# Belts Vs. Couplings

## THE QUESTION

Are there special criteria for using belts or couplings as power transmitters for rotary-type blowers? Examples: for motor KW; RPM; temperature; pressure production; lifetime; etc.

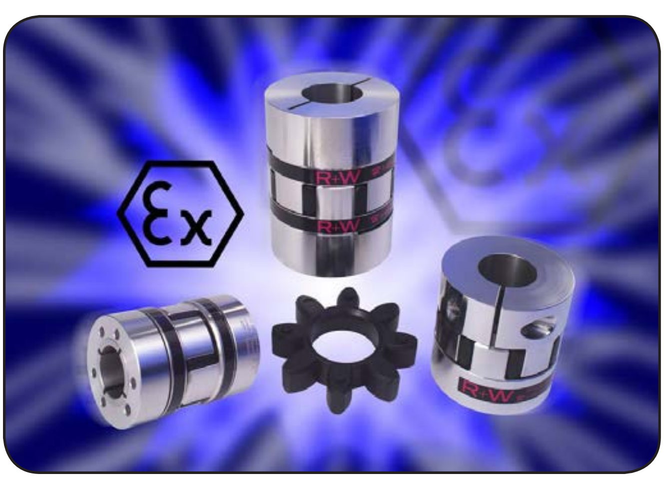
In other words, how do I choose between belts or couplings?

In our company we require a rotary-type blower (main blower) for a gas plant application, and some vendors offer belts as power transmitters; but our licensor indicates coupling as the power transmitter. So it would be appreciated if you could provide me with some evidence of which is best for us.

Expert responses provided by: Andy Lechner (sales manager) and Nillo Nykanen (senior applications engineer)—R+W America (rw-america.com); and Don Labriolla (president)—QuickSilver Controls (Don_Labriola@QuickSilverControls.com).

**Lechner:** What I can tell you is that, while it may or may not be applicable here, belts are often a highly effective way of achieving a low-cost gear reduction between motor and machine, potentially saving up-front investment dollars while also saving space, in some instances, in addition to offering vibration damping and misalignment compensation. They can, however, be considered a wear item. Especially in the oil and gas sector, maintenance-free solutions are very popular. This same industry was responsible for the initial development of the flexible disc pack coupling, which is a style designed for fatigue resistance and a theoretically infinite service life—without any lubrication or replacement parts required. This could have something to do with why the licensor has requested couplings in this particular instance.

**Nykanen:** Couplings or belts are used to drive industrial rotary blowers. Small radial fans such as regenerative blowers are often direct-coupled with inexpensive, rigid couplings. This is possible through precision casting and machining in large production quantities which allows for pilot mounting motor and blower—essentially eliminating the labor of alignment. Medium-to-large centrifugal fans are either belt- or coupling-driven. These systems often use inexpensive, elastomeric coupling or belt drives that result in fairly easy installation, with rudimentary alignment typically necessary. Economy- and mid-cost-range positive displacement blowers often use v-belt drives. The belt drive allows for flow and pressure adjustment by changing the size of the pulleys. Low-to-mid-cost systems often use mass-produced, low-precision cast metal or molded plastic parts. Most of these blowers are operated in an open-loop electrical system with a start/stop switch being the only control. High-end screw and helical lobe machines use either direct-drive or belt drives, depending on system requirements. Expensive air-movers often employ sophisticated electronics such as variable frequency drives, sensors, and controls that operate in a closed-loop system that dynamically adjusts to operating conditions using PID controls. High-cost systems often demand precision-made coupling systems that tend to be machined from quality metals custom-specified for the application.



Indirect-drive belts are economical and easily allow for connection of a motor (shafts in parallel) in many orientations to a piece of driven equipment. Due to the multiple connection options, belts allow options for many space constraints. Elastomeric belting also adsorbs mechanical vibration and takes up misalignments. V-belts are a common choice with positive-displacement blowers and



some centrifugal blowers. In a blower system, flow and pressure are controlled by driven speed. Belt sheaves function like gears by increasing or decreasing motor speed ratio to achieve desired system parameters. After a belt-driven machine and the motor are in place and lined up, removing the belts can normally be done without unbolting anything but the sheaves, making maintenance easy. A no-load motor test or belt and sheave change can take as little as a few minutes once the guarding is removed. However, belt sizing can be tedious using manual calculations; computer selection software offered by major manufacturers can alleviate this. With belt drives, overhung shaft loads must always be considered and manufacturers of economy blowers often do not allow for enough bearing loads to give the drive designer many options in choosing belts. This often leads to custom guarding, which can add considerable cost to a system. Due to a constant radial load on bearings with belts, there is a decrease in lifespan vs. direct-driven machines. Elastomeric belts are also a wear item that essentially stretch out over time and need to be manually or automatically tensioned throughout the life of the belt — creating a need for maintenance or purchase of an additional automatic belt tensioner.

Direct-drive (shaft-to-shaft) couplings for blowers are normally fairly simple to size, often by simply looking at a catalogue page and evaluating torque, speed and safety factors. Often, standard off-the-shelf guarding can be used, resulting in a bit of cost and labor savings. A well-aligned coupling places little radial pressure on bearings, thus increasing their life. Also, losses in mechanical efficiency can be somewhat reduced via direct-drive by saving some electricity. Although most couplings offer a 1:1 speed ratio, limiting speed to number of motor poles (in the case of standard AC motors), they are often used in conjunction with variable frequency drives that offer many electrical and mechanical advantages for blower systems. A common example of this is programming a soft start and constant torque, or current limiting. Many VFDs also can be wired with sensors that provide PID speed control to maintain constant pressure in a blower system; this is very common when variable orifices in pipework are present, e.g., filters and valves.

Another advantage with direct-drive couplings for blower systems is that several prominent manufacturers offer ATEX-certified couplings that provide electrical continuity between shafts and prevent sparking. Many blowers and motors are specifically designed to operate in ATEX or NEMA hazardous locations and are name-plated accordingly. This is especially important and is often specified by system designers in the gas and fuel processing industries. Couplings used in high-end equipment can be precisely machined and balanced, which can impact budgets and lead times. Thus great care must be taken in shaft alignment and in planning the installation projects for these systems. Custom-wound-and-name-plated electric motors can have lead times of several months; the same applies for blowers and drive components — especially when material certificates and specific countries of origin become a factor.

In conclusion, a designer behind a gas blower system likely would choose a direct-coupling over belt drive for the reasons given above. A belt drive usually requires more maintenance than a coupling. Given the highly competitive nature of processing a commodity product, downtime for maintaining the system is a huge factor in determining the parts to be used. Also, there are more options for couplings operating in hazardous locations then there are for belts in most markets, affording the system designer a wider variety of choices.

**Labriolla:** Full-disclosure — I do not typically work with blowers, but in general motion the two main issues between couplers are usually 1) geometry and 2) speed ratio. (System stiffness may be a third, but is not likely related to blowers.)

***Geometry of the layout***: With a belt the motor can be in the same width as the blower, sometimes making a more compact configuration, whereas the coupler forces an in-line configuration.

***Speed ratio***: A belt can be used to change the speed — to make the fan turn slower (or faster) than the base motor by making the pulleys different diameters. The belt can also be used to move the motor out of the opening of the fan — i.e., away from the central axis of a blower to reduce turbulence and help increase air flow. This is really dependent upon the layout of the blower.

Finally, the belt may reduce acoustical noise transmitted between motor and fan; this may or may not be important, dependent upon the particular application.

The coupler has advantages in that it may not need as much finger protection from pinch points and often has less maintenance and slightly lower losses. **PTE**