



## WP-2003: Shaft Loading and Sealing vs. Bearing Life Expectancy

The mechanical life of an encoder is mainly determined by the life of the unit's bearings. Several factors affect bearing life, including shaft loading, heat, ingress and rotational speed.



Shaft loading is likely the top cause of premature bearing failure. There are two types of loading to consider - radial and axial. Radial loading is the perpendicular force applied to the shaft. Common

causes of radial loading include misalignment of the shaft when mounted or use of items such as pulley and gears. Axial loading is the parallel force, or force applied along the same direction of the shaft. As radial and/or axial loading increases, bearing life shortens. For this reason, the minimum amount of shaft loading or misalignment should always be the goal when installing an encoder. One important loading fact to remember: radial shaft loading increases as a linear function the further away from the bearing the force is applied, much the same way a longer wrench gives you greater leverage against a stubborn bolt. It is always best practice to place any unavoidable radial load as close to the bearings as possible.

Heat is another factor affecting bearing. Excessive temperatures can thin out the grease in the bearings. As the grease thins, lubrication reduces and bearing wear increases.

Ingress is the introduction of foreign matter into the bearings. Ingress of foreign matter, whether it is in liquid or solid form, is another common cause of rapid bearing failure. Ball bearings are precision devices with very critical internal clearances. Anything that disturbs these clearances will shorten the life of the bearing, often quite drastically. For this reason, many encoders are available with shaft seals that help guard the unit and bearings against the ingress of foreign substances.

All of the above factors, combined with the speed of rotation, work together to determine bearing life. In a worse case condition that combines high shaft loading, high heat, and excessive foreign matter with high rotational speeds, bearing life will likely not be what you would expect. An encoder subjected to the same factors at lower rotational speeds might never cause any concern with the life expectancy of the bearings.

To realize the maximum life potential of an encoder, take the necessary precautions when installing the unit to ensure proper shaft alignment, specify shaft seals when needed to protect from foreign materials and take care not to subject your unit to any unnecessary heat.