

The solar contribution is rated up to 30kW input, providing significant energy saving opportunities, reduced gas bills and a lower carbon footprint.

The cylinder is designed for condensing performance using a large coil heat exchanger and a fully modulating down firing pre-mix burner, achieving up to 96% gross efficiency, to maximise fuel economy.

Each Dorchester DR-TC solar water heater is supplied complete with matching solar transfer station and integrated controls. The solar package can be completed by using Hamworthy Trigon solar collectors, which are available for sloping roof or A-frame on flat roof/ground installation.

A range of options include heat metering and monitoring to provide an effective and sustainable solution to commercial hot water generation, reflecting the needs of today's designers and specifiers for both new build and refurbishment projects.

Options

- **Two solar transfer stations**
- **Remote monitor unit**
- **Remote display unit**
- **Top-to-bottom recirculation kit**
- **Unvented supply kit**
- **Room-sealed or open-vented flues**
- **Heat metering equipment**
- **Dummy sensor kit**

BENEFITS

- **Space-saving commercial DHW solution**
- **Solar-prioritised to save fuel**
- **Integrated intelligent controls**
- **Solar pump modulation maximises solar contribution**
- **Low NOx (Class 5) emissions**
- **Ultra-quiet operation**

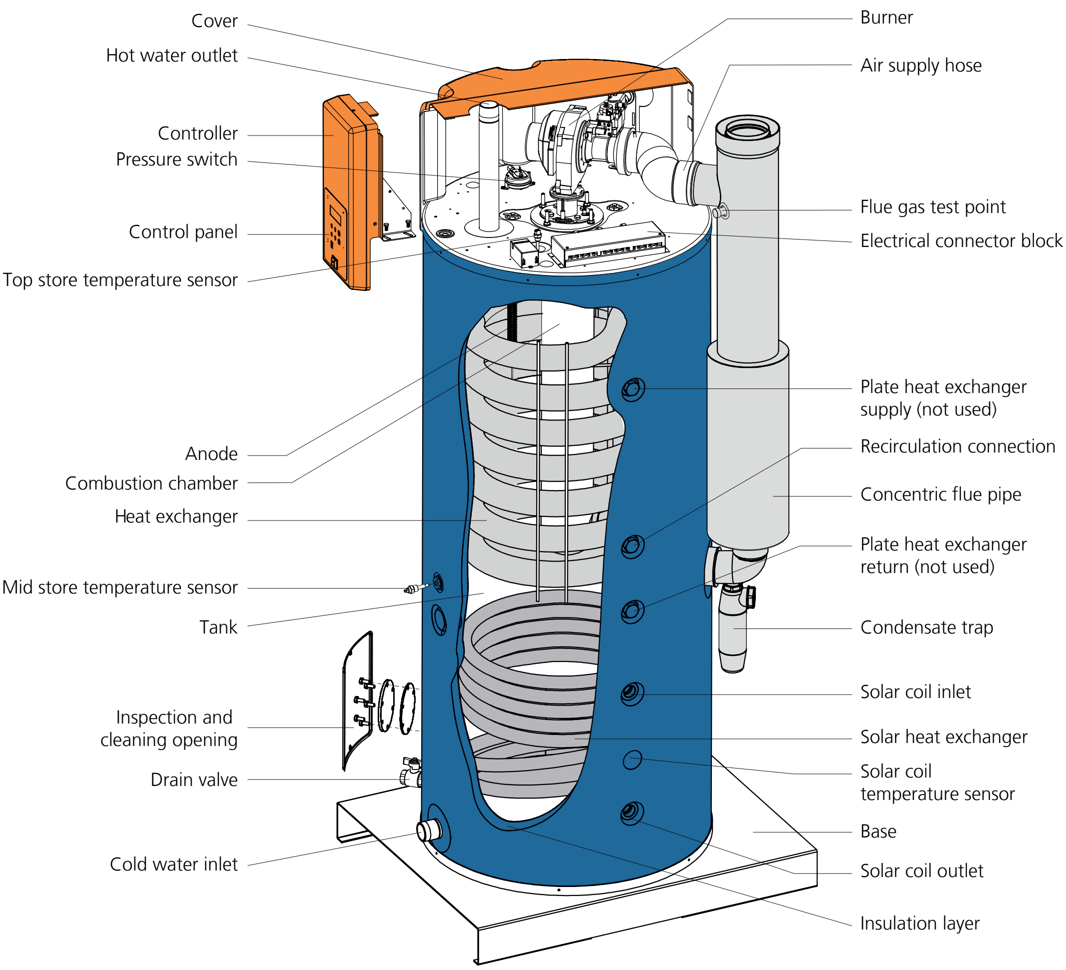
Gas consumption for hot water production is significantly reduced by the solar contribution and condensing performance.

Separating hot water production from the space heating load can also significantly reduce overall gas consumption of the heating plant.

Integrated controls maximise the solar contribution

Typical Layout

Dorchester DR-TC



Hybrid Solar and Gas Design

The well-proven Hamworthy Dorchester range of commercial direct-fired water heaters has further evolved to include the latest Dorchester DR-TC range.

This range uses a hybrid design of storage water heater that combines a solar thermal hot water system with a high efficiency gas combustion system capable of condensing operation, together in a single self-contained heating and storage vessel, and is designed and built to exceed minimum requirements of UK Building Regulations.

The hybrid solution, with integrated intelligent control, results in tangible savings in fuel usage and hence reduced running costs, lower overall emissions, as well as offering space saving advantages when compared with more traditional DHW water heater solutions, and yet still provides fast response time and impressive continuous output to satisfy demand, all year round.

The Dorchester DR-TC is a great choice when space is a premium, as it does not require any auxiliary external heater for topping-up heat or for anti-legionella cycling.

Solar Energy Benefits

The Dorchester DR-TC is able to take advantage of nominally "free" solar energy in place of gas heating whenever the collector temperature is just a few degrees above that of the stored water.

For every kilowatt of solar heat used in preference to gas heat (the solar coil has the potential to produce up to 30kW/hr) there is a corresponding fuel cost saving, which equates to an equivalent reduction in CO_2 emissions.

Combine the Dorchester DR-TC's intrinsic efficiencies with those gained by separating Domestic Hot Water (DHW) from space heating and this Hamworthy DHW solution becomes a very attractive proposition.

Also, with the various government financial incentives and capital allowances now available for solar thermal systems, the case for investing in a Dorchester DR-TC system becomes even more compelling–and of course, with solar heating zero-carbon rated, and very low carbon emissions from the combustion system when in use, the Dorchester DR-TC is good news for the environment too.

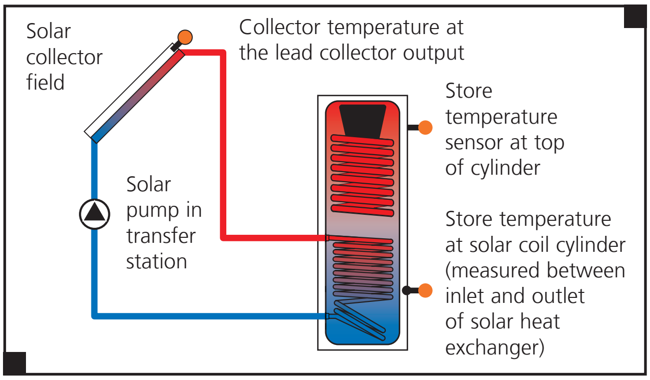
System Overview

Dorchester DR-TC

Solar Prioritised Operation

The solar and combustion heating circuits act in tandem to heat the stored water, with solar circuit providing heat whenever collector temperature is just a few degrees (a programmable value, typically 5°C) above that of the stored water at bottom of the tank, and with the gas circuit providing heat when the heating demand cannot be satisfied by solar heating alone.

When the stored hot water temperature falls below the combustion stat setting for gas burner operation, the controller makes an assessment of available solar energy. If sufficient solar energy is available the burner operation will be held off allowing solar energy to heat the store. However, if the store temperature continues to fall, the burner will be brought into operation to heat the water.



Simplified solar circuit

A simplified view of the solar circuit is shown above detailing the temperature measurement points that are key to the operation of the Dorchester DR-TC.

A functional block diagram showing the main equipment is shown on page 5.

Dual Thermostat Temperature Control

The solar circuit has its own independent solar thermostat setting separate from the main combustion circuit thermostat setting. If ambient conditions allow, the available solar energy may, with the solar stat set higher than the combustion stat, be sufficient to raise the store temperature above the combustion stat setting, up to the solar stat setting (maximum 80°C).

This means, when used with thermostatic mixing valves downstream, a greater rate or volume of draw-off is possible before any need may arise for supplementary heating via the combustion circuit.

Also, storing at a higher temperature, combined with efficient insulation to reduce the rate of heat loss from the tank, means the hold-off time before use, or before the combustion circuit is required is extended, which again saves gas.

Solar Control

The system comes with one of two solar transfer stations, depending on required solar circuit flow rate for connection to a solar collector field to complete the Dorchester DR-TC's solar circuit. The transfer station includes the variable speed solar pump and necessary safety devices for safe and efficient operation of the solar circuit. A sensor is included to measure the temperature at the leading collector and is connected to the controller via a solar controls interface unit.

The controller continually measures the solar differential, i.e. the difference between temperatures measured at the collector and store, and continually compares this with the user-programmed solar differential setting (typically +3°C). If at any time the measured differential is greater than the programmed differential then the solar circuit is switched on and heats the store. It continues heating if ambient conditions allow until the measured solar store temperature equals the user-programmed solar stat setting.

The controller modulates the solar pump speed between 15% and 100% depending on the measured temperature differential to maintain optimum heat transfer, maximise solar contribution and to prevent overshoot beyond thermostat settings.

Combustion Circuit Control

The controller features a user-programmable, 3-period per day, 7-day timer which can be used to set up a planned water heating schedule. It allows different temperatures to be set at different times to suit anticipated demand. A separate timer function is available for programming anti-legionella purge cycles.

The controller decides whether or not the combustion circuit needs to be switched on during a water heating period to achieve the user-programmed combustion stat temperature, whereas the solar circuit operation is completely independent of this timer.

The combustion circuit may fire outside of the programmed water heating period for example if the anti-legionella function is enabled, or if frost protection is enabled.

Hysteresis parameters can be programmed to hold off firing the burner, to reduce burner cycling, save gas, and improve overall efficiency of the system.

Also, with a modulating burner, the store temperature can be more precisely controlled, saving fuel and reducing wear on the working parts.

Dorchester DR-TC System Features

- Versatile positioning with small footprint
- Compact hybrid design to save space
- Stringent compliance to European Standards
- 7-day programmable timer
- Anti-legionella schemes
- Frost protection
- Overheat protection
- Pressurised and unvented
- Room-sealed or open-vented flues
- Flues types B23, C13, C33 and C53
- Easy installation with steel pallet base

Solar Circuit

Dorchester DR-TC

Solar Circuit Equipment

Supplied with the Dorchester DR-TC is a choice of solar transfer stations. The TX1 is for flow rate range 0.5 to 15 l/min, the TX2 for flow rate range 4 to 22 l/min.

Each includes a solar pump on the return line to the collector to pump solar fluid (40% propylene glycol) around the circuit under control from the Dorchester DR-TC controller.

A wall mounted solar controls interface unit acts as the termination point for temperature sensors and contains the circuitry that controls the on/off and speed of the solar pump via a 4-wire power and control link. It has no user-interface of its own, but its operation and parameter programming is carried out at the Dorchester DR-TC controller to which it is connected via a local data bus.

An optional remote display unit can be connected to the controller bus to remotely display system parameters, and with optional Q/T sensors fitted to the system, solar heat contribution can also be displayed.

An optional remote monitoring unit is available to facilitate remote monitoring at a Building Management System (BMS). This unit translates system data from the Dorchester DR-TC's proprietary format into Modbus formatted data for output to an external BMS system via a 3-wire Modbus connection.

