Greenstore LECP ground source heat pump series

NEW

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Bosch Group

Worcester and you. Making a difference.

BOSCH
Invented for life

As part of the Bosch Group, Worcester products are designed and manufactured to provide customers with the highest levels of quality and reliability which are synonymous with the Bosch name throughout the world.

As part of Europe's largest supplier of heating products, Worcester, Bosch Group has the UK-based resources and support capability to offer you the value-added solutions needed to drive your business forward. Worcester employs a nationwide network of Service Engineers and technically trained Field Sales Managers supported by an experienced technical services team which is able to provide comprehensive support and advice from designing system layouts through to installation.

Worcester is dedicated to providing energy efficient gas- and oil-fired condensing boilers, as well as an extensive range of renewable technologies. All of our products have been developed and introduced with the aim of reducing climate change, helping the UK to achieve the Government's efficiency targets.

The reception and main entrance at our Worcester headquarters

"At Worcester we recognise the vital role you play in the specification and installation of energy efficient appliances in homes across the UK. We will continue to invest in our products, people, facilities and support services to ensure you can continue to deliver only the best solutions to your customers' requirements."

Carl Arntzen,
Managing Director,
Bosch Thermotechnology Ltd.

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Greenstore LECP ground source heat pump series

The Certification Mark for Onsite Sustainable Energy Technologies

The Greenstore low energy circulation pump (LECP) ground source heat pump is the latest ground source heat pump range from Worcester to meet future legislation, while allowing consumers to take advantage of renewable and sustainable energy. Our ground source heat pumps make use of the energy emitted from the sun which is absorbed by the earth. This thermal energy is available below the surface and can be extracted by the heat pump.

By utilising the energy stored in the ground, in combination with a refrigerant circuit that is built into the heat pump, the ground source heat pump provides enough heat for the provision of heating or hot water for the home.

The system is made up of an energy collector placed in the ground, a ground source heat pump, a hot water cylinder (System only) and the space heating emitter for the property, preferably an underfloor heating system or, alternatively, radiators designed for the heat loss of each room.

Worcester heat pumps are available in two versions. The system version has been designed for use with a G3 approved Worcester Greenstore solar-ready cylinder for the production of hot water, whilst a G3 approved Combination model is available and includes a built-in 185 litre cylinder.

Reduced requirement for the purchase of fuels

By extracting stored energy from the ground and by using an electrically powered compressor within the unit, the LECP ground source heat pump does not require the use of additional fossil fuels and subsequently, when fitted in a property that is well insulated, helps towards reducing the rising prices that are often associated with them.

Integrated additional heater

Worcester heat pumps should be sized to be the sole source of heating and hot water production for the home giving the homeowner the option of removing the existing heat source from the property. In all our Greenstore products we have an integrated additional heater to supplement in extreme temperatures.

High performance renewable technology

Greenstore LECP ground source heat pumps feature a highly efficient and effective scroll-type compressor which allows up to 65ºC flow temperature from the appliance. This higher output temperature allows Worcester heat pumps to be effectively combined with radiators, which should be designed for the heat loss of each room. Heat pumps run more efficiently when run at lower temperatures i.e. 50ºC for radiators and 35ºC on underfloor heating.

Grants and incentives

Renewable Heat Incentive (RHI)

Any consumer who is looking to enhance their current heating system with renewable technology, such as the Greenstore ground source heat pump series, or who has installed any such technology since 15th July 2009, could be eligible for the tariffs.

Example of horizontal collector system

Example of bore hole collector system

Green Deal

All Worcester Greensource heat pumps are eligible for the Green Deal incentive, providing the installer is an authorised Green Deal installer. For information about the scheme you can visit **www.decc.gov.uk/greendeal**

GREEN DEAL APPROVED

Greenstore LECP ground source heat pumps at a glance

	Greenstore 6 System	Greenstore 7 System	Greenstore 9 System	Greenstore 11 System
Part No.	8 738 203 184	8 738 203 185	8 738 203 186	8 737 203 187
Output kW 0/35ºC[1]	5.4	6.6	8.7	10.2
Output kW 0/45ºC[1]	5.1	6.2	8.3	9.6
CoP* 0/35ºC[1]	3.96	3.82	3.84	3.97
CoP* 0/45ºC[1]	3.15	2.97	3.15	3.17
MCS certification no.	MCS HP0015/24	MCS HP0015/25	MCS HP0015/26	MCS HP0015/27

	Greenstore 6 Combi	Greenstore 7 Combi	Greenstore 9 Combi	Greenstore 11 Combi
Part No.	7 716 180 025	7 716 180 026	7 716 180 027	7 716 180 028
Output kW 0/35ºC[1]	5.4	6.6	8.7	10.2
Output kW 0/45ºC[1]	5.1	6.2	8.3	9.6
CoP* 0/35ºC[1]	3.96	3.82	3.84	3.97
CoP* 0/45ºC[1]	3.15	2.97	3.15	3.17
Storage cylinder capacity	185 litres	185 litres	185 litres	185 litres
MCS certification no.	MCS HP0015/28	MCS HP0015/29	MCS HP0015/30	MCS HP0015/31

Note: 0/35ºC is used to designate in a situation where the collector side of the system generates a temperature of 0ºC and the flow temperature from the heat pump is 35ºC.

[1]According to BS EN 14511

**Coefficient of Performance*

Features of the Greenstore LECP ground source heat pump series

Greenstore LECP
System ground source
heat pump series

- Illuminated text display menu – easy for the user to operate
- Weather compensation
- Slow build-up compressor – saves electricity
- Low noise output – quiet operation
- Room controller (accessory) – shows outdoor temperature, as well as the ability to view and change room temperature setting
- Suitable for heating a swimming pool – subject to design conditions (IOB Multi-module box accessory required)
- 2 years' parts and labour guarantee* – peace-of-mind for your customer.

The Greenstore LECP ground source heat pump can be used to heat swimming pools

Applications

Worcester offers a series of LECP ground source heat pumps which are intended to provide all the heating and hot water requirements of the home. The System variant heat pumps can also be combined with our Greenskies solar thermal panels and solar compatible cylinder for high efficiency hot water production and storage.

The Greenstore heat pump also has the versatility to be used with our Greenfloor heating range allowing the homeowner to benefit from a total Worcester system solution.

The low energy circulation pump means lower energy consumption and higher seasonal performance factors (SPF)

Key benefits to the end user

- Excellent CoP ratings when combined with underfloor heating or solar thermal
- Stand-alone heating system – contains a built-in hot water cylinder** and an integrated scroll compressor which can achieve flow temperatures of up to 65ºC
- Ability to cascade two heat pumps of the same output† i.e. up to 22kW (2 x 11kW) without any additional accessories – perfect for large domestic properties and light commercial/non-domestic properties

*†When cascading two System models or a System model and a Combi model only. *Subject to terms and conditions **Combination model*

Key benefits for installers

- Ease of siting – no flue system required and no gas or oil-fired boiler needed
- Total heating and hot water solution – compatible with all Greenstar condensing boilers, Greenfloor heating and Greenskies solar water heating collectors and Greenstore compatible 280 litre cylinder (IOB Multi-module box accessory required)
- Expert installation advice – Worcester's design team can produce technical drawings and provide plot-specific schematics in the support of your installation
- MCS approved products – quality assurance (see page 5 for MCS Certification numbers)
- Can be used on mixed heating circuits.

