Helping you to comply with the Code for Sustainable Homes

Air Source Heat Pumps
Frequently Asked Questions

Certificate No. HP0004, approved to MCS 007

What are the benefits of Air Source Heat Pumps over Ground Source Heat Pumps?
There are a number of benefits when using an Air Source Heat Pump (ASHP). Capital cost is lower as the ASHP’s are normally self-contained units without additional heat transfer requirements such as ground pipe work. This also means that installation costs are lower as the ASHP simply needs siting in an appropriate position and connecting to the mains supply electricity and building wet system; whereas a GSHP will require significant ground works, either bore holes or deep furrows. This type of work is not always possible on existing buildings due to limited access and is always costly. New technology has enabled ASHP’s to achieve similar seasonal efficiencies to those traditionally associated with GSHP’s.

What issues are associated with installing ASHP’s in existing properties?
If heat pumps are fitted as part of a completely new wet system there are no problems as everything will be designed to suit the heat pump. If it is replacing another heat source on an existing wet system then there may be issues that need attention.

Radiator systems
Existing radiator sizes should be checked to ensure that they are suitable to work with a supply temperature of 50°C. The system should be a pressurised sealed system with an appropriately sized expansion vessel. The old system should be thoroughly flushed and cleaned prior to connecting the heat pump and a cleanable filter should be added to the system. Aluminium radiators will provide 50% more heat for the same size steel radiators, and should always be considered in your new ASHP system. Heat pumps should not be connected to a micro-bore system as there may be flow restrictions due to high water side pressure drops. A suitable inhibitor and anti-freeze should be added to protect the system down to the lowest expected outdoor temperature. Check that the pipe insulation meets the current requirements of the Building Regulations.

Under-floor heating systems
These do not pose the same problems, as they will already be sized to work with a lower water temperature. The building itself should be assessed for suitability, as heat pumps will not work efficiently with all types of buildings. Heat losses should be kept to a minimum with building insulation and draught proofing better than current regulations if possible.

How many Air Source Heat Pump units can be fitted in parallel?
There is no absolute answer as it depends upon the size and type of system being installed. When connecting multiple units to a system it is advisable to connect them to a buffer tank or thermal store.

The Airsource Master/Slave control system will allow up to four units to be connected together and operated as a Master/Slave system with Auto Change-over, Lead/Lag and Run/Standby.
How often does the heat pump go into de-frost, and what is the effect?
Heat pumps de-frost on demand and the frequency is relative to the operating conditions. It is reasonable to expect a heat pump to defrost once an hour when outdoor temperatures are low, but will not require it to de-frost once the temperature rises above 5°C.

Can units be hidden behind fences, bushes etc...?
Units may be installed behind barriers or even inside enclosures. The important consideration is ensuring that adequate airflow is available and that the discharge air cannot be re-circulated back onto the inlet as this will result in a continual lowering of the air temperature reducing the efficiency of the unit. See siting guidelines below.

How does the heat pump noise level compare with other heating appliances?
Sound levels inside the house are generally lower than those that would be expected from a gas or oil boiler with a fan assisted flue and will not cause a nuisance provided the installation guidelines have been followed correctly. Noise levels outside may be 2-3 dB higher than those expected from a condensing boiler flue and this should be considered when selecting the position of the heat pump.

Can the heat pump cool as well as heat?
Airsource heat pumps are supplied for heating only. Some heat pumps provide cooling as well and these may be used with under floor heating or with fan coil units but it is not recommended with radiators as even though the minimum water temperature can be controlled, on certain days, depending upon conditions, the radiators could sweat and cause water damage to carpets or flooring. Also consider cool hard surface floors could also be subject to condensate and become slippery.

What is the minimum water content in the system?
See table below for recommended water volume for all units. Water quantities lower than these given are achievable with the addition of a boost heater to aid de-frost. The lower the water volume the more the unit will cycle on and off.

