Development of Heat Pump System Certification

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In a European context where current or future regulations, such as those on eco-design, are effectively based on the declaration of product performance by the manufacturers themselves, voluntary certification provides reliable product data, and helps organise the market.

The publication of certified performance by an independent and accredited body ensures that the design offices, installers, and users in general have a consistent, reliable, and continuously up -o-date database at their disposable, and manufacturers to enhance the best features of their products.

In a highly competitive market, product certification plays a key role in ensuring fair trade and establishing trust between operators.

In addition, transparency and availability of certified performance constitutes a very effective tool in promoting new product development and ever more effective technical solutions. Either directly when the certification standards introduce performance thresholds, or only indirectly through free competition. Over the years, it was possible to observe a steady increase in COP values for certified heat pumps.

Finally, it should be noted that certifications, such as those granted by Eurovent Certita Certifications, are developed closely with the professional sectors involved, which ensures consistency with market expectations and developments. Examples include the introduction, in consultation with AFPAC, in the size certified characteristics and the acoustic specifications relating to heat pump noise. Researching consistency with market expectations also signifies anticipating future developments in support of manufacturer and industrial developments. In particular, this is what is implemented in the NF PAC and Eurovent Certified Performance certifications, as the application of Eco-design regulations will dramatically shake up the current situation.

Since 2013, the trademarks "Eurovent Certified Performance" (**Figure 1**), "NF PAC - Heat Pumps" (**Figure 2**) and "NF Multi-Energies" (**Figure 3**) have been issued by a single certification body: "Eurovent Certita Certification" [1, 2]. These trademarks, which have an impact on French and European level and are also globally renowned, cover all types of heat pumps

Figure 1. ECP trademark.

Figure 2. NF PAC trademark.

Figure 3. NF Multi-energy trademark.

in their various functions, a scope which is described later in this document. In a complex context, where the thermal regulation of buildings RT2012 [3] specific to France, in addition to regulations on marketing products with European texts that are gradually being written, certification will showcase in a more understandable manner energy efficient products to prescribers and final users, products which have an acceptable acoustic performance. The development of this trademark certification is presented below.

Current status of heat pump certification

October 2014, marked the 20th anniversary of Eurovent Certification activities. On the other hand NF exceeded its thousandth heat pump certification, and a new reference document appendix for the Multi-energy standard dedicated to hybrid systems is available, which combines heat pumps and boilers. On this occasion we can review the road we have gone down and the status on the current type and number of certified reference documents. (**Table 1**).

Faced with market statistics available from Eurovent Market Intelligence and Clim'Info, this data support the assertion that the coverage of certified Heat Pumps on the European market is very high.

From "Standard" performance to "Seasonal" performance

Energy performance characterisation for eat pumps is gradually migrating from EER and COP nominal performance EN 14511 [4]) to seasonal performance (EN 14825 [5]), whose recent developments, and those to come, will cover more and more types of products.

Whilst the industry has implemented ESEER (European Seosonal Efficiency Ratio), certified since 2007, recently published regulations or those in the process of being published talk about seasonal coefficient of performance (SCOP) in heating mode, and its equivalents SEER and SEPR in cooling mode (see **Table 2**).

In order to compare the heating solutions between different technologies, the seasonal effectiveness is defined in primary energy etas (η_s). In order to respond to these developments, Eurovent Certita Certification suggests that manufactures certify this new performance. Since the 2013 revision of the reference document "AC1" (Air Conditioners ≤ 12 kW - Luxury Air Conditioning Units), manufacturers are required to declare the SEER, covered by eco-design 206/2012 [6] and labelling 626/2011 [7] regulations. Products which do not fall within the thresholds of the regulation are excluded. Since revision 8 of the reference document NF PAC published in the autumn of 2014, manufacturers can certify SCOP and seasonal energy efficiency for the heating premises η_s, covered by regulations 813/2013 [8] 811/2013 [9], as an option. Since the 2015 revision of the reference document LCP-HP (Liquid chilling packages and heat pumps), published December 2014, manufacturers are required to declare the SCOP and η_s, data that will be published in the autumn of 2015.