Ease of installation and maintenance

- Easy access to components
- Compact design
- Error codes clearly displayed on Rego 1000 LCD screen.

Improvements to the Greenstore LECP ground source heat pump series

In addition to our own extensive testing and research, we also listen and respond to installers as part of our continuous product development programme.

As a result of such feedback, our latest Greenstore LECP ground source heat pumps incorporate a number of new innovative features which are beneficial to both the installer and the end user.

Annual heating cost reduction

Excellent CoP ratings with the option for an even greater return when combined with solar thermal or underfloor heating.

Improved Seasonal Performance Factor (SPF)

Our ground source heat pumps now use (LECP) low energy Class A circulation pumps for low energy consumption.

New LCD controller

A new room controller accessory enables flexible customer control from the controller itself and not directly from the heat pump.

Automatic Delta control – modulating pump instead of fixed speed

No speed setting needed to obtain optimum differential between flow and return. The pump will modulate to maintain optimum temperature.

Enhanced Domestic Hot Water (DHW) logic

A new innovative DHW logic which increases DHW efficiency by adapting to customer usage (quick or slow tapping pattern) allows for an improved SPF.

Swimming pool control

The new Rego 1000 control now has the facility to control heat for a swimming pool via an external heat exchanger.

Ability to cascade

The Greenstore heat pumps have the ability to cascade two of the same output† up to 22kWs without any additional accessories – perfect for large domestic properties and light commercial/non-domestic properties.

Controls – Rego 1000

Greenstore LECP ground source heat pumps are controlled by the in-built Rego 1000 control unit. The unit ensures that the heat pump runs efficiently and that the hot water heating is given priority over space heating.

Rego 1000 control unit

Standard controls functions

- One unmixed and one mixed heating curve
- Cascade of two heat pumps of the same output*
- Step electrical heater (3, 6 and 9kW)
- DHW circulation
- Summary alarm output
- Delta T control of heating circulating pump.

Dynamic pump control – energy-saving start/stop function

- The Rego 1000 control unit senses when heat is required, while also having the ability to stop the pump during periods when there is no demand.

Accessory control functions – IOB Multi-module control box

The IOB Multi-module control box (part number 8 738 204 316) allows installers to achieve the following:

- Up to three mixed heating curves (two added to standard mixed heating curve, giving a total maximum of three)
- Electric heater in DHW cylinder
- Swimming pool control.

Additional electrical heater in three steps 3/6/9kW that is controlled automatically by control unit

Outdoor sensor

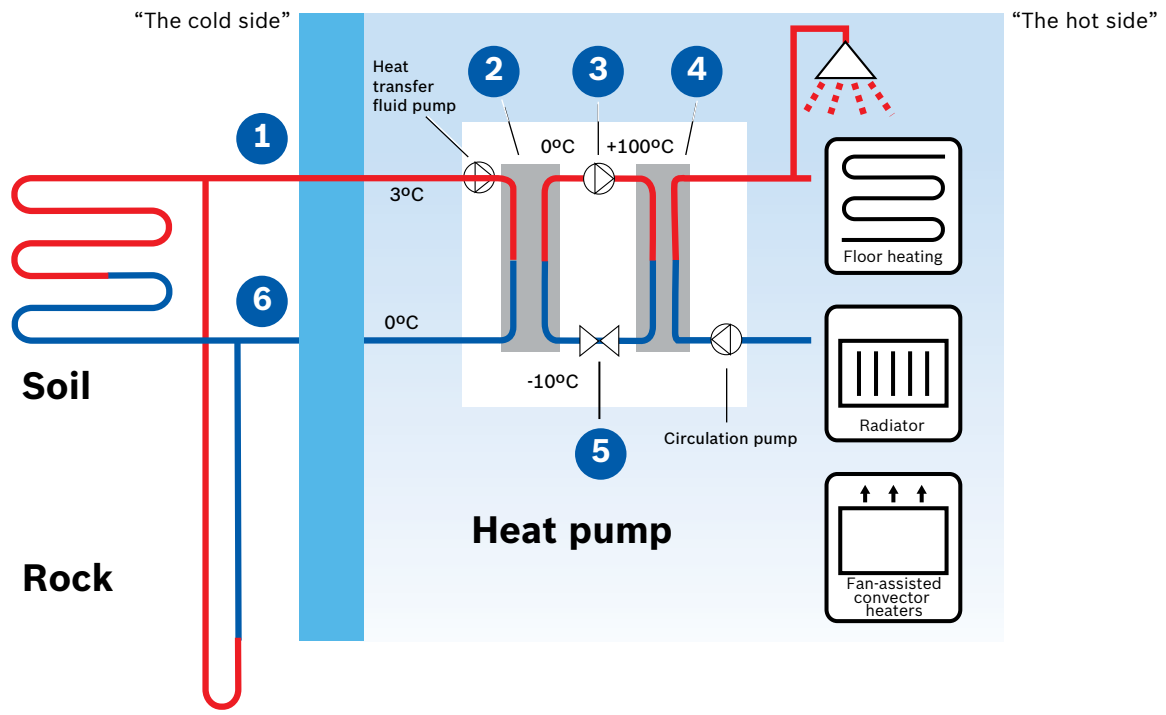
- The heat pump is controlled with an outdoor sensor (fitted on a north-facing wall) which determines the temperature outside the property and relays this back to the heat pump
- The control on the heat pump uses a heat curve to provide a matching flow temperature from the appliance, the heat pump always endeavours to provide the lowest flow temperature possible whilst maintaining the desired room temperatures.

Room sensor

In addition to the outdoor sensor, a room controller (accessory) supplements the control of the heat pump in the property. This allows the controller to compare the internal and external temperatures and to provide the best possible energy savings.

**When cascading two System models or a System model and a Combi model only.*

Principles of operation



1. As the heat transfer fluid, which is a mixture of water and glycol, goes into the unit, the heat pump collects stored solar energy. This anti-freeze mixture absorbs the heat from the earth and is fed into the evaporator. The temperature is on average around 3-5ºC.

2. In the evaporator, the heat transfer fluid meets the refrigerant. At this stage, the refrigerant is in a fluid state and is at approximately -10ºC. When the refrigerant meets the heat transfer fluid it starts to boil. The subsequent vapour produced, which is approximately 0ºC, is fed into the compressor.

3. In the compressor, the pressure of the refrigerant increases and the vapour temperature rises from 0ºC to approximately +100ºC. The hot gas is then forced into the condenser.

4. The condenser then transfers the heat to the heating (e.g. underfloor heating or radiators etc.) and hot water system. The vapour is cooled in the condenser and becomes a liquid. The pressure in the refrigerant is still high when it reaches the expansion valve.

5. Once in the expansion valve, the refrigerant pressure is lowered and the temperature drops to approximately -10ºC. When the refrigerant passes the valve and the evaporator, it changes to vapour again.

