

# Sealtech Vietnam

\*\*\*One stop sealing solution\*\*\*

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# OIL SEAL

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OIL SEAL

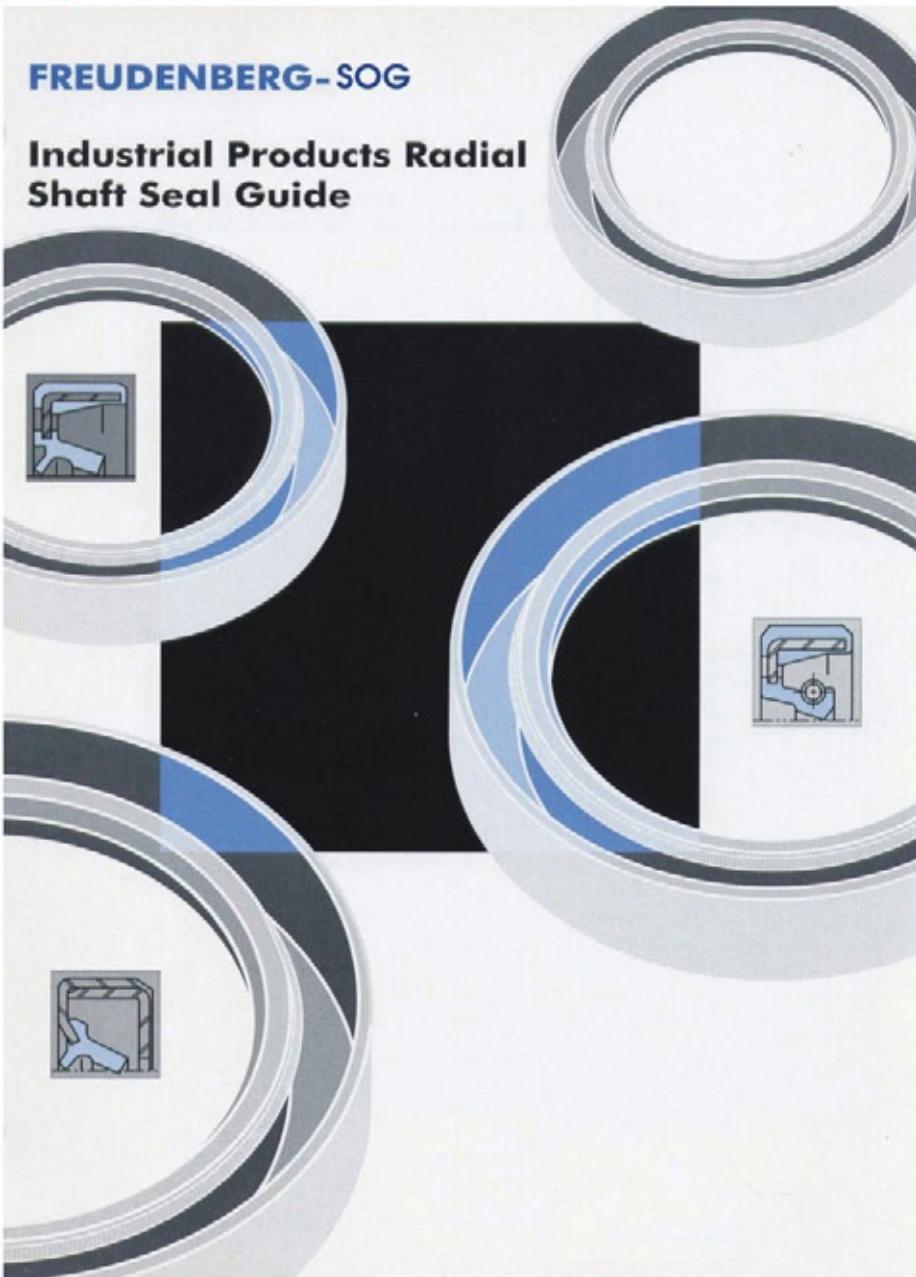
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# OIL SEAL