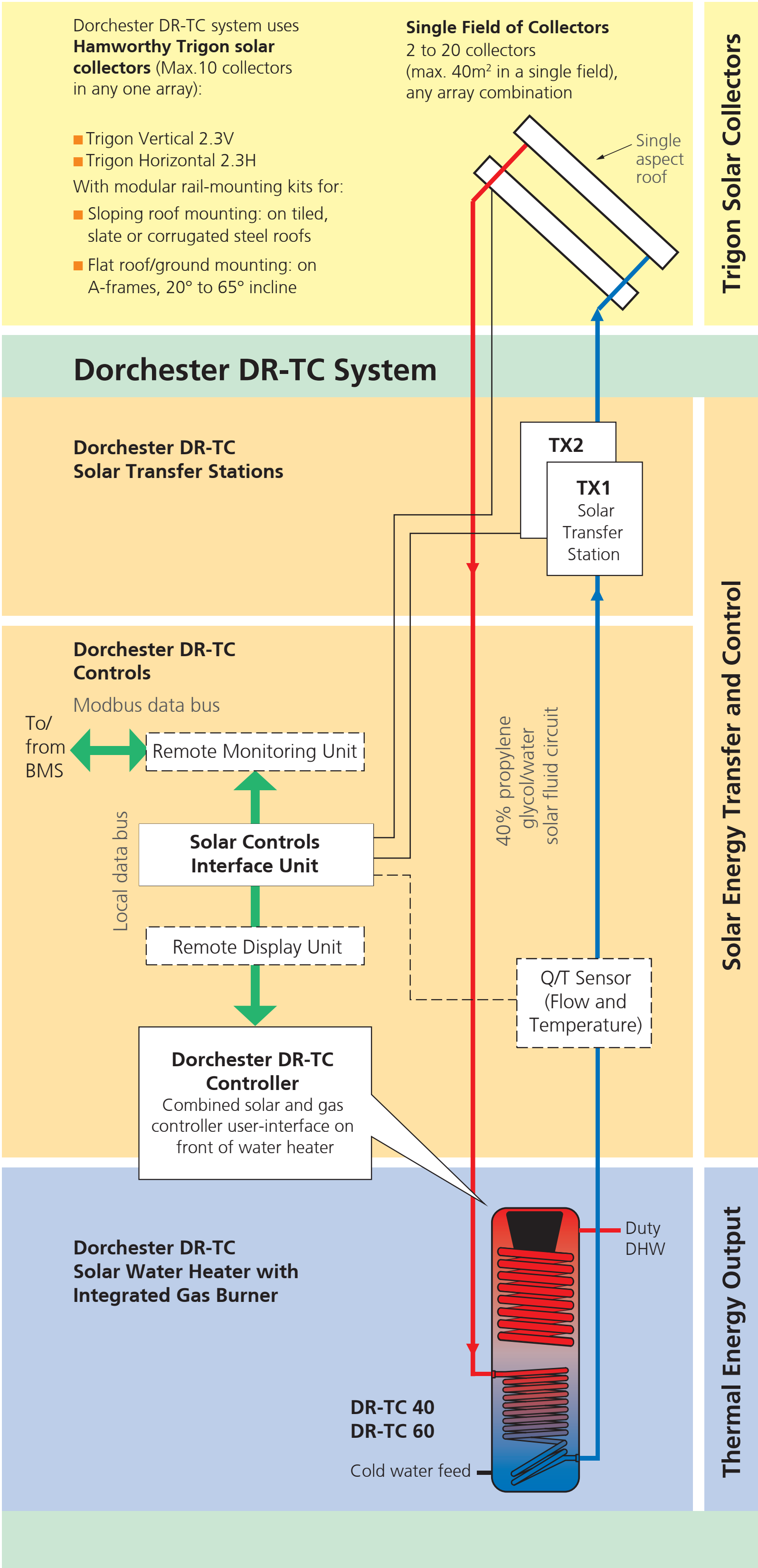
A special Renewable Heat Incentive (RHI)-approved, tamper-resistant, heat meter is also available for independent measurement of eligible solar heat contribution.

Solar Collector Recommendations

The system must be used with a correctly sized solar collector field. To complete the Dorchester DR-TC system we recommend the highly efficient Hamworthy Trigon 2.3V vertical and 2.3H horizontal collectors together with the appropriate roof/ground mounting kits and accessories (see Trigon brochure 500002597).

The Dorchester DR-TC can be used with a single field of solar collectors in any array combination (up to a maximum of 10 collectors in any one array), but is not suitable for dual-field systems requiring two individually controlled solar pumps.

Please contact Hamworthy sales as we can provide advice and assistance in sizing an appropriate collector field for a given application and location. Telephone 0845 450 2865 or email sales@hamworthy-heating.com



Specification

Dorchester DR-TC System: Solar and Gas Heating Circuits

Gas Heating Circuit

The gas heater in the Dorchester DR-TC water heater is a downwards firing, modulating premix burner for efficient operation.

Combustion air is supplied through the outer flue line of a concentric flue, via a fan, and gas (natural or LPG depending on the model) is supplied via a gas isolation valve, a gas control valve and venturi on the intake side of the fan to the burner for combustion.

For safety, the burner firing sequence includes a pre and post firing purge of any gases in the system using fan-blown combustion air, as well as a pre-glow period while the surface igniter is heated before the gas control valve can be opened to begin combustion.

When the burner is fully lit, hot flue gases lead downwards through the combustion chamber then upwards through the gas heat exchanger and downwards again alongside the water in the tank, with the gases cooling in the process as they give up heat to the stored water.

As the cooled flue gases flow in pipework alongside the cold water lower down the tank, they start to condense if the surrounding water is below the dew point of 55°C.

This condensation causes latent heat normally lost in the flue system to contribute to heating the water, thereby increasing the performance of the unit, being most effective at cold start-up, high demand and when the control scheme is set to a low comfort setting.

The condensate formed during any condensing operation is discharged via a condensate trap. This should be fed to a drain via a tundish arrangement.

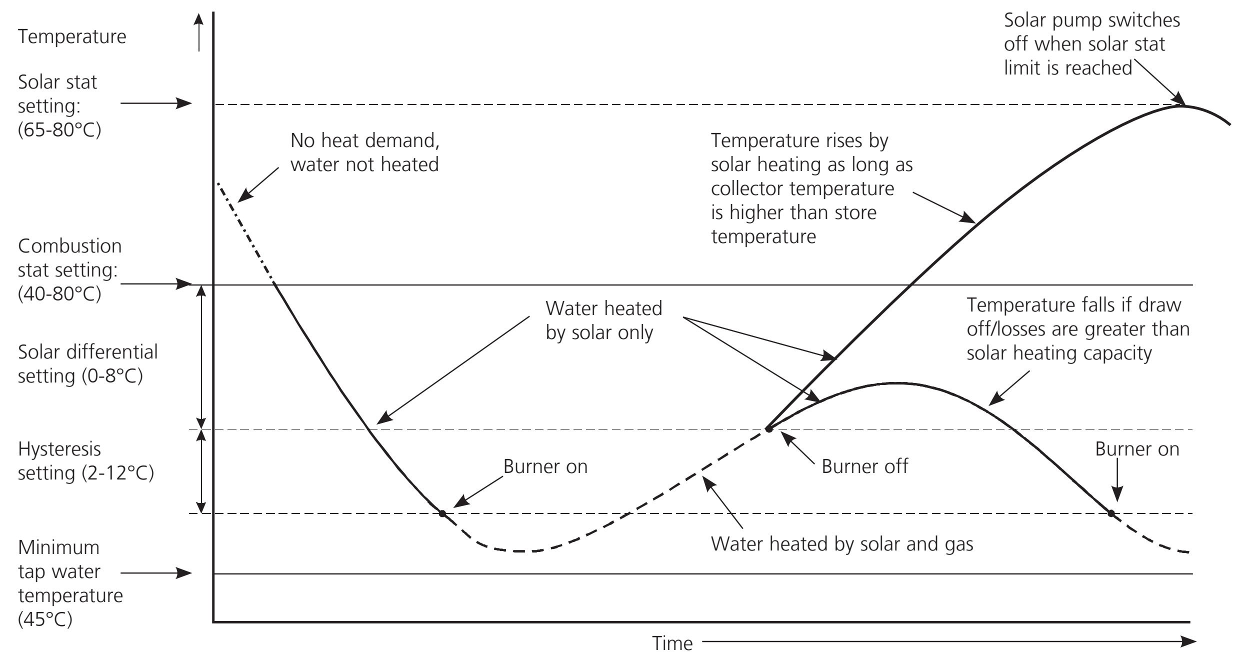
The gases are exhausted though the inner flue of the concentric flue, and out to atmosphere via concentric or parallel flues.

Hamworthy offer flue kits for the Dorchester DR-TC with options for installation types B23, C13, C33 and C53.

Combined Gas and Solar Operating Cycle

The graph below shows typical temperature of the top of the tank against time. This is a simplified curve to illustrate that the combustion circuit is held off from firing by hysteresis settings plus at least the programmed minimum solar differential. Thermostat and parameter settings can be adjusted, allowing the operation of the solar and gas heating cycles to be tuned to the specific installation.

Graph of Measured Top of Tank Temperature against Time Illustrating the Operation Cycle



Programmable Thermostat and Temperature Parameter Settings

Solar stat setting is the maximum storage temperature when heated by solar; programmable range 65-80°C, default 65°C.

Combustion stat setting is the maximum storage temperature when heated by gas; programmable range 40-80°C, default 65°C.

Solar differential setting is the differential between collector and stored hot water temperature that the measured differential must exceed before solar circuit will operate; programmable range 0-8°C, default 3°C DR-TC 40, 5°C DR-TC 60.

The hysteresis setting is the temperature differential between measured hot water temperature plus any solar differential and the combustion stat setting. Hysteresis holds off gas burner operation to reduce cycling; programmable range 2-12°C, default 5°C.

Specification

Dorchester DR-TC 40 and DR-TC 60

Efficient Design

The Dorchester DR-TC gross efficiency is 96%. High efficiency equates to lower gas use and low carbon emissions when compared to traditional water heaters.

In the Dorchester DR-TC system, the solar circuit begins to supply solar-derived energy to the water heater solar coil as soon as two conditions are met: the difference between solar collector field temperature and the store must equal or exceed the programmed solar differential setting (typically 3°C), and at the same time the solar collector field temperature must equal or exceed 30°C. Therefore, for an early morning start from cold, with sufficient solar energy the entire contents of the water heater could be up to full temperature before the time clock initiates the gas side therefore not requiring the gas burner to operate at all.

With the Dorchester DR-TC, pre-heating always operates when solar energy is available up until the stored water temperature measured at the top of the tank reaches the programmed solar stat temperature setting (maximum 80°C). Therefore during low use periods when the gas burner setting temperature is reduced there is a good chance the entire hot water store could be heated by solar up to full operating temperature in time for the start of the high use period with higher temperature requirement, reducing operation of the gas burner.

In a traditional pre-heat arrangement with a direct-fired water heater being supplied with a solar pre-heated cold water feed from a separate calorifier, the water heater burns gas to a single temperature setting throughout the low use period, only benefiting from solar energy during draw off when hot water is drawn in to the heater. Burner operation will only be prevented when the pre-heat water has reached the same temperature as the water heater temperature setting.
In addition, reliance on the gas burner of a traditional water heater that may have a gross efficiency typically 20% lower than that of a Dorchester DR-TC means a lot more gas is burnt.

By reducing the Dorchester DR-TC's gas burner operating temperature set point during low use periods, when there are reasonable solar energy levels, collector stagnation can be reduced due to the prolonged reliance on solar energy to raise the water heater temperature.

Dorchester DR-TC water heaters can operate at higher temperatures than equivalent traditional direct fired water heaters. Operating at up to 80°C stored hot water temperature, and by use of mixing valves at point of use, the volume of stored hot water can last longer further reducing the dependency on the gas burner to heat the water. Supplying higher temperature hot water heated by solar energy to the point of use for mixing can provide up to 15% greater hot water capacity from the same volume of stored water at traditional temperatures.

Cylinder Construction

The Dorchester water heater cylinder is constructed of high grade steel and fully fabricated before the application of a high quality vitreous enamel lining, ensuring the integrity of the lining. The cylinder is insulated with a layer of CFC-free foam to minimise standing heat losses. The cylinder storage capacity is 388 litres.

Burner System

A down-firing cylindrical burner is positioned centrally within the combustion heat exchanger and is designed for good flame stability at low turndown rates. The woven fibre construction of the burner also results in lower flame temperatures being achieved and thus lower NOx emissions.

Gas Burner Heat Exchanger

The gas burner heat exchanger extends from the burner combustion chamber at the top of the cylinder, and comprises an axially mounted, gradually tapering pipe which descends halfway down the tank and then rises back up to the top of the tank before changing profile to become a constant diameter pipe. This then winds in a helix back down the tank to the flue and condensate drain point. The heat exchanger is designed in this way to increase the condensing operation capability and therefore to maximise operating efficiency.

LPG fuels

All Dorchester water heaters are suitable for Natural Gas or LPG fuel. The fuel type must be specified at ordering.

It is strongly recommended that on LPG installations, gas detection equipment is fitted and that this equipment is positioned near the heater and at a low level. It is also imperative that the plant room is ventilated at high and low level.

