WHITE PAPER

INSTALLING EFFICIENT HEAT PUMPS

A challenge of environmental transition

MCS CERTIFIED

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SUMMARY

01.

WHY A WHITE PAPER ON HEAT PUMPS?

#1

The heat pump: A renewable energy for heating

The heat pump is a thermodynamic heating system using renewable energy. This method of heating has many advantages in terms of energy performance. Firstly, on average the heat pump produces three times more energy than it consumes. Secondly, the higher the COP (Coefficient of Performance) of the appliance, the lower the amount of energy required to operate it.

The challenge of the environmental transition is to produce and install more energy-efficient heat pumps.

It is therefore recommended to install certified heat pumps that guarantee an optimum energy efficiency.

Eurovent Certita Certification, one of the world's leaders in heating, ventilating and air conditioning (HVAC) product performance certification, explains why in this white paper. But that's not all. Indeed, the conditions under which a heat pump is installed, also count for the energy performance. Consequentially, a part of this white paper is devoted to installation advice.

As you know, there are two main types of electric heat pumps:
1. The aerothermal heat pump which draws its energy from the air,
2. The geothermal heat pump, which draws its energy from water or the ground.

The following heat pumps are excluded from this white paper:
- Absorption gas heat pumps,
- ICE (Internal Combustion Engine) gas-fired heat pumps,
- ECE (External Combustion Engine) gas heat pumps.

In renovation strategies, all heating and cooling solutions should be analysed and considered. Therefore, this white paper addresses the two main types of electric heat pump. Eurovent Certita Certification has particularly focused in on geothermal energy, which is currently less developed, despite the fact that it achieves very high efficiency.

#2

OBJECTIVE:

Achieve carbon neutrality in

2050

Why does the UK government subsidise the installation of heat pumps to replace existing heating systems?

According to the Department for Energy Security & Net Zero, heating is the main source of household energy consumption, and therefore the main source of greenhouse gas emissions in the home. In 2021 the UK emitted 426.5 million tonnes of carbon dioxide equivalent (MtCO2e), with heating homes and businesses responsible for a third of all UK carbon emissions.

To achieve the objective of carbon neutrality by 2050, the UK must rapidly increase the installation of heat pump technology. Indeed, over 30 million homes and businesses have to decarbonise their heating and hot water systems. According to government figures an estimated 55,000 hydronic heat pumps - those that connect to a water-based central heating system - were sold in the UK in 2021. The UK government aims to grow the heat pump market to 600,000 installations per year by 2028.

Manufacturers, certifiers, installers, users, we are all involved in achieving this ambitious objective for the planet!

02.

HEAT PUMPS: A GROWING MARKET

The heat pump market has been rapidly growing in the UK, with an average year-on-year growth rate of 25 per cent between 2016-2021.

#1

Several factors are driving the heat pump market

State incentives for homeowners

The Boiler Upgrade Scheme In England and Wales offers homeowners between £5,000-£6,000 off the cost and installation of heat pumps and biomass boilers, plus a zero rate on VAT. In Scotland the Home Energy Scotland Grant and Loan offers homeowners grants and interest free loans towards improving energy efficiency, and installing heat pumps and renewables.

State incentives for manufacturers

The Government's Heat Pump Investment Roadmap for Great Britain and Northern Ireland is providing a number of measures to help drive the manufacture of heat pumps within the UK. The aim is for a minimum of half the 660,000 required heat pumps in 2028 to be UK manufactured. Measures include targeted regulation, clean heat public funding, tax relief, export finance, and a new Heat Pump Investment Accelerator Competition to strengthen local supply chains and create thousands of new low carbon jobs.

The war in Ukraine

Another cyclical factor is the war in Ukraine. The reduction in gas supplies are certainly also having an impact on behaviour.

In conclusion, the heat pump market will continue to grow exponentially. By the end of this decade it is expected the UK will be one of the largest heat pump markets in Europe, growing to an estimated 1.9 million installations a year by 2035.

#2

Growth will continue despite many obstacles

Heat pump sales may well be held back by several issues currently facing the market.

A shortage of labour

Heat pump installation companies are suffering from a chronic labour shortage, at all levels of qualification: technician, engineer, skilled worker or installer. Industry bodies such as the Heat Pump Association predict that around 100,000 heating installers will need some form of retraining to reach demand.

