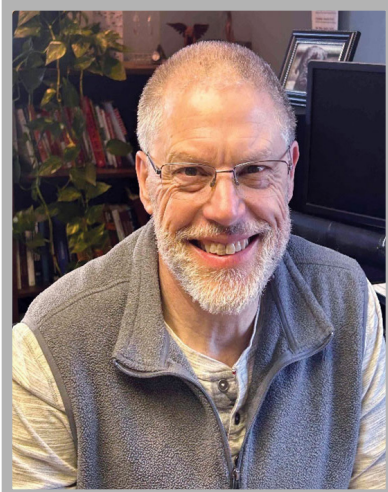




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ASK THE EXPERT

How to Choose the Right Air-Bearing Spindle



KEN ABBOTT

President, ABTech

An optical lens — like that used in a car's backup camera or bar code scanners — is manufactured to extremely precise complex optical shapes and measured to nanometer-level geometries.

Machining and measuring something with this tight of a tolerance is challenging but increasingly common across the aerospace, automotive, medical device, semiconductor and electronics sectors. Not only do these lenses need to be measured and inspected to ensure they meet the required specifications, but manufacturers also must use high-precision manufacturing technologies to cut and polish the lenses.

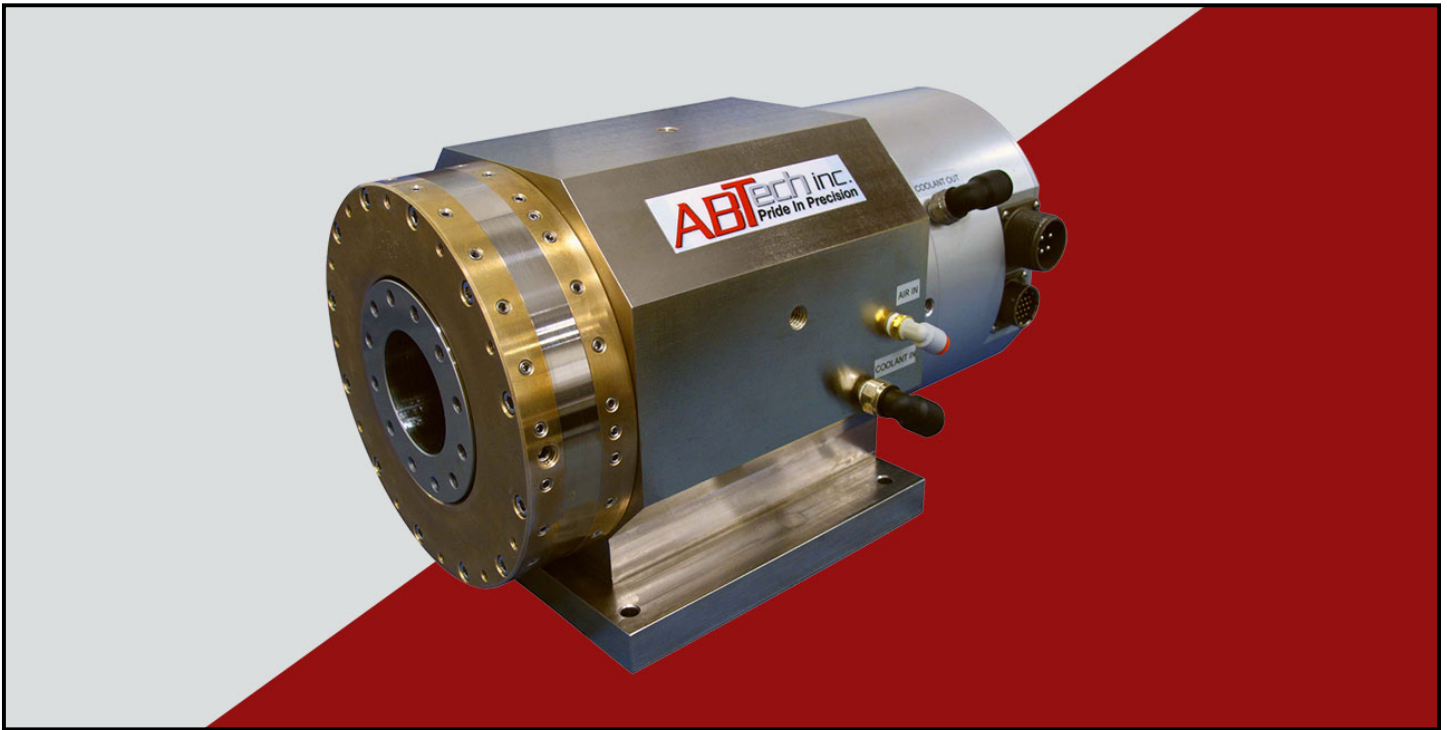
A key component of some of these high-precision technologies is the air-bearing spindle. These types of spindles are used for high-precision machining processes such as single-point diamond turning, work holding, grinding, and polishing, as well as high-precision scanning for measurement and inspection. They can be found in equipment such as lathes, rotary tables, and metrology tools.

