



RS 8/C/002-2017

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RATING STANDARD
for the
CERTIFICATION
of
**AIR TO AIR REGENERATIVE HEAT
EXCHANGERS**

RS 8/C/002-2017

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Modifications as against last version:

Nb	Modifications	Section	Page
1	<i>Airspeeds for testing condtions for wheels have been changed to 1, 2 and 3 m/s</i>	IV.3	10
2	<i>Definition of the foil thickness is added</i>	III	4
3	<i>Eurovent Certita Certification is entitled to select any wheel diameter that falls into the limits of the laboratory (instead of between 900 and 1100 mm before)</i>	IV.2c	8
4	<i>Modification of the test conditions for rotors (1.0, 2.0 and 3.0 m/s instead of 1.5, 2.5 and 4.0m/s)</i>	V	11
5	<i>Requirement for the consistency of certified data</i>	V	11
6	<i>The wheel diameter shall not differ from the selected diameter from more than the tolerance defined</i>	VII	13
7	<i>Editorial revisions</i>	VARIOUS	

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I. PURPOSE

The purpose of this Rating Standard is to establish definitions and specifications for testing and rating of Air to Air Regenerative Heat Exchangers (RHE) for the related Certification Programme of Eurovent Certita Certification, in accordance with Operational Manual OM-10.

II. SCOPE

This certification programme applies to all ranges of Air to Air Regenerative Heat Exchangers, as defined in OM-10.

III. DEFINITIONS

Air to Air Regenerative Heat Exchanger: Device incorporating an alternating storage system or a rotating cylinder or wheel for the purpose of transferring energy (sensible or total) from one air stream to the other. It incorporates heat transfer material, a drive mechanism, a casing or frame, and includes any seals which are provided to retard the bypassing and leakage of air from one air stream to the other.

Face Air velocity: Velocity of air entering the unit. It shall be calculated as follows:

$$v = \frac{q_v}{A_{\text{tot}}/2}$$

where q_v is the Volume flow under standard conditions (with density $\rho = 1.2 \text{ kg/m}^3$, according to $20^\circ\text{C}/50\%$ rel. humidity, 1013 hPa atmospheric pressure)

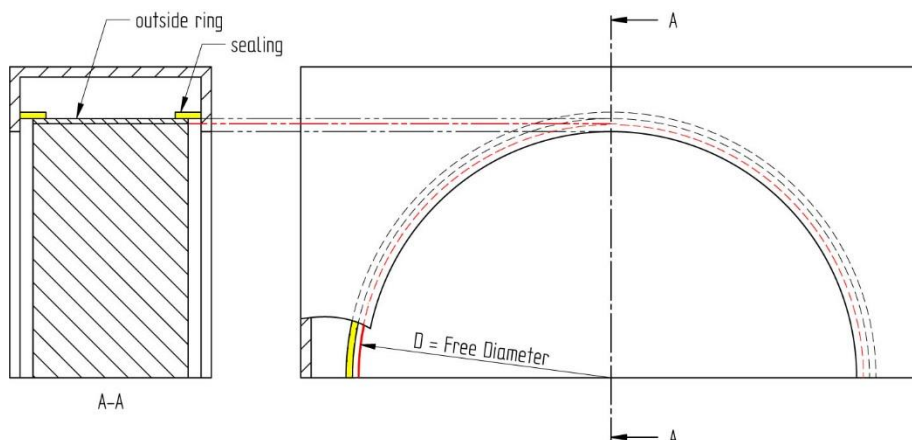
and For rotors, $A_{\text{tot}} = \pi \cdot \frac{D_o^2 - D_i^2}{4}$ is the free face area with free diameter D_o and inside diameter D_i (diameter of the hub).

For alternating storage systems, $A_{\text{tot}} = (h_{i1} + h_{i2}) \cdot (w_{i1} + w_{i2})$

It is recommended to use this definition of face air velocity to simplify the comparability for the user of RHE. This definition allows translating the certified characteristics to other RHEs of the same class, material, RHE geometry and depth but different diameters.

Free area: Area of a RHE where the air can go through.

Free diameter: Diameter of the free area of a rotor.



