

# Requirements for Seasonal Efficiency for Air-conditioning Units

Performance of air-conditioners used to be compared at a fixed condition. However, this condition does not represent the usual operating conditions of the equipment over a season, which becomes especially important for the calculation of the energy efficiency. Seasonal performance first appeared in Eurovent Certification programme for chillers in 2006. The European Commission defined a seasonal efficiency for residential Air Conditioners applicable since 1<sup>st</sup> January 2013; consequently Eurovent Certita Certification has updated its programme in accordance with this regulation.



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## Scope of the programme

Air Conditioners certification programme concerns comfort units, air-to-air and water-to-air below 100 kW (nominal capacity in cooling mode). It also applies to units intended for both cooling and heating by reversing the cycle. Concerning multi-split air conditioners, only systems with two indoor units are included.

## Process of Certification

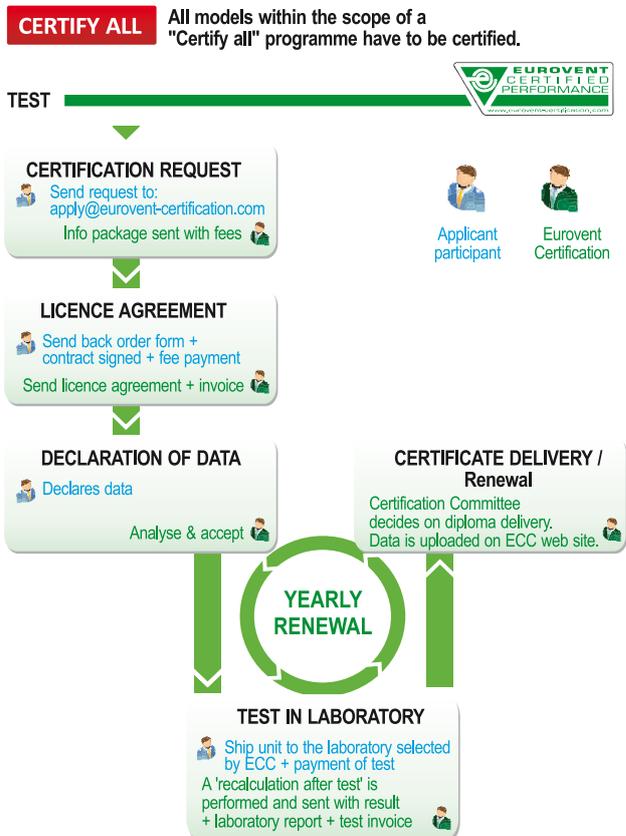
The purpose of all Eurovent Certita Certification Programmes is to encourage honest competition and to assure customers that equipment is correctly rated on the market. The purpose is achieved by verifying the accuracy of ratings claimed by manufacturers by continuing testing of production models, randomly selected, in independent laboratories.

One particularity of Air Conditioners programme is to apply the “Certify-all” principle, meaning:

*All products of the relevant certification programme manufactured or sold by a Participant inside the defined scope must be certified. When applicable, “Certify-all” principle means at least “all products inside the defined scope presented, at least, on the European market”.*

“Certify-all” brings clarity and transparency and therefore increases the value of the whole system.

Launched in 1994, the Air Conditioners certification programme was the first programme of Eurovent Certita Certification (ex Eurovent Certification Company). After almost 20 years it is well recognized on the market as well as the mandatory energy efficiency labelling for air conditioners below 12 kW since 2003.



**Figure 1.** Steps in the certification process of the product performance.

**Table 1.** Requirements of minimum energy efficiency of air condition units with cooling capacity under 12 kW in the European market according to the EC regulation (see the definitions of abbreviations in the article by Sandrine Marinhas in this issue).

