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Updated Eurovent proposal for requirements to limit internal leakage in non-residential ventilation units

In a nutshell

With this paper, Eurovent puts forward an updated proposal to set requirements in the revised VU regulation to reduce internal leakage in NRVUs in order to eliminate redundant electricity consumption and improve indoor air quality.

1. Background

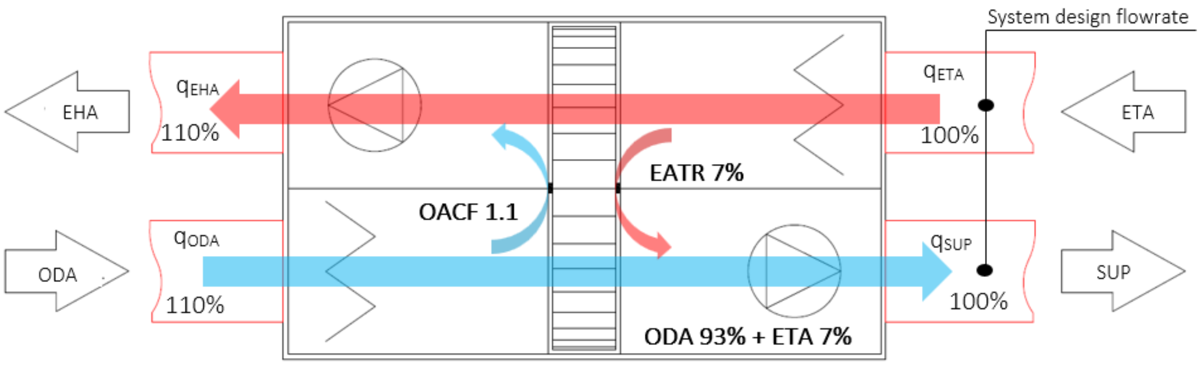
With reference to the previous papers, including PP - 2020-12-18, PP - 2021-04-30 and PP - 2024-06-25, Eurovent submits an updated proposal to limit internal leakage in bidirectional NRVUs, for consideration by the Commission and Consultant to include in the revision of Regulation (EU) 1253/2014.

2. Objective of the proposal

The proposal aims to:

- Reduce leakage of extract air to supply air (EATR) to avoid deterioration of indoor air quality (IAQ) and ensure that the volume of outdoor (fresh) air supplied to the building is as designed.
- Reduce leakage of outdoor air to exhaust air (OACF >1) and consequently eliminate redundant energy use by fans.

The figure below illustrates the problem.



With the illustrative OACF and EATR values, the unit delivers only 93% of the design fresh air volume to the building and the exhaust fan moves 10% of the excess flow consequently resulting in useless energy consumption. As explained in Eurovent 6/15, in practice OACF and EATR values may be significantly higher.

3. General concept of the proposal

The proposal assumes reducing leakage of extract air to supply air by setting a limit for EATR and implicitly at the same time for OACF<1, since EATR and OACF<1 are concurrent.

OACF leakage is intended to be limited indirectly via the SFP_{int_limit} by including the effect of OACF leakage on SFP_{int} calculation. With an OACF value significantly above 1, the SFP_{int_limit} could not be met by NRVUs with high outdoor air leakage to exhaust air, thereby eliminating them from the market.

Values of all other parameters for the whole unit and individual components at the actual operating point will be calculated and reported in the data sheet, including the impact of OACF. The actual air flow rates, resulting from the impact of OACF will also be shown in the data sheet.

3.1 OACF and EATR values

The OACF and EATR leakages are typically associated with rotary heat exchangers which, according to Eurovent Market Intelligence statistic, account for almost 60% or heat recovery systems used in bidirectional NRVUs. Leakages occur on the rotary exchanger itself but can also be related to the AHU fitting elements around the exchanger. Both cases are considered in test methods of EN 308:2022. However, as the test of the exchanger alone is more common and accessible, the proposal assumes the OACF and EATR values considered hereafter are tested according to EN 308:2022 type A test, with a pressure difference Δp_{22-11} at the nominal working point of the AHU.