Fully Automatic Ignition

Dorchester DR-TC models are equipped with a fully automatic ignition system.

Water Input/ Output

The cylinder is fed through a connection at the base from an open-vented cold water system directly, or from an unvented system (mains supply) via an optional unvented kit specific to the individual water heater, which limits the cold fill pressure to a maximum of 3.5bar. The water is heated by both the solar and gas heat exchanger coils with the resulting hot water output delivered through a connection at the top of the tank.

Specification

Dorchester DR-TC Safety and Protection

Frost Protection

The cylinder is protected against freezing. If store temperature falls below 5°C the burner fires and heats the water to 20°C. This will override any OFF period set in any programmed timer schedule.

Overheat Protection

If the store temperature reaches 88°C overheat protection is enabled, switching off solar and combustion circuits and allowing the cylinder to cool. When the store temperature falls back to 81°C, the controller resets the water heater.

As an additional safety feature, if the temperature in the system reaches 93°C or above, a lockout condition is set at the controller requiring a manual reset of the system before the solar or combustion circuits can be restarted, and then only if store temperature has fallen to below 81°C.

Gas Safety Measures

The gas valve includes a double gas flow shut off valve, and a pressure switch which is used to guarantee the supply of combustion air during pre-purging which is preset to a differential pressure of <115 Pa.

An ionization detection flame probe is included which causes the gas control valve to close the instant it detects there is gas flow but no flame.

Anodic Protection

Titanium electrode anodic protection is included in the cylinder as additional protection against any corrosion in addition to the enamel coating. It is effective in providing internal corrosion protection with water supplies having electrical conductivity levels as low as 125uS. It is essential for correct operation that an uninterrupted 24-hour power supply is maintained at all times to ensure proper protection of the unit.

Thermostatic Heating Valves

With hot water output temperatures potentially up to 80°C, thermostatic mixing valves must be deployed between the Dorchester DR-TC and the points of use to ensure the supplied DHW temperature is reduced to safe levels.

Controlling Legionella

Legionella bacteria are common in natural water sources and therefore low concentrations may be present in water systems. It is important that hot water services are designed and operated in such a way that these organisms are prevented from multiplying.

Water temperature is a significant factor in controlling the risk, with optimum conditions for bacterial growth occurring between 20°C and 45°C but at 60°C legionella bacteria cannot survive.

Like all Dorchester water heaters, the Dorchester DR-TC conforms to Health and Safety (HSC) requirements for the control of legionella, in line with the approved code practice and guidance document L8. It includes a programmable anti-legionella cycle which, in the default setting, heats the stored water once a week to 65°C, maintaining this minimum temperature for 1 hour.

The system pump can be set to operate simultaneously with the programmed anti-legionella cycle ensuring the circulating system is also heated fully. If there is sufficient solar energy supply then the gas burner will not need to fire, saving the energy required to carry out the anti-legionella purge that day.

Regular cleaning of the system will help avoid the build-up of sediments which may harbour the bacteria. The Dorchester DR-TC is designed with a base shaped to avoid sludge traps and with a large access hatch near the base to facilitate cleaning.

Water stagnation may encourage the growth of biofilm, which can provide local conditions that may promote the proliferation of bacteria. To prevent this, the cylinder is designed with a number of tappings correctly positioned to facilitate recirculation, destratification and to obviate stagnation areas.

Top to Bottom Recirculation Kit (Optional)

In order to prevent stratification, a top-to-bottom recirculation kit should be specified, and should be controlled to run during the anti–legionella purge cycle. The kit includes a pump, isolation valves, non-return valve and pipework for fitting on site.

Pressure Relief Valves

On open vented systems a suitable scaled pressure relief valve (PRV) in accordance with BS 6644 is required on the DHW flow line. For unvented systems, Hamworthy can supply an optional unvented kit with an appropriate Pressure Relief Valve (PRV) and expansion vessels. On the solar circuit a PRV is included in each solar transfer station, along with a connection for an expansion vessel for the solar circuit. An additional PRV will be required in the solar circuit between any collector or collector array and any isolation valve that may be fitted to isolate that collector or collector array.

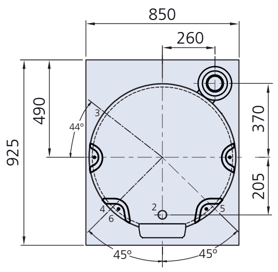
Technical Data

Dorchester DR-TC 40 and DR-TC 60

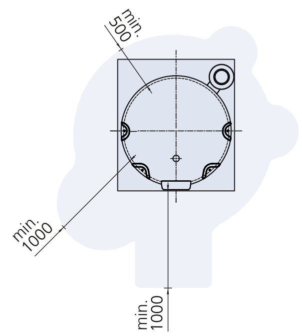
	Description	Unit	DR-TC 40	DR-TC 60
Water	Continuous output with 44°C □T	l/h (l)	820	1200
	Continuous output with 50°C □T	l/h (l)	730	1100
	Continuous output with 55°C □T	l/h (l)	660	930
	Storage capacity	litres	388	
	Maximum operating water pressure (vented)	kPa (bar)	800 (8)	
	Maximum operating water pressure (unvented)	kPa (bar)	550 (5.5)	
	T&P valve maximum temperature and pressure (unvented systems)	bar/°C	7/97	
Energy	Gross efficiency	%	96	
	Heating-up time, □T = 44°C	min.	16	11
	Heating-up time, □T = 50°C	min.	18	13
	Heating-up time, □T = 55°C	min.	20	14
Nat. Gas G20 20mbar	Input, gross/ (net) – Maximum	kW	43.5/ (39.2)	62.1/ (55.9)
	Output maximum	kW	41.9	59.3
	Nominal gas inlet pressure	mbar	20	
	Gas flow rate - maximum @1013.25 mbar and 15°C	m^3/h	4.2	6.0
LPG G31 37mbar	Input, gross/ (net) – Maximum	kW	42.6/ (39.2)	60.8/ (55.9)
	Output maximum	kW	41.9	59.3
	Nominal gas inlet pressure	mbar	37	
	Gas flow rate - maximum @1013.25 mbar and 15°C	kg/h	3.1	4.4
Flue	NOx emission (DAF)–European Class 5	mg/kWh	51	
	Approximate flue gas volume @ 15°C, 9.0%CO_2, N.T.P.	m^3/h	57.1	81.4
	Maximum flue gas temperature	°C	50	60
	Minimum pressure at the flue outlet	Pa	94	181
Electrical	Water heater only, start current–maximum (maximum power)	A (W)	0.6 (135)	
	Water heater only, run current–maximum (maximum power)	A (W)	0.52 (120)	
	Transfer station and solar controls interface, run current–(maximum power)	A (W)	3.05 (700)	
	Electrical power rating of the solar pump-maximum	W	165	
	Nominal supply voltage	volts	230V 1PH 50Hz	
Solar	Recommended solar fluid		Propylene glycol e.g. Tyfocor L (diluted 40% Tyfocor /60% water)	
	Maximum pressure of solar fluid circuit	bar	6	
Misc.	Noise level @ 2m distance from roof duct	dB(A)	<45	
	Number of (power) anodes	-	2	
	Approximate shipping weight	kg	245	
	Maximum floor load/ weight filled with water	kg	633	

Dimensional Details

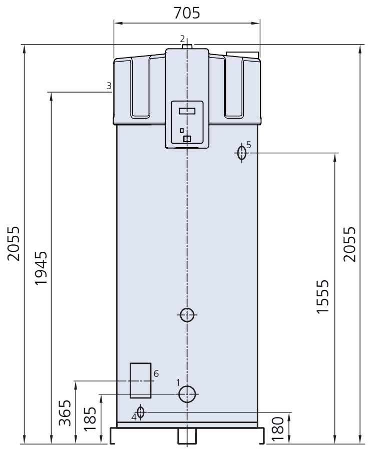
Dorchester DR-TC 40 and DR-TC 60



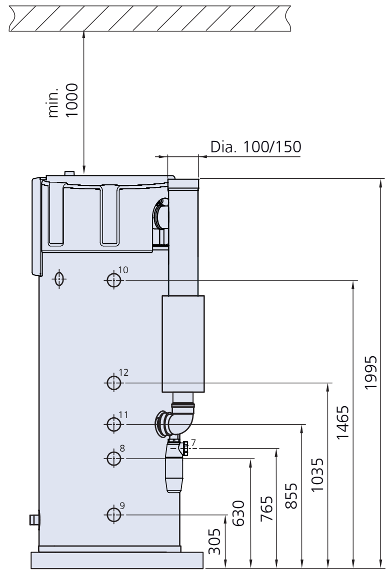
Plan view



Plan view of clearances



Front view



Side view

All dimensions in mm

Ref.	Description	Unit	DR-TC 40 and DR-TC 60
1	Cold water inlet connection (male)	Inch	R 1½
2	Hot water outlet (male)	Inch	R 1½
3	Gas inlet connection (female)	Inch	Rp □
4	Drain valve connection (female)	Inch	□"
5	T&P valve connection (female)	Inch	1" - 11.5 NPT
6	Cleaning/inspection opening	mm	95 x 70
7	Condensation drain connection (female)	Inch	Dia. 40
8	Coil inlet connection (female)	Inch	Rp 1
9	Coil outlet connection (female)	Inch	Rp 1
10	Blanked connector (female), not used	Inch	Rp 1
11	Blanked connector (female), not used	Inch	Rp 1
12	Hot water recirculation return inlet (female)	Inch	Rp 1

Controls

Overview

The Dorchester DR-TC features a comprehensive and yet easy to use controller for managing DHW production. The controller is integral to the water heater, and connects via a 2-wire bus to a wall-mounted solar controls interface unit to which the solar temperature sensors and any flow sensors are connected. The unit includes a semiconductor relay with four-wire (power and control) connections for the stepped variable-speed solar pump in the solar transfer station.

The control panel features a 4-line 20 character display panel which displays operating status information in conjunction with 6 graphical symbols above the display. A 6-button keypad below provides the user interface: Up and down arrow keys are used for navigation through the menu structure, and programming is via Enter or Reset keys.

Two menu levels are available, the user-level by pressing the key with the book symbol, or the maintenance level menu by pressing the key with the spanner symbol.

The panel includes a standard 2-pin Molex connector for connection to the manufacturer's test and diagnostic equipment.

The primary control of the water heater gas burner is the combustion circuit thermostat setting. This can be set and adjusted either in the ON mode, or set to a value that is valid for a particular time period, with three uniquely programmable burner ON—OFF time periods per day (up to 21 uniquely programmable time periods per week).

Error and warning messages may also be displayed e.g. to indicate that a service is required, or that a fault has developed.

If combustion circuit thermostat setting is not met by the water temperature measured at the top of the water heater, and there is not a valid solar contribution available, then the gas burner will operate during the programmed ON time period, heating the water until measured temperature reaches the programmed temperature set for that time period.

Time-programmable Temperature Settings

A traditional water heater has just one temperature setting and is typically set at 60°C to ensure legionella bacteria is managed. Using the Dorchester DR-TC time clock controlled temperature program, a lower temperature can be selected for gas operation during low use periods, encouraging condensing operation when there is little solar energy and the burner has to operate. The timer can also be used to limit the burner use, for example, to peak loading time only.

A higher temperature can be selected for a high usage period to allow greater mixing and to increase the hot water capacity.

When the water heater is operating at lower temperatures during low-use periods, there is a greater possibility of the hot water load being satisfied by solar energy, even if full solar energy conditions do not prevail.

During any ON period, the combustion circuit will only fire up if it needs to, i.e. if the store temperature is less than the programmed combustion circuit thermostat setting. With sufficient solar heating prior to the ON period, the stored water may be held at a temperature above the combustion stat setting and so will not fire until draw off and replenishment reduces the store temperature to below the combustion stat setting.

During any OFF timer period, the combustion circuit will not operate, unless the store falls to below 5°C, in which case frost protection function is enabled.

In addition to the main timer control an anti-legionella function is available with its own day, time on, time off and temperature programmable settings, which, by factory default settings, heats the water every Monday for one hour between 02:00 and 03:00 to 65°C.

Optional Control and Monitoring Equipment

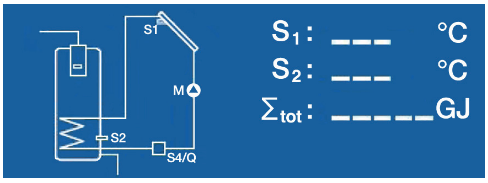
Remote Monitoring Unit

A remote monitoring unit is available to provide an interface to a remote Building Management System (BMS) and facilitates the remote monitoring of the Dorchester DR-TC system data, such as current status of the water heater and the solar controls, solar performance (if a Q/T sensor is fitted in the system), and any error messages.

