Bulletin of the *Transilvania* University of Braşov • Vol. 10 (59) Special Issue No. 1 - 2017
Series I: Engineering Sciences

NEW REQUIREMENTS FOR AIR HANDLING UNITS IN COMPLIANCE WITH ERP DIRECTIVE

C. G. POPOVICI[1]

Abstract: *Environmentally friendly design The European Ecodesign Directive 2009/125/EU (Energy-Related Products), also called the Eco-Design Directive, defines minimum requirements on energy consumption-relevant products. With the help of the Directive, the consumption of electric energy as well as CO2 emissions should be drastically reduced. In addition, the proportion of renewable energies or systems for heat recovery should be increased. A look at the minimum requirements shows that starting in 2018, very high requirements will be placed on HVAC units and their components. The paper analyses the new requirements for Air Handling Units under ErP Directive and case study.*

Key words: *new requirements, Air Handling Units, Ecodesign Directive 2009/125/EU.*

1. Introduction

Within the scope of the Ecodesign Directive, the (EU) regulation 1253/2014 was adopted which describes an "environmentally friendly" design of HVAC units for living space and non-domestic ventilation equipment.

The Ecodesign Directive applies to HVAC units that replace consumed air with outdoor air in a building or building unit. HVAC units for treating industrial or production emissions and removing heat loads do not fall under the scope of the Ecodesign Directive.

Regarding the AHUs, EC-Directive 1253/2014 came into force on November 26th 2014 and began January 1st 2016, new requirements concerning the energy efficiency of AHUs was apply within the European Economic Area (EEA).

This standard aimed ventilation units for intake air and exhaust air in a building or part of a building and enumerate – roof fans, duct fans, residential ventilation units and modular air handling units.

All these ventilation units has to fulfil a minimum efficiency and need to have at least a multi speed control which is under the response of the installer.

AHUs that are delivered after January 01 2016 must comply with ErP-Directive. As of January 01 2018, the next step will further tighten the requirements. In the year 2020, additional tightening up is scheduled.

The directive applies to ventilation units for intake/exhaust air in buildings or part of buildings. This does not include applications, during which at least one air flow is defined

[1] Faculty of Civil Engineering and Building Services, "Gheorghe Asachi" Technical University of Iasi.

by an industrial or production process.

Specific Ecodesign requirements are different for non-residential ventilation units-NRVU and residential ventilation units – RVU from 01.01.2016 with an intensification of 2018.

No blanket statements can be made about applications that apply as process air! Applications must be examined case by case.

Exceptions:[1-2]

HVAC units with the following properties are excluded from the scope of validity:

- Electrical power consumption <30W
- Functioning air temperature rises above 100°C or decreases <-40°C (moving air)
- Operating temperature of the motor >65°C or <-40°C
- Supply voltage >1,000V AC or >1,500 V DC
- Special conditions at the installation site (toxic, extremely corrosive, combustible)
- Environment with abrasive materials
- HVAC unit for pure recirculated-air mode or with a circulatory air portion >90%

Next we look Ecodesign requirements for non-domestic ventilation units for two situations:

- Unidirectional ventilation units - Supply air – extract air
- Two-directional ventilation equipment - Supply air – extract air – outside air – exhaust air

2. Unidirectional Ventilation Units (UVU)

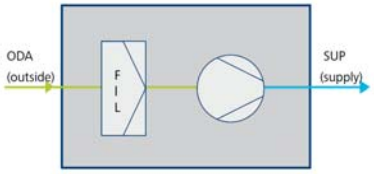
Unidirectional ventilation units or one directional ventilation plants are typically simple supply- or extract-air units. The delivery configuration of such units contains the casing, a filter, and a fan. Additional components such as heat transfer unit are designated as "non"-ventilating components.

All **unidirectional ventilation units (UVU)** have to be equipped with 1 filter F7 (ODA) - see Table 1. [1-2]

All fans suitable for multi-speed-drive (min. 3 steps plus 0) or variable-speed-drive. Controller can be external.

