1. **Air to Water Heat Pumps**

<table>
<thead>
<tr>
<th>Date published</th>
<th>2019</th>
</tr>
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<tbody>
<tr>
<td>Date previously reviewed</td>
<td>2016</td>
</tr>
<tr>
<td>Date first launched</td>
<td>2009</td>
</tr>
<tr>
<td>Former name</td>
<td>Air Source: Air to Water Heat Pumps</td>
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</tbody>
</table>

1.1 **Scope**

Air to water heat pumps are products that are specifically designed to transfer heat from ambient air outside a building to a water-based heating system, by means of a refrigeration cycle.

This specification covers reversible and irreversible models below 45kW and irreversible heat pumps above 45kW. Reversible products above 45kW may be considered within the Packaged Chillers sub-technology.

1.2 **Definitions**

An air to water heat pump uses an electrically driven refrigeration system to transfer heat from outside air into a water-based heating system. It is primarily used to provide space heating in a wide range of buildings. Additional functionality which may be available includes:

- Provision of heat to domestic hot water
- Space cooling using a water loop by reversing the product’s refrigeration cycle.

Air to water heat pumps are available with a wide range of efficiencies and the ECA Scheme aims to encourage the purchase of higher efficiency products.

The ECA Scheme distinguishes between three categories of Air to Water Heat Pumps:

1. Low-temperature heat pumps - specifically designed for low-temperature applications, that cannot deliver heating water with an outlet temperature of 52 °C at an inlet dry (wet) bulb temperature of -7°C (-8°C) in the reference conditions for average climate, with rated output not greater than 45kW.

2. Medium and high temperature heat pumps – that are capable of delivering water with an outlet temperature of 52°C or greater at an inlet dry (wet) bulb temperature of – 7°C (– 8°C) in the reference conditions for average climate, with rated output not greater than 45kW.

3. Large irreversible heat pumps with rated output greater than 45kW.

1.3 **Requirements**

1.3.1 **Eligibility requirements**

Investments in air to water heat pumps can only qualify for Enhanced Capital Allowances if the specific product is named on the Energy Technology Product List. To be eligible for inclusion on the Energy Technology Product List, products shall meet the eligibility criteria as set out below.

To be eligible, products shall:

- Incorporate an electrically driven refrigeration system.
■ Be designed for, and include fittings for, permanent installation.
■ Be CE marked
■ Be designed primarily to provide space heating and:
  - space heating only, i.e. “space heater” as defined by Commission Regulation (EU) No 813/2013, or
  - providing heat to deliver domestic hot water, i.e. “combination heater” as defined by Commission Regulation (EU) No 813/2013.

In addition, single split products shall consist of an ‘outdoor’ unit and an ‘indoor’ unit that are:
■ Factory–built sub-assemblies.
■ Supplied as a matched set of units.
■ Designed to be connected together during installation.

1.3.2 Performance requirements
Eligible products shall meet the performance criteria set out in Table 1.1 below for:
■ Seasonal Space Heating Energy Efficiency ($\eta_{s,h}$), as defined by Commission Regulation (EU) No 813/2013.
■ Seasonal Energy Efficiency Ratio (SEER) for average climate conditions, where the product is designed to provide cooling.

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Heating mode ($\eta_{s,h}$)</th>
<th>Cooling mode (SEER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low temperature heat pumps</td>
<td>$\geq 155%$</td>
<td>$\geq 4.50$</td>
</tr>
<tr>
<td>2. Medium and high temperature heat pumps</td>
<td>$\geq 130%$</td>
<td>$\geq 4.50$</td>
</tr>
<tr>
<td>3. Large irreversible heat pumps</td>
<td>$\geq 125%$</td>
<td>n/a</td>
</tr>
</tbody>
</table>

“$\geq$” means “greater than or equal to”

1.4 Measurement and Calculations

1.4.1 Energy efficiency metrics
Seasonal Space Heating Energy Efficiency ($\eta_{s,h}$) – ratio between the space heating demand for reference heating season, supplied by a space heater and the annual primary energy consumption required to meet this demand (BS EN 14825:2016).

Seasonal Coefficient Of Performance (SCOP) – overall coefficient of performance of a heat pump using electricity, representative of the heating season, calculated as the reference annual heating demand divided by annual energy consumption for heating (BS EN 14825:2016).

Seasonal Energy Efficiency Ratio (SEER) – ratio of the total cooling capacity to the effective power input of the unit (BS EN 14825:2016)

Primary energy consumption for electricity usage is obtained using **Conversion Coefficient (CC)**, known also as Primary Energy Factor, equal to 2.5, as defined by Ecodesign Commission Regulation (EU) 813/2013.

**Reference heating season**, also called **climate** – a set of operating conditions describing per bin the combination of outdoor temperatures and the number of hours these temperatures occur for heating for which the unit is declared fit for purpose.
There are three reference heating seasons: “A” average, “C” colder and “W” warmer. UK is located in two reference zones: A and W, but for the ETL purposes A for average is to be used.

