the air handling company

Energy efficiency classes of air handling units.

February 2022
English

AHUs from robatherm with energy efficiency class A+ according to EUROVENT.

Energy efficiency: Always up to date with robatherm.

As has been the case for years with electrically operated household appliances (refrigerators, washing machines), energy efficiency classes provide a reliable guide for air handling units. These classes are clearly defined: Energy efficiency for air handling units (AHUs) is regulated by several directives.

Efficient air handling technology from robatherm

Efficiency means more than just an efficiency label on the AHU. Together with you, we will find the solution that you really need, that actually meets your efficiency requirements and that is compliant with standards.

In addition to the consideration of energy efficiency classes, this solution-finding process can consist of the determination of efficient and short installation times on the construction site and convenient maintenance conditions or the examination of the entire life cycle costs from investment to operation and maintenance to disposal. If you have any questions about efficient air handling technology, our contact persons will be happy to advise you.

On the pulse of time

A wide variety of standards and guidelines influence the classification of the energy efficiency of air handling units. The table provides an overview of the standards and guidelines that are decisive in this classification.

We are involved in a wide variety of normative workgroups, both nationally and internationally. Only in this way can we offer you sustainable solutions with which you are on the safe side.

Directive and standards	Title	Description
1253/2014/EG 2281/2016/EU	ErP (Energy-Related Products) Directive (Ecodesign Directive)	The European ErP Directives define the efficiency requirements for air handling, air heating and air cooling units, among others.
DIN EN 16798-3	Energy evaluation of buildings – Ventilation of buildings – Part 3: Ventilation of non-residential buildings – Performance requirements for ventilation and air conditioning systems and room cooling systems	This European standard focuses on the energy-relevant values and their calculation method. It also describes how to certify the complete system.
DIN EN 13053	Ventilation of buildings – Central air handling units – Performance characteristics for devices, components and assemblies	The European standard provides recommendations for the planning and design of an air handling unit, as well as defining requirements and classifications for special components.

Different SFP values mean: Efficiency in current consumption.

The specific fan power is the ratio between the electrical power consumption of a fan and the delivered air volume (in W/m³/s). In this way, the efficiency of an AHU is demonstrated.
This is how the SFP value is calculated:

$$SFP = \frac{P}{q_v} = \frac{\Delta p}{\eta}$$

This performance is cited in various directives and standards, but it is never the same value and can have different meanings.

SFP_{int} value for evaluation of the AHU

With the introduction of the ErP Directive 1253/2014/EC (Energy-related-Products) by the European Union, the SFP_{int} value has been used as a criterion for evaluating and comparing AHUs according to a specific reference configuration since January 1, 2016. The efficiency evaluation must be performed on a reference configuration depending on whether it is a unidirectional ventilation unit (UVU) or a bidirectional ventilation unit (BVU).
The AHU is evaluated on the basis of the efficiency of the fan-motor unit, the filter and heat recovery in the form of the so-called internal specific fan power SFP_{int}.
Since no additional built-in components or external pressure drops are taken into consideration here in contrast to the SFPV value, the efficiency of the AHU can therefore be assessed directly. In ErP Directive 1254/2014/EC, energy efficiency ratings are defined and prescribed only for residential ventilation units – but not for non-residential ventilation units. The latter devices have corresponding guidelines for the definition of energy efficiency ratings from both the European manufacturers' association EUROVENT and the German manufacturers' association Raumlufttechnische Geräte e.V.. These guidelines can be applied on a voluntary basis.

SFP_v value for evaluation of the complete AHU

The specific fan power under validation conditions – the SFPV value (specific fan power) according to EN 16798-3 – only allows a rudimentary assessment of the entire ventilation and air conditioning system. The efficiency of the AHU is only indirectly taken into consideration because the SFPV value is largely determined by the external pressure drop, which cannot be influenced by the device manufacturer and does not depend on the quality of the device.

