SHAFT SEAL SELECTION

GENERAL

When selecting an oil seal, consideration must be given to the specific requirements of the application. There are many variables that should be taken into account before selection of the proper seal for the application can be made. The following information is provided for the guidance of the oil seal user.

SHAFT SPEED

Usually measured in "Feet per Minute". The rule for computing shaft speed in FPM is:

FPM = shaft dia. X RPM X .26

The graph on the following page can be used to determine FPM when the shaft diameter and RPM are known.

Maximum allowable shaft speed for a specific seal is dependent on shaft finish, eccentricity and runout of the shaft, amount and kind of lubrication and the type of seal. It follows that an installation that uses a smooth, polished shaft running true and concentric with the housing bore permits the use of higher speeds than would a rough shaft having a large amount of eccentricity, runout and/or whip.

TEMPERATURE

When selecting a seal for a specific application, make certain that the operating temperature of the device falls within the temperature range of the seal. Using a seal in an application where the operating temperatures exceed the upper limit of the seal temperature range shortens the life of the seal. Continuous running at temperatures above the recommended levels will cause the sealing member to become hard and ineffective.

PRESSURE

Most standard Trostel shaft seals are not designed for pressure applications. Internal pressures reduce the life of standard seals by exerting excessive pressure on the sealing member. It is best to provide internal pressure relief at the point of sealing. If pressure is a factor in the application, Trostel can provide a seal of special design.

SHAFT HARDNESS

Cold rolled steel shafts are sufficient for good sealing performance. However, better life expectancy can be obtained by the use of shafts of 20 Rockwell C hardness or better. When the application precludes lubrication, contains abrasives, or requires high speeds, use of a hard shaft is strongly recommended.

SHAFT HARDNESS - Continued

The table below indicates the shaft hardness required for the different sealing members.

SHAFT HARDNESS

APPLICATION AND TYPE OF SEALING MEMBER	HARDNESS
Clean Environment (free from abrasive substances such as dirt, sand, etc.)	20 Rockwell C
Abrasive Environment (sealing member exposed to gritty or abrasive substances)	
Leather and Assembled Synthetic Seals	45 to 60 Rockwell C
Bonded Synthetic	60 Rockwell C
Felt	40 Rockwell C

LUBRICATION

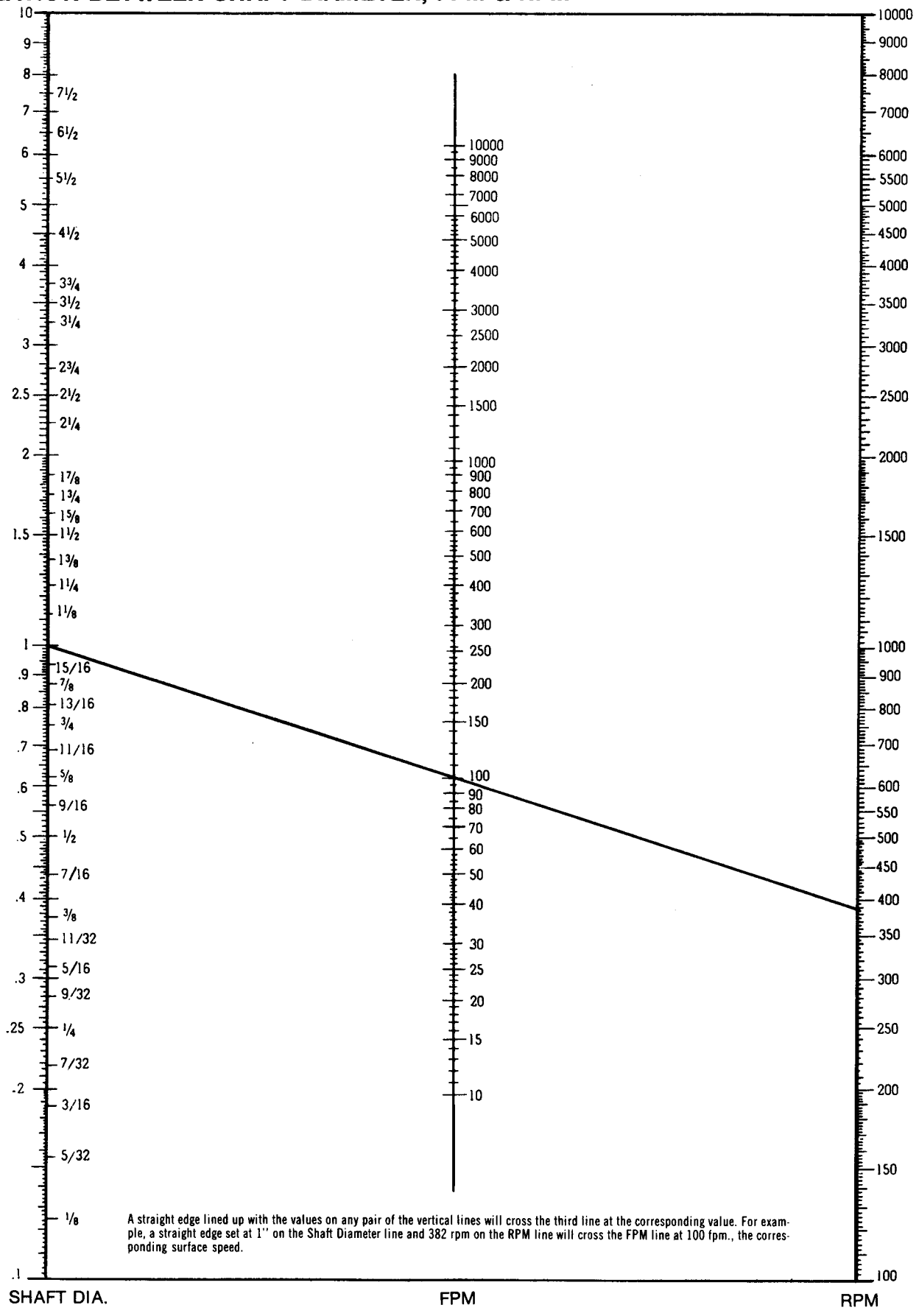
Generally, all types of seals perform best under wet or flooded conditions with the sealing member continuously exposed to a lubricating substance. However, when the application does not provide a wet environment, certain types of seals will perform more effectively than others. See following table.

