Frans de Wind

Eurovent WG6C

Part 2
Eurovent Certification AHU

Eurovent Certification AHU

European Association of Air Handling and Refrigerating Equipment Manufacturers

Eurovent includes 14 National Associations from 12 countries

Main objectives Eurovent

- Represent the European manufacturers with national trade associations on international and European issues
- Inform members of relevant legislation emanating from the European Union or other bodies
- Assure participation in international and European **standardisation**
- Together with the **Eurovent Certification Company**, to develop product certification programmes
- Publish **guides and technical application manuals**

Eurovent Certification AHU

Eurovent Certification Company

Eurovent Certification certifies the performance ratings of air-conditioning and refrigeration products according to European and international standards.

The objective is to build up customer confidence by levelling the competitive playing field for all manufacturers and by increasing the integrity and accuracy of the industrial performance ratings.

Eurovent certification is made up of different **Programmes**, each corresponding to one type of refrigeration or air-conditioning product. A manufacturer whose products are certified is called a Participant.

Eurovent Certification AHU

Eurovent Certification Programmes

Air to Air Plate Heat Exchangers
Air to Air Rotary Heat Exchangers
Comfort Air Conditioners (AC 1-3)
Air Handling Units
Chilled Beams
Close Control Air Conditioners
Fan Coil Units
Ducted Fan Coil Units
Rooftop units

Fine Air Filters Class F5-F9
Air Coolers for Refrigeration
Air Cooled Refrigerant Condensers
Dry Coolers
Heating and Cooling Coils
Liquid Chilling Packages
Refrigerated Display Cabinets
Cooling Towers

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Eurovent Certification Documents

- Certification Manual (resp. CPPC)

  General manual explaining the organisation structure and procedures for Eurovent Certification.

- Operation Manual for certification of AHUs (resp. CC)

  Procedures for the operation of Eurovent certification of air handling units

- Rating Standard for AHUs (resp. CC)

  Definitions and specifications for testing and rating

CPPC : Certification Programmes and Policy Committee
CC : Compliance Committee (all companies participating in the programme)

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Certification procedure AHUs

- Scope

  Applicable to a selected range of air handling units. Range shall include at least one size performing less than 7m^3/s

- Certification of AHUs

  Eurovent certifies the selection software of the manufacturer, based on:
  - mechanical performance casing construction (EN 1886)
  - performance testing of (a number) of components

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Certification procedure AHUs

- Application procedure
  - Factory visit by Eurovent expert, suitability check software and selection of unit for test
  - Signing License Agreement if Eurovent OM compliant
- Qualifying procedure
  - mechanical performance casing construction model box
  - performance testing of (a number) of components and casing of a real unit, randomly selected from units under production or just built
- Repetition test
  - mechanical performance testing model box every 6 years (ISO 9001)
  - performance test randomly selected real unit every 3 years (ISO 9001)
- Annual check
  - Parts and assembly check production place to verify model box compliancy
  - Software version check on technical data for unit in production (no limits)

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Measurements mechanical performance EN1886

Model boxes are measured in laboratory TÜV-SÜD in Munich

TEST CRITERIA CASING	MODEL BOX	REAL UNIT
Mechanical strength	X	X
Air leakage	X	X
Filter bypass leakage	X	X
Thermal transmittance	X	–
Thermal bridging	X	–
Acoustic insulation	X	–

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Performance measurements real unit EN 13053

Real units are measured in laboratory TÜV-NORD in Essen

Certified performance characteristics

- Mechanical strength
- Air leakage casing
- Filter bypass leakage
- Air flow rate - external pressure - electric power input (5 points)
- Octave band in-duct sound power level supply unit openings (only sup. running)
- Casing radiated total sound power level (only supply running)
- Heating and cooling capacity (2 conditions)
- Dry efficiency and pressure drop heat recovery (1 condition)
- Water side pressure drop coils
- Eurovent energy efficiency class

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Requirements for selection software

- Certified components shall be included in software
  - Components not included in manufacturer's software can not be certified
  - Application of non certified components allowed under certain conditions:
    -remark in quotation: "***component is not included in certified software***"
    -no remark in quotation if component serves a non-certified characteristic
- Software version identification
  - software version number with date of issue on each page of quotation
  - Eurovent shall be informed about most recent technical software version
  - Version identification codes from manufacturer and Eurovent shall match
- Software changes
  - technical alterations are allowed if version code key and date are changed
  - casing modifications allowed if reported to Eurovent
  - Eurovent is entitled to demand additional tests to check impact of changes

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Ranges produced in several production places

- Joint certification of several locations allowed if selection software, components, casing and assembly methods are identical
- Each production location is annually checked
- For repetition tests each time a different location will be chosen
- If a repetition test fails all production places have to downgrade their software to comply with the latest test results
- If during the annual check irregularities are observed, Eurovent may demand that a real unit and/or model box is tested beyond the normal repetition tests

