Savings and flexibility worth celebrating!
The Atec air source heat pump from Thermia

Air source heat pumps are growing in popularity, thanks to the use of the latest innovations and technology, which means they are more efficient than ever before. When they were first introduced in Europe, some 10 years ago, their Coefficient of Performance (COP) was much less than manufacturers and homeowners would have liked when compared with their ground source equivalent.
There was also the problem of air-source heat pumps generating noise outside buildings, which could cause problems in residential areas. A further challenge was the perception of potential customers who found it hard to believe that heat could be extracted from the air during freezing winter weather.

**Addressing the challenge**

In April this year, Thermia Heat Pumps introduced the new Atec air-source heat pump onto the market. During the design and development stages, the objectives were as follows:

1. Achieve high annual efficiency, measured by seasonal performance factor (SPF);
2. Reduce emitted sound to a minimum;

**Core Technology**

The key factors influencing heat pump performance are use of the proper refrigerant, combined with a well-engineered and optimised refrigerant circuit, which means that the maximum amount of heat can be extracted from the air. This is why R407C was chosen as the refrigerant for the new pump, as it has the best trade-off between evaporation and condensation temperature, coupled with a low operating pressure. The heart of the pump cooling system is the dedicated scroll compressor. The compressor is optimised for dedicated heat pump applications. Its benefits are:

- high capacity at low evaporating (heat source) temperatures, when compared to piston-type compressors; this can result in lesser supplementary heating,
- has a special scroll design, which attains high efficiency in heat pump operating conditions, especially when the heat source temperature is low. The compressor’s efficiency tends to increase over time, whereas most reciprocating compressors tend to lose some efficiency,
- the scroll is durable and reliable. Fewer moving parts, rugged running gear and low vibration due to balanced compression mechanism make the scroll the most reliable solution available on the market,
- the compressor also has a larger operating envelope than the air conditioning scroll, which allows it to match exactly the dedicated heat pump operating conditions.

There is an electronic expansion valve applied in the refrigerant circuit which adjusts performance characteristics to the variable air temperature. Air temperature varies throughout the day, especially during the winter months, when conditions are immediately followed by a change in the amount of heat which needs to be supplied to the building.
The electronic expansion valve delivers precise doses of refrigerant to the evaporator, and thus optimises the compressor performance to changing outdoor air temperatures, this air being the primary energy source for the heat pump. The changing temperature of the air being drawn across the evaporator has an effect on refrigerant evaporation pressure and consequently the possibility of appearing after evaporator vapours and liquid refrigerant mixture. The electronic expansion valve allows superheating of vapours at the right level in all conditions, and ensures a more effective use of the heat source, thus lowering the system thermal inertia and enabling higher control precision of the whole system.

An important part of ensuring the efficiency of the Atec heat pump refrigeration system is that it is filled with refrigerant and hermetically sealed in the factory. Each heat pump is tested at the end of its production cycle and marked with an individual serial number. A further innovation which increases the efficiency of the system is the application of OPTI technology, which involves running an electronically-controlled circulating pump (class A) on the heat distribution side.

**Acoustic performance**

Noise from air source heat pumps has been a recurring problem in many European countries, and one that has been addressed with the Atec. The Atec is designed to minimise:

- compressor vibration and noise levels,
- the noise level of the variable speed EC fan which forces air flow through the evaporator,
- noise levels across all operational modes.

In heat pumps with a lower noise output, this is produced by the operating compressor as well as the EC fan (air flowing through fan blades and heat exchanger-evaporator ducts). However in the 16kW and 18kW units, the dominating noise source is the fan.

With the Atec heat pump, an electronically operated motor is used to run the fan, and the fan blades also feature an innovative design to keep noise levels to a minimum. The pump's electronic motor has a reversed electromagnetic circuit, so that permanent magnets are part of the rotor and stator windings surround it. This ensures better rotor balance and increases the life of its bearings. This design also ensures that the motor has a higher rotational speed, and makes it possible for the unit to be reduced in size. The EC motor does not generate significant EMC emissions and is not the main source of noise caused by acoustic vibrations, since there is a special winding element placed inside which eliminates cyclic variations of motor torque resulting from the pulsatory changes of the magnetic field rotor.