3.2 Including the effect of OACF on SFP_{int}

Regarding modifications to SFP_{int} calculations, the proposal is as follows:

- SFP_{int} would be corrected if OACF > 1,0
- Flow rate across respective NRVU sections would be corrected to include the effect of OACF leakage
  - $q_{ODA} = q_{nom} \cdot OACF$ (for balanced flows) or $q_{ODA} = q_{nom\_SUP} \cdot OACF$ (for unbalanced flow)
  - $q_{SUP} = q_{nom}$ (for balanced flows) or $q_{SUP} = q_{nom\_SUP}$ (for unbalanced flow)
  - $q_{ETA} = q_{nom}$ (for balanced flows) or $q_{ETA} = q_{nom\_ETA}$ (for unbalanced flow)
  - $q_{EHA} = q_{nom} + q_{nom} \cdot (OACF -1)$ - for balanced flows or $q_{EHA} = q_{nom\_ETA} + q_{nom\_SUP} \cdot (OACF-1)$ - for unbalanced flow.
- Pressure drop of all ventilation components and additional non-ventilation components in the ODA, SUP, ETA and EHA sections of the non-residential BVU are calculated for the corresponding q_{ODA}, q_{SUP}, q_{ETA} and q_{EHA}.
- Internal pressure drop of the ERS is determined for q_{nom} (balanced) or q_{nom_SUP} and q_{nom_ETA} unbalanced flows).
- Fan efficiency for SFP_{int} calculation is determined for internal pressure drop as indicated above, nominal external pressure (for q_{nom}), and for the flow rate corresponding to the NRVU section in which the fan is located.

3.3 Impact of considering the OACF effect

Simulations for the proposed SFPint calculation model show that with an OACF value significantly above 1.0, the SFP_{int} value for a bidirectional NRVU can increase by several up to over a dozen percents. This is believed a suitable measure to eliminate units of high internal leakage and redundant electricity consumption.

By specifying all other parameters at the actual operating point in the data sheet, including the impact of OACF, the customer will be able to assess the deviation from design parameters due to OACF>1 leakage, and take this information into account when selecting the product.

3.4 Compliance check

For the time being the is no CEN standard for testing SFP_{int} including the effect of OACF leakage. However, CEN/TC 156/WG5 (AHU), involving many Eurovent members, is about to launch a new work item on this subject. In addition, as of 2024, the Eurovent certification programme for air handling units has included the OACF and its impact on energy consumption under actual operating conditions in its certification test, meaning that the suitable methodology is already in place.

3.5 Higer OACF of small diameter rotary exchanger

OACF value is intrinsically higher for small diameter rotors, which are technically not able to meet the same requirements as larger rotors. For this reason, if further study shows difficulties in meeting the requirements with small diameters, it is proposed to set an additional and higher SFP_{int_limt} for NRVUs with rotors of diameter below 1 meter, which corresponds to flowrate of XX (to be defined) m^3/s.

4. Concrete proposal for changes in the Regulation text

With reference to the working document presented at the Consultation Forum in 2021, the proposed amendments to related definitions and provision are the following.

DEFINITIONS

'fan efficiency (η_{fan})' means the static efficiency including motor and drive efficiency of the individual fan(s) in the ventilation unit (reference configuration) determined at nominal air flow across the ventilation and non-ventilation components including the effect of OACF leakage and nominal external pressure drop;

'$\Delta P_{22\text{-}11}$' means the pressure difference as defined in EN 308 at the nominal working point of the bidirectional NRVU.

'throttling device' means an element (such as damper and perforated plate) in the extract air of the bidirectional NRVU to create additional internal pressure drop in order to balance the $\Delta P_{22\text{-}11}$ pressure difference across energy recovery component with the main purpose to reduce the EATR.

'reference configuration of a BVU' means a product configured with a casing, at least two fans with variable speed or multi-speed drives, an ERS, a throttling device to meet the EATR limit (if applicable), and the clean filters according to the manufacturer instructions;

'internal pressure drop of ventilation components ($\Delta_{ps,int}$)' (expressed in Pa) means the sum of the static pressure drops of a reference configuration of a BVU, at nominal flow rate including the effect of OACF leakage;

'internal pressure drop of additional non-ventilation components ($\Delta_{ps,add}$)' (expressed in Pa) means the remainder of the sum of all internal static pressure drops at nominal flow rate including the effect of OACF leakage and nominal external pressure after subtraction of the internal pressure drop of ventilation components ($\Delta_{ps,int}$);

'outdoor air correction factor (OACF) of a non-residential BVU' means the ratio of the outdoor airflow measured at the outdoor air inlet duct to the supply airflow measured at the supply air outlet duct when the units operates at nominal flowrate and nominal external pressure. OACF refers to the test type A according to EN 308:2022.

