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Five Things To Consider Before Buying Spiral Bevel Gear Drives

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Introduction

Spiral bevel gear drives — a refined type of right-angle drive — function as important motion control components of equipment for packaging, food processing, military, textile, agricultural, and a wide variety of material handling and marine applications. These power transmission products play a critical role where motive force within a machine must be transferred “around a corner.”

Spiral bevel gearboxes are often specified in challenging locations such as washdown processing areas, or, conversely, where the end-use environment must avoid contamination from an open drive.

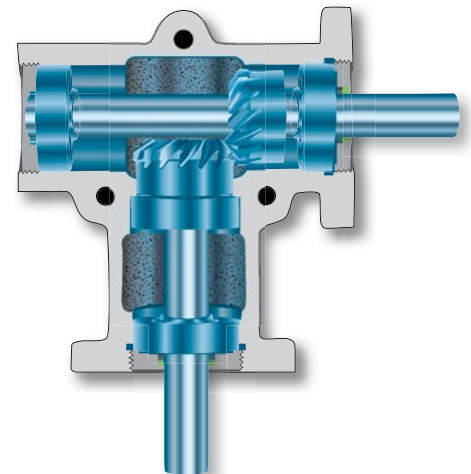
Drives are offered by a wide variety of vendors, large and small. They’re specified and bought by design engineers and purchasing agents for original equipment manufacturers (OEMs), as well as by in-plant maintenance and repair operations (MROs).

How can these specifiers and purchasers obtain the most suitable drives for their needs? This report touches on variables such as lead times, costs, reliability, ordering ease, applications expertise, and customized solutions. A primary focus: key questions to ask prospective vendors in determining whether their spiral bevel gear drives are the optimum choice for your unique application.

1. Are they suited for use in challenging environments?

Many applications require specialized drive materials, components, or designs to deliver required performance in difficult environments.

For best results, designers and purchasers should describe end-use conditions to vendors carefully. Where exactly will the drive be located? Note any possibilities of contamination, either from the environment to the drive or vice-versa. Warn of temperature extremes. Can gearing be open, or are closed housings mandated? Must any special governmental regulations or industry association standards be met? What service life is expected? What’s been the previous experience of similar drives for this use?



Housings and coatings. Food processing presents a number of challenging locales. For example, poultry plants subject drive housings to continually caustic washdown conditions. Where standard housings may corrode, some vendors furnish extra protection via expensive stainless steel housings. Especially responsive vendors may offer a variety of coatings to increase resistance. Examples: popular *hardcoat* or hard anodizing provides an electrochemical, corrosion-resistant aluminum oxide coating that penetrates outer surfaces. Another option, durable *nickel plating*, uniformly deposits a specified thickness of nickel phosphorous alloy onto metallic substrates, preventing the environment from reacting with the metal. Finally, *powder coating* applies a solvent-free, attractive finish for extreme durability and long life. Ask your supplier for your most suitable choice.

Seals. Ordinary elastomer seals provide excellent service for many standard applications. But they may fail under difficult conditions such as the poultry plant example above. Is your product or equipment susceptible to damage by a poorly sealed drive? Does your vendor offer special sealing materials or arrangements that can reduce these risks?

Lubricants. Contamination is also a concern in numerous applications. For food processing, make sure your supplier lubricates its gears with food-grade grease for incidental contact with food products. Similar gearbox-generated contamination may also be a risk in clean room environments. As a drive turns, it generates heat that may vaporize a small amount of any lubricant on the gears. This vapor could get past housing seals and escape into the environment, contaminating the room. Only a few spiral bevel gear drive makers offer special clean-room-rated grease to address this concern. Finally, other applications occasionally demand specialized solutions such as dry lubricant coatings, or, in the case of nuclear facilities, grease-free drives.

Bearings. Normally, any contamination concerns can be met with well-sealed drives. However, in a few cases, challenging end-use conditions may actually demand the use of sealed bearings as well. Since this is an unusual requirement, only a few suppliers will be prepared to meet it.

Gears. The majority of drive uses may be handled by gears made of good grades of alloy steel. Only rare circumstances require more exotic solutions. For instance, the extreme regulatory regimen found in nuclear power plants demands gearing materials made of specialized stainless steel. Very few gear makers are equipped to manufacture their products using anything but standard steels. If you require such an accommodation, make that a primary qualification for any prospective vendor.