6. The heat transfer fluid is led out from the heat pump to the ground loop, where it collects the new stored solar energy. The temperature of the fluid is approximately 3ºC cooler than the flow in.

System layouts

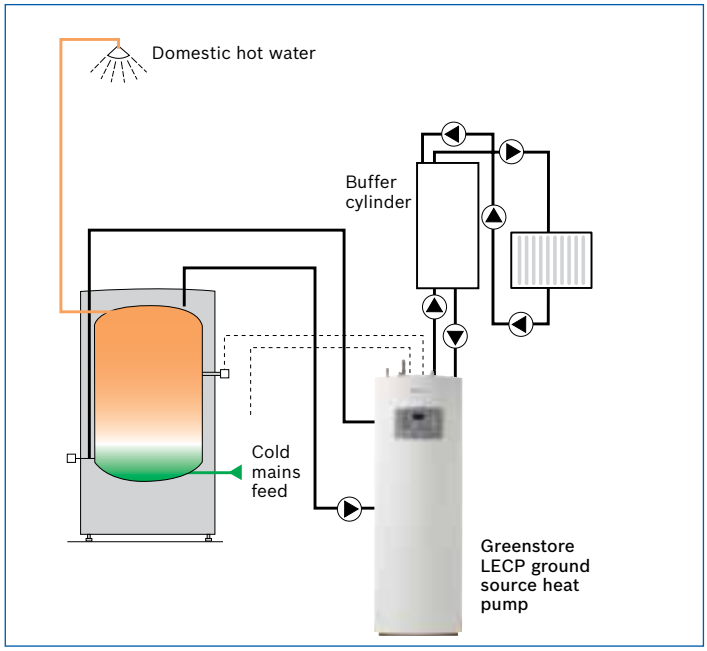
The Greenstore series of heat pumps have the versatility to be used in a variety of different system designs.

The Greenstore Combination models benefit from a built-in 185 litre cylinder of unvented DHW, providing a convenient heating and hot water solution in one product.

Greenstore ground source heat pumps and hot water cylinders

With this in mind, Worcester offers a Greenstore solar-compatible 280l cylinder with a tank-in-tank design for use with Greenstore System series heat pumps.

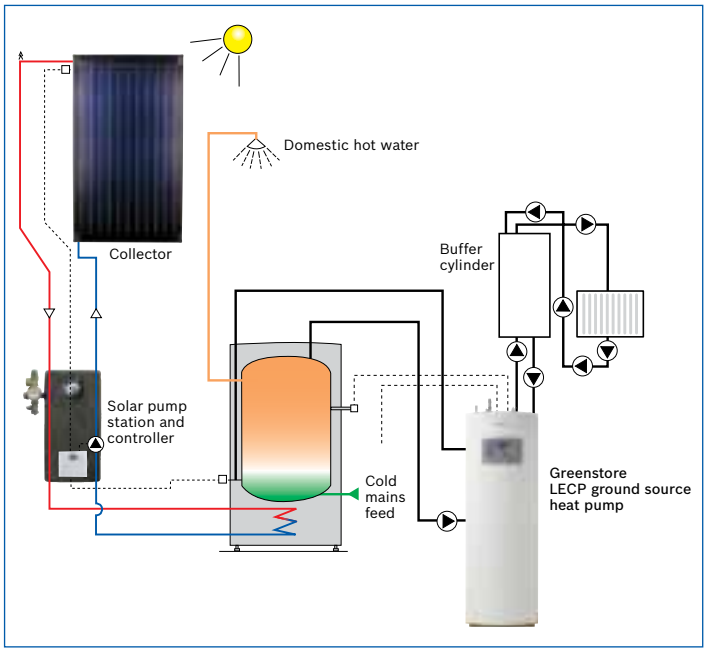
Hot water cylinders specifically designed for use with heat pumps must have a coil surface area of at least 3.0m^2 and pre-defined positions for the temperature sensor to ensure effective heat transfer. This ensures that the lower flow temperatures and small temperature differential do not adversely affect the re-heat time. Failure to do so could result in poor domestic hot water performance. This is especially important as the heat pump operates on hot water priority, meaning a long re-heat time would adversely affect household heating.



Greenstore ground source heat pumps with solar support

This particular system uses the same products as the previous system layout, but with the solar coil within the cylinder linked to a Worcester Greenskies solar system. The system allows each of the technologies involved to work together seamlessly. The advantage is that the heat pump is not required to be the sole provider of domestic hot water and therefore will have the opportunity to run at lower flow temperatures when the solar system is producing the hot water.

The heat pump will automatically support the solar system with DHW supply if demand means that additional heat is required.



Performance

Greenstore LECP ground source heat pumps feature a highly efficient and effective scroll-type compressor which allows up to 65ºC flow temperature from the appliance. This higher output temperature allows Worcester heat pumps to be effectively combined with radiators designed for the heat loss of each room.

However, wherever possible Worcester recommends an underfloor heating system as the most compatible heat emitter system. The scroll compressor allows Worcester heat pumps to offer excellent CoP ratings.

The heating circuit will require a buffer cylinder, which is available as an accessory, to improve system efficiency and result in lower running costs.

Coefficient of Performance

The performance and efficiency of a heat pump system is commonly measured by the Coefficient of Performance.

The CoP is a simple calculation which works out how much energy the heat pump is able to extract from the energy source compared to the amount of electrical energy used by the heat pump.

$$\text{CoP} = \frac{\text{Heat output of system (useful heat)}}{\text{Electrical input from compressor and circulating pumps}}$$

$$\text{e.g.} \quad \frac{\text{9kW heat pump}}{\text{2.7kW of electrical input}} = \text{CoP of 3.3}$$

The CoP depends on the temperature that can be extracted from the collector and the temperature required by the heating system of the property. The best combination for a high CoP would be a higher source temperature (e.g. 10ºC) and a lower flow temperature for the heating (e.g. 35ºC).

The return on the energy employed in this case is higher, since the heat pump has to increase the temperature by only 25ºC. If the energy from the source is lower in temperature and the required flow temperature is higher, the CoP will be reduced.

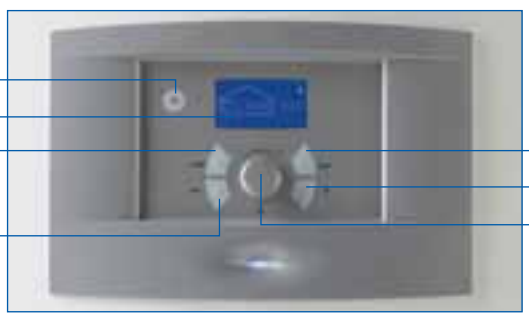
The equation shown opposite results in 2.7kW of heat provided by the pump (which is provided by electrical consumption) and 6.3kW of energy extracted from the ground source.

