INTECH Power-Core™

Power of Knowledge Engineering®

2021
WHITE PAPER

Durable, Self-Lubricating Polymer Bearing Surface Excels in Motion Systems

Learn how a polymer-based hybrid track roller design overcomes the pitfalls of traditional metals and plastics in motion systems.

One of the key advantages of Power-Core track rollers is that they eliminate the metal-on-metal wear that drives the use of expensive rail materials. The polymer track rollers can even work with aluminum rails, which cost far less than ground hardened steel.

Beyond a cursory review of dimensions and load capacities, you may not pay much attention to track rollers and cam followers. But you should. These components can make or break the performance of the motion systems found on packaging, medical, semiconductor and other industrial machines.

The wrong type of track roller or cam follower can lead to frequent maintenance, reduced service life, contamination issues and speed limitations. It can also drive up costs in unexpected ways — not just the cost of operating the machine but also the cost of building it. The right components, by contrast, will contribute to the reliable, fast motion that machine builders and buyers expect.

So how do you pick the right track roller or cam follower for the job at hand? You need to consider not just sizes and loads but also the materials that make up the roller's bearing surface.

Many engineers still believe that heavily loaded applications require metal track rollers or cam followers. Yet polymer bearing surfaces can withstand enormous forces if designed properly. At Intech, for example, we've delivered polymer rollers that withstand forces up to 8 tons. These robust designs have seen use in ski lifts and in rigs capable of lifting entire buildings. These heavy-duty applications, however, require no small amount of custom engineering, regardless of whether the bearing surface is metal or plastic.

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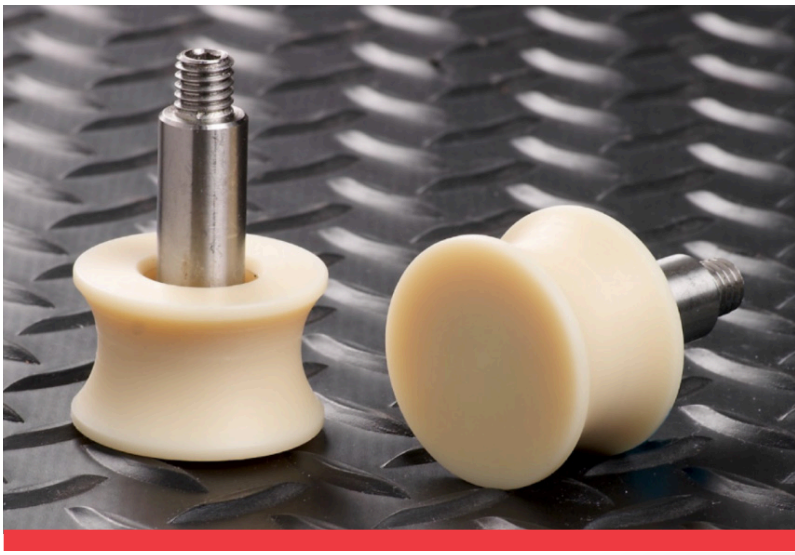
Intech's composite cam followers and track rollers combine a Power-Core polymer bearing surface with metal hubs and roller bearings. The use of polymers eliminates the need for lubrication and makes these components significantly quieter than their all-metal counterparts.

Most applications are not so heavily loaded. The primary role of the track roller or cam follower is to transmit motion, rather than support heavy loads. In these applications, off-the-shelf rollers and cam followers will do a good job without the need for a custom-engineered solution.

And increasingly, these off-the-shelf products are not made entirely from metal. Instead, they are are hybrid designs that consists of a polymer load bearing surface over a metal track roller bearing or structural hub. Sized as drop-in replacements for standard sized metal rollers, the hybrid rollers offer some compelling technical advantages thanks to their use of polymers.

- **Polymers Can Lubricate Themselves.** The engineering polymers best used for track rollers, such as Power-Core™, exhibit an internal lubricity that lasts for the life of the component. Bearing surfaces made from these polymers require no external lubrication between the roller and the rail. When combined with lubed-for-life track roller bearings, polymer bearing surfaces eliminate the maintenance costs associated with lubrication. More importantly, self-lubrication puts an end to the loss of performance and catastrophic failures that occur when metal rollers and rails aren't regularly lubricated.
- **Polymers Wear Better.** Even with some lubrication, metal-on-metal contact can result in excessive wear and galling. Metal-on-metal wear takes a toll not just on the track roller itself but also on the rails, which are far more expensive to replace. Plastic rollers eliminate this wear mechanism altogether.



Capped cam follower

Capped Cam Followers Excel in Contamination-Sensitive Environments

If you're designing for packaging or processing machines in the food and beverage, pharmaceutical or electronics industries, then you might want to reach for cam followers with a sealed bearing design. Intech iCam Followers® feature sealed bearings, as well as a self-lubricating, wear-resistant bearing surface that eliminates two potential sources of contamination: stray lubricant and particulates from metal-on-metal wear—both of which can contaminate your product.

