Eurovent Industry Recommendation / Code of Good Practice

Eurovent 17/12 - 2021

Factors influencing performance of Energy Recovery Components embedded in Air Handling Units

First Edition

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Document history

This Eurovent Industry Recommendation / Code of Good Practice supersedes all of its previous editions, which automatically become obsolete with the publication of this document.

Modifications

This Eurovent publication was modified as against previous editions in the following manner:

Modifications as against	Key changes
1st edition	Current document

Preface

In a nutshell

This Recommendation specifies how to consider the factors which influence performance test results of Energy Recovery Components (ERCs) when embedded in Air Handling Units (AHUs). These factors must be taken into account when processing the outcomes of the ERC Dynamic-link library (DLL) by the AHU selection software.

Authors

This document was published by Eurovent and was prepared in a joint effort by participants of the Product Group 'Energy Recovery Components' (PG-ERC), which represents a vast majority of all manufacturers of these products active on the EMEA market.

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Important remarks

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Contents

List of abbreviations and symbols

AHU	Air Handling Unit
DLL	Dynamic-Link Library (integral sub-programme integrated with the AHU selection software to calculate the ERC performance based on the AHU selection input data; developed and provided by the component supplier)
EATR	Exhaust Air Transfer Ratio expressed in % (ratio between the exhaust air amount in supply air and supply air mass flow)
ECC	Eurovent Certita Certification
EHA	Exhaust Air (airflow leaving the extract air treatment system and discharged to the atmosphere)
ERC	Energy Recovery Component
ETA	Extract Air (airflow leaving the treated room and entering the air treatment system)
OACF	Outdoor Air Correction Factor (ration between ODA and SUP mass flows)
ODA	Outdoor Air (airflow entering the system from outdoors before heat recovery)
PHE	Plate Heat Exchanger
RHE	Rotary Heat Exchanger
SUP	Supply Air (airflow entering the treated room after heat recovery)

Referred standards

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

[2] prEN 308:2020 – Heat exchangers – Test procedures for establishing performance of air to air and flue gases heat recovery devices

1. Introduction

The reference test conditions specified in the current EN 308:1997 standard differ (sometimes considerably) from the actual test conditions when the exchanger is installed in the AHU. This means that the performance data calculated by the ERC DLL for the EN 308:1997 test conditions cannot always be accurately reproduced during the test of the AHU. Pressure drops are most vulnerable to deviations.

For that reason, DLL outputs at default settings should not be directly declared in the AHU selection data as the performance of the embedded ERC, if actual operating conditions are not accounted for.

The revised EN 308 (expected to be published in 2022) will specify a new procedure for testing the ERC installed in the AHU at actual working conditions. This will mitigate the current problem of data declaration but will increase the responsibility of the AHU manufacturer to know their products' characteristics better.

Many Eurovent-certified ERC suppliers already provide DLLs that enable performance correction considering the factors described further in the recommendation. Others are expected to offer this functionality soon. Eurovent Certification programmes for Energy Recovery Components are constantly being improved to take into account in the best possible manner the differences between test conditions and actual operating conditions. Air handling unit manufacturers are advised to always consult ERC suppliers on how their software handles correction factors.

2. Potential range of performance deviations

To obtain correct performance data from the DLL and eliminate differences between the EN 308:1997 test conditions and the actual operating conditions, the following parameters must be considered in calculations:

- Appropriate mass flow given at the reference air density (1,2 kg/m^3)
- Pressure difference between air streams
- Impact of purge zone
- Influence of the OACF value
- Installation losses (system impact)

A detailed list of influencing factors is presented in points 3.1 and 3.2.

To avoid deviations, all these factors must be properly allowed for in the calculations of AHU performance by its selection software. If these factors are not taken into account, the variation may be significant. The following examples show the magnitude of the problem.

2.1 Example deviations in DLL outcomes

The selection examples below illustrate the impact that the pressure difference between supply and extract side have on the ERC pressure drop. The performance was calculated using Eurovent-certified heat exchanger selection software.

2.1.1 Rotary heat exchanger

Exchanger selected at face velocity 2 m/s. Deviation in air pressure drop in relation to ΔP_{22-11} (which results in a higher OACF value) is presented below. See also point 3.1.

ΔP_{22-11}	Δp_{sup}	Δp_{ext}	Δp_{ext} deviation compared to $\Delta P_{22-11} = 0$
20 Pa	127 Pa	132 Pa	5 Pa (4%)
250 Pa	127 Pa	139 Pa	12 Pa (9%)
500 Pa	127 Pa	162 Pa	35 Pa (28%)
750 Pa	127 Pa	185 Pa	58 Pa (46%)

Table 1: Δp_{ext} performance deviation in rotary heat exchangers

2.1.2 Plate heat exchanger

Exchanger selected at 200 Pa pressure drop. Deviation in pressure drop in relation to ΔP_{2M-1M} is presented below. See also point 3.2.

ΔP_{2M-1M}	Δp
0 Pa	200 Pa
250 Pa	220 Pa
500 Pa	226 Pa
750 Pa	231 Pa
1000 Pa	235 Pa

Table 2: Δp performance deviation in plate heat exchangers

2.2 Examples of real case deviations based on Eurovent-certified data

The following examples illustrate deviations between pressure drops of an ERC calculated by the certified AHU software and values measured during the real AHU certification test. The AHU software included DLLs of Eurovent Certified Performance ERCs, and the correct integration of the DLL regarding the performance was checked during the audit.

