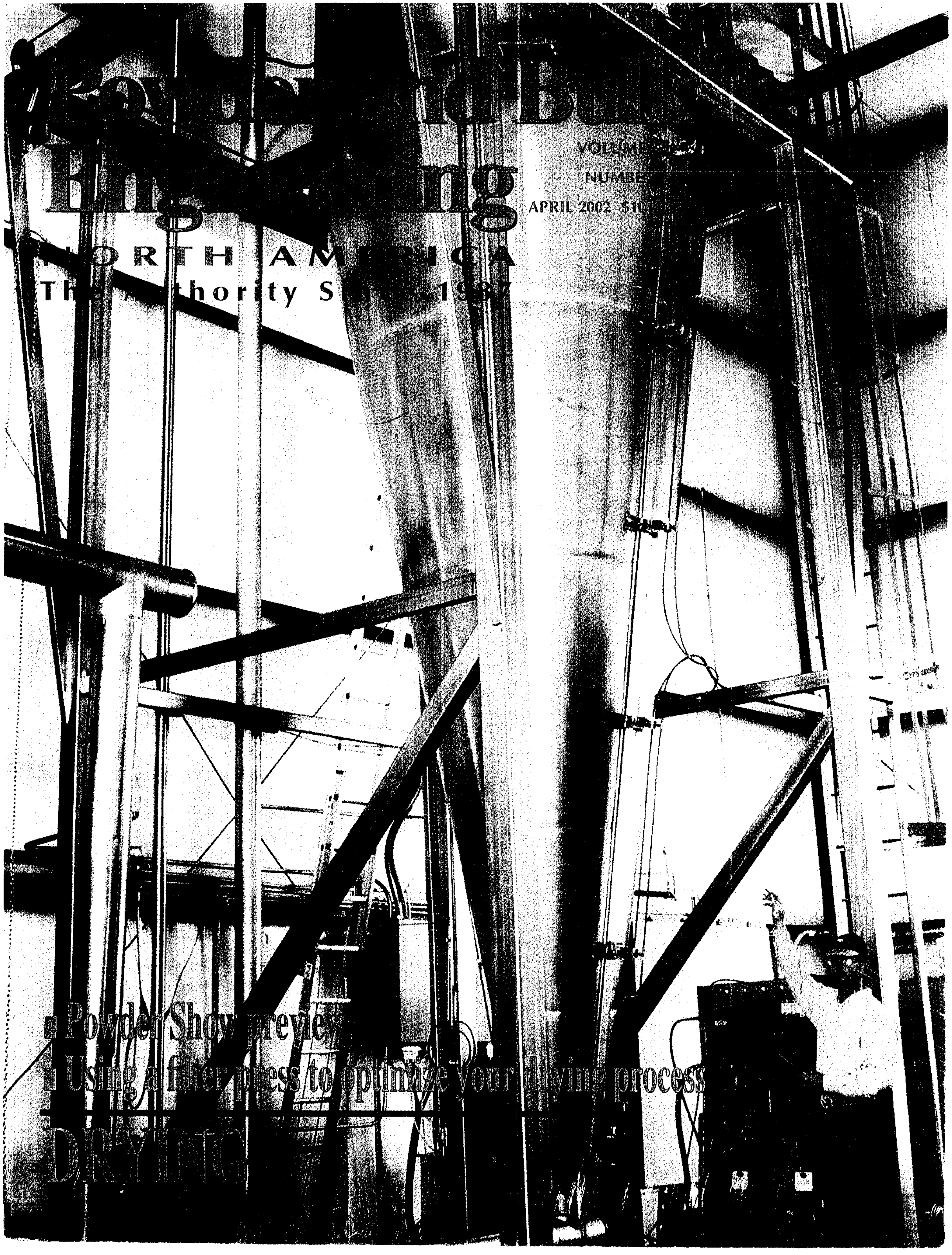
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How to choose a reliable, long-lasting rotary valve

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Selecting a rotary valve used to be a matter of matching the valve's feeding capacity, based on your product's bulk density, to your required process or pneumatic conveying system capacity. Today this is only the beginning. Now valve selection involves a combination of materials testing, computer-aided design engineering, high-quality raw materials, advanced casting and certified fabrication procedures, accurate machining, and high-quality bearings and shaft seals. As this article explains, the result is a rotary valve engineered to match your application and provide reliable, long-lasting service.

How long should your rotary valve last? In the chemical, food, and pharmaceutical industries, equipment is considered reliable if it operates unattended, with no downtime, for 100 percent of the time, 24 hours a day, 7 days a week. A reliable, long-lasting rotary valve should operate continuously in your process without adjustment or service except when purposely shut down for preventive maintenance. And with good preventive maintenance, you can expect your valve to operate for 30 to 40 years.