A shortage of electronic components

Manufacturers, for their part, are facing a shortage of electronic components (or semi-conductors), which is affecting the whole world. As 70% of production is located in Taiwan, Asian manufacturers are the first to be served.

Slowness of transport by sea and road

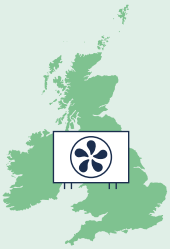
In addition to the shortage of electronic components, there are problems in maritime and road transport. The Covid crisis, followed by the very strong recovery, has completely destabilised the sea freight market. This has resulted in longer delivery times between China, UK and Europe and soaring logistics costs.

All these factors combine to lengthen installation times. A return to normal is only envisaged from 2024 onwards.

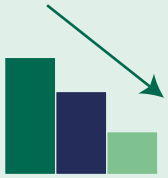
Key figures

2,2 millions heat pumps
sold in 21 European countries in 2021
(Source EHPA)

55 000 hydronic heat pumps
sold in the UK in 2021
(Source : UK Government)



Aim of 600 000 heat pump
installations a year by 2028
(Source : UK Government)



Ambition to reduce installation costs by 25-50%
by 2025 and towards parity with boilers by 2030
(Source : UK Government)

03.

12 INSTALLATION TIPS FOR BETTER PERFORMANCE

The energy performance of a heat pump depends on the choice of appliance, and on how it is installed. We interviewed experienced heat pump installer Luis Martins. He gives us his 12 installation tips.

1. Carry out a thermal assessment before installation

A thermal assessment is essential to evaluate the energy loss and calorific needs of the client's home. In addition, it is necessary to ask whether the heat pump will be the best solution for reducing energy bills, taking into account all the existing elements (boiler, hydraulic circuits, etc.).

If heat loss is poor, i.e. if the building is poorly insulated, there is no point in installing a heat pump. Insulation work is a prerequisite. This then allows the installation of a less powerful, less energy consuming and therefore less expensive heat pump.

2. Choosing the right type of heat pump

The installer must ask themselves what type of heat pump should be installed: aerothermal or geothermal? This depends on the location of the land, the presence of water in the ground, the climate, the size of the land, the type of housing (individual, collective) and the space allocated to the installation area, etc. Remember, to access Government grants and incentives MCS certified heat pump products must be installed by an MCS certified installer.

3. Properly dimensioning the heat pump

The thermal assessment allows you to calculate the power of the heat pump required for the house. Professional software can be used to calculate the necessary sizing of the heat pump. The calculation is based on a number of factors including the surface area of the house, the ceiling height, heat loss, climate zone etc.

Luis Martin,
heat pump installer

«There is no point in installing a heat pump to pay less for energy, if the heat loss from the house is unacceptable!»

4. Check the available electrical power

Once the kW requirement of the heat pump has been calculated, it is essential to check that the electrical system can support the required power. Older properties may need their main electrical fuse upgraded by the energy network operator. Otherwise, there is a risk that the fuse board (consumer unit) trips regularly and that this may damage the heat pump.

5. Check the equipment delivered with the order

It is a good idea to first ensure that the equipment received corresponds to that specified by the installer.

6. Check the premises before installation

Before installing the heat pump, the engineer should come and examine the premises to check the surface area, the installation space, and determine the location of the of the various components: the outdoor unit, cables, indoor units, etc. All the constraints of the building must be studied beforehand to choose the right equipment.

7. Ensure that the equipment is accessible

You also need to think about the future maintenance of the equipment. To do this, the equipment should be easily accessible.

8. Check and uninstall the old heating system

The decommissioning of the old heating system should be carried out by an appropriately qualified and registered professional. When the installer dismantles the old gas boiler, they must check that there is no gas left in the system. Oil-fired boilers must be drained, cleaned, degassed and neutralised.

9. Check one week after operation

The installer must return one week later to remove air from the heating circuit (purge the heating circuit) and check that everything is working properly.

10. View info on refrigerants

It is mandatory to mention the nature and quantity of refrigerant contained in the appliance. This information must be found on the nameplate of the heat pump. Most residential heat pumps are charged at the factory. If the charging is carried out by the installer, it is the installer who must check the overall tightness of the installation before it is charged, in accordance with the manufacturer's instructions in the manual supplied with the appliance.