In all cases the seal should be provided with maximum lubrication either by prepacking the seal or by providing at least intermittent exposure to a lubricant.

TYPE OF SEALING MEMBER	MINIMUM LUBRICATION REQUIRED
Leather or Felt	Can Be Run Under Moderate Or Intermittent Dry Condition
Synthetic	Must Be Flooded Or Exposed To Lubricant Continuously

For combination type seals with two or more sealing members, treat the lubrication requirements of each member separately.

RELATION BETWEEN SHAFT DIAMETER, FPM & RPM



A straight edge lined up with the values on any pair of the vertical lines will cross the third line at the corresponding value. For example, a straight edge set at 1" on the Shaft Diameter line and 382 rpm on the RPM line will cross the FPM line at 100 fpm., the corresponding surface speed.

SHAFT SEAL SELECTION

SHAFT FINISH

Maximum sealing efficiency requires the correct shaft finish. Excessive wear and great possibility of leakage are the penalties paid when shafts with improper finishes are used. Moreover, the direction of the finishing marks on the shaft as well as the spiral lead are factors of shaft finish that must be considered. Polished or ground finishes with concentric finish marks are best. If spiral finish leads are present, they must work toward the fluid when the shaft rotates.

The table below provides a general guideline for determining optimum shaft finish.

SHAFT FINISH

TYPE OF SEALING MEMBER	RMS
Leather	
Under 800 F.P.M.	5-30 RMS
Above 800 F.P.M.	5-25 RMS
Synthetic	10-20 RMS
Felt	Rough

ALIGNMENT

Bore and Shaft Center are factors affecting sealing efficiency. Misalignment shortens seal life, for wear is concentrated on one side of the sealing lip. This factor becomes more critical in direct proportion to any increase of speed.

RUNOUT

Shaft runout is the misalignment of the shaft sealing surface and the center of its rotation. Movement of the center of rotation due to bearing looseness or shaft whip is also considered runout. Runout should be kept at a minimum. If coupled with shaft to bore alignment, sealing performance is very difficult.

BORE AND SHAFT TOLERANCES & OTHER FACTORS

Close tolerances are required for best seal performance. Follow the table below for recommended shaft tolerances. The listed tolerances are satisfactory for slow or medium speed applications. Other factors that must be considered in the selection of an oil seal include shaft eccentricity, end play and vibration. The condition (amount of dirt, etc.) of the media being sealed requires consideration also.

