Heat Pump Data
HEAT PUMP ASSOCIATION DATA SHEET
Helping you save energy
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www.heatpumps.org.uk
Data Sheet No. 3

AIR TO WATER HEAT PUMPS — COMMERCIAL

What is an air to water heat pump?

A device which extracts energy from the air and uses it to heat water.

How does it work?

An air to water heat pump absorbs low temperature energy from the surrounding air and raises it to a higher more useful temperature. Most air to water heat pumps are based on a vapour compression refrigeration cycle. A liquid refrigerant is forced to evaporate within a heat exchanger inducing the energy required for such evaporation to be taken from the air and transferring it to a refrigerant which is at a lower temperature and pressure. The warmed vapour is mechanically compressed to a higher pressure and corresponding higher saturation temperature. The refrigerant then condenses in a second heat exchanger and the latent heat of evaporation then has to be given up and is transferred to a water delivery system. The pressure of the refrigerant is then reduced by an expansion device, its temperature falls, and it is ready to start the cycle again and absorb energy from the air. The compressor is usually electrically driven.

Types of commercial air to water heat pump

The majority of commercial air to water heat pumps are reversible units that can provide cooling as well as heating. The unit usually has a single water circuit (flow & return) providing either hot water for heating or chilled water for cooling, but not both simultaneously, although there are relatively few dual water circuit heat recovery units. Some manufacturers also offer dedicated, heating only products. Most products are designed for outdoor installation. Typical heating capacities range from 20 kW to 200 kW but larger units are available as single units or modular packages. For smaller capacity units also see the HPA's data sheet 'Air to Water Heat Pumps — Domestic'.

Air to water heat pumps can be:

- Single packaged for outdoor installation (fully weatherproofed connected via site supplied insulated water distribution pipes to and from the building).
- Single packaged for indoor installation (requires an air intake and outlet if the source is outside air).
- Split (a matched pair of units with the heat pump evaporator mounted separately from the condenser — the two units are linked with refrigerant pipe-work).

See diagram overleaf of basic heat pump system configuration.

What you need to know to select a product

- The building heat loss or other load — it is important to size the heat pump accurately. Heat pumps can be sized to meet all or part of the heating load.
- Heat pump dimensions, weight and location requirements — The physical size will vary depending on the output and type but will be larger than a gas boiler of the same capacity.
- Heat pump efficiency — in heating usually given as the Coefficient of Performance (CoP)* at a specific operating condition (the Standard rating condition is an ambient air inlet dry bulb temperature of 7ºC, water outlet temperature of 35ºC for low temperature heating mode) and in cooling given as Energy Efficiency Ratio (EER)† (the Standard rating condition is an ambient air inlet dry bulb temperature of 35ºC, water outlet temperature of 18ºC). A Standard is under development for measuring seasonal performance.‡
- The operating range of the heat pump — usually the minimum and maximum air temperature (typically –15°C to 35°C). The minimum air temperature may be lower (–20°C) if it is fitted with a supplementary direct electric heater which boosts the output at low air temperatures or if the refrigerant is CO_2.
- The required water temperatures — typically the maximum water temperature is 55°C but can be up to 80°C (in the case of CO_2 cascade type systems). Reversible units can typically cool to 6°C.
- The type of heating (and cooling) distribution system, including buffer/storage tank arrangement (if required depending on the water quantity in the system and the manufacturer's recommendations).

Applications

Air to water heat pumps are suitable for both new build and retrofit.

Space heating

The lower the distribution temperature in the heating system the higher the efficiency of the heat pump will be. Heat pumps therefore operate at optimum efficiency when used in conjunction with low temperature heating systems such as:

- Underfloor heating (delivery temperature 30-45ºC).
- Fan coils (delivery temperature 35-55ºC) — the most frequently used system for commercial buildings.
- Low temperature radiators (delivery temperature 45-55ºC).
- To maintain the temperature of an internal water loop used with individual water to air heat pumps (WLHP) or in conjunction with a water cooled Variable Refrigerant Flow (VRV/VRF) system.

Space cooling

In most commercial applications cooling is required as well as heating and the main design criteria for building load may be based on cooling requirement. To achieve the best efficiency in cooling reversible heat pumps should be operated with the chilled water temperature as high as possible.

Reversible heat pumps can be used with fan coils to provide cooling. With under-floor heating usually only partial cooling can be provided (the minimum temperature is limited to about 18°C to limit the risk of condensation).
Note: Changeover delays from heating to cooling and vice versa will occur.

* The Coefficient of Performance is measured as the heating output (kW) divided by the total power consumed by the unit including fans, internal water circulation and controls (kW). The British/European Standard for testing and rating heat pump performance is BS EN 14511.

† The Energy Efficiency Ratio is measured as the cooling output (kW) divided by the total power consumed by the unit including the power necessary to overcome the resistance of the air and water heat exchangers (kW). The British/European Standard for testing and rating heat pump performance is BS EN 14511.

‡ prEN 14825.

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Systems using a water loop with individual water to air heat pumps or a water cooled VRF system can provide simultaneous heating and cooling and changeover delay is very small.