This unit continually polls the controller capturing system data in the Dorchester DR-TC's proprietary format and converting this into Modbus format for output to an external BMS system, via a 3-wire Modbus connection.

Remote Display Unit

A wall-mountable remote display unit is available to present in real-time the solar contribution of the system, typically to building users outside of the plant room. The display offers individual parameter views of sensor temperatures, pump status, and solar heating contribution, and a combined summary view.



Remote display unit summary screen

Solar Heat Metering and Q/T Sensor Option

To enable the Dorchester DR-TC controller to meter heat, Hamworthy can offer a Q/T sensor option, in which a Q/T sensor measures the solar fluid flow rate and temperature in the return to the collector and passes this to the controller to calculate the instantaneous and cumulative solar energy produced. The results can be made available for viewing at the controller, remote display unit or BMS.

RHI-Approved Heat Meter

To claim the Renewable Heat Incentive (RHI), an approved heat meter must be deployed in the solar circuit. For this purpose Hamworthy can provide an independent, tamper resistant, RHI-approved heat meter in place of the above-mentioned Q/T sensor option, which meets the requirements of European Guidelines MID-2004/22/EC and Standard EN 1434 Class 2.

Dummy Sensor Kit

An optional dummy sensor kit is available to allow the Dorchester DR-TC to operate without a solar circuit; for use in a staged development where DHW may be required ahead of fitting a solar circuit.

Solar Equipment

Solar Collectors and Dorchester DR-TC Solar Transfer Stations

Solar Collector Recommendations

The Dorchester DR-TC water heater is supplied with a transfer station only, and requires a solar collector field to complete the solar circuit.

Hamworthy recommend its Trigon flat-plate solar collectors for use with the Dorchester DR-TC system. These rugged, highly efficient collectors are designed to BS EN12975. They feature a one-piece aluminium casing and tempered glass cover housing a specially coated absorber; and come with a 5-year guarantee.

The Dorchester DR-TC system can be sized up to 40m^2 using a maximum of 20 Hamworthy Trigon vertical (2.3 V) or horizontal (2.3H) flat plate collectors in a single field of collectors organised in any array combination.

The Trigon collector field connects via the solar transfer station to the solar coil in the Dorchester DR-TC water heater forming a sealed (pressurised) solar circuit, and uses Tyfocor L solar fluid (40% propylene glycol/water) as the recommended heat transfer medium.

The collectors can be array-mounted using the modular rail-mounting system, which comes with different array fixing kits for use on tiled, slate or corrugated steel sloping roofs, or for flat roof/ground installations using A-frame fixing kits.

Each array can have a maximum of 10 collectors if flow and return lines from/to the array are connected at opposite ends of the array, or a maximum of 5 per array if flow and return lines are connected at the same end of the array.

Collector fields can be designed with multiple arrays and an unequal number of collectors in each array to suit available space, as Hamworthy provide balancing valves with each Trigon collector array kit to balance out pressures across multiple arrays.

The flow requirement for the solar circuit using Trigon collectors is 0.66 l/min per collector based on 20l/hour per m^2 collector absorber area. For more information about the Trigon collectors, refer to Trigon brochure 500002597.

Note: the size of the solar coil (30 kW) in the Dorchester DR-TC water heater limits the number of Trigon collectors to 20.

Dorchester DR-TC Solar Transfer Stations

Dorchester DR-TC water is supplied with one of two solar transfer stations depending on flow rate requirements. The solar transfer stations are compact wall mounted units which include a stepped variable speed solar pump and all the necessary safety equipment, valves, gauges and hydraulic hardware together in a blown-polystyrene insulated housing. The transfer station controls the flow of solar fluid in the closed solar circuit under automatic control from the electronic controller on the front of the water heater.

The solar transfer station sits between the solar coil of the Dorchester DR-TC water heater and the collector field on the return line to the collectors.

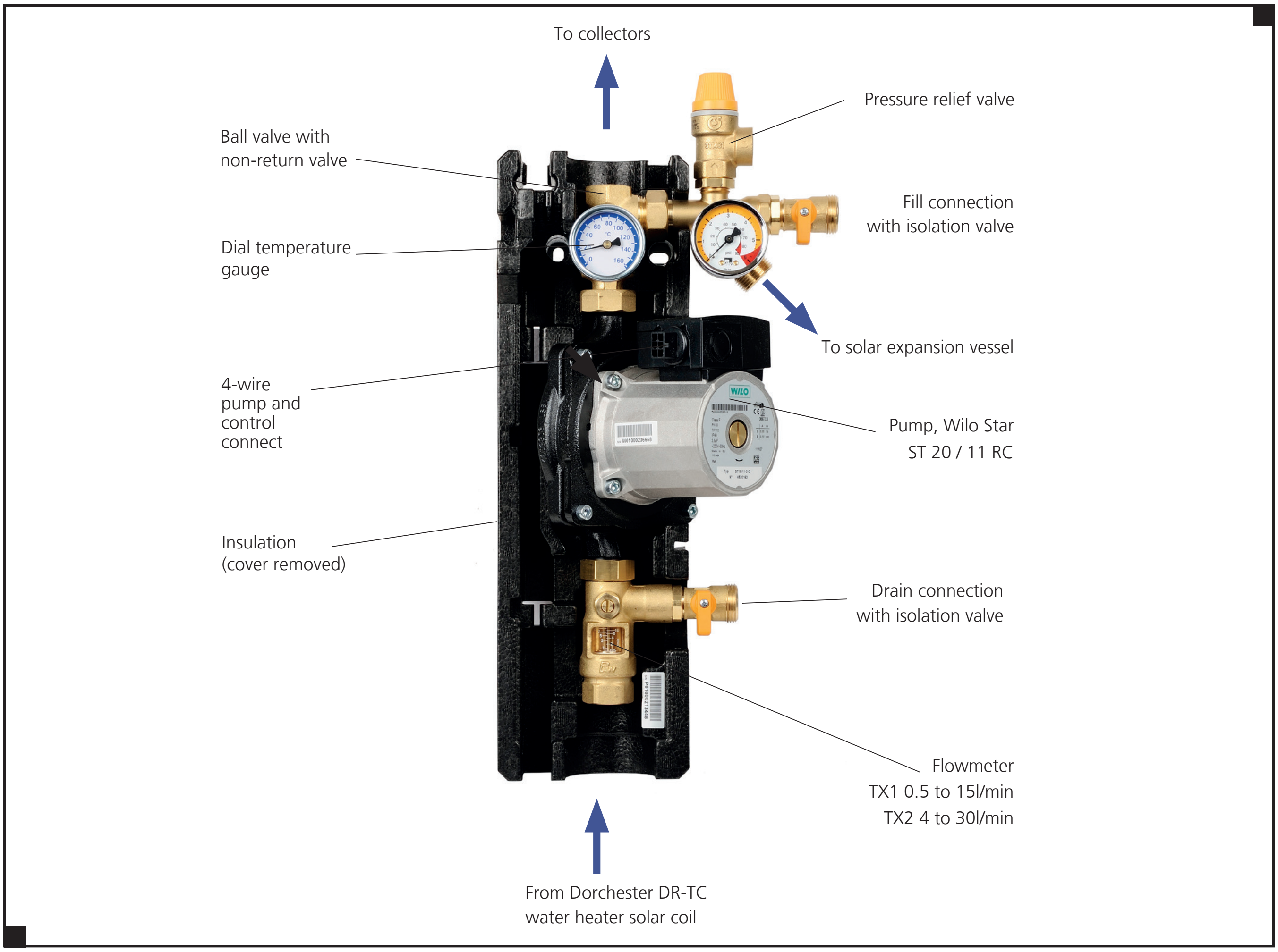
Two solar transfer stations are available, both using the same pump:

- Solar Transfer Station TX1, with 0.5 to 15 l/min solar circuit flow capacity, for use with 4 to 30m^2 of total collector area (2 to 15 Trigon collectors)
- Solar Station TX2 with 4 to 22 l/min solar circuit flow capacity, for use with 12 to 40m^2 of total collector area (6 to 20 Trigon collectors)

Each solar transfer station includes:

- Circulation pump (Wilo Star-ST 15/11-2 C)
- Inline sight-glass flowmeter with flow rate adjustment valve
- Fill/drain point
- Isolation valves
- Anti-thermosyphon non-return valves
- 6bar safety valve
- Dial pressure gauge (flow side) 0–6bar
- Dial temperature gauge
- Connections to solar expansion vessel
- Temperature sensor for solar collector

High quality, highly efficient Trigon solar collectors



Dorchester DR-TC solar transfer stations TX1 and TX2

Solar Pump

Both transfer stations use a Wilo Star glandless solar pump for maintenance–free operation, suitable for solar installations running up to a maximum of 50% propylene glycol water mix solar fluids (Hamworthy recommend 40% propylene glycol : water ratio for the UK and offer solar fluid in this ratio, refer to the Trigon brochure 500002597).

The pump's long life and low maintenance is assured thanks to a cast iron housing with cataphoretic coating, a stainless steel shaft with metal-impregnated carbon plain bearings and an impeller made of GF polypropylene.

The pump features a current-protected modulating AC motor which can modulate down to 15% of maximum flow, to closely match the available solar energy for continuous loading of the cylinder, and to reduce wear and tear on the pump caused by repeated stops and starts.

Flow Rate Adjustment

Flow rate adjustment of the required maximum solar fluid flow rate is made with the pump set to maximum flow rate at the controller, by adjustment of the manual flow restriction valve above the flowmeter in the transfer station, along with adjustments of an equalisation valve which must be fitted between collector field and the transfer station.

Note: The Dorchester DR-TC system has dedicated solar transfer stations and controls. The Trigon solar system uses different transfer stations and control systems which are not designed for use with the Dorchester DR-TC system.

Supplementary Equipment for Solar Circuit: Solar Expansion Vessel and Cooling Tank/Pipe

A solar expansion vessel is an essential safety component in the pressurised solar system required to absorb the additional volume of solar fluid that is generated due to the fluid expanding as it is heated. It should be installed on the designated connection on the solar station (on the return to the collector).

The expansion vessel must be capable of taking the pressurised solar fluid up to 10 bar, and be resistant to high temperature (120°C). The vessel itself may need protection from operating outside its designed maximum operating temperature by connecting the vessel to the system via an intermediate cooling tank or suitable length of pipe of a much larger diameter to that of the normal flow and return pipes.

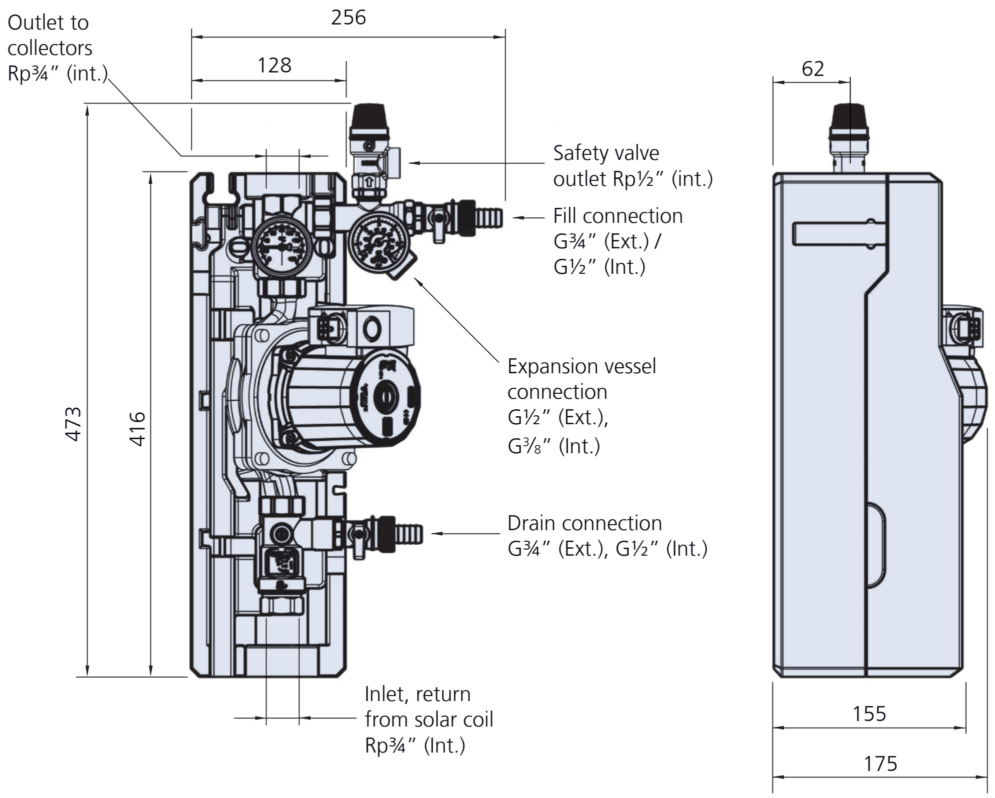
The vessel must be sized to absorb the full expansion volume from cold to stagnation temperature whilst maintaining system operating pressure within safe design conditions. Hamworthy can offer a range of suitable expansion vessels for use with a Trigon collector–based solar circuit.