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Administration of the programme

- Eurovent certified ranges, participants and production places are presented on the website: www.eurovent-certification.com
- Online directory of Eurovent certified products is the only source with updated information
- In case of violation of rules, a range and/or production place is withdrawn from the website for one year
- In case of a relapse after one year, the certified range is withdrawn from the website for three years
- The certification programme is promoted by Eurovent and by the participant displaying the logo on quotations, literature and products

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Advantages of Eurovent certification

- Fair competition in the market for manufacturers
- Certified technical data in quotations facilitate comparison suppliers
- No allowance required on design specifications for AHUs
- Warranty on claimed mechanical performances casing
- Certified data for absorbed electrical power and efficiency HRS for reliable LCC-calculations
- Certified heating and cooling capacities and coil pressure drops
- Credible data for sound power levels for acoustic calculations

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Possible impact of lacking performance AHU

- Deficit air volume performance fan

  Fan speed increase causes substantial rise power consumption (P : n^3) and higher sound power levels and everlasting higher energy costs, proportional to power consumption

- Higher absorbed motor power

  Additional energy costs proportional to deviation

- Lack of capacity heating and cooling coils

  -increase water flow (50% more flow → ~ 10% higher capacity)*

  -increase air volume flow (15-20% more volume flow → ~ 10% higher capacity)*

  -increase water temperature heater, decrease water temperature cooler

  * Estimated corrections values strongly dependent on coil design conditions

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Possible impact of lacking performance AHU

- Lower efficiency heat recovery system
  - Higher energy costs for heating and cooling
  - Possible deficit heating and/or cooling capacity
- Higher water side pressure drop coils
  - Higher power consumption individual circulation pump
  - Insufficient flow if coil is decisive for manometric head central pump or higher power consumption central circulation pump
- Higher sound power levels than specified
  - Additional acoustic measures required (duct attenuators, heavier building constructions)

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False arguments for the acceptance of a non-compliant AHU

No complaints on site!!

- Installation overdesigned; hence a cheaper, Eurovent certified unit with lower performance (however equal to delivered) would have been a better solution
- End user charged with higher energy costs (often without notice installer)

Client does not get what he paid for!

- Ethical issue

Supplier is responsible in case modifications are needed

- How to prove that unit or components do not meet the technical specifications?
- Accurate measurement of acoustic and thermal performance on site very complex and time consuming, even for skilled professionals

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Existing energy labelling of air handling units

Shortcomings existing labelling system

- **O**nly 2 labels A & B (C-label with no requirements), insufficient grading
- **C**lassification requirements for labels not appropriate (A-label unit with higher energy consumption than B-label possible)
- **L**abelling system not adequate throughout Europe (no climate differentiation)

Revision of EN 13053

- **R**equirements for the existing labels are based on EN 13053–2006
- **N**ew labelling system without revision EN 13053 not acceptable for German participants
- **E**nergy related topics in Revised EN 13053 must be the basis for the new energy labelling system

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Requirements for old Eurovent labels A & B

Requirements for old Eurovent labels A & B					
CLASS	AHU Configuration	Requirements for			
		Velocity v [m/s]	Heat recovery		Absorbed fan motor power
			Efficiency [%]	Pressure drop [Pa]	
A	Units without thermodynamic air treatment	v ≤ 3,0	-	-	0,95x P_{max}
	Units with air heating	v ≤ 2,5	-	-	
	Units with additional functions: $q_v \leq 1,5$ m^3/s	v ≤ 2,5	≥ 47%	≤ 180	
	Units with additional functions: $1,5 < q_v \leq 3,0$ m^3/s	v ≤ 2,5	≥ 50%	≤ 200	
	Units with additional functions: $3,0 < q_v \leq 7,0$ m^3/s	v ≤ 2,0	≥ 55%	≤ 225	
	Units with additional functions: $7,0 < q_v \leq 14$ m^3/s	v ≤ 2,0	≥ 64%	≤ 250	
	Units with additional functions: $q_v > 14$ m^3/s	v ≤ 2,0	≥ 69%	≤ 270	
B	Units without thermodynamic air treatment	v > 3,0	-	-	P_{max}
	Units with air heating	v ≤ 3,0	-	-	
	Units with additional functions: $q_v \leq 1,5$ m^3/s	v ≤ 3,0	≥ 43%	≤ 200	
	Units with additional functions: $1,5 < q_v \leq 3,0$ m^3/s	v ≤ 3,0	≥ 45%	≤ 225	
	Units with additional functions: $3,0 < q_v \leq 7,0$ m^3/s	v ≤ 2,5	≥ 50%	≤ 250	
	Units with additional functions: $7,0 < q_v \leq 14$ m^3/s	v ≤ 2,5	≥ 58%	≤ 275	
	Units with additional functions: $q_v > 14$ m^3/s	v ≤ 2,5	≥ 63%	≤ 300	
C	Any	No requirements			