In addition, Intech cam followers are available with a sealed end-cap design, which includes a one-piece, enclosed tire. One side of the plastic roller is enclosed, or capped, protecting the roller bearing from contamination and washdown. These units are also assembled with an eccentric, galvanized steel shaft.

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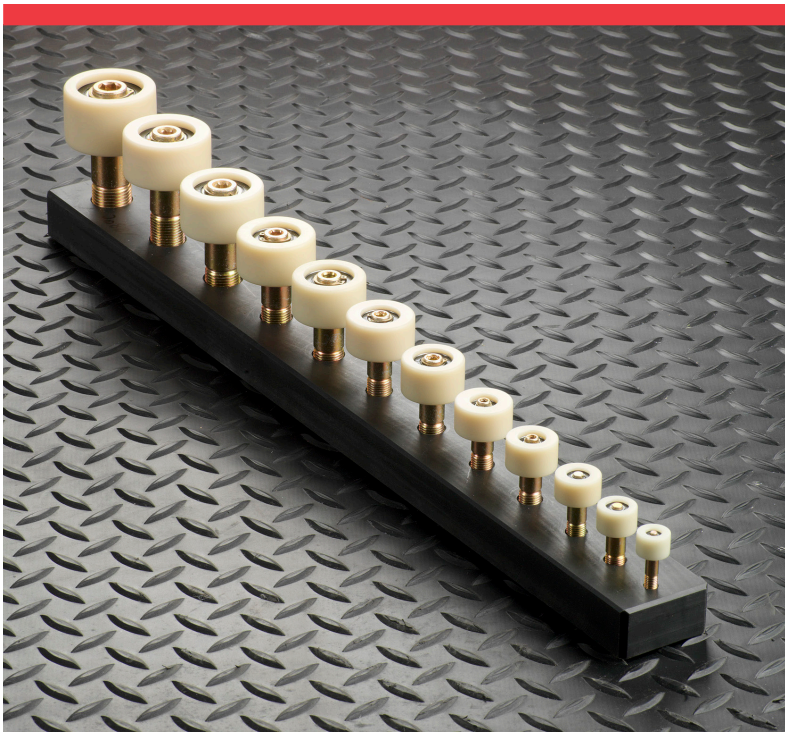
- **Polymers Run Smoothly and Quietly.** Unlike metals, polymers such as Power-Core have the ability to dampen shock and vibration. In cam follower applications, the polymers absorb the damaging shock and vibration caused by reciprocating motion. This damping ability prolongs the life of machine bearings, especially in high-speed applications. In track roller applications, the damping ability contributes to quiet motion. Polymer rollers typically run about 10 dB quieter than their metal counterparts. They run smoothly too, thanks to their precision roundness specifications. For example, total runout on a machined Power-Core polymer cam follower with a 1.5-inch OD would be below +/–0.001-inch.
- **Polymers Are Cleaner.** Self-lubricated polymers eliminate two potential sources of contamination — stray lubricant and particulate from metal-on-metal contact. For this reason, polymer cam followers and rollers are a good choice for use in medical, semiconductor, food processing and cleanroom applications. Self-lubricated polymers have the added benefit of eliminating the time it takes to regrease moving components after washdown cycles.
- **Polymers Are Fast and Efficient.** Polymer track rollers facilitate high-speed, energy-efficient motion in three ways. For one, polymer rollers weigh about 40% less than similarly-sized metal rollers, reducing inertia. For another, polymer track rollers typically use high-speed roller bearings, which exhibit a lower rolling resistance than the greased needle bearings found in traditional metal rollers. Finally, polymers eliminate resistance caused by viscous drag from lubricants and by worn metal bearing surfaces.

Ceramic or Hybrid-Ceramic Ball Bearings Boost Durability

While iCam Followers® with sealed stainless-steel bearings and shafts are the traditional, go-to choice whenever corrosion is likely, you also have ceramic options, which are preferred by customers who use more aggressive washdown solutions. These ceramic bearings reduce friction, feature a high static load capacity and don't rust, which is especially appealing for hygienic environments. Two types are available, all-ceramic or hybrid ceramic bearings, the latter of which combines ceramic ball bearings with a steel race. The hybrid type can also withstand some shock load.



Intech sizes its composite cam followers and track rollers in standard sizes that make them true drop-in replacements for traditional metal models.