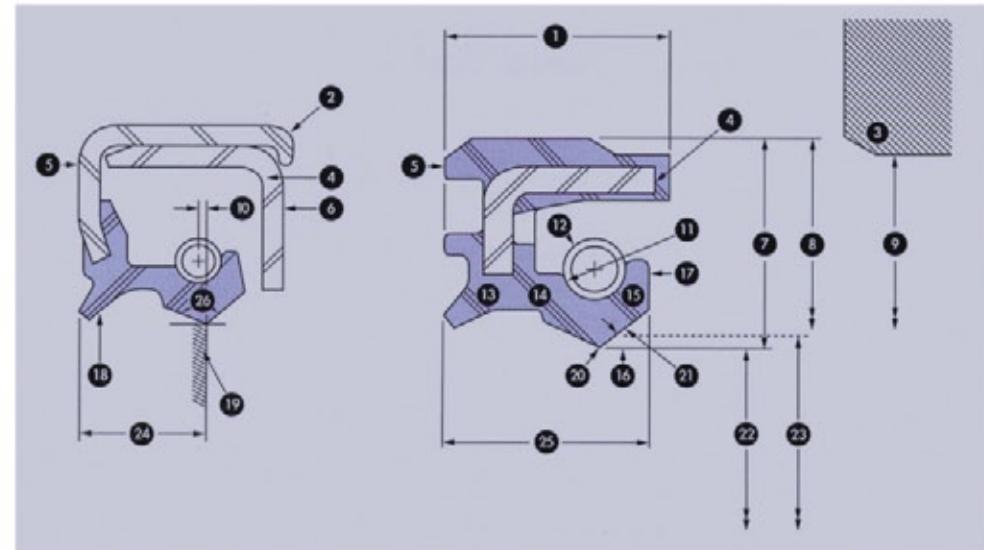


## FREUDENBERG-SOG

### Industrial Products Radial Shaft Seal Guide



## SEAL NOMENCLATURE



- |                          |                               |                          |                                  |
|--------------------------|-------------------------------|--------------------------|----------------------------------|
| 1. Seal Width            | 8. Seal Outer Diameter        | 14. Flex Section         | 21. Inside Lip Surface           |
| 2. Metal Case (Outer)    | 9. Housing Bore Diameter      | 15. Spring Retainer Lip  | 22. Sprung Lip Diameter          |
| 3. Housing               | 10. Spring Position (R-Value) | 16. Inside Lip Angle     | 23. Free Lip (Unsprung) Diameter |
| 4. Inner Case            | 11. Spring Groove             | 17. Toe Face             | 24. Contact Line Height          |
| 5. Outside Face          | 12. Garter Spring             | 18. Auxiliary (Dust) Lip | 25. Lip Height                   |
| 6. Inside Face           | 13. Heel Section              | 19. Rib (Helix)          | 26. Lip Angle                    |
| 7. Radial Wall Dimension |                               | 20. Contact Point        |                                  |



