

MITRPAK

Power Transmission

5 QUESTIONS TO ASK BEFORE BUYING RIGHT ANGLE **GEAR DRIVES**

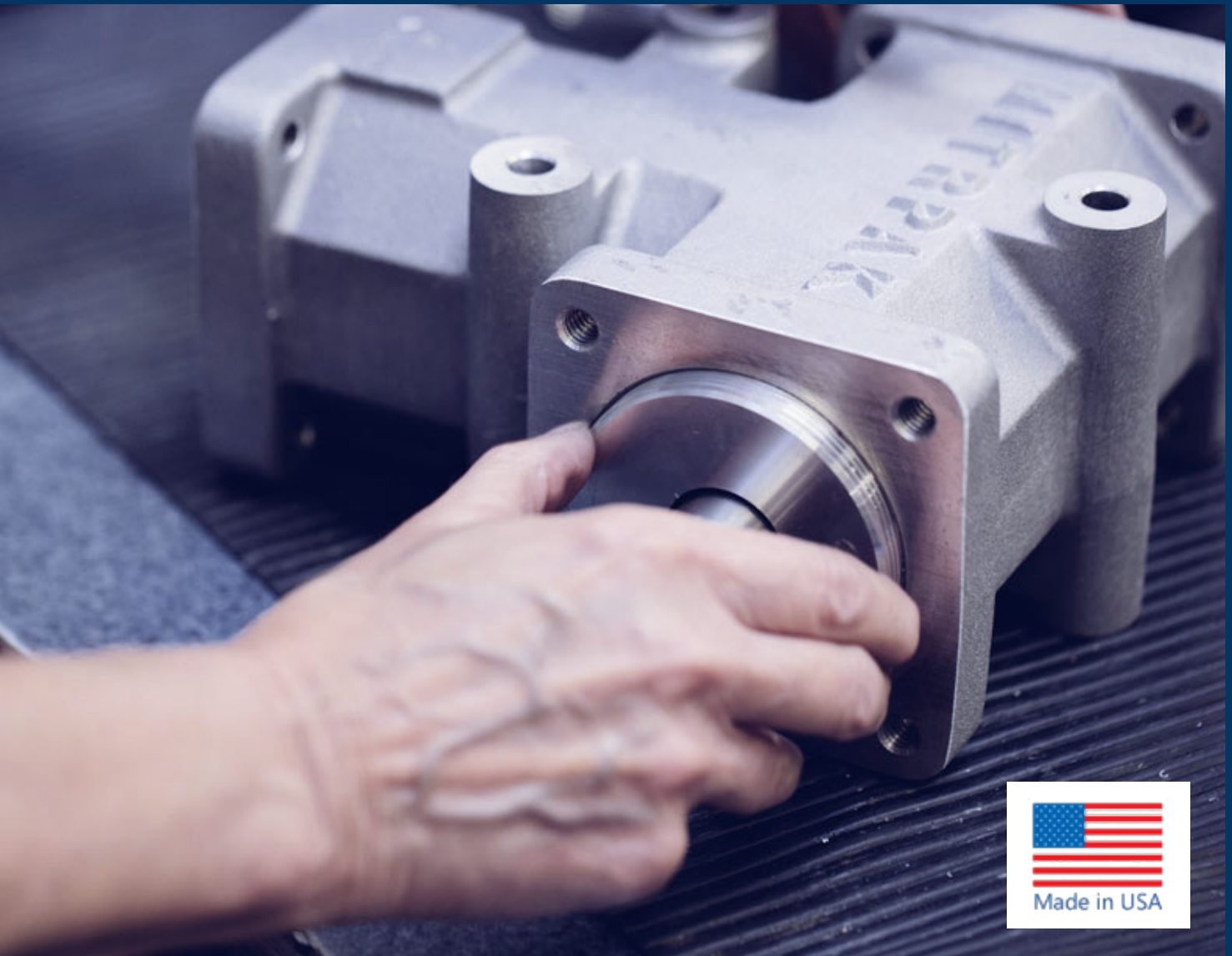




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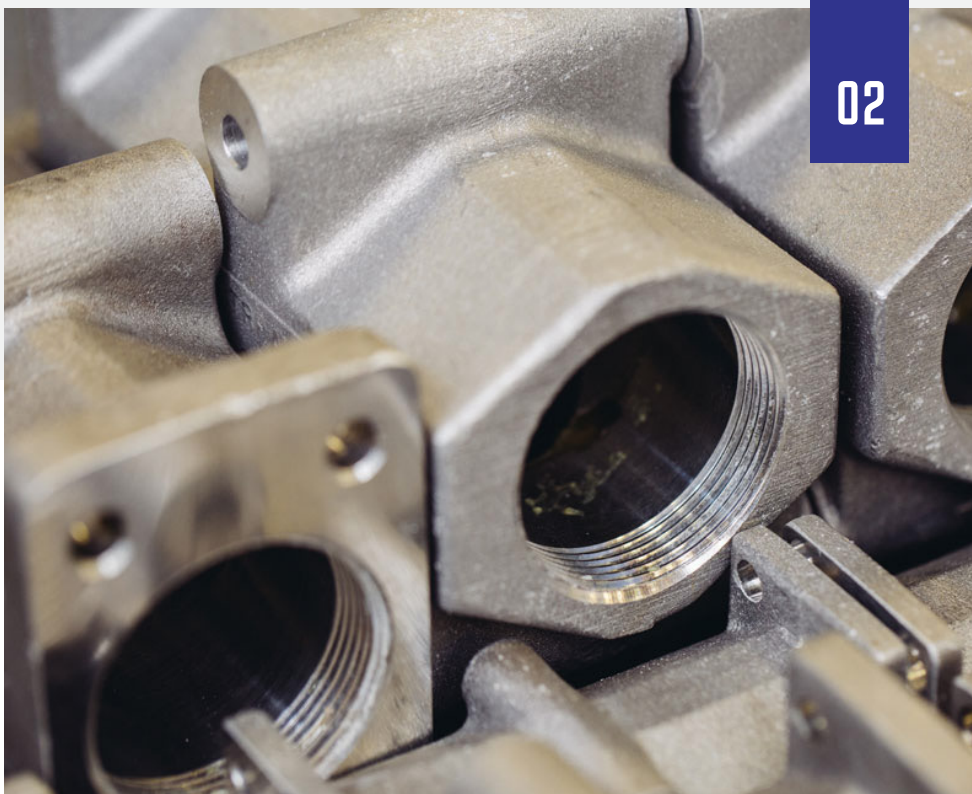
POWER TRANSMISSION PRODUCTS

Introduction

Shafts transmit rotary motion. When you need to take that motion through 90° you need either a simple right-angle gearbox or a spiral bevel gear drive. Both perform the same basic function of transferring rotation and torque from one shaft to a second one at right angles, but they're not the same thing.



This guide explains what makes spiral bevel gear drives a superior form of right angle gearbox and reviews the main points to consider before selecting a vendor and a product. The five questions in this guide will help you to qualify potential suppliers. The background information provided with each question should help improve your understanding of what the drive will do and what's important in the selection process.



Basics of Spiral Bevel Gear Drives

The heart of both a right angle gearbox and a spiral bevel gear drive is a pair of conical gears. Nominally 45° from the shaft axis, (for a 90° included angle at the top of the cone,) these have teeth that mesh and transmit the motion. The number of teeth on each cone determines the ratio of input to output speed and torque. If the numbers are equal, the drive has a 1:1 ratio. (For completeness and accuracy, note that some designs will have different angles on the two cones, but together they will total 90° .)