As an example of a supplier with an unusually broad solutions range, MITRPAK Power Transmission Products offers numerous options for difficult applications. In *poultry plants*, where even enclosed gear housings with standard nitrile seals may be challenged by washdowns,



contamination, or temperature extremes, MITRPAK recommends special Viton® seals for greater resistance. An exclusive double-seal approach further extends drive life. Instead of expensive stainless steel housings, aluminum housings and bearing locknuts with hardcoat or powder coating provide similar protection at lower cost. And food-grade lubricant meets requirements for use under FDA regulation section 121.2553, and carries the USDA “AA” rating. In *clean rooms*, MITRPAK provide specialized clean-room-grade grease. And for *nuclear plants*, it can replace standard 8620 hardened steel with gears of 17-4 PH®, a specialized stainless steel that combines high strength and hardness with corrosion resistance.

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

Properly assembled and sized for the application, a well-made spiral bevel gear drive should last for years in all but the most difficult applications. If a drive develops trouble or fails after warranty, depending on age and condition it is often most cost-effective to purchase a new unit. However, in some cases it may still be worth considering maintenance, repair, or rebuild instead of replacement. Before you buy, ask vendors if such services are possible with their products.

How serviceable will the drive be in your plant? Some models are not easily disassembled or adjusted in the field to determine if they are repairable.

Are parts readily available? To minimize any machine downtime in your operation, standard parts should be stocked and ready to ship the same day.

If service is needed, is technical support available? A person with requisite expertise in the given drive — plus its typical applications as well as common problems and solutions — should be available in person for troubleshooting. Whether by phone or e-mail, your questions should be answered within a reasonable time.

Does the vendor supply field maintenance installation instructions with every drive? These provide information on topics such as determining the required amount of grease or adjusting the unit for optimum backlash. Good instructions make repairs less frustrating, can extend the life of a rebuild, and may reduce future downtime. Be aware that some vendors don't supply this documentation, and plan your purchases accordingly.

Overall, look for a supplier that's responsive. This pays off for OEMs with design change flexibility and faster time to market; for MROs with greater asset availability; and for all with reduced risk, greater efficiency and productivity, and rightsized inventories.

Ideally, you want a gear drive vendor that quotes quickly and accurately, based on the specifications you supply — and fulfills orders just as fast. Many claim they will assemble and ship a new drive within 24 hours of your order, or get a replacement part out the door the



same day. But in practice, some don't live up to this promise. Keep track of different vendors' responsiveness until you find one that can consistently meet your needs.

3. How do they minimize noise and backlash?

Most designers and end users like their gearsets as quiet as possible. Noisy gears actually may signify mechanical deficiencies that contribute to poor performance and shortened drive life. Plus even where an unusually hushed environment is not a prime consideration, quiet gears provide a perception of high quality and superior functionality.

The type of gear you choose can depend on the gear performance you require. For lower speeds and lighter loads, *straight bevel* gears may be adequate, although their abrupt transfer from tooth to tooth tends to create higher impact stress and greater noise. By contrast, *spiral bevel* gears are designed so that their curved teeth come into contact gradually. You get higher tooth-to-tooth contact covering a greater surface area. This allows well-made spiral bevel designs to offer smooth, quiet operation, even at high speeds and greater load capacities.

When comparing different spiral bevel designs, complex considerations determine the final amount of noise emitted by any given gearset. One prime factor: *backlash*. This is defined as the distance between meshing gear teeth. All else being equal, the greater the backlash, the louder the impact when gear meets gear.

A critical question: can your drive vendor make the adjustments required to minimize backlash? Most manufacturers assemble their gears to a "loose" distance. They then close the gap just enough to get minimally acceptable tolerance by locking each gear permanently into place with a shim or retaining ring. However, even a slight variation in the manufacturing process can substantially increase the backlash on an individual gearset.

One exception is the MITRPAK® spiral bevel gear design. It eliminates shims and rings. Instead, its unique adjustable locknut allows each gearset to undergo extremely precise final adjustment by hand. Result: absolutely minimal backlash and the smoothest, quietest possible operation.

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

Different jobs demand different drives. Look for vendors that are willing to discuss your precise application, then offer options in terms of sizes and ratings that can deliver high performance and optimized drive service life within the parameters your job generates.

Pay particular attention to suggested *torque ratios*. These ratings are based on revolutions per minute under a given horsepower. In an all-too-common scenario, a customer may underestimate the amount of torque a drive will routinely encounter on the job. Suppliers



sometimes discover that their drives rated for 190 inch pounds of torque are instead running at 400 inch pounds!

This is bad news, since each drive is rated for an ultimate static torque. If operation frequently exceeds recommended levels of torque and/or horsepower, a good drive may still operate acceptably for some time. However, eventually, teeth wear; bearings fail; roll pins fatigue, and then shear.