The following sections explain what you need to know to choose a rotary valve that will go the distance in your application.

Partnering with the valve supplier

Expect to work closely with your valve supplier when you choose a rotary valve. The supplier should evaluate your material and process requirements and use this information to design a valve that can handle these requirements without problems. The supplier's experience with a range of processing and handling applications can help you identify potential valve problems and choose your valve's features and size.

For instance, if your rotary valve will serve as an airlock feeder for a pressure pneumatic conveying system that operates in dilute phase, the valve supplier needs to understand which valve features and valve size will deliver the performance you need in this system. The resulting valve design and its fill efficiencies will differ from those required for a vacuum system, and the supplier's pneumatic conveying experience is a big factor in ensuring that you make the right valve choice.

Other factors that contribute to choosing the right valve include materials testing, computer-aided design engineering, high-quality raw materials, advanced casting and certified fabrication procedures, accurate machining, and high-quality bearings and shaft seals. [***Editor's note:*** For fundamentals on rotary valve components and operation, see the sidebar "Quick review: Some rotary valve basics" on page 62.]

Materials testing

Start your valve selection process by sending a sample of your material to the valve supplier. The supplier will test the sample to determine the material's characteristics.

To ensure that the sample has the same characteristics as the material that will be handled by your rotary valve, take a sample that's identical to the material your valve will handle. For instance, if you're handling nylon pellets and the valve will be located at a point in the process before the fines are removed from the pellets, the sample should include the fines. Taking a sample that's been further processed and thus has different characteristics can result in choosing a rotary valve that can't handle your material and creates problems in your process.

Computer-aided design engineering

Advances in computer-aided design (CAD) engineering and proprietary software allow your rotary valve supplier's design engineers to make small valve improvements that add up to a big increase in your process uptime. These tools enable the design engineers to produce a state-of-the-art valve that meets your specifications, plant codes, and industry standards. Among the tools in the engineers' CAD arsenal are three-dimensional solid modeling programs that help diagnose problems with valve component assemblies, analyze material stresses, and examine safety and environmental factors. The result is speedier valve design, better valve quality, fewer design errors, and lower overall valve cost.

High-quality raw materials

A rotary valve made of high-quality raw materials will provide long service life. Whether a valve component is cast or fabricated, its raw materials should be certified to standard material specifications, such as those of the American Society for Testing Materials (ASTM) International.[1] This way, you'll be sure that your valve components have exactly the material properties you specify and the right mechanical strength.

Advanced casting and certified fabrication procedures

For valve components that are cast rather than fabricated, using advanced casting methods can extend the valve's service life. These high-tolerance casting methods provide greater design freedom, allowing precise pattern construction and optimal entry paths for the molten metal into the mold cavities. This permits the components to be designed for optimal performance without the constraint of older casting methods that tend to produce less-than-smooth component surfaces with defects and inclusions (small cavities caused by sand, gases, or other impurities trapped in the molten metal during casting).

Weld strength and quality in a fabricated rotary valve and fabricated valve components are also important. A fabricated valve's durability depends on having sound, full-penetration welds. A cast rotary valve has fabricated rotors and supports, so their welds must also be strong. To achieve strong, high-quality welds, the valve or component supplier's welders should use welding materials and procedures certified to the American Society of Mechanical Engineers (ASME) code.[2]

Accurate machining

A valve supplier with machining equipment operated by computer numerical control (CNC) rather than a human operator can produce valve components that reduce your rotary valve's operating and maintenance costs. For instance, CNC machining can produce closer rotor-tip-to-housing tolerances in the valve, reducing air leakage. The method's precision layout of each component makes the final valve easier to assemble, disassemble, install, and maintain.

High-quality bearings and shaft seals

Your valve should have close-tolerance, premium bearings. They should be Annular Bearing Engineering Committee (ABEC) Class 1[3] bearings with tighter-than-normal clearances; wide inner and outer races; a deep-groove, zone-hardened inner race; and a land-riding metal retainer. The bearings should be mounted outside the rotary valve (called *outboard mounting*) to isolate them from your material and prevent particles from contaminating the bearing lubricant. Securing the bearings to the rotor shaft with a squeeze-locking collar will eliminate any rotor shifting and provide near-perfect concentric alignment of the rotor in the valve. Concentric alignment prevents the valve from jamming when material wedges in the rotor-tip-to-housing clearance. These close-tolerance bearings produce a minimum rotor-tip-to-housing clearance, reducing air leakage from the valve.

