VENTILATION GUIDELINE

Improving Indoor Air Quality

ROTARY HEAT EXCHANGERS

AIR-TO-AIR HEAT EXCHANGERS

HEATEX

INDOOR AIR QUALITY

Ventilation systems play a key role to maintain healthy and comfortable indoor air quality (IAQ) in almost all buildings. Adequate indoor air quality involves many factors, including heating or cooling, depending on the local situation and climate, humidity control, and filtration of pollutants. Health issues, such as breathing problems, can arise from air contaminated with dust, pollen, or other contaminants.

In respect to Covid-19, several organizations (e.g., ASHRAE and REHVA) are recommending boosting the ventilation rate to reduce the concentration of contaminants inside the building. Ventilation systems should be running longer and with a higher flow rate.

"Dilution of contaminants , including infectious aerosouls, by outdoor air Ventilation is an integral IAQ strategy . . ." - ASHRAE Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems, June 9, 2020

However, there are concerns around the leakage and recirculation of air and its impact on the number of harmful particles inside the building.

RECIRCULATION OF AIR

Even before Covid-19, ventilation systems and components were designed to eliminate carbon dioxide, smell, particles, and other contaminants in the air. However, the recirculation of air (exhaust air reused as supply air) might still appear in two ways, through unintended leakages (e.g. in ducting and heat recovery units) or through intended recirculation (e.g. using recirculation dampers). Consequently, if the source of contamination occurs inside the building, it's crucial to close the recirculation damper and reduce any leaks to avoid exhaust air from re-entering the buidling.

Worth keeping in mind is that, *"When HVAC systems include recirculated air . . . , that typically is responsible for much more reintroduction of contaminated air from the space than is Exhaust Air Transfer in the Energy Recovery Ventilator . . ."* - ASHRAE Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems, June 9, 2020

ENERGY RECOVERY UNITS

At the heart of a ventilation system, you'll find an air handling unit and an energy recovery unit for heat and energy recovery. The two most used types are rotary heat exchangers and plate heat exchangers. If correctly installed and maintained, they have equally low leakage rates.

"For properly operating rotary heat exchangers, fitted with purge sectors and correctly set up, leakage rates are about the same as that of plate heat exchangers, being in the range of 1-2%."
- REVHA COVID-19 guidance document, April 3, 2020.

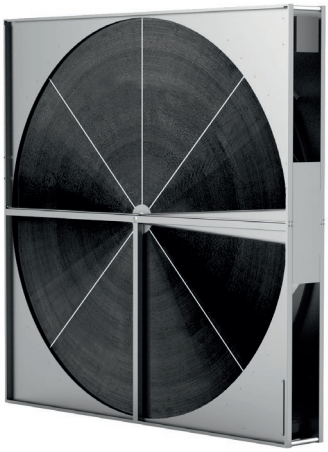
REGENERATIVE AIR TO AIR HEAT EXCHANGERS

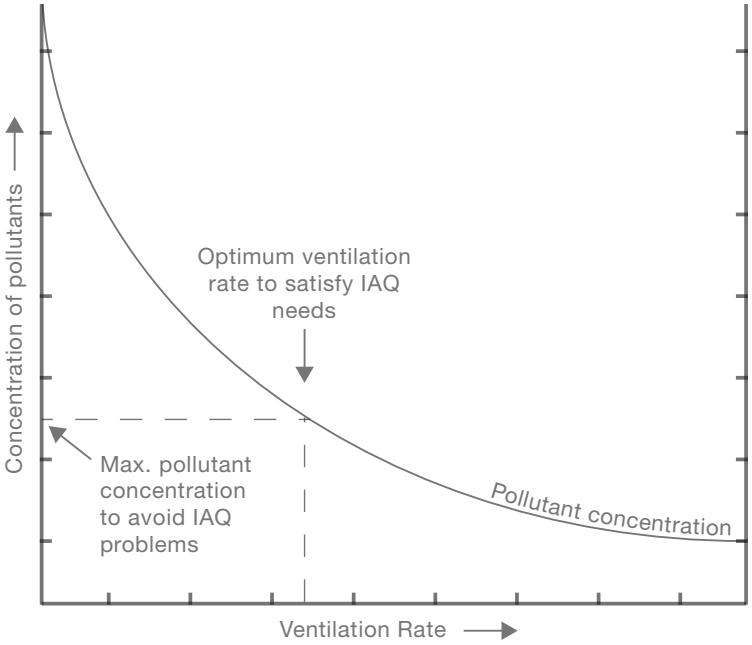
Rotary heat exchangers are often the preferred choice thanks to their low freezing risk (wheels by definition defrost themselves), compact size, and high sensible efficiency. The possibility of adding a coating to the wheel, which allows latent transfer, is another factor favoring these products.