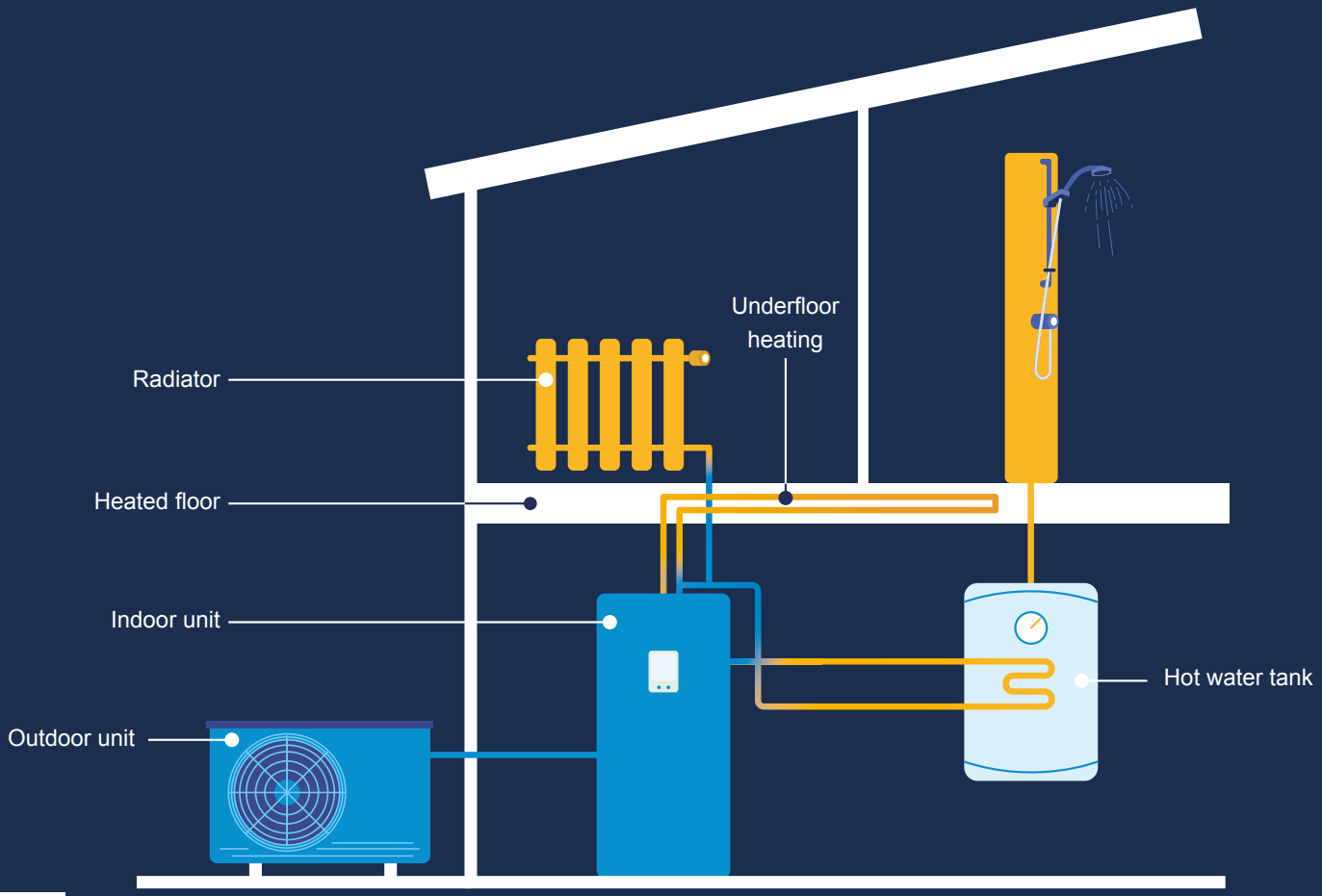
11. Training heat pump users

The installer must educate the occupants of the dwelling in the correct use of the heat pump, and provide them with the operating instructions. Incorrect use can lead to excessive electricity consumption. For further information, end users should refer to the manufacturers operating instructions.

12. Commissioning and maintenance

Check the manufacturers instructions and warranty for commissioning and maintenance requirements. Some heat pumps will require yearly servicing. Those undertaking heat pump servicing including a refrigerant check will need an FGas certificate. Those with a Category 1 certificate can carry out all activities. Those with a Category 2 certificate can install, maintain, service and recover refrigerant from systems containing less than 3kg of F gas, or less than 6kg of F gas if hermetically sealed. Category 3 certificate holders can recover refrigerant from systems that contain less than 3kg of F gas, or less than 6kg of F gas if hermetically sealed. Category 4 certificate holders can check equipment for leaks if they do not break into the refrigeration circuit.