2.2.1 Rotary heat exchanger

The table below shows a real case deviation in pressure drops of a rotary heat exchanger.

	Calculated by AHU software	Tested	Deviation
Supply air pressure drop	257 Pa	372 Pa	115 Pa (44,7%)
Exhaust air pressure drop	257 Pa	300 Pa	43 Pa (16,7%)

Table 3: Real case performance deviations in rotary heat exchangers

2.2.2 Plate heat exchanger

The table below shows a real case deviation in pressure drops of a plate heat exchanger.

	Calculated by AHU software	Tested	Deviation
Supply air pressure drop	252 Pa	339 Pa	87 Pa (34,5%)
Exhaust air pressure drop	262 Pa	304 Pa	42 Pa (15,9%)

Table 4: Real case performance deviations in plate heat exchangers

3. Consideration of influencing factors

All influencing factors must be properly accounted for by the AHU manufacturer when calculating the performance of the ERC installed in the AHU.

In order to obtain the most accurate ERC performance data from its DLL, with consideration of the actual operation conditions, all relevant influencing factors must be provided by the AHU selection software to the component's DLL.

DLLs of all Eurovent-certified ERCs enable input of most relevant factors to correct the outcome of performance data calculations and adjust them to the actual operating conditions.

The guidelines for the correct consideration of the factors influencing performance outcome are presented in the following paragraphs. The set of input data for correct calculations depends on the type of exchanger.

3.1 Rotary heat exchangers

The basic input data required for each RHE DLL include:

1. Supply air and extract air volume flows

The nominal air volume flows (at 1,2 kg/m^3) corresponding to the rotor face air velocity preferably between 1 and 3 m/s (typical test range of ECC Certification Programme), and the actual inlet air parameters must be given. If the input is beyond this velocity range, it means that the values returned by the DLL come from extrapolation and not from measurements, which impairs the accuracy.

2. Selecting purge zone (YES / NO)

If the purge zone is selected, its set angle must be defined.

3. Selecting drive system (factory selected and supplied / supplied by the customer)

If the drive system is installed by the customer, the actual rotation speed, which has an impact on the EATR value, is unknown. In such a case the EATR value is calculated at the default rotation speed and may be incorrect.

4. Pressure difference ΔP_{22-11} at the operating conditions

This parameter is essential for the correct calculation of the EATR and OACF but also for the pressure drop and efficiencies.

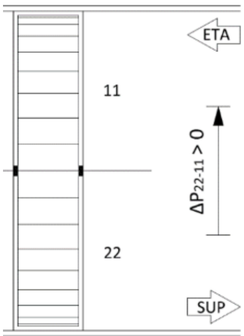

Figure 1: ΔP_{22-11} in RHE

3.2 Plate heat exchangers

The basic input data required for each PHE DLL include:

1. Supply air and extract air volume flows

The nominal air volume flows (at 1,2 kg/m^3) corresponding to the pressure drop preferably between 100 – 300 Pa (typical test range of ECC Certification Programme), and the actual inlet air parameters must be given. If the input is beyond this pressure drop range, it means that the values returned by the DLL come from extrapolation and not from measurements, which impairs the accuracy.

2. Pressure difference ΔP_{2M-1M}

Where 2M = $(p_{22} + p_{21}) / 2$ and 1M = $(p_{12} + p_{11}) / 2$

This parameter is essential for the correct calculation of pressure drop with consideration of any possible deflection of the exchanger's plates.

The pressure difference must be within the operating range of a specific exchanger according to its technical documentation.

3.3 Handling of the DLL outputs by the AHU software

Depending on the DLL developer, the computed outcomes (performance data) may include the final corrected performance of the exchanger or corrections to be added to the default values of pressure drop and thermal efficiency.

The data must be correctly processed within the AHU selection software in accordance with the DLL documentation.

Particularly regarding the pressure drop, it must be noted that the actual pressure drop, calculated at the actual inlet air density (and not at the standard 1,2 kg/m^3 density), must be considered in the AHU calculations.

In addition, for rotary heat exchangers but also for plate exchangers if the static leakage test > 3%, the remaining EATR and OACF values resulting from leakages between AHU sides (not within the exchanger) and determined by testing, should be considered.

3.4 Consideration of installation losses in the AHU selection software

Air pressure drops calculated by the ERC DLL (and other perforce data if appropriate), should be further corrected because of installation loses by the AHU selection software. The loses must be evaluated by the AHU manufacturer based on unit testing. They can result for instance from the change of flow direction, flow constriction or obstacles at the exchanger inlets.

3.5 Consideration of AHU-related deviations

Any AHU performance related deviations (e.g. compensating air flows due to OACF and EATR or balancing pressures) must be correctly handled by the AHU manufacturer in its selection software. Comprehensive guidance on this issue is provided in the Eurovent Recommendation 6/15 - 2021.

About Eurovent

Eurovent is Europe's Industry Association for Indoor Climate (HVAC), Process Cooling, and Food Cold Chain Technologies. Its members from throughout Europe represent more than 1.000 organisations, the majority small and medium-sized manufacturers. Based on objective and verifiable data, these account for a combined annual turnover of more than 30bn EUR, employing around 150.000 people within the association's geographic area. This makes Eurovent one of the largest cross-regional industry committees of its kind. The organisation's activities are based on highly valued democratic decision-making principles, ensuring a level playing field for the entire industry independent from organisation sizes or membership fees.

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