Minimising the risk of transmission for AHUs with thermal wheels.

Ventilation systems have been a focus of attention due to the pandemic. The European Centre for Disease Prevention and Control (ECDC) has stated “The risk of human infection with SARS-CoV-2 caused by air distributed through the ducts of HVAC systems is rated as very low.”1 but it is prudent to review existing or future installations to ensure that systems are as safe as possible.

CIBSE produced a ventilation guidance document 2 which identifies the three principle types of Air Handling Units (AHU) – run around coils (RAC), plate heat exchangers and thermal wheels -and the associated risks of recirculating contaminated air. However, it didn’t go into detail for the various configurations of fans associated with thermal wheels and some confusion remains as to whether it is safe to operate AHUs with Thermal wheels.

Section 4.2.2.1 of the CIBSE guide states that RAC and plate heat exchange units keep the supply air and the extract air streams physically separate. Whilst this is true for RAC there is always a risk of leakage from plate heat exchangers. A plate can comply with EN308 3 with an internal leakage of up to 3% - Though this figure is reduced for 0.5% for a Eurovent certified unit.

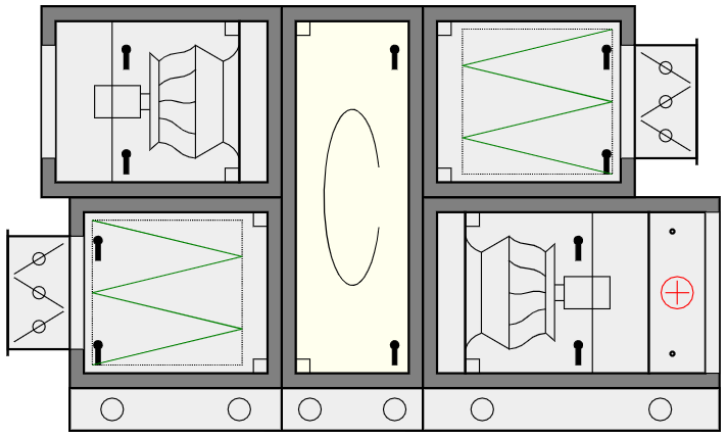
Section 4.2.2.2 of the CIBSE guide covers thermal wheel units but some detail is missing.
The supply and extract airstreams of an AHU with a thermal wheel can never be completely sealed and some degree of leakage between air streams is inevitable. This leakage occurs even when the rotor is switched off so there is no benefit in deactivating the rotor if the fans are kept running for ventilation. The amount of leakage is dependent on the location of the fans relative to the rotor, if the rotor is fitted with a purge sector and the static pressures in the ductwork. It is the location of the fans relative to the rotor which is missing from the guidance document.

“The purge sector is a device that can practically eliminate the leakage resulting from the rotation of wheel (carry-over). Its location and setting (angle) must be arranged according to manufacturer guidance depending on the configuration of fans and pressure relation.“ 6

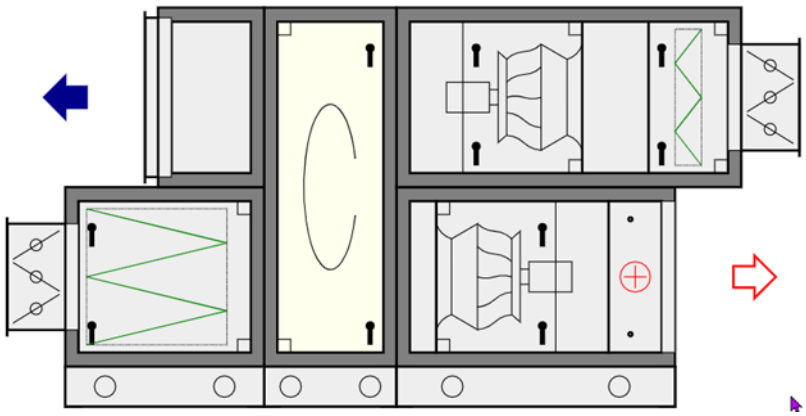
There is a standard for the amount of exhaust air that is transferred into the supply Airstream. EN 16798-3 4 defines the Exhaust Air Transfer Ration (EATR) as the “level of carry over of extract air to the supply air”. Reducing the EATR reduces the amount of contaminated material that can be recirculated.

Eurovent – the independent product performance certification organisation - has produced a guide to air leakage in AHUs 5. In the guide Eurovent identify the four possible fan configurations of AHUs with thermal wheels and gives the typical EATR with and without a purge sector for given external and internal pressure regimes.

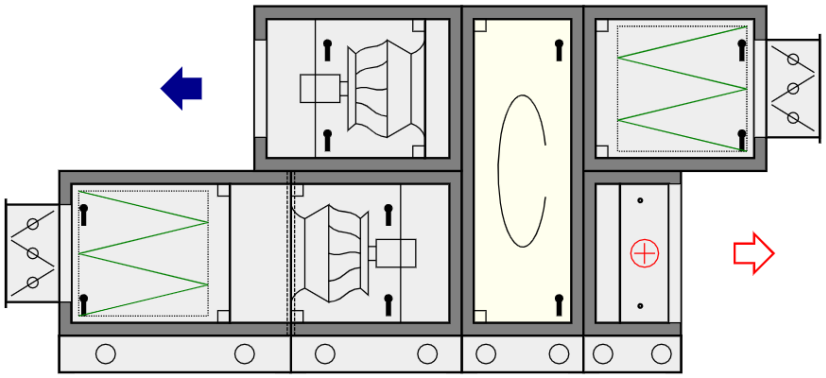
The four configurations are identified, and the table below gives the EATR based on normal Part L compliant external static pressures.