Diagram: The components of an air to water heat pump



04.

GEOTHERMAL HEAT PUMP POTENTIAL IN THE UK

Geothermal heat pumps represent a very important potential market in the UK, which is currently underestimated by manufacturers and installers.

#1

Where

to install a geothermal heat pump in the UK?

The potential of geothermal energy in the UK is significant because the terrain is favourable in many regions, and many towns and cities are crossed by large rivers. Geothermal heat pumps include ground source heat pumps and water source heat pumps. Geothermal energy can be recommended for a number of applications, whether it be heating, domestic hot water or cooling.

For individual homes, with suitable access to land, the application of geothermal energy is clear. In residential city buildings, a massive replacement of boilers will have to be carried out over the next 10-15 years. In cities with a high water table such as London, Cardiff, Birmingham, Manchester and Nottingham, geothermal energy from both water and the ground offer an exciting prospect for the provision of heat in buildings. Especially as the installation can be individualised from a single common source.

Finally, in industry, geothermal energy is very interesting because it is possible to draw energy from water from industrial processes. The system allows a lot of flexibility and adaptability.

#2

How does a geothermal heat pump work?

Ground source heat pumps draw energy from the subsoil where the temperature remains stable, between 14°C and 15°C, at a depth of 100 metres, regardless of the outside temperature. Water source heat pumps draw energy from water (groundwater, lakes, ponds, rivers, wells etc.), with groundwater also offering stable temperatures between 7°C and 12°C, even in winter.

Geothermal heat pumps achieve very high efficiencies throughout the year, as the year-round temperature of the subsoil / groundwater is constant.

Geothermal heat pumps can produce heating, cooling and domestic hot water, by means of their refrigeration cycle, which is powered by electricity consumption and does not involve any combustion.

Geothermal heat pumps are installed inside the building like a conventional boiler. They are best situated in a closed and protected area.

#3

What are the advantages of a geothermal heat pump?

The geothermal heat pump has **7 main advantages:**

1. It lasts longer

The lifespan of a geothermal heat pump is 30 to 40 years on average, compared to 15 to 20 years for an aerothermal heat pump. This is because geothermal heat pumps are protected from external climatic conditions, and its mechanical components are less stressed.

2. It is more aesthetic

The visual impact of the geothermal heat pump is less than other types of heat pumps. It takes up no more space than a fridge.

3. It is more quiet

It is quieter than an air source heat pump because it is designed for indoor operation and does not emit any noise to the outside.

4. It offers efficient cooling

It returns the heat recovered in the house into the ground or water. This minimises the impact of drawing energy for heating in winter. Cooling improves the efficiency of geothermal energy in the long term and minimises the environmental impact. Putting energy back into the ground or water has a very positive effect.

It is also possible to implement passive cooling by means of geothermal cooling, a cooling method with almost zero cost.

5. It does not need a large plot of land

You don't need a large area to install a geothermal heat pump. It is only necessary to have a large enough access for the drill rig. In fact, new technologies for drilling are currently being used to drill in less space.

6. It has a superior performance

It works at stable source temperatures. So the yield remains high throughout the year, regardless of the outside temperature. Unlike air source heat pumps, whose efficiency is lower when temperatures drop in winter.

7. It is more profitable

Finally, the return on investment of a geothermal heat pump is better in the long term, because of its higher annual yield and longer lifespan compared to other heating systems.

Visit the Ground Source Heat Pump Association (GSHPA) for more information: **www.gshp.org.uk**

#4

What are the disadvantages of the geothermal heat pump?

In most cases, the purchase cost of a geothermal heat pump is not higher than the cost of an aerothermal heat pump. However, it is the installation that is more expensive, as a borehole must be drilled in order to set up the collection system.
This work consists of digging a hole in the ground and inserting equipment to extract the heat.

There are three types of boreholes

1. Vertical probe drilling

A closed loop is set up using vertical plastic probes buried in the ground to depths of between 80 m and 150 m. The cost is higher than with a horizontal probe, but the efficiency (COP) is 15% to 20% higher than with horizontal probes.