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Requirements for new Eurovent labelling system

Revised velocity classes in EN 13053

Class	Air velocity [m/s]
V1	$\leq 1{,}6$
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	$2{,}8 < v \leq 3{,}2$
V8	$3{,}2 < v \leq 3{,}6$
V9	$v > 3{,}6$
Proportional steps	*ISO 3: R20 series*

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Requirements for new Eurovent labelling system

Requirements for power consumption of fans in revised EN 13053

Class	P_m max [kW]
P1	$\leq Pm_{ref}$ x 0,85
P2	$\leq Pm_{ref}$ x 0,90
P3	$\leq Pm_{ref}$ x 0,95
P4	$\leq Pm_{ref}$ x 1,00
P5	$\leq Pm_{ref}$ x 1,06
P6	$\leq Pm_{ref}$ x 1,12
P7	$> Pm_{ref}$ x 1,12
Proportional steps	*ISO 3: R40 series*

Reference value for absorbed motor power fan + drive

$$Pm_{ref} = \left(\frac{\Delta p_{stat}}{450}\right)^{0,925} \times (q_v + 0,08)^{0,95}$$

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Requirements for new Eurovent labelling system

Revised heat recovery classification in EN13053

Class	η_t	Δp_{HRS} [Pa]	ε	η_e
H1	0,75	2 x 280	19,5	0,71
H2	0,67	2 x 230	21,2	0,64
H3	0,57	2 x 170	24,2	0,55
H4	0,47	2 x 125	27,3	0,45
H5	0,37	2 x 100	26,9	0,36

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Requirements for new Eurovent labelling system

General considerations for Eurovent labelling system

5 Energy labels for AHUs

Velocity in filter cross section leading parameter for unit size

Compensation weighting of major parameters, affecting energy consumption of AHU

Heat recovery system effectiveness-evaluation, depending on outdoor climate

Three subgroups defined (with & without heat recovery and extract units)

Weighting ratio between electric energy and thermal energy is 2 (1 kWh electric energy ≈ 2 kWh thermal energy)

Fan efficiency, motor efficiency, drive efficiency (transmission & fan speed controller) taken into account

System effects on fan in- and outlet considered

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Requirements for new Eurovent labelling system

Definition of subgroups

Subgroup 1: Units for full or partial outdoor air at design winter temperature ≤ 9°C

Full fresh air units or units with a mixing section designed for a minimum outdoor temperature ≤ 9°C

Subgroup 2: Recirculation units or units with design inlet temperatures always > 9°C

This group also includes units taking in pre-conditioned air from a make up air unit upstream

Subgroup 3: Stand-alone extract air units

The design outdoor temperature has no relevance; nevertheless the unit might comprise heat recovery connected to another system

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Requirements for new Eurovent labelling system

Basic prerequisites for compensation weighting

- Relationship between velocity and internal pressure drop AHU

$$p_{st-1} = \left(\frac{V_1}{V_0}\right)^{1,4} \times p_{st-0}$$

- Climate dependent pressure–efficiency equivalence HRS

$$f_{pe} = (-0{,}0035 \times T_{ODA} - 0{,}79) \times T_{ODA} + 8{,}1$$

f_{pe} = pressure efficiency factor [Pa/%]

(break even point pressure/efficiency)

