

MOTORS & DRIVES

# Direct-Coupled Alignment

## Effects of Coupling-Generated Forces on Motor Bearings

Motors with anti-friction bearings used in direct-coupled applications are typically designed to provide an L10 life of at least 100,000 hours. This life is assuming that the bearings do not support any external load other than the weight of the motor’s rotor and the half coupling.

If the motor is misaligned or the coupling is locked up, its bearings will be subjected to axial load and the bearing life will be reduced. Depending on the external loading, the life reduction can be dramatic. As an example, consider a hypothetical 500 HP, 3600 RPM, 4 kV motor that has a 6315C3 ball bearing on the drive end, which is the fixed bearing (the opposite drive-end bearing is free to move axially to account for thermal growth of the shaft). Since the drive-end bearing is fixed, it will be subjected to any external axial forces. The L10 Life versus External Axial Load curve is shown in Fig. 1.

L10 Life versus External Radial Load curve is shown in Fig. 2. These graphs represent a specific design of bearing housing and a specific bearing. Different combinations of design and bearing size will have different life versus load characteristics, but all motors will be affected adversely. In the worst-case situation, the coupling can exert both axial and radial loads on the motor shaft at the same time.

L10 Life Vs. External Axial Load

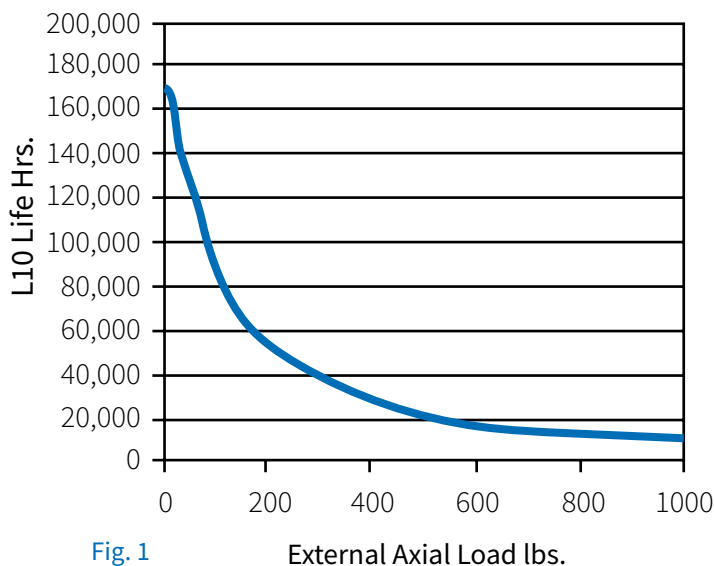


Fig. 1

L10 Life Vs. External Radial Load

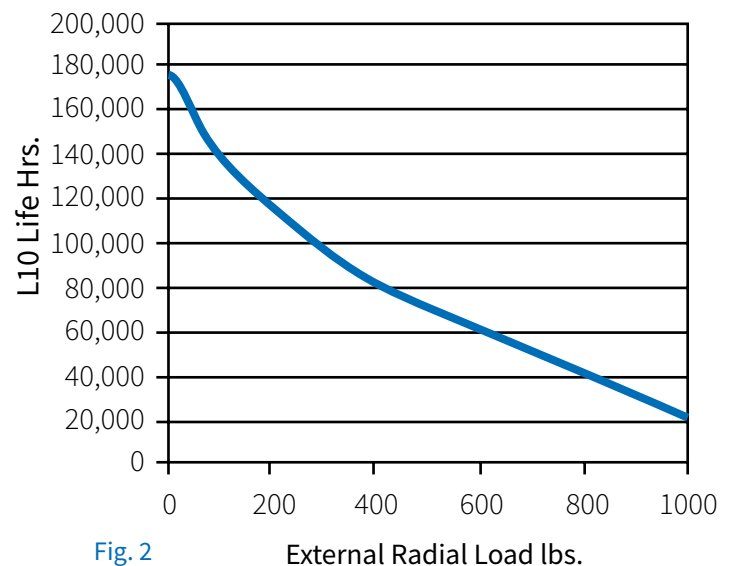


Fig. 2



L10 Life versus Axial = Radial Load is shown on the curve in Fig. 3. With the motor used in the Life versus External Load examples, the shaft stress limiting external load for infinite fatigue life for even a mild steel shaft would be 1,400 lbs. exerted at the end of the shaft. With this amount of load, the drive-end bearing life would be 11,300 hours in the case of the coupling exerting radial load only and 1,865 hours in the case where the coupling exerts an axial load equivalent to the radial load.

These values are off where Axial Load = Radial Load, the charts in Figs. 2, 3. It is unlikely that the coupling could generate 1,400 lbs. of force. However, even at a much lesser load, such as 300 lbs., where axial load equals radial load, the L10 life drops off to 26,000 hours. This life would not normally be acceptable for direct connect duty.

Coupling forces due to misalignment are often accompanied by vibration issues. This vibration may be misinterpreted to be motor-generated. Eventually, vibration will increase as the bearings deteriorate.