2. Horizontal probe drilling

A closed circuit is created with horizontal probes buried at a depth of only 1 to 2 metres deep. The installation is therefore less costly, but the yield is lower. You also need more outdoor space for this type of system.

3. Groundwater drilling

The solution of geothermal drilling with vertical collectors on the water table assumes the presence of an underground water table close to the building. This system consists of an open loop of water collected from the groundwater table, which then discharges through a heat exchanger that allows the heat pump to extract its energy. The efficiency of this type of system is very high, it is however necessary to check the quality of the water available for its use.

05.

TOWARDS FLUIDS WITH ULTRA LOW GWP

(GLOBAL WARMING POTENTIAL)

The European F-Gas II regulation, in force since 1 January 2015, is currently being revised. Which fluid will be chosen for the future regulation and will the UK follow suit? The refrigerants used in the manufacture of heat pumps have their own advantages and disadvantages.

#1 The draft revision of European F Gas Regulations

Most heat pumps work with a fluorinated gas. R32, for example, is gradually replacing R410A, which is considered too polluting.

The European regulation EC 517/2014, or F-Gas regulation, was put in place in the European Union to regulate the use of fluorinated refrigerants or HFCs (Hydro Fluoro Carbons). It came into force on 1 January 2015, with its ultimate objective to reduce greenhouse gas emissions by 80% by 2050. While the UK is no longer subject to EU law, UK legislation remains aligned with the F Gas regulations.

The EU regulation imposes a maximum GWP (Global Warming Potential) of 750 kg CO2 equivalent. However, R410A fluid was at 2,088 kg CO2 equivalent. It will therefore be completely banned by 2025. The GWP of R32 is calculated at 675 kg CO2 equivalent.

However, R32 is not virtuous enough in the eyes of the European Union. Drastic efforts are still needed, since the European aim is to achieve a GWP rate of less than 100 kg. The ultimate goal is to replace all refrigerants in heat pumps.

#2 Criteria for the selection of refrigerants

To select new refrigerants, it is necessary to have a global approach and to consider the different selection criteria:

- performance,
- material compatibility,
- safety, including flammability and toxicity,
- environmental protection,
- cost.

#3 Other possible refrigerants

Unfortunately, no refrigerant meets all the criteria. For example, propane, also known as R290, is a very efficient environmentally friendly gas, with a GWP of only 3. Its coefficient of performance is 3 to 5, so it is much better than R32. However, its major drawback is its highly flammable quality.

There is also ammonia (NH3), which is a non-flammable, but very toxic refrigerant. Its transport requires compliance with a number of safety standards and regulations.

06.

WHY SHOULD YOU CHOOSE CERTIFIED HEAT PUMPS?

Choosing a certified heat pump by Eurovent Certita Certification (ECC) ensures that it will meet the energy performance declared by the manufacturer. Energy performance is indeed essential to reduce consumption.

#1 Heat pump certification

While Eurovent Certita Certification offers a number of heat pump certification schemes, there are two prominent schemes for the UK market:
- MCS (Microgeneration Certification Scheme) for Heat Pumps,
- Eurovent Certified Performance for heat pumps.

Both schemes offer HVAC professionals the assurance that products will perform as expected and comply with UK regulations.

#2 MCS for heat pumps

MCS certification assures suppliers, regulators and consumers that an independent organisation has reviewed a product's manufacturing process and determined that the product complies with MCS specific standards for quality, reliability and performance. It also means that customers can rest assured that the renewable systems they choose will deliver the results that manufacturers say they will.

Choosing products certified under the MCS 007 heat pump standard offers a number of benefits including:

1. Access to the UK's small-scale renewable energy market

Manufacturers who obtain MCS certification for their products gain access to the UK's largest base of small-scale renewable energy installers, who under their certification, are obliged to only install MCS certified products.

2. Quality mark for products

MCS certification is a demonstration of the quality and reliability of products, through adherence to the UK's recognised, small-scale renewable energy Standard. The MCS certification mark instils consumer confidence in products, which are marked out from the competition.

3. Enabling consumer access to government incentives

MCS is the route through which small-scale renewable energy installations can qualify for available government incentives, as determined by UK legislation.