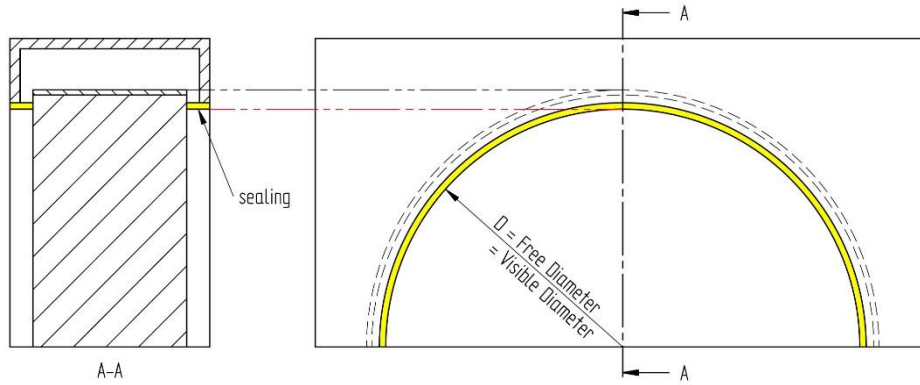


Figure 1: Illustration for free diameter

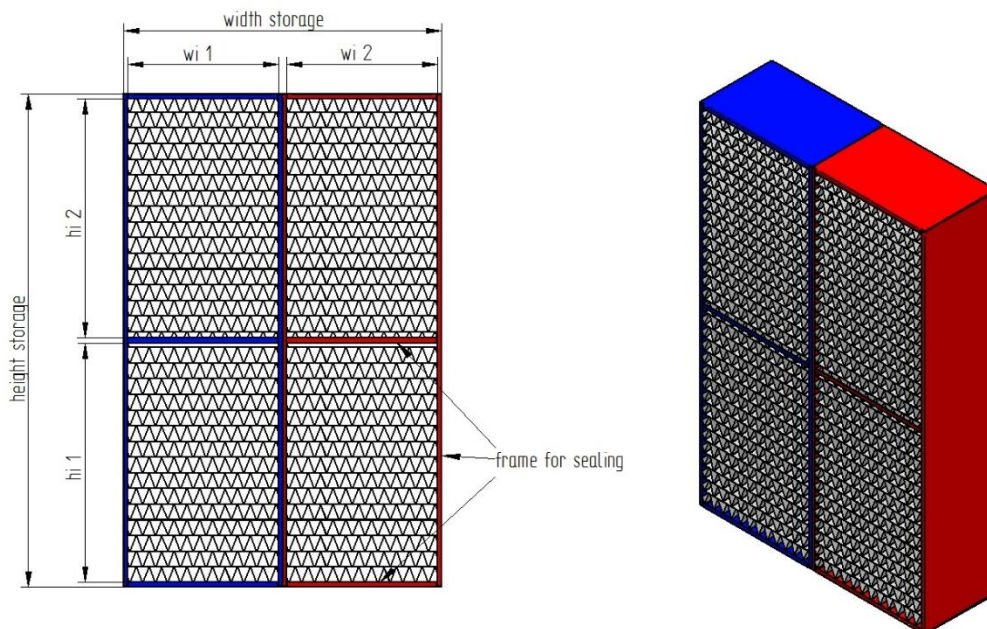


Figure 2: Illustration for free area of an alternate storage system

Foil thickness *Total thickness of the foil, including the coating.*

Wave Length: *Mean length of one wave (bottom).*

The mean length of one wave shall be obtained from the length of the arc corresponding to 10 waves. The following formula for the arc of a circle, L , shall be used: $L = D \cdot \arcsin(c/D)$ with L the arc of the rotor, D the diameter, and c the chord.

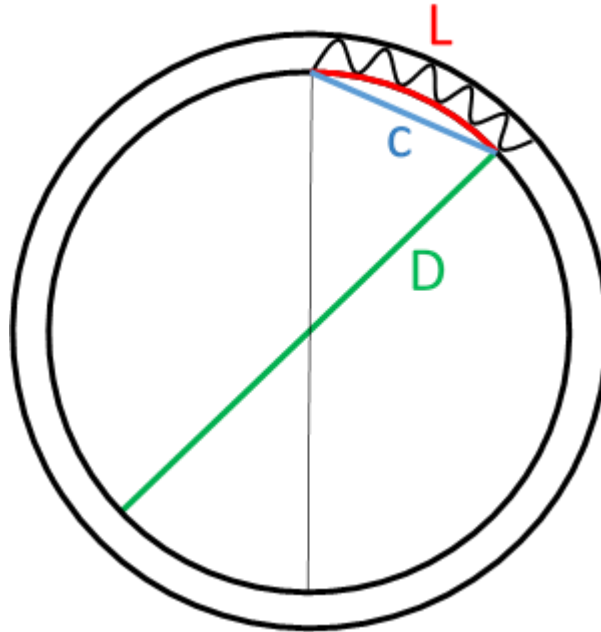


Figure 3: Illustration for wave length

Wave Height: Mean height of one wave, including one flat foil thickness.



