SUPERIOR UNDERFLOOR HEATING & COOLING SYSTEMS
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HEAT PUMPS

HEAT PUMPS-GUIDANCE ON USE WITH UNDERFLOOR HEATING.

Heat Pumps are now becoming widely used in preference to heating boilers, and work ideally with underfloor heating, however, they are not suitable for all applications and the following guidance is provided for application and installation.
Whilst we all want to save the planet, the decision to use heat pumps , with the greater expense of installation involved, should be carefully considered, bearing in mind the suitability of the building.
Heat pumps coupled with an underfloor heating system are an ideal choice as the underfloor system can utilised the low water temperatures produced by the heat pumps more efficiently that any other form of heat emitter

SUITABILITY

1. Lower energy use in buildings relies mainly on the building being constructed with high levels of insulation so that the heat requirements of the building are less. The introduction of new building regulations in the last few years has necessitated the construction of buildings to have much higher wall, floor and roof insulation in them and to be tested for air leakage.
These are the prime factors in reducing energy use, insulation and building air tightness...
2. So whether the heating is from a boiler or heat pump the energy usage will be much less in a well insulated, airtight building.
3. Heat pumps are efficient generally only when coupled with low energy buildings, so if the building has a high heat requirement it is more than likely that their use is not suitable. This is particularly important to remember when considering the use of a heat pump in older commercial or domestic buildings

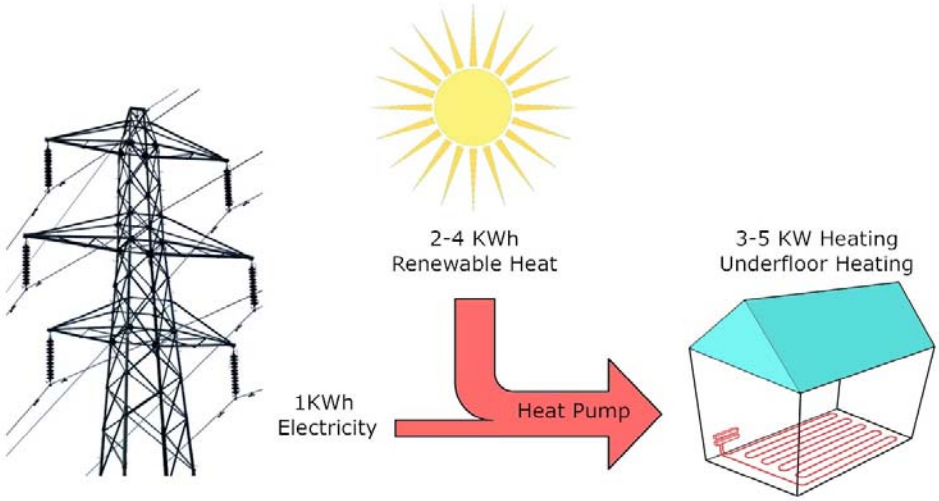
TYPES OF HEAT PUMP

There are three types.

Air to Water
Water to water
Ground source.

1. **Air to water.** This type of heat pump extracts the heat from the outside air and transfers the energy received to water which is then pumped around the building.
2. **Water to water.** This type of heat pump extracts energy from natural sources of water by using a heat exchanger. The natural water sources can be a lake, river or sea water etc..

3. **Ground source.** This type of heat pump extracts energy from the ground. This is achieved by installing, boreholes our loops of pipework (called slinkies) in the earth, though which water is circulated. This circulating water picks up the temperature of the earth and circulates it back to the heat pump which then transfers the energy received to water which is then pumped around the building.



COST

The type of heat pump selected will affect the installed cost. Air to air heat pumps are the cheapest to install as unlike ground source heat pumps they do not rely on any external piping in the ground or elsewhere to be installed and connected to it. The cost of which can be quite high. So it will pay in all circumstances to check cost against payback time for the different heat pumps and also to compare that with a gas boiler installation.

RUNNING COSTS

Whilst it may be thought that ground source heat pumps provide the lowest running costs, recent comparison tests have shown that the running costs of air to water heat pumps are in fact just as good. It can be argued therefore why use ground source heat pumps at all as the installation cost is so much greater. The only benefit being that ground source heat pumps can provide cheap cooling.