- **Polymers Thrive in Harsh Environments.** Power-Core polymer track rollers do not swell in moisture and are also highly resistant to chemicals and temperature fluctuations. These characteristics make them well-suited to washdown applications, outdoor exposure and other harsh environments. In applications subject to corrosion, it's really the metal cam follower components, not the polymer, that you should worry about. So it's a good idea to specify cam followers with enclosed stainless steel bearings and shafts whenever corrosion is likely.
- **Polymers Ultimately Cost Less.** The true cost of cam followers and track rollers has very little to do with their purchase price and everything to do with their lifecycle cost. Polymers also save over the long haul by eliminating the need for lubrication, by extending maintenance intervals and by reducing energy costs. An even greater payback, however, comes from the elimination of metal-on-metal wear. Polymer rollers, for example, will pay for themselves many times over if they extend the life of a motion system's rails.

While it's not well known, polymer cam followers and track rollers can also make it possible to build machines more cost-effectively — because polymers' wear characteristics make it feasible to use low-cost aluminum for rails and cams rather than expensive case-hardened and ground steel. Polymers also allow machines to be built without central lubrication systems, reducing costs even more.

Not Just Any Plastic

Keep in mind that not all plastics will be equally suited for use in cam followers and track rollers. Even different grades of plastic within the same broad polymer family can perform very differently as bearing surfaces in cam followers, rollers and other power transmission applications.

When evaluating different plastics for use in track rollers, it's particularly important to look not just at stated load capacity but also at the polymer's likely stability under the expected operating conditions. All polymers have properties that can change in response to variations in moisture, temperatures, loads, chemicals and other exposures. With polymer power transmission components, all these factors can trigger losses in physical properties and lead to premature failures.

In our decades of experience with polymer power transmission components, the type of exposure that engineers most often neglect is moisture. Many engineering polymers can lose a substantial amount of their tensile strength — 50% is not uncommon — upon long-term exposure to moisture. Hygroscopic engineering polymers will also swell substantially, sometimes by as much 3% or more, impeding the relative motion of components that need to work together smoothly.

Power transmission components that are both weakened and out of dimensional tolerance can spell doom for an otherwise well-designed motion system. Yet engineers often fail to account for the possibility and effects of moisture uptake. Or if aware of moisture's harmful effects, they simply avoid polymers altogether.

The same goes for other types of environmental exposures. Engineers either fail to recognize that polymers can change in response to operating conditions, or they steer clear of polymers.

At Intech, we've found that we can design our way around the problems associated with moisture and other environmental exposures by picking the right type of polymer. We use our proprietary Power-Core material almost exclusively. Based on its unique balance of physical properties and cost, Power-Core polymer is the gold standard when it comes to plastic power-transmission bearing surfaces.

More exotic engineering polymers can work in track roller and cam follower applications too, but you should expect to pay a lot more for them.

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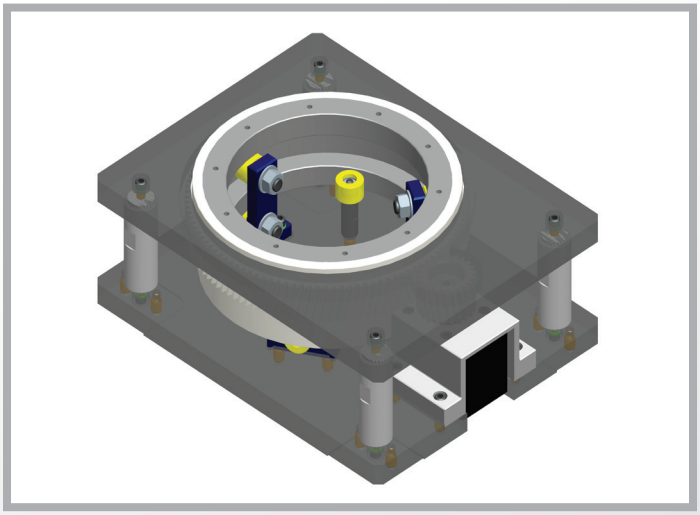
Application Example: Lube-Free Rotary Positioning for Cleanrooms



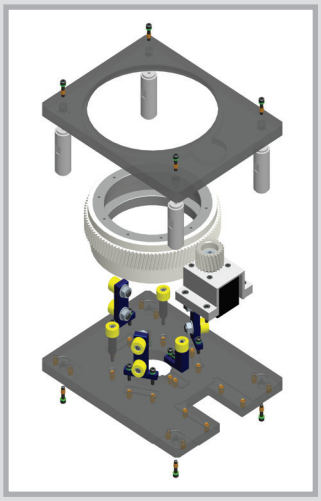
Intech's transmission components have been combined in a precision rotary stage whose gearing and bearing surfaces are made from cast and machined Power-Core polymer. The resulting stage runs without the need for lubrication.

Intech's Power-Core® polymer track rollers have found uses in applications ranging from industrial machines to transportation. Most of them have seen use in linear motion systems of one kind or another, but there's no reason that these Power-Core polymer track rollers cannot be incorporated into rotary motion systems such as our new rotary index table.