Contact our technical team for further assistance.
Tel 01202 662500.

Dimensional Details

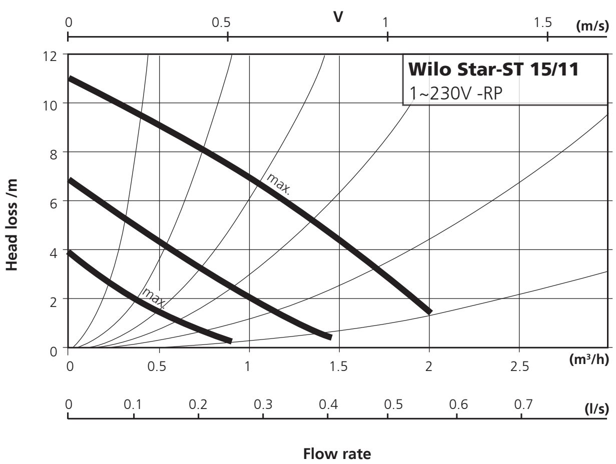
Dorchester DR-TC Solar Transfer Stations TX1 and TX2

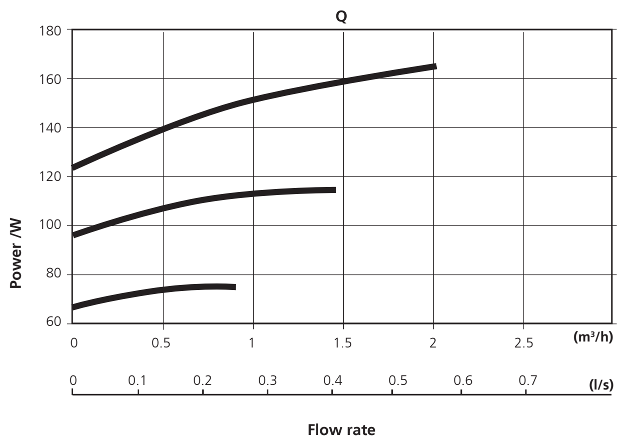
Dorchester DR-TC Solar Transfer Station Dimensions (TX1 and TX2)



All dimensions in mm

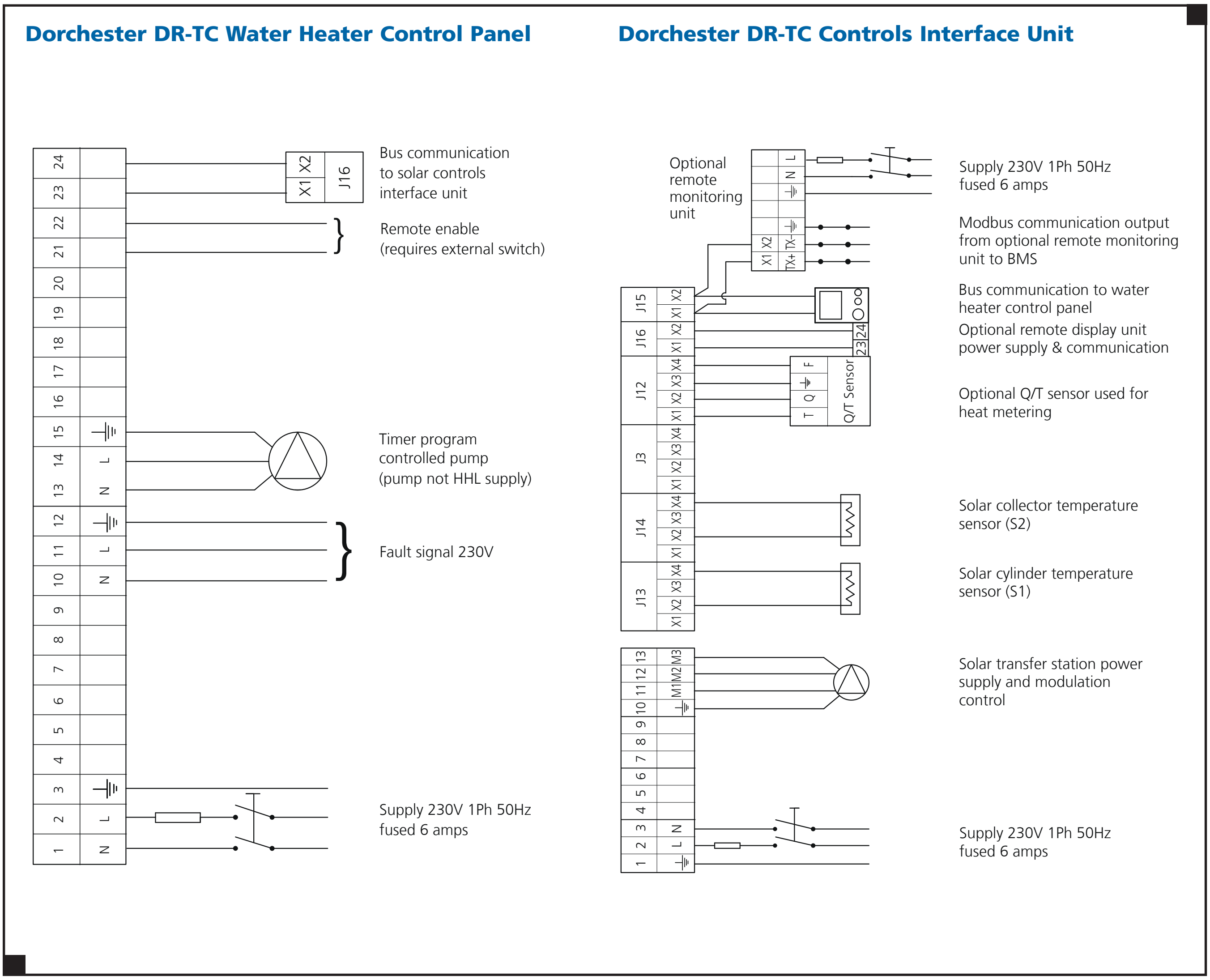
Dorchester DR-TC Solar Transfer Station Head Loss and Power against Flow Characteristics





Wiring Diagram

Dorchester DR-TC



Power Supply

An independent isolator and fused electrical supply is required for each water heater, solar controls interface unit, optional remote monitoring unit for interfacing with a building management system (BMS). Supply is 230 volt, 50Hz, single phase. Wiring external to the water heater, solar controls interface unit, remote monitoring unit and remote display unit must be in accordance with IET regulations and any local regulations which apply.

Wiring must be completed in heat resistant cables, and mains supply cables should be a 3-core cable, size 1.00mm^2. External fuses should be 6 Amp.

Remote Enable

Each water heater has the facility for receiving a remote enable signal to control the combustion heating circuit of the water heater installation, for connecting external controls such as remote time clocks or BMS, where the water heater's internal time clock program facility is not used.

Programmable Timer-Controlled Pump

Each water heater has a pump power output that can be co-ordinated to operate in tandem with the water heater anti-legionella program to start the system recirculation pump and optional top-to-bottom de-stratification pump. Wiring is not provided.

Local Bus Communication Cables

Communication between the water heater, solar controls interface unit, optional remote display and optional remote monitoring unit is via a local 2-wire communication bus. The bus circuits operate at low voltage and should be completed using the 2-core cables provided where possible.

The length of the 2-wire bus communication cable between the water heater and solar control interface unit is approximately 5m, and between the solar controls interface and remote monitoring unit is approximately 2m. The 2-wire communication cable for the remote display is not HHL supply.

Electrical Connections

Dorchester DR-TC

The local bus communication cables can be extended using 2-core heat resistant cables in accordance with the table below, and these should be routed separately to mains power carrying cables to prevent interference. Extension wiring is not HHL supply.

Cable Diameter/mm	Maximum Cable Length/m
0.25	100
0.50	200
0.75	300
1.00	400
1.50	600

Optional Q/T Sensor

For heat metering via the water heater the optional Q/T sensor must be installed in the system and connected to the controls interface unit using the cable supplied with the sensor. Cable length is approximately 3m.

Optional Remote Display Unit

An optional remote display unit can be connected to the controls interface unit for remote indication of operating status and, if a Q/T sensor is fitted, the cumulative energy supplied from the solar circuit.

The cable providing communication between the devices also powers the display unit and should be a 2-core heat-resistant shielded cable. It should be routed separately to mains power carrying cables to prevent interference. Wiring is not HHL supply.

Optional Remote Monitoring Unit (BMS Interface)

For building management system (BMS) access to the Dorchester DR-TC operating status data, and, if a Q/T sensor is fitted, cumulative energy output from the solar circuit, an optional remote monitoring unit is required which acts as an interface to the BMS system to allow remote monitoring at the BMS. It connects between the controls interface unit and the BMS, converting the system data into Modbus protocol that can be read at the BMS. The remote monitoring unit is supplied from the solar controls interface unit as detailed on page 15.

The communication cable between the remote monitoring unit and the solar controls interface unit should be completed using the 2-core cables provided, approximately 2m length. Communication cables can be extended using 2-core heat resistant cables and should be routed separately to mains power carrying cables to prevent interference. Extension wiring is not HHL supply.

Modbus output from the remote monitoring unit is via a 3-core cable. A cable, approximate length 300mm, is provided with the unit together with a plug and socket so that the cable can be extended to the BMS using shielded cable up to a maximum length of 1200m. The Modbus cable should be routed separately to mains power carrying cables to prevent interference. Extension wiring is not HHL supply.

Solar Temperature Sensors

The cable length of the temperature sensor for the solar collector is approximately 10m. The solar temperature sensor for the water heater cylinder is provided with a cable approximately 5m length. Temperature sensors are resistance type and may be extended using 2-core heat resistant cable up to 50m using 0.25mm^2 diameter cable, or up to 100m using 0.5mm^2 diameter cable. The sensor cables should be routed separately to mains power carrying cables to prevent interference. Extension wiring is not HHL supply.

Optional Dummy Sensor Kit

The optional dummy sensor kit includes six cables with resistive loads which connect across specific buslink terminals in the solar controls interface unit to allow operation of the water heater without a solar circuit. These cables must not be modified or extended.

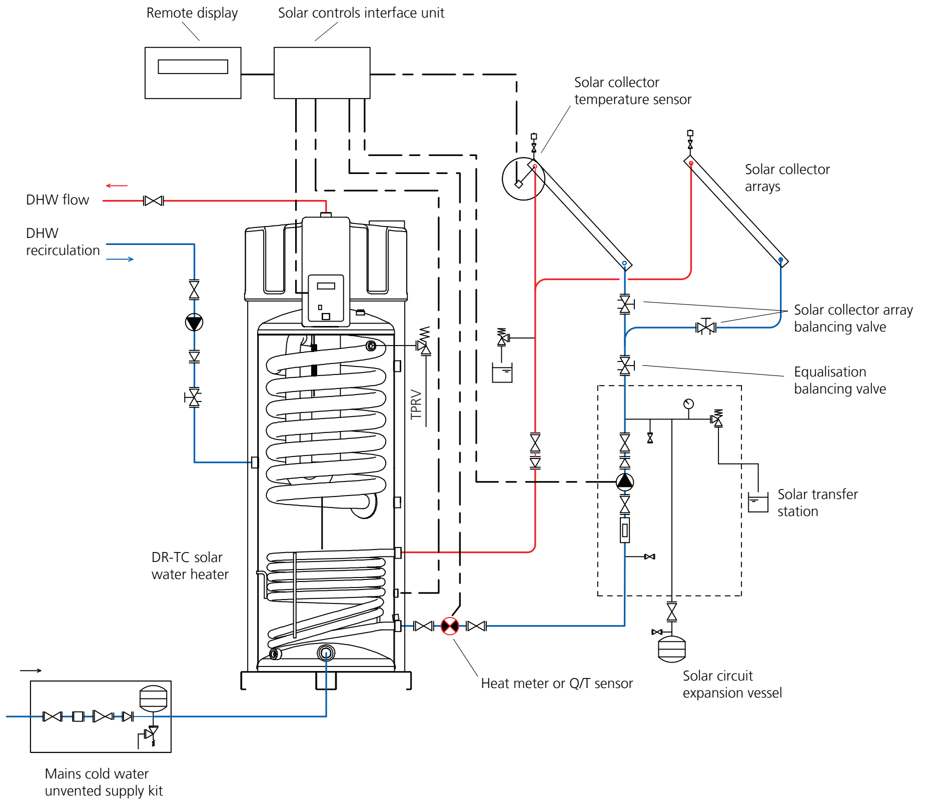
Solar Transfer Station Pump

Power supply and speed modulation control of the transfer station pump is from the solar controls interface unit. The solar pump is provided with a dedicated 4-core power supply cable approximately 4m length for connecting to the solar controls interface unit.

