# What is Seal Eccentricity?

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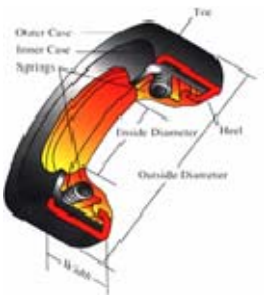
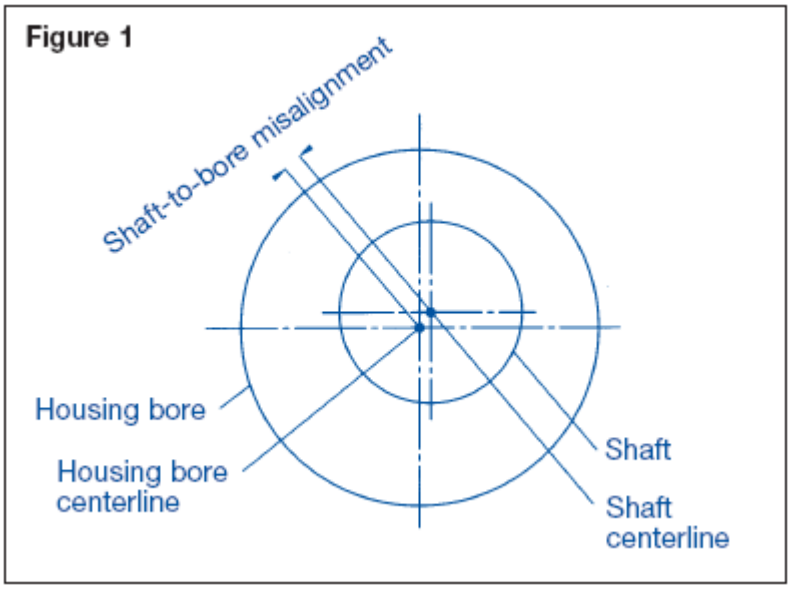


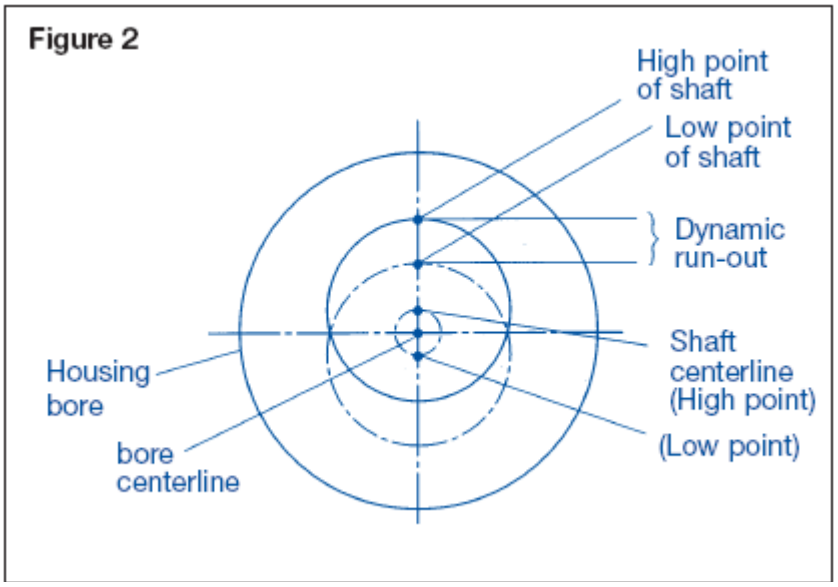
From the dictionary, one of the meanings of the word eccentric is *a deviation from an established pattern or norm.* From the shaft seal perspective eccentricity is: *A measure of the deviation of an elliptical path, especially an orbit, from a perfect circle. It is equal to the ratio of the distance between the foci of the ellipse to the length of the major axis of the ellipse (the distance between the two points farthest apart on the ellipse). Eccentricity ranges from zero (for a perfect circle) to values approaching 1 (highly elongated ellipses).*

There are two elements of eccentricity that should be considered when designing a seal: **Shaft-to-Bore Misalignment**(STBM) and **Dynamic-Runout**(DRO). Shaft-to-Bore-Misalignment (figure 1) is the amount that the shaft center is offset relative to the bore center. Taking a static measurement with the shaft at rest, STBM almost always exists to some degree, but should never be more than 0.010 inches(0.25 mm). STBM is normally the result of machining and assembly inaccuracies. STBM beyond the limits will probably result in light interference and wear on one side of the seal with heavy interference and wear directly opposite that point.

