

Dodge® mounted bearings: how misalignment affects performance

Bearings do not have infinite life. Bearings will fail over time from material fatigue or prematurely from external influences. Premature failures can be prevented with proper maintenance, proper installation and alignment of the bearings. A common cause of premature failure is bearing misalignment. There are two types of bearing misalignment: static and dynamic.

Static Misalignment

Static misalignment is misalignment that is constant throughout the rotation of the inner ring and can occur when housings are mounted offset in the horizontal, vertical or axial directions. It is also a concern when a housing is mounted at an angle. The illustration below shows how a housing can be offset causing static misalignment. **Figure 1** and **Figure 2** illustrate static misalignment.

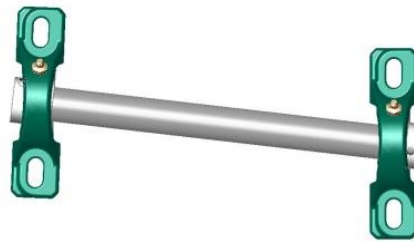


Figure 1. Static Misalignment Top View



Figure 2. Static Misalignment Side View

Static misalignment can also be caused by shaft deflection. Belt tensions from sheaves, sprockets or pulleys are examples of shaft deflection. The deflection is always in one direction. The below image depicts a shaft deflection situation. Static misalignment can be prevented by properly aligning the bearings when mounting. Laser alignment or straight edge tools can assist in this process. Dial indicators can also be used to sweep the face of the bearing housing to ensure that it is aligned. **Figure 3** illustrates static misalignment created by shaft deflection.



Figure 3. Static misalignment created by shaft deflection

Some static misalignment is inherent to the application and may not be prevented. Additionally, ideal alignment can be cumbersome and time consuming. In these circumstances, many Dodge bearings are available to accommodate a limited amount of static misalignment. Dodge ball bearings are capable of $\pm 2^\circ$ static misalignment. The Dodge Type EXL, Type K, DI and TAF tapered roller bearings are also capable of static misalignment. The static misalignment capability of the tapered roller bearing products is dependent on bore size. Typical ball and tapered roller bearings are designed to accommodate static misalignment similar to a ball and socket joint. The insert acts as the ball and the housing acts as the socket allowing the movement of the bearing insert to misalign in the housing. The Dodge spherical roller bearings; such as the Imperial and S-2000 have $\pm 1^\circ$ of static misalignment capability. The spherical roller bearings tolerate misalignment based on the geometry of the spherical roller bearing natural design. The inner ring and roller assembly align with the spherical design of the outer ring. Typically the spherical roller bearing will get $\pm 2^\circ$ of misalignment but is limited to $\pm 1^\circ$ by the seals in the bearings.

Static misalignment can also be easily identified during a failure analysis of components. Typically the outer ring will show a meandering wear pattern on the raceway 180° apart that is evident with static misalignment. When aligned properly, any wear pattern will be located in the same position around the circumference of the outer ring. **Figure 4** shows the meandering wear pattern of a statically misaligned bearing.





Figure 4. Meandering Wear Pattern

Dynamic Misalignment

Dynamic misalignment is misalignment that does not remain constant throughout the rotation of the inner ring and can occur in an application where an unbalanced load is present. Examples would be an out of balance fan, a vibration screen or heavy eccentric loading. Dynamic misalignment also occurs with bent shafts. **Figure 4** below shows the oscillation between the inner unit and housing that will occur from dynamic misalignment.

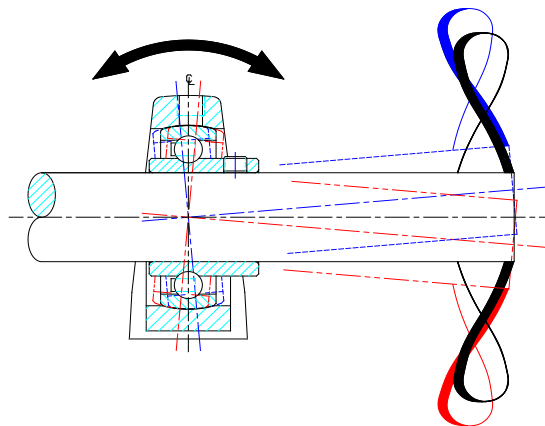


Figure 5. Dynamic Misalignment



Dynamic Misalignment can be prevented by replacing a bent shaft or balancing the equipment. In some applications the eccentric load cannot be prevented, and some instances is designed into the equipment like a shaker screen application. For this, Dodge spherical roller bearings, such as the Imperial and S-2000, are ideal for dynamic misalignment. The spherical roller bearing is the only style bearing that accommodates dynamic misalignment. Under heavy eccentric loading, Dodge can provide a modified bearing assembly. This modified bearing will include an interference fit between the outer ring of the bearing and the inner bore of the housing. This modification will help prevent the outer ring creep within the housing.

Misalignment is one of the easiest failures to recognize. When bearings are installed and aligned properly, a shaft should be able to turn freely without any binding. With an overly misaligned bearing, the shaft will be difficult to turn or will not turn at all. Misalignment is a common failure, but one that can easily be prevented by proper alignment, and maintenance of the equipment.