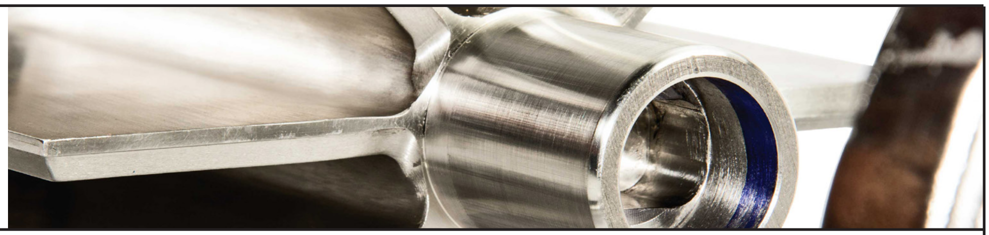

Finding and Fixing Common Rotary Airlock Valve Problems

by Ray Galuska

A rotary airlock valve is one of the most important components in your pneumatic conveying system. But do you know how to troubleshoot valve problems? After describing rotary airlock valve selection and operation, this article explains how you can find and fix common valve problems.

Many manufacturers supply rotary airlock valves, but all types include these basic components, a housing and headplates (which form a cylindrical cavity with a material inlet and outlet), bearings supporting a rotor with blades (also called vanes), and shaft seals. In operation, a motor and drive chain turn the rotor shaft, spinning the rotor inside the housing and headplates. As the blades rotate a fixed volume of material passes through the material inlet to the spaces between adjacent blades (called rotor pockets) and is carried in the pockets toward the material outlet.

The valve components can be configured in hundreds of ways to handle your material and operating conditions. The inlet can be round, square, or rectangular to fit your equipment. The rotor can typically have 6, 8, or 10 blades, and the blade tips can be square or beveled or mounted with flexible seal strips. The blade-to-housing and blade-to-headplate clearances can be adjusted within a range of a few thousandths of an inch.

The housing can be drop-through, side-entry, or blow-through style. In the conventional drop-through housing, material enters at the top and exits the bottom. In a side-entry housing, material enters the offset inlet, filling less than 100 percent of each rotor pocket and reducing clipping of material at the feeder inlet; the material exits the bottom. A blow-through housing can help feed a fine, lightweight, or sticky material because material enters the housing top and the conveying air passes through the bottom rotor pockets to blow out the material. The valve's operating speed can vary widely, depending on the valve manufacturer and your application.

The valve can be used as an airlock, a feeder, or a combination of these. An airlock minimizes air leakage while allowing material to pass between vessels at different pressures. A feeder operates under a head of material and regulates material flow between vessels at the same pressure. A combination feeder-airlock minimizes air leakage while regulating material flow between vessels at different pressures. In any application, the valve always functions as a gravity-flow device.

Selecting the right valve to avoid operating problems

If your valve exhibits operating problems or a valve component fails from other than normal wear, it's typically because you selected the wrong valve or valve component for your application. You can prevent such problems by avoiding these common selection pitfalls:

- Improperly choosing the valve for your material's properties (such as bulk weight in pounds per cubic foot, maximum particle size, and tendency to compact, aerate, absorb moisture, corrode, or ignite).
- Failing to consider what device (such as a mechanical conveyor, belt, or process vessel) or condition (such as pressure or temperature) is below or above the valve.

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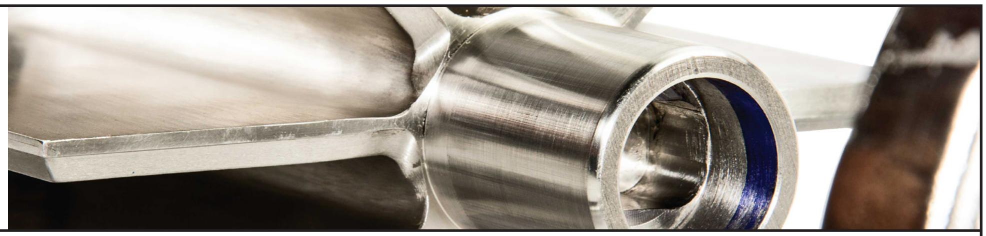

- Disregarding your application’s special operating conditions (such as the system’s average flowrate versus its instantaneous rate in tons, pounds, or bushels per hour and its maximum and minimum flowrates).

Take the guesswork out of your valve selection process and minimize future operating problems by working closely with your valve manufacturer. The manufacturer will ask for data about your material and operating conditions to help you select and size a valve for your application. For instance, if a screw feeder will be located below the valve, the manufacturer can help you size the valve to avoid overfeeding the screw.

How to find and fix common operating problems

A rotary airlock valve is subject to these common operating problems:

- Jamming,
- Excessive air leakage,
- Noisy operation, and
- Insufficient material throughput.

Although these problems usually spring from improper valve selection, they can also be caused by changes in your operating conditions or material properties or by poor maintenance. The following information explains what can cause each problem, how to spot the problem, and how to fix it.

Jamming

Material can get caught or pinched between the rotor blades and the housing or headplates, jamming the valve and excessively wearing the valve components. Such problems are more likely with a large fibrous material, such as wood fibers, or a hard material, such as some plastic pellets. Jamming can also occur when the valve is undersized. For instance, 4-inch chunks can’t pass freely through an 8-inch valve because the chunks are larger than the rotor pockets.

First, check the valve’s rotation. Is the rotor turning clockwise (or counterclockwise) as the manufacturer intended? Is the rotor turning smoothly without contacting the housing or headplates? Do you hear or feel the valve shuddering? Shuddering can indicate material is jammed between a blade tip and the housing and can eventually cause the drive chain to “hop” or the valve to stall.

Depending on your application, you can remedy the problem by beveling (or relieving) the blade tips to reduce the likelihood of catching material between the blade and housing or headplates and achieve proper rotation. You can also install flexible seal strips on the blades to extend beyond the blade tips; the strips permit material to pass over the blade tips while maintaining a seal. The strips can be made from urethane, neoprene, Teflon, carbon steel, stainless steel, abrasion-resistant steel, or other materials and are typically attached to the blade with bolts. However, maintaining the strips can be labor-intensive.

Jamming can occur even when the valve rotates properly at startup and for some time afterward. If you’ve checked the rotation and still have jamming, consider other jamming sources:

- *Has a foreign object (even such an unlikely item as a hand tool or welding rod) entered the valve?*
  If your search yields such an obstruction, don’t just remove it -- track its source to prevent such objects from getting into the valve again.
- *Has the material changed? Has any condition changed the material’s properties and affected flow through the valve?*

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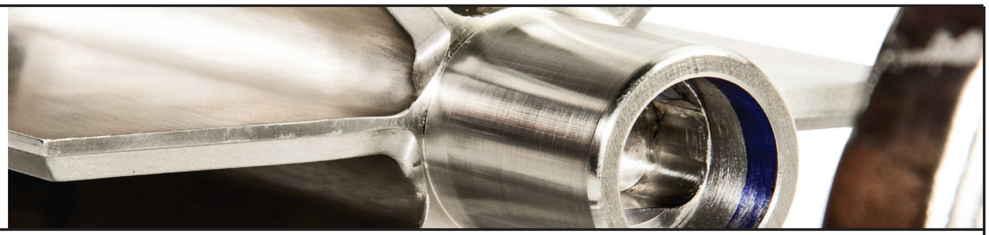

For instance, water vapor from a slurry tank or mixing vessel below the valve can reach the material and moisten it, forming lumps that can jam the valve. Or the onset of cold weather can cause jamming in a system that conveys dry powder from inside a plant to an outdoor storage vessel: As the system's dust collector draws warm plant air through the cold line, condensation forms and contacts the powder, making chunks that jam the valve. You can prevent the first problem by venting the moist air before it reaches the valve. You can prevent the second problem by running the system continuously, by running it for a while before feeding material to the system, or by using a valve equipped with a device that automatically adjusts valve operation to temperature changes.

- *Is the material temperature higher than you expected?*

  A higher-than-anticipated material temperature can cause the valve components to expand -- particularly the rotor, which is affected by a hot material faster than the housing. Such expansion can reduce the valve clearances, even causing the rotor blades to contact the housing or headplates and seize up.

If you can't reduce the material temperature, your only solution is to open the valve clearances. This is labor-intensive because workers must remove the rotor from the unit and then typically machine the rotor, reassemble the valve, and check clearances before returning the valve to operation.

Excessive air leakage

Before discussing air leakage problems and how to fix them, it's important to understand valve leakage in general. No rotary airlock valve is 100 percent leak-proof. Because of how the valve is constructed, some clearance must be left between the rotor and the housing and headplates. Although each valve manufacturer has individual clearance standards, typical blade-to-housing and blade-to-headplate clearances are between 0.003 and 0.012 inch.

You can avoid air leakage problems by discussing your clearance needs with the manufacturer before selecting the valve. Base the decision on your material and application conditions, such as pressure differential (the difference in pressure across the valve) and operating temperature. If air leakage will be critical to your application (as in any pneumatic conveying application), consult the valve manufacturer to estimate how much air can potentially leak through the valve based on its size and your operating conditions.

There are two types of air leakage in a rotary airlock valve:

1. **Clearance leakage** - Clearance leakage is the leakage through the blade-to-housing and blade-to-headplate clearances. Clearance leakage typically drops after material enters the valve.
2. **Displacement leakage** - Displacement leakage is the amount of air that enters each rotor pocket as the pocket passes the material outlet; this leakage increases with the valve's running speed and actual displacement. More information on both types of leakage is available from your valve manufacturer.

You can calculate the expected total air leakage through your valve by summing the clearance leakage and displacement leakage estimated by your valve manufacturer. If your valve's air leakage is excessive, you'll notice symptoms such as a drop in material throughput or an increase in the conveying system's air requirement.

To minimize clearance leakage, you can often install flexible seal strips to reduce the clearances or select a valve with more rotor blades. You can also minimize the effect of displacement leakage by installing a housing or headplate vent in your valve or installing a vent adaptor at the material inlet, although the latter can restrict the inlet opening.

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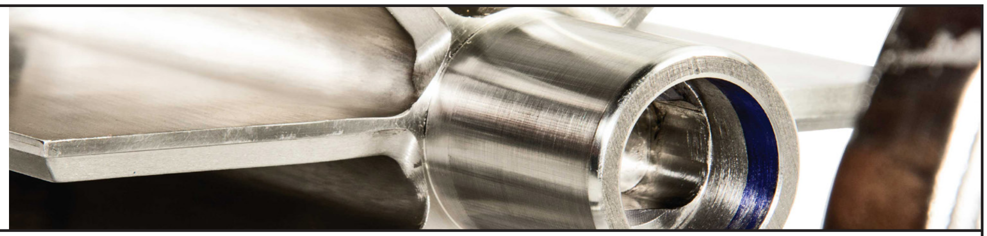

If you've made these changes and the valve still leaks excessively, the rotor blades (or the flexible seal strips), housing, or headplates are probably worn and the clearances must be adjusted. To do this, disassemble the valve and machine the blades or adjust or replace the seal strips and other worn parts according to the manufacturer's operating manual. Be sure to inspect your housing bore and headplates for wear before reinstalling the valve after service. And regardless of which steps you take to minimize leakage, never assume that servicing or replacing the rotor blades and flexible seal strips will restore your valve's original clearances.

Noisy operation

A rotary airlock valve generally operates very quietly. However, some operating noise is normal at startup. Before you run any material through it, thoroughly test the valve to ensure the rotor is running in the right direction and doesn't contact the housing or headplates. For instance, a valve that has been improperly stored before installation can rust, reducing the clearances inside the valve. Or the valve can be dented or otherwise damaged before installation. Turning the rotor to test the valve's rotation before installation can help you find such problems.

But if the valve's rotation checks out properly before installation and noise occurs after startup, try to determine when and where it occurs. The best way to do this is by listening to the valve just after startup and at regular intervals afterward.

If you hear noise, it usually comes from material (typically fines) getting into the clearances -- for instance, a hygroscopic material, such as sugar, can build up on the housing and headplates. You can often prevent material buildup by coating the valve interior with nickel or chrome or by frequently polishing the interior to remove buildup, although this is labor-intensive. Depending on your application or the material you're conveying, you can also dry the conveying air to prevent moisture from reaching a hygroscopic material or vent the moist air before it reaches the valve.

In some cases, you may have to bevel the rotor blade tips to reduce the tip land area. This well reduce the drag. You can also hear noise when the material temperature is higher than you originally expected and expands the rotor, reducing clearances or even causing one (or more) blade tip to contact the housing or headplates. To reduce rotor expansion at high temperatures, you take steps previously discussed in the "Jamming" subsection.

Insufficient material throughput

Because the rotary airlock valve is a gravity-flow device, running it faster won't let you handle more material. In fact, nothing could be further from the truth. Dry bulk material doesn't run like water, so a valve handling dry material will never be 100 percent efficient.

If your system's material throughput is too low, first make sure that excessive air leakage through the valve isn't the culprit. After that, if there still isn't enough material flow or the valve fails to operate when all of its components (such as rotor blade style and shaft seals) check out, the valve is probably the wrong size for your application.

In this case, re-examine and validate the operating conditions, environmental factors, and material properties you originally specified for your application. For instance, if the conveying system's operating speed has dropped or your material's properties have changed since you installed the valve, you may need to install a smaller or larger valve. Consult the valve manufacturer to determine which valve size can improve your material throughput. Many valve manufacturers can also suggest appropriate field-applied modifications to your valve that will improve throughput.

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