For long service, you need the right compression packing for the rotor shaft seal. Multiservice, lattice-braided aramid filament packing material with polytetrafluoroethylene (PTFE) dispersion lubrication is standard, but your valve supplier can help determine which packing material is right for your valve based on your application. For instance, for a valve handling a hot material, you can select graphite packing material, which is rated to withstand temperatures 500°F and higher. For a valve handling a reactive chemical, you can choose chemically resistant all-PTFE fiber packing material.

A word about valve options

Selecting the right rotary valve options from those available will ensure that your rotary valve can reliably handle your application over the long term. Your supplier should offer several valve housing configurations, including drop-through, side-entry, and blow-through versions, as well as valves for high-pressure and sanitary applications. The valves should be available with a range of optional features and accessories and in custom designs.

These options are commonly offered:

- High-temperature designs rated up to 1,600°F.
- High-pressure housings rated up to 350-psig internal pressure.

- Differential-pressure designs rated up to 60 psig.
- Construction materials including cast iron, cast steel, cast stainless steel, cast aluminum, fabricated carbon steel, fabricated stainless steel, Hastelloy, Inconel, Incoloy, Stellite, titanium, and engineered plastics.
- Various interior coatings and platings to handle abrasive, reactive, sanitary, or other applications.
- Rotors with partial-fill pockets; square, beveled, adjustable-length, or inlaid blade tips; and shrouds.
- Inlet baffles.
- Housing vent connections to suit your housing configuration.
- Inspection doors.
- Air-purged packing gland shaft seals and mechanical shaft seals.
- End seals to seal the rotor's outer perimeter.
- Endplate seals, including air-purged and O-ring types.
- Adjustable-speed drives, direct drives, and special drives.
- Motion switches. **PBE**

References

1. The American Society for Testing and Materials (ASTM) International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959; 610-832-9585, fax 610-832-9555 (www.astm.org).
2. The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; 212-591-7722, fax 212-591-7674 (www.asme.org).
3. ABEC determines standards for bearings for the American Bearing Manufacturers Association (ABMA), 2025 M Street Northwest, Suite 800, Washington, DC 20036; 202-367-1155, fax 202-367-2155 (www.ama-dc.org). Classes 1, 3, 5, 7, and 9 indicate a bearing's manufacturing tolerances.

For further reading

For a technical equipment specification for rotary valves, contact the author.

Find more information on rotary valves in articles listed under "Valves" and "Pneumatic conveying" in *Powder and Bulk Engineering*'s comprehensive "Index to articles" (in the December 2001 issue and at www.powderbulk.com).

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Quick review:

Some rotary valve basics

A rotary valve (sometimes called a *rotary airlock valve* or *rotary feeder*) controls the flow of a dry, free-flowing bulk material between atmospheres that are typically at different pressures. Always functioning as a gravity-flow device, the valve can operate as an airlock, a feeder, or a combination feeder-airlock. As an airlock, the rotary valve minimizes air leakage while allowing material to pass between vessels at different pressures. As a feeder, it [illegible] material and [illegible] flow [illegible] pressure [illegible] airlock, the valve minimizes air leakage while regulating material flow between vessels at different pressures.

The rotary valve, as shown in Figure 1, consists of a rotor that has blades (also called *vanes*) and is mounted on a rotor shaft. The rotor is supported by bearings inside a housing with endplates; the housing forms a cylindrical cavity with a material inlet and outlet. Shaft seals prevent air (or other gas) and material from leaking into or out of the valve.

In operation, a motor drives the rotor shaft, causing the rotor to rotate inside the housing. Material enters the inlet and drops into the space between adjacent blades, called a *rotor pocket*. As the blades rotate, the material is carried in the pocket toward the outlet.

[illegible] drop-through, side-entry, or blow-through design. In a drop-through housing, material enters at the top and exits the bottom. In a side-entry housing, material enters through an offset inlet, filling less than 100 percent of each rotor pocket and thus minimizing material clipping at the inlet. In a blow-through housing, material enters the top and air passes through the bottom rotor pockets to blow out the material, allowing the valve to handle a fine, lightweight, or sticky material.

The valve inlet can be round, square, or rectangular; the rotor can have 6, 8, 10, or 12 blades, and the blades can have adjustable tips and be square, beveled, or inlaid (such as with brass inlays to prevent sparking). The rotor can have open or closed ends; a closed-end rotor has plates (called *shrouds*) at either end of the rotor housing. The rotor-tip-to-housing clearance can be adjusted to suit your material [illegible]

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Figure 1

Anatomy of a rotary valve (drop-through configuration)