	Greenstore 6 System	Greenstore 7 System	Greenstore 9 System	Greenstore 11 System
CoP* 0/35ºC[1)]	3.96	3.82	3.84	3.97
CoP* 0/45ºC[1)]	3.15	2.97	3.15	3.17

	Greenstore 6 Combi	Greenstore 7 Combi	Greenstore 9 Combi	Greenstore 11 Combi
CoP* 0/35ºC[1)]	3.96	3.82	3.84	3.97
CoP* 0/45ºC[1)]	3.15	2.97	3.15	3.17

1) According to BS EN 14511
**Coefficient of Performance*

Inside story – Greenstore LECP System ground source heat pump



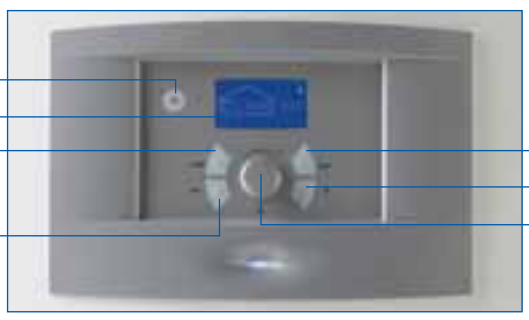
Greenstore LECP System ground source heat pump Rego 1000 control panel

Technical data

Model	Greenstore 6 System	Greenstore 7 System	Greenstore 9 System	Greenstore 11 System
Height	1,520mm	1,520mm	1,520mm	1,520mm
Width	600mm	600mm	600mm	600mm
Depth	645mm	645mm	645mm	645mm
Weight (without packaging)	150kg	155kg	165kg	175kg
Permitted operating temperature	10ºC - 35ºC	10ºC - 35ºC	10ºC - 35ºC	10ºC - 35ºC
Sound power[5)]	47dBA	50dBA	52dBA	48dBA
Mode fluid/water				
Heat output (B0/W35)[1)]	5.4kW	6.6kW	8.7kW	10.2kW
Heating output (B0/W45)[1)]	5.1kW	6.2kW	8.3kW	9.6kW
CoP (B0/W35)[1)]	3.96	3.82	3.84	3.97
CoP (B0/W45)[1)]	3.15	2.97	3.15	3.17
Heat transfer fluid				
Nominal flow (delta_T = 3K[2)])	0.20 l/s	0.41 l/s	0.50 l/s	0.62 l/s
Permitted external pressure drop[2)]	47kPa	43kPa	80kPa	91kPa
Max. pressure	4bar	4bar	4bar	4bar
Internal pipework contents	5 litres	5 litres	5 litres	5 litres
Operating temperature	-5ºC - +20ºC	-5ºC - +20ºC	-5ºC - +20ºC	-5ºC - +20ºC
Connection (Cu)	28mm	28mm	28mm	28mm
Compressor				
Type	Mitsubishi scroll	Mitsubishi scroll	Mitsubishi scroll	Mitsubishi scroll
Refrigerant R407c[3)]	1.6kg	1.6kg	1.8kg	2.4kg
Max. pressure	31bar	31bar	31bar	31bar
Compressor oil	FV 50S	FV 50S	FV 50S	FV 50S
Heating system				
Nominal flow (delta_T = 7K)	0.20 l/s	0.25 l/s	0.31 l/s	0.38 l/s
Min. flow temperature	20ºC	20ºC	20ºC	20ºC
Max. flow temperature	65ºC	65ºC	65ºC	65ºC
Min. permitted operating pressure	0.5bar	0.5bar	0.5bar	0.5bar
Max. permitted operating pressure	3bar	3bar	3bar	3bar
Primary water content	7 litres	7 litres	7 litres	7 litres
Connection (Cu)	22mm	22mm	22mm	22mm
Values for electrical connection				
Electrical supply	230V 1N~50Hz	230V 1N~50Hz	230V 1N~50Hz	230V 1N~50Hz
Fuse, slow; with electric additional heat 3/6/9kW[4)]	25/40/63A	32/40/63A	32/50/63A	40/50/63A
Nominal power consumption compressor (B0/W35)	1.17kW	1.48kW	1.78kW	2.09kW
Max. current with soft starter	<35A	<35A	<35A	<35A
Enclosure class	IP X1	IP X1	IP X1	IP X1

1) With internal pump according to EN 14511
2) Glycol
3) Global Warming Potential. GWP_{100} = 1526
4) aM type fuse. D characteristic MCB
5) According to EN 3743-1

Inside story – Greenstore LECP Combination ground source heat pump



Greenstore LECP Combination ground source heat pump Rego 1000 control panel

Technical data

Model	Greenstore 6 Combi	Greenstore 7 Combi	Greenstore 9 Combi	Greenstore 11 Combi
Height	1,800mm	1,800mm	1,800mm	1,800mm
Width	600mm	600mm	600mm	600mm
Depth	645mm	645mm	645mm	645mm
Weight (without packaging)	200kg	202kg	210kg	218kg
Permitted operating temperature	10ºC - 35ºC	10ºC - 35ºC	10ºC - 35ºC	10ºC - 35ºC
Sound power[5)]	44dBA	47dBA	49dBA	48dBA
Mode fluid/water				
Heating output (B0/W35)[1)]	5.4kW	6.6kW	8.7kW	10.2kW
Heating output (B0/W45)[1)]	5.1kW	6.2kW	8.3kW	9.6kW
CoP (B0/W35)[1)]	3.96	3.82	3.84	3.97
CoP (B0/W45)[1)]	3.15	2.97	3.15	3.17
Heat transfer fluid				
Nominal flow (delta_T = 3K[2)])	0.20 l/s	0.41 l/s	0.50 l/s	0.62 l/s
Permitted external pressure drop[2)]	47kPa	43kPa	80kPa	91kPa
Max. pressure	4bar	4bar	4bar	4bar
Internal pipework contents	5 litres	5 litres	5 litres	5 litres
Operating temperature	-5ºC - +20ºC	-5ºC - +20ºC	-5ºC - +20ºC	-5ºC - +20ºC
Connection (Cu)	28mm	28mm	28mm	28mm
Compressor				
Type	Mitsubishi scroll	Mitsubishi scroll	Mitsubishi scroll	Mitsubishi scroll
Refrigerant R407c[3)]	1.6kg	1.6kg	1.8kg	2.4kg
Max. pressure	31bar	31bar	31bar	31bar
Compressor oil	FV 50S	FV 50S	FV 50S	FV 50S
Heating system				
Nominal flow (delta_T = 7K)	0.20 l/s	0.25 l/s	0.31 l/s	0.38 l/s
Min./max. flow temperature	20/65ºC	20/65ºC	20/65ºC	20/65ºC
Min. permitted operating pressure	0.5bar	0.5bar	0.5bar	0.5bar
Max. permitted operating pressure	3bar	3bar	3bar	3bar
Heating water incl. outer shell hot water heater	47 litres	47 litres	47 litres	47 litres
Connection (Cu)	22mm	22mm	22mm	22mm
Hot water				
Max. output with/without electric additional heat (9kW)	5.0/14.0kW	6.6/15.6kW	8.7/17.7kW	10.2/19.2kW
Domestic hot water	185 litres	185 litres	185 litres	185 litres
Min./max. permitted operating pressure	2/10bar	2/10bar	2/10bar	2/10bar
Connection (stainless steel)	22mm	22mm	22mm	22mm
Values for electrical connection				
Electrical supply	230V 1N~50Hz	230V 1N~50Hz	230V 1N~50Hz	230V 1N~50Hz
Fuse, slow; with electric additional heat 3/6/9 kW[4)]	25/40/63A	32/40/63A	32/50/63A	40/50/63A
Nominal power consumption compressor (B0/W35)	1.17kW	1.48kW	1.78kW	2.09kW
Max. current with soft starter	<35A	<35A	<35A	<35A
Enclosure class	IP X1	IP X1	IP X1	IP X1

1) With internal pump according to EN 14511
2) Glycol
3) Global Warming Potential. GWP_{100} = 1526
4) aM type fuse. D characteristic MCB
5) According to EN 12102 (1 meter)

Is a heat pump suitable for the property?