	Air conditioners, except double and single duct air conditioners	
	SEER	SCOP (Average climate)
If GWP of refrigerant > 150 for < 6 kW	4,6	3,8
If GWP of refrigerant ≤ 150 for < 6 kW	4,14	3,42
If GWP of refrigerant > 150 for 6–12 kW	4,3	3,8
If GWP of refrigerant ≤ 150 for 6–12kW	3,87	3,42

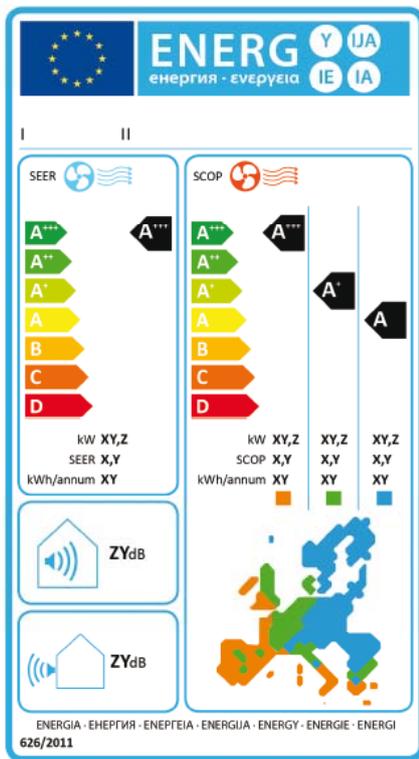
GWP = Global Warming Potential

**Table 2.** Energy Classification for Conditioners except double ducts and single ducts.

Energy Efficiency Class	SEER	SCOP
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER < 8.50	4.60 ≤ SCOP < 5.10
A+	5.60 ≤ SEER < 6.10	4.00 ≤ SCOP < 4.60
A	5.10 ≤ SEER < 5.60	3.40 ≤ SCOP < 4.00
B	4.60 ≤ SEER < 5.10	3.10 ≤ SCOP < 3.40
C	4.10 ≤ SEER < 4.60	2.80 ≤ SCOP < 3.10
D	3.60 ≤ SEER < 4.10	2.50 ≤ SCOP < 2.80
E	3.10 ≤ SEER < 3.60	2.20 ≤ SCOP < 2.50
F	2.60 ≤ SEER < 3.10	1.90 ≤ SCOP < 2.20
G	SEER < 2.60	SCOP < 1.90

The Directive defines energy efficiency as shown in the **Table 1**.

Moreover, Commission Regulation (EU) No 626/2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air conditioners makes mandatory energy labelling of all air conditioners with the cooling capacity below 12 kW introduced on the European market after the 1<sup>st</sup> January 2013. The Directive defines, for each function, the energy class going from A+++ (more efficient) to G (less efficient). The classification is given in the **Table 2**.



**Figure 2.** The model of the required energy label for all air conditioning unit in the European market from the beginning of 2013.

The certified performances depend on the product (below or above 12 kW) and the applicable EU Directives.

### Directive Requirements for Air Conditioners below 12 kW

Commission Regulation (EU) No 206/2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to EcoDesign requirements for air conditioners and comfort fans gives requirements for all air conditioners with the cooling capacity under 12 kW (AC1) introduced on the European market after the 1<sup>st</sup> January 2013.

### New Energy Efficiency Ratio and Standard for Air Conditioners below 12 kW

The SEER and SCOP, mentioned in the Directive, represent the usual operating conditions of the equipment over a season. This operating condition can be better assessed by comparing equipment at representative reduced capacities (**Table 3**).

European standard EN 14825 provides part-load conditions and calculation methods for calculating the SEER and SCOP of such units when they are used to fulfil the cooling and heating demands.

Other energy consumptions can occur when the unit is not used to fulfil the cooling and heating demands such as those from a crank case heater or when the unit is on standby. These consumptions are considered in the calculation methods for reference SEER and reference SCOP.

Fixed capacity air conditioners deal with varying loads by varying the operation time. The efficiency of the system is dependent on the effectiveness of the control-

ling thermostats. Variable capacity air conditioners, by continuous or step control of the compressor, can more closely match the varying load improving system efficiency.

### Certification for Air-Conditioners below 12 kW

These Seasonal Energy Efficiency Ratio for cooling mode (SEER) and Seasonal Coefficient of Performance for heating mode (SCOP) came in addition, since the 1<sup>st</sup> January 2013, to the well-known Energy Efficiency Ratio (EER and COP).

