ROLLON PLAYBOOK

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LINEAR BEARINGS FOR CNC

Doors and auxiliary axes on machine tools need different linear motion components than spindles.

The makers of CNC machine tools are not known for skimping on their motion control components, especially those related to spindle movements. Yet not every motion on a CNC machine is mission critical. In fact, most machines have one or more axes that, unlike the spindle, do not require high degrees of accuracy and precision.

These axes can include doors and other auxiliary systems not associated with cutting. By picking an appropriate motion solution for these auxiliary axes, machine builders can not only take some cost out of a CNC machine but also improve that machine’s reliability in the field.

Doors, in particular, are an axis that are often designed with less-than-ideal motion components. From an accuracy standpoint, door motion may seem like an open and shut case, but they do present some challenging design issues of their own. They tend to be large sheet-metal structures that are subject to deflection and alignment problems. They also have to work reliably in a contamination-prone environment filled with metal chips and cutting fluids.

These size and contamination issues can be especially hard on linear bearings. Engineers who work in machine tools will sometimes reflexively specify recirculating ball linear bearings, in part because of familiarity. Yet this style of bearing is not the best choice when it comes to creating a dependable, cost-effective door.

Rollon Corp. has developed an alternative bearing solution for doors and related auxiliary applications. It’s based on Compact Rail bearings, which are both self-aligning and resistant to contamination.

On CNC machines, not all motion axes are created equal. While spindle motions are all about accuracy and precision, doors and other auxiliary axes require a linear motion solution that’s easy to install and reliable.
LINEAR BEARINGS FOR CNC

SELF ALIGNING

Aligning linear bearings is usually a difficult process that takes place during the machine building phase. Machine builders must first machine mounting surfaces to near perfect flatness. Then they’ll install bearings using fixtures to ensure that rails are aligned horizontally and vertically. Both of those steps can add significant time and cost to the machine.

And in the case of machine tool doors, both of those steps may be both ineffective and unnecessary. They’re ineffective because the doors tend to be large sheet metal structures that will deflect in use, undoing even the most careful installation techniques. And they’re unnecessary because self-aligning bearings can accommodate deflection without the need for the expensive machining or fussy installation procedures.

Rollon’s Compact Rail system gets its self-alignment capability from the way that its large roller bearings interact with a set of rail profiles. The profiles are designed to allow the rollers an extra degree of freedom or two to offset misalignment between rails.

In the case of machine tool doors, an emerging solution combines Compact Rail’s U and K rail profile to support the slider. The U-style rail has a flat raceway that allows a roller freedom translate in an out relative to the axial direction of the rail. The K-style rail has a geometry that allows for limited angular rotation of the roller, while still offering precise linear guidance. Together, these rails can absorb significant alignment errors in two axes: Parallelism on the horizontal plane and height differences between rails in the vertical plane.
LINEAR BEARINGS FOR CNC

SELF ALIGNING

How significant? It depends on the distance between rails. For example, at a two-meter span between rails, the system can absorb parallelism errors up to 4 mm in the horizontal plane and differences in rail height of +/- 50 mm.

With the Compact Rail system, the source of the alignment errors is not important. Whether the errors are caused by the machine structure, installation or deflection in the field, the Compact Rail will adjust and do so without affecting the wear characteristics or lifespan of the bearing.
LINEAR BEARINGS FOR CNC

CONTAMINATION RESISTANT

Another important linear bearing attribute important in doors and other machine tool auxiliary axes is contamination resistance. Recirculating ball linear bearings, which have little clearance between balls and raceways, have historically been susceptible to contamination-related failures and require elaborate protective measures. Making matters worse, metal chips are among the most damaging contaminants in the industrial world.

Rollon’s Compact Rail keeps contamination at bay in a few ways. It has small features, like seals and wipers, that minimize contaminants on the rails. Installation tricks, such as installing rails upside down, can further reduce contamination levels.

Mostly, though, Compact Rail’s contamination resistance rests on its overall design. Its small ball bearings are permanently sealed within larger rollers. And the rollers have a large size relative to typical contaminants. They can roll over many chips that would stop a recirculating ball bearing in its tracks.

LOW CLOSING FORCE

Compact Rails additionally make the doors easy to open and close—and not just because design tolerates misalignment without impeding motion. Compact Rails also contribute to the smooth door motion because they have a low coefficient of friction (COF). The typical COF for a Compact Rail ranges from 0.003 and 0.006, depending on size. Thanks to the low-friction operation, a Compact Rail Size 43, for example, would require an opening-closing force of just 1.5 lbs when supporting a 200-lb door.
LINEAR MOTION SOLUTIONS FOR TROUBLE-FREE PALLETIZING
LINEAR MOTION SOLUTIONS FOR TROUBLE-FREE PALLETIZING

Lubed-for-life bearings that eliminate misalignment problems keep palletizers up and running.

With their round-the-clock operating schedules and demanding uptime requirements, the palletizing systems used in packaging plants can challenge the reliability of even the best linear motion components. Linear bearings are no exception, especially when inadequate lubrication or alignment problems cause premature wear.