4. Product Directory Listings

MSC Installers can find MCS certified products via both the MCS product directory at www.mcscertified.com and the Eurovent Certified Product Directory at **www.eurovent-certification.com**

Eurovent Certita Certification is accredited to certify products under the MCS 007 heat pump standard. There is mutual recognition between MSC and ECC, so that products certified by ECC under the Eurovent Certified Performance (ECP) programme for heat pumps, and the NF mark NF414 for heat pumps can automatically qualify for MCS certification, with no further audits or tests.

#3

Certifications: The NF mark and Eurovent Certified Performance (ECP)

NF and ECP certification cover:

- Aerothermal or geothermal heat pumps,
- Single or multi-split heat pumps,
- Heat pumps with electric generators.

The Eurovent Certified Performance programme for heat pumps is based on the NF414 mark for heat pumps. The NF414 programme certifies several characteristics of heat pumps including:

1. Energy efficiency

Eurovent Certita Certification certifies energy efficiencies, regardless of the operating mode of the heat pump. Previously efficiency was only measured at full load only. However, this was not representative of the actual use of the appliance. Indeed, the efficiency of a heat pump varies during the year according to the outside temperature. The warmer it is, the more the heat pump is used at partial load. Since the European eco-design regulation entered into force, it is the seasonal performance based on these full and part-load efficiencies that are certified. The certified seasonal performance is more representative of real-life heat pump use.

2. Sound power level

The objective is to characterise the sound power level of the heat pump. Under the Eurovent Certita Certification NF heat pump standard, the acoustic test takes place at full load. Thanks to this method, the loudest potential sound power is displayed, so that there is no discomfort for the consumer.

3. The production of hot water

NF for heat pumps also certifies the energy efficiency of domestic hot water production.

4. Other performances certified

Eurovent Certita Certification certifies criteria in addition to the regulatory requirements. For example, we certify the ability to start the heat pump when the outside temperature drops to -15 degrees, as we want to ensure that the heat pump works properly in extreme conditions.

We are also able to certify cooling mode for heat pumps that offer this function.

Heating professionals choosing products bearing the MCS, NF and Eurovent Certified Performance logos can rest assured that product performance is guaranteed.

#4

How does certification work?

For manufacturers, the certification process is voluntary and not mandatory. It allows them to guarantee the performance of their products for their customers. Certification is the first link in the chain of trust from the manufacturer to the end customer.

The certification process for heat pumps is demanding and rigorous. Performance is tested and production sites are audited regularly. The certified performances are accessible to all professionals on the website **www.eurovent-certification.com**

The heat pump certification process takes place in 6 stages:

1. Declaration of products

The manufacturer shall first declare its products and their performance, as well as production sites.

2. Signing the contract

The manufacturer signs a contract with the certifying body.

3. Sampling and on-site audit

Eurovent Certita Certification organises the following controls:
- tests carried out in independent laboratories in order to certify the accuracy of the declared performances,
- audits of production sites to verify the quality and reliability of products leaving the factory, and in particular their suitability for use.

4. Control of the documentation

Eurovent Certita Certification checks the product communication media, ensuring the correct use of product marking and advertisements.

5. Issuance of the «product» performance certificate

On the basis of these assessments, we issue «product» performance certificates. The certified products and their performance are then published on our website **www.eurovent-certification.com**

6. Follow-up of the certification

Our certification process includes regular assessments to ensure the continued performance of the products, throughout the time they are on the market.

The certification process

ADMISSION

1. Admission of the application

- Certification contract
- Scope of certification (ranges, models)
- Declaration of the manufacturing site
- Technical file.

2. Assessment of operations

- Sampling
- Testing
- Audits
- Documentation control.

3. Decision

SURVEILLANCE

Annual assessment of operations

07.

ABOUT EUROVENT CERTITA CERTIFICATION

Eurovent Certita Certification is one of the world leaders in certifying performance of HVAC and refrigeration products for residential, commercial and industrial applications.

Since 1993, Eurovent Certita Certification has been offering professionals and end users the most complete database of products on the market:

- More than 47 certification programmes
- 40 certified product families
- 6 certification marks, including: Eurovent Certified Performance, NF, QB (Quality for Building), MCS (Microgeneration Certification Scheme) for Heat Pumps and Keymark
- European and worldwide customers.

Eurovent Certita Certification is accredited as a certification body for products and services to ISO/IEC 17065:2012 by COFRAC (Comité Français d'Accréditation) which has issued it with accreditation n° 5-5017. This accreditation is recognised internationally by the signatories of the IAF (International Accreditation Forum).

Consult the online directory of certified products:

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