High Pressure Addendum for Heat Wheel Seals

Heat wheel manufacturers have developed many different types of seals to prevent leakage between the airstreams that flow through their products. Leakage can occur around the wheel's perimeter or through the gap between the wheel and the crossbar separating the two airstreams, and these are the locations where seals are installed.

Leakage is driven by the difference in pressure between the two airstreams that flow through the wheel. For example, when the pressure is higher in the supply airstream than in the return, air leaks from the high-pressure supply airstream to the low-pressure return. This difference in pressure, called "differential pressure," can vary widely depending on blower location and equipment configuration. Although no seal design eliminates leakage completely, AIRotor has developed an optional seal system that effectively prevents leakage at higher differential pressures.

Types of Seals

All heat wheel seal systems operate on one of two principles. They either create a physical barrier to leakage or form a restrictive air flow path to prevent or reduce leaking air.

Brush Seals

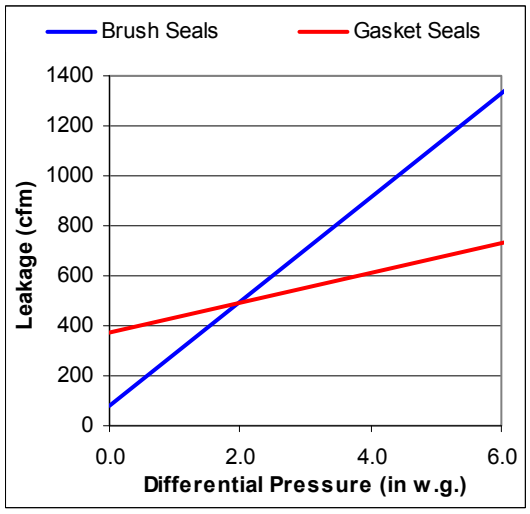
Brush seals form a physical barrier to leakage. They are designed to attach to one surface and maintain contact with another that moves across it. They therefore physically block any air that would otherwise flow between the two surfaces. Some brush seals (including the standard AIRotor seals) also have an embedded wiper—a plastic blade that that makes the otherwise-permeable brush barrier airtight.

Labyrinth Seals

As their name implies, labyrinth seals use a convoluted, narrow path that creates a resistance seal to airflow at higher pressure differentials and velocities. The result is that labyrinth seals effectively diminish the ability of higher differential pressures to increase the leakage flow rate.

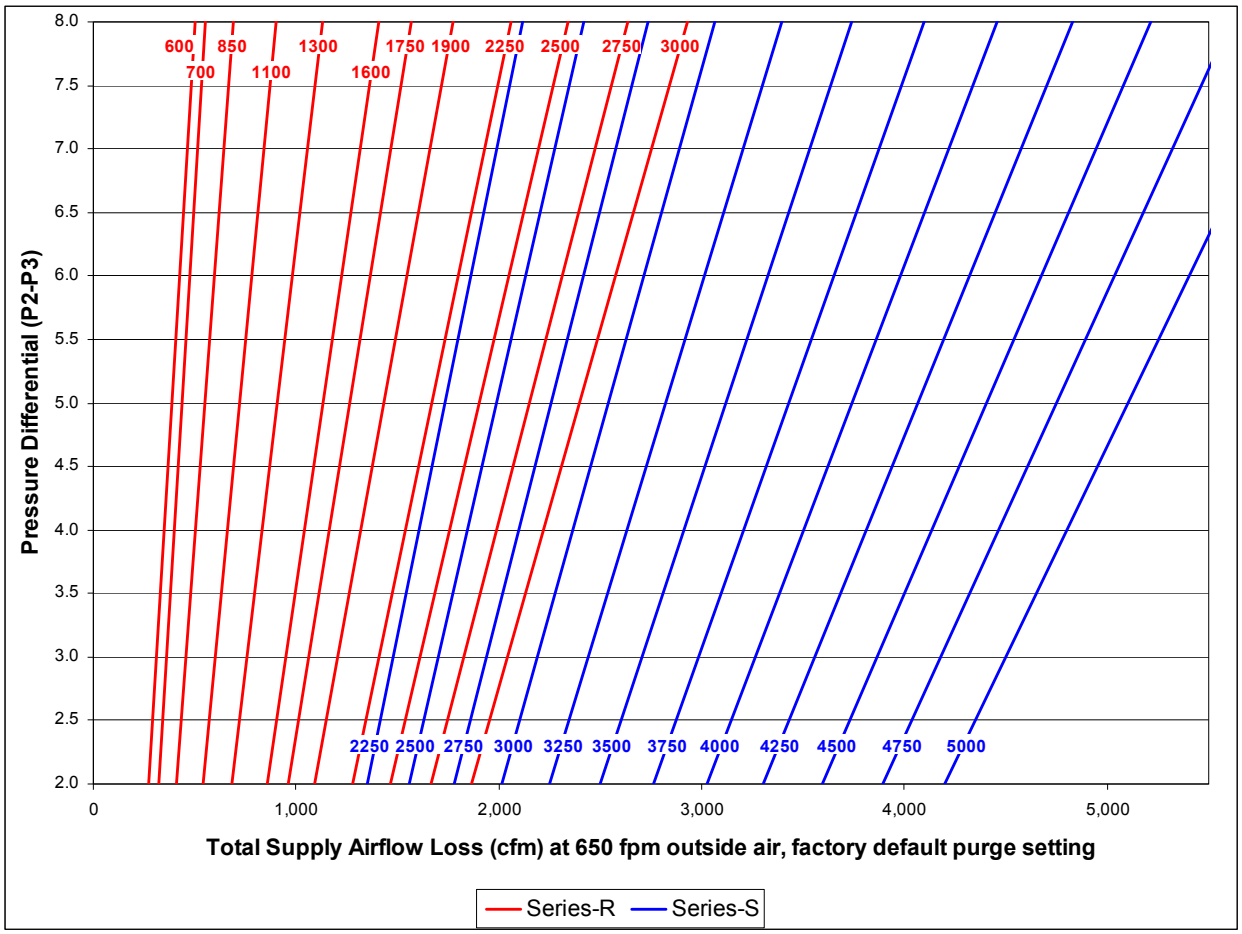
Seal Performance

As shown on the graph below, brush seals are generally more effective than labyrinth seals for lower differential pressures. In this range, the brush seals are easily able to maintain contact with the surface that moves across them. Labyrinth seals, on the other hand, depend on a higher differential pressure to drive the high velocity leakage flow that creates resistive labyrinth pressure. When differential pressures are small, the slow moving leakage air easily passes through the narrow gap that labyrinth seals leaves open between airstreams.



Seal performance test data for one wheel

At higher differential pressures, however, brush seals have a problem. As this pressure builds, it will eventually become strong enough to bend the brush. Leakage air will then be easily able to flow through the open gap created between the brush and the moving surface with which it is no longer able to make contact. Labyrinth seals do not have this problem. They are made of a (relatively) rigid material that does not bend under the pressures of the airstreams. Further, with increasing differential pressures, the higher velocity of leakage air through the narrow labyrinth gap creates increasingly effective resistance to leakage.



Combined total airflow loss due to purge and leakage over a range of high differential pressures for AIRotor Series–R and XeteX Series–S heat wheels with High Pressure Seals

AIRotor High Pressure Seals

As an option for high differential pressure applications, AIRotor has developed a labyrinth-type seal using typical gaskets. Testing and research have shown that brush seals are more effective than gasket-type seals at limiting leakage caused by pressure differentials up to 2.5"–3.0" w.g.. At pressure differentials above 3.0" w.g., gasket seals are more effective.

The AIRotor High Pressure Seal System consists of a Double-Brush and Blade brush seal and a Gasket seal. The Gasket seal provides a physical barrier to leakage and supports the brush seal, preventing it from bending at high differential pressures. As can be seen from the chart below, this system is very effective at preventing leakage across a wide range of differential