To function properly over the long haul, all linear bearings need regular lubrication. The lube helps minimize any wear caused by metal-on-metal contact between the rolling elements and raceways. Left unchecked, this wear can reduce the life of a typical linear bearing significantly. Even so, under-lubrication is common because maintenance workers sometimes have trouble keeping up with aggressive lubrication schedules of most linear bearing designs.

Palletizers are particularly susceptible to lubrication problems because they often handle cardboard, which tends to generate cardboard dust. This dust is an extremely aggressive contaminant that tends to “soak up” the lubrication the system needs to function smoothly.

Misalignment is another source of wear—and reduced bearing lifespan. Bearings that aren’t aligned properly during their installation can cause problems on any precision machine, including modern robotic palletizers.

Rollon Corporation has developed a unique linear bearing system that has achieved long-lasting success in palletizers or related machines. These Compact Rail bearings reduce lubrication levels substantially and ease alignment tolerances while still offering lifetimes measured in millions of cycles.

Compact Rail’s lubrication and alignment advantages came into play on a vertical palletizer developed by a Rollon customer. Capable of handling up to 50 lbs of cartons at speeds up to 30 cycles per minute, the system runs day in and day out on rails that are both self-lubricating and capable of tolerating parallelism errors of up to 4 mm without any performance or lifespan penalties.
LINEAR MOTION SOLUTIONS FOR TROUBLE-FREE PALLETIZING

LOW CLOSING FORCE

Compact Rails have minimal lubrication needs by design. With these bearings, the slider rides on large rollers that house permanently lubricated and sealed ball bearings. Unlike bearings that rely on recirculating balls which must be lubed frequently, the large roller bearings never require internal lubrication. They truly are “lubed for life” in a way that completely protects the lube from exposure to dust and other contaminants.

Like other types of linear bearings, the Compact Rail rollers do benefit from a small amount of external lubrication—between the roller and their track. However they require just a fraction of the lubrication needed to keep a recirculating ball system running smoothly. Standard Compact Rails need just a spritz of additional lubrication every 50,000 cycles.

What’s more, Compact Rail’s nominal lubrication needs are easily automated by inexpensive self-lubricating wipers. These wipers can provide constant lubrication for up to two million cycles before they need to be replaced with a new set, which costs only about $20 plus a few minutes of labor.

In a typical palletizer, which may not have to last for two million cycles, linear bearings with lubed-for-life rollers and the self-lubricating wipers will in essence be maintenance free. They’ll also keep the lubrication at an optimum level. As detrimental as too little lubrication can be, too much lubrication can be a problem, too. Over-lubed bearings can spew excess oil into the factory environment. This issue is particularly troublesome in applications such as packaging that deal with finished consumer goods.
LINEAR MOTION SOLUTIONS FOR TROUBLE-FREE PALLETIZING

EASY ALIGNMENT

Palletizers move sizable loads over long motion axes at high speeds, all of which makes linear bearing alignment crucial. Rollon’s Compact Rail system can help on this score too.

The Compact Rail system features multiple rail profiles that can be combined to give rollers added degrees of freedom to offset any bearing misalignment. For example, the system’s U Rail has flat raceways that allows the roller some lateral movement to compensate for parallelism errors in two-rail installations. Typically, the U Rail would be combined with a T Rail, whose profile is best suited to supporting the load and guiding it precisely. These rails can together accommodate a 4 mm axial misalignment over a 2 meter span without affecting the wear, performance or predicted life of the bearing.

Compact Rail’s misalignment tolerance pays off in two ways. During the machine build, it allows bearings to be installed less precisely. Builders can often eliminate expensive machining of bearing mounting surfaces and costly installation fixtures altogether. During the machine’s working life, the misalignment tolerance eliminates a key source of wear, maximizing bearing life.
MEDICAL MOVES
MEDICAL MOVES

Linear bearings play a crucial, yet under-appreciated role, in medical imaging systems.

Medical imaging systems contain so many high-tech electronic elements that it’s all too easy to overlook the mechanical components that contribute to the success or failure of these systems in the field. Consider linear bearings, for example.

They’re found on a variety of imaging systems from traditional X-ray machines to advanced systems such as magnetic resonance imaging (MRI), computed tomography (CT) and positron emission tomography (PET). Usually, the bearings are used to guide and support the motorized beds that position patients under the system’s scanning elements, though they are sometimes used for auxiliary motion axes, too.

Guiding a motorized bed is a seemingly simple task, but it’s also a crucial one. If these linear bearings fail, they can take even the most advanced imaging system out of commission.

Failure in these medical imaging applications usually results when bearings are not truly robust enough to handle the heavy loads associated with the moving patient beds. With these loads routinely topping 3,000 lbs, the bearings can all too easily become misaligned and wear prematurely.
In this unique bearing design, the slider moves on large roller bearings that travel within profiled rails. This arrangement offers three key advantages in medical imaging applications.

For one, the large roller bearings make for a system that’s both space efficient and heavy-duty. The largest Compact Rails measure less than 2.5-inches high and can handle maximum load of 3,400 lbs, more than enough to accommodate a motorized bed rated for 500 lb with a safety factor of 6.