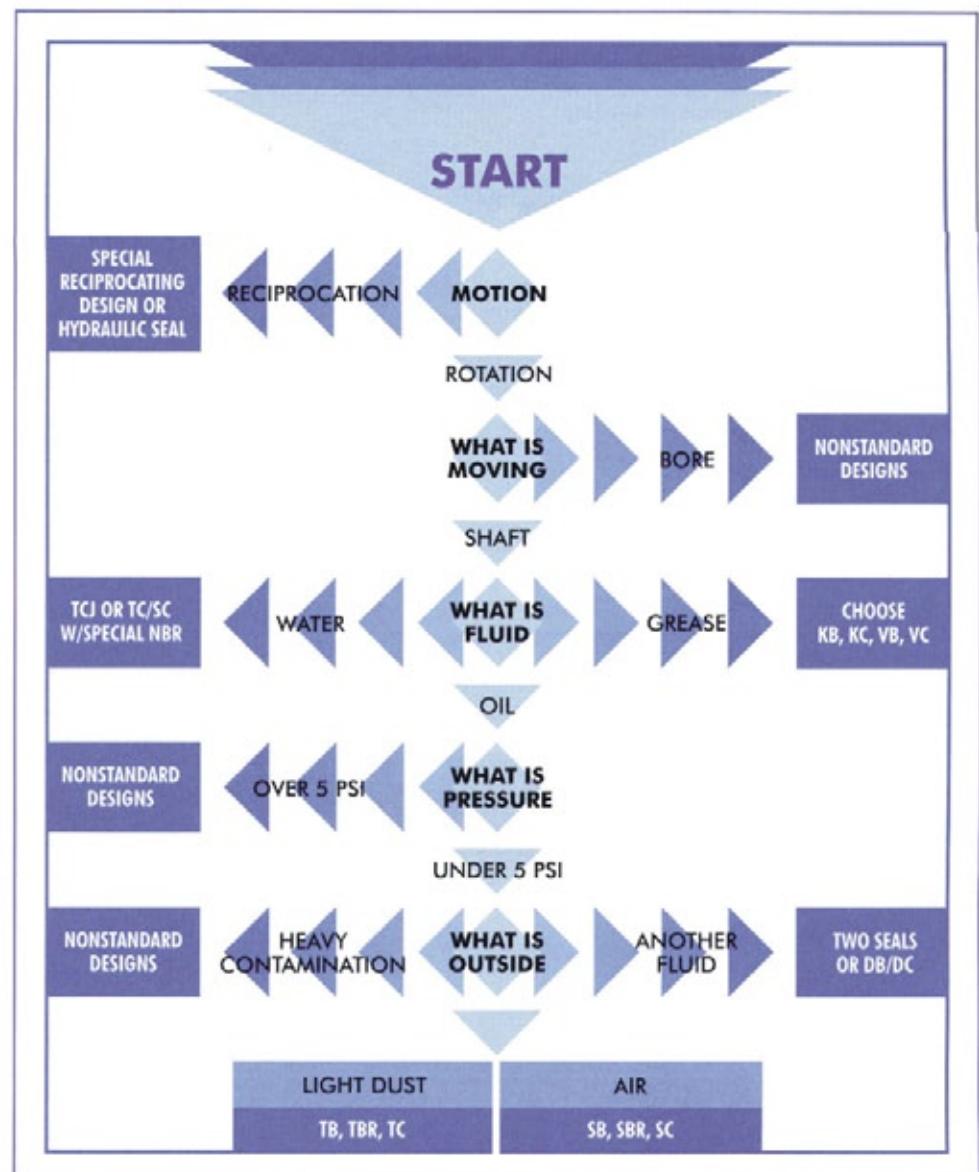
## OIL SEAL SELECTION

The engineering data presented here is to provide a guideline for selection of a standard seal for a general purpose application. The user needs to be aware that many design configuration of seals exist to meet specific requirements. Deviation from the standard limitations provided here

### GENERAL GUIDELINES

- A. Determine the general category the seal application falls within (Table 1).
- B. Determine if operating conditions exceed the design limits (Table 2).
  1. Shaft Speed
  2. Pressure
  3. Eccentricity
- C. Select appropriate lip, case and spring material (Table 3). Selection is based on temperature of application, fluid and environment to be sealed and excluded.
- D. Review bore and shaft configuration (Table 4) to ensure compatibility with seal.
- E. If design limits are exceeded, review nonstandard designs and contact Freudenberg-SOG