RECOMMENDED BORE AND SHAFT TOLERANCES

SHAFT AND SEAL DIAMETER	MAXIMUM BORE TOLERANCE	RECOMMENDED SHAFT TOLERANCE	SEAL O.D. OVER NOMINAL BORE TOLERANCE	POSSIBLE * VARIATION
APPROXIMATE DIMENSIONS IN INCHES				
Up to 3	±.001	±.003	.004 ±.002	.001 to .007
3 to 6.256	±.0015	±.005	.005 ±.002	.0015 to .0085
6.381 to 8	±.002	±.005	.006 ±.002	.002 to .008
8.007 to 8.882	±.002	±.005	.007 ±.002	.003 to .011
9.008 to 14.008	±.002	±.010	.008 ±.002	.004 to .012

* Type "RO", "ROS", "ROSW" and "ROW" are designed to allow a minimum of .004" press fit.

BORE CONSIDERATIONS

A Trostel Oil Seal is assembled by means of a press fit into a bore or counterbore in the housing. The counterbore is the preferable method, inasmuch as it furnishes a positive stop for the seal. Where room is not available for use of the counterbore method, the seal can be assembled in a straight bore. In either case, the housing should be bored to the correct dimension to insure the proper press fit for the seal.

CAUTION: If the press fit is too loose, radial movement and seepage of lubricant around the outside case may occur. If the press fit is too tight, it will tend to distort the seal and cause it to function improperly.

CORROSIVE APPLICATIONS

If Oil Seals are to be used on applications where corrosive fluids or gases are present, the outer case and metal parts can be made of any non-corrosive metal, such as brass, or, the unit can be furnished with a non-corrosive plating.

OPERATING PARAMETERS BY SEAL TYPE

SEAL TYPE	LIP MATERIAL	OPERATING PARAMETERS								
		SHAFT SPEED F.P.M.	TEMPERATURE F	PRESSURE (Depending On Shaft Speed) psi ①	SHAFT DIAMETER (Tolerance)		SHAFT TO BORE MISALIGNMENT (Indicator Reading)		SHAFT RUNOUT (Indicator Reading)	
					SLOW SPEED	FAST SPEED	SLOW SPEED	FAST SPEED	SLOW SPEED	FAST SPEED
B	S	1000	—40° to 275°F	0-15 psi	.002"		.005"	.003"	.010"	.005"
BR, BT	S	2000	—40° to 275°F	0-10 psi	.002"		.010"	.005"	.015"	.005"
BRS, GRS, ROS, RMS	S	3000	—40° to 275°F	0-15 psi	.002"		.015"	.005"	.015"	.005"
BRSO	S	3000	—40° to 275°F	0-15 psi	.002"		.015"	.005"	.015"	.005"
BRSW, GRSW, ROSW, RMSW	S	3000	—40° to 275°F	0-15 psi	.002"		.015"	.005"	.010"	.005"
BTMS	S	3000	—40° to 275°F	0-15 psi	.002"		.015"	.005"		
BW, G3WS, GWS, WS, WWS	S	2000	—40° to 275°F	0-5 psi	.005"	.002"	.015"	.005"		
DF	Lf	2000	—60° to 200°F ②	0-15 psi	.005"	.002"	.010"	.002"	.015"	.005"
DFS	Sf	3500 ③	—40° to 250°F	0-10 psi	.005"	.002"	.015"	.005"		
DFW	LfL	2000	—60° to 200°F ②	0-10 psi	.005"	.002"	.015"	.005"	.015"	.005"
DO, DT	Ll	2000	—60° to 200°F ②	0-15 psi	.005"	.002"	.010"	.005"	.015"	.005"
DOS	Ss	3500	—40° to 275°F	0-10 psi	.005"	.002"	.015"	.005"	.015"	.005"
DW	Ll, Ls	2000	—60° to 200°F	0-15 psi	.005"	.002"	.010"	.005"	.015"	.005"
DWS	Sl	3500	—40° to 200°F	0-10 psi	.005"	.002"	.015"	.005"	.015"	.005"
	Ss	3500	—40° to 275°F	0-10 psi	.005"	.002"	.015"	.005"	.015"	.005"
E	L	1000	—60° to 200°F ②	0-15 psi	.001" ⑤		.010"	.005"	.015"	.005"
	F	1000	—60° to 250°F	Nil	.001" ⑤		.005"	.002"	.010"	.003"
EB, EBW	S	2500	—40° to 275°F	0-15 psi	.002"		.010"	.005"	.030"	.025"
EBR	S	3000	—40° to 275°F	0-15 psi	.002"		.010"	.005"	.030"	.025"
EBRS	S	4000	—40° to 275°F	0-15 psi	.002"		.015"	.005"	.040"	.030"
F, GF	F	2000	—60° to 250°F	Nil	.005"	.002"	.005"	.002"	.010"	.003"
G ⑥	L	800	—60° to 200°F ②	0-2 psi	.005"	.002"	.010"	.005"	.010"	.005"
GTW	T			0-250 psi						
GW, W, WW	L	1000	—60° to 200°F ②	0-5 psi	.005"	.002"	.005"		.005"	
R	L	2000	—60° to 200°F ②	0-15 psi	.005"	.002"	.010"	.005"	.015"	.005"
RM, RO	S	2000	—40° to 275°F	0-10 psi	.002"		.010"	.005"	.015"	.005"
RMW	S	2000	—40° to 275°F	0-15 psi	.002"		.010"	.005"	.010"	.005"
RS	S	3500	—40° to 275°F	0-10 psi	.005"	.002"	.015"	.005"	.015"	.005"
T, TK	S	3000	—40° to 275°F	0-10 psi	.005"	.002"	.015"	.005"	.015"	.005"
TKW, TW	S	3000	—40° to 275°F	0-15 psi	.002"		.015"	.005"	.010"	.005"