Designed for integration into third-party servo systems, this new rotary index table makes extensive use of track rollers and gearing made from Power-Core material. The table's drive mechanism consists of a pinion-driven ring gear whose helix tooth profile eliminates wear and backlash. The gear is machined from a polymer blank that has been cast around an aluminum ring. This ring serves as a circular rail and as the mounting surface for the payload. The Power-Core polymer track rollers, which mount on the unit's base plate, support the rotating gear and integrated mounting surface. They feature enclosed stainless steel bearings, making the unit suitable for washdown and other corrosive environments.

The use of Power-Core polymer for the drive and bearing elements helps this rotary table outperform all-metal designs in several ways:

- **Low wear without lubrication.** This design avoids the metal-on-metal contact that can shorten the working life of motion systems. The only contact is between two Power-Core polymer components in the case of the drive mechanism and between Power-Core and aluminum in the case of the supporting rails. Power-Core material is formulated with an internal lubricant, so no external lubricant is needed. The metal bearings are lubed for life too.
- **Backlash free.** Power-Core polymer gears offer a couple of intrinsic advantages when it comes to reducing backlash. For one, their dimensional stability eliminates the need for the backlash compensation required by moisture-sensitive plastics. For another, the uniform crystalline structure of Power-Core material and our gravity casting production methods produce gear blanks with very low internal stresses and uniform machining resistance. These characteristics allow very precise machining of tooth profiles that have been optimized for backlash reduction — and would be difficult to achieve in metal.
- **Fast and smooth.** The low-inertia of the gearing and the track rollers helps the table operate at higher speeds. By producing a tighter inertia ratio between the motor and driven load, the low inertia of the Power-Core drive components also makes it easier to tune the controls for a smooth, precise motion profile, particularly when moving light payloads.
- **Washes down, resists chemicals.** Power-Core polymer's dimensional stability in the presence of moisture and its thermal stability make this rotary table a good fit for washdown, high-humidity and high-temperature applications that would prohibit the use of less capable polymers. Nylon 6, for example, can exhibit a dramatic loss in tensile properties and undergo dimensional changes when exposed to moisture and high heat levels. Power-Core material also offers excellent chemical resistance compared to nylon 6 and other polymers used in power transmission applications.
- **Cleanroom friendly.** Because Power-Core polymer resists wear and does not throw off the particulate associated with externally lubricated metal power transmission components, cleanroom use is a natural fit for this rotary table design.
- **Scaleable.** By manipulating the size of the gear and track roller components, the table design can be scaled to handle payloads ranging from ounces to tons.



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About Intech

Intech Corporation specializes in the design and manufacture of lightweight, robust, low-noise machine components that eliminate the need for lubrication. Our self-lubricating products include gears, guide rollers, cam followers and custom-designed motion components. To meet your application requirements, we employ a variety of advanced polymers, low friction coatings, metal alloys, or polymer-metal hybrid structures. We have pioneered many design solutions and support each design with advanced durability calculations, including stress simulations.

For more detailed information on our engineering capabilities, check out our latest white papers and case studies.

Durable, Self-Lubricating Polymer Bearing Surface Excels in Motion Systems

Polymer-based hybrid track roller design overcomes the pitfalls of traditional metals and plastics in motion systems

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Redesign Improves High-Speed Can Making Machine

Solving a costly lubrication problem triggers unexpected productivity improvements

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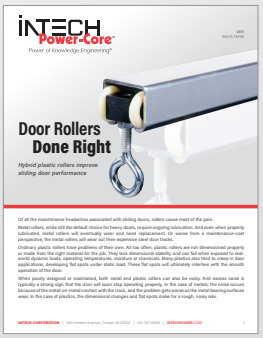

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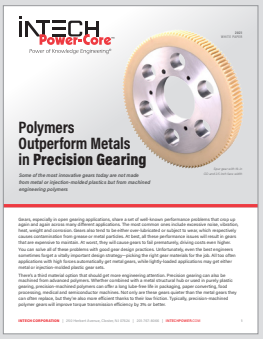

Polymers Outperform Metals in Precision Gearing

Some of the most innovative gears today are made from machined engineering polymers rather than metal or injection-molded plastics

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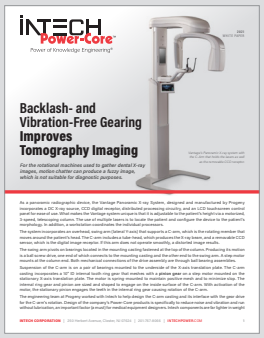

Backlash- and Vibration-Free Gearing Improves Tomography Imaging

For rotational machines used to gather dental X-ray images, motion chatter can produce a fuzzy image unsuitable for diagnostic purposes

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