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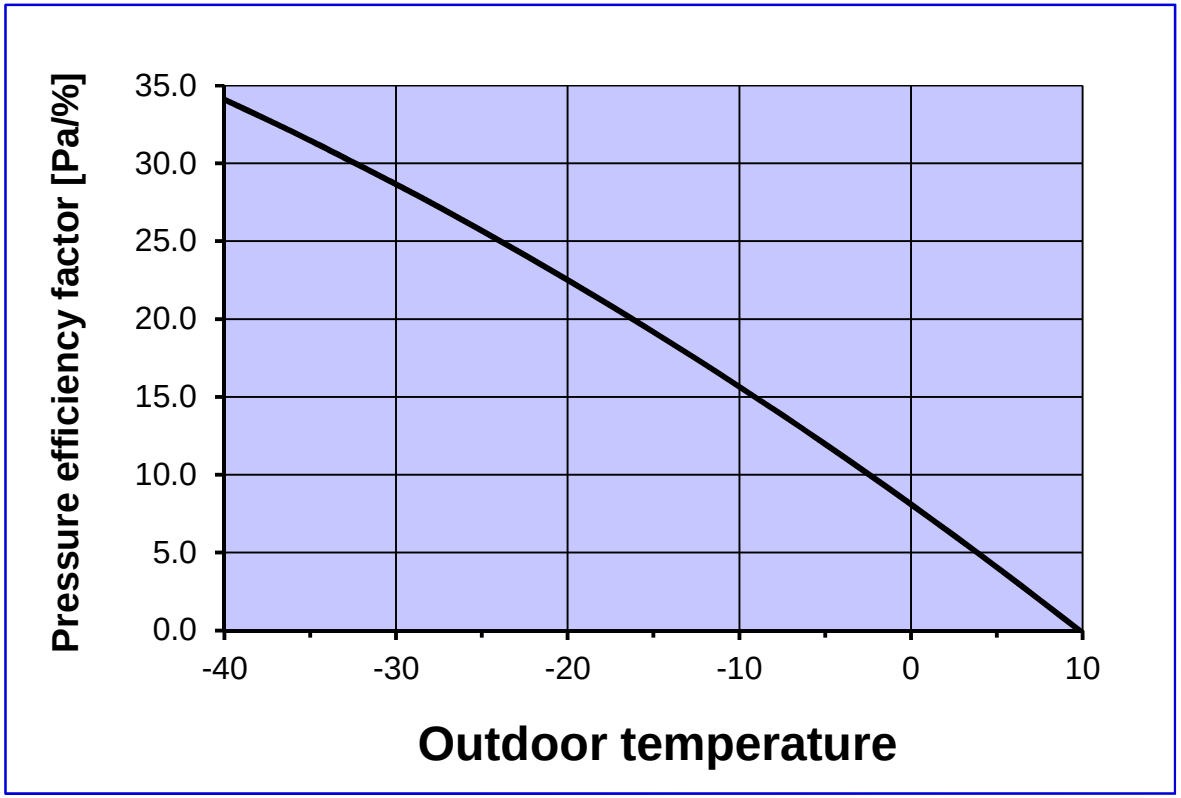
Requirements for new Eurovent labelling system

Impact of design outdoor temperature winter on f_{pe} [Pa/%]



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Requirements for new Eurovent labelling system

Reference table with basic requirements for classes

CLASS	*Reference values to be used in the calculations*			*Final check of class*
	All Subgroups	Subgroup 1		
	Velocity	Heat recovery		Absorbed power factor
Subgroup 1 / 2↳ / 3↑	v_{class}	$\eta_{t\text{-}class}$	Δp_{class}	$f_{class–Pref}$
	[m/s]	[%]	[Pa]	[-]
A / A↳ / A↑	1,8	75	280	0,9
B / B↳ / B↑	2,0	67	230	0,95
C / C↳ / C↑	2,2	57	170	1,0
D / D↳ / D↑	2,5	47	125	1,06
E / E↳ / E↑	2,8	37	100	1,12
<E / <E↳/ <E↑	No calculation required			No requirements

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Evaluation of new Eurovent labelling system

Methodology for energy parameter deviation weighting

The principle of the evaluation method is to establish whether the selected unit with (slightly) different energy parameters will consume no more energy than a unit that would exactly meet the requirements for the particular class.

Basic evaluation steps:

Assume an AHU is designed to meet the requirements for a particular (aimed) class.

The actual selection values for velocity (v_s), absorbed motor power ($f_{s\text{-}Pref}$), HRS efficiency (η_s) and pressure drop (Δp_s) will in general deviate from the specified figures for the particular class.

With the equivalence figures for primary energy and heat recovery (f_{pe}), a conversion to static pressure surplus or deficit in comparison with the fully energy class compliant unit is made. A surplus means that the actual unit demands a higher static pressure; a deficit means that the actual unit has a lower static pressure than the class compliant unit. Hence a surplus of static pressure means a higher energy consumption and a deficit of static pressure a lower energy consumption!

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Evaluation of new Eurovent labelling system

Methodology for energy parameter deviation weighting

Calculation of pressure drop corrections:

Velocity deviation: $$\Delta p_x = (\Delta p_{internal\text{-}S} - \Delta p_{HRS}) \times \left\{ 1 - \left(\frac{V_{class}}{V_S} \right)^{1,4} \right\}$$

HRS pressure drop deviation: $$\Delta p_y = \Delta p_S - \Delta p_{class}$$

HRS efficiency deviation: $$\Delta p_z = (\eta_{class} - \eta_S) \times (1 - mr) \times f_{pe}$$

Total correction on pressure drop: $$\Delta p_x + \Delta p_y + \Delta p_z$$

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Evaluation of new Eurovent labelling system

Methodology for energy parameter deviation weighting

Calculation of absorbed reference power:

The total static pressure correction has a negative or positive value. A negative value means that the required static pressure for the selected unit is lower than the static pressure for the class compliant unit would be. For a positive pressure value it is just the other way round.

