EUROVENT SUMMIT ANTALYA 25-28 OCT 2022 #BuildingBridges

# New Energy Efficiency Label for AHUs in Hot and Humid Climates

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# Introduction

1. Eurovent AHU Programme
2. Energy Efficiency Labels in AHU Programme
3. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)
   a. Why energy labels for Summer Application?
   b. Subgroups of AHUs for Summer Application
   c. Reference Table for the Summer Application classes
   d. What unit performances are considered for the classification?
   e. Additional considerations for the classification?

# 2. Eurovent AHU Programme

**The programme scope**

- All ranges of Air Handling Units that can be selected in a software.
- Selection software shall be certified.
- Certify-all: All Real Unit sizes available in the software and up to the maximum stated air flow, All Model Box configurations, shall be declared.

- ✓ 142 participants (manufacturers)
- ✓ 144 brands are published as certified in ECC WebSite
- ✓ ~1000 model boxes
- ✓ ~15000 base models are certified
- ✓ With the selection software certification in the programme, all these base model units and all the Real Models, which can be derived from the base models, are certified

**ECC Reference Documents**

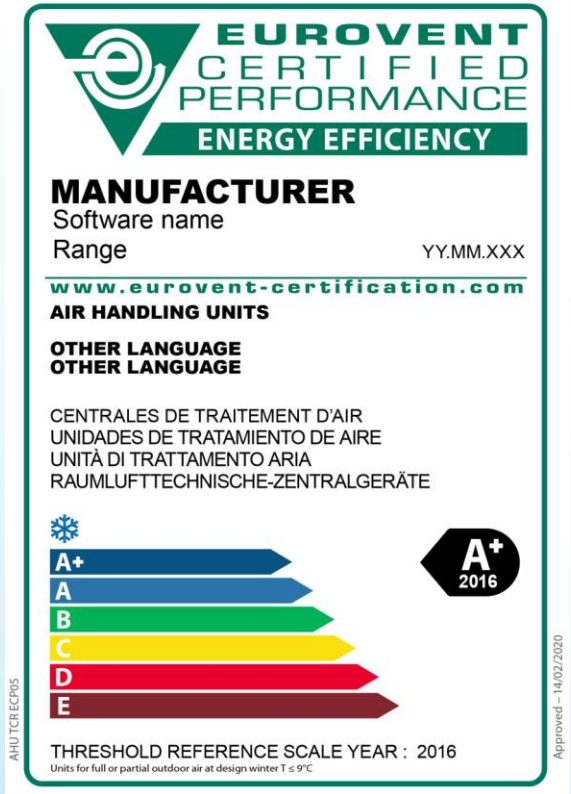
The Certification Manual

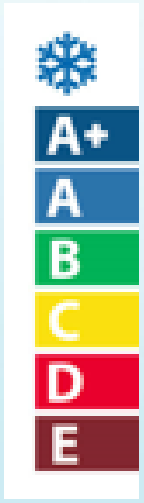
TCR (Technical Certification Rules) for AHU