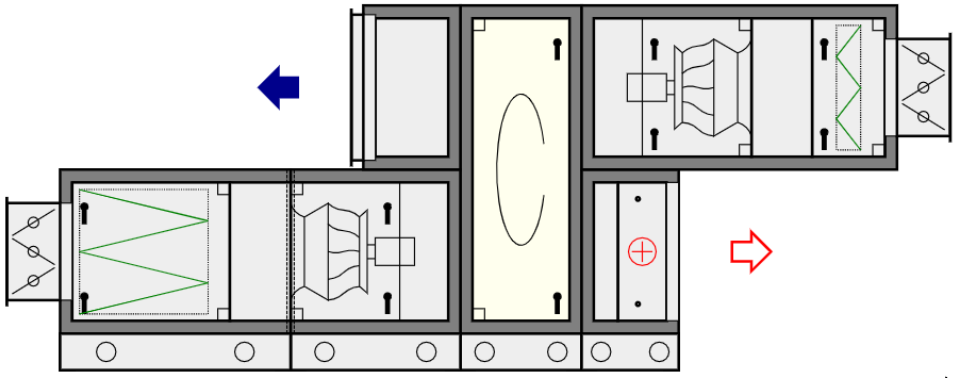
Type 1. Both fans after the rotor



Type 2. Both fans on the building side



Type 3. Both fans on the outdoor side



Type 4. Both fans upstream of the rotor

Type	EATR without purge	EATR with purge	Note
1	EATR<3%	EATR<1%	Dependent of external pressures. See Eurovent 6/15
2	10%< EATR < 20%		Purge does not function in this configuration
3	EATR <1%	EATR=0%	
4	EATR <3%	EATR<1%	

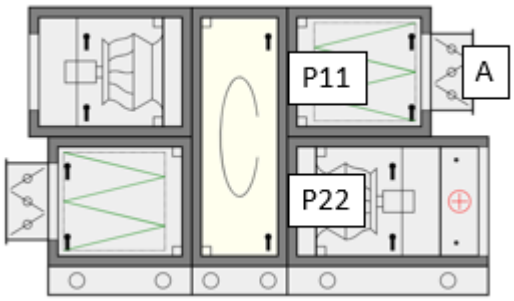
Eurovent also give guidance for each individual configuration and I have added an additional comment if applicable

Type	Eurovent	Additional comment
1	This configuration is most recommended to minimize internal leakages	The most common configuration in the market
2	Price driven solution. Very high internal leakage rates and should be avoided	
3	Very high supply air leakage to exhaust	Supply air leakage lowers unit efficiency
4	Higher internal static pressure	Very uncommon solution.

As can be seen in the table above the Eurovent recommended configuration- which is the most common from reputable suppliers – has an EATR equivalent or lower than an EN308 compliant plate heat exchanger.

There is an additional measure than can lower the EATR even further. REHVA are the European umbrella organisation for all the countries version of CIBSE. REHVA have produced a document 6 "Limiting internal air leakages across the rotary heat exchanger", which states that "Next step to eliminate a leakage is to set the correct relation between pressures p22 and p11 (see diagram)."

This pressure can be achieved by regulating the exhaust damper (A) correctly positioned
On the system side of the exhaust airstream. If the correct pressure is achieved for the recommended configuration the EATR can be considered virtually zero.



REHVA have given guidance for all configuration types and these are shown in the table below.

Type	REHVA guidance	comment
1	Adjust the throttle in the extract air so p11 will become at least p22 – 20 Pa	The damper could be in the ductwork or at the AHU
2	There is no possibility to use throttling in this case	
3	There is no need to use throttling in this case	
4	Adjust the throttle in the extract air so p11 will become at least p22 – 20 Pa	The damper could be in the ductwork or at the AHU

In conclusion, AHUs with rotors can have an EATR equivalent or lower than plate heat exchangers if the fans are in the recommended configuration, and the unit is fitted with a purge sector.
Many existing installations could safely be put back into operation, but it would be prudent to get a competent engineer to undertake a survey to ensure the unit is in the recommended configuration and fitted with a purge sector. For additional security adding pressure control would be advised.

Specifying AHUs with the recommended configuration, purge sector and pressure control will ensure new installations reduce the already very low potential risk to an absolute minimum whilst delivering the highest efficiency and resulting lowest life cycle costs.

References

1. ECDC - Heating, ventilation and air-conditioning systems in the context of COVID-19: first update 10 November 2020
2. CIBSE - CIBSE COVID-19 VENTILATION GUIDANCE, Version 4 23 October 2020
3. prEN308 May 2020- Heat exchangers - Test procedures for establishing performance of air to air and flue gases heat recovery devices
4. EN 16798-3 December 2018 Ventilation for buildings. Part 3: For non-residential buildings. Performance requirements for ventilation systems
5. Eurovent 6/15 – 2020 Air leakages in Air Handling Units. Guidelines for improving indoor air quality and correcting performance. First Edition Published on 01 April 2020
6. REHVA COVID-19 specific guidance document. Limiting internal air leakages across the rotary heat exchanger. July 2020