The reference absorbed motor power for a class compliant unit is derived from the available static pressure of the selected unit by taking into account the calculated total static pressure correction. The following equation is used.

$$P_{ref\text{-}class} = \left(\frac{p_{static\text{-}s} - (\Delta p_x + \Delta p_y + \Delta p_z)}{450} \right)^{0,925} \times (q_v + 0,08)^{0,95}$$

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Evaluation of new Eurovent labelling system

Methodology for energy parameter deviation weighting

Calculation method for subgroup 1:

Combined unit:

Calculate pressure drop corrections Δp_x, Δp_y and Δp_z for supply and extract unit

Calculate $P_{SUP\text{-}ref}$ for supply unit and $P_{ETA\text{-}ref}$ for extract unit with aforementioned equation

In the f_{pe} factor it has been assumed that efficiency correction Δp_z is applied on both supply and extract fan

Class compliance check:

Check if selected unit is (aimed-)class compliant with the equation below.

If the value $f_{s\text{-}Pref}$ is equal or lower than the value $f_{class\text{-}Pref}$ in the table for the class of interest, the unit meets the requirements for the class. If not the same calculation procedure shall be repeated for a lower class.

$$f_{S\text{-}Pref} = \frac{P_{S\text{-}SUP} + P_{S\text{-}ETA}}{P_{SUP\text{-}ref} + P_{ETA\text{-}ref}}$$

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Eurovent energy labelling system

Comparison between old and new system (3,0-7,0 m^3/s)

A	B		C			D	E
		A+		A	B		
75%	67%	58%	57%	55%	50%	47%	37%
≤ 280 Pa	≤ 230 Pa	≤ 188 Pa	≤ 170 Pa	≤ 225 Pa	≤ 250 Pa	≤ 125 Pa	≤ 100 Pa
≤ 1,8	≤ 2,0	≤ 2,0	≤ 2,2	≤ 2,0	≤ 2,5	≤ 2,5	≤ 2,8
≤0,9	≤ 0,95	≤ 0,9	≤ 1,0	≤ 0,95	≤ 1,0	≤ 1,06	≤ 1,12
yes	yes	no	yes	no	no	yes	yes

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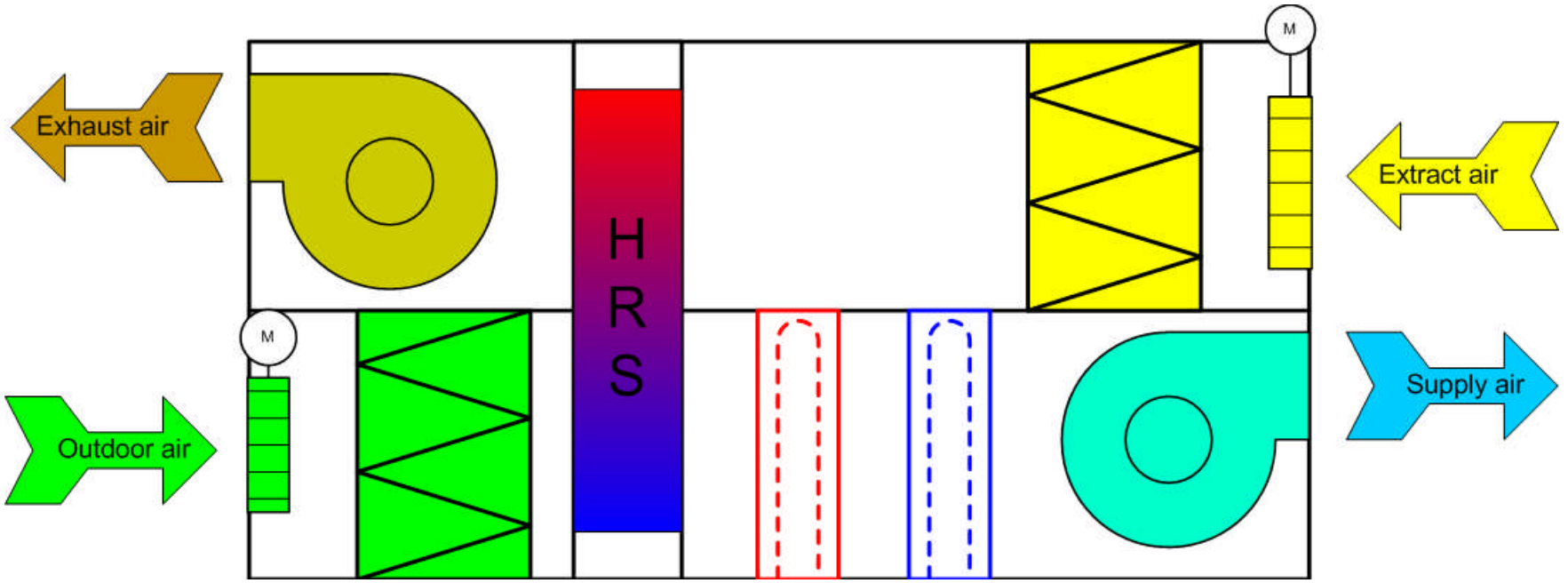
Eurovent energy labelling system