### SELECTION PROCESS





## FREUDENBERG-NOK STANDARD SEAL TYPES

TABLE 1

BODY SYMBOLS	A2	B2	B	BR	C	
LIP SYMBOLS	Metal O.D. design with an inner case for greater structural rigidity.	Most standardized and economical metal O.D. design.	Metal O.D. design with fluid side rubber covered.	Port rubber/part metal O.D. design for greater O.D. sealing ability.	Rubber O.D. design for excellent O.D. sealing ability.	
S	General nonpressure fluid sealing applications and severe grease sealing conditions.	<b>SA2</b> 	<b>SB2</b> 	<b>SB</b> 	<b>SBR</b> 	<b>SC</b> 
T	General nonpressure fluid sealing applications and severe grease sealing conditions with light duty exclusion of foreign materials.	<b>TA2</b> 	<b>TB2</b> 	<b>TB</b> 	<b>TBR</b> 	<b>TC</b> 
V	Economical design for grease retention or sealing viscous fluid.	<b>VA2</b> 	<b>VB2</b> 	<b>VB</b> 	<b>VBR</b> 	<b>VC</b> 
K	Economical design for grease retention or sealing viscous fluid with light duty exclusion of foreign materials.	<b>KA2</b> 	<b>KB2</b> 	<b>KB</b> 	<b>KBR</b> 	<b>KC</b> 
WP	Dust wiper or scraper for hydraulic or pneumatic cylinder applications			<b>WPB</b> 		<b>WPC</b> 

NOTE:

Metal O.D. seals are most suitable for steel or cast iron housing materials.

Rubber covered O.D. seals are preferred for soft alloy or plastic housing materials and are suitable as well for steel or cast iron housings.

Also, this design category is best for rough bore finishes or for materials with a high coefficient of thermal expansion.

## OPERATING CONDITIONS ("S" & "T" CONFIGURATIONS)

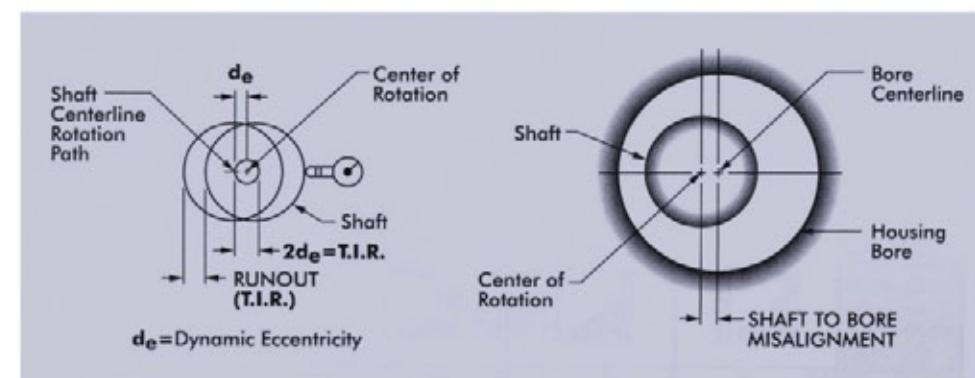
TABLE 2 DESIGN LIMITATIONS

SHAFT DIAMETER	NITRILE LIP MAXIMUM CONTINUOUS SHAFT SPEED	MAXIMUM CONTINUOUS PRESSURE	MAXIMUM TOTAL ECCENTRICITY
General	3,500 rpm	5 psi	.020"
.500	8,000 rpm	5 psi	.004"
1.500	7,000 rpm	5 psi	.006"
2.500	4,500 rpm	5 psi	.010"
3.500	3,800 rpm	5 psi	.013"
4.500	2,750 rpm	5 psi	.017"

NOTE:

Higher shaft speeds possible using higher temperature materials such as polyacrylate, fluoroelastomer or silicone. Slightly higher continuous pressure is possible for shaft speeds below 200 fpm. Higher eccentricity is allowable if shaft speed is reduced.

### ECCENTRICITY



Eccentricity is determined by measuring the shaft runout, TIR, and the shaft-to-bore misalignment. Combine the two results for the total eccentricity the seal lip must follow to

function effectively. As eccentricity increases, and/or shaft speed increases, it becomes more difficult for the lip to follow the shaft.



