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Important Factors to Consider when Choosing a Rotary Indexer

White Paper

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Important Factors to Consider when Choosing an Indexer

When it comes to the manufacturing of indexers, there are many ways to achieve movement of mass. Whether extremely light inertia loads or loads in the hundreds of thousands of kgm2. Whether it is rotating, lifting or pushing, there are many variables to consider when choosing a robust solution that will meet or exceed your expectations. Below are six important aspects to consider when choosing an indexer for your next application.

1. How important is accuracy for your application

This is all relative. To some a ¼" +/- is fantastic and will meet the accuracy for their application. Others need accuracies in the microns for measurement indexing devices for example. Then, there is the applications that fall within those extremes. The misconception is that you can take an inaccurate indexing device and make it accurate by introducing shot pin or wedge lock devices. These devices add complexity and cycle time to use and in the case of introducing these devices with a highly accurate indexing machine can cause damage also making it less accurate. Under real world testing, with choosing specific components, Motion Index Drives, servo rotary indexers have measured accuracies as high as 5-6 microns. These are not results professed by Motion Index Drives, these are results testified by customers.

2. Backlash in the indexing system

When it comes to starting and stopping masses, it is important to know how fast you need to stop your applications mass. In a less rigid environment or where increased backlash is present, the faster starts and stops will pose many problems with control. When moving a mass whether rotary or linear, starting and stopping in a system with several arc minutes of backlash can cause a lot of back and forth motion within the gearing system. The result is a force that can be difficult and maybe even impossible to calculate. Furthermore, when a gear head is used for a rotational application, the further from the center of rotation the mass is, the more backlash is magnified. In applications where the decelerations times are extremely slow the backlash may not be a problem. Think of a ferris wheel at a carnival, it takes several seconds to stop. Now, can you imagine if that ferris wheel is to start and stop in fractions of a second? The vibrations alone would most likely tear the ride apart within days or maybe hours of constant starting and stopping in a fraction of seconds. In the case of cam indexers, there is "Zero Backlash." The mechanics of a cam indexer offers an extremely rigid, very controlled system. Our cam indexer systems are able to withstand fast cycle times with stop times in the milliseconds. We utilize this same technology in our linear Precision Link Conveyors to give an extremely accurate smooth motion.

3. **Mass moment of inertia**

This is most relevant piece of information you must know when rotating masses. I will emphasize this term, **MASS MOMENT OF INERTIA**!! Often times overlooked when sizing a rotary device for applications. Cam indexing companies have been doing this for nearly 100 years, engineering their rotary index tables based on mass moment of inertia load capabilities. I am going to say it again, knowing your mass moment of inertia is the #1 most important factor. Once mass moment of inertia is known, a rotary index table can be sized correctly for whatever speed needs to be achieved. The most common mistake most companies makes is believing rotating a mass is the same as pushing a mass. Most often they calculate a torque required to move a certain weight. This more often than not leads to total failure. It is important to understand the companies with the most experience in these types of applications are manufacturers of rotary index tables utilizing cam technology. Why is this? It is because companies who have been engineering and manufacturing rotary cam systems have a very acute knowledge of turning mass and the importance of really understanding mass moment of inertia.

4. **Acceleration and Deceleration**

In regards to the development of servo or commonly referred to as fully programmable rotary index table acceleration and deceleration times are at times overlooked for the sake of overall cycle time. As most of us know cars are sometimes rated by acceleration time, such as 0-60 MPH times. Common sense tells us that to push a car to extreme limits by introducing more HP to the engine alone will cause failure in components that are engineered for much slower acceleration and are not made for such forces. On the other side during deceleration, downshifting at an extreme rate will put exponential forces on a transmissions the faster you are going and trying to decelerate. The case is the same when it comes to rotating mass on a rotary index table. Some people will say 3.0 seconds for 180 degrees takes the same amount of force regardless, 3.0 seconds is 3.0 seconds right? Wrong, with servo drives, you can program a drive to instantly accelerate in tenths of a second. The torque required to ramp up to speed in 0.1 instead of say 1.0 is tremendous. Every tenth of a second makes a major difference in some cases, especially when moving mass moment of inertia loads in the thousands and tens of thousands of kgm2. It is vital to be certain what the acceleration and deceleration rates should be prior to operation. As a side note, when light screens are present or e-stop procedures need to be incorporated, all servo or AC motors with encoders must have a programmed deceleration. There is no servo or robot motor manufacture that recommends applying a brake instantly during any of these conditions. The motor manufacture and rotary index table manufactures both know instantly applying brakes while turning mass will cause premature damage to both components.

5. **Environment**

When integrating a rotary index table some environments can cause premature failure of standard rotary index table. If a food manufacturing facility, there is wash-down chemicals that can cause corrosion to standard steel components. In some cases a simple nickel plating can suffice and chemicals used will not penetrate the plating and cause damage to the steel components. Sometimes this has to be taken a step further by manufacturing these standard indexing units to be made of stainless steel components. Motion Index Drives, Inc. has manufactured rotary index tables and precision link indexing conveyors with stainless steel components that will withstand these harsh chemicals used in the food manufacturing world. Also, it necessary to have the proper sealing to keep these chemicals from getting in to the indexing machines. This is done by creating labyrinth sealing with special seals that have coating that will not break down from these harsh chemicals. Foundries pose another issue with contaminants in the form of a fine metallic dust that can destroy internal components of standard index tables that don't have proper sealing. The fine metallic dust can penetrate standard sealing systems and mix with the internal oil. When enough of this fine metal dust gets into the oil in becomes extremely abrasive and quickly wears bearings, cam followers, cams and gears.

6. **Speed**

Index time or how fast can you get to your next position to perform the next process in your automated system, is always at the top of the customers wish list. Sometimes customers want an extremely fast index time for all the right reasons and sometimes index time requested is just a guess to the customer. The speed of index relative to the mass moment of inertia, as explained earlier, dictates the final size of which indexer will perform the speed under the application inertia load conditions. As most cam indexing companies know, a quarter of a second (250 milliseconds) can sometimes equate to thousands of dollars in a more expensive unit. When requesting a specific index time make sure that index time is absolutely required. Another huge mistake that companies just getting into the business of manufacturing rotary index devices is that they do not have a good grasp on what effects the slightest change in index time has on the components. One example: An application having a mass moment of inertia of 175 kgm2 (598,005 in-lb2) of inertia. One customer wants an indexing time of 0.50 seconds for 45 degrees and the other customer is satisfied with approximately 1.75 seconds for a 45 degree move. The customer with slower index time may be able to pick up time in other processes he has in his production, whether it faster loading or other processes are able to move quicker. The cost difference is nearly 5 times by being able to go with a slower index time. When speeds get extremely fast even under small inertia loads it is sometimes necessary to use servo motor technology to achieve such high indexing speeds. The reason a servo motor must be introduced under these conditions, is that the peak torque coming from a servo motor is instantaneous. Standard AC motors require flux in times just to get the motors going. This can range from 100 milliseconds up to 500 milliseconds depending on the drive and size of motor.

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