Working document on possible Commission Regulations implementing Directive 2009/125/EC with regard to professional refrigeration products

Brussels, 09.12.2011

PART 5 – REMOTE CONDENSING UNITS

Subject matter

This working document pursuant to Directive 2009/125/EC establishes eco-design requirements related to remote condensing units. The preparatory study showed that energy in use phase is the only significant environmental aspect which can be addressed through product design. Other Ecodesign parameters referred to in Annex I, Part 1 of Directive 2009/125/EC, are not considered as significant.

Definitions

Remote condensing units are considered as energy related products within the meaning of Article 2 (1) of Directive 2009/125/EC.

For the purpose of this working document the following definition shall apply.

A ‘condensing unit’ is a piece of refrigeration equipment including at least one compressor and one condenser, placed on the EU market as a package, and intended to provide refrigerating energy to one or several remote refrigeration appliances.
This includes:

- Condensing units including several compressors (e.g. parallel compressors)
- Condensing units of all cooling capacities ranges
- Condensing units operating at medium and low temperature
- Air-cooled condensing units

This excludes:

- Condensing units operating at high temperature intended for air-conditioning (indicatively corresponding to H1 temperature class, i.e. +10°c), including “split systems” sold with a remote evaporator
- Monoblock units which include the evaporator
- Compressor packs or racks which include compressors only, with no condenser
- Water-cooled condensing units

'Operating temperature' means the target storage temperature which is intended to be maintained within the appliance(s) served by the condensing unit
'Medium operating temperature' means a refrigerated operating temperature above 0°c, with reference point at +5°c (M1 temperature class)
'Low operating temperature' means a frozen operating temperature below 0°c, with reference point at -18°c (L1 temperature class)

Eco-design requirements

Products falling under the definitions of paragraph "Definitions" above in this document shall meet the Ecodesign requirements set out in Annex I.

Energy consumption in the use phase accounts for 99% of the Gross Energy Requirement (GER) of a condensing unit; overall, this is the dominating environmental impact over the product life cycle. However, direct greenhouse gas emissions from refrigerant fluids account for more than one third of the Total Equivalent Warming Impact (TEWI) of a condensing unit over its lifetime (8 years). This is due to estimated annual leakage rate of 15% and to dumped refrigerants at end of life (estimated 50% of the refrigerant charge). As a result, the end of life phase significantly contributes to the total Global Warming Potential (GWP) over the product lifetime. Therefore, the preparatory study mentioned the use of low GWP refrigerants and reduced leakage rates among possible improvement options for remote condensing units. Reduced leakage rates are primarily achievable through enhanced maintenance practices and this is beyond the scope of legal requirements under the Ecodesign Directive 125/2009/EC.
As regards the use of low GWP refrigerants, R290 (propane) was selected as an improvement option by the preparatory study. However, R290 is highly flammable. Condensing units are mainly found in class B or C environments, and refrigerant charge limits specified by EN378 should be taken into account. The refrigerant charge of the base case is 11kg with HFC refrigerant (R404a). The refrigerant charge would be lower with HC refrigerant such as R290 or R600a, but may remain too large to cope with flammability risks. Most condensing units in the EU market are still sold for use with HFC refrigerant (R404a), including the best available technology identified by the study. No model intended for use with HC refrigerant could be identified. The preparatory study identified CO2 and unsaturated HFC refrigerants as best not yet available technologies for remote condensing units. However, some manufacturers already offer CO2 condensing units.
As a whole, the potential to promote low GWP refrigerants through product design requirements is considered to be limited so far. A “bonus” would not effectively encourage the use of R290 and CO2, which allows higher energy efficiency compared to R404A (~5% reduction in energy consumption with R290 and higher efficiency with CO2, except in Southern climates). Besides, a ban of high GWP refrigerants in condensing units would prejudge the outcome of other political debates at EU-level (in particular, F-Gas Regulation) and would risk creating a market shock.

Emissions due to the production of materials (steel, other ferrous metals) were not deemed significant by the preparatory study.

Condensing units below 20kW account for more than 80% of the market (in units). Condensing units with reciprocating compressors account for 95% of the market (in units). The market is still much focused on the purchase price and new technologies allowing capacity modulation (e.g. scroll compressors, variable speed drives, electronically commutated motors) are still perceived as too expensive by most users.

The proposed requirements are based on the results of the preparatory study. These were refined on the basis of new product data and technical analysis provided by manufacturers[1].

[1] Mainly members of expert group set up by EPEE, Eurovent and Asercom

For example, the average COP of condensing units operating at medium temperature was revised from 1.9 down to 1.56, and the average COP of condensing units operating at low temperature was revised from 1.0 down to 0.95.

The following staged requirements are proposed.