For another, the bearings are inherently tolerant of misalignment. The rail profiles have been specially designed to allow the rollers axial freedom within the raceways. Depending on the styles of rail selected, this freedom can offset parallelism errors in either one or two axes. When imaging machines are being built, this capability greatly simplifies the preparation of bearing mounting surfaces and installation of the bearings. Over the machine’s life, the misalignment tolerance helps reduce bearing wear.

Lastly, Compact Rail bearings are quiet compared to systems that rely on recirculating balls. In tests conducted by Rollon, Compact Rail sliders with ground raceways generated less than 70 db of noise while traveling 2 m/s with a 4,000 N load. A comparable recirculating ball slider operating under the same conditions generated 86 db.
Rollon’s Semi- and Full-Telescopic Rails feature a sturdy ball-cage design that allows them to extend well beyond their mounting structure with negligible deflection. The largest Telescopic Rails have strokes of more than 6.5 ft in one direction—or 13 ft in designs that telescope from two ends of a fixed intermediate member. Built from hardened or standard cold-rolled steel, these slides can take heavy loads that would shock any engineer who thinks that telescoping slides are just for drawers and cabinets.

To take an example of a semi-telescopic rail that’s often used in medical imaging applications, Rollon’s ASN63-1970 rail can support a 10,000 lb load with negligible deflection even when extended by 50% of its overall length to its full 40-inch stroke. Using two of these semi-telescopic rails together doubles the load capacity to 20,000 lb.

Full-telescopic rails are also an option for even greater extensions. Rollon’s DMS63-2210 rail, for instance, has a fixed length of 87 inches and a total stroke of 89 inches. When fully extended, a pair of these full-telescopic rails can support a 2,000 lb load with a maximum deflection of 0.5 inches.

Telescopic Rails rails are most often used in applications that require a low-profile, simple and cost-effective support for a cantilevered beds or imaging tables.
SMOOTH MOTION FOR LASER GLASS ENGRAVING
Automated laser engraving systems make plain glass more beautiful, but not without some ugly linear motion challenges. The linear axes that move the engraving head along the glass workpiece need to be precisely aligned, resist contamination and have a low installed cost. Rollon Corporation has developed a mechanical design solution that meets all three of these competing requirements.

Rather than employing a single type of linear bearing for the engraving head, Rollon’s solution combines two different styles of linear guides. Together, they handle the axial and moment loads exerted by the cantilevered laser engraving head, which typically has a mass of roughly 25 lbs and moves at speeds up to 70 inches/second.

The top guide system in this design uses a Rollon T Series Rail to support the bulk of the engraving head’s axial loads from above. The bottom bearing uses a Rollon U Series Rail to help guide the head precisely while supporting the head’s moment loads. The lower rail also prevents the head from swinging under the influence of any vibration or inertia effects.

When installed as a system, the two bearing styles offer alignment, contamination resistance and cost attributes that make them a natural fit for this application:
When installed together, the T and U Series Rails form a self-aligning system that can function even if the two rails are not parallel to one another. The U Series features flat raceways that make this self-alignment possible because they allow the slider freedom to move laterally within the rail. This movement can offset significant out-of-parallel conditions. On larger rail sizes with a rail length of 4080 mm, for example, the axial deviation from parallel can be as much as 4 mm without affecting the function of the bearing system. The T Rail, meanwhile, has a raceway profile that constrains unwanted lateral or radial slider movement, which helps maintain the system’s overall precision. The self-aligning capability of the two-rail system is particularly important in this application, which requires the engraving head to maintain a positioning accuracy of less than 0.004 inches.
SMOOTH MOTION FOR LASER GLASS ENGRAVING

CONTAMINATION RESISTANT

Glass particles thrown off during the engraving process can be an especially abrasive contaminant, one that could drastically shorten the working life of linear bearings. Rollon’s bearing design, however, features large rollers that have an intrinsic resistance to contamination compared to bearings that use smaller recirculating balls. The rollers have an easier time running over contaminants that can stop recirculating balls dead in their tracks. It’s like the difference between a car and a skateboard rolling over a speed bump. In the glass-engraving application, Rollon’s intrinsic contamination resistance was further improved through a smart design decision; the bottom U-Series rail is installed with its open end facing the down, so that glass particles can’t fall into the raceway.

LOW INSTALLED COST

Machine builders always want to save time and money during the build phase, and the Rollon solution helps here, too. Aside from any advantage in the direct cost of the bearings, Rollon’s solution can drastically reduce the installed cost of the bearings. Because the T and U Rails don’t require strict parallelism, they can eliminate the costly machining of mounting surfaces to tight tolerances. What’s more, the Rollon bearings don’t take as long to install, again because strict parallelism does not matter as much as it does with conventional bearings. For the makers of glass engraving systems, the ability to install bearings on less substantial machine surfaces is particularly important. These machines don’t need the same level of structural integrity as a metal cutting machine, so upgrading the frame elements just for the sake of mounting bearings would be an unacceptable cost.
While this particular two-rail design solution was developed specifically for a laser glass engraving system, it is important to keep in mind that the same design principles apply to many types of computer-controlled machines that use a moving head to perform cutting, marking or reading tasks.
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