If the heat recovery unit is switched off or bypassed, heating coils might not be able to handle the entire heat load, which leads to low inlet air temperature and an uncomfortable indoor climate. The reaction might be switching off the whole ventilation system, making IAQ even worse by preventing the dilution of airborne contaminants through fresh outdoor air supply.

Consequently, it's suggested to keep operating the heat recovery unit and continue to supply the building with fresh air before trying anything else.

"In well-designed commercial buildings, energy recovery ventilators should remain operating and are essential to maintain ventilation rates."
- REVHA COVID- 19 guidance document, April 3, 2020.





However, to ensure the best performance and cleanest air possible, it's essential to understand the basics and best practices around rotary heat exchangers!

LEAKAGES

There are two kinds of leakages, internal and external. The most relevant leakage when it comes to the rotor is internal leakage.

Internal leakages

Are considered to be the leakages within the unit. In this definition, there are two different leakages; one is the carryover (or EATR) as a consequence of the wheel rotation. The other one is the outside air correction factor (OACF), which is the leakage taking place between the two air ducts due to pressure differences.

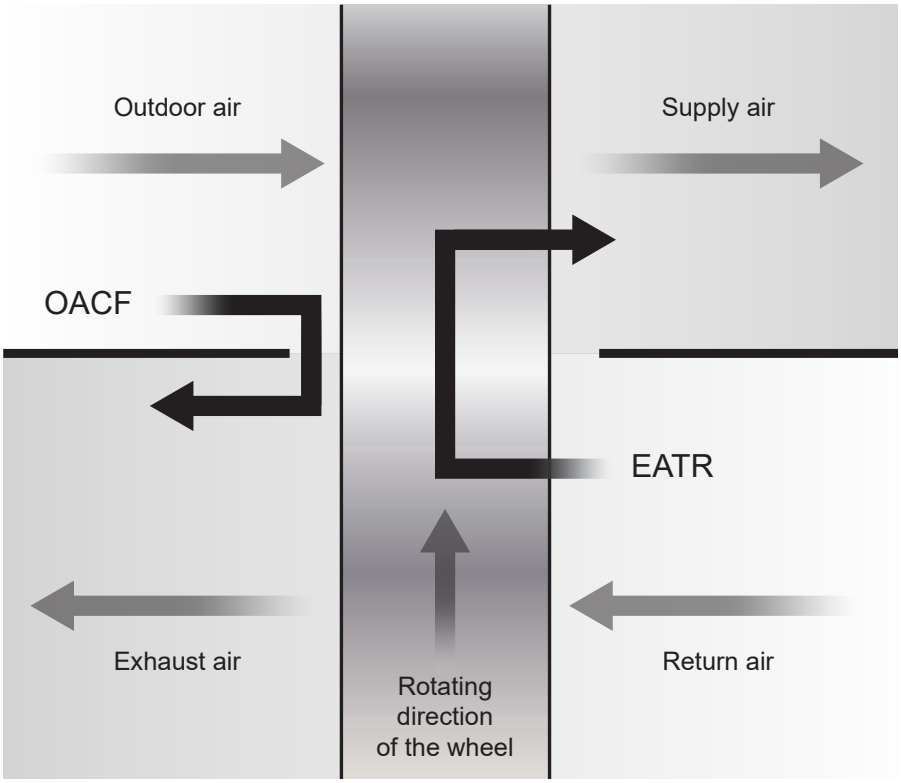
Outside Air Correction Factor (OACF)

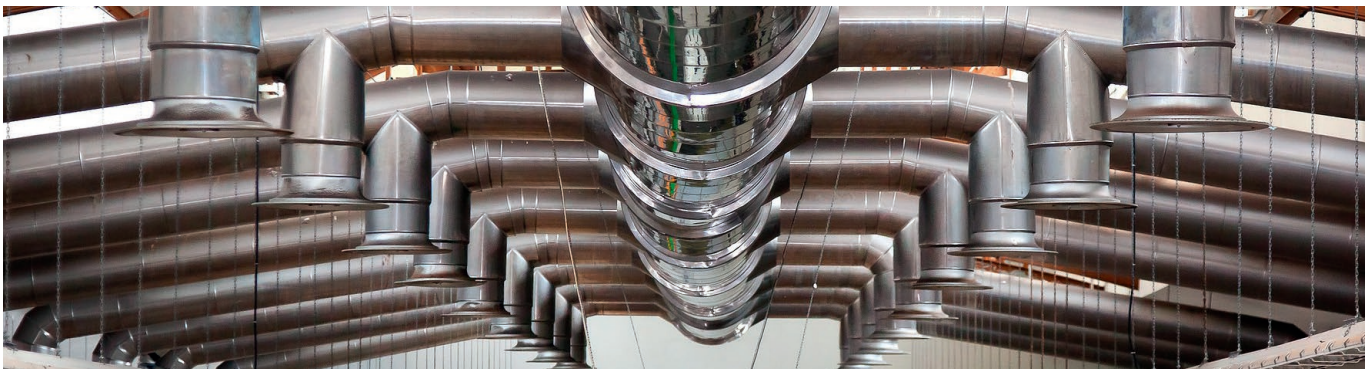
To ensure clean and fresh supply air, higher pressure in the supply air compared to the exhaust air is needed. That pressure difference causes a gap in the seals between the air ducts and thus generating a leakage between the supply inlet and the exhaust outlet. This effect reduces the amount of supply air going through the wheel and entering the building. The scheme below shows the distribution of internal leakages if the pressure on the outdoor side is higher than on the exhaust side. By adding an optional special seal, OACF is reduced.