## OPERATING CONDITIONS ("V" & "K" CONFIGURATIONS)

TABLE 3 DESIGN LIMITATIONS

SHAFT DIAMETER	MAXIMUM SHAFT SPEED	MAXIMUM CONTINUOUS PRESSURE	MAXIMUM TOTAL ECCENTRICITY
General	2,000 rpm	4 psi	.005"
.500	4,000 rpm	4 psi	.003"
1.500	3,000 rpm	4 psi	.005"
2.500	2,300 rpm	4 psi	.006"
3.500	1,700 rpm	4 psi	.008"
4.500	1,400 rpm	4 psi	.010"

A nonsprung seal design offers a cost effective way to seal high viscosity grease applications. Because the design does not benefit from the constant load of a garter spring, the allowable eccentricity is decreased and the fluids to be sealed are limited.

NOTE:

Higher eccentricity is allowable if maximum shaft speed is reduced.

## OPERATING CONDITIONS ("WP" CONFIGURATIONS)

TABLE 4 DESIGN LIMITATIONS

Maximum Shaft Linear Velocity	200 fpm (1 m/sec.)
Maximum Pressure Capability	4 psig (.28 kg/cm <sup>2</sup> )
Maximum Stroke Length	78 inches (1.98 m)
Maximum Shaft-To-Bore Misalignment	0.004 inches (0.1 mm) TIR

The "WP" design was developed as a dust wiper (scraper) for reciprocating applications, such as hydraulic cylinder rods. As a result, the operating limits are different from the "V" & "K" type provided above.

## NONSTANDARD DESIGNS

TABLE 5

Special applications which cannot be adequately satisfied by standard designs are illustrated on the next two pages.

FREUDENBERG-SOG DESIGN		DESIGN CHARACTERISTICS
"D" Style		Applications which require separating two fluids from each other should use two garter spring loaded lips. The "D" style seal incorporates the two lips into one design. Note: The bore depth must be increased to accommodate the two seal lips.
"TCV" (Medium Pressure)		For applications up to 50 psi (3.5 kg/cm <sup>2</sup> ), the "TCV" design is recommended. Pressure limit is dependent on shaft speed. Available for shaft diameters less than 2.500" (65 mm).
"TCN" (High Pressure)		Type "TCN" is designed for high pressure applications where continuous pressure may reach 150 psi (10.6 kg/cm <sup>2</sup> ). Maximum pressure limit is dependent on shaft speed.
"H" Style		Hydrodynamic sealing lips are available with most designs. Both unidirectional and bidirectional helical ribs are available. The helical ribs help "pump" the fluid back under the seal lip. Basic lip design is same as standard seal.
"K" (Fabric Auxiliary Lip)		Where dirt or dust ingestion is a problem, the "TCK" design provides superior exclusion. Where dust or dirt and moisture (small quantities of water) mixture are evident, combination with a slinger provides excellent results (TCKY).
"QL" (Sleeve Oil Seals)		The "QL" seal is specially designed for mud or very dirty applications. Maximum shaft speed is limited to 10 ft/sec. (3 m/sec.).
"T4" (Reciprocating)		Severe reciprocating shaft applications can be effectively sealed by the "T4" design. Pressure up to 100 psi (7 kg/cm <sup>2</sup> ) can be sealed, such as in shock absorbers.
"DK" (Reciprocating)		Dust wiper for hydraulic cylinders. Not recommended for pressures above 5 psi (.35 kg/cm <sup>2</sup> ).



## NONSTANDARD DESIGNS

For oil seal designs not shown, please contact Freudenberg-SOG for recommended designs to meet your application requirements.

TABLE 5 (cont.)

DESIGN TYPE	APPLICATION	EXAMPLE
VS	Valve Stem Seals	
V	Special Mud Seals	
"5"	Flange Seals	
"9"	Side Lip Seal	
"UJ"	Universal Joint Seals	
"J"	PTFE Seals	
"O"	Rotating Bore	
"E"	High Shaft Eccentricity	

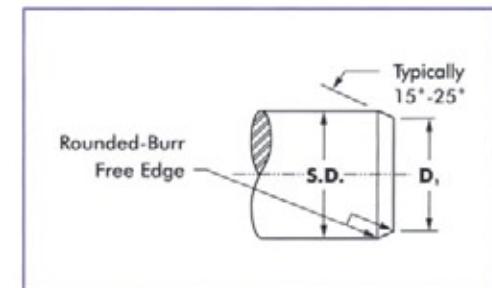
## SHAFT RECOMMENDATIONS

### SHAFTS

Seal and shaft compatibility is dependent on four conditions: shaft tolerance, lead-in chamfer, finish and hardness. Proper consideration of these conditions will assist in providing optimal seal performance.