Filter pressure switch is require according ErP 2018 but will require according ErP 2018.

Ecodesign requirements for non-domestic unidirectional ventilation units Table 1

Ecodesign Directive valid from		2016	2018
Reference configuration of unidirectional ventilation equipment 			
Number	Air flow direction	1	1
	Fan	1	1
Filter classes	Outdoor air	F7	F7
	Extract air	M5	M5

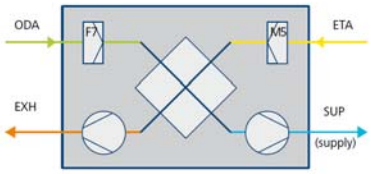
Minimal requirements			
Fan efficiency	P≤30 Kw	6.2% *ln(P[kW])+35.0%	6.2%*ln(P[kW])+42.0%
	P>30 Kw	56.1%	63.1%
Internal specified fan power requirements SFP_{int_limit}	W/(m^3/s)	250	230
Fan speed regulation		Required	required
Filter differential pressure monitoring		Not required	required

3. Bidirectional Ventilation Equipment (BVU)

Bidirectional Two directional ventilation plants are typically HVAC units with supply- and extract-air function. The delivery configuration of such units contains the casing, a filter, and a fan for every air stream. Additional components such as heat exchangers are designated as "non-" ventilation components. These units are equipped with a performance-regulated heat/cold recovery (HCR).

Ecodesign requirements for non-domestic bidirectional ventilation units -Supply air – extract air – outside air – exhaust air are presented in Table 2. [1-2]

Ecodesign requirements for non-domestic bidirectional ventilation units Table 2

Ecodesign Directive valid from			**2016**	**2018**
Reference configuration of bidirectional ventilation units 				
Number	Air direction		2	2
	Fans		2	2
Filter classes	Outdoor air		F7	F7
	Extract air		M5	M5
Heat recovery systems			required	required
Minimal requirements				
Heat recovery efficiency (dry) ηt [%]	KVS		63	68
	Other HCR systems		67	73
Internal spec. fan power SFP_{int_limit} [w/(m^3/s)]	KVS	q <2m^3/s	1.700+E-300xq/2-F	1.600+E-300xq/2-F
		q ≥2m^3/s	1.400+E-F	1.300+E-F
	Other HCR systems	q <2m^3/s	1.200+E-300xq/2-F	1.100+E-300xq/2-F
		q ≥2m^3/s	900+E-F	800+E-F

Efficiency bonus E [w/(m^3/s)]	KVS	(η_t-63)x30	(η_t-68)x30
	Other HCR systems	(η_t-67)x30	(η_t-73)x30
Filter correction F	Delivery configuration	0	0
	M5 filter is missing	160	150
	F7 filter is missing	200	190
	F7+ M5 filters are missing	360	340
Fan speed regulation		required	required
Filter differential pressure monitoring		Not required	required

The minimum requirements shows that starting in 2018, very high requirements will be placed on HVAC units and their components. According to today's state of technology, the requirements of the Ecodesign Directive with respect to SFP, HCR and fan efficiency result in technically more exacting HVAC units to conform with these high efficiency standards. The EU Commission has moreover indicated it might apply an even more rigorous Ecodesign Directive for HVAC units starting in 2020. This conforms with the EU Directive 2010/31, which regulates the total energy efficiency of buildings and requires that all new buildings (public buildings from 2018) must be lowest-energy buildings by the end of 2020.

4. Case Study

It is very important to see the impact of the Directive from all perspectives. How much we invest in and how much we save. We have analyzed a case study of DencoHappel for AHU with total flow 14000cm/h , a heat recovery of 55% and an air velocity of 2.2 m/s in the clear unit cross-section (version 2015).