<table>
<thead>
<tr>
<th>Unit Size</th>
<th>Water Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS-508 (8kW)</td>
<td>60 litre</td>
</tr>
<tr>
<td>AS-609 (9kW)</td>
<td>60 litre</td>
</tr>
<tr>
<td>AS-512 (12kW)</td>
<td>90 litre</td>
</tr>
<tr>
<td>AS-613 (13kW)</td>
<td>90 litre</td>
</tr>
</tbody>
</table>

What size should the radiators be?
Radiators should be sized to operate with a supply water temperature of 50°C and a return temperature of 45°C. using the radiator manufacturers data to select appropriately sized radiators for the application. Aluminium radiators however give up to 50% more heat than a standard radiator and are ideal for ASHP

Can radiator and under floor systems be combined?
Yes, but if used in this way the heat pump return water temperature should be set to suit the radiator system and a mixing valve used to reduce the under floor supply to the design temperature.
What is the Design Outdoor Temperature (DOT)?
This is the lowest normally expected temperature in the area where the heat pump is to be installed. The DOT will vary from region to region, being lower in the North of Scotland and gradually increasing moving south. Local information on weather patterns should be used to determine the correct DOT to use. The building heat load and the capacity of the heat pump should be calculated using this temperature.

How often should the water temperature be boosted to raise its operating temperature?
In most conditions the heat pump will start and raise the water temperature as expected. In periods of very cold weather, when the external ambient temperature drops below the external design temperature, a boost heater is available to top up the heating duty available. This can be programmed to switch on automatically with the addition of a digital stat kit. The boost heater will increase the flow to the radiators and will also aid the heat pump at start up. Where connected to a thermal store this is not always required.

Can the heat pump raise the water temperature to 65°C?
This would depend on the system chosen. The standard heat pump will raise the supply water temperature to 55°C as set by the controller. If applying the A609 or A613 heat pumps, water temperatures of up to 65°C will be possible but the higher the water temperature the lower the overall unit efficiency. The A609/A613 units are recommended when connecting to existing heating systems with radiators or new Aluminium radiators.

How should Domestic Hot Water be heated?
The heat pump should be used to pre-heat the water before additional heating is added to raise the water (if required) to the desired temperature. The A609/A613 units when connected to the matching thermal store should not normally require boost heating. If connected in parallel with a Solar Heating System the heat pump should be set to operate if the Solar cannot provide adequate heating. DHW systems should be designed to comply with current regulations.

Where connected to a Thermal store, the water temperature does not need to go above 65°C, as the Domestic hot water is made on demand by cold mains tap water passing through a heat exchanger coil. This means that the water from your hot taps is fresh mains water heated when you need it. This is energy saving as the thermal store does not need to be heated by an immersion once a week.

Thermal stores lose only 2°C a day approx. and so all your energy is stored until needed.

When connected to a solar thermal system, it is also possible to use the suns energy in the winter in your heating system.
**What is the best type of wet system to connect a heat pump to?**

For optimum efficiency an under floor system provides the best results, as it requires a lower flow temperature and the heat pump can be programmed to provide the water at the required temperature with no need for a mixing valve. Any system will benefit from using a thermal store rather than a direct feed which will allow the heat pump to raise the water to the correct operating temperature more quickly as there is no direct heat loss from the thermal store during the start-up period.

*Aluminium radiators* are designed to work with ASHP units as they give out **50% more heat** than conventional steel radiators, and therefore make a sensible choice if upgrading a property.

**What is the lower limit operating temperature?**

-20°C is defined as the lower operating limit but the heat pump will not switch off at this temperature. At -20°C the maximum supply water temperature will be 45°C (55°C for the AS-613 unit).

**What controls will the heat pump work with?**

The heat pump is fitted with a controller that is pre-programmed with all of the operating set points and alarms and simply requires an input from an external time clock/thermostat. Any standard type of central heating controller will work with the heat pump but the best solution is to use a controller with a number of on/off options for each day to take advantage of any special off peak tariffs available. (Digital thermostat for heating only systems)

**What are the maintenance requirements?**

The heat pump should be serviced once a year by a qualified technician and the following items checked:

- The unit structure for signs of corrosion or damage.
- Panels are securely fastened and vibration free.
- All electrical connections are secure and that there is no damage to any of the wiring.
- All water connections are tight and the system water pressure is correct.
- Pipe insulation has not deteriorated or come loose.
- The air path to and from the unit is clear.
- Condensate drain pan and pipe are clear and clean. (if fitted)
- Switch on the unit and check;
- The controls are working correctly.
- The water pump is free and operating correctly.
- The unit fan is operating.
- The unit raises the water to the correct operating temperature.
How should the unit be sited to ensure adequate air flow and access?
Sufficient space is required for airflow into the machine and adequate clearance is needed at the front of the heat pump to prevent cold air re-circulation. Access is also needed for service and maintenance. If possible the unit should be sheltered from high winds to improve efficiency by reducing the fan power requirement. Units are best placed in a south facing aspect to gain maximum benefit from solar gains. Shown below are the minimum clearances (in mm) required for an Airsource Heat Pump.