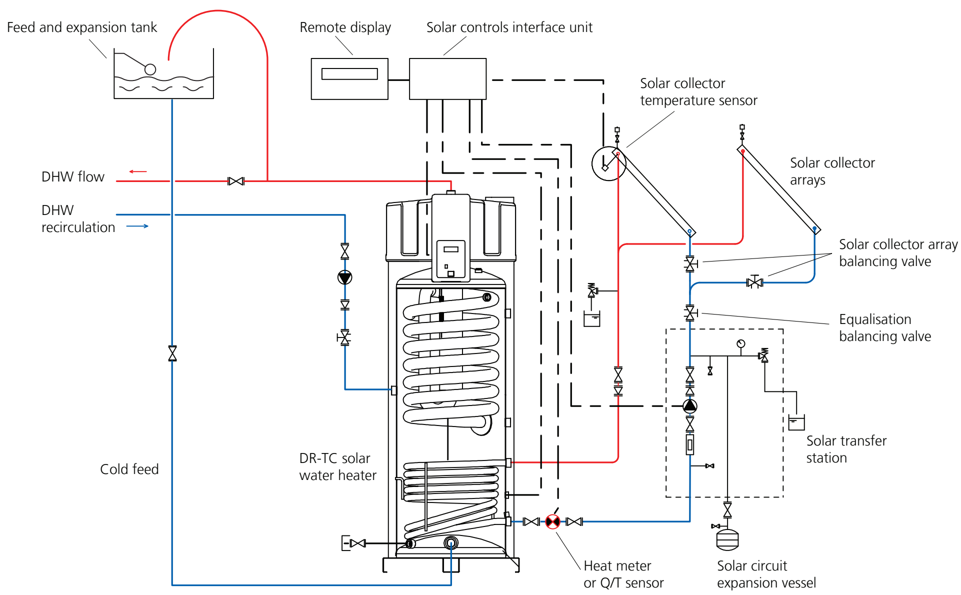
System Schematics

Dorchester DR-TC 40 and DR-TC 60

Unvented Cold Water Supply



Open Vented Cold Water Supply



Application & Systems Information

Dorchester DR-TC Solar Circuit

Solar Circuit Design

Solar collectors should be installed in accordance with the manufacturer's instructions, typically up to a maximum area of 40m² for flat plate collectors. If using Hamworthy's recommended Trigon collectors for the collector field, then these may be installed in arrays of:

Up to 5 collectors, hydraulically connected in series if connections are made at one end, or

Up to 10 collectors if flow and return are on opposite ends of the array,

Maximum 20 collectors in total.

An automatic air vent should be installed at the highest point of each solar collector array.

A commissioning set or double regulating valve (equalisation valve) should be installed within the solar circuit for the purpose of setting the correct flow rate.

A means by which to introduce/ top-up glycol solar fluid mixtures must be provided e.g. a manual or automatic pump attached to the solar transfer station.

A means by which to increase pressure lost via leaks must be provided e.g. make up unit or quick fill loop.

Solar Pipework

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

Where copper pipe is used joints should be brazed. Soft solder jointing is not permitted due to the possibility of elevated operating temperatures within the solar circuit.

Sizing the Solar Expansion Vessel

A qualified solar water system designer should calculate the appropriate expansion vessel size requirements based on CIBSE recommendations.

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 loose 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 used with the Dorchester DR-TC. Contact our technical team for further assistance. Tel 01202 662500.

Insulation

Stored hot water temperatures will at times be higher than with traditional DHW systems. It is therefore important that all pipes within the solar circuit are insulated to BS476 Part 7. All exterior pipe insulation should be such that it is protected from rodent/bird attack, and such that it is 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.

Thermostatic Mixing Valves

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. Depending on application these will need to be either TMV2 or TMV3 standard. Further information relating to application requirements can be found at the Thermostatic Mixing Valve Manufacturers Association web site, www.beama.org.uk.

Reducing Stagnation in Solar Circuit

To help reduce the occurrence of stagnation within the solar collector field, 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.

Automatic Air Vent (AAV)

The solar circuit must be equipped with a means to purge air from the solar circuit to ensure its efficient operation. It is recommended to use an automatic air vent (AAV) for this purpose, which should be fitted at the highest point in the solar circuit. In multiple array configurations, an AAV should be used at the highest point in each array. Typically the AAV is fitted to a connection above the flow outlet of the lead collector in each array.

If Hamworthy Trigon collectors are to be used, then the collectors are specified along with a hydraulic fittings kit for each array of collectors to be used in the installation. Each hydraulic fittings kit includes an AAV and connections for fitting it above the lead collector flow outlet in the associated array.

The solar circuit pipework should be designed so as to avoid other potential air trap points where possible, otherwise additional AAVs may be required. Additional AAVs are not HHL supply.

Application & Systems Information

Dorchester DR-TC Applicable Regulations

Regulations

The installation of the water heater MUST be in accordance with the relevant requirements of the Gas Safety Regulations, Building Regulations, IET Regulations and the Water Supply (Water Fittings) Regulations. It should also be in accordance with any relevant requirements of the local gas region and local authority and the relevant recommendations of the following documents:

These British Standard Codes of Practice and additional publications have relevant recommendations regarding the installation of Dorchester DR-TC water heaters.

British Standards

BS 5440 Part 1 Flueing and ventilation for gas appliances of rated input not exceeding 70kW net. Installation of gas appliances to chimneys, and for maintenance of chimneys.

BS 5440 Part 2 Flueing and ventilation for gas appliances of rated input not exceeding 70kW net. Installation and maintenance of ventilation provision for gas appliances.

BS 6798 Installation and maintenance of gas-fired boilers of rated input not exceeding 70kW net.

BS 6644 Installation of gas-fired hot water boilers of rated inputs of between 70kW net and 1.8MW net.

BS 6700 Design, installation, testing and maintenance of services supplying water for domestic use.

BS EN 806-2 Specification for installations inside buildings conveying water for human consumption—Part 2: Design
BS 6891 Installation of low pressure gas pipework of up to 35mm (R1 ¼) in domestic premises.

BS 7671 Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition.

I. Gas E. Publications

IGE/UP/1 Strength testing, tightness testing and direct purging of industrial and commercial gas installations.

IGE/UP/1A Strength testing, tightness testing and direct purging of small low pressure industrial and commercial natural gas installations.

IGE/UP/2 Installation pipework on industrial and commercial premises.

IGE/UP/10 Installation of flued gas appliances in industrial and commercial premises.

Health and Safety Executive

Guidance note PM5—Automatically controlled steam and hot water boilers.

CIBSE Publications

CIBSE Guide H Building Control Systems

CIBSE Guide Energy Efficiency in Buildings

CIBSE Commissioning Code B: 2002

Third edition of the 1956 Clean Air Act Memorandum

Department of the Environment, Scottish Development Department & Welsh Office.

Solar Safety

ENV 1991-2-3
Eurocode 1—Basis of design and actions on structures—Part 2-3: Actions on structures–Snow loads.

ENV 1991-2-4
Eurocode—Basis of design and actions on structures—Part 2-4: Actions on structures–wind actions.

COSHH
Applicable to storage and use of heat transfer fluid and water treatment chemicals.

Planning Permission

Seeking the opinion of the local authority on planning matters prior to starting work on the solar installation is advised. However planning permission is generally only required for installations in conservation area or on listed buildings.

Location

The location chosen for the water heater must permit the provision of a satisfactory flue system and an adequate air supply. The location must also provide adequate space for servicing and air circulation around each unit. This includes any electrical trunking laid along the floor and to the appliance.

The water heater mounting surface should be a non-combustible flat and level surface capable of supporting the weight of the boiler when full of water and any additional ancillary equipment.

Any combustible material adjacent to the boiler and the flue system must be so placed or shielded to ensure that its temperature does not exceed 65°C.

Water Treatment

Due to the variable chemical composition of distributed water supplies it is necessary to identify the properties of the cold water feed to the water heater with the local provider.

Appropriate water treatment, where advised to reduce scale build up, should be referred to water treatment specialists.

Specification

Dorchester DR-TC Gas, Water Supply, and DHW Circuits

Unvented Water Supply Kit Option

The Dorchester DR-TC is suitable for installation in direct unvented systems, using the optional unvented supply kit. Refer to the Unvented Cold Water Supply schematic on page 17.

Unvented water supply kit option

The expansion vessel is sized for the water heater and local pipework only.

For large hot water systems or systems with additional storage tanks, additional expansion vessel capacity may be required.

The unvented supply kit allows the water heater to be fed directly from the mains water supply or boosted cold waters supply, without the need for header tanks.

Each unvented supply kit is designed to be used with an individual water heater. Multiple water heater installations should be provided with one unvented supply kit per water heater.

Each unvented supply kit is sized 1” and comprises the following items:

- Strainer
- Adjustable pressure reducing valve with tapping points for inlet and outlet pressure measurement
- Non return valve
- ¾” expansion relief valve, 6 bar
- Temperature and pressure relief valve, 7 bar, 95°C
- 24 litre expansion vessel, 3.5 bar cushion pressure

Delivery

Dorchester water heaters are delivered factory assembled and mounted within frames, shrink-wrapped and on a timber pallet base. They are equipped with a steel pallet base which is fitted permanently to the unit.

All Hamworthy products are delivered to site on a tail-lift vehicle, and deliveries are closely co-ordinated with the customer, to suit the site construction programme. Standard delivery is to ground level from the tail-lift vehicle. To enquire about special delivery services, please contact our customer services team.

Commissioning

Hamworthy Heating Ltd strongly recommends that all water heaters are commissioned by their service department, who will issue an appliance log-book that details the initial operating settings, and which can be used to record all future maintenance work.

For more information on commissioning contact Hamworthy Heating Service Department. Telephone 0845 450 2866 or email service@hamworthy-heating.com

Maintenance

Installed water heaters will experience a wide variation in operating conditions that can occur due to differing patterns of usage and the variable chemical nature of distributed water supplies. It is therefore strongly recommended that water heaters be drained and inspected within 3 months of the initial commissioning. Once the levels of calcium deposition are established a suitable maintenance schedule can be implemented, however as a minimum all water heaters should be serviced annually.

The solar circuit installation that accompanies the Dorchester DR-TC should be installed by MCS approved installers and serviced annually.

Warranty

The Dorchester DR-TC solar water heater carries a standard two year warranty on parts. Where Trigon collectors are used in conjunction with a Dorchester DR-TC, the collectors carry a 5-year warranty.

Where the product is commissioned by Hamworthy Service Engineers, then the warranty also covers labour for the warranty period, subject to servicing and warranty conditions.

Air Supply and Ventilation

Dorchester DR-TC

An adequate supply of fresh air for combustion and ventilation must be provided in accordance with BS5440 and BS6644. Where Dorchester DR-TC water heaters are installed as room sealed units, the air supply is for ventilation only. Air supply and ventilation must be sized for the entire plant. The combined net heat input of all gas fired appliances within the plant room or compartment must be used for these calculations.

Water Heater Installations <70kW Net Rated Input

Air supply and ventilation must be in accordance with BS5440

Model	Compartment Ventilation – Open Flue		Compartment Ventilation – Room Sealed	
	Direct to outside air	To room or internal space	Direct to outside air	To room or internal space
Dorchester DR-TC 40 Net heat input 39.2kW	High level–197cm^2	High level–394m^2	High level–197cm^2	High level – 394cm^2
	Low level–394cm^2	Low level–788cm^2	Low level–197cm^2	Low level – 394cm^2
Dorchester DR-TC 60 Net heat input 55.9kW	High level–281cm^2	High level–562cm^2	High level–281cm^2	High level – 562cm^2
	Low level–562cm^2	Low level–1124cm^2	Low level–281cm^2	Low level – 562cm^2

The areas quoted are minimum free areas for ventilation grilles. For further guidance refer to BS5440.