# 3. Energy Efficiency Labels in AHU Programme

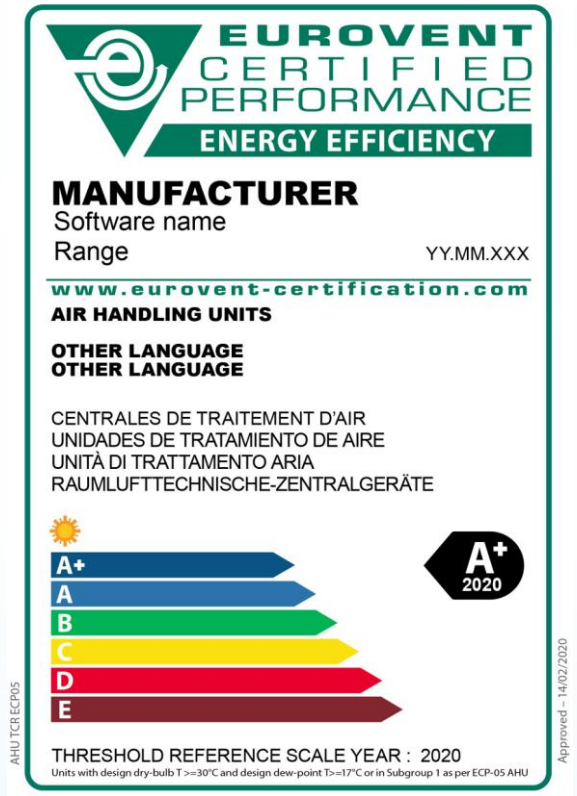
*Hot and Humid Climate*

## Winter Application



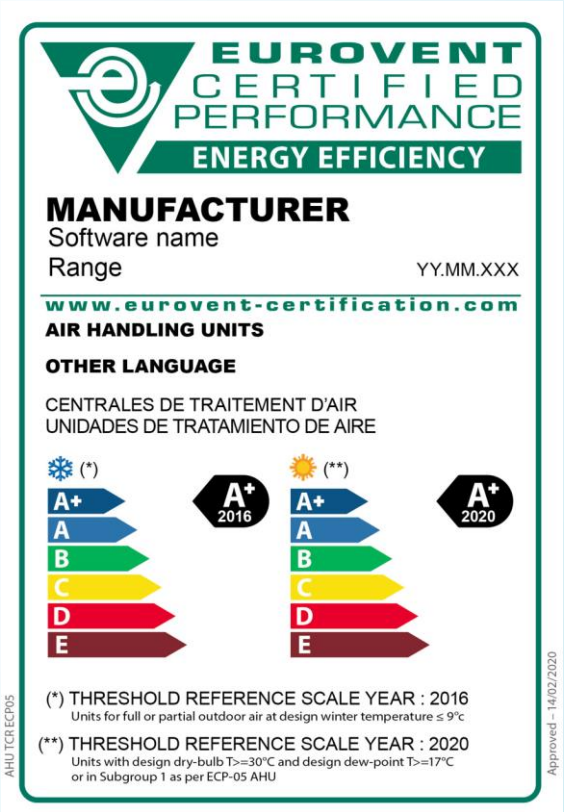




## Summer Application





## Both Applications



# 3. Energy Efficiency Labels in AHU Programme

or, mini labels are also available…

## Winter Application


### Subgroups for Winter Application

A+ 2016

Units with full/partial outdoor air w/ HRS at winter design temperature ≤ 9 °C

**Recirculation**
Units with full/partial recirculation air with design inlet temperatures always > 9°C *(Even if existing, HRS not taken into account)*

**Stand-alone**
Units with full extract air w/o HRS *(No design condition taken into account)*

## Hot and Humid Climate
## Summer Application


+

**Both Applications**
Both can be used for the same unit.

# 3. Energy Efficiency Labels in AHU Programme



**Winter Application**


**Summer Application**


**Years shall always be shown, as they refer to the classification method used.**

# 4. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)

## a. Why an energy label/classed for Summer Application?

- As in the classes for Winter Application, to promote the most efficient units at cooling function operating at hot and humid climates.
- Based on the operation performances as well as the following points.
  - Humidity Recovery – *(In force)*
  - Reduction of the ΔP in the Heat Recovery System (HRS) bypass - *(Soon)*
  - Indirect adiabatic cooling (IAC) – *(Soon)*
- **The classes are therefore based on the project location.**
- It can be also done with the Region Approach when the exact location of the project is unknown.

*Europe, Middle East, North Africa and some other locations with extreme weather.

# 4. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)

## b. Subgroups of AHUs Summer Application

**Subgroup 1** *(Mandatory to use Energy Label)*

The unit fall under the subgroup 1 if the outdoor conditions of the place where the unit will be installed are the following:

- Winter Design condition[1] ≥ -3°C and Design dry-bulb temperature[1] ≥ 30°C, or,
- Winter Design condition[1] ≥ -3°C and Design dew-point temperature[2] ≥ 17°C, or,
- Design dry-bulb temperature[1] ≥ 30°C and Design dew-point temperature[2] ≥ 17°C.

[1] from ASHRAE 2017 Climatic Design Conditions
[2] calculated with wet bulb temperature from ASHRAE 2017 Climatic Design Conditions

# 4. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)

## b. Subgroups of AHUs Summer Application

**Subgroup 2** *(Not mandatory to use Energy Label)*
If the outdoor design conditions, where the unit will be installed, are different than the ones covered by Subgroup 1, then the unit falls under **Subgroup 2**.

Then the class will be displayed with 

Recirculation of Winter Application. The class becomes the same as the winter application (subgroup 2, when the winter design temperature Toda >9 °C).

**Subgroup 3** *(Not mandatory to use Energy Label)*
Unit with pure extract air. The class will then be the same as the subgroup 3 of Winter Application, 

.

For this two subgroups, the same class, which shall be determined for the Winter Application, **can** be used in the Summer Application labels.

# 4. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)

## c. Reference Table for the Summer Application classes

| CLASS | All Units | Units for full or partial outdoor air at design summer: winter dry bulb temperature ≥ -3°C AND dry bulb temperature ≥ 30°C OR winter dry bulb temperature ≥ -3°C AND dew-point temperature ≥ 17°C OR dry bulb temperature ≥ 30°C AND dew-point temperature ≥ 17°C | | | | |
|---|---|---|---|---|---|---|
| | Velocity | Heat recovery system | | | | Fan Efficiency Grade |
| | $v_{class}$ [m/s] | $\eta_{class-T}$ [%] | $\Delta p_{class-T}$ [Pa] | $\eta_{class-H}$ [%] | $\Delta p_{class-H}$ [Pa] | $NG_{ref-class}$ [-] |
| 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 |

*Table 8: Table for energy efficiency calculations (summer application)*

These are not the thresholds or criterion to determine the classes!

They are the guide values to be used for the calculations.

Based on actual measurements of units operating at different design conditions.

# 4. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)

## d. What unit performances are considered for the classification?

For the AHU to be classified at design air flow rate, the following actual performances (selection) during the summer time shall be used.