'internal specific fan power of ventilation components (SFP_{int})' (expressed in $W/(m^3/s)$) is the ratio between the internal pressure drop of ventilation components and the fan efficiency, determined for the reference configuration and the nominal flow rate including the effect of OACF leakage.

The effect of OACF leakage is considered if OACF > 1.0 as follows:

Flow rates

Flow rate in the ODA section of the unit (between outdoor air inlet connection and ERS), (q_{ODA})

$q_{ODA} = q_{nom} \cdot OACF$ - for balanced flows

$q_{ODA} = q_{nom\_SUP} \cdot OACF$ - for unbalanced flows

Flow rate in the SUP section of the unit (between ERS and the supply air outlet connection), (q_{SUP})

$q_{SUP} = q_{nom}$ - for balanced flows

$q_{SUP} = q_{nom\_SUP}$ - for unbalanced flows

Flow rate in the ETA section of the unit (between extract air inlet connection and ERS), (q_{ETA})

$q_{ETA} = q_{nom}$ - for balanced flows

$q_{ETA} = q_{nom\_ETA}$ - for unbalanced flows

Flow rate in the EHA section of the unit (between ERS and the exhaust air outlet connection), (q_{EHA})

$q_{EHA} = q_{nom} + q_{nom} \cdot (OACF - 1)$ - for balanced flows

$q_{EHA} = q_{nom\_ETA} + q_{nom\_SUP} \cdot (OACF - 1)$ - for unbalanced flows

Internal pressure drop

Pressure drop of all ventilation components and additional non-ventilation components in the ODA, SUP, ETA and EHA sections of the non-residential BVU are calculated for the corresponding q_{ODA}, q_{SUP}, q_{ETA} and q_{EHA}.

Internal pressure drop of the ERS is determined for q_{nom} (balanced) or q_{nom_SUP} and q_{nom_ETA}.

Fan efficiency

Fan efficiency is determined for pressure drop of ventilation components and additional non-ventilation components at the flow rate including the effect of OACF leakage, additional throttling to meet the EATR limit (if applicable), nominal external pressure, and for the flow rate corresponding to the NRVU section in which the fan is located.

EATR limit

The maximum EATR at nominal flow and nominal pressure is 5%, except for NRVUs with recuperative heat exchangers with maximum static internal leakage not higher than 3%, when tested using static pressure differences according to Table 7 in Annex VII. If a non-residential BVU has the recirculation function (which is actually included within the bidirectional NRVU and that it is a regulated damper fitted to allow a controlled amount of air to pass from extract to supply) during its regular operation (building occupied by people) the EATR limit is NOT applicable.

EATR limit applies either to ERS with or without purge, according to supplier's choice.

Information requirements

Actual OACF and EATR (for actual operating conditions) are included in the information requirements

Solving the issue of high OACF for small rotors

If further research shows difficulties in meeting the SFP_{int_limit} by units with small diameter rotors, we suggest adding another SPF_{int_limit} requirement range.

Range 1: $q_{nom} < XX\ m^3/s$

Range 2: $XX\ m^3/s \leq q_{nom} < 2\ m^3/s$

Range 3: $q_{nom} \geq 2\ m^3/s$

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1. Who receives which number of votes?	**2. Who has the final decision-making power?**
At Eurovent, the number of votes is never determined by organisation sizes, country sizes, or membership fee levels. SMEs and large multinationals receive the same number of votes within our technical working groups: 2 votes if belonging to a national Member Association, 1 vote if not. In our General Assembly and Eurovent Commission ('steering committee'), our national Member Associations receive two votes per country.	The Eurovent Commission acts as the association's 'steering committee'. It defines the overall association roadmap, makes decisions on horizontal topics, and mediates in case manufacturers cannot agree within technical working groups. The Commission consists of national Member Associations, receiving two votes per country independent from its size or economic weight.
3. How European is the association?	**4. How representative is the organisation?**
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Check on us in the European Union Transparency Register under identification no. 89424237848-89.

We are Europe's Industry Association for Indoor Climate (HVAC), Process Cooling, and Food Cold Chain Technologies – thinking 'Beyond HVACR'

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