Each gear is mounted on a shaft using a roll pin or dowel pin passing radially through gear and shaft. The shaft is then located in a housing by bearings that allow low-friction rotation. Outside of the bearings, seals are often used to stop contaminants from getting in and to prevent the lubricants inside from escaping. While standard bonded shaft seals and petroleum-based grease, food-grade grease (Vestan HT/AW clear #2), Viton seals, and double seals are all available on MITRPAK right angle gear drives, seal options and availability will vary by maker.

The fundamental difference between the right angle design and the spiral bevel is the manner in which the teeth run down the flanks of the cone. In the right angle gearbox, these teeth are cut vertically and run straight down from top to bottom. Think of them as taking the shortest path.

Basics of Spiral Bevel Gear Drives



In the spiral bevel gear drive the teeth wrap around the surface of the cone. This makes them longer than those on the straight-cut right angle gears. It's harder to cut them this way, but the design has several advantages

- Greater contact area, which means higher torque transmission capability from the same size cone
- A more compact design for a given torque rating
- Teeth come into mesh more gradually, which means less noise and vibration

Right angle drives are produced in 2-way and 3-way form factors. This refers to the number of output shafts. Drives can also be configured to keep the output rotation in the same direction as the input, or to reverse it. For 3-way drives, the two output shafts can turn in the same direction or opposite.

