

SELECTING A DROP THRU ROTARY VALVE

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SELECTION GUIDE - YOUNG INDUSTRIES DROP THRU ROTARY VALVES

Selecting the most appropriate Young Industries Rotary Valve for your application is important to properly meet the application requirements. The task may seem difficult because of the many types and sizes of valves available...Model LH, HC Drop-Thru, RNHC, Quick Clean or Blow-Thru Rotary Valve with choice of many rotor designs. The choice of construction materials; optional features; and special design configurations must also be considered. The selection is not difficult when the following step-by-step procedure is used.

1.Product Characteristics- The product to be handled dictates the first decision to be made, whether the conventional Drop-Thru Valve will meet the requirement, or if a Side Entry, or the Blow-Thru Valve should be used.

- A. Particle Size - Is it a powder, granules, chips or flakes, cubes or pellets? If a powder, a Drop Thru Rotary Valve will be used. If it is larger than 1/16" size, a Side Entry or Model RNHC Rotary Valve may be needed for metering applications. Larger particles if being metered by the valve may jam at the inlet pinch point on the downward side of the inlet throat in Drop Thru Rotary Valves. If the valve is a non-metering airlock an oversized Drop Thru Rotary Valve with baffle/deflector may be used.
- B. Is it Abrasive? Abrasive products may require valves with special construction for wear resistance including special plating or coatings at wear surfaces. Rotor vanes may require adjustable/replaceable tips, and housings equipped with access ports for tip adjustment. Shrouded rotors may be preferred to minimize wear on the rotary valve end plates
- C. Is it corrosive? Chances are you know what the preferred material of construction of your process equipment due to the environment in and around equipment. Normally cast iron. Carbon steel, or 300 series stainless steel is used, but in some cases other materials are needed.
- D. Does it pack or smear? Products that are heat sensitive may pack or smear and require a valve with smooth interior surface, and sometimes, a coating with low friction coefficient (such as Teflon). In some applications, the trailing edges of vane tips and sides are beveled to reduce friction.
- E. Flow characteristics – Does it flow freely? Is it sluggish flowing? Is it cohesive? If it flows freely then most any Rotary Valve can be used. If it tends to have sluggish flowing characteristics, then consideration is needed as to the size and type of valve. The Straight vertical Drop Thru Model HC may be preferred for these sluggish flowing or cohesive powders that tend to “cling” to interior surfaces.
- F. Is the product combustible? – If the powder is combustible more process information regarding adjoining equipment may be needed. Combustible properties, Kst and P-max will also be needed. The Rotary Valve will most likely need to be designed to comply with NFPA-69 standards.

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2. Application- What do you expect the Rotary Valve to do in your process? This is an easy question but often misunderstood.

Metering – If the valve is metering product, then it is controlling flow of product at that point in the process. When metering there is always a volume of stored material above the rotary valve and as the rotor rotates, the pockets are filled with material and delivered volumetrically to the discharge of the valve into the process below.

Non-Metering- There are times when a Rotary valve will not control the flow of product. A prime example of this is the discharge of a dust collector where powder must discharge from the collector without building up in the hopper. The rotary valve is over-sized volumetrically so product cannot build up in the dust collector. Most cases of non-metering applications are also an Airlock condition as explained below.

Airlock – The term Airlock when referring to a Rotary Valve is a device to seal between two areas of different pressure or vacuum. A rotary valve has tight internal clearances between rotor and housing so that leakage of gas between the two pressure zones is minimal and controlled. The term Airlock can apply to either a metering or non-metering Rotary Valve.

The application helps further define the model, size, and rotor type. Young Drop-Thru Valves are calculated at 80%- to 100% pocket fill for metering applications depending on the flow characteristics of the product. Non-metering (Airlock) valves should be selected to have a maximum of 66% pocket fill (capacity x 1.5).

3. Volume & Weight- How much and how fast? This establishes the size rotary valve required, for either metering or non-metering applications. First determine: weight of product in pounds per cubic foot; and, volume required in cubic feet per hour. Output capacity is computed based on the following
$$\text{CAPACITY PER HR. (LBS.)} / \text{PRODUCT BULK DENSITY (LBS. PER CU. FT.)} = \text{CU. FT./HR.}$$

Valve capacity is a function of pocket fill and valve speed. Valves for non-metering applications should be a minimum of 1.5 times the maximum required volume. This allows for the valve to keep ahead of the flow of product so the valve does not become the bottle-neck in the system.

The specification table shown in the drawing for each Young Industries Rotary Valve shows “Standard Speed” for each valve size. The Standard Speed is the highest recommended for computing valve throughput. These figures are based on extensive testing performed by Young’s Laboratory using a wide variety of products. Additional speed above the “Maximum” shown, can sometimes be used but the application of the valve must be evaluated by Young Industries application specialists.