Specific fan power SFP_v[1,2] according to DIN EN 16798-3

SFP class	$P_{SFP} = P_M / q_v = Dp_{stat} / \eta_{stat}$ [W/m³/s]
SFP 0	< 300
SFP 1	300 bis 500
SFP 2	500 bis 750
SFP 3	750 bis 1.250
SFP 4[3]	1.250 bis 2.000
SFP 5	2.000 bis 3.000
SFP 6	3.000 bis 4.500
SFP 7	> 4.500

[1] To be determined with clean filters and dry installed parts
[2] Additional allowances for components according to EN 16798-3
[3] Minimum requirement according to EnEV 2016

Allowances for components according to EN 16798-3

Component	Allowance [W/m³/s]
Each additional filter stage above the first filter stage	+ 300
Absolute filter stage (HEPA filter)	+ 1000
Activated carbon filter (gas filter)	+ 300
High-efficiency HRS of class H1 or H2 (according to EN 13053)	+ 300

Recommended SFP classes for AHUs according to EN 16798-3

AHU	SFP class
Exhaust air system, simple (without HRS)	SFP 2
Exhaust air system, complex (with HRS)	SFP 3
Supply air system, simple (without HRS)	SFP 3
Supply air system, complex (with HRS)	SFP 4

Weatherproof AHUs must also meet efficiency requirements.

Other energy-relevant values.

The energy demand of AHUs is largely determined by the following parameters: the air velocity in the unit, the electrical power consumption of the fan motor and the quality of the heat recovery function.

System efficiency of the fan

The static system efficiency is determined by four individual efficiencies – the efficiency of the fan (η_F), the motor (η_M), the drive (η_D) and the control (η_C):

$$\eta_{sys} = \eta_F \times \eta_M \times \eta_D \times \eta_C$$

The system efficiency usually lies between 54% and 70%. Below 54%, the 2018 ErP tier of Regulation 1253/2014/EC becomes difficult to achieve. This regulation is currently being revised, a first draft of the EU Commission has already been presented and is under discussion.

Air velocity classes[14] according to DIN EN 13053

V-class	Speed in clear cross-section [m/s]
V1	$v \leq 1,6$
V2	$1,6 < v \leq 1,8$
V3	$1,8 < v \leq 2,0$
V4	$2,0 < v \leq 2,2$
V5	$2,2 < v \leq 2,5$
V6	$2,5 < v \leq 2,8$
V7	$v > 2,8$

[14] The velocities are related to the internal cross-section of the AHU in the filter chamber

Final pressure drop of filter according to EN 13053

In order to reduce the power consumption of a fan during the operation of the AHU, the final pressure drop of the filter must be kept low. EN 13053 defines this maximum pressure drop:

Filter group[16]	Max. permissible pressure drop according to EN 13053
ISO coarse	The lower value between: • 50 Pa + initial pressure drop • 3x initial pressure drop
ISO ePM_1 ISO $ePM_{2,5}$ ISO ePM_{10}	The lower value between: • 100 Pa + initial pressure drop • 3x initial pressure drop

[16] In the new version of EN 13053, filters must be designed according to ISO 16890. The former EN 779 is no longer valid.

Classes of electrical power consumption according to EN 13053

Maximum permissible power consumption P_{m_ref}[15] [kW]
$P_{m\_ref} = (\frac{Dp_{stat}}{450})^{0,925} \times [q_v + 0,08]^{0,95}$

[15] with static pressure drop Δp_{stat} [Pa] and airflow q_v [m³/s]

P-class	Absorbed electrical power [kW]
P1	$\leq 0,85 \times P_{m\_ref}$
P2	$\leq 0,90 \times P_{m\_ref}$
P3	$\leq 0,95 \times P_{m\_ref}$
P4	$\leq 1,00 \times P_{m\_ref}$
P5	$\leq 1,06 \times P_{m\_ref}$
P6	$\leq 1,12 \times P_{m\_ref}$
P7	$> 1,12 \times P_{m\_ref}$

Heat recovery via two rotors.

Heat recovery classes according to EN 13053

EN 13053 has been comprehensively revised. For example, the energy-related characteristic values were adjusted. These changes were necessary because the energy requirements were significantly tightened by the ErP Directive and therefore the requirements of EN 13053 were no longer up-to-date at that time. The current version of EN 13053 appeared in 2020.