Some new characteristics are currently being tested with a view of being certified, as the performances at Bivalent Temperature<sup>1</sup> or at Operation limit temperature<sup>2</sup>, and also the annual electric power consumptions. These new items will better help customers to compare and make their choices.

The certified performances available on the Eurovent Certified Performance Website are listed in **Table 3**.

**Figures 3 and 4** show the distribution of the Seasonal Performance in relation with the capacity.

**Figure 5** shows the SEER in relation with the SCOP.

These graphs show that the requirements for the European regulation were more stringent for the heating mode than for the cooling mode, as the cut-off is more vertical than horizontal. Indeed, as shown in **Figure 5**, strong parallel requirements on both performances would have generated a more angular shape of the distribution.

SCOP limits SEER when SCOP is between 3.4 and 3.75. For a SCOP above 3.8 the amplitude of SEER is increased (SEER up to 7 to 8). Correlation between SCOP and SEER becomes chaotic for high SCOPs: these units are for sure on the radar screen of certification for verification of their high declared performance.

### Certification for Air-Conditioners above 12 kW

Currently, the certified data are EER and COP at Standard Rating Conditions and Sound Power Level (**Table 4**).

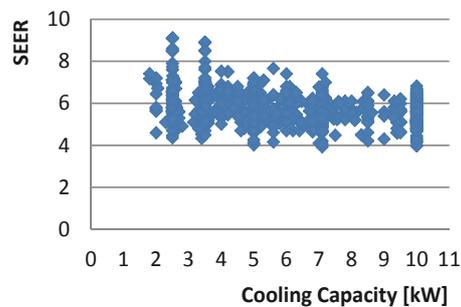
<sup>1</sup> Bivalent temperature: lowest outdoor temperature point at which the heat pump is declared to have a capacity able to meet 100 % of the heating load.  
<sup>2</sup> Operation limit temperature: lowest outdoor temperature at which the heat pump can still deliver heating capacity, as declared by the manufacturer.

**Table 3.** Testing conditions for rating of air conditioning units and the information available from the units tested and certified by the Eurovent Certita Certification.

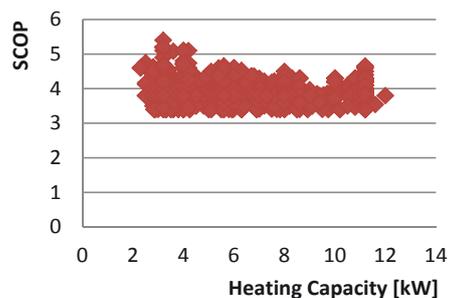
Cooling Mode	Heating Mode
<b>Performances in Standard rating conditions (according to standard EN 14511)</b>	
Cooling Capacity @ 35°C EER @ 35°C	Heating Capacity @ 7°C COP @ 7°C
<b>Seasonal Performances (according to standard EN 14825)</b>	
Design Capacity  <b>SEER</b> Annual electric power consumption	Design Capacity Bivalent Temperature Performance @ T <sup>biv</sup> TOL (Operation limit temperature) Performance @ TOL  <b>SCOP</b> Annual electric power consumption
Auxiliary Power consumption (Standby mode, Off mode...etc.)	
<b>Sound Power Level (according to standard EN 12102)</b>	

**Table 4.** Rating conditions and standards used to measure the performance of the air conditioning units with cooling capacity over 12 kW.

Cooling Mode	Heating Mode
<b>Performances in Standard rating conditions (according to standard EN 14511)</b>	
Cooling Capacity @ 35°C EER @ 35°C	Heating Capacity @ 7°C COP @ 7°C
<b>Sound Power Level (according to standard EN 12102)</b>	



**Figure 3.** Seasonal Energy Efficiency Ratio for cooling mode (SEER). Each dot represents a different unit. (Eurovent 2013 certified data for Air conditioning units <12kW).



