White Paper

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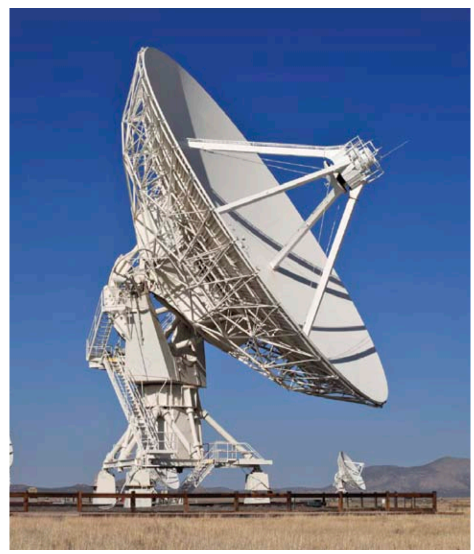
9 questions to ask when specifying a slewing ring bearing

Les Miller and David VanLangevelde, Kaydon Bearings



Slewing ring bearings have many advantages in applications where the bearing must support an upper structure and facilitate its rotation. Typically large-diameter combination load bearings that lie flat, they are widely used in heavy equipment, such as cranes, excavators, aerial platforms, radar, wind turbines, and material handling equipment. But slewing ring bearings also play key roles in many military applications (tank turrets, missile launchers) and high-precision applications, like machine tool indexing tables and optical devices.

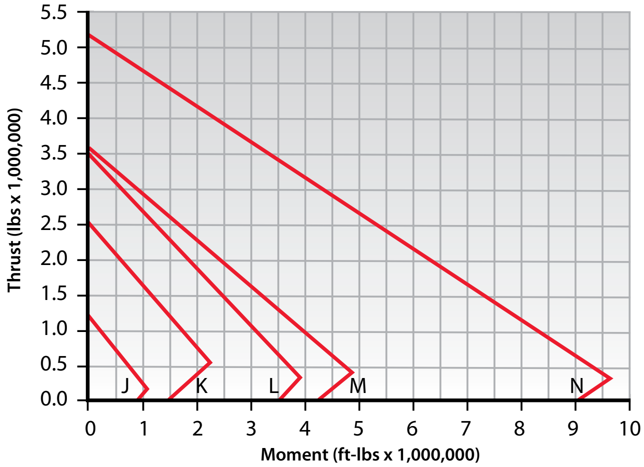
Compared to a kingpost-type design, which features a large spindle for the turntable supported by two bearings spaced along the length of the spindle, a slewing ring bearing saves considerable space and weight. They also make low-profile designs more practical. In a kingpost configuration, resistance to moment loads or overturning is a function of bearing spacing along the spindle. With slewing ring bearings, however, the diameter of the bearing and its internal geometry provide the necessary moment resistance.

The applications in which these bearings are used, both commercial and military, put a premium on performance and reliability. Premature bearing failure can damage costly equipment and expose the people who operate the equipment to risk. When specifying slewing ring bearings, especially for lifting devices, equipment designers need to consider not just the bearing but its mounting, supporting structure, installation, and even storage before it is used.

To increase the chances of a successful application and reduce the chances of putting people and equipment at risk, it's a good idea to ask the following nine questions early in your design process.

1. Are there design factors not mentioned in the published specs?

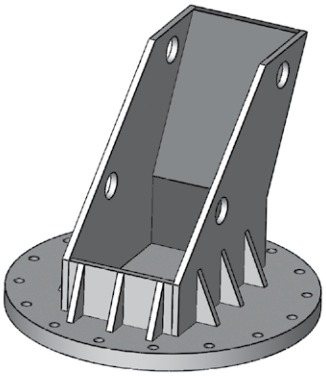
Although manufacturers' catalogs and websites are rich in data and specifications, they cannot answer every question about every application. For example, does yours have a unique combination of forces in the system that might affect the bearing or its mounting? If so, the bearing manufacturer may be able to recommend an alternate mounting, or even a different bearing.



Load capacity is the obvious starting point, but even in straightforward applications you can't stop there. In lifting device applications especially, you should consider sealing, lubrication, bolt strength and spacing, mounting tolerances, and other factors. And resist the temptation to exceed a bearing's rated capacity — even slightly. Even incremental "upgrades" may put allowable loading beyond the capacity of the bearing or fasteners.

Bottom line: talk to your bearing manufacturer before making a decision. Most are happy to share their experiences and help you make the right selection.

2. Does the support structure concentrate the load?



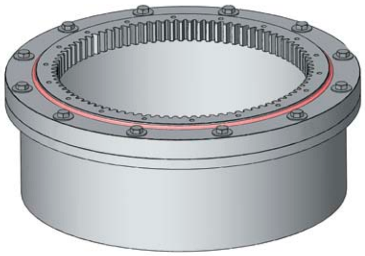
Braces increase structure rigidity and distribute the load.

Support structures that are under-designed or don't uniformly distribute the load are all-too common. Many designs with slewing ring bearing assume that the support structures will be rigid when in fact localized deflections can change the loads the bearing "sees" by several orders of magnitude. Bearings mounted on an interrupted surface, or a surface with non-uniform support, can yield under load. This can lead to localized internal overload and perhaps failure of the bearing and/or mounting bolts.