To determine the Output Capacity Rating of a given valve use the following:

$$\text{VALVE CAPACITY (CU. FT./HR.)} = \text{ROTOR CAPACITY (CU. FT./REV)} \times \text{SPEED (RPM)} \times 60(\text{REV./HR})$$

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4. Internal and Differential Pressure- What is the maximum internal pressure that the Rotary Valve will experience during operation? What will the differential pressure be across the rotor (inlet to outlet)? Young Industries standard Rotary Valves are designed for negative or positive pressure of up to 15 PSIG. When internal and differential pressures are greater than 15 PSIG, there are additional considerations and Young Industries application specialists should be advised. Young Industries has been manufacturing high pressure Rotary Valves for many years and we are a qualified ASME code shop.

5. Operating Temperatures- Will operating and/or design temperature be a factor? Young standard Rotary Valves are designed for operation for temperatures up to 250°F. When higher temperatures are needed, special high temperature bearings and shaft seals may be required. Internal valve clearances are reviewed to make sure at operating conditions the clearances are proper to minimize leakage.

6. Interface- What is the flange size requirements? Is there a height restriction? Often, the rotary valve is selected based on the inlet and outlet sizes. When a Rotary Valve is to be mounted on an existing piece of equipment, the flange size of the valve usually matches, or comes close to the size on the adjoining equipment flange size. Young Industries Rotary Valves with round flanged connections use standard 150 lb. ANSI flange dimensions. There is no national standard for square flange dimensions so we have our own standard square flange dimensions, but these dimensions can be altered to match adjoining equipment as needed.

7. Experience – Many of our Rotary Valve users know what is needed to make the valve work best in their process due to previous experience. There are many options available for our Rotary Valves and it is important to understand when they are needed.

Common Questions:

1. *When do I need partially filled Type B and C rotors?*

- a. When product does not flow and is cohesive, the deep V of the standard rotor pocket can be eliminated by placing a metal filler in each pocket. This eliminated the deep V and gives product a better chance of releasing from the pocket at the valve discharge.
- b. When the valve size is determined by the interface with adjoining equipment, so a given flange size is needed but the volumetric capacity of a full rotor is too great for the application (normally metering). The filler is added to the pockets to reduce the volume of the rotor. Type B filled pocket rotors have more volume than the Type C filled pocket rotors for any given valve size.

2. *When do I vent a Rotary Valve?*

A vent connection is provided in the housing for metering airlock applications when there is a greater pressure at the valve discharge than at the inlet. The high-pressure gas can disrupt the flow of product at the inlet as it tries to escape, if the valve is not vented. We provide the vent connection so the higher-pressure gas can be vented on the return rotation of the rotor after the product has been discharged from the rotor pocket. The gas discharges to the vent so the gas can be directed to another connection remote from the valve.

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3. When do I need a purge connection with lantern ring in the shaft seal area?

Normally the purge connection is used in applications where the interior of the valve is under positive pressure. In that case the positive pressure gas and product from the interior of the valve tries to escape through the packing at the shaft seal. The lantern ring and purge provides a means to purge the shaft seal at a pressure of +1-2 PSIG greater than the pressure at the interior of the valve.

4. Most of Young Industries Rotary Valves have a maximum recommended speed of between 26-38 RPM. Why can't I run a valve faster to achieve more volumetric throughput?

When the centrifugal force of the rotor reaches a given velocity, material will not enter the rotor pockets reliably. We refer to this as a fan affect. Based on experience and testing we established the rotor speeds for a given valve size based on the diameter of the rotor and rotor tip speed. There are times when the bulk density of the powder being handled is very light and our recommended speed is less than our listed speeds.

5. How do I know when to use an open or shrouded rotor?

Open rotors have machined clearances between the OD of the rotor and ID of the housing, also at the rotor ends and end plates. With the tight clearances the open rotor offers the least amount of gas leakage for valves that are less than 15 PSIG differential pressure. With open rotors there is always wear on the diameter and ends since product will be sweeping these areas whenever the valve is operating.

Shrouded rotors have machined clearances between the OD of the rotor and housing. The ends of the rotor are enclosed with shrouds that are also machined on the OD. The main advantage of the shrouded rotor is that there is virtually no wear on the ends since product is contained in the pockets between the shrouds and does not normally contact the end plates. The open gap between the shroud and end plate varies based on valve size but is between ¼" and ½". The shrouded rotor has a bit more leakage around the rotor when compared to an open rotor and is mainly selected when the pressure at the discharge is equal to or less than the pressure at the valve inlet.