Pre-installation

Ground source heat pump operation

As the outside temperature gets colder, the heat demand of a property increases and the output of a ground source heat pump will decrease. Eventually it becomes so cold outside that the output of the heat pump alone is not able to heat the building effectively. The Greenstore range of ground source heat pumps therefore allows for monoenergetic and bivalent operation.

Monoenergetic means that in the event of very low external ground temperatures a 3-stage electrical additional heater in the indoor unit will automatically be activated to provide additional heat to supplement the heat pump and keep the building warm.

In bivalent operation a second heating appliance (e.g. gas or oil boiler) is used to supplement the heat load.

Selection and sizing of a heat pump

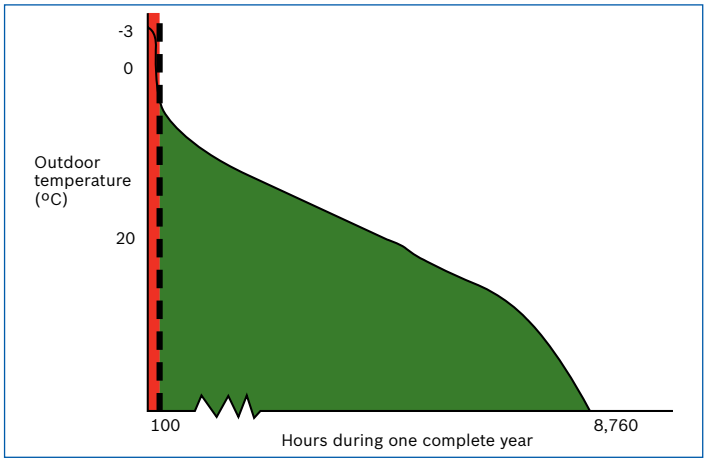
It is essential that heat pump systems are designed to operate efficiently in order to meet the heating needs of the property and the expectations of the customer. In order to achieve this, the following design activities must be completed prior to installation:–

- Pre-design assessment – Determine the suitability of a heat pump system for the building based on the customer requirements, expectations and building type.
- Detailed design – Complete building heat loss calculations and domestic hot water usage assessment.
- Specification – Select a suitable heat pump and system components based on the detailed design. Calculate and communicate the predicted energy use and running costs of the system to the customer.

A suitable design methodology for the above is detailed in MIS 3005, the Microgeneration Certification Scheme (MCS) heat pump installer standard. Worcester, Bosch Group recommended that this standard is followed for heat pump systems. The standard covers the design, installation and commissioning requirements to ensure that 100% of the building heat loss can be met efficiently by the heat pump system. A heat pump system must be designed to this standard to be eligible for government financial incentives e.g Renewable Heat Incentive (RHI).

The graph below is intended to show the principle behind the sizing of heat pumps to take into account the small number of hours where the peak heating load of the property is required. The dotted vertical line shows that there have, in the example shown, only been 100 hours of outdoor temperature below 0ºC in the given 8,760 hours.

There are significant climatic differences across the UK and this example is not intended to provide information on any particular installation. The Worcester system design service is able to provide information on an individual basis.



The Worcester Bosch Group design team offer a heat pump sizing service which is MCS compliant. To request this service, download and submit the form using the guidance notes from our website address: **www.worcester-bosch.co.uk/hp**

Heat loss

The total heat loss of the property is calculated from the addition of fabric and ventilation heat losses. Fabric heat loss is the transmission of heat by conduction through the building structure, i.e. windows, walls, roof and floor. Ventilation heat loss is heated air escaping from the property and being replaced by cold air from outside.

Calculating the heat loss of the property

It is essential to accurately calculate the heat loss of the property to ensure correct sizing of the heat pump system. The heat loss is dependent on the construction of the building, room sizes, external and internal design temperatures and air change rates. The heat loss calculations should satisfy the requirements of BS EN 12831.

Estimating heat loss

Estimating the heat loss of the property is useful in determining the suitability of a heat pump system. However, assumptions based on floor area (e.g. 50 W/m² for new build etc.) and SAP (the governments Standard Assessment Procedure) should not be used for the detailed design and specification stage. It should be noted that the heat loss for non-standard properties i.e. buildings with large areas of glazing, high ceilings, log burners etc. or properties in exposed locations may deviate significantly from any rules of thumb.

In existing properties, boilers are often oversized and should therefore not be used to determine the actual heat requirements of the building. However, estimates may be made on the basis of the existing energy consumption of the space to be heated.

This installation manual does not cover all the necessary details to calculate the heat loss. The information given here is provided to remind the heating system designer and installer of the process and considerations.

Heat emitters

Worcester, Bosch Group heat pumps are fitted with weather compensation controls as standard. However, for a heat pump to perform to its highest energy efficiency, the central heating emitter circuit should be designed so that the flow temperature is as low as possible.

As a guide, the system should be designed using the following maximum flow temperatures:

- Underfloor heating: 35-40°C
- Radiators: 45-50°C

If underfloor heating has been installed, it is important to remember that the underfloor system designer should have been informed that the heat source will be from a ground source heat pump. It is also important to remember that radiators should have been correctly sized to work effectively with lower flow temperatures.

A tool to aid installers and end users to understand the relevance of building heat loss and heat emitter selection on heat pump performance, has been created by the joint trade associations. The 'Heat Emitter Guide' can be downloaded from the following website: **www.microgenerationcertification.org**

Worcester Design Service

Worcester's design team offers design support across all of the Worcester, Bosch Group product range. The design team produces technical drawings and provides specification advice for a range of customers. All of our team are authorised SAP assessors and hold a IDHEE Domestic Heating Certificate. Worcester provides a range of indemnified design solutions in support of our core range of Greenstar gas- and oil-fired boilers, Greenfloor underfloor heating and a growing portfolio of renewable technologies, including Greenskies solar thermal panels as well as Greenstore ground source and Greensource air source heat pumps.

The Design Service for Worcester Greenstore ground source heat pumps includes calculations for:

- Heat pump sizing
- Collector sizing
- Estimated annual running costs
- Fact sheets

For more information on the suitability of a heat pump for your home, visit **www.worcester-bosch.co.uk**

Worcester on-site technical expertise

Worcester has a team of technical representatives based at head office for telephone assistance and national coverage of technical representatives available for on-site assistance.

Regulations and standards

Installation of this heat pump should be done in accordance with MCS/MIS 3005.