① Reciprocating applications may exceed specifications.
② Intermittent rise to 250° permissible.
③ If felt wiper is amply lubricated.
⑤ Under 3" shaft diameter. Over 3" ± .0015".
⑥ Not recommended for oscillating applications.

SHAFT SEAL SELECTION

LEATHER VS SYNTHETIC

WHEN TO USE LEATHER SEALS

Leather seals can be used on the majority of applications. The special heat-proof, wear-resistant leather used in these seals provides a rugged, durable general-purpose sealing element.

Leather oil seals are less sensitive to shaft finish than synthetic rubber. They work well even when shaft or bore is rough. Leather, being absorbent, provides a self-lubricated seal even with little or no lubrication. Shaft speed and temperature are limited.

Trostel makes the two basic types of cased leather oil seals: the flange unit (Type R) and the springless washer style unit (Type W). For Type illustrations see pages 50 and 51 of this catalog. The flange type unit has the widest use and is often selected for automotive applications, farm implements and similar products. The washer type unit is primarily used where space or price is a limiting factor and application is not severe.

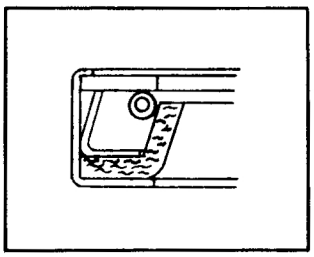
WHEN TO USE SYNTHETIC RUBBER SEALS

In general, synthetic rubber oil seals are specified when shaft speeds exceed 2000 FPM on a substantial head of oil is present. Synthetic rubber seals resist high temperatures and are impervious to water, oil, mild acids and alkalies. They allow greater shaft run-out, whip and eccentricity and have less drag than leather seals.

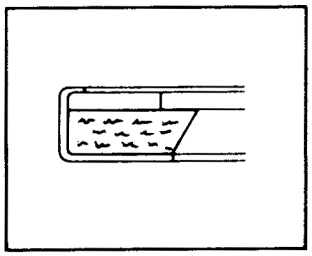
Synthetic seals can provide almost total sealing, assuring near zero seepage. They require good full time lubrication and the shaft finish must be finer than necessary for leather type units.

Synthetic rubber seals are usually used on more intricate mechanisms including motors, transmissions, pinions and similar equipment that operates at high speeds.

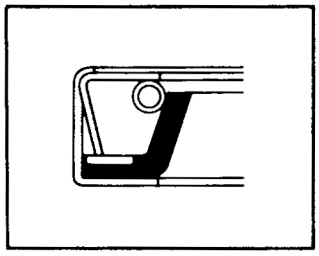
Trostel makes two basic types of oil seals using synthetic rubber sealing elements: the assembled case type seal (Type RS) and the bonded rubber oil seals (Type BR). See pages 50 and 51 of this catalog for illustrations of seal Types. Most known synthetic rubber compounds are available, including silicone.



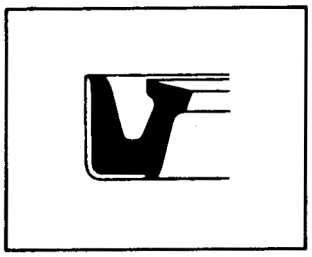
TYPE R



TYPE W



TYPE RS



TYPE BR