H-class	Energy efficiency[17] [%]
H1	$h_e \geq 74$
H2	$74 > h_e \geq 70$
H3	$70 > h_e \geq 65$
H4	$65 > h_e \geq 60$
H5	$60 > h_e$

[17] The data is based on the EN 13053 values shown in the table above on the right.

Temperature transmission efficiency (HRS)[18] [%]

$$h_t = \frac{t_{SUP} - t_{ODA}}{t_{ETA} - t_{ODA}} \times 100$$

[18] with a temperature transfer coefficient (dry) ηt [%] according to EN 308 (at mass flow ratio 1:1)
Calculation conditions of EN 308:
Outside air: 5 °C, 0% RH; exhaust air: 25 °C, 0% RH

Pressure drop of HRS [Pa]

$$Dp_{HRS} = Dp_{HRS\_SUP} + Dp_{HRS\_ETA}$$

Electrical auxiliary energy of HRS[19] [W]

$$P_{el\_HRS} = q_v \times Dp_{HRS} \times \frac{1}{0{,}6} + P_{el\_Aux}$$

[19] with airflow: q_v [m³/s]; drive energy of HRS: P_{el_Aux} [W]

Performance number of HRS [-]

$$e = \frac{Q_{HRS}}{P_{el\_HRS}}$$

Energy efficiency of HRS [%]

$$h_e = h_t \times \left(1 - \frac{1}{e}\right)$$

Energy efficiency classes according to EUROVENT.

EUROVENT's energy efficiency classes have been divided into two labels since 2020: the summer label and the winter label, with the winter label continuing to be regarded as the main label on the European market. This division allows the energy efficiency of an AHU to be taken into consideration under two different conditions; Making the classification more realistic and thus more meaningful when viewed over the entire course of the year. For both energy efficiency classes according to the EUROVENT method, six ratings (A+ to E) are possible in each case.

At EUROVENT, the compensation procedure applies. Here, not all individual reference values of the desired energy efficiency class have to be met. For example, a heat recovery coefficient of the heat recovery system (HRS) that is too low can be compensated by a better (lower) power consumption of the fan motor. This applies to both labels (summer and winter). The compensation of the influencing variables air velocity, the pressure loss of the heat recovery system, the (dry or humid) heat recovery coefficient of the heat recovery system and the efficiency of the fan is based on the conversion into uniform pressure drop allowances. The weighting of these allowances is based on the primary energy demand.

In order to use this process, members must undergo a rigorous certification process. In addition to the annual monitoring of the design software, this process also includes testing of specified performance data by means of measurements on real equipment. This monitoring may only be carried out by accredited testing institutes (e.g., TÜV).

The winter label from EUROVENT
The winter label is the previous, successfully established and internationally recognized EUROVENT energy efficiency label. Due to the strong differentiation in the various classes, differences in interpretation can be easily recognized. In some cases, the individual requirements are significantly higher than the legally required minimum requirements according to the ErP Directive 1253/2014/EC for AHUs.

The summer label of EUROVENT
The summer label was published in 2020 and has had to be listed on technical data sheets ever since. It was primarily initiated for regions with a hot, humid climate, such as southern Europe or Asia. Until now, energy consumption in summer or in cooling mode in particular has not been taken into account. As a result, the certification was not particularly meaningful for such regions. The comparison of different AHUs was therefore difficult. The summer label counteracts this lack of transparency and now provides a better basis for decision-making.

Two new values are used to determine the new EUROVENT summer label: the dry bulb temperature (summer) and the dew point temperature. Both values are consistent with ASHRAE's climatic design conditions and are official weather data (from the 2017 reference year). They depend on the project location and must be used equally by all manufacturers.

When calculating the summer label, special attention is paid to moisture recovery. Influential factors for the classification into the different classes are the humidity recovery coefficient (ratio of absolute humidity), as well as the humidity pressure losses. AHUs with rotors therefore usually achieve better summer label efficiency classes than AHUs with other HRS technologies.