This appliance must be installed and serviced only by a competent person in accordance with the current: IEE Regulations, Building Regulation, Building Standards (Scotland) (Consolidation), Building Regulations (Northern Ireland), local water by-laws, Health & Safety Document 63S (The Electricity at Work Regulations 1989), IS 813 (Eire) and other local requirements.

The relevant Standards should be followed, including:
BS7074:1: Code of practice for domestic and hot water supply
EN:12828: Central heating for domestic premises
BS7593: Treatment of water in domestic hot water central heating systems
BS814 EN 14511: Requirements heat pumps for space heating
BS EN 378: Safety and environmental requirements for heat pumps
The Health and Safety at Work Act 1974
The Management of Health and Safety at Work Regulations 1999
The Construction (Health, Safety and Welfare) Regulations 1996
The Construction (Design and Management) Regulations 1994
The Lifting Operations and Lifting Equipment Regulations 1998

Where no specific instruction is given, reference should be made to the relevant Codes of Practice.

Potable water: All seals, joints, compounds (including flux and solder) and components used as part of the secondary domestic water system must be approved for use with potable water supplies.

This is to certify that the above ranges of products manufactured by Bosch Thermotechnology Ltd have been tested and found to comply with:

- The requirements of the (Water Fittings) Regulations 1999 for England and Wales, the Water Byelaws 2000, Scotland and the Water Regulations Northern Ireland.
- The requirements of the UK Building Regulations:
  The Building Regulations 1991 (England & Wales) Requirements G3, L1 and Regulation 7.
  The Building Standards (Scotland) Regulations 1990. Regulation 10 (B2), 22 (J3.3a and J3.4), 27 and 28 (P2.6 and P3).
  The Building Regulations (Northern Ireland) 2000.

In accordance with current EU legislation (the F-gas regulation, EC Regulation No 842/2006 which came into effect on 4 July 2006), a heat pump that contains more than 3 kg of refrigerant R410A must be checked regularly by an accredited technician.

The manufacturer’s notes must not be taken in any way as overriding statutory regulations.

Groundworks and collectors

Survey

It is strongly recommended that a ground survey is carried out to identify any service/utility pipes or other underground obstacles in the area before any groundworks commence. To ensure accurate sizing of the ground array, for either horizontal collectors or borehole (vertical) collectors, and to determine the Lambda values, a full geological report should be carried out in accordance with MIS 3005.

Groundwork considerations

All groundworks should be carried out with the proper safety considerations appropriate to the depth of any trench work being carried out. Shuttering should be considered on steep sided trenches where people will be working.

Ground loop connections – horizontal and vertical

Pipework connecting collectors to the appliance should be buried to a depth of between 800mm and 1,200mm. It must also be insulated in accordance with the recommendations made in the insulation section (see following page).

The minimum permitted bend radius is 1 metre.

Where possible, collector pipework should be run in the longest single lengths possible to reduce the number of connections in the system. The connections in 40mm PEM pipe can be made using ultrasonic welding equipment or using compression fittings.

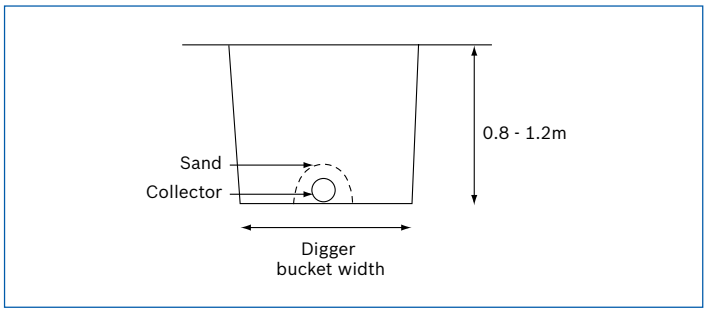
Collector types

Horizontal collector

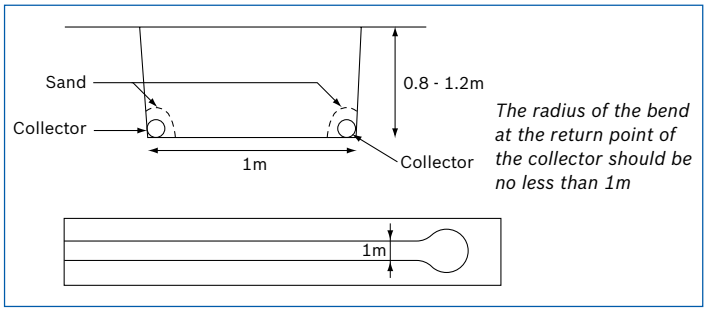
Horizontal collectors were the collection method originally introduced with ground source heat pumps. The horizontal collector recommended should have a 40mm diameter pipe. Compared to other options this method has a lower energy yield per metre of collector. As such, a larger collector length is often required.

The collector should be covered with 10cm of sand in case the material used when back filling contains sharp stones which may damage the collector. Sand should not be required where the earth to be backfilled contains smaller round stones.

This type of horizontal system typically provides between 10 and 18W of energy per metre of active collector. The lower figure in the range would apply if the heat pump is running all day whereas the higher figure would be typical of a system running a few hours per day. When sized to 100% of the peak load of the property, the energy drawn from the collector could be around 15W per metre.



Horizontal collector – single array in a trench



Horizontal collector – two pipes within a trench

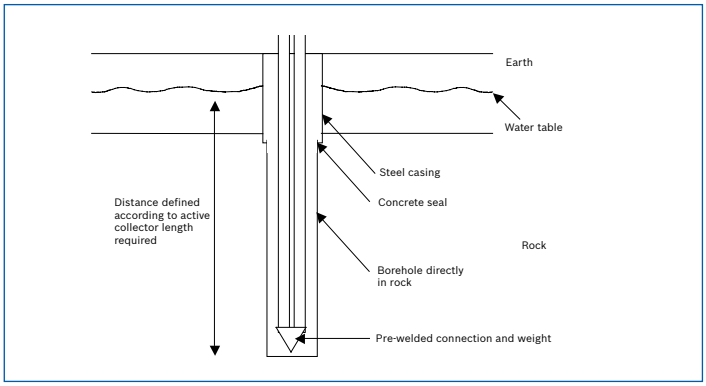
Borehole (vertical) collectors

A borehole (vertical) collector allows a ground source heat pump to be installed in a property where the area of land available is insufficient for a horizontal collector.

Vertical collectors typically provide a higher energy yield per metre of active collector when compared to horizontal collectors.

Vertical collectors can provide between 35 and 55 Watts per metre of active collector, which depends on the heat conductivity of the rock into which the hole is drilled. A hard rock such as granite has a better conductivity than a softer rock such as limestone. The actual yield will depend, amongst other factors, on the geological conditions on site.

Pipework for vertical collectors may be supplied by the borehole contractor to the specification indicated in the pipework section.



Borehole (vertical) collectors cross-section

Sizing the vertical collector to the heat pump

The term active collector is used to denote collector pipe that is in direct contact with the ground source, for example below the water table or in contact with a borehole filling material such as bentonite. Any part of the tube that is in contact with air will not generate a significant yield and must not be included when calculating the energy that the collector will provide.