Main characteristics of AHU studied [3] Table 3

Basics of LCC calculation	
Annual operating hours	4171
Annual heating hours	3606
Annual cooling hours	565
Volume flow (ABL=ZUL)	12,000 m^3/h
Heat-recovery system	Plate heat exchangers
Electrical costs	0.15 € /kWh
Heating costs	0.06 € / kWh

The values from the example reflect the future trend. HVAC units will require more space in order to comply with the requirements of the Ecodesign Directive.
It is noted that according to ERP 2016, investment costs increase by 26%, reducing energy consumption in winter time by 42% and 2% in summer time, reducing the fan's electricity consumption by 4%, thus a slush period 1.9 years.

The Table 4 presents the unit configuration, energy consumption and lifecycle costs in accordance with ERP 2016 and ERP 2017.

ERP 2016 and ERP 2018 [1-2] Table 4

Ecodesign Directive valid from	**2016**	**2018**
Unit configuration		
Front air velocity	1.8 m/s	1.4 m/s
Heat recovery efficiency	68%	75%
Footprint (set-up area)	39%	48%
Weight	39%	70%
Energy consumption		
Heating capacity	-42%	-64%
Cooling capacity	-2%	-4%
Fan Power	-4%	-15%
Lifecycle costs		
Investment costs	25%	57%
Annuity of the energy costs	-19%	-33%
Annuity of the capital costs	25%	57%
Total annuity	-14%	-24%
Amortisation	1.9 years	2.7 years

Looking to ERP 2018, investment costs increase by 57%, reducing energy consumption in winter time by 64% and 4% in summer time, reducing the fan's electricity consumption by 15%, thus a slush period 2.7 years.

Figure 1 presents the annual heating capacity HCR without ErP, with ErP 2016 and ErP 2018.

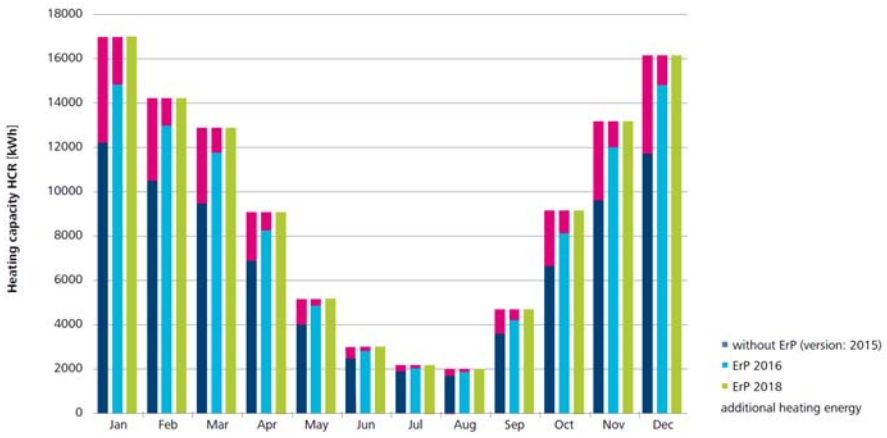


Fig. 1. *Annual heating capacity HCR without Erp, with Erp 2016 and ErP 2018.*

5. Conclusions

There is world-wide demand for more efficient products to reduce energy and resource consumption. The EU legislation on Ecodesign and energy labelling is an effective tool for improving the energy efficiency of products. It helps eliminate the least performing products from the market, significantly contributing to the EU's 2020 energy efficiency objective. It also supports industrial competitiveness and innovation by promoting the better environmental performance of products throughout the Internal Market.

A case study for an AHU with a flow rate of 14,000 cm / h shows that according to ERP 2016, investment costs increase by 26%, reducing energy consumption in winter time by 42% and 2% in summer time, reducing the fan's electricity consumption by 4%, thus a slush period 1.9 years.

For the same case study , according to ERP 2018 , investment costs increase by 57%, reducing energy consumption in winter time by 64% and 4% in summer time, reducing the fan's electricity consumption by 15%, thus a slush period 2.7 years.

The values from the case study reflect the future trend.

References

1. ***Directive 2009/125/EC
2. ***Commission Regulation (EU) No 1253/2014
3. ***http://dencohappel-doqu.com