Figure 4: Illustration for wave height

Temperature efficiency (η_t) [%]: Ratio of temperature differences:

$$\eta_t = \frac{t_{22} - t_{21}}{t_{11} - t_{21}}$$

with: t temperature [°C]
 11 exhaust air inlet
 12 exhaust air outlet
 21 supply air inlet
 22 supply air outlet

Humidity efficiency (η_x) [%]: Ratio of absolute humidity differences

$$\eta_x = \frac{x_{22} - x_{21}}{x_{11} - x_{21}}$$

Pressure drop (DP) [%]: Loss in total pressure between the inlet and the outlet of the unit within one air stream.

External leakage (λ_{ext}) [%] (not tested): Air leakage between the casing and the environment:

$$\lambda_{ext} = \frac{q_{L, external}}{q_{nominal}}$$

$$\lambda_{co} = \frac{q_{carry\ over}}{q_{nominal}}$$

Exhaust Air Transfer ratio (EATR) [%]: Transfer of exhaust air into the supply air side in air to air regenerative heat exchanger. EATR provides information on the level of the percentage of the exhaust air in the supply air.

$$EATR = \frac{a_{supply,out} - a_{supply,in}}{a_{exhaust,in}}, \text{ with a: average tracer gas concentration}$$

Outdoor Air Correction Factor (OACF) [-]: Ratio of the entering supply mass airflow rate and the leaving supply mass airflow rate. This parameter can be used as a correction factor for the supply air fan:

- If OACF > 1: the outdoor air mass flow is higher than the supply air mass flow
- If OACF = 1: the outdoor air mass flow equals the supply air mass flow
- If OACF < 1: the outdoor air mass flow is lower than the supply air mass flow

$$OACF = \frac{q_{m,supplyin}}{q_{m,supplyout}}$$

Absolute leakage rate: Difference between the entering supply mass airflow rate and the leaving supply mass airflow rate:

$$q_{m,leakage} = q_{m,supply,in} - q_{m,supply,out} = (OACF - 1) \cdot q_{m,supply,out}$$

Sealing leakage rate: Leakage rate only due to sealing (that is when there is no purge sector)

$$q_{m,sealing} = q_{m,leakage,withoutpurge}$$

$$q_{m,sealing} = (OACF_{withoutpurge} - 1) \cdot q_{m,supplyout,withoutpurge}$$

If one can assume that: $q_{m,nominal} \approx q_{m,supply,out,withpurge}$, then:

$$q_{m,sealing} \approx (OACF_{withoutpurge} - 1) \cdot q_{m,nominal}$$

Purge leakage rate: Leakage rate only due to the purge sector

$$q_{m,purge} = q_{m,leakage,withpurge} - q_{m,leakage,withoutpurge}$$

$$q_{m,purge} = (OACF_{withpurge} - 1) \cdot q_{m,supply,out,withpurge} - (OACF_{withoutpurge} - 1) \cdot q_{m,supply,out,withoutpurge}$$

If one can assume that: $q_{m,nominal} \approx q_{m,supply,out,withpurge} \approx q_{m,supply,out,withoutpurge}$, then:

$$q_{m,purge} \approx (OACF_{withpurge} - OACF_{withoutpurge}) \cdot q_{m,nominal}$$

Static pressure difference Δp_{22-11} : Static pressure difference as defined in EN 308:1997 (static pressure of the supply air outlet minus static pressure of the exhaust air inlet).

$$\Delta p_{22-11} = p_{22} - p_{11}$$

Sorption RHE = enthalpy sorption RHE: RHE demonstrating a latent efficiency which is at least 70 % of the temperature efficiency under all tested conditions with nominal airflow rate. Units having a lower humidity efficiency only can be certified in the class "hygroscopic RHE = enthalpy hygroscopic RHE".

$$\frac{\eta_x}{\eta_t} \geq 0.7$$

IV. TESTING REQUIREMENTS

IV.1 Test standard

Performance ratings claimed by manufacturers shall be verified by tests performed in one of independent laboratory selected by Eurovent Certita Certification.