- **SHAFT HARDNESS** is an important factor to prevent excessive wear, deformation, scratches or nicks, and to allow for easy machining for proper roughness. Under normal conditions, the seal contact area of the shaft should be Rockwell C45 minimum.
- **SHAFT SURFACE ROUGHNESS** is very important as this greatly influences the amount of lip wear. The recommended roughness is as follows:
  - Rotating 10 to 20  $\mu$  inch Ra (.25  $\mu$ M to .50  $\mu$ M Ra);  $R_{max}=31\text{-}126 \mu$  inch (0.8-3.2  $\mu$ M)
  - Reciprocating 5 to 10  $\mu$  inch Ra (.13  $\mu$ M to .25  $\mu$ M Ra) The method of achieving this finish should not be overlooked.
- **PLUNGE GRINDING** is recommended for rotating shaft applications. For reciprocating applications, centerless grinding is acceptable. Rotating shaft applications require a surface with no machine lead, as machine lead may actually pump fluid from under the seal lip. Also, hard chrome plating is suggested for any cast iron or stainless steel shafts for rotating applications and for steel shafts with reciprocating applications.
- **A SHAFT CHAMFER** is suggested to assist in the installation process. Without a proper chamfer, the seal lip may be damaged or distorted resulting in a dislodged garter spring.
- **SHAFT TOLERANCE** recommendations for general applications are listed in Table 7 below. The tolerance range should be decreased for high speed or pressure applications.

TABLE 6  
RECOMMENDED SHAFT CHAMFER



INCHES			
S.D.	D <sub>1</sub>	S.D.	D <sub>1</sub>
Up to 1.000	S.D. - .094	4.001 to 5.000	S.D. - .220
1.001 to 2.000	S.D. - .140	5.001 to 5.000	S.D. - .260
2.001 to 3.000	S.D. - .166	6.001 to 5.000	S.D. - .276
3.001 to 4.000	S.D. - .196	-	-

MILLIMETERS			
S.D.	D <sub>1</sub>	S.D.	D <sub>1</sub>
Up to 25.00	S.D. - 2.4	100.01 to 125.00	S.D. - 5.6
25.01 to 50.00	S.D. - 3.6	125.01 to 150.00	S.D. - 6.6
50.01 to 75.00	S.D. - 4.2	150.01 to 250.00	S.D. - 7.0
75.01 to 100.00	S.D. - 5.0	-	-

TABLE 7  
RECOMMENDED SHAFT TOLERANCE

SHAFT DIAMETER (INCH)	TOLERANCE	SHAFT DIAMETER (DIN/METRIC)	TOLERANCE
Up to 4.000	$\pm .003$	Up to 100 mm	$\pm .008$
4.001 to 6.000	$\pm .004$	100.10 to 150.00	$\pm .10$
6.001 to 10.000	$\pm .005$	150.10 to 250.00	$\pm .13$



## HOUSING RECOMMENDATIONS

### HOUSINGS

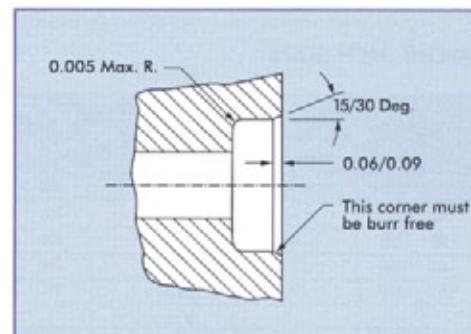
Steel and cast iron provide good surfaces for both rubber covered and metal O.D. seals. For soft alloy (aluminum) bores, rubber covered O.D. seals provide better sealing capability. In aluminum or other soft alloy bores, metal O.D. seals occasionally back out of the bore due to thermal expansion of the soft alloy. Rubber, having a higher coefficient of thermal expansion than carbon steel, will tighten in the bores as temperature rises. Plastic or nylon are not recommended because they typically expand at a high rate causing a major problem for metal O.D. seals. If plastic is to be used, rubber O.D. seals are recommended.