While these spindles offer added benefits, they also have a significantly higher price tag, so it's important to do your due diligence before you invest in one. Ken Abbott, president of ABTech, a manufacturer of both air-bearing and mechanical-bearing spindles, walks us through what to consider when investing in an air-bearing spindle — and how to ensure it meets your needs for many years to come.

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When does it make sense to invest in an air-bearing spindle over a ball-bearing spindle?

It really comes down to the application. Unlike traditional ball-bearing spindles, which are prone to vibrations and inaccuracies due to their rotating metal-on-metal components, air-bearing spindles utilize a thin layer of pressurized air to buffer between the rotating and stationary parts.

This not only ensures unparalleled stability and accuracy but also allows the spindles to reach speeds of 1,000 rpm to 20,000 rpm.

So, if you're manufacturing a part that requires exceptional accuracy — for instance, to a couple millionths of an inch — an air-bearing spindle will be your only option. In other situations, we've seen clients who have pushed their mechanical bearing spindles as far as they can go in terms of accuracy and reduced vibration, and they're not able to meet their product's specifications.

That said, there are certain scenarios where an air-bearing spindle simply doesn't work. For example, perhaps you don't have air supply because you're lacking a compressor.

In these cases, there may be a high-precision ball-bearing option capable of meeting your needs.

Generally speaking, an air-bearing spindle makes sense if you're looking for sub-micron accuracy, zero-friction and wear, exceptional repeatability, ultra-precision motion, and high speeds.

How much do air-bearing spindles typically cost?

It really depends on exactly what you're trying to do and the physical size of the system, but they can range from \$30,000 to \$320,000. For context, a small ball-bearing spindle can cost less than \$10,000.

The things that typically drive up the cost are the amount of labor involved to create the geometry to achieve the necessary accuracies, as well as the more expensive motors and encoders.

You generally don't buy an air-bearing spindle because it's the least expensive option out there. You buy it because you need the accuracy and because your application justifies the extra expense.

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What should companies look for when choosing an air-bearing spindle?

Every application is unique, and it's important to find an air-bearing spindle that's the right fit for your needs. This involves considering things like radial and axial accuracy vibrations, duty cycle, load capacity, stiffness, speed, and how fast you need to ramp up — the list goes on.

There are many vendors out there that offer off-the-shelf air-bearing spindle options. If you choose to order one from a catalog, you want to find a vendor who will take the time to understand your unique situation, ask the right questions, and help you make sure the catalog product meets your needs. It's also helpful if they have extensive catalog options to choose from.

In most cases, however, it's very difficult to find a perfect option without customization.

What can manufacturers expect if they go the custom route?

When you go the custom route, you have an opportunity to work with the vendor's engineering team to create a robust air-bearing spindle design that will help you achieve your exact end goal.

The most proficient teams are great problem-solvers who have worked on a variety of different applications across many different markets and product lines. They have experience providing both high-precision ball-bearing spindles, as well as air-bearing spindles, and have used a variety of different materials such as aluminum, ceramic, stainless steel, and granite.

Are custom-engineered solutions substantially more expensive?

They may have a more expensive price tag, but they make up for it over their lifespan. In fact, over the long run, it may be more costly to buy an off-the-shelf option that doesn't meet your exact needs.

If an air-bearing spindle is sized correctly from the beginning and meets all specifications, you simply have to make sure you keep the air clean and take care not to damage it. We've seen some air-bearing spindles that are still functioning well after 30 years — if they're properly maintained, they really can last forever.

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