Domestic hot water

The WRAS recommended DHW temperature is 50°C but the temperature of stored water has to be raised (to >60°C) periodically to provide protection from legionella contamination. Heat pumps able to provide heating water in the range 60-80°C can provide full domestic water heating. Air to water heat pumps using CO_2 as the refrigerant are particularly suited to this. Heat pumps only capable of output temperatures lower than this can provide the majority of the water heating but supplementary heating, most usually an electric heating element in the storage cylinder, will be needed to provide periodic legionella protection.

Swimming pool heating

Hot water from the heat pump can be used to heat indoor or outdoor swimming pools (sometimes indirectly through an intermediate heat exchanger). Given the aggressive nature of chlorinated water particular care must be taken with the choice of materials for the intermediate heat exchanger. The heat pump may also provide other functions for example dehumidification or heat recovery.

Combining space cooling with heat recovery to produce hot water

There are many possible applications including for example:

- Beer/wine cellars.
- Commercial kitchens.
- Laundries.
- Spas and clubs.
- Waste heat recovery from boiler rooms, IT centres, etc.

Advantages

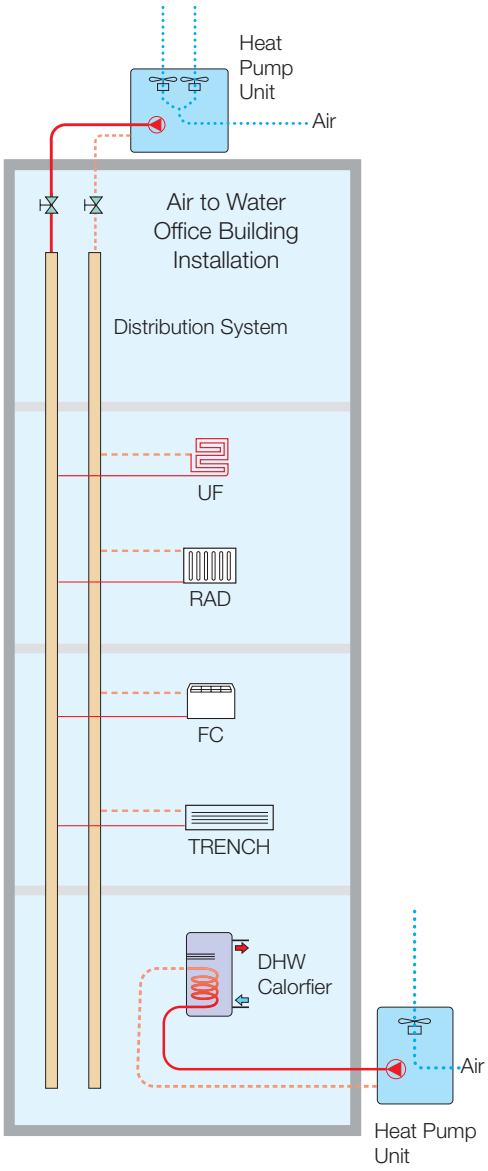
- Relatively low capital cost (higher than gas condensing boiler, lower than ground source heat pump). Where heating and cooling is required the capital cost may be lower than a separate boiler and chiller.
- Reduced plant-room space. A reversible air to water heat pump would usually have the same footprint as the equivalent cooling only chiller.
- Gas supplies to site and flues can often be eliminated.
- Low running costs.
- Low maintenance. The maintenance requirements are similar to those for a packaged chiller.
- Easy to install.
- High efficiency.
- Low energy consumption.
- Low heating related carbon emissions (generally lower than a gas condensing boiler).
- No local pollution.

Aspects to consider

- As the air temperature drops both the efficiency and the heating capacity of the heat pump will reduce and vice versa.
- At low air temperatures water from the air can condense to form ice on the outdoor heat exchanger which will need to be defrosted. This is usually done automatically by reversing the refrigerant flow. During this short process heat output from the heat pump can be interrupted. Provision must be made for removal of the condensate, Reverse cycle defrost generally allows operation down to –15°C and in some cases –20°C although most frosting occurs around freezing point.
- When supplementary heating is in use the heat pump efficiency will be decreased so the use of supplementary heating needs to be carefully controlled.
- Ensure that the heat pump is sized to achieve the majority of the required duty.
- Possible disturbance from noise especially from the outdoor fan at night.
- Possible fouling of the air intake.

Financial incentives

- VAT on heat pump installations is charged at 5% (residential installations only).
- Enhanced Capital Allowances can be claimed for products listed on the Energy Technology Product List i.e. 100% of the capital cost, including associated installation costs can be charged against corporation tax in the first year of purchase. The products listed meet minimum performance requirements.
- The Government is considering extension of support under the Renewable Heat Incentive scheme to cover air to water heat pumps which could be available from summer 2013.



Further information

The Heat Pump Association (HPA) (www.heatpumps.org.uk and www.feta.co.uk).

The Microgeneration Certification Scheme (www.microgenerationcertification.org) — The Scheme provides lists of certified products and installers.

The Enhanced Capital Allowances Scheme (www.eca.gov.uk).

Visit our Website
www.heatpumps.org.uk

a FETA Association

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