**Figure 4.** Seasonal Coefficient of Performance for heating mode (SCOP). Each dot represents a different unit. (Eurovent 2013 certified data for Air-conditioning units <12kW).

## Seasonal Efficiency for Air Conditioners above 12 kW ongoing?

The objective of the Eco-design Directive is to improve the energy efficiency and to reduce the environmental impacts. The seasonal performance of air conditioning units represents better the energy efficiency of the unit than peak performance. A first draft of regulation based on Eco-design Directive, including the seasonal performance criteria was in consultation with stake holders already in 2013.

This document contains products in relation with:

- ENER<sup>3</sup> Lot<sup>4</sup> 21 (central air heating products)
- ENTR<sup>5</sup> Lot 6 (air conditioning products)
- ENTR Lot 1 (high temperature process chillers)

This future directive will impact:

- Heat Pumps air-to-air  $\geq 12$  kW
- Heat Pumps water-to-air up to 1 MW
- Chillers (reversible Heat Pumps in cooling mode) air-to-water and water-to-water up to 2 MW

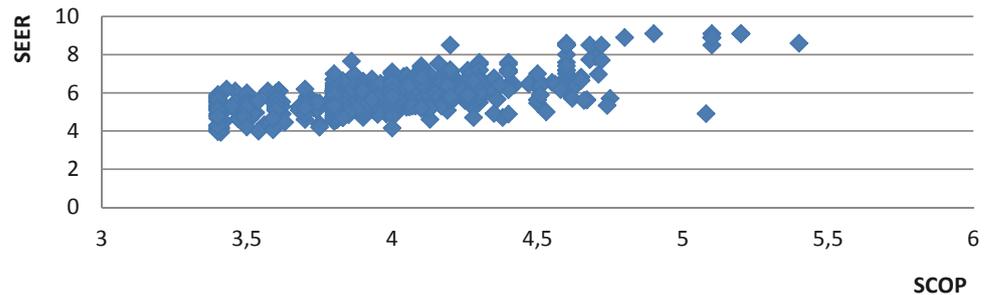
and also:

- Air Conditioners air-to-air  $\geq 12$  kW
- Air Conditioners water-to-air up to 2 MW

The preparatory study identified the following significant environmental aspects to be regulated:

- Energy efficiency
- Carbon dioxide and nitrogen emissions,
- Sound power levels.

The energy performance requirements related to the seasonal performance SCOP/SEER with calculation methods very similar to those already existing in EN 14825.



**Figure 5.** SEER vs. SCOP (Eurovent 2013 certified data for Air conditioning).

Consequently, if the timeframe doesn't change, all Air Conditioners (below and above 12 kW) have to have Seasonal Performances Data from January 2017 and will have to respect the Directive requirements.

**The Air Conditioners programme offered by Eurovent Certita Certification will integrate these parameters as soon as possible in order to /offer to our participants a programme in line with the future EU directives.**

## Data publication

Making the certified data easily available for end-users and consultants has always been a priority for Eurovent Certita Certification. Our directory of certified data, available since the creation of the company, and launched as an interactive website around 2001, brings reliable data to end-users. In addition to the certified data a dedicated description page for each certification programme containing the outline of the programme, definitions and rating conditions is made accessible and constantly updated to help visitors understand the value of certified data (<http://www.eurovent-certification.com>)

## Conclusion

We are at the turning point concerning the Energy efficiencies for all thermodynamic systems (Air Conditioners, Rooftops, Liquid Chilling Packages ...). The usual energy efficiencies achieved at full load are going to disappear gradually in order to be replaced by new performances which will better describe these units in terms of energy consumption. Soon, the new European Regulation will change also the current market by fixing higher requirements. With them, the verification of the published data by a third-party body, such as Eurovent Certita Certification for e.g., remains a useful added value to verify the announced performances as a complement to the market surveillance, and to help comparing the products thanks to the online database. ■

<sup>3</sup> ENER= Directorate General of Energy

<sup>4</sup> Lot= product group

<sup>5</sup> ENTR= Directorate General of Enterprise and Industry