1) **Tier-1**: January 1, 2014 onwards, packaged condensing units falling into the scope of the present Regulation shall comply with minimum efficiency requirements and corresponding product information requirements as indicated in Annex 1. Tier-1 requires a reduction of energy consumption and power input of at least 5 %. It is estimated to be achievable with negligible increase of purchase price (~5%), leading to a slight reduction in life cycle costs for the users (~3%). Tier-1 requirements would ban the least efficient 10% among condensing units, but these are believed to be sold in large numbers.
2) **Tier-2**: January 1, 2017 onwards, packaged condensing units falling into the scope of the present Regulation shall comply with more stringent minimum efficiency requirements as indicated in Annex 1. Tier-2 requires a reduction of power input of at least 10% when measured at full load. There is however uncertainty about the actual energy saving potential (maybe up to 23% when part load is taken into account) and price increase (maybe up to 30%) related to Tier-2 requirements. Tier-2 requirements are very close to the Least Life Cycle Cost calculated by the preparatory study[2] and compare with the real BAT, at least for larger units.
3) **Seasonal Energy Performance Ratio (SEPR)**: Tier-1 and Tier-2 requirements are based on COP and on a new SEPR which is meant to encourage capacity modulation for units with a higher cooling capacity than 5kW and 2kW for medium and low operating temperatures respectively. The SEPR also allows taking into account the variation in the condensing efficiency due to changing ambient temperature throughout the year, and therefore, it better reflects actual operating conditions for these condensing units, which are often located outdoor.
4) **Review**: no later than 4 years after entry into force, and preferably before the entry into application of Tier-2 requirements, the present Regulation shall be reviewed by the European Commission

The estimated saving potential of the proposed requirements is 20.9 TWh per year in 2020 and 46.4 TWh in 2025 compared to a “freeze” scenario. If Tier-2 requirements would enter into application in 2018, the estimated saving potential would be 16.7 TWh in 2020 and 42.3 TWh in 2025.

The proposed Regulation will put Europe at a global forefront regarding energy efficiency of packaged condensing units, which is not regulated in other major economies yet. It is expected that European rules and standards will be rapidly taken up by other regions of the world.

[2] Revised calculation with product data submitted by manufacturers

Form of the Implementing measure
It is intended to propose a directly applicable Implementing Regulation under Directive 2009/125/EC. The proposed Regulation is not expected to have a particular impact on the EU acquis.

Measurement methods

– As regards the method for measuring the COP of condensing units for the purpose of this Regulation, the Commission intends to publish the references of EN13771-2 and EN13215 in the Official Journal, C series.
– As regards the method for measuring the Seasonal Energy Performance Ratio (SEPR) referred to Annex 1, the Commission intend to mandate the adoption of a new harmonised standard. Appendix A contains a draft measurement method which is expected to serve as a key input into the standardisation process[3]. This should feed into the draft update of Annex B of the Horizontal Mandate under the Ecodesign Directive. It is proposed to leave the choice to standardisers whether the new standard should be adopted as an update of EN13215, an addendum to prEN14825 or a new separate standard. Once adopted, the Commission intends to publish the references of the new standard in the Official Journal, C series.

An Excel calculation sheet (Appendix B) will be available on-line for helping SME manufacturers to comply with the SEPR calculation requirements.

Conformity Assessment
A conformity assessment shall be carried out according to Chapter 8 of Directive 2009/125/EC, Annex IV (Internal design control) or Annex V (Management system for assessing conformity).

Market surveillance

When performing the market surveillance checks referred to in Directive 2009/125/EC, Chapter 3 (2), Member State authorities shall apply the verification procedure set out in Annex IV of this working document.

Benchmarks

No Ecodesign benchmarks are proposed for condensing units.

Review

A review of the proposed requirements shall be presented to the Consultation Forum depending on technological progress and not later than 4 years after its entry into force.

[3] This measurement method was proposed by EPEE, Eurovent and Asercom, and is presented to the members of the Consultation Forum with the agreement of the Commission.

Annex I: Ecodesign requirements

a) Specific requirements - Minimum energy efficiency requirements

Condensing units intended for use at medium and low operating temperature shall comply with both minimum requirements.

January 1, 2014 onwards, remote condensing units falling into the scope of the present Regulation shall meet the following minimum requirements

Table 1

Medium operating temperature			**Low operating temperature**		
Cooling capacity in kW	COP at +32°c	SEPR	Cooling capacity in kW	COP	SEPR
<1	1.2	n/a	<0.4	0.75	n/a
<5	1.4	n/a	<2	0.85	n/a
<20	n/a	2.25	<8	n/a	1.5
>20	n/a	2.35	>8	n/a	1.6

January 1, 2017 onwards, remote condensing units falling into the scope of the present Regulation shall meet the following minimum requirements

Table 2

Medium operating temperature			**Low operating temperature**		
Cooling capacity in kW	COP at +32°c	SEPR	Cooling capacity in kW	COP	SEPR
<1	1.4	n/a	<0.4	0.8	n/a
<5	1.6	n/a	<2	0.95	n/a
<20	n/a	2.55	<8	n/a	1.6
>20	n/a	2.65	>8	n/a	1.7

b) Product information requirements

January 1, 2014 onwards, the following parameters shall be reported in the product documentation accompanying remote condensing units falling into the scope of the present Regulation which have smaller cooling capacity than 5kW and 2kW for medium and low operating temperatures respectively:

- Intended operating temperature(s), expressed in °c
- COP at full load and +32°c ambient temperature, rounded to two decimal places, and corresponding cooling capacity and power input, expressed in kW and rounded to three decimal places
- COP at full load and +25°c ambient temperature, rounded to two decimal places, and corresponding cooling capacity and power input, expressed in kW and rounded to three decimal places

January 1, 2014 onwards, the following parameters shall be reported in the product documentation accompanying remote condensing units falling into the scope of the present Regulation which have higher cooling capacity than 5kW and 2kW for medium and low operating temperatures respectively:

- SEPR, rounded to two decimal places, and corresponding cooling capacities and power inputs at all reference points A, B, C and D, expressed in kW and rounded to three decimal places

January 1, 2014 onwards, the following parameters shall be reported in the product documentation accompanying remote condensing units falling into the scope of the present Regulation which are intended to be useable in ambient conditions above +35°c:

- COP at full load and +43°c ambient temperature, rounded to two decimal places, and corresponding cooling capacity and power input, expressed in kW and rounded to three decimal places

Annex II: Calculation methods

For the purpose of this Regulation, the following calculation formulae apply

COP is the coefficient of performance of a remote condensing unit, measured at full load, rounded to two decimal places, with

$$COP = \frac{P}{D}$$

Where

P is the cooling capacity, expressed in kW and rounded to two decimal places

D is the power input, expressed in kW and rounded to two decimal places

SEPR is the seasonal energy performance ratio of a remote condensing unit, rounded to two decimal places, with

$$SEPR = \frac{\sum_{j=1}^{n} h_j \cdot P_R(T_j)}{\sum_{j=1}^{n} h_j \cdot \left(\frac{P_R(T_j)}{COP_{PL}(T_j)} \right)}$$

Where

T_j = the bin temperature

j = the bin number, with $j \in \{1,2,\ldots n\}$

$P_R(T_j)$ = the refrigeration demand for the corresponding bin temperature T_j.

h_j = the number of bin hours occurring at the corresponding bin temperature T_j.

$COP_{PL}(T_j)$ = the COP values of the unit for the corresponding bin temperature T_j., which are determined through linear interpolation between the COP measured and calculated for the 4 reference points A, B, C and D, as indicated in Tables 1 and 2 below

Table 1- Part load conditions for reference points A, B, C, D for the SEPR calculation of condensing units operating at medium temperature

Reference point	**Part load ratio (%)**	**Outdoor heat exchanger**
		Air dry bulb temperature (°C)
A	100%	32
B	89.6%	25
C	74.8%	15
D	60%	5

Table 2- Part load conditions for reference points A, B, C, D for the SEPR calculation of condensing units operating at low temperature		
Reference point	**Part load ratio (%)**	**Outdoor heat exchanger**
		Air dry bulb temperature (°C)
A	100%	32
B	94.8%	25
C	87.4%	15
D	80%	5

For load conditions above load conditions indicated for reference point A, the same COP value as for reference point A shall be reported
For load conditions below load conditions indicated for reference point D, the same COP value as for reference point D shall be used

Annex III: Measurement methods

For the purpose of compliance with the requirements of this Regulation, measurements shall be made using a reliable, accurate and reproducible measurement procedure, which takes into account the generally recognised state of the art measurement methods, including methods set out in documents the reference numbers of which have been published for that purpose in the Official Journal of the European Union.

Annex IV: Verification procedure for market surveillance purposes

For the purposes of checking conformity with the requirements laid down in Annex I, Member State authorities shall test a single remote condensing unit. If the measured parameters do not meet the values declared by the supplier within the ranges set out in Table 1, the measurements shall be carried out on three more remote condensing units. The arithmetic mean of the measured values of these three remote condensing units shall meet the values declared by the manufacturer within the range defined in Table 1.

Otherwise, the model and all other equivalent remote condensing unit models shall be considered not to comply with the requirements laid down in Annex I (Ecodesign requirements).

Member States authorities shall use reliable, accurate and reproducible measurement procedures, which take into account the generally recognised state-of-the-art measurement methods, including methods set out in documents the reference numbers of which have been published for that purpose in the Official Journal of the European Union.

Table 1.

Measured parameter	Verification tolerances
COP value (full load, +32°c)	The measured value of the COP at declared capacity shall not be lower than the declared value by more than 10 % and shall not be lower than the minimum COP allowed in Annex 1 by 10%
Cooling capacity (full load, +32°c)	The measured value shall not be lower than the declared value by more than 10%
Power input (full load, +32°c)	The measured value shall not be greater than the declared value by more than 5 %
SEPR value	The measured value of SEPR at declared capacity shall not be lower than the declared value by more than 10% and shall not be lower than the minimum SEPR allowed in Annex 1 by 10%
Cooling capacity at reference points A, B, C, D	The measured value shall not be lower than the declared value by more than 10 %
Power input at reference points A, B, C, D	The measured value shall not be greater than the declared value by more than 5 %