Representation of the dry bulb temperature (summer) and the dew point temperature
Some project sites in Europe are not yet affected by this label because the winter dry bulb temperature and summer dew point temperature have been set quite high.
Disadvantage of this label: the northern half of Europe will unfortunately never be able to use it as the climate there can be too cold and too dry in summer.
However, EUROVENT already has plans to expand it. Later, technologies such as a heat recovery system bypass and adiabatic cooling will be included in the calculation.

EUROVENT reference values of the winter label according to ECP05-2021

Energy efficiency class	All devices	Devices for an outdoor air temperature ≤ 9 °C (winter)		Fan system efficiency
	Speed	Heat recovery		
	v_{class} [m/s]	h_{class} [%]	Dp_{class} [Pa]	$NG_{ref\text{-}class}$ [-]
A+ / A+↻ / A+↑	1,4	83	250	64
A / A↻ / A↑	1,6	78	230	62
B / B↻ / B↑	1,8	73[10]	210	60
C / C↻ / C↑	2,0	68[11]	190	57
D / D↻ / D↑	2,2	63	170	52
E / E↻ / E↑	No calculation required			No requirement

A+ to E: Units with an outdoor air connection and a design temperature $t_{Winter} \leq 9°C$
A+↻ to E↻: Recirculation unit (100%) or units with a design temperature $t_{Winter} > 9°C$
A+↑ to E↑: Pure exhaust air units

[10] Minimum requirement ErP tier 2018 for other heat recovery systems (HRS)
[11] Minimum requirement ErP tier 2018 for run around coil heat recovery systems (RAC)

EUROVENT reference values of the summer label according to ECP05-2021

Energy efficiency class	All devices	Dry bulb temperature (winter) ≥ -3°C + Dry bulb temperature (summer)[12] ≥ 30°C — or — Dry bulb temperature (winter) ≥ -3°C + Dew point temperature[12] ≥ 17°C — or — Dry bulb temperature[12] ≥ 30°C + Dew point temperature[12] ≥ 17°C				Fan system efficiency
	Speed	Heat recovery				
	v_{class} [m/s]	$h_{class\text{-}T}$ [%]	$Dp_{class\text{-}T}$ [Pa]	$h_{class\text{-}H}$ [%]	$Dp_{class\text{-}H}$ [Pa]	$NG_{ref\text{-}class}$ [-]
A+	1,4	83	167	81	222	64
A	1,6	78	160	73	213	62
B	1,8	73	155	65	207	60
C	2,0	68	151	58	202	57
D	2,2	63	147	50	197	52
E	No calculation required					No requirement

[12] According to ASHRAE climatic design conditions

Efficient and hygienic: AHUs from robatherm.

Energy efficiency classes according to the German RLT-Herstellerverband.

The energy efficiency classes according to the German AHU manufacturers' association (RLT-Herstellerverband) are based on the minimum requirements of ErP Directive 1253/2014/EC, which have been legally required since January 1, 2016. AHUs without an ErP tier fall under rating B and may no longer be placed on the market in the European Economic Area. In addition, the defined classes for air velocity must be observed. In contrast to the EUROVENT procedure, all required performance requirements for the award of the efficiency rating of the AHU manufacturers' association must be fulfilled; i.e., there is no compensation based on primary energy demand.

Energy efficiency class	A+	A	B
ErP-Tier (1253/2014/EG)	ErP READY 2018	ErP READY 2016	ErP NOT READY
Air velocity class			
- without thermodynamic air treatment	V5	V6	V7
- with air heating	V4	V5	V6
- with further functions (including HRS)	V2	V3	V5

RLT (AHU) Guideline 01

Not to be confused with the energy efficiency classification of the manufacturers' association is the "Regelkonformität" (Regulatory Compliance) label of the same association. This label refers to Guideline 01 of the manufacturer's association. In it, the association describes generally accepted rules of technology and makes specifications if standards and guidelines offer scope for interpretation. This description has no influence on the certification and is not legally binding. The "Regelkonformität" label is only intended to provide information that the respective AHU manufacturer has determined in its own testing that the AHU complies with all criteria of the RLT (AHU) Directive 01.