The following standards shall be used as a basis for these tests:

EN 308:1997: Heat exchangers – Test procedures for establishing performance of air to air and flue gases heat recovery devices

AHRI Standard 1060 (2011): Rating air-to-air heat exchangers for energy recovery ventilation equipment.

IV.2 Test pre-requisites

a. Production place

The laboratory shall verify that the production place of the delivered unit corresponds to the production place selected by Eurovent Certita Certification.

If a unit is not compliant, the laboratory shall not perform the test and contact Eurovent Certita Certification who shall ask the Participant to send another unit.

b. Sealing system

The laboratory shall verify that the sealing sytem of the delivered unit corresponds to the sealing system declared on Eurovent Certified Performance website.

If a unit is not compliant, the laboratory shall not perform the test and contact Eurovent Certita Certification who shall ask the Participant to send another unit.

c. Dimensions

Tests shall be carried out on the sealing system selected by Eurovent Certita Certification, with a wheel which nominal diameter *within the limits of the laboratory* or an alternating storage system of 0.785 m² of free area. Before testing, the laboratory shall check minimum and maximum free diameter for rotors, or surface area for alternating storage systems, to evaluate mean free diameter as $(\text{min}+\text{max})/2$. The following tolerance is acceptable:

- Free diameter for rotors:
+/-1 %
- Free area for alternating storage system:
+/-1 % (i.e 0.00785 m² for alternating storage system)

If a unit is not compliant, the laboratory shall not perform the test and contact Eurovent Certita Certification who shall ask the Participant to send another unit.

d. Wave length and height

30 wave heights shall be measured at two locations (one at 50% of the radius and one at 80% of the radius). The mean wave height measured shall be compared to the declared value. If the measured value doesn't correspond to the declared value within +/- 0.1 mm the laboratory shall stop the test and contact Eurovent Certita Certification who shall ask the participant to send another unit.

The chord of 10 wave lengths shall be measured at the same two locations. The mean wave length measured shall be compared to the declared value. If the measured value doesn't correspond to the declared value within +/- 10 % the

laboratory shall stop the test and contact Eurovent Certita Certification who shall ask the participant to send another unit.

e. Exhaust air transfer ratio

Air tightness of the casing shall be ensured.

The internal leakage test according to EN 308:1997 shall be carried out at the following testing conditions:

- Static pressure difference (Leaving supply airflow static pressure, minus Entering exhaust airflow static pressure) remaining between 0 Pa and 20 Pa
- Nominal air flow according to the face air velocity of 2 m/s (1.5 m/s for ASM)
- Density between 1.16 kg/m³ and 1.24 kg/m³

Measured values outside this range shall be converted into standard conditions.

If the EATR is higher than 3% of the nominal air flow rate according to the face air velocity of 2 m/s (1.5 m/s for ASM) the unit shall not be further tested.

If a unit is not compliant, the laboratory shall stop the test and contact Eurovent Certita Certification who shall ask the Participant to repair or send another unit.

IV.3 Test specifications

Table 1: Testing conditions for sensible and latent efficiency and pressure drop

*) The Condensation units shall be tested only under the Heating condition.		"Regular" test conditions		"Additional" conditions	
		Heating	Cooling*	Heating	Cooling*
Entering Supply Airflow	Temperature	2° C	35° C	- 3° C	35° C
	Relative humidity	80%	50%	90%	14.0 g/kg 22.0 g/kg
Entering Exhaust Airflow	Temperature	22° C	25° C	22° C	25° C
	Relative humidity	45%	50%	11.0 g/kg	50%
Leaving Supply Airflow for rotors	Face air velocity	1 m/s, 2 m/s, 3 m/s		2 m/s	
Leaving Supply Airflow for alternating storage systems	Face air velocity	1 m/s, 1.5 m/s, 2.5 m/s		1.5 m/s	
Entering Exhaust Airflow	Face air velocity	Same rate as 'Leaving supply airflow' (Mass Flow Ratio of 1.0)			
Pressure Difference	'Leaving supply airflow static pressure' minus 'Entering exhaust airflow static pressure'	0 Pa ... 20 Pa			
Rotor speed [rpm] or damper alternate period [s]		Specified by the manufacturer			
Purge configuration		Specified by the manufacturer			