While installed in the Atec heat pump, the EC motor provides fluent control of the fan's rotational speed, a low noise level and high efficiency at relatively low power consumption levels. Another innovation in the applied fan is the HyBlade technology which has been implemented.

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**Figure 3,4,5: Components of indoor units: Standard, Plus, Total: 1) control module, 2) auxiliary heater, 3) reversing valve., 4) circulation pump, 5) water heater**
adapted from aircraft engine design. The fan blades are made of plastic, with an aerodynamic shape and moulded edges which form ‘winglets’ on the blade tips. These ‘winglets’ minimise turbulence between the blade and the housing, making the fan quieter and more efficient. The blades are also resistant to corrosion, salt, humidity and chemicals, which is especially important if the heat pump is to be installed near the sea.

Because the speed of the circulating pump is automatically adjusted according to the varying heat demand within the building, the condenser performance is optimised, which increases the system’s efficiency.

‘Plug & Play’ - simple installation

The Atec has been designed to make both its hydronic and electrical connections as simple as possible to install. The pump consists of two components: a heat pump installed outdoors, and an indoor module including a control panel.

The Atec heat pump takes heat from the air which is forced through one of the heat exchangers so as to maintain adequate air flow. When deciding on the location of the heat pump, it is important to ensure adequate space around the unit. If the pump unit is too close to the building the air may recirculate between intake and outlet, reducing the efficiency of the pump. Installers should also allow enough space to provide access to the unit for future servicing and maintenance.

The Atec heat pump must be fixed on a firm foundation, for example a concrete base. Each of the four pump fastening points should be stably anchored in the foundation, and the load capacity of the foundation should be adjusted to the heat pump unit’s overall weight. The outdoor unit is connected to the heating installation in the building by supply and return copper pipes, which should be 28mm in diameter. Heat hoses should be used to connect the Atec to the heating circuit in order to eliminate vibration transmission. An internal electric cabinet with output terminal strip is located on the outdoor unit (on the top left hand side) to allow for installation. The power should be connected to the heat pump unit and to the control panel located in the building.

<table>
<thead>
<tr>
<th>Indoor kit</th>
<th>Components</th>
<th>Investment type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Heat pump, controller</td>
<td>Modernization</td>
</tr>
<tr>
<td>Plus</td>
<td>Heat pump, controller, circulation pump (class A), auxiliary heater (400V - 3/6/9/12/15 kW; 230V - 3/6/9 kW), three way valve</td>
<td>Modernization</td>
</tr>
<tr>
<td>Total</td>
<td>Heat pump, controller, hot water tank (180 l), circulation pump (class A), auxiliary heater (400V - 3/6/9/12/15 kW; 230V -3/6/9 kW), three way valve</td>
<td>Modernization or New investment</td>
</tr>
<tr>
<td>Total (+60)</td>
<td>Heat pump, controller, hot water tank (180 l), circulation pump (class A), auxiliary heater (400V - 3/6/9/12/15 kW; 230V -3/6/9 kW), three way valve, 60 liters volume tank kit</td>
<td>Modernization or New investment</td>
</tr>
</tbody>
</table>

Figure 6: Indoor kits: Standard, Plus, Total
The control panel and heat pump must be connected by means of a three-core electric cable. Air source heat pumps will create condensed water, the amount of which will vary depending on outdoor air temperature and humidity. Condensed water from the evaporator drops into a tray which is supplied with the pump, and from there it flows through the tray outlet and flexible hose, which should be connected to the tray outlet, either into well-drained ground or the sewage system. A special 1mm diameter heating cable is built into the tray bottom to prevent freezing, and the outlet pipe should also be provided with a self-regulating heating cable and connected to the electric cabinet within the heat pump unit. Defrosting is automatically controlled by a temperature sensor, and lasts as long as it is required to defrost the evaporator. In case of system failure, adequate frost protection for the circulating fluids must be provided. The application of innovative technology makes the Atec heat pump one of the most efficient and quietest in terms of running noise on the market. The use of prefabricated kits rather than the separate components common in other air source pumps can save installers up to six hours on site.