Case study for AHU performing 4m^3/s

Unit configuration



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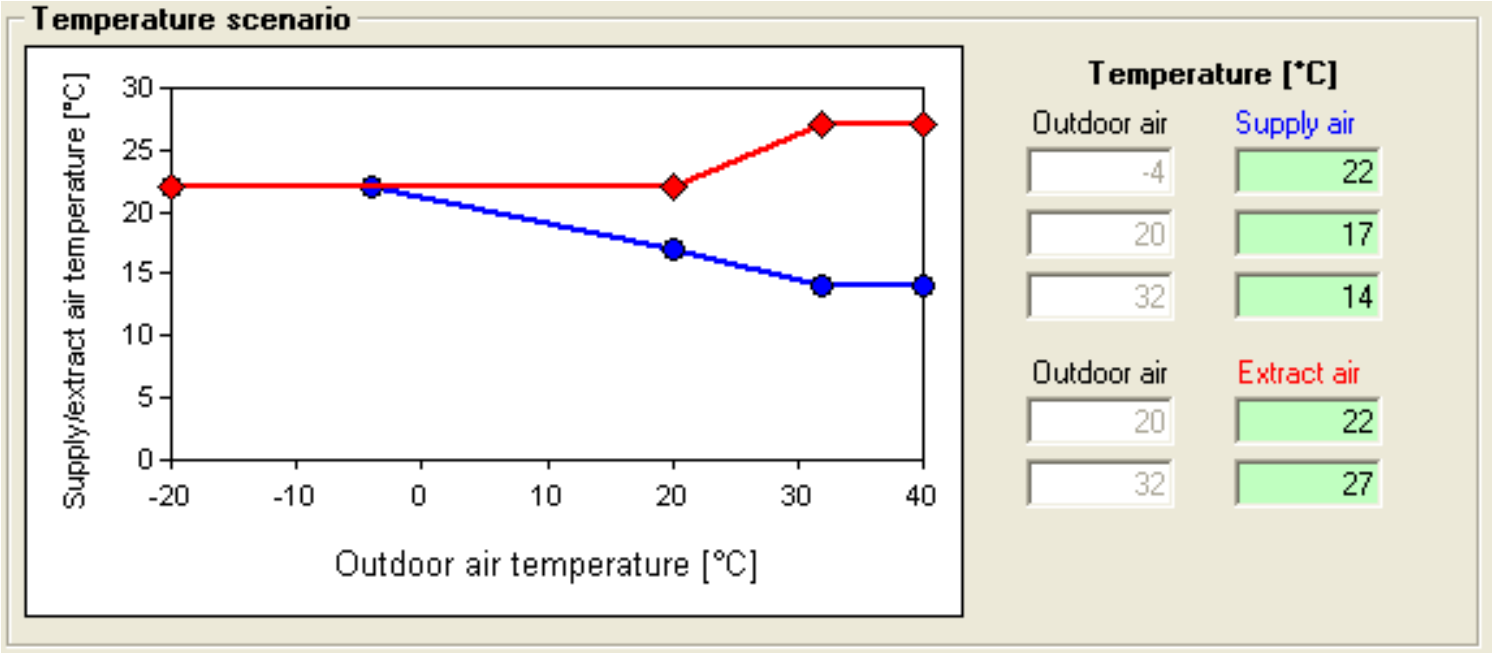
Eurovent energy labelling system