The following particular specifications shall be applied during the test in the independent laboratory selected by Eurovent Certita Certification:

- For Condensation RHEs, temperature efficiency, humidity efficiency and pressure drop shall be measured under the above three "regular" heating and one "additional" conditions (see Table 1).
- For Enthalpy and Sorption RHEs, temperature efficiency, humidity efficiency and pressure drop shall be measured under the above six "regular and three "additional" conditions (see Table 1).
- All ratings shall be performed at the rotor speed or damper alternate period specified by the manufacturer. If an adjustable purge/cleaning sector is provided, it shall be set to the manufacturer's specified purge angle or setting. All ratings shall be performed at the same rotor speed or damper alternate period and purge setting.
- The pressure drop has to be established in all tests in both air flows, for each test the average of the two measured values has to be compared with the average of the two rated values. This is to eliminate asymmetries due to the arrangement of sealing or of the purge system.

Table 2: Testing conditions for OACF and EATR

		Standard conditions	
Entering Supply Airflow	Temperature	20° C (+/-3K)	
	Relative humidity	50% +/-3%-p	
Entering Exhaust Airflow	Temperature	20° C (+/-3K)	
	Relative humidity	50% +/-3%-p	
Leaving Supply Airflow for rotors	Face air velocity	2 m/s	
Leaving Supply Airflow for alternating storage systems	Face air velocity	1.5 m/s	
Entering Exhaust Airflow	Face air velocity	Same rate as 'Leaving supply airflow' (Mass Flow Ratio of 1.0)	
Pressure Difference	'Leaving supply airflow static pressure' minus 'Entering exhaust airflow static pressure'	OACF: 0, 250, 500, 750 Pa ⁽¹⁾	OACF and EATR: 250 Pa
Rotor speed [rpm] or damper alternate period [s]		Specified by the manufacturer	
Purge configuration (for rotors)		Without purge	With purge configuration optimized for 250 Pa

⁽¹⁾ If the software does not allow using 750 Pa, the maximum pressure difference allowed by the software will be tested.

IV.4 Checking specifications

When calculating the deviation between the claimed values and the measured values using the selection software under the tests conditions, Eurovent Certita Certification shall use the following inputs:

- for airflows: exhaust air inlet (1.1) and supply air outlet (2.2);
- for temperature: exhaust air inlet (1.1) and supply air inlet (2.1);
- for humidity: exhaust air inlet (1.1) and supply air inlet (2.1).

V. RATING REQUIREMENTS

Translation of performance data to different RHE surface areas: Other RHE of the same class, material, geometry and depth but different surface areas shall have the same thermal performance data at the same face air velocity defined under "3. Definitions".

Translation of sealing leakage rate $q_{m,sealing}$ to different rotors surface areas: Other rotors of the same class, material, geometry, depth, sealing system, rotor speed but different surface areas shall have the same ratio between sealing leakage rate and rotor diameter at the same pressure differences defined under "3. Definitions".

$$\frac{q_{sealing,1}}{q_{sealing,2}} = \frac{D_1}{D_2} \text{ or } \frac{q_{sealing}}{D} = cst$$

$$\frac{q_{m,sealing}}{D} = \frac{(OACF_{withoutpurge} - 1) \cdot q_{m,supplyout,withoutpurge}}{D} \approx cst$$

$$\frac{q_{m,sealing}}{D} = \frac{(OACF_{withoutpurge} - 1) \cdot cst \cdot D^2}{D} \approx cst$$

$$(OACF_{withoutpurge} - 1) \cdot D \approx cst$$

Translation of purge leakage rate $q_{m,purge}$ to different rotors surface areas: Other rotors of the same class, material, geometry, depth, sealing system, rotor speed, purge configuration but different surface areas shall have the same ratio between purge leakage rate and the square of the rotor diameter at the same pressure differences defined under “3. Definitions”.