### BORE CHAMFER

A bore chamfer is necessary to assist in installation of the seal. To the right is the recommended configuration for the chamfer.

Proper chamfer angle and depth minimizes cocking or lack of squareness of the seal to the shaft, distortion of the seal cases, and reduces assembly SOG.

### RECOMMENDED BORE CHAMFER



### SURFACE ROUGHNESS

Excessively rough bore finishes may allow paths for fluid to leak between seal O.D. and bore. Below shows the recommended maximum roughness.

	METAL O.D.	RUBBER O.D.
MAXIMUM ROUGHNESS	100 $\mu\text{M}$ inch Ra	150 $\mu\text{M}$ Ra
	2.50 $\mu\text{M}$ Ra	3.75 $\mu\text{M}$ Ra
	12.5 mm $R_{\max}$	
	492 $\mu\text{inch}$ $R_{\max}$	

The rubber O.D. seal is capable of functioning with a rougher finish.

	METAL O.D.	RUBBER O.D.
MAXIMUM ROUGHNESS	None	60 $\mu\text{inch}$ Ra
	None	2.4 $\mu\text{M}$ Ra

A minimum bore roughness is recommended for rubber O.D. seals. This improves retention.

### BORE DIAMETER TOLERANCE

The recommended housing bore diameter, bore tolerance and nominal pressfit.

TABLE 8 INCH SIZES

BORE DIAMETER	BORE TOLERANCE	NORMAL PRESSFIT		O.D. TOLERANCE (1)		OUT OF ROUND (2)	
		SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.	SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.	SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.
Up to 1.000	$\pm .001$	.004	.006	$\pm .002$	$\pm .003$	.005	.010
1.001 - 2.000	$\pm .001$	.004	.006	$\pm .002$	$\pm .003$	.006	.012
2.001 - 3.000	$\pm .001$	.004	.006	$\pm .002$	$\pm .003$	.006	.014
3.001 - 4.000	$\pm .0015$	.005	.008	$\pm .002$	$\pm .004$	.007	.018
4.001 - 6.000	$\pm .0015$	.005	.010	$+ .003$ $- .002$	$\pm .004$	.009	.023
6.001 - 8.000	$\pm .002$	.006		$+ .003$ $- .002$		.012	
8.001 - 9.000	$\pm .002$	.007		$+ .004$ $- .002$		.015	
9.001 - 10.000	$\pm .002$	.008		$+ .004$ $- .002$		.015	

TABLE 9 EQUIVALENT METRIC SIZES

BORE DIAMETER	BORE TOLERANCE	NORMAL PRESSFIT		O.D. TOLERANCE (1)		OUT OF ROUND (2)	
		SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.	SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.	SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.
Up to 25.00	$\pm 0.025$	0.10	0.15	$\pm 0.05$	$\pm 0.08$	0.13	0.25
25.01 - 50.00	$\pm 0.025$	0.10	0.15	$\pm 0.05$	$\pm 0.08$	0.15	0.30
50.01 - 75.00	$\pm 0.025$	0.10	0.15	$\pm 0.05$	$\pm 0.08$	0.15	0.36
75.01 - 100.00	$\pm 0.038$	0.13	0.20	$\pm 0.05$	$\pm 0.10$	0.18	0.46
100.01 - 150.00	$\pm 0.038$	0.13	0.25	$+ 0.08$ $- 0.05$	$\pm 0.10$	0.23	0.58
150.01 - 200.00	$\pm 0.051$	0.15		$+ 0.08$ $- 0.05$		0.30	
200.01 - 225.00	$\pm 0.051$	0.18