Case study for AHU performing 4m^3/s

Temperature scenario Istanbul



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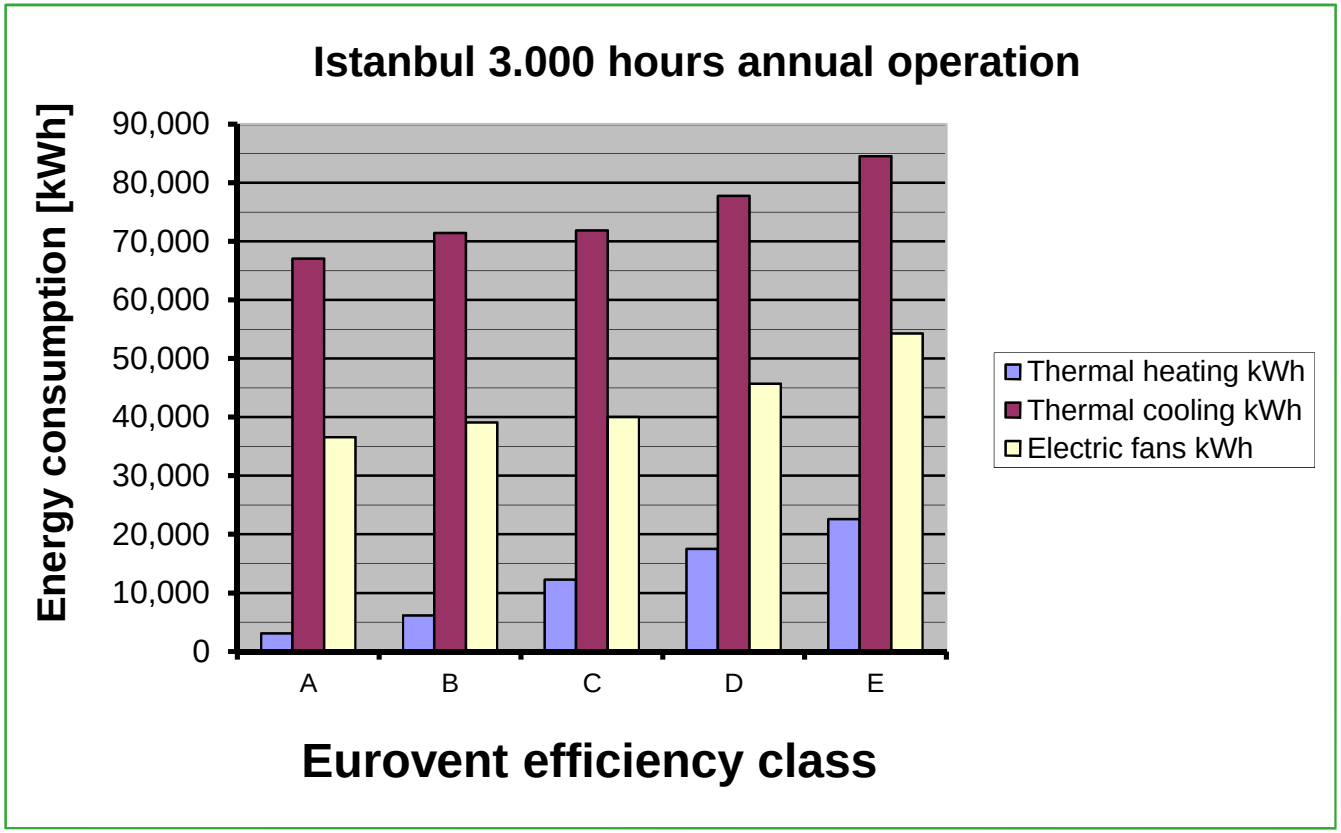
Eurovent energy labelling system

Case study for AHU performing 4m^3/s



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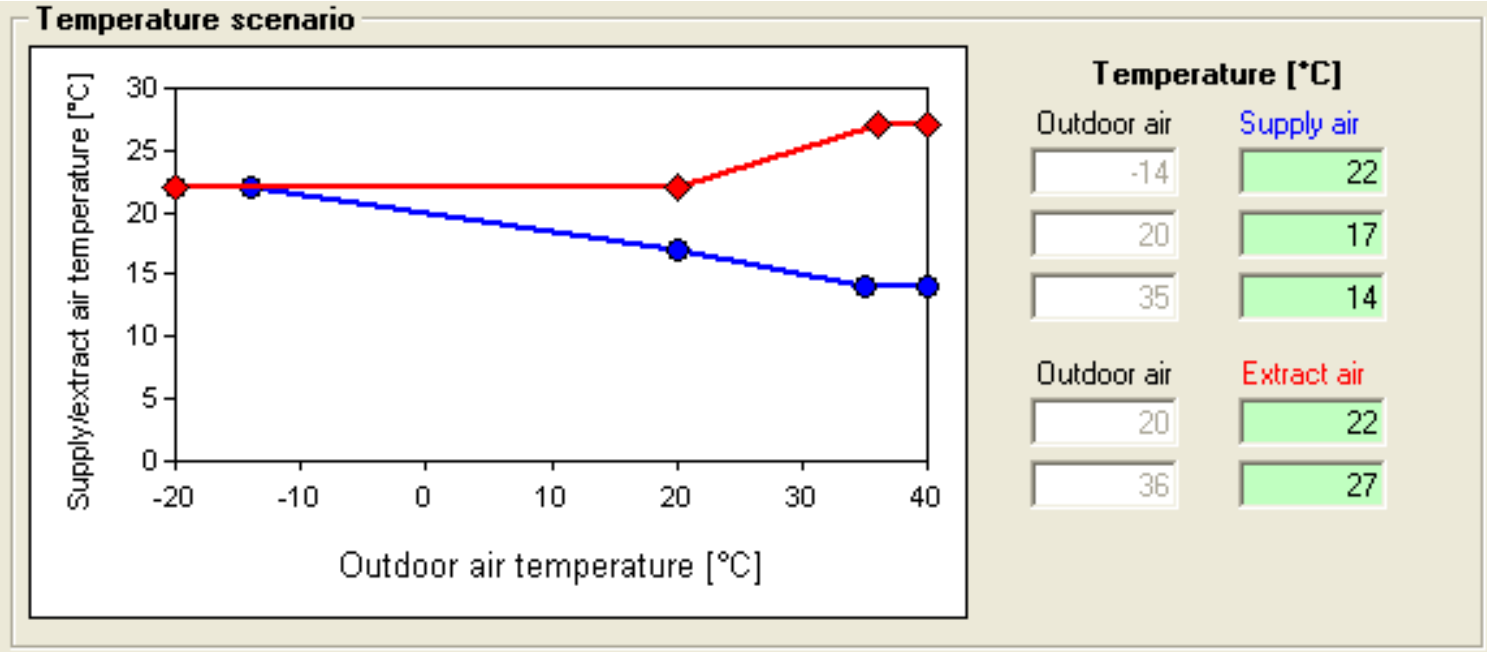
Eurovent energy labelling system