Exhaust Air Transfer Ratio (EATR)

Due to the wheel rotation, some air gets trapped inside the matrix during the rotation from one air duct to the other. The air amount trapped in the wheel is transferred and mixed with the next airflow. If the air transferred is exhaust air into the supply air, the result is the contamination of the supply air. This effect is called carryover or Exhaust Air Transfer Ratio (EATR onwards) and is expressed in percentage (%) of the total airflow. By adding an optional purge sector, carryover is reduced.

To examine if there is any leakage connected to the rotary heat exchanger, measure in the air duct around the rotor.





BALANCE PRESSURE DIFFERENCE

The most critical step to prevent exhaust air from mixing in with the supply airflow and reentering the building is the correct distribution of pressure between the separate airflows. Air pressure should always be higher on the supply side compared to the exhaust side. This minimizes any leakage from the exhaust air into the fresh supply air. This applies not only to the heat recovery unit itself but to the building as a whole and most of the parts constituting the ventilation system (e.g., ducting and recirculation dampers).

The combination of higher pressure in the exhaust airflow versus the supply airflow affects the rotary heat exchanger by disabling the purge sector, which leads to a carryover effect through the matrix. Turning off the rotor will only stop the carryover, but leakage through the sealings might still appear.

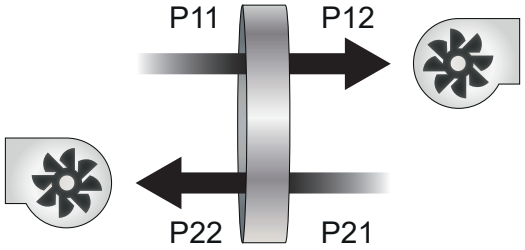
An alternative would be to keep the rotor running and improve the difference in pressure.

"If leaks are suspected in the heat recovery sections, pressure adjustment or bypassing (some systems may be equipped with bypass) can be an option in order to avoid a situation where higher pressure on extract side will cause air leakages to supply side. Pressure differences can be corrected by dampers or by other reasonable arrangements. In conclusion, we recommend inspecting the heat recovery equipment, including the pressure difference measurement."
- REHVA COVID- 19 Guidance Document, April 3, 2020.

FAN POSITIONING

Different fan positioning has different advantages. To minimize EATR and OACF values the combination of two pulling fans for both the supply and the exhaust airflows has proven to be a favorable solution, although it leads to negative pressure on both sides. Yet to compensate, slightly increase pressure on the supply side.

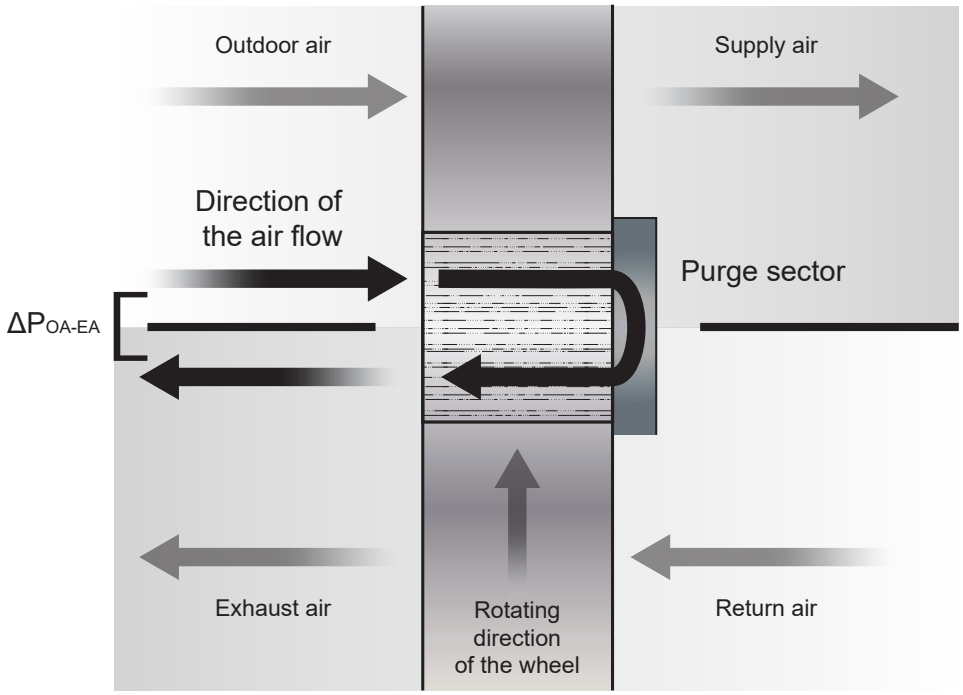
"In this configuration, with correctly balanced pressures and properly set-up purge sector, EATR is usually below 1%." - REHVA, Limiting internal air leakage across the rotary heat exchanger.



