INNERGY-2
SAVE
TECHNOLOGIES

THE NEW REVOLUTIONARY
AIR LOOP™
LABYRINTH SEAL (Patent Pending)

AHRI Air-Conditioning, Heating, and Refrigeration Institute
www.ahrinet.org

Finally a seal tested for real applications of up to 5" WC and leading to greatly reduced fan operating costs.

A technology used on our AHRI 1060 certified I3 energy recovery wheels

Up until now, the seals used for the energy recovery wheel industry fell in two main categories: Rubber 4 Pass labyrinth seals, great for their labyrinth effect but hard to install (if installed too close the seal damages the wheel and if installed too far the leakage level is greatly increased), and brush seals, easy to install but quick to use and lacking any kind of labyrinth effect.

Knowing well the advantages and disadvantages of each design, the Innergy tech R&D team, through state of the art computer simulations and laboratory tests, worked on a seal that would keep and improve the benefits of each design and eliminate their major drawbacks. The goal was simple: To design the ideal seal that would produce the smallest leakage level by offering an improved labyrinth effect and zero seal-tomedia installation distance. Our team would not stop there however, the seal would also have to remain effective for real life conditions and every day designs which means for pressure differentials of up to 5" WC.

Following this intensive research and development program, Innergy tech is proud to present you the next generation seal: The new AirLoopTM Labyrinth Seal.

REDUCED LEAKAGE FACTOR 1

Completely redesigned seal for a true labyrinth effect

As seen in the following computer simulations, the turbulence and contraction effects are not improved by adding more lips or pass. In fact, the opposite happens and too many lips even eliminate most of the desired expansion needed to produce the entering and leaving edge restrictions.

The labyrinth effect

The labyrinth effect is the result of the air expansion within the seal's cavity. For an ideal labyrinth seal, the air expands adiabatically within the seal and all its kinetic energy is transformed into thermal energy so that its velocity as it reaches the second lip is zero.

While no real life seal will reach the ideal concept, getting it to behave as closely as possible to the theory greatly depends on the level of air expansion that one is able to create through its design.

setting the standard for **energy recovery**

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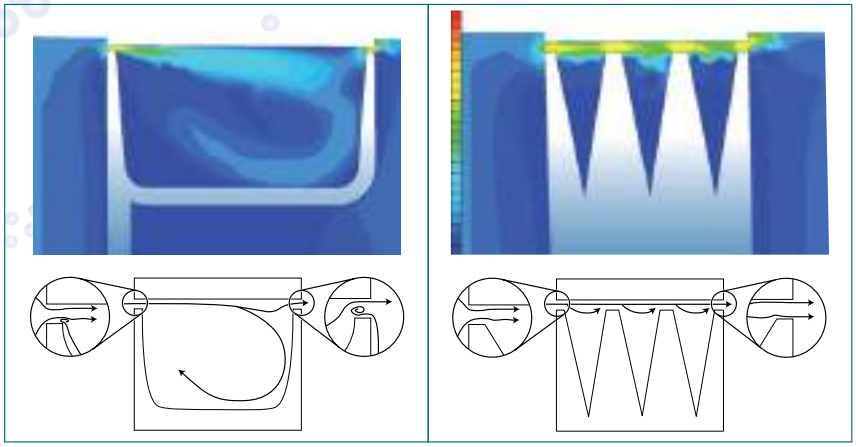
With the 4 Pass design (Simulation 1), the air remains between the seal and media and fails to create the desired labyrinth effect. The air velocity as it passes through the seal is also fairly constant which prevents any of the desired entering and leaving edge restrictions.

The new AirLoop™ Labyrinth Seal (Simulation 2) solves these problems and creates a true labyrinth effect

by allowing the air to expand and use the whole depth of the seal. Consequently, the air velocity through the seal greatly varies and leads to real edge restrictions.



Simulation 1: Classic 4 Pass Labyrinth Seal

Simulation 2: AirLoop™ Labyrinth Seal

Computer simulations: Colors represent the air velocity from dark blue (0 fpm) to red (Maximum speed).

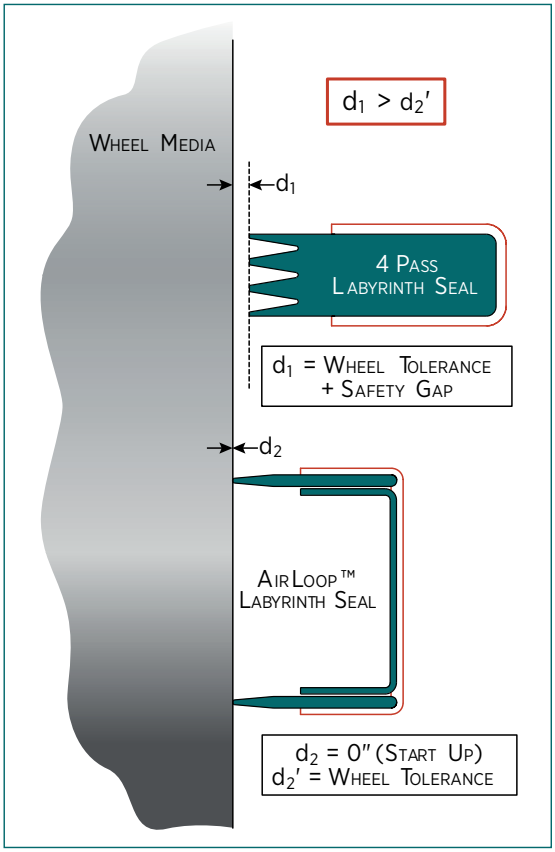
REDUCED LEAKAGE FACTOR 2

Zero gap installation between the seal and media

Another critical aspect directly affecting the overall seal leakage is how close the seal can be installed from the wheel's media. Here, differences as small as 1/32" will have an impact so it is imperative that the seal be installed as close as possible to the wheel.

With conventional 4 Pass rubber labyrinth seals (Drawing 1, top section), any contact between the seal and media will lead to damages so, on top of the wheel tolerance, a "safety" distance must be added. The result is an installation distance "d1" that goes from 1/16" to 1/8" or even more depending on the wheel's construction and installer.

The AirLoop™ Labyrinth Seal (Drawing 1, bottom section) is made out of a special material which was specifically chosen to make sure it could never damage the media. As a result, there is no need for any added "safety" distance with this design. The seal can therefore be allowed to touch the wheel for no initial gap. As the wheel turns, the seal will automatically adjust itself to the wheel's tolerance (approximately 1/32") for the smallest possible air leakage. Once adjusted, the seal essentially becomes a non contact, no maintenance seal that will last for the life of the wheel.



Drawing 1: Classic 4 Pass VS AirLoop™ Labyrinth Seal installation

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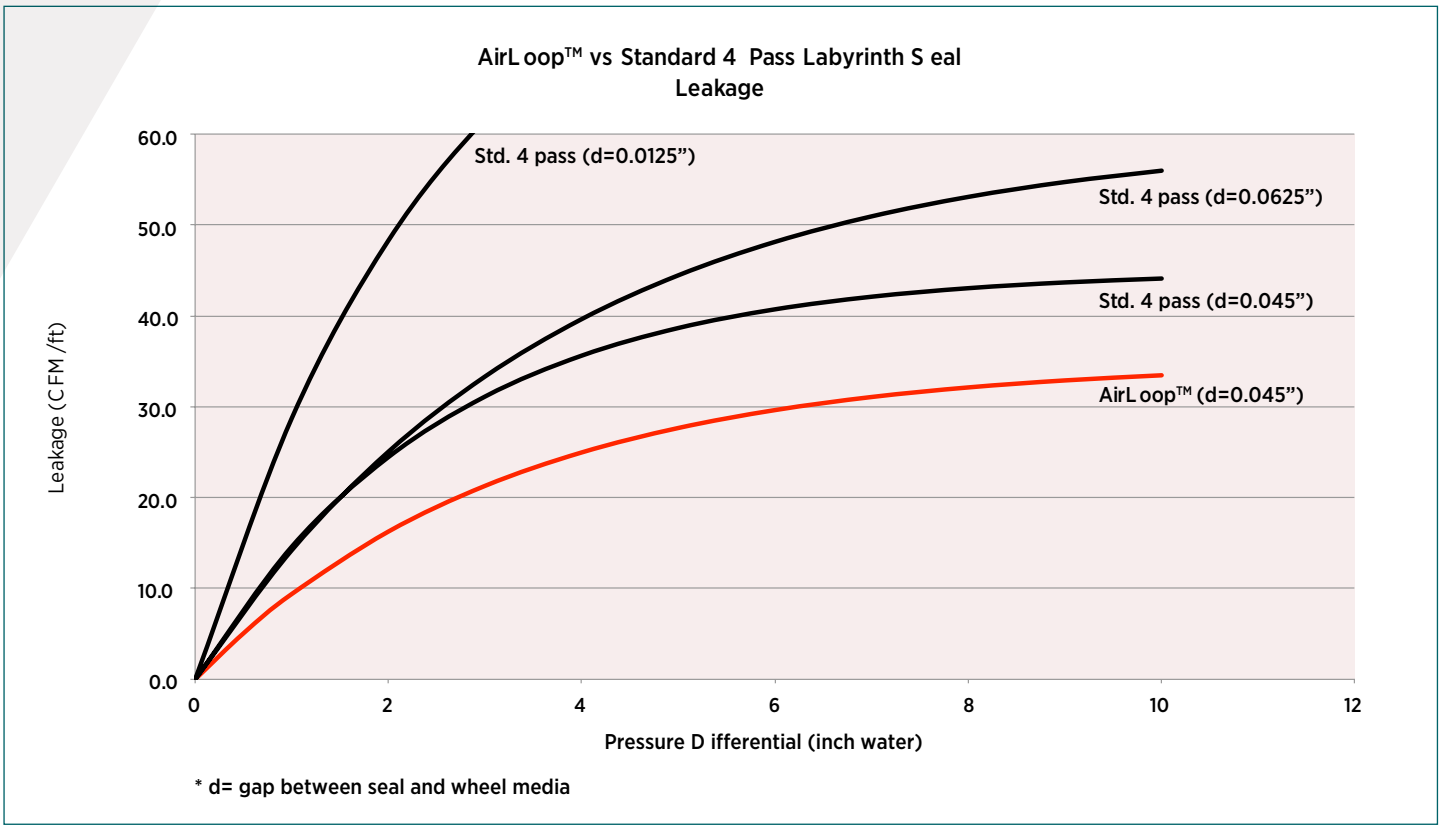
REDUCED LEAKAGE FACTOR 3

High pressure design for extra low leakage even for pressure differentials of up to 5" WC

The following graph (Graph 1) clearly shows the improvement obtained by using the Innergy tech AirLoop™ Labyrinth Seal. Note that the tests leading to this graph were made by controlling the static pressures on both sides of seal sections only to eliminate the variation that could come with different wheel designs. Interesting to compare are the curves of both types of seal at 0.045" gap that clearly show the superiority of the labyrinth effect created by the AirLoop™ Labyrinth Seal.



Graph 1: Leakage per foot length comparison of Classic 4 Pass VS AirLoopTM Labyrinth Seal

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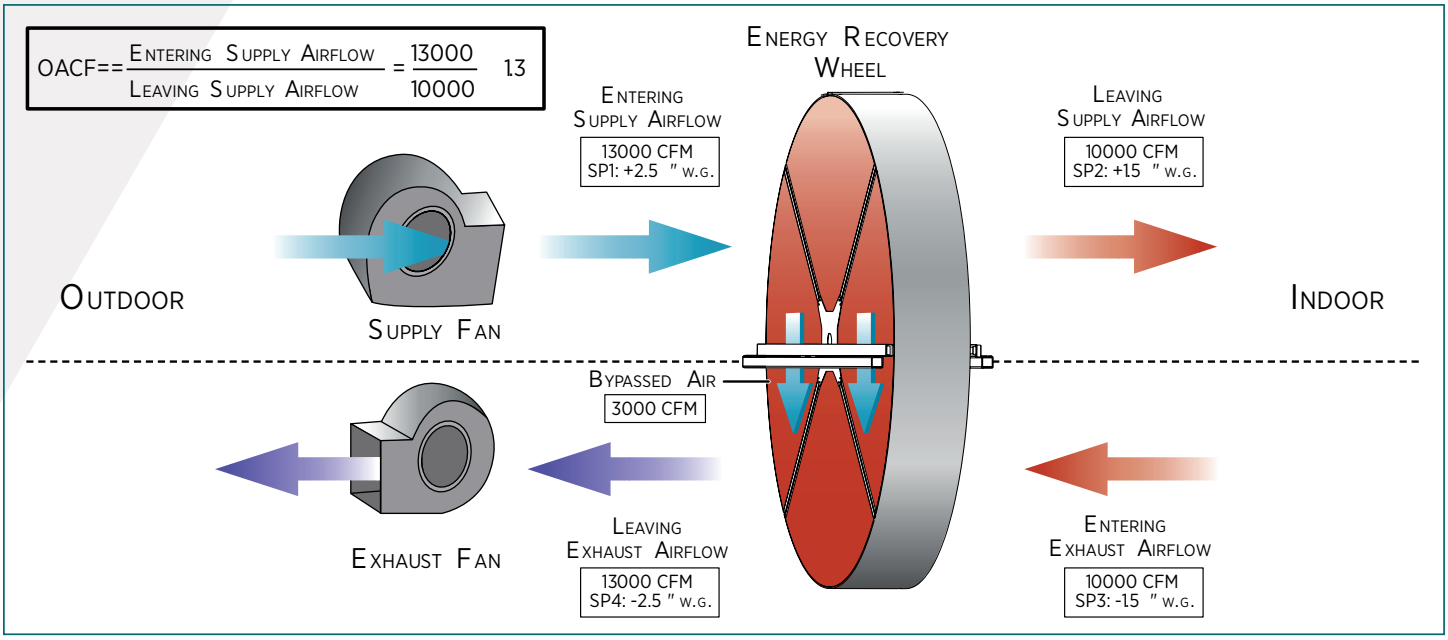
THE AIRLOOPTM LABYRINTH SEAL EFFECT:

REAL COST SAVINGS THROUGH BETTER OACF AND EATR VALUES

A lower OACF means lower operating costs

The OACF or Outdoor Air Correction Factor is the ratio of the entering supply airflow on the leaving supply airflow. Directly affecting the fans energy consumption, the OACF is by far the most overlooked aspect of energy recovery wheels



OACF Diagram

1-OACF REDUCTION WITH AIRLOOP™ LABYRINTH SEAL MEANS COST REDUCTION:

As shown in the OACF diagram above, with high enough pressure differentials, OACF values of 1.3 or more can be obtained with certain wheel designs. In this example, this means that the supply fan, instead of delivering the required 10000cfm, will have to deliver a total of 13000 cfm.

Based on a similar 10000 cfm unit, an estimated fan operating cost increase can be calculated for different locations and OACF values. As shown on the chart below, the OACF's influence on operating costs can't be neglected.

ESTIMATED FAN OPERATING COST INCREASE PER YEAR (24/24, 7/7)						
OACF	CFM increase	New York ($0.24/kWh)	Boston ($0.19/kWh)	Miami ($0.11/kWh)	San Francisco ($0.18/kWh)	Houston ($0.10/kWh)
1.05	500	$915	$725	$420	$687	$381
1.10	1000	$1.831	$1.449	$839	$1.373	$763
1.20	2000	$3.661	$2.899	$1.678	$2.746	$1.526
1.30	3000	$5.492	$4.348	$2.517	$4.119	$2.288

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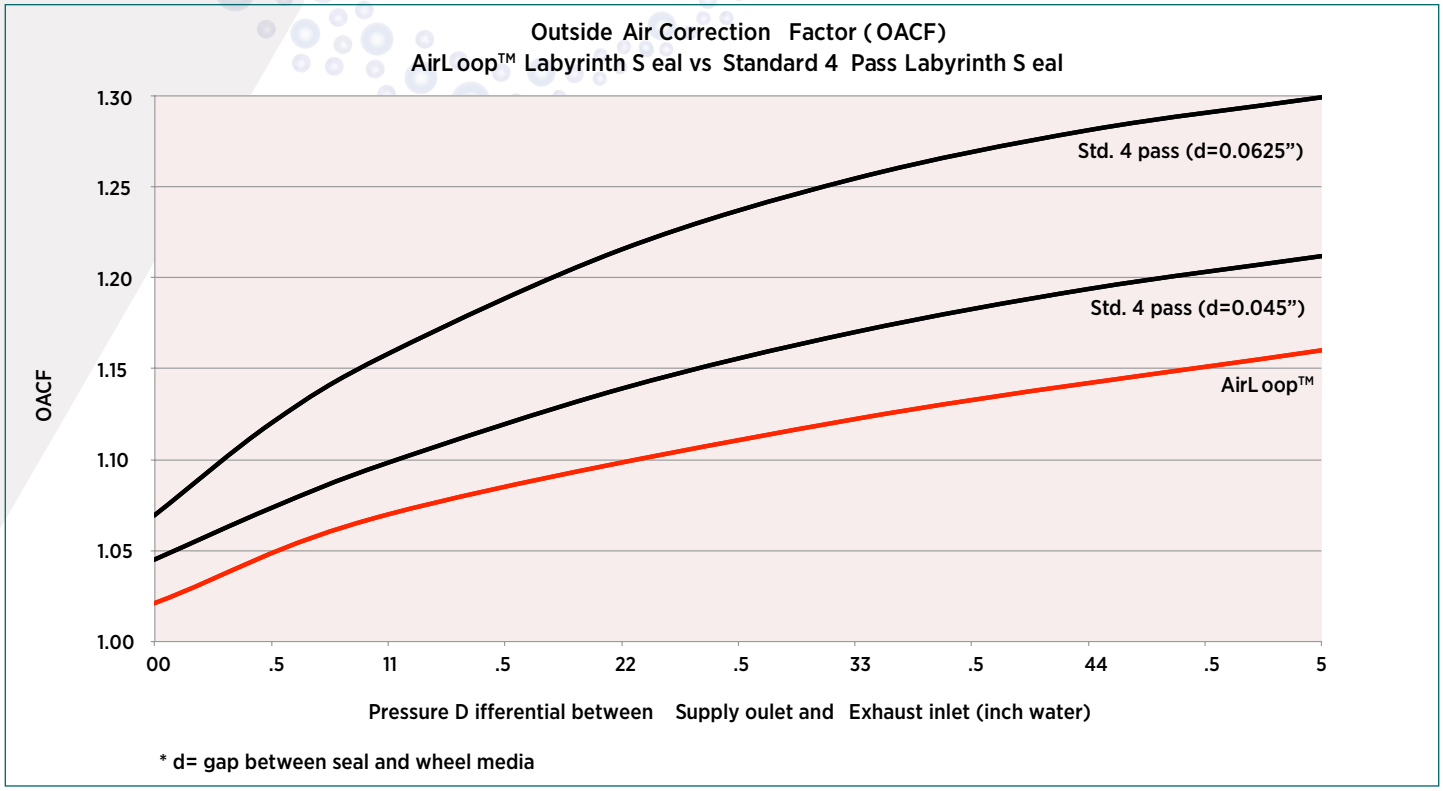
The OACF graph below shows just how the AirLoop™ Labyrinth Seal improves the OACF level of an energy recovery wheel. While the improvement is already important at low pressure differentials, it becomes major as pressure differentials increase in the range where most air handling units are operated (2" to 3" WC). At these levels, the difference in the fans operating costs can mean savings equal to the wheel total cost in just a few years.



Graph2: OACF comparison of Classic 4 Pass VS AirLoopTM Labyrinth Seal

Reduced EATR for better Indoor Air Quality

The EATR or Exhaust Air Transfer Ratio, as it name implies, is simply a measure of the wheel exhaust transfer level. As shown in the EATR diagram on page 6, it is measured by first introducing a certain tracer gas concentration in the Entering exhaust airflow (C3). The EATR result, expressed as a percentage, is calculated by dividing the concentration difference between the Leaving Supply Airflow (C2) and Entering Supply Airflow (C1) by the concentration difference between the Entering exhaust airflow (C3) and Entering Supply Airflow (C1).

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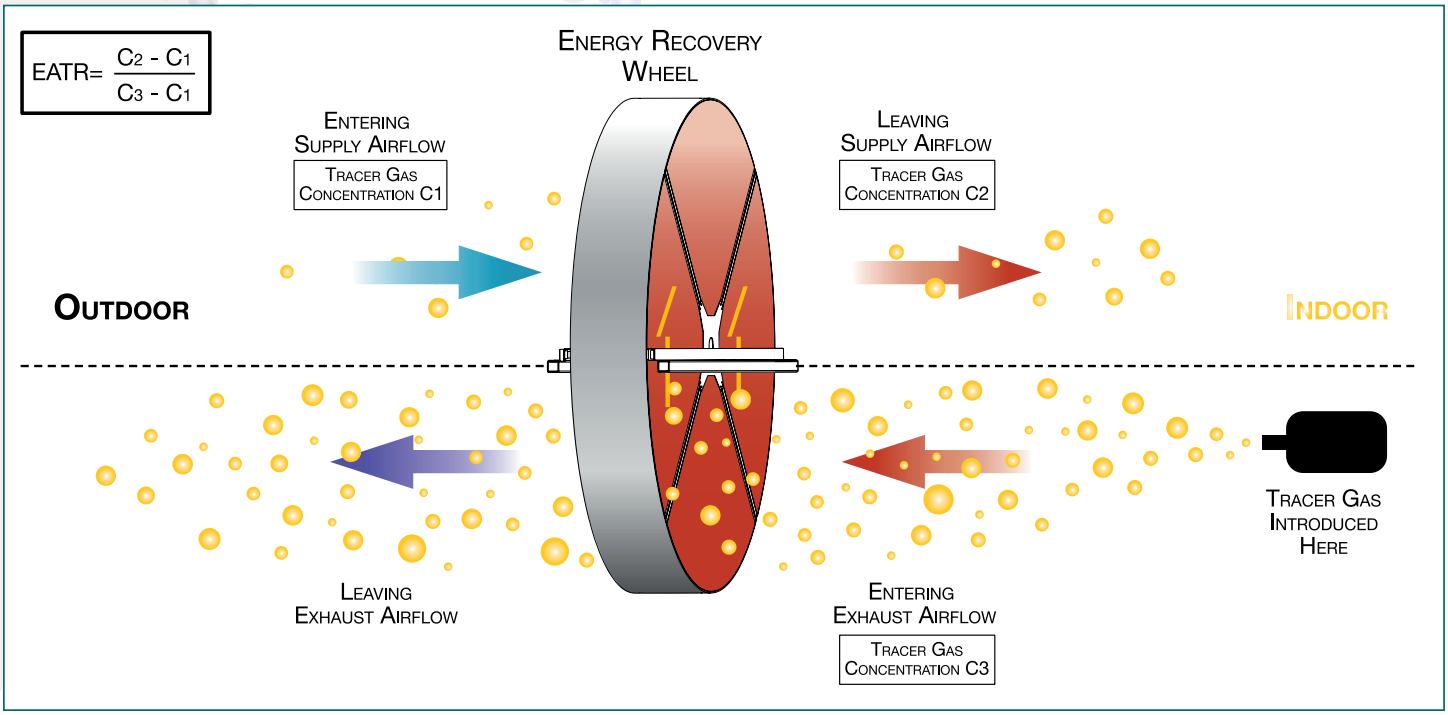
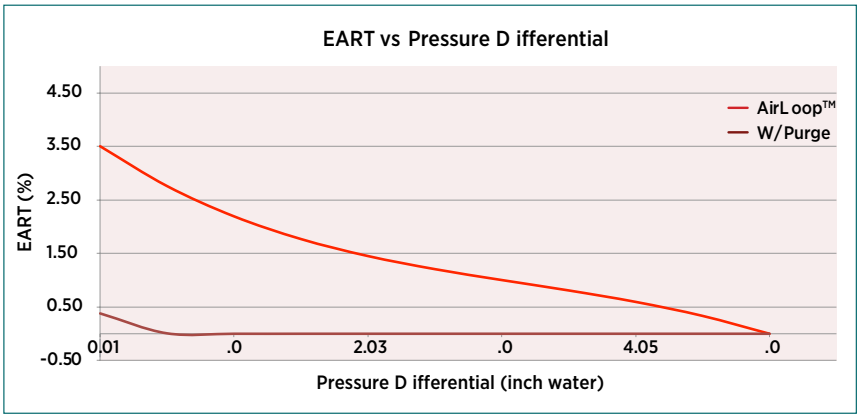


EATR Diagram

2-EATR REDUCTION WITH AIRLOOP™ LABYRINTH SEAL MEANS A BETTER AHRI 1060 CERTIFIED ENERGY RECOVERY WHEEL:

Factors influencing the EATR levels of a given energy recovery wheel are the seals, the pressure differential, the presence of a correctly adjusted purge section and lastly, to a lesser extent, the desiccant. The EATR Graph to the right (Graph3) shows the EATR level of the Innergy tech I3 energy recovery wheel equipped with AirLoopTM Labyrinth Seals. Important values to note is that an EATR of 0% (no exhaust transfer) can be obtained with no purge for a pressure differential of 5"WC while the same value can be obtained with the use of a purge section starting from pressure differentials as low as 0.5"WC.



Graph 3: EATR vs Pressure Differential of the Innergy tech I3 wheel with and without purge AirLoop™ Labyrinth Seal.

Conclusion:

The new AirLoop™ Labyrinth Seal has been independently tested and is certified through the AHRI 1060 standard for up to 5" WC pressure differentials (Innergy tech I3 energy recovery wheel). It's improved labyrinth effect, easier installation and optimized high pressure design result in an all time low when it comes to energy recovery wheel leakage levels. Most importantly, the AirLoopTM Labyrinth Seal results in great savings thanks to greatly reduced fan energy use.

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