Right angle drives are used in a wide range of power transmission applications. Motion control systems for large and small mechanisms are an example. These can range from telescopes to precision spindle drives. Factory automation depends on such drives for precise actuation of valves, rods, and levers. Processing equipment is another sector, with these drives being found in agricultural equipment, textile machinery, and many more.



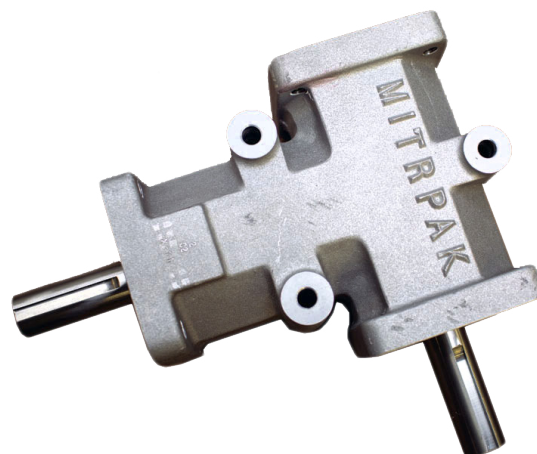
Basics of Spiral Bevel Gear Drives



Design engineers often prefer the spiral bevel gear drive over the right angle gearbox. With a more compact form factor it's more readily integrated into complex machinery. In addition, in applications where noise would either be a problem or affect the customer's perception of product quality, the spiral bevel designer is significantly quieter. In cleanroom environments where it's vital to ensure no lubricant can escape into the atmosphere, spiral bevel gear drives are the preferred solution.

Customization maximizes the benefits of the spiral bevel gear drive. Selecting materials to suit the application environment and sizing components for the expected loads and forces avoids oversizing and can result in longer life and higher performance. It also ensures that factors such as form, strength, corrosion protection, noise, and backlash are optimized for the function.

Not all spiral bevel gear drive manufacturers have the same understanding of and capabilities for customization. Thus not all drives are the same. To aid selection of both vendor and drive product, this guide offers five questions to ask potential suppliers.



Question 1

Can they be customized for my application?

A standard product satisfying all the selection criteria will almost certainly be larger, heavier, and possibly more expensive than the application requires. Compromising on any quality, performance, durability, or size requirements will mean falling short in some areas of the design.

Customization leads to a design optimized for the specific application. It will be the right size and weight, with the right torque transmission capabilities, the permissible levels of backlash and noise, and the desired life.



For OEMs, customization cuts costs and design time, simplifies the design and engineering process, and reduces risk. This comes about because it gives designers the freedom to configure layouts for optimal function and hone in on the components that optimize cost and performance.

For MROs, customization helps ensure greater asset availability because failures will be fewer and life longer. And for both OEMs and MROs, it improves system performance and extends equipment life.

Common reasons a drive might need customizing include:

- To reduce gear noise and backlash
- To safeguard operations against challenging operating environments
- To protect the gear drive from harsh or repetitive cleaning procedures
- To increase ultimate torque and rating from a given size or envelope

Question 1

Can they be customized for my application?



When a manufacturer says they can customize, check what is meant by this.

Can they customize all these parts of a spiral bevel gear drive?

- | | |
|------------------------|--------------|
| • Housings | • Seals |
| • Roll pins/dowel pins | • Shafts |
| • Plating | • Bearings |
| • Locknuts | • Lubricants |

If your application is at all out of the ordinary, it's crucial to find a vendor that provides problem-solving expertise and customization.

Larger manufacturers of drives are typically not the best source. Configured for volume production, they often lack the organizational flexibility to respond to small, unique orders. If they do take on such work, they will often batch it with other jobs to gain economies of scale, resulting in an unacceptably long lead time.

On this basis, smaller suppliers would seem better candidates. However, many keep relatively little inventory on hand or lack the expertise to take on such work.

The answer is to find a supplier big enough to have deep expertise in gear design and manufacturing, but not so big that they only want high volume business. One benefit of seeking out these 'just right' sized companies is that you will; work directly with the technical specialists rather than the sales team.

Question 2

Are they suited for use in challenging environments?

Many things can make an environment challenging. Temperature, vibration, dirt, and humidity are often the first factors considered, but there's also the question of whether exposure is continuous or cyclic/periodic. Cleaning processes are an example of something periodic that can create conditions far outside of those for which the drive was designed. Other examples of unusually challenging conditions include intense magnetic fields, x-rays, radiation, and vacuum.