What is the required footprint for each unit?
The overall footprint will be the size of the unit plus the free area around the unit for airflow and access.

What is the electric current rating for the units?
Each unit has a different mains power requirement as the compressor size differs from unit to unit and it is the compressor that draws most of the power. To minimise the peak starting current a soft start device is fitted to all single phase units. This device reduces the starting peak to a level acceptable to the electricity suppliers and also prevents possible interference with other electrical equipment. The table below gives the nominal running current for each unit.

What size of MCB should be fitted?
The AS-508 & AS-609 units require a 32A `D` Type motor rated MCB. The AS-512 & AS-613 units require a 40A `D` Type motor rated MCB.

What size of cable should be used to connect the unit to the mains supply?
This will need to be calculated to suit an individual installation, as a number of variables need to be considered. The size of unit, the length of the cable run and the type of cable being used are all factors in determining cable size. Electrical installation work must be carried out by suitably qualified personnel, who should be able to provide the cable sizing once the position of the unit has been determined.
**Is single phase or three phase best?**
As the majority of dwellings in the UK are connected to a single phase supply, this is the only option for most domestic applications. If three phase is available either in domestic or commercial applications then it is better when considering the load on the mains supply as it spreads the starting and running load evenly, however all single phase units are fitted with ‘soft start’ systems reducing start up load issues. The capacity and efficiency of 1 Phase and 3 Phase units is almost identical.

**What is the most efficient water temperature setting?**
As with any form of heating the efficiency of a heat pump is directly related to the amount of work it has to do. Heat pumps are used with various heating systems and can operate over a range of return water temperatures of 30 to 50°C. The lower the return water temperature the less work the heat pump has to do and therefore the more efficient it will be. This has to be balanced out against the type of heating system the heat pump is attached to and the length of time the unit has to run to satisfy demand.

**How long does it take for the radiators to get up to temperature?**
This will depend upon a number of factors. An Airsource heat pump will raise the water passing through it by between 5 or 6°C depending upon the water flow rate. As a rule of thumb the heat pump will raise the water temperature at a rate of 1°C per minute therefore the time taken to achieve the maximum operating temperature will be the difference between the standing temperature and the required operating temperature in minutes.

Example: Required operating temperature 50 °C; Standing temperature 45°C (Thermal store)
50 – 45 = 5 minutes
For best results always fit a thermal store. This will improve efficiency, allowing the heat pump to raise the water in the thermal store to the required operating temperature before water is distributed around the heating system.

**What is the maximum number of radiators per heat pump system?**
The number of radiators is less significant than the total capacity of all of the radiators added together. This should not exceed the expected heat pump output at the design condition; i.e. if the heat pump output is 6kW at the design outdoor condition then the radiator capacity should be 6kW based upon the water supply temperature of 50°C.

**What type of costs and saving can I expect?**
ASHP units make a saving compared to other boilers as heat pumps make more energy than they use. This is shown as a figure called CoP. This means that for 1kw of electric used the heat pump makes between 2.2kw (cold air) and 5kw (warm air) depending on the external air temperature. Basically this can be shown easily as follows.

<table>
<thead>
<tr>
<th>Heat source</th>
<th>Efficiency per £1 used or Relevant operating cost*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas boiler</td>
<td>98%</td>
</tr>
<tr>
<td>Oil Boiler</td>
<td>50%</td>
</tr>
<tr>
<td>LPG Boiler</td>
<td>60%</td>
</tr>
<tr>
<td>ASHP</td>
<td>220%-480%</td>
</tr>
</tbody>
</table>

Therefore where used in a comparison –V- Gas boilers, the savings are easy to see, and even greater when compared to replacement Oil and LPG fired boilers.

* Where used in same running situations as previous system.
Want additional information?
If you want to find out more about any of the topics in this booklet or your question has not been answered then please contact us.

KRA Technical LTD

Phone: +44 (0) 1273 455642
Fax: +44 (0) 1273 455642
Email: info@kra-technical.com

Or visit our web site at: www.kra-technical.com