Case study for AHU performing 4m^3/s

Temperature scenario Ankara



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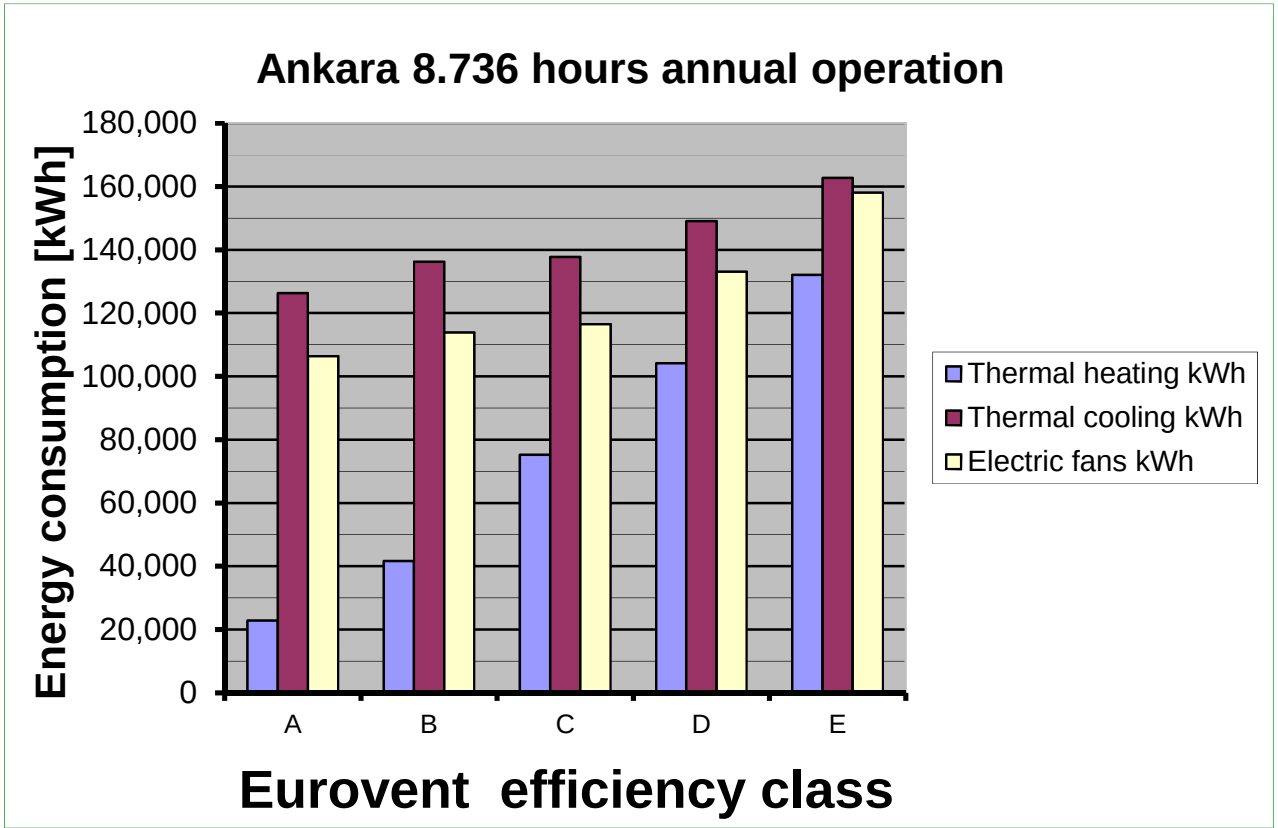
Eurovent energy labelling system

Case study for AHU performing 4m^3/s



End of presentation part 2

THANK YOU FOR YOUR ATTENTION