When assessing environmental conditions, it's essential to focus on where the drive will be located and not just the averages in the room or vicinity. For example, a drive might be used close to a furnace, inside a freezing tunnel for processed foods, in a mine, or a pressurized enclosure.

Cleaning poses two types of challenges. First, the cleaning media may be corrosive, especially if steam or caustic. Second, consider how it will impinge on the drive. Drips are one thing, but a high-pressure jet needs special protection.

Installation location is another environmental factor to take into account. If the drive will be placed somewhere difficult or dangerous to reach, or if taking it out of service will be particularly expensive, it's important to decide how long it should be expected to run without maintenance. Extreme use cases would be in satellites and undersea oil and gas operations.

A related issue is the risk of contamination, and this works in both directions. Engineers usually think in terms of preventing ingress to the drive, but it may also be important to consider what the drive could release into the atmosphere. This is the case in cleanroom-type environments as found in metrology, pharmaceutical manufacturing, and semiconductor production.

Question 2

Are they suited for use in challenging environments?

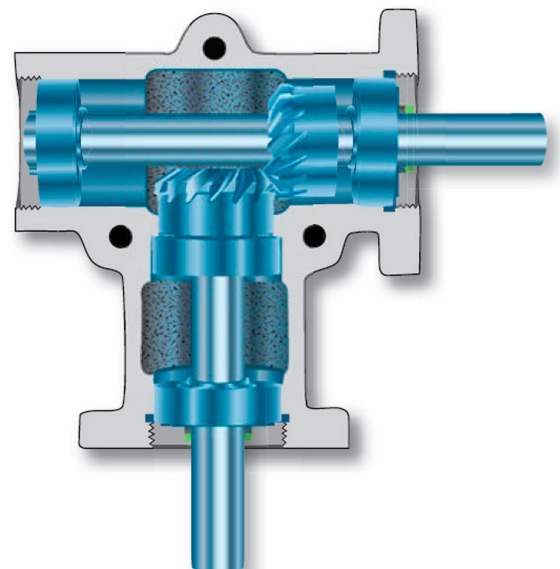
Some environments have particular standards for equipment to prevent product or atmospheric contamination. Examples include requirements for cleanroom grease and FDA-approved food-grade lubricants.

To give some additional examples, consider these:

- Installation on a ship or in a locomotive or an aircraft
- Use in a deep-freeze storage warehouse
- As part of a transfer mechanism inside an oven or furnace
- In power generation equipment (fossil-fuel based or solar/wind/geothermal)
- In medical equipment

Aspects of spiral bevel gear drives that are often customized to suit environmental requirements include:

- **Open/closed housing** — material and design (stainless steel is expensive, coated aluminum may work just as well)
- **Seals** — materials and design (for example, food processing plants may need seals made from Viton® rather than nitrile rubber)
- **Bearings** — Standard MITRPAK® spiral bevel gear drives have double-shielded, permanently greased, standard-metric-series ball bearings. While these satisfy most applications, some end-use conditions may require sealed bearings to ensure long drive life
- **Lubricant** — for ultra-high cleanliness it should not release particulates into the air: food-grade lubricants are often required in food processing equipment and plants
- **Coating & Plating** – anodizing, powder-coating, nickel plating are all used to increase corrosion resistance



Question 3

Have they been designed for field maintenance, repair, and rebuild?

A spiral bevel gear that's correctly sized and assembled properly should provide many years of trouble-free operation in all but the most challenging applications. However, even if the drive is performing as expected there is always a chance that a related equipment component will fail or break and cause some damage. This could entail removing the drive to make a repair. Some MROs will have a policy of replacing damaged or defective drives, but there are scenarios where repair or rebuild are a better option. This might be simply to save money, or because the drive was a special unit and a replacement is not immediately available.

To determine the extent to which the drive can be repaired or rebuilt, consider these points:

- **Serviceability** — can it be accessed easily and replaced or repaired in a reasonable time frame? Consider factors like repair/service frequency and ease of access as factors in your selection.
- **Spare parts availability** — before removing and disassembling the drive, you'll want to know the manufacturer maintains a comprehensive inventory of spare parts and can ship quickly
- **Technical support** — spiral bevel gear drives are highly-engineered items that need precise adjustment. Verify the manufacturer can provide the level of support required to help with repairs and rebuilds.
- **Quality of documentation provided** — this should cover every aspect of drive construction and repair procedures, from the type of grease needed to detailed instructions for backlash adjustment. Without these, there's a high risk of the rebuilt drive not meeting its original performance specifications. MITRPAK provides basic written instruction for right angle gearbox installation and maintenance, and has engineers available to help troubleshoot unique challenges.