$$\frac{q_{m,purge,1}}{q_{m,purge,2}} = \left(\frac{D_1}{D_2}\right)^2 \text{ or } \frac{q_{m,purge}}{D^2} = \text{cst}$$

$$\frac{(OACF_{\text{withpurge}} - OACF_{\text{withoutpurge}}) \cdot q_{m,nom}}{D^2} \approx \text{cst}$$

$$\frac{(OACF_{\text{withpurge}} - OACF_{\text{withoutpurge}}) \cdot \text{cst} \cdot D^2}{D^2} \approx \text{cst}$$

$$OACF_{\text{withpurge}} - OACF_{\text{withoutpurge}} \approx \text{cst}$$

Translation of absolute leakage data to different ASM surface areas: Other ASM of the same class, material, geometry, depth, sealing system, alternating period but different surface areas shall have the same ratio between absolute leakage performance and sealing length at the same pressure differences defined under “3. Definitions”.

$$\frac{q_{\text{sealing},1}}{q_{\text{sealing},2}} = \frac{\sqrt{A_1}}{\sqrt{A_2}} \Leftrightarrow \frac{q_{\text{sealing}}}{\sqrt{A}} = \text{cst}$$

$$\frac{q_{m,\text{sealing}}}{\sqrt{A}} = \frac{(OACF - 1) \cdot q_{m,\text{supply out}}}{\sqrt{A}} \approx \text{cst}$$

$$\frac{q_{m,\text{sealing}}}{\sqrt{A}} = \frac{(OACF - 1) \cdot \text{cst} \cdot A}{\sqrt{A}} \approx \text{cst}$$

$$\frac{OACF - 1}{\sqrt{A}} \approx \text{cst}$$

Translation of EATR to different RHE surface areas: Other RHE of the same class, material, geometry, depth, sealing system, rotor speed, purge configuration but different surface areas shall have the same EATR at the same pressure differences defined under “3. Definitions”.

Consistency of certified data:

- Pressure drop and efficiencies of rotors having different wave heights and wave lengths (the other characteristics being the same) shall be consistent with the following statements: 1) the pressure drop shall increase with decreasing wave height and decreasing wave length; 2) the efficiency shall increase with decreasing wave height and decreasing wave length.
- Rotors having different diameters (all the other characteristics being the same) shall have the same pressure drops and efficiencies.
- Given two rotors with different wave height and wave length (all other characteristics being the same), the slope of the Pressure Drop vs Efficiency line at a given air speed shall be between the slopes of the higher and lower air speeds.
- For a given technology line drawn for the Pressure drop / efficiency points at a given air speed, for rotors with different wave heights and wave lengths (all other characteristics being the same), all points shall be within a band which centre is defined by the trend line of 2nd degree polynomial of the technology line and which width corresponds to the tolerances of the programme.

- Unless proven by test, a manufacturer shall not declare higher values than the one given by these formulas or statement. Should a unit be rerated following a test, the complete range shall also be rerated so that the consistency of the previous formulas or statements is maintained.

VI. CERTIFIED PERFORMANCE ITEMS

The following performance items shall be certified.

- Under standard conditions (20°C, 50% rel. Humidity and 1.013 10⁵ Pa – or 1.20 kg/m³)
 - ◆ Airflow
 - ◆ Pressure drop
 - ◆ Outdoor Air Correction Factor
 - ◆ Exhaust Air Transfer ratio
- Under “regular” winter conditions for all RHEs
 - ◆ Temperature efficiency
 - ◆ Humidity efficiency
- Under “regular” summer conditions for Enthlapy and Sorption RHEs
 - ◆ Temperature efficiency
 - ◆ Humidity efficiency

VII. TOLERANCES

For the test to be acceptable, the testing unit shall not differ from a *wheel* with *the selected diameter* or an alternating storage matrix of 0.785 m² of free area from more than:

- Free diameter for rotors or free surface area for alternating storage system:
+/-1 %

For the test to be acceptable, measured leakage shall be below (as defined in EN 308:1997):

- EATR: 3%

When tested in the laboratory the obtained performance data shall not differ from the claimed value by more than the following tolerance values:

- Pressure drop at standard condition: +10%, at least 10 Pa
- Temperature efficiency: - 3 percentage points
- Humidity efficiency: - 5 percentage points (with a minimum tolerance of 0.2 g/kg in absolute humidity of leaving supply air)
- Outdoor Air Correction factor (OACF): 0.05
- Exhaust Air Transfer Ratio (EATR): +1 percentage point