Options available
The Atec air-source heat pump can supply space heating and hot water, and can also be used to cool buildings as an all-in-one application for every season. It is available in three sizes: Standard, Plus and Total. The Total (+60) is special version of Total indoor kit which is equipped in tank that gives an extra working volume on 60 liter. The volume tank will fit into the lower part on the Atec Total indoor unit. This volume tank for Atec Total is available as an accessory for retrofit but it also possible to order Atec Total with the volume kit built-in from factory. This solution has been developed to secure that the heat pump work with the amount of water it requires to operate safely. The Volume tank will be a good complement for one pipe system. For example a floor heating system with high pressure drops. Volume tank will also help to eliminate knockings in the heating system. With the addition of non-return valve (in installation kit) and an extra circulation pump, this will work as a 4-connection buffer tank.

These three different pump sets and new controller functions ensure that the Atec heat pump can be
used in over 50 different heating applications. When the heating system is modernised, the pump can operate with a gas boiler, oil boiler, solar system and private water source. Individual sets have been carefully selected and prepared so as to reduce the installation requirements to a minimum.

Air-source heat pumps are available with the following power outputs: 6 kW, 9 kW, 11 kW, 13 kW, 16 kW, 18 kW. It is possible to connect two pumps to one control module, which enables pumps to be installed in buildings where total heat demand may rise up to 36 kW, such as schools or hotels. The pump operates efficiently even when outdoor air temperatures drop as low as -20°C, enabling customers to benefit from low energy costs even in the harshest winter conditions. The low noise levels mean less disturbance, which can also help with securing planning permission. In addition, the TWS (tap water stratification) system offered in the Total set enables quick and effective supply of hot water.

The pump demonstrates the best in Scandinavian design. As air-source heat pumps are normally installed near to the house or commercial property, Thermia’s designers were keen to enhance the aesthetics of the heat pump. The result is an air source heat pump with a sleek modern appearance to suit the needs of today’s customers.

Thermia - driven by innovation
Thermia’s history starts with its founder, Per Andersson, born 1861. Just ten years old he started his career as an apprentice black smith, and he later began his own production of kitchen stoves. The driving force behind his business was his desire to always develop better and better products. The stoves had to be more efficient, easier to use and more fuel efficient. When one model was ready, work began immediately to develop one that was even better. In time the range expanded to include wood-burning boilers, coke-fired boilers, hot water tanks, radiators and numerous other products used for heating.

Always with the same basic philosophy: to have the market’s best products. Or in the words of Per Andersson himself: “The products one releases must be not only the best of their time, but before their time, over time.” To this day, long after Per Andersson’s passing in 1942, this philosophy is alive and well at Thermia. And even if Thermia’s focus since 1973 has been on heat pump production, the same drive and passion still inspire the company to advance – to constantly develop, with the aim of continuous improvements.
**Technical article Atec air source heat pump**

Today Thermia’s facility in Sweden includes factory, warehouse and the company’s 3,000 square metres global R&D centre for heat pumps. Here, engineers and technicians work to meet future global demands for high-tech, energy-efficient heating solutions. The centre has a state-of-the-art climate chambers where conditions varying all the way from tropical to arctic can be simulated. This enables the heat pumps to be tested in all types of climates, which is necessary when the aim is to develop heat pumps of the future, for use worldwide. As a result we’re now one of Europe’s leading heat pump producers.

In 1973 Thermia manufactured the very first heat pump with an integrated hot water tank. Over the years Thermia has continued to develop new solutions in its quest to create better and more efficient heat pumps, providing a more comfortable life in thousands and thousands of households around Europe.