Question 3

Have they been designed for field maintenance, repair, and rebuild?



Drives from small suppliers are commonly designed and manufactured in ways that permit field servicing. However, the businesses often lack the resources needed to provide comprehensive maintainability information. Getting answers to questions is often a matter of being lucky in reaching the right person by phone or email.

Large suppliers may have good technical documentation but don't design with servicing in mind. Instead, they'd rather users discarded old drives and bought new ones. In addition, people assigned to technical support duties may not be familiar with all the products manufactured and likely lack hands-on experience.

A "right-sized" supplier provides the best of both the small and the large company. Their drives are designed to be field-serviceable and they have technical specialists with the expert knowledge needed to help diagnose and resolve problems. However, their organization is big enough that keeping spare parts on the shelves does not drain their resources and they can produce all the technical documentation needed for rebuilding and repairing.

Question 4

How do they minimize noise and backlash?

Backlash appears as “play” in the drive. It’s when the input shaft can be turned a fraction of a degree, sometimes more, without moving the output shaft. For this reason it’s sometimes called “lost motion”.

Backlash results from clearance between the two gears. Clearance is needed to:

- Provide room for thermal expansion
- Allow lubricant between the meshed gear teeth
- Take up manufacturing tolerances

However, this play is a problem in many motion applications. It can result in grippers not moving to the right position, leading to dropped and misplaced parts. It’s also the biggest source of noise in a drive, which signifies wear and creates a perception of poor quality in the product where it’s used.

The absence of appreciable backlash in a gear drive signifies that it’s a well-designed and manufactured product. In light load applications and those that don’t need precise, repeatable movement, straight bevel gears may be adequate. However, spiral bevel gears, with their longer contact region, will always mesh more smoothly, run quieter and handle higher loads within a compact envelope.

Many spiral bevel gear manufacturers reduce backlash by adding shims or retaining rings to take up the clearances that result from manufacturing tolerances. This still leaves some backlash in the drive, and the problem will only increase as components wear. MITRPAK takes a different approach.

Our spiral bevel gear drives use a unique, adjustable locknut design that enables extremely precise final adjustment by hand. This results in minimal backlash and smooth, quiet operation. An additional benefit is the adjustment is possible to compensate for wear. For exceptionally quiet performance we can perform a special lapping process that creates even smooth gear tooth flanks.

Question 5

Can they be ordered in sizes and ratings for specific applications?



When selecting a right angle gear drive as part of a larger mechanical system, choosing the correct size and rating helps ensure the equipment will function as intended. Size is self-explanatory. It relates to how much room the drive will need. Rating refers to the performance of the drive in terms of its ability to transfer and resist torque.

Two numbers to look at are torque rating and ultimate static torque. Torque rating is the torque that can be transmitted at a specific power and rpm. In general terms higher rotational speed permits more power to be transmitted without increasing torque.

Static torque refers to the maximum torque that can be applied before something fails. (It's different to dynamic torque in that the latter produces rotation while the former is a measure of strength.)

It's not uncommon for design engineers to underestimate or incorrectly calculate the torque and horsepower to which a drive will be subjected. The consequences of this may not be apparent initially but will appear over time as accelerated wear and rising noise and backlash, culminating in premature failure.

Size is about more than fitting the space available. A good vendor will help you find the drive that meets your size constraints while handling the applied torque without being strained or overloaded. Where no standard product exists they will be able to help you understand your options for a customized unit. To give an example, installing stronger roll pins may permit use of smaller diameter shafts.



Find a Partner Who Can Meet Your Right Angle Drive Needs

Spiral bevel gear drives are for use when space is tight, when it's important to minimize noise and for precision motion applications. However, the drive must be matched to the application. If a regular right angle drive will perform the functions needed, this may be sufficient. If not, it's essential to get the right spiral bevel drive for the application. One that's undersized will suffer accelerated wear and fatigue that will shorten its life. Conversely, buying a drive that's too big will mean paying more than necessary for something larger and heavier than what's needed.

A final point only hinted at through this paper is the importance of finding and working with the right vendor. Spiral bevel gear drives are specialized items and it's important to work with experts who understand their function and also their limitations and requirements. While the large vendors have ample resources their willingness and ability to spend time on individual projects is limited. At the other end of the spectrum, small vendors will enthusiastically pursue every inquiry but lack the capabilities and depth to provide support for the long term.