However it is a requirement when specifying the total length of tube required to include the active collector, any inactive pipework (from the property to the borehole and back) and collector system.

It is considered good practice (and a requirement of the Environment Agency) to fill the bore hole with a thermal conductive grout (e.g. a cement compound such as bentonite) in order to guarantee conduction of energy to the collector and to guard against disturbing rock strata or ground water layers.

The borehole (vertical) collector should be filled before being lowered into the borehole with glycol mixture.

Borehole contractors

Specialist borehole contractors will be required for vertical collector installations. Contractors are normally able to drill the borehole and supply, fill and install the collector ready for connection by the installer. The collector must be filled before being lowered into the borehole. The contractor should be able to provide a geological survey of the area before drilling commences.

Insulation

All pipework from and to the collector (which is not active collector) must be insulated with Class O insulation (nominal wall insulation of 19mm), especially when there is less than 0.8m separation between the pipes. Insulation which is to be buried must be robust enough to withstand the weight of the earth above it.

All pipework running to and from the collectors inside the property must also be insulated. In addition, all pipework outside the property must be insulated for a distance of at least 2 metres from the property. It is recommended that insulation is done prior to clipping pipes to walls to ensure complete coverage.

In some instances on pipework and exposed fittings, condensation may form and should be accounted for when choosing to site the product.

Collector system

Installation and filling

Installation and filling of the collector system should comply with applicable laws and current regulations, the MCS MIS 3005 standard should be referred to for guidance.

Soil used for refilling around the collector hose must not contain stones or other sharp objects.

Pressure test the collector system with water before refilling to ensure that the system is watertight.

When cutting the collector, it is important that no dirt or gravel enters the system. This can lead to blockages in the heat pump and damage to system components resulting in a lower performance from the heat pump. A biocide cleanser can be used to prevent blockages within the system prior to filling.

Filling unit

An in-line filling unit is included in the delivery and should be installed close to the collector circuit inlet.

Care should be taken to ensure that all connections remain clean and free from debris and all pipe ends must be capped when not in use. It is also important to ensure that pipe cuts are cut square and are fully deburred. It is recommended that hose pliers are used to make clean pipe cuts.

A fluid leak test should be made on all connections between the heat pump and the ground loop.

It is recommended that external pipework is marked to ensure that the correct connections are made at the heat pump indicating the flow and return.

Ground loop testing and filling

The collectors should be pressure tested with water in line with MIS 3005 and the latest Building Regulations. A 40mm PEM pipe loop system should be tested to a pressure of 3-4bar over a period of 2 hours.

It is advisable the collector is pressurised (to 2bar) during the back filling process with water.

Care should be taken when disconnecting from the ground loop. Please ensure that the pressure is reduced fully before disconnection.

After filling the system with the required concentration of heat transfer fluid the filling pump should be run for an hour to ensure that all the air has been purged from the system. The system filter should also be checked and cleaned.

Worcester's NEW Greenstar System Filter can be used with the LECP ground source heat pump.

Product info	
Part number	7 716 192 609

Pipework

Appropriate pipework (PEM 40 x 2:4 SDR 11).

Antifreeze/corrosion preventative

Frost protection to -15°C should be ensured. We recommend the primary use of bioethanol, otherwise propylene glycol.

Propylene glycol

Glycol is not normally used in the heating system. In special cases, where increased protection is required, glycol can be added with a maximum concentration of 15%. Heat pump performance will however decrease.

Mixing ratio in litres per metre of coil (40/35mm hose)		
Product	**Water (l)**	**Antifreeze (l)**
Propylene or ethylene glycol	0.65	0.35

Mixing ratio in % by weight	
Product	**Antifreeze (l)**
Propylene or ethylene glycol/water	35/65

For planning regulations and advice please see Energy Savings Trust website: **www.energysavingtrust.org.uk** and also the Micro Generation website: **www.microgenerationcertification.org**

Greenstore LECP ground source heat pump

Heat pump	Part number
Greenstore LECP system ground source heat pump	
Greenstore 6 System	8 738 203 184
Greenstore 7 System	8 738 203 185
Greenstore 9 System	8 738 203 186
Greenstore 11 System	8 737 203 187

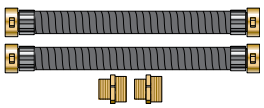
Greenstore LECP combi ground source heat pump	
Greenstore 6 Combi	7 716 180 025
Greenstore 7 Combi	7 716 180 026
Greenstore 9 Combi	7 716 180 027
Greenstore 11 Combi	7 716 180 028

Greenstore LECP ground source heat pump accessories

Filling pump unit

Worcester Part No.
7 716 192 420

Filling pump hose kit



Worcester Part No.
7 716 192 421

Air compressor

Worcester Part No.
7 716 192 422

Compressor connection kit

Worcester Part No.
7 716 181 103

Greenstore 280 solar compatible cylinder

Worcester Part No.
7 716 180 018

Room controller

Worcester Part No.
8 718 581 097

120 litre buffer tank

Worcester Part No.
8 718 544 081

IOB multi-module control box

Worcester Part No.
8 738 204 509

The very best training programmes from Worcester

Worcester has always placed great emphasis on technical support and training for installers and service engineers. Advances in heating technology, including the increasing use of renewables, make the need for training greater than ever.

To ensure the highest levels of competence and expertise in the installation of all Worcester products, we run intensive training courses for installers, commissioning engineers and operatives involved with servicing and fault finding.

Courses available

Our training facilities offer a number of courses suitable for the installer and commissioning engineers, and more in-depth courses for the servicing and fault finding engineers.

Training centres throughout the UK

To enable us to meet the growing demand for training we have invested in additional facilities at the award-winning training academy at our Worcester headquarters. In addition to the original academy there is now a new 400m^2 unit, 25% of which is devoted to an open-plan domestic training area with life-size single-storey brick buildings. These feature working Greenskies solar thermal systems which enable installers to get up onto the roof of the building to get more realistic training. There are bays full of all Greenstar gas-fired appliances, so installers can really get to grips with the importance of system design. The additional space also contains dedicated training areas for our renewable and future products. The training centre also runs certified domestic and commercial ACS training and assessment.

Further academies are located at West Thurrock in Essex, Wakefield and Clay Cross in Derbyshire, all offering our full suite of courses. Please phone 01905 752526 for more information about a course near you. Each course is run by specialist trainers and is superbly equipped to deliver a combination of classroom theory and practical hands-on experience that's second to none.

College-linked Learning

As well as offering training at our own centres, Worcester has established close partnerships with many colleges around the UK, equipping them with our latest products. Call us on 01905 752526 to find out when we will be running the course of your choice at a college in your area.

Mobile training

To complement our training venues across the country, we can also bring training to you.

We have mobile vehicles fully equipped with operational Greenstar gas-fired boilers, dry strip-down models and even a Greensource air to air heat pump, ensuring that quality training in a comfortable environment can be achieved on your doorstep!

If it's oil training you require, our 7.5 tonne mobile oil vehicle is available throughout the country for hands-on product training and OFTEC assessments.

Distance learning/web based learning

Worcester has produced a selection of Distance Learning CD ROMs/DVDs which are packed with information. Call 0844 892 9800 for your copies, or visit **www.worcester-bosch.co.uk** for information on Web Based Learning.