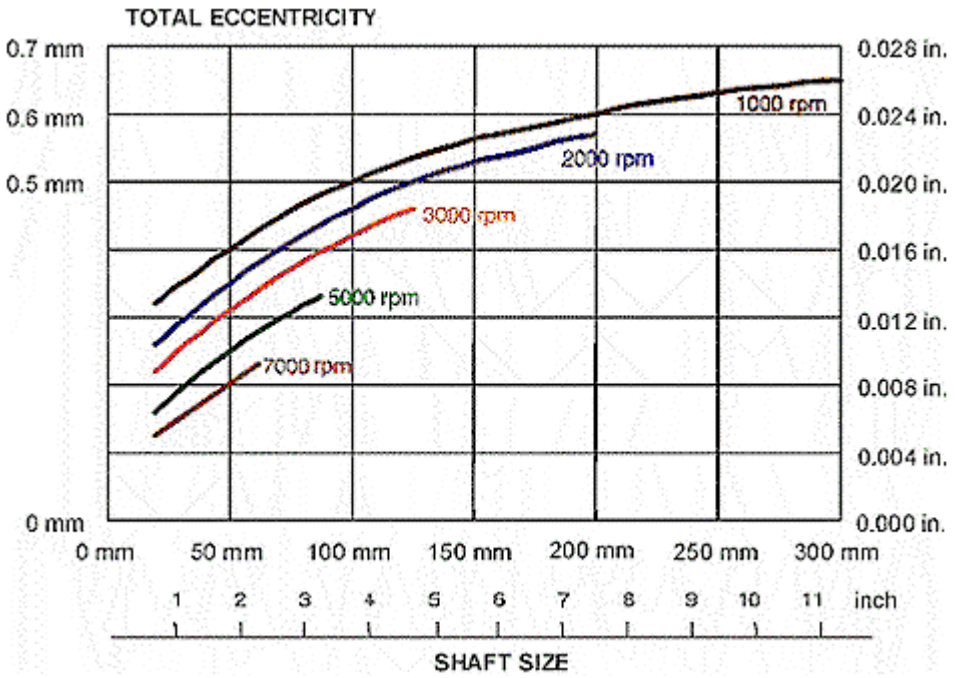



Dynamic Run-out (figure 2) is the amount that a shaft's sealing surface does not rotate around the true center. DRO is caused by mis-alignment, shaft flexing,

shaft vibrations due to imbalance, shaft lobing, and/or other manufacturing inaccuracies. Lip design and lip material must provide flexibility to follow the radial motion of the shaft without allowing gaps to form. If these gaps do form then leakage occurs. DRO should also never exceed 0.010 inches(0.25mm), as measured dynamically by applying an indicator to the side of the shaft as it rotates slowly. If the DRO value increases, then seal life will decrease. As an example: An NBR standard design seal for a 3.00 inch shaft with little or no DRO, a shaft speed of 2,165 rpm in a SAE 30 oil with a sump temperature of 250 degrees F should have a 600 hour seal life. With a DRO of 0.010 inches that seal life will be reduced to 340 hours in the same conditions.




The amount of eccentricity(DRO and/or STBM) that a seal can withstand depends on the shaft speed. Typical shaft seal designs will operate satisfactorily if total eccentricity(DRO + STBM) does not exceed the maximum.




Minor variations in DRO and STBM(under 0.020 inches) have little effect upon seal torque, power consumption, pumping ability or underlip temperature. If total eccentricity is expected to exceed these limits, then special seal designs would need to be considered.

If you suspect DRO or STBM, then please contact your Colonial Seal technical representative at engineering@colonialseal.com to evaluate design options.

References:

Brink, Robert. Handbook of Fluid Sealing. McGraw Hill. 1993

Horve, Les. Shaft Seals for Dynamic Application. New York; CRC. 1996

SAE Fluid Sealing Handbook 1996 Edition