EFFICIENCY

Most heat pump quotations show running costs and energy saving likely to be achieved based upon a certain COP (Coefficient of performance) rating.
However it should be noted that the COP (efficiency) of the heat pump varies according to the flow temperature of the water from the unit.
As an example-

Flow Temperature oC	**COP**	
55	**3.3**	**worse**
45	**4.2**	
35	**5.4**	**best**

Figures provided by manufacturer

As can be seen, the lower the flow temperature the greater the efficiency. So to achieve optimum efficiency the water flow temperature has to be as low as possible whilst matching the building heat loss.
High heat loss buildings will require a higher flow temperature so the COP (efficiency) and hence running costs, will be higher. So a heat pump may not be the correct choice.

INSTALLATION – UNDERFLOOR DESIGN

1. **Open loops** on the underfloor system. When heat pumps are used it should be noted that whilst larger systems normally operate through a buffer tank, on small systems without a buffer tank there needs to be at least one area of heating (normally the coldest room) where the heat pump thermostat is located, not a normal thermostat. This thermostat controls the heat pumps operation and ensures that there is always an open loop of circulation until this thermostat is satisfied and can shut down the heat pump and circulation pump in the correct operational manner.
   This is particularly so on domestic systems and type of control should be confirmed by manufacturer.

2. **Underfloor circuit design**- whilst the installation is generally the same as an underfloor heating design there are a few particular requirements that need to be taken into consideration.

   a) The water for the underfloor system comes directly from the heat pump so the system design relies on central pumping from the heat pump at the required flow temperature. Systems where the use of underfloor manifolds with pump mixers are used are not suitable.

   b) Pipe size (dia), length of circuit and spacing of pipe will affect the output of underfloor heating at a given flow temperature. When designing the underfloor circuits individual room heat loses (in watts per sq mtr of floor area)
   need to be taken into account so that the spacing is correct. Closer pipework spacings provide a greater output per sq mtr at the same flow temperature.
   The lower the flow temperature the greater the heat pump efficiency so the closer the spacings the better- within reason.
   Different rooms will have different heating (watts per mtr²) requirements, so different rooms may require different spacings.
   An example of different floor outputs at different spacings is as below based upon the resistance of a tiled floor on screed.

Mean flow temp Flow 40°C Return 30°C	Room temp	Output watts/mtr² @200 mm spacing	Output watts/ mtr² @250mm spacing	Output watts/ mtr² @300mm spacing
35°C	20°C	68°C	60°C	52°C

   c) Water flow rates through heat pump-The underfloor design flow rates and pressure drops must be calculated early on during the underfloor design and provided to the heat pump manufacturer who is to check against the design flow rates of the heat pump. If the flow rates and pressure drops are within the capability of the heat pump this is fine.
   However, if the underfloor design flow rates and pressure drops are greater than the flow rate capability of the heat pump then additional pumps, pipework and controls/ wiring will be required. The heat pump manufacturer should advise what is required.
   Experience has also shown that heat pump manufacturers units have different connection requirements so it is most important that the connection and control detail required by the manufacturer is checked and co-ordinated with the underfloor heating requirements.
   There is a greater risk of the under floor heating or heat pump not working correctly if this information is not checked and confirmed at the design stage.
   It should be noted that generally with smaller and domestic heat pumps the circulation pump is provided within the heat pump unit. Whilst with commercial heat pump units this may not be the case.

4. Floor coverings. The resistance of the floor covering material will reduce the output of any underfloor system, so the less the resistance the greater the output of the system when running the underfloor pipework at the same temperature. So for the best efficiency floor coverings should be kept to the minimum resistance. Carpets/underlays and timber coverings all have high resistance, when selecting this care should be paid to choosing products with low resistance so that flow temperatures and hence running cost are reduced. Some floor coverings have excessive resistance.

An example of how the floor coverings affects the floor output.
Underfloor pipework at 200 and 300 centres.

Floor Covering	Floor covering Resistance *W/ m²k*	Mean Water Temperature	OUTPUT @200 mm pipe spacing *Watts m²*	OUTPUT @ 300 mm pipe spacing *Watts m²*
Tile	**0.00**	**35° C**	**68**	**52**
Carpet (light duty)	**0.10**	**35° C**	**44**	**36**
Floorboards	**0.15**	**35° C**	**38**	**32**

UNDERFLOOR COOLING

Heat pumps can also be used for underfloor cooling in the summer when they run in the reverse pattern to heating. This can provide a very effective-efficient form of comfort cooling especially if ground source or air to water heat pumps are being used.
If underfloor cooling is being utilised the room thermostats need to be a suitable heating/cooling thermostat with control wiring to suit this option.
The flow /return temperatures for underfloor cooling are generally 19-14° C.