Get on course for a more profitable future now.

Call now for more information 01905 752526

Worcester heat pump training courses

All academies allow customers to gain hands-on experience with our entire range of renewable products and inform installers about the true benefits of installing heat pumps and underfloor heating. The introduction to heat pumps course is designed for installers and heating engineers who have no experience in installing heat pumps. The various one day heat pump courses are designed for those with more practical experience in heat pump technology.

Renewable courses

- **Introduction to heat pumps.**
- **Greenstore LECP ground source heat pumps.**
- **Greensource split air to water heat pumps.**
- **Greensource air to water heat pumps.**
- **Greensource air to air heat pumps.**
- **Greenstar Plus Hybrid heat pumps.**
- **Renewable range overview.**

	Intro to heat pumps	GSHP	Split AW	AWHP	AAHP	Hybrid	Renewable Overview
Duration	1 Day	1 Day	1 Day	1 Day	1 Day	1 Day	1 Day
Cost	£65	£65	£65	£65	£65	£65	£65
Training course covers							
Specification	✔	✔	✔	✔	✔	✔	✔
Installation	✔	✔	✔	✔	✔	✔	–
Commissioning	✔	✔	✔	✔	✔	✔	–
Servicing	✔	✔	✔	✔	✔	✔	–
Maintenance	✔	✔	✔	✔	✔	✔	–
Product overview	✔	✔	✔	✔	✔	✔	✔
System design	✔	✔	✔	✔	✔	✔	–
Course locations							
Worcester	✔	✔	✔	✔	✔	✔	✔
Clay Cross	✔	✔	✔	✔	✔	✔	✔
Wakefield	✔	✔	✔	✔	✔	✔	✔
West Thurrock	✔	✔	✔	✔	✔	✔	✔
College Links*	✔	✔	✔	✔	✔	✔	✔
Mobile*	–	–	–	–	✔	–	–

*Please contact Worcester Training for specific colleges and mobile dates

To complement the above courses, Worcester also runs a **Hot Water Systems and Safety course** and **IDHEE domestic heating design course.** For more information turn to page 25.

Please note: it is recommended that unless you have experience installing/commissioning/servicing heat pumps or have worked previously with heat pump technology, that the one day introduction to heat pumps course be attended before commencing with any specific heat pump product courses.

Additional product and industry training courses

The diversity of products in today's heating industry gives you the opportunity to expand your expertise, whilst offering more choice to your customers. Worcester provides comprehensive training from all its academies on its entire range of technologies.

We are here to provide you with training and assistance for all areas of your business, not just product training. Call us on **01905 752526** to order a full course training brochure or to book yourself onto a training course, alternatively, you can visit **www.worcester-bosch.co.uk/training**

Gas-fired condensing boiler courses

- **Greenstar CDi Classic gas-fired condensing combi boilers.**
- **Greenstar CDi Compact gas-fired condensing combi boilers.**
- **Greenstar Si & i Junior gas-fired condensing combi boilers.**
- **Greenstar system & regular gas-fired condensing boilers** (covers Greenstar Ri, Greenstar CDi Classic Regular, Greenstar FS CDi Regular, Greenstar 30CDi Classic System and Greenstar i System boilers).
- **Greenstar Highflow CDi & FS CDi regular floor standing gas-fired condensing combi and regular boilers.**

Oil-fired product courses

- **Greenstar oil-fired products.**
- **Oil advanced fault finding.**
- **OFTEC 101, 105e and 600a.**

Accessories training courses

- **Greenfloor heating.**
- **Worcester controls.**

Commercial product courses

- **Greenspring CWi47 water heater.**
- **GB162 overview.**
- **GB162 domestic.**
- **GB162 commercial.**
- **Greenstar Heat Distribution Unit.**
- **Commercial ACS training and assessment – CODNCO1.**

Industry focused courses

- **BPEC underfloor heating installation.**
- **Hot water systems & safety.**
- **Chemical water treatment.**
- **Construction skills F-Gas training/ assessment certification.**
- **IDHEE domestic heating design.**
- **Domestic ACS training and assessment – reassessment. CCN1 + 3 appliances.**
- **MCS Made Easy.**

A complete after-sales service

As part of the worldwide Bosch Group, Worcester strives to maintain the highest possible standards of after-sales care.

In addition to the no-nonsense parts and labour guarantee applicable to all Worcester products, you and your customers have the assurance that every Worcester product is manufactured to both the appropriate British and European standards.

Worcester Contact Centre

Should you require support, our award winning Contact Centre team, based at our head office in Worcester, are ready to take your calls. Whatever your query our contact centre operators along with our nationwide team of engineers are ready to help you.

Tel: 0844 892 9900

Opening times

Monday – Friday: 7.00am – 8.00pm
Saturday: 8.00am – 5.00pm
Sunday: 9.00am – 12 noon
Bank Holidays: 8.00am – 4.30pm

All the technical advice you need

Spares

Genuine replacement parts for all supported Worcester products are readily available from stock, or on a next day delivery basis. Visit our website at www.worcester-bosch.co.uk/**spares** to find your local stockist.

Customer Technical Support

The Worcester Technical Helpline is a dedicated phone line – committed to providing a comprehensive service to complement the brand name and quality of our products. Our experienced team of technical experts provides answers to queries of a technical nature across the entire Worcester range.

Worcester also has a pre-sales department, which provides assistance in selecting a heating system to suit a particular application, along with full guidance on installation. For more information please contact the Technical Helpline or alternatively visit our website where literature can be downloaded at **www.worcester-bosch.co.uk**.

Technical

Tel: 0844 892 3366
Fax: 01905 752 741
technical.enquiries@uk.bosch.com

Opening times

Monday – Friday: 7.00am – 8.00pm
Saturday: 8.30am – 4.00pm
Bank Holidays: 8.00am – 4.30pm

Notes

Useful numbers

Sales
Tel: 01905 752640
Fax: 01905 456445

Spare Parts
Tel: 01905 752576
Fax: 01905 754620

Technical Helpline (Pre & Post Sales)
Tel: 0844 892 3366
Fax: 01905 752741
technical.enquiries@uk.bosch.com

Renewables Technical Helpline
Email: renewable.energy@uk.bosch.com
or telephone 0844 892 4010

Training
Tel: 01905 752526
Fax: 01905 752535

Literature
Email: literature@uk.bosch.com
or download instantly from our website
or telephone 0844 892 9800

Customer Service

Engineer Appointments
Email: appointment.worcester@uk.bosch.com
or telephone 0844 892 3000

Enquiries
Email: service.mailbox@uk.bosch.com
or telephone 0844 892 3000

Guarantee Registration
To register your Worcester guarantee,
please visit our website or
telephone 0844 892 2552

Calls to the listed 0844 numbers are charged at up to 3 pence per minute from BT land lines.
Calls from mobiles and some other networks may vary. Calls to and from Bosch Thermotechnology Ltd
may be recorded for training and quality assurance purposes.

www.worcester-bosch.co.uk

In partnership with

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Worcester, Bosch Group,
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Worcester, WR4 9SW