Water Heater Installations >70kW Net Rated Input

Air supply and ventilation must be in accordance with BS6644

Open Flue Appliances

Compartment Ventilation – Room Sealed	Boiler House Ventilation – Open Flue
Direct to outside air	Direct to outside air
High level–5cm^2/kW net input	High level–2cm^2/kW net input
Low level–10cm^2/kW net input	Low level–4cm^2/kW net input

Room Sealed Appliances

Compartment Ventilation – Room Sealed	Compartment Ventilation – Room Sealed	Boiler House Ventilation – Room Sealed
Direct to outside air	To room or internal space	Direct to outside air
High level–typically 5cm^2/kW net input	High level–typically 10cm^2/kW net input	High level–typically 2cm^2/kW net input
Low level–typically 5cm^2/kW net input	Low level–typically 10cm^2/kW net input	Low level–typically 2cm^2/kW net input

The areas quoted are minimum free areas for ventilation grilles. For net heat input, refer to technical data table on page 10. For further guidance refer to BS6644.

General Ventilation Requirements

Plant Room Temperatures

Additional requirement of BS6644 for multiple water heater installation requires that the air supplied for plant room ventilation shall be such that the maximum temperatures within the plant room do not exceed:

At floor level, or 100mm above floor level: 25°C

At mid-level, 1.5m above floor level: 32°C

At ceiling height, or 100mm below ceiling height 40°C

Ventilation Grille Openings

High and low level ventilation grilles shall be positioned as high and as low as practicable. Low level grills additionally shall be located within 1m of floor level for natural gas or LPG. High level grilles are recommended to be positioned within 15% of the water heater height from the ceiling.

High and low level ventilation grilles shall communicate with the same room or internal space where compartment ventilation is used. Where ventilation grilles communicate directly with outside air they shall be positioned on the same wall.

Air Supply

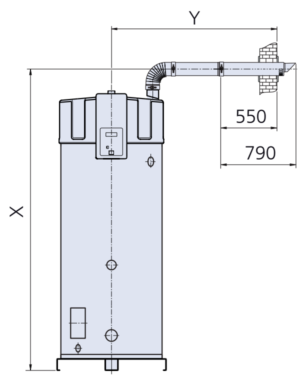
The air supply should be free from contamination such as building dust and insulation fibres from lagging. To avoid unnecessary cleaning and servicing of the water heater modules the water heaters should not be fired whilst building work is being undertaken. Where a water heater installation is to operate throughout the summer months, e.g. for domestic hot water production for more than 50% of the time, then additional ventilation allowances are required. Refer to BS6644 for more information.

Flue Design

Dorchester DR-TC 40 and DR-TC 60

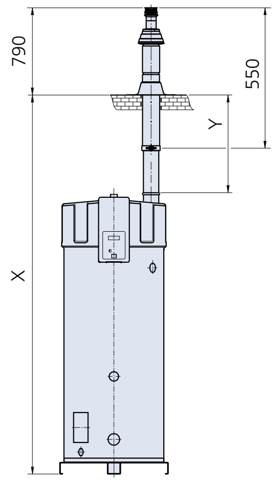
Minimum Space Requirements

Wall Duct



All dimensions in mm

Roof Duct



All dimensions in mm

Ref.	Minimum Space for Wall Duct /mm
X	2335
X*	2785
Y	1475
Y*	1025

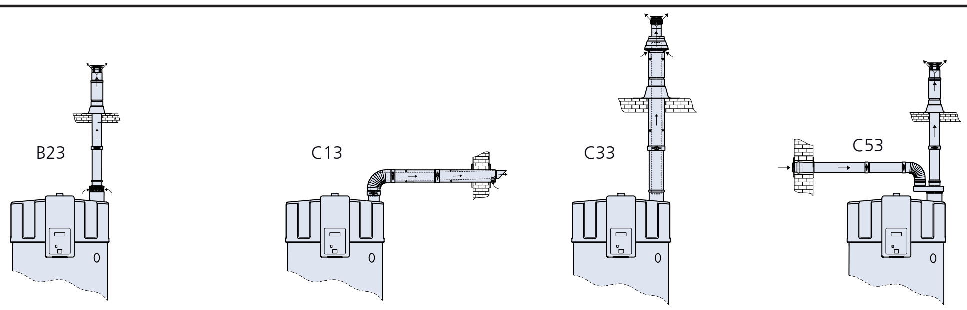
* *Distance without concentric pipe between bend and wall duct.*

Ref.	Minimum Space for Roof Duct /mm
X	3585
X**	2635
Y	1415
Y**	465

** *Distance without concentric pipe between appliance and roof duct.*

Installation Options

The Dorchester DR-TC water heaters are approved for and should be installed in accordance with categories: B23, C13, C33 and C53 as shown below:

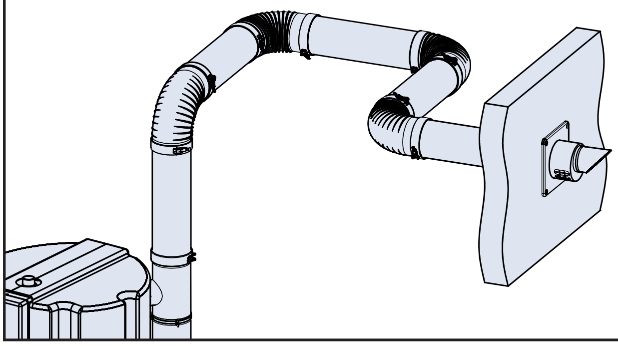


Installation Type (Ref PD CR 749:2001)	Description
B23	Air for combustion is drawn from the boiler room (open-vented) and incorporates a fan* upstream of the combustion chamber/heat exchanger
C13	Horizontal (wall), concentric or parallel wall flue terminal (room-sealed), incorporating a fan* upstream of the combustion chamber/heat exchanger
C33	Vertical (roof), concentric and/or parallel roof flue terminal (room sealed), incorporating a fan* upstream of the combustion chamber/heat exchanger
C53	Air supply and flue gas discharge terminal types mixed (room sealed, twin duct), which may terminate in zones of different pressure, and incorporating a fan* upstream of the combustion chamber/heat exchanger
	*The flue fan is integral to the DR-TC water heater, no additional fan is required.

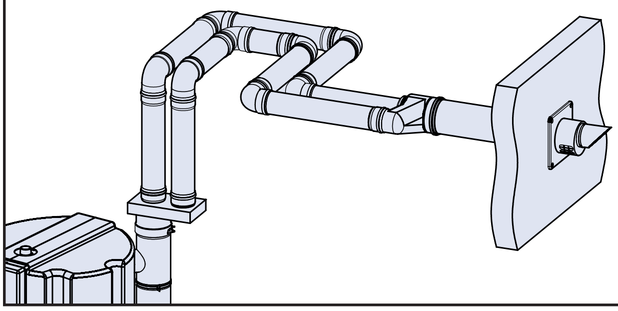
Flue Design

Dorchester DR-TC 40 and DR-TC 60

Dorchester DR-TC with concentric flue discharge



Dorchester DR-TC with parallel flue discharge



Room Sealed and Open Flue Systems

The Dorchester DR-TC water heaters are designed to operate as room sealed appliances or in open flue systems, and are available with a choice of flueing options using a range of matched components to provide versatility in where the water heater can be located. Options are available for room sealed concentric or twin duct, or open flue single pipe arrangements.

Room sealed concentric flues can reduce the cost of installation and simplify flue runs. Room sealed configurations reduce the volume of ventilation air required, resulting in tighter, and more energy-efficient buildings. Open flue applications provide solutions where balanced flue terminals are unsuitable, or where existing flue routes are to be retained.

The flue is constructed from aluminium for twin duct and open flue arrangements (single wall) and this forms the inner wall of concentric flue components. The outer wall of concentric flue components is constructed from galvanised steel, with the concentric ring carrying the combustion air to the appliance, which also acts as the insulation to the inner duct, which carries the exhaust flue gases.

Flue pipes are joined with a simple push fit connection with a silicone seal ensures water and pressure tight joints every time and clamp bands complete the installation.

Flues are ordered separately from the water heater. To simplify the selection process, Hamworthy have a flue order form available for the Dorchester DR-TC. Simply telephone 0845 450 2865 or email sales@hamworthy-heating.com to request an order form 500002447 and state which Installation type (B23, C13, C33 or C53) you are planning to use.

Flue System Dimensions (DR-TC 40 and DR-TC 60)

Flue Type	Unit	Concentric	Parallel (Standard Diameter)	Parallel (Larger Diameter)
Diameter	mm	100/150	100	130
Maximum Length	m	40	55	100
Maximum no. of 45° or 90° bends		7	-	-
Equivalent Length/90° bends	m	-	4.6	2.4
Equivalent Length/45° bend	m	-	1.2	1.4
Note: Horizontal Flue runs must be installed with a fall of at least 5mm/metre.		It is not permitted to use more than the specified number of bends, even when the duct is shorter than the maximum length. A 45° bend is equivalent to a 90° bend when counting the maximum number of bends.	The maximum permissible length should be reduced by the equivalent length of each bend. For a parallel installation this means that, for example, 3 changes in direction equates to 6 bends (3 in the air supply duct and 3 in the flue). The maximum length also applies if a parallel installation has different supply and flue duct lengths.	

Hot Water Sizing

Guidance Notes

The following notes are given for guideline purposes and the assumptions made are general. The diversification of hot water requirements are great and each particular application must be examined in detail.

General Guidelines

There are applications where sizing a water heater is a straightforward exercise. An obvious example is an industrial hot water load for a process requiring a specific amount of hot water, in a specified time at a specified temperature. All that is required is the lowest cold water supply temperature and the heater(s) output can be directly related to the amount of hot water required. If the load is continuous the heater or heaters must be sized to cope with the full amount. If the load is intermittent consideration can be given to a smaller heater installed in conjunction with a suitably sized storage tank.

Other types of installations which can be easily sized are sports pavilions and leisure centres, especially those catering for team games, when a known number of people will use showers, baths etc. at a known time. This is in effect the peak load when a large quantity of hot water may be dumped quickly since all showers may be running continuously. For sizing it is necessary to determine the duration of continuous use, which will depend on the maximum number of players using the showers. Showers can save water, but one shower running continuously for 1 hour can dump 328 l. Multiplied by 10 or 20 this can represent a large load which is best catered for by storage with a long recovery time. However, due consideration should be given to additional heaters and lower storage on the grounds of standby and cost.

The third category comprises almost all other commercial and industrial applications where hot water demand is random. To size the hot water requirement it is necessary to determine when the demand is greatest. Obviously if the water heater can cope with the peak demand, the remainder will be adequately catered for. However, the heater cannot be sized on the assumption that all outlet appliances will run continuously for 1 hour since this will result in gross over -sizing of heaters. Simple guide-lines and common sense must be used to estimate appliance usage.

Sizing a Dorchester DR-TC solar water heater system is very similar to sizing any other direct fired water heater system as it must be sized to ensure it will be capable of satisfying the full hot water demand under gas operation only should no solar energy be available. Depending on the application, heating strategy and achievable solar fraction at the location, storage volumes may be larger than those of traditional water heater systems to take as much advantage as possible of solar heating when available. Also the solar collector field that supplies solar energy to the Dorchester DR-TC must be carefully sized for efficient operation and this is explained further on page 26.

Listed below are a series of guide-lines which may prove helpful in sizing Hamworthy water heaters.

Restaurants, Kitchens, etc. Serving Main Meals

Each meal will use: 9 litres at 60°C (140°F) Made up from: 3 litres preparation, 6 litres washing up.

The peak period would be spread over 1, 2 or 3 hours etc., depending on the establishment. Bar sinks—allow 114 litres per hour.

School kitchens in general use 30% less than restaurants but allowance should be made for the number of sittings.

Hotels and Motels

Assume average occupancy as 1½ people per room unless specified as single rooms.

Generally the peak will occur over a two hour period in the morning (7am-9am). In specialised hotels catering for specific functions (i.e. conferences) the peak could be reduced to one hour. For medium sized hotels with 100-200 people allow 25-35 litres hot water per person over two hour peak period. For smaller hotels allow more per person-for larger hotels allow slightly less. These figures assume that mainly showers are used, one per room.

Always check restaurant load to ensure that peak morning capacity will cover it. Overall, allow 115-135 litres per guest per day.

Dormitories

Allow 15 litres per man, 20 litres per woman over a peak 1 hour period.

Flats and Apartment Blocks

Assume average occupancy of 2½ people per flat. Allow 38 litres per person over a peak 3 hour period.

Rest and Convalescent Homes - with Kitchen and Laundry

Allow 38 litres per person over a peak 3 hour period.