P_{11} = Static pressure, exhaust air inlet
P_{12} = Static pressure, exhaust air outlet
P_{21} = Static pressure, supply air inlet
P_{22} = Static pressure, supply air outlet

PURGE SECTOR

The purge sector is optimized to reduce the carryover or EATR. It will stop the inlet of exhaust air in the small area right before airflows switch, thus avoiding exhaust air to get trapped into the matrix. A small amount of the supply air is used to blow out the minor amount of exhaust air that might have been trapped to ensure a fresh and clean supply air. Note, Heatex provides modular purge sectors to be assembled at a later stage.

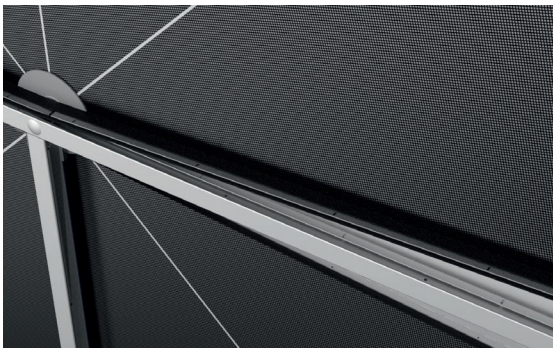


"The purge sector is a device that can practically prevent air leakage resulting from the rotation of the wheel (carryover)" - REHVA, Limiting internal air leakage across the rotary heat exchanger.

Heatex does not support lowering the flow rate to reduce the leakage rate because the flow rate induces a pressure drop required by the purge sector to function. We recommend therefore running the rotor at a nominal (or if possible) higher flow rate.

SEALING

By adding an optional Heatex "Special Seal" made of polymer on the middle beam and across the purge sector, leakage through OACF is reduced by 50% compared to standard seal. *"Perimeter and middle beam sealing prevent air leakage from supply side to exhaust side."* - REHVA, Limiting internal air leakage across the rotary heat exchanger.



"It is shown that rotary heat exchangers, which are properly constructed, installed and maintained, have almost zero transfer of particle-bound pollutants (including air-borne bacteria, viruses and fungi), but the transfer is limited to gasesous pollutants such as tobacco smoke and other smells."
- REHVA COVID- 19 Guidance Document, April 3, 2020.

SOURCES

For more information and guidance we refer to the offical documents released by REHVA and ASHRAE.

- *ASHRAE Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems, June 9, 2020*
- *REHVA COVID-19 Guidance Document, April 3, 2020*
- *REHVA, Limiting internal air leakages across the rotary heat exchanger*

THE PROMISE:

With Heatex as the leader of air-to-air heat exchangers and heat recovery ventilation solutions, you will have the best possible partner for your heat transfer applications.

THE PROOF:

With a global team of sales and technical support, Heatex responds quickly to inquiries with the optimized solution for your application.

All Heatex products are custom made and designed to match the customer's technical specifications. Heatex Select, always available online for free at heatex.com, enables accurate calculations of the performance of a product under different conditions.

We have a well established reputation of being honest and reliable and hold several certifications covering product and operation quality worldwide, for example Eurovent, AHRI, EAC and ISO 9001.

Moreover, our products are field tested and proven to have very high efficiency and a fast ROI.

Being the leader, Heatex will always provide the best expertise to find a solution for your application.

Heatex is a global manufacturer of air-to-air heat exchangers. The company was founded in the 60's, and incorporated into Heatex AB in 1987.

The company uses advanced algorithms to design and improve its products. These are based on scientific calculations within fluid dynamics, the fundamentals of heat transfer and fifty years of practical experience of heat transfer processes.

Heatex products are well known for providing high energy recovery and for enabling a fast return on investment. The company has a history of steady growth and has over the years established itself as the market and technology leader of air-to-air heat transfer.