3. Are the bolts strong enough?

The main bearing mountings in any lifting device should use SAE Grade 8 bolts (ASTM-A490) or better. For maximum fastener integrity, coarse threads are generally recommended with hardened-steel flat washers under fastener heads and nuts. Bearing manufacturers' fastener recommendations are a good place to start, but the buck stops with the equipment designer, who is ultimately responsible for specifying number, size and type. Consult with fastener suppliers if you need help calculating expected bolt loads, and test prototypes to verify those loads. Choose the fasteners every bit as carefully as you choose the bearings: if they aren't adequate, you could experience failure at loads well below bearing load capacity.

4. Are bolt hole patterns uniform?



Bolt holes should be located throughout the support surface, not just in the maximum load area.

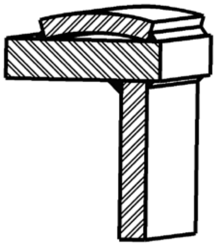
Fastener location is as important as fastener strength, yet many designers put fasteners only in the maximum load areas. This can be just as dangerous as an interrupted support surface. In a heavily loaded application, substantial forces exist even in the "unloaded" sections of the arc, despite the theoretically low level of the load. A uniform bolt circle will minimize flexure and distribute the load better — in the bearing, the fastener and the support structure.

5. Is bolt tensioning adequate?

Even the strongest available bolts won't do the job if they aren't adequately preloaded. Proper preload is essential, due to the high-level cyclic loading to which the bolts will be subjected. Without going into detail about bolt tensioning methods (an article by itself), there are three important points to consider:

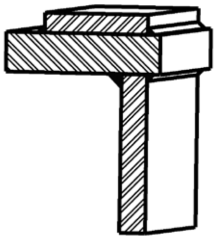
- Preload bolts to fastener manufacturers' recommendations.
- If possible, measure bolt tension as well as torque.
- Re-check bolt tension after assembly AND periodically during equipment use.

6. Is there any distortion in the mounting surface?



Distorted riser pad

Distortion is one of the most insidious threats to a good mounting, and can happen several ways. Even a tiny piece of debris or a metal chip lodged between the bearing and the mounting surface during assembly can cause a major distortion, leading to load concentration in the bearing. A mounting surface that is out-of-flat is another hazard. That surface needs to be machined to the same accuracy as the bearing mounting face.



Riser pad
flush to base

Welded riser pads are another common source of mounting surface distortion. A riser pad should be thick enough to resist distortion during welding and flush against the base to avoid any gap below the bearing seat. Distortion here may cause a false reading during bolt tensioning and even generate a spring action when the bearing is in service, leading to bolt fatigue and, ultimately, failure. Deflection is another riser pad consideration: differences between bolt locations can cause circumferential distortions and load concentrations within the bearing.

7. Will the bearing be properly sealed and lubricated?

It's essential to keep out debris and corrosion to avoid excessive wear, high torque and stress concentrations, any of which can cause the bearing to fail prematurely. Specifying integral seals on bearings is a great way to accomplish this, as is incorporating shrouding to protect machine-cut gears and bearings.

Lubrication is another key to reducing wear. Bearings are generally packed with a suitable grease when they are assembled, and whenever grease is used, re-lubrication fittings should be specified. Bearings in slow-rotating equipment (such as backhoes, cranes, and excavators) need to injected with a little fresh lubricant every 100 operating hours, while bearings in continuously-rotating equipment (trenchers, borers) should be re-lubricated daily. So should gears. Any equipment with bearings should explain these procedures in its operation and maintenance manual.

8. How will the bearing be stored?

When slewing ring bearings are being readied for shipment, they are usually given a light coating of preservative oil and packaged in a tire wrap of protective paper and a shipping container. This provides adequate protection during the typical short-term storage in a protected area, but not for long periods or outdoors. If a bearing sits for more than a year before being installed, it should be re-lubricated.

Proper handling is very important, both during receiving and installation. Eyebolts in the mounting holes — or a non-metallic sling — are recommended to avoid damage to the mounting surfaces or gear teeth. The bearing should not be set down on any surface that hasn't first been checked for cleanliness. This will avoid picking up dirt or "dings" that can lead to stress.

9. Have proper installation practices been made clear?

Improper installation can negate all the care you take in choosing and acquiring a bearing. Here are three things to tell the installer to reduce the chances of future bearing problems.

- Position the bearing's loading plug (the hole in the race through which the balls are loaded) and the hardness gap in the minimum load zone. Locating the plug in the heavy load zone will likely result in premature bearing failure.
- Check the bearing races after the bolts are tightened to be sure they are round and true. (If one race is piloted, mount that one first; this will "round up" the other ring before bolts are tightened. If neither ring is piloted, leave all mounting bolts loose until both rings are attached, then add a moderate thrust load and tighten all the bolts to the tension recommended by the manufacturer.)
- Remember to check gear backlash and final bearing torque after completing the installation. If the bearing torque after installation is significantly different than it was before the installation, check for a mounting problem.

Conclusion

Clearly, the success of a slewing ring bearing is influenced by many factors, including (once it goes into service) operators and maintenance departments. But so long as the equipment is used and maintained properly, and the designer has asked all the right questions during the selection process, the bearing should lead a long, productive life. As the old saying goes, an ounce of prevention is worth a pound of cure.

If you have an application involving a slewing ring bearing and could use some advice, the experienced engineers at the Kaydon Bearings Division would be pleased to help.

Kaydon Bearings
2860 McCracken Street
Muskegon, Michigan 49441 U.S.A.

231.755.3741 tel
800.514.3066
231.759.4102 fax

bearings@kaydon.com
www.kaydon**bearings**.com