6. When do I use a Blow-Thru Rotary Valve?

The Blow-Thru Rotary valve is a Drop-Thru Valve specifically designed to be used as a metering or non-metering airlock for introducing powder into a pneumatic convey system. This valve has a flanged inlet connection and integral pneumatic convey pipe connections attached to the end plates of the valve. This valve saves valuable headroom versus a standard Drop-Thru Rotary Valve and inlet manifold for a pneumatic system.

The Blow-Thru Rotary Valve is also used in situations where powder being handled is cohesive and does not want to discharge by gravity from a rotor pocket. This valve has partially filled rotor pockets that align with the convey pipe in the end plate. With the velocity of air through the piping from the pneumatic system, the powder is forced out of the pocket by the velocity of the air in the system.

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7. *Why are the standard rotors 8-vanes when other manufactures use 6 vanes?*

Young Industries Rotary Valves are manufactured to have minimal leakage due to differential pressure across the rotor. As the rotor rotates there is always a two-blade seal from inlet to discharge. The two-blade seal is preferable to a one blade seal for reduced gas leakage.

8. *Why does the number of rotor blades increase when vents are positioned in the housing?*

We use 12 bladed rotors as standard when vent connections are placed in the housing. This is required so there is always one blade seal between the vent and the inlet and discharge throats of the valve as the rotor rotates.

9. *When do I need an RNHC Rotary Valve?*

The Model RNHC Rotary Valve was developed to meter pellets reliably. The inlet of the valve is constructed with a baffling system the directs pellets to an area in the rotor that will not clip pellets. Pellets 1/16" to 3/8" size can be metered with this valve with minimal degradation and shearing of the pellets. Conventional Rotary Valves will shear pellets and cause damage to the valve.

10. *Why is Young Industries Quick Clean Design so different from other manufacturers.*

When we developed the Quick Clean Valve, we evaluated using a linear bearing/rail system like most of our competitors Easy Clean Valves. It became apparent that the linear bearing design is not preferable since it requires more space for the rails and even the slightest damage to the rail system can cause the linear slides to fail when taking the valve apart. We also wanted to develop a valve where the rotor could be completely removed from the valve for cleaning. Our Quick clean Valve has two bearings on one side of the valve with the rotor cantilevered on the shaft supported by the bearings. The rotor can be completely removed from the valve to make cleaning the rotor and valve interior very easy.

11. *What is recommended if a variable feed rate is required?*

We will size the valve for the highest capacity needed and typically use a Variable Frequency Inverter (VFD) to vary the rotor speed. Normal TEFC motors can run at a 5-1 turn-down ratio and if needed motors are available with 1000-1 turn-down.

12. *Why is there an over-sizing factor when sizing a Rotary Valve?*

As mentioned earlier in the article most metering applications are oversized by 10 to 20%. The main reason for this is that most powders do not flow reliably and consistently to and from the valve. Some powders may tend to cling to the surfaces of the rotor thus reducing the volume. Users do not complain if the Rotary Valve is running at slightly greater capacities than required. They sometimes complain if the Rotary Valve is below the required rate.

For a non-metering airlock application, it is necessary to oversize, so the rotary valve does not control the process rate. Oversize factor will vary but for many powders it is 50% over the required capacity.

13. *What is the definition of high temperature* – Standard valves are designed for operating at temperatures up to 250 degrees F. With the addition of high temp bearings, and special internal clearances, we can easily go to 500 degrees F. At temperatures over 500 degrees F. we evaluate the

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internal and differential pressure requirement and adjust bearing sizes and placement of bearings based on the operating conditions. We evaluate the combination of temperature and pressure and adjust the construction and material thickness of the valve to comply.

14. *What is the definition of high pressure* – Standard Rotary Valves are designed for operating at pressures up to 15 PSIG. For internal pressures above 15 PSIG, we evaluate housing, end plates, and rotor materials to be sure they are acceptable. Many times, our standard valve can be used for the slightly higher pressures with some minor changes.

15. *What is differential pressure* – this is the difference in pressure between the environments at the valve inlet and discharge. The rotor of the valve must withstand this difference in pressure while maintaining the close internal clearances. Standard valves except for Quick clean valves are designed for 15 PSIG differential pressure. At higher differential pressures the diameter of the shaft and bearing size may increase. To maintain low leakage Young Industries developed the patented End Seal design for high differential pressure applications.

16. *What should be done if the product handled is combustible* – NFPA 69 defines guidelines for using Rotary Valves for combustible powders. It is important that you know the properties of the powder handled and how the Rotary Valve will be used in the process. Young Industries Application Engineers can assist you in the selection of the proper valve.