Energy comparison of both classification systems.

robatherm offers both the energy efficiency classification of the European manufacturers' association EUROVENT and the German manufacturers' association Raumlufttechnische Geräte e.V.
However, these classifications are based on different calculations. As a result, an AHU with class A+ according to EUROVENT is not identical with an AHU with class A+ according to AHU manufacturers association.
The following example shows how the two classifications can differ in result.

Sample calculation reveals the differences
Calculation conditions:

- Combination unit with 9,000 m³/h each
- Filter:
  Outdoor air: ISO ePM_1 50%
  Exhaust air: ISO ePM_{10} 50%
- Heat recovery system (HRS): Rotor
- Additional components in the supply air:
  1 heating coil, 1 cooling coil, 2 silencers, 1 damper
- Additional component in the exhaust air:
  2 silencers, 1 damper
- EC fans in both air streams
- Location: Paris
  Dry temperature in winter: -3 °C,
  Dry temperature in summer: 31.2 °C, dew point temperature: 13.3 °
- Type of use: Group office from seven workstations
- Operating time: 5 days/week, 5:00 a.m. to 8:00 p.m

Technical data

	EUROVENT		RLT-Herstellerverband
	Summer label	Winter label	
Energy efficiency class			
ErP-Tier	ErP 2018		ErP 2018
V-class	V2		V2
Speed	1,72 m/s		1,72 m/s
Unit cross-section per air flow at the filter chamber	1,40 m²		1,40 m²
Dry heat recovery coefficient EN 308	82%		74%
Pressure drop of HRS	SUP: 158 Pa ETA: 158 Pa	SUP: 158 Pa ETA: 158 Pa	SUP: 170 Pa ETA: 170 Pa
Humidity recovery coefficient	87%	-	50%
Electrical power consumption	SUP: 3,77 kW ETA: 3,22 kW		SUP: 3,94 kW ETA: 2,92 kW
Total static pressure drop	SUP: 969 Pa ETA: 731 Pa		SUP: 980 Pa ETA: 742 Pa
System efficiency	SUP: 64 % ETA: 57 %		SUP: 62 % ETA: 64 %

Cost comparison
The example clearly shows how much air handling units can differ, designed either according to class A+ of the AHU manufacturers' association or according to class A+ of EUROVENT.
EUROVENT classification in this case means additional investment of 6% of the investment sum. This is due to the highly efficient heat recovery system. The sorption rotor used also enables significantly better moisture recovery in summer. This component is more expensive, but helps to achieve class A+ in summer conditions.
The AHU according to the AHU manufacturers' association meets only the minimum requirements of the ErP. Heat recovery in summer is thus insignificant and such systems can be designed and operated with lower efficiencies.

Since the launch of the summer label, the difference has now become clear. According to EUROVENT, the AHU must also be able to operate efficiently in summer. Throughout the entire year, the air handling unit in this practical example requires 15% less energy according to EUROVENT. The concrete savings in this case are €16,500 after 5 years, which is almost the complete energy costs for one year. The additional investment in the AHU paid for itself after 1.3 years.

	EUROVENT		RLT-Herstellerverband
	Summer label	Winter label	
Energy efficiency class			
Additional investments	6%		-
Energy costs	18.700 € / Year		22.000 € / Year
Savings of energy costs	15%		-
Additional costs for energy after 5 years	-		16.500 €

Outlook for the future.

The energy efficiency of air handling units is becoming increasingly important. This is also the case in the European Union, which has revised a wide variety of directives and regulations in recent years and will continue to tighten them. The primary goal is for the entire building sector to become more environmentally friendly and sustainable. However, environmentally friendly means not only efficiency in terms of energy consumption, but also that people feel comfortable and stay healthy in buildings and their surroundings.

To achieve these goals, other characteristic values are available that focus on the quality of the AHU casing and the installation of components. Here, for example, the external and internal casting leakage, the correct component arrangement or the filter stage used have great significance.
You want to know more about air quality and its parameters? Our contact persons will be happy to advise you at any time.

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