- Fan static pressure increase – $\Delta p_s$-static
- External static pressure drop – $\Delta p_s$-external
- Velocity at the cross section – $v_s$
- Power supplied to selected fans – $P_s$
- HRS temperature efficiency – $\eta_s$-T
- HRS humidity efficiency – $\eta_s$-H
- HRS pressure drop – $\Delta p_s$-HRS
- Mixing ratio: Recirculated air / Supply air

# 4. Energy Efficiency Labels for Hot and Humid Climates (Summer Application)

## e. Additional considerations taken during the classification

With the given empirical equations, the following factors are calculated for each class (starting from the A+ to below)

- $f_{T\text{-}H}$ : how much the humidity efficiency is affective depending on the design conditions
- $f_{pe\text{-}DB}$ : the relation between the HRS temperature efficiency and HRS pressure drop at design dry bulb temperature (not so much like in Winter Application: ~2 Pa for +1% at 35 °C)
- $f_{pe\text{-}DewP}$: the relation between the HRS humidity efficiency and HRS pressure drop at design dew point temperature (~20 Pa for +1% at $T_{dp}$ of 20 °C, but has small impact on classification)

By following the methodology given in the TCR document, with the use of these factors pressure corrections due to HRS pressure drop and to HRS efficiency are calculated.

At the end for each class, absorbed power factor of the unit ($f_{s-Pref}$) is found. The class, where this factor is firstly found less than or equal to 1, shows the energy class of the unit at Summer Application.

**1. Units for full or partial outdoor air at design summer:**
**[winter dry bulb temperature ≥ -3°C AND dry bulb temperature ≥ 30°C]**
**OR**
**[winter dry bulb temperature ≥ -3°C AND dew-point temperature ≥ 17°C]**
**OR**
**[dry bulb temperature ≥ 30°C AND dew-point temperature ≥ 17°C]**

| ENERGY EFFICIENCY CLASS | B |
|---|---|

**INPUTS - Energy Efficiency Class**

| | | SUPPLY | ☑ EXTRACT |
|---|---|---|---|
| Air flow | [m3/h] | 10000 | 10000 |
| Total static pressure = internal_without_fan_sys_effect + external | [Pa] | 680 | 690 |
| Internal static pressure = total static - external | [Pa] | 260 | 270 |
| Real power input (considering fan system losses) | [kW] | 4.2 | 4.3 |
| Size Reference: velocity | [m/s] | 1.2 | 1.2 |
| Summer temperature efficiency, HRS mass flow balanced for actual selectio | [%] | 85 | 85 |
| Summer humidity efficiency, HRS mass flow balanced for actual selection | [%] | 90 | 90 |
| Pressure drop HR standard density for actual selection | [Pa] | 110 | 110 |
| Mixing ratio = recirculated air / supply air | [%] | 0 | |
| Design dry-bulb temperature (ASHRAE 2017 Climatic Design Conditions) | [°C] | 38.3 | |
| Design dew-point temperature (ASHRAE 2017 Climatic Design Conditions) | [°C] | 9.6 | |
| Winter design outdoor temperature (ASHRAE 2017 Climatic Design Conditio | [°C] | 3.1 | |

**CELLS LEGEND**

| BACKGROUND COLOR CELL | TEXT COLOR |
|---|---|
| INPUT CELLS | SUPPLY |
| OUTPUT CELLS | EXTRACT |

*Revision 2.2: 2021-01-26*

**OUTPUTS - Energy Efficiency Class**

| | | A+ | A | B | C | D | E |
|---|---|---|---|---|---|---|---|
| v | m/s | 1.4 | 1.6 | 1.8 | 2 | 2.2 | |
| $\eta_T$ | % | 83 | 78 | 73 | 68 | 63 | |
| $\Delta p_T$ | Pa | 167 | 160 | 155 | 151 | 147 | |
| $\eta_H$ | % | 81 | 73 | 65 | 58 | 50 | |
| $\Delta p_H$ | Pa | 222 | 213 | 207 | 202 | 197 | |
| $Ng_{ref}$ | - | 64 | 62 | 60 | 57 | 52 | |
| ΔPx | Pa | -36.1 | -74.4 | -114.6 | -156.7 | -200.5 | |
| ΔPy | Pa | -57 | -50 | -45 | -41 | -37 | |
| ΔPz | Pa | -7.1 | -24.7 | -42.4 | -60 | -77.7 | |
| $P_{sup.\ Ref.}$ | kW | 3.6484 | 3.9843 | 4.3584 | 4.8505 | 5.601 | |
| ΔPx | Pa | -38.5 | -79.4 | -122.3 | -167.1 | -213.8 | |
| ΔPy | Pa | -57 | -50 | -45 | -41 | -37 | |
| ΔPz | Pa | -7.1 | -24.7 | -42.4 | -60 | -77.7 | |
| $P_{ext.\ Ref.}$ | kW | 3.7022 | 4.0511 | 4.4393 | 4.9476 | 5.7209 | |
| $f_{s\text{-}Pref}$ | - | 1.16 | 1.06 | 0.97 | | | |

# Thank you !

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Eurovent Certita CERTIFICATION

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