Correction factor (F1) is a correction that accounts for a negative contribution to the seasonal space heating energy efficiency of heaters due to adjusted contributions of temperature controls, equal to 3% (BS EN 14825:2016).

Equation for calculating $\eta_{sh}$ corresponding to section 7.1 of BS EN 14825:2016:

$$\eta_{sh} = \frac{SCOP}{CC} - F1$$

1.4.2 Test Requirements

No additional testing requirements beyond the measurement standard below.

1.4.3 Measurement standards

Performance data shall be determined and the $\eta_{sh}$ calculated, following the requirements of Commission Regulation (EU) No 813/2013.

The product’s capacity and SEER (where the product is designed to provide cooling), must be determined at the conditions shown in Table 1.2 and in accordance with the procedures detailed in BS EN 14825:2016 “Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling - Testing and rating at part load conditions and calculation of seasonal performance.”

Table 1.2 Part load conditions for air to water heat pumps

<table>
<thead>
<tr>
<th>Product category</th>
<th>Heating mode</th>
<th>Cooling mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low temperature heat pumps</td>
<td>Commission Regulation (EU) No 813/2013, Annex III, Tables 4 and 5 and Table 3 for outdoor air and low-temperature heat pumps</td>
<td>BS EN 14825:2016 Table 4, Part load condition A, cooling floor application</td>
</tr>
<tr>
<td>2. Medium and high temperature heat pumps</td>
<td>Commission Regulation (EU) No 813/2013, Annex III, Tables 4 and 5 and Table 3 for outdoor air and heat pump space heaters other than low-temperature heat pumps</td>
<td>BS EN 14825:2016 Table 4, Part load condition A, cooling floor application</td>
</tr>
<tr>
<td>3. Large irreversible heat pumps</td>
<td>Commission Regulation (EU) No 813/2013, Annex III, Tables 4 and 5 and Table 3 for outdoor air and heat pump space heaters other than low-temperature heat pumps</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The $\eta_{sh}$ shall be calculated in accordance with the requirements of Commission regulation (EU) No 813/2013 Annex III, by dividing the SCOP by the factor 2.5 (to allow for generation efficiency), corrected by contributions accounting for temperature controls.

Where results are determined by calculation then this should be on the basis of design and/or extrapolation. In this case, details of such calculations and/or extrapolations, and of tests to verify the accuracy of the calculations undertaken (including details of the mathematical model for calculating performance of such
combinations, and of measurements taken to verify this model) shall be made available.

1.4.4 Rounding

For the avoidance of doubt test data should be presented to three significant figures. As an example, a low temperature heat pump with a cooling mode SEER of 4.444 or a heating mode $\eta_{s,h}$ of 154.4% would be deemed to be a fail.

1.5 Verification for ETL Listing

There are five main ways that applicants can demonstrate their product’s performance:

- In-house testing – Self-certified
- In-house testing – Self-tested and verified or cross-checked by an independent body
- Witnessed testing
- Independent testing
- Representative testing (see clause 1.5.1)

Further information regarding the first four routes can be found within Guidance Note 5 on the ETL product testing framework.\(^1\)

1.5.1 Representative Testing

Where applications are being made for a range of products that are variants of the same basic design, test data may be submitted for a representative model, provided that all variants, i.e. models, share following characteristic features:

- Use the same refrigerant
- Have the same compressor type (i.e. manufacturer, line of models), which should imply:
  - same method of compression (e.g. reciprocating or scroll) and
  - same type of enclosure (e.g. hermetic or semi-hermetic)
- Use the same defrosting method (e.g. hot gas defrost)
- Fit within the same product category (i.e. are all low-temperature air to water heat pumps, or are all non-low-temperature air to water heat pumps.

The representative models may be selected by dividing the range of products into groups of models with similar design characteristics. The performance of each model shall be predicted using a validated mathematical model. At least one model in each group shall be tested for validation purposes. A report documenting performed model calculations, showing all significant calculation steps, shall be submitted with the application.

\(^1\) [https://www.gov.uk/government/publications/energy-technology-list-etl-product-testing-framework](https://www.gov.uk/government/publications/energy-technology-list-etl-product-testing-framework)
It should be noted that:

- If a manufacturer voluntarily removes the representative model from the Energy Technology Product List (ETPL) then other products linked with that representative model may or may not be permitted to remain on the ETPL.
- If any product submitted under these representative model rules is later found not to meet the performance criteria when independently tested, then all products based on the same representative model will be removed from the ETPL.

1.6 Conformity testing

Products listed on the ETL may be subject to the scheme’s conformity testing programme in order to ensure listed models continue to meet the ETL requirements.

1.7 Scope of Claim

Expenditure on the provision of plant and machinery can include not only the actual costs of buying the equipment, but other direct costs such as the transport of the equipment to site, and some of the direct costs of installation. Clarity on the eligibility of direct costs is available from HMRC.

1.8 Review

1.8.1 Indicative review date

The next technical review is scheduled for 2022-23.

1.8.2 Illustrative future direction of the requirements

Future changes to the Specification may include:

- Increasing performance thresholds for $\eta_{s,h}$ and/or SEER,
- Introduction of refrigerant’s GWP requirements.