Make a preliminary attempt to spec your drive by consulting the vendor's catalog or Web site. Then, especially if your requirements seem at all out of the ordinary, contact the vendor or distributor. At a minimum, a good vendor should be willing to work closely with you, ensuring that the drive and components you select match the requirements of the work you want the drive to do.

An excellent vendor may go further, customizing a drive to meet your special needs. For example, standard pins could be replaced by specifying solid roll pins that offer much higher static torque ratios, for better performance and much improved drive life. (See next section.)

5. Can they be customized for my application?

In many cases, a spiral bevel gear drive is much more than a commodity part. It's a complex machine that's precisely engineered for your exact needs.

If your application is at all out of the ordinary, it's crucial to find a vendor that provides problem-solving expertise and customization. For OEMs, this helps cut costs and design time, simplifies the design and engineering process, and reduces risk. For MROs, it helps ensure greater asset availability. And for both OEMs and MROs, it improves ultimate performance and extends equipment life.

Vendors willing to undertake specialized designs can meet specific performance requirements by customizing any of the following gear drive components:

- Housings
- Gear materials
- Roll pins/dowel pins
- Plating
- Locknuts
- Seals
- Shafts
- Bearings
- Lubricants



For example, when a customer wants an exceptionally low-noise drive, the previously mentioned locknut adjustment of backlash offers a uniquely effective solution. Incremental improvements in smoothness and quietness may be obtained by running gears during manufacture in a special lapping machine using liquid abrasive. This customization step further smoothes tooth surfaces by abrading away minute amounts of metal as the gears rotate.

Components may need to be modified to suit specific needs. Can the number of connecting components be minimized by altering shaft length, tapping the shaft, replacing a keyway with a flat, or making other changes? For example, when a customer must fit a drive into a very tight space, creativity can be crucial. On one application for an unmanned underwater vehicle, machine space was extremely limited. Even the smallest standard drive was too large. The supplier was able to slightly modify the housing and produce special shafts only ½-inch long that met the job's relatively modest torque requirements — while just fitting the space available.

Costs may also be trimmed in creative ways. In one case, a job that would normally call for a ¾-inch drive didn't actually demand the hefty torque that drive could supply. The supplier applied a less expensive 5/8-inch drive, but instead of using standard roll pins, substituted solid dowel pins that could take enough extra torque to meet requirements. Result: an optimized drive at a considerable saving.

When it comes to these or other customization efforts, larger drive suppliers are usually not the best source. Concentrating on turning out components in high volumes, such vendors often lack the organizational flexibility to respond to small, unique orders. And even if they do take such an order, they may batch or gang it with other jobs to gain economies of scale. Thus delivery can take weeks or months longer than desirable.

Smaller suppliers, then, would seem to be better candidates for customized capabilities. However, many of these keep a relatively limited inventory on hand, or simply don't have the experience or business focus to make such work worthwhile.

In fact, *most* drive suppliers, large and small, prefer to focus on filling catalog orders for standard products. Fortunately, a few are different.

For instance, MITRPAK Power Transmission Products specializes in spiral bevel gear drives, and puts intense focus on fast, responsive customization. It has produced special solutions like all those above, and more. Based in Uxbridge, Massachusetts, USA, the company has designed, machined, and assembled most components in-house for more than 30 years. When customers call with change orders or other special requirements, MITRPAK engineers thus can closely oversee manufacturing and draw from a comprehensive inventory of readily



available parts. Results: rapid design, manufacture, and shipping of the proper right-angle gear drive, supporting components, and assemblies for each unique job.

Conclusion

Don't just think of drives as simple commodities. They're actually complex mechanisms whose specification can demand close collaboration with distributors or suppliers.

Before you undertake the ordering process, make sure you understand the vendor and its products' specific capabilities. Both can greatly affect performance in your equipment. Query prospective vendors closely on suitability for difficult environments, repair/rebuild, noise levels, sizes and ratings, and customization possibilities.

With careful attention to vendor choice and product specification, you can obtain the right spiral bevel gear drive to deliver optimum performance over a long service lifetime.

About MITRPAK Power Transmission Products

Lampin Corporation, a 100% employee-owned firm, designs and manufactures the MITRPAK line of high-quality, precision-machined spiral bevel gear drives. These products enable motive force within a machine to be transferred "around a corner." 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.

Lampin makes most components in-house in Uxbridge, Massachusetts, USA. This helps ensure responsiveness to customer needs; increased opportunity for effective customization; the highest degree of manufacturing quality; and rapid, reliable delivery.

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