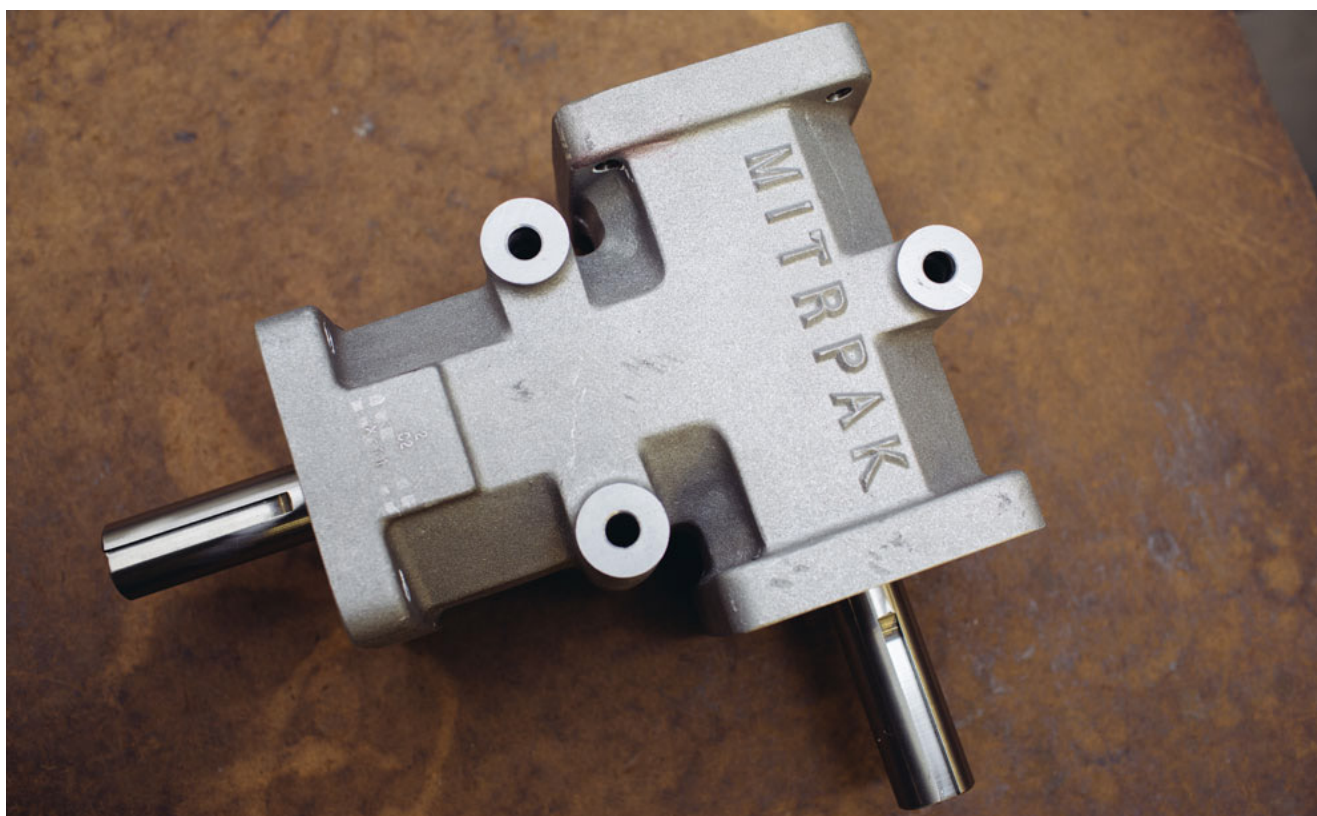
The solution is to connect with a vendor big enough to put expert resources on your project and provide long term support, but also small enough that prospects of only limited volumes will not diminish their interest.

One such vendor is MITRPAK. In addition to an extensive range of standard products, we are also willing to undertake customization to give you the exact solution to your power transmission needs. Standard products are produced in 2-way and 3-way formats, with same and opposite rotation and in various reduction ratios, but special products can also be produced to meet specific requirements.

**For more information
or to start your technical
discussion, visit**

WWW.MITRPAK.COM
today

About MITRPAK Power Transmission Products



MITRPAK, a division of Lampin Corporation, a 100% employee-owned firm, designs and manufactures high-quality, precision-machined spiral bevel gear drives.

For more than 30 years, MITRPAK drives have set reliability standards in a variety of industrial, food and beverage, pharmaceutical, military, textile, agricultural, consumer, and marine applications worldwide.



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