In the 2016 or 2017 revision of the reference documents AC2, AC3 (Air-Condition Units<=100 kW) and RT (Rooftop Units), manufacturers shall declare the SCOP, SEER and/or the etas, knowing that the regulation was passed in April 2014 but the unreleased documents have not been published in the official EU journal yet, and the mandate to meet the harmonised standards on the needs and regulatory testing methods is in its early stages.

Sanitary Hot Water

Present in the source document NF PAC since August 2012, the certification of dual service heat pumps producing hot sanitary water evolved in its 7th revision, which was published at the end of June 2014 to ensure the further certification of heat pumps and storage tanks with a reference simulation tool.

Regarding future developments, a work group has been meeting since September 2014 to introduce by the summer of 2015, the possibility of certifying

Table 1. Distribution of Certified Products (June 2014).

Type of Heat Pump	NF Heat Pump	Eurovent Certified Performance
Air/air	/	2835
Air/Water	1845	10417 of which 1512 x 100 kW
Water/Water	258	3068 of which 560 x 100 kW
Glycol Water/Water	471	/
Sanitary Hot Water	192	/
Swimming Pool	34	/
Gas	6	/
Variable Refrigerant Flow	/	20

Table 2. Summary Term Table (in English) and the principal equations on the seasonal performance characterisation of Heat Pumps.

Terms	Cooling mode	Heating mode	unit
reference design conditions reference temperature conditions cooling mode: 35°C dry bulb (24°C wet bulb) outdoor and 27°C dry bulb (19°C wet bulb) indoor heating: for average: -10°C, colder : -22°C and warmer: +2°C climates	$T_{designc}$	$T_{designh}$	°C
load or demand load of the building at certain temperature conditions	P_c	P_h	kW
full load load at reference design conditions	$P_{designc}$	$P_{designh}$	kW
part load ratio load divided by the full load	**PLR**		%
capacity capacity a unit can deliver at certain conditions	**DC**		
capacity ratio load divided by the declared capacity	**CR**		
bin hours duration at a given temperature for a specific location	h_j		h
bivalent temperature (CR=100%) lowest outdoor temperature where capacity is equal to the load		$T_{bivalent}$	°C
operation limit temperature lowest outdoor temperature where the unit still delivers capacity		T_{OL}	°C
reference annual demand(s) representative annual demand(s)	Q_c	Q_h	kWh
efficiency (energy efficiency ratio and coefficient of performance) capacity divided by the effective power input at standard conditions: at conditions of EN 14511	**EER**	**COP**	kW/ kW
at part load: at conditions of EN 14825 (degraded for fixed stage units)	EER_j	COP_j	
electric back up heater (below Tbivalent) supplementary electric heater, with a COP of 1		**elbu**	kW
thermostat off corresponding to the hours with no load	TO		
standby unit partially switched off but reactivable by a control device or timer	sb		
off unit completely switched off	off		
crankcase heater (to limit refrigerant concentration in oil at compressor start) where a crankcase heater is activated	CK		
auxiliary power consumptions $\sum h_{aux}.P_{aux} = h_{TO}.P_{TO} + h_{sb}.P_{sb} + h_{CK}.P_{CK} + h_{off}.P_{off}$	**TO, sb, off, ck**		kWh
degradation coefficient for fixed stage units (same equations for COPj) efficiency loss due to the cycling of respectively chillers and ACs	**Cc / Cd**		%
$EER_j = EER.\frac{CR}{c_c.CR+(1-c_c)}$; $EER_j = EER.\left(1 - C_d.(1 - CR)\right)$ = *EER.(Part Load Factor)*			kW/ kW
reference seasonal efficiency [reference: EN 14825, 2013] seasonal efficiency calculated for the reference annual demand $SEER = \frac{Q_c}{\frac{Q_c}{\sum h_j.P_{c,j}}+\sum h_{aux}.P_{aux}}$; $SCOP = \frac{Q_h}{\frac{Q_h}{\sum h_j.P_{h,j}}+\sum h_{aux}.P_{aux}}$	**SEER**	**SCOP**	kWh/ kWh
active seasonal efficiency seasonal efficiency excluding auxiliary consumptions	$SEER_{on}$	$SCOP_{on}$	kWh/ kWh
European seasonal energy efficiency ratio [reference: Eurovent Certification, 2008] Antecedent term used for SEER before European standard was issued $ESEER = 0.03.EER_{100\%}+0.33.EER_{75\%}+0.41.EER_{50\%}+0.23.EER_{25\%}$	**ESEER**	-	kWh/ kWh
integrated part load value [reference AHRI, 1998] (EER in kW/Ton) First equivalent to ESEER, with weighting coefficients related to the United States $IPLV = 0.01.EER_{100\%}+0.42.EER_{75\%}+0.45.EER_{50\%}+0.12.EER_{25\%}$	**IPLV**	-	kW/ Ton