Industrial Shower Rooms

Assume shower period to be 20 minutes at the end of each shift and that all showers and wash taps are running continuously for this period at full flow i.e. dump load ideal for heater plus storage application.

School Changing Rooms

Assume all showers and wash basins are used at full flow for 10 minutes after each gym period.

Offices

Allow 1.5 litres per person per hour for 1 hour peak load.

Commercial Laundry

Allow 13 litres per kg of wash at 71°C.

Hot Water Sizing

Guidance Notes

Launderettes

Determine the cycle time of the machines (add 10 minutes for unloading and reloading). Calculate the number of cycles that occur in one hour and multiply the number of machines and then multiply by the amount of hot water used by one machine in one cycle to arrive at the maximum demand.

Hairdressers and Beauty Salons

Allow 280 litres per hour of water at 60°C (140°F) per wash basin per peak demand.

Hospitals etc.

Demand will depend on the type of hospital, nursing home, etc. Overall consumption per person per day of hot water can range between 70 litres - 230 litres.

In all applications it is desirable to cross check general assumptions with actual flow rates and capacities and in applications where no general guidelines exist it may be necessary to calculate hot water demand by listing the number and type of appliance in use.

The following tables give the approximate flow rates for standard hot or mixed water fittings and the approximate capacity in normal use. By appraising what function appliances perform it is possible to determine peak usage i.e. three baths per hour, two showers each of 10 minutes, sinks filled one per hour, etc.

Fitting	Flow rate l/s
Wash basin tap	0.15
Wash basin spray tap	0.05
Bath tap	0.30
Sink tap 15mm	0.20
Sink tap 20mm	0.30
Shower spray head	0.15
Shower 100mm rose	0.40

Approximate Mixed, Hot and Cold Capacities of Appliances in Normal Use

Cold water 10°C (50°F), hot water 60°C (140°F), mixed water 40°C (104°F)

Appliance	Capacity in Normal Use	Amount of Hot Water	Amount of Cold Water	Temperature in Use
	l	l	l	l
Wash basin	5	3.0	2.0	40
Bath	80	48.0	32.0	40
Small sink	12	7.2	4.8	40
Large sink	18	10.8	7.2	40
1 min shower spray	9	5.4	3.6	40
5 min shower spray	45	27	18.0	40
1 min shower (100mm rose)	24	14.4	9.6	40
5 min shower (100mm rose)	120	72.0	48.0	40

The quantities of hot water shown above are only correct to those particular temperatures. For other combinations use the following formula to determine the proportion of hot water.

$$\textbf{Quantity of hot water} = \textbf{capacity of appliance} \times \frac{\textbf{Mixed water temperature} - \textbf{Cold water temperature}}{\textbf{Hot water temperature} - \textbf{Cold water temperature}}$$

Factors at Various Cold Water and Mixed Water Temperature for Determining Hot Water Quantity at 60°C (140°F)

As a further example, the table opposite gives the factors by which the capacity of an appliance is multiplied to obtain the quantity of hot water required when stored at 60°C (140°F) for various cold water supply temperatures and various mixed water temperatures.

Cold Water Supply Temperature	Mixed Water Temperature						
	60°C	55°C	50°C	45°C	40°C	35°C	30°C
5°C	1.0	0.91	0.82	0.73	0.64	0.55	0.45
10°C	1.0	0.90	0.80	0.70	0.60	0.50	0.40
15°C	1.0	0.89	0.78	0.67	0.55	0.44	0.33
20°C	1.0	0.88	0.75	0.63	0.50	0.38	0.25

Hot Water Sizing

Guidance Notes

Having established the number of appliances, the usage, and the quantity of hot water required, the outputs of the heaters must be related to the hot water storage temperature. Any decrease in the cold water supply temperature or increase in the hot water storage temperature will result in a decreased output from the heater.

The output figures given are based on a rise in the temperature of 44°C i.e. with a storage temperature of 60°C the cold water supply must be at 16°C. It is possible however that for certain applications a higher storage temperature will be required, in which case, assuming the cold water supply temperature remains constant, as the required storage temperature setting increases, there will be a proportional increase in required temperature rise across the water heater and a proportional fall in water heater continuous output rating. The table (below) indicates the continuous output of the heater with various temperature rises across the heaters.

Any solar heating contribution will act to reduce the amount of gas required to achieve the continuous outputs quoted in the table.

Various factors need to be taken into account to determine appropriate storage capacity requirements of the application, and how much if any, additional storage may be required. These include general consumption throughout the day, recovery times, whether the peak is spread over 1 hour or 3 hours, and whether a larger storage buffer than the water heater's own storage is required to guard against the possibility of high flow rates at peak times.

Where the installation requires the use of large volumes of hot water over short periods and a storage tank is specified, a loading pump will be required to transfer hot water from the water heater into the storage tank. This should be a bronze pump and sized to suit the continuous output of the water heater under design temperature conditions.

One or more storage tanks may be used in conjunction with the Dorchester DR-TC to satisfy hot water demand.

It is important that cold water supply capacities and pressures as well as pipe work layouts are suitable for high volume draw off at peak times to ensure satisfactory hot water delivery to draw off points.

Water Heater Continuous Output (l/h) against ΔT

Model	Temperature Rise Across Water Heater ΔT (Hot Water Temperature minus Cold Water Supply Temperature)						
	40°C (72°F)	44°C (80°F)	50°C (90°F)	56°C (100°F)	60°C (108°F)	70°C (126°F)	80°C (144°F)
DR-TC 40	910	820	730	650	610	520	450
DR-TC 60	1300	1200	1100	910	850	730	640

Solar Circuit Sizing

The Dorchester DR-TC high operating efficiencies increase when solar energy can be used to heat the store. However the solar field connecting to the Dorchester DR-TC must be appropriately sized to make best use of the available solar energy. It is not simply a case of maximising the number of collectors to fit the available installation area. On the contrary, there are probably more disadvantages than advantages to having an oversized collector field.

Apart from the additional material cost and increased payback time, having an oversized collector field with too many collectors can result in a system that cannot dissipate heat to the store faster than it can absorb heat, and when the required store temperature has been satisfied and solar pump consequently switched off, collector temperatures could quickly rise above the stagnation temperature at which the solar fluid boils and vapourises in the top of the collectors.

Regularly exceeding the stagnation temperature in the collectors will have a detrimental effect on the usable lifetime of the solar fluid, and also put equipment under undesirable thermal stresses. Also, in prolonged stagnation periods saturated steam, which conducts heat rapidly, could cause equipment downstream from the collectors potentially to reach scalding temperatures.

An undersized solar system, with fewer collectors, may make savings in terms of the capital cost of equipment and installation, and there will be a reduced risk of stagnation in the collector field, extending the life of the solar fluid. However overall operating costs will increase as gas usage will be greater than it needs to be to satisfy demand, when compared with a correctly optimised system.

An optimum sized solar system allows for maximum operating time of the solar circuit, which will achieve the best efficiency and return on investment. The solar circuit operation may be set to deliver water at a higher temperature than the gas circuit, and so extend the capacity of the hot water store due to higher resulting mixing requirements at the points of use.

Hamworthy can assist with sizing of hot water demand and selection of appropriate hot water products to suit the application. Hamworthy can also assist in the selection and specification of the solar circuit equipment for a specific application based on energy simulation using an industry recognised solar sizing program, which will give results that include projections of solar efficiency, carbon reduction and energy saving.

Sustainable Heating and Hot Water

Dorchester DR-TC Solar Thermal System

Why Choose Hamworthy?

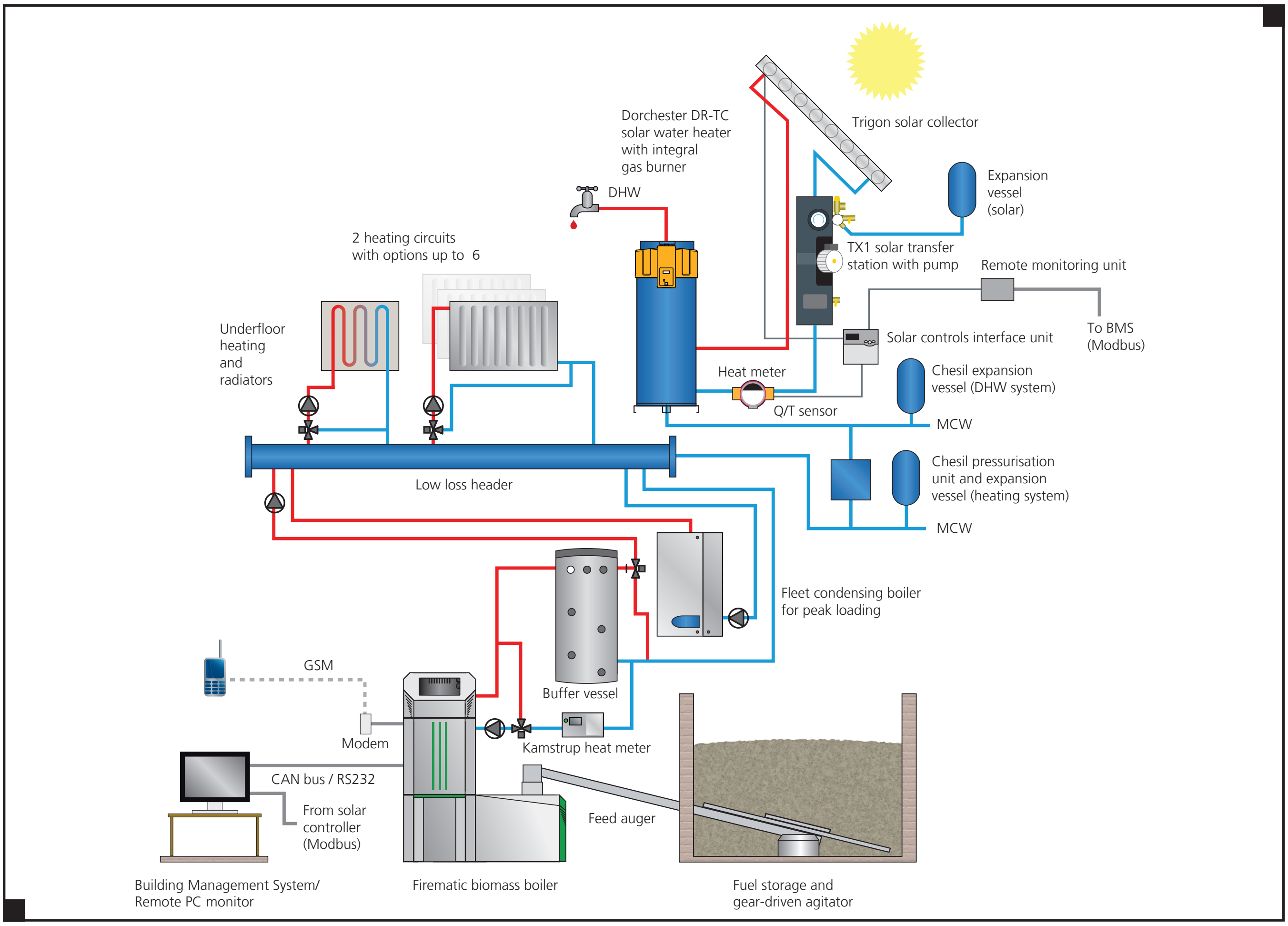
Hamworthy has extensive knowledge and over 40 years of experience of heating and hot water systems for commercial buildings, including supply of gas fired boilers for peak-load delivery alongside biomass boiler and solar hot water systems. We can advise on the optimum boiler or water heater selection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

Whether it's for a new build, or for a refurbishment project, and whether it's a partial or total migration to solar and/or other renewable heating systems, we have the knowledge and expertise to help guide you through every stage of the process, from feasibility studies 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 separate biomass heating and solar DHW systems.

A typical Hamworthy renewable solution, which has efficiency benefits gained by keeping the DHW system separate from the heating system, is shown above, and includes the following equipment:

Renewable heating system: Firematic biomass boiler with bespoke automatic wood chip/pellet feed system and fuel store, heat meter, low loss header, Chesil pressurisation unit and expansion vessel and back–up gas-fired Fleet condensing boiler.

Renewable DHW system: Field of Trigon solar collectors feeding a Dorchester DR-TC solar system comprising: Dorchester DR-TC solar water heater with integral gas burner, TX1 solar transfer station and solar controls interface unit, Q/T sensor for heat meter function, and separate expansion vessels for the solar and DHW circuits.

Both renewable systems can be bus-connected to the Building Management System for remote monitoring. remote monitoring. Flues are not shown for clarity however Hamworthy can supply a comprehensive range of flue solutions to complete the package.

Your local contact is:

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