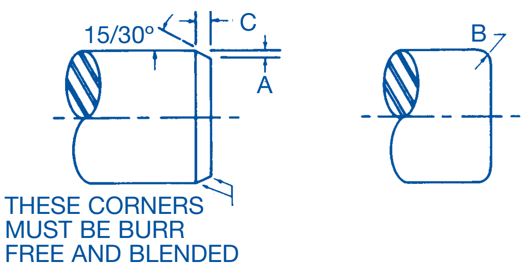
Tobar, Inc.

design criteria for the shaft

Shaft Configuration

The most demanding function placed on an oil seal is creating the seal between the lip element and the rotating shaft. For this reason the shaft preparation is most critical since it represents 50 percent of the dynamic seal assembly.

A lead-in angle or radius on the shaft is required to ensure against seal damage during installation. The following chart shows recommended chamfers and radii for varying shaft diameters. As with the bore, it is most important to ensure that there are no burrs or sharp edges at the lead-in end of the shaft.



SHAFT DIAMETER				
Shaft (inches)	(A)	(B)	Preferred C@15Þ	Optional C@30Þ
Up to 4.000	.093	.188	.347	.156
4.001 to 7.000	.125	.250	.466	.218
7.001 to 40.000	.188	.375	.702	.323
40.001 and larger	.250	.500	.933	.433

Shaft Material

For the best dynamic seal results, a medium carbon steel shaft of SAE 1035 or 1045 is recommended. Stainless steel shafts can also be utilized successfully. Hard plated surfaces such as chrome-plate or nickel-plate can also be used satisfactorily if the surface finishes are proper. Shafts of brass, bronze, aluminum alloys, zinc, magnesium and other such soft metals are not recommended for normal oil seal application. It may be possible to utilize these softer materials if the dynamic action between the seal and the shaft is very limited.

Shaft Surface Finish

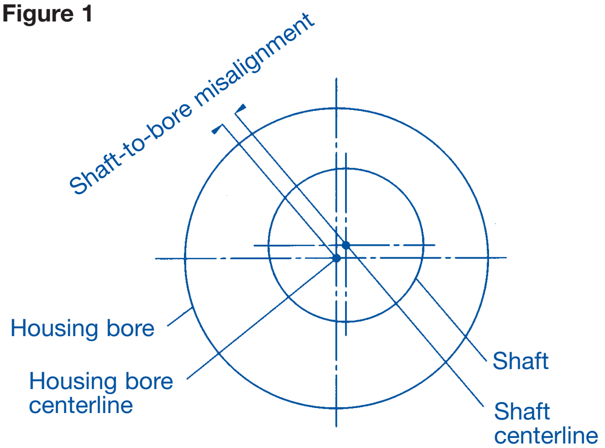
To optimize seal life a plunge grind is recommended. Through plunge grinding, a surface finish is created that does not have a Helical machine lead and will produce an improved surface finish for the seal to ride against. The optimum surface finish recommendation is 0.25-0.50 micrometers (10-20 microinches) Ra.

Shaft Eccentricity

Eccentricity between the oil seal and shaft takes two forms: dynamic and static. Static eccentricity is described as the misalignment between the shaft and the bore. That is, the amount the shaft centerline is offset from the bore centerline when both components are in the assembled condition. Non-spring loaded oil seals will handle a static eccentricity of .005 total indicator reading when operating between 0 and 2000 ft. per minute. A spring loaded oil seal will accommodate .015 static eccentricity when operated between 0 and 1000 ft. per minute and .010 static eccentricity when operating between 1000 and 3600 ft. per minute.

Figure 1
Dynamic eccentricity is described as the misalignment created by the shaft not rotating about its true centerline. This is produced by a bent shaft, an improperly supported shaft, or a shaft with high side loads. A non-spring loaded oil seal will accommodate dynamic eccentricity of .003 total indicator reading when operated between 0 and 2500 ft. per minute. A spring loaded oil seal will handle .020 total indicator reading when operated between 0 and 1000 ft. per minute, .015 total indicator reading when operated between 1000 and 2500 ft. per minute, and .010 when operated between 2500 and 4500 ft. per minute.

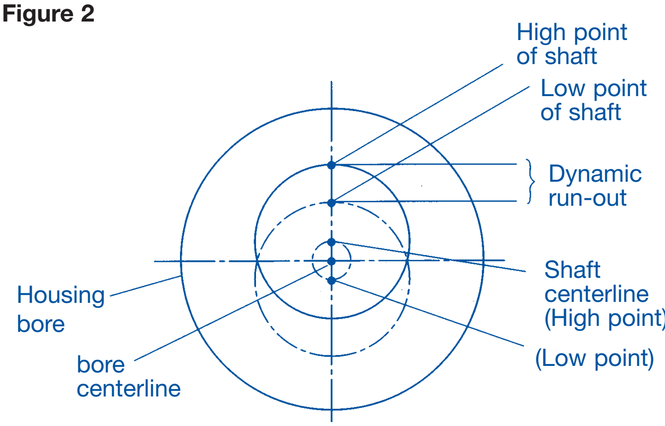
Figure 1



Shaft to bore Misalignment
The distance that the center of the shaft rotation is from the center of the bore.

Figure 2
Seals with increased width are more capable of handling both dynamic and static eccentricities. This is a result of the seal's increased beam length, and the resulting lack of resistance within the seal lip to following the eccentric motion of the shaft surface.

Figure 2



Dynamic run-out
Dynamic run-out is calculated as twice the distance that the center of the shaft is displaced from the actual center of rotation.

Shaft Tolerance Chart
The following chart shows the recommended shaft tolerance for use with Tobar oil seals. Other requirements in the overall design may require tighter tolerances for the shaft than are shown in this chart.

INCHES	
Nominal Shaft Diameter	Tolerances
Up to and including 4.000	± .003
4.001 to 6.000	±.004
6.001 to 10.000	±.005
10.001 and larger	±.006

Design Exceptions
The design recommendations in this catalog are only suggestions and do not imply that designs outside of these recommendations will not function. Tobar recommends, in all cases, that thorough functional testing be conducted on all designs to ensure their success. Trade-offs between temperature, pressure, shaft speed, eccentricity, and seal style to handle conditions beyond those stated in this catalog may be possible. However, care and thorough testing are recommended for satisfactory results.