collective sanitary hot water, with or without the 2000L capacity limit.

A new and truly European certification for heat pumps

The "European Heat Pump" certification program is a bridge between the NF programme and the ECP trademark. The first certificates shall be distributed at the beginning of 2015 and the data shall be available online at the end of winter.

Multi-Energy Systems

Concerning the NF Multi-Systems trademark, it does not concern the enhancement of each component, but the enhancement of the system's performance as a whole.

The first appendix of the multi-energy reference document is dedicated to hybrid heat pumps (hybrid heaters). In this case specifically, it concerns the enhancement of the performance regulation system that can be optimised in such a way so as to use fossil fuels or electricity in the most favourable conditions during the key operating points of the product. It can also be for consumers using electricity during off-peak rather than peak periods

The first certificate was published in November 2015. The trademark committee also addressed it in 2014 to introduce seasonal performance in certified data in 2015 or 2016, while the taking into account these systems in the EN 14825 standard has not been resolved in the next version of the standard, but is in the process of being defined in the following version.

European Eco-Label

To promote the most environmentally friendly products, the Eco-Label Directive [10] completes the eco-design and labelling guidelines. For heat pumps, the criterion for the attribution of the co-label, initially published 9 November 2007 [11] and valid until 31 October 2014, were updated by the decision of the committee' dated 28 May 2014 [12]. Note that the eco-label had been attributed to a handful of product lines in France, Belgium and Germany.

An extension of the scope of the text on hybrid devices is amongst the latest advances, including the emergence of a Total Equivalent Warming Impact (TEWI), based on the Global Warming Potential (GWP) of the refrigerant used with conventional end-of-life leakage rate fixed at 35% and the seasonal energy effectiveness for the heating of premises η_s.

Conclusion

In a changing regulatory and normative context, the offer of certification by Eurovent Certita Certification may be adapted to the heat pump market, therefore ensuring a guarantee to the final client a better understanding of performance thanks to the collaborative work including all stakeholders, while covering as extensively as possible existing solutions and technologies. ■

References

[1] www.eurovent-certification.com

[2] www.certita.org

[3] http://www.rt-batiment.fr/

[4] EN 14511 - Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.

[5] EN 14825 - 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.

[6] Commission regulation (EU) No 206/2012 of 6 March 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.

[7] Commission delegated regulation (EU) No 626/2011 of 4 May 2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air conditioners.

[8] Commission regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters.

[9] Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device Text with EEA relevance.

[10] http://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html.

[11] Commission decision 2007/742/CE of 9 November 2007 establishing the ecological criteria for the award of the Community eco-label to electrically driven, gas driven or gas absorption heat pumps.

[12] Commission Decision 2014/314/EU of 28 May 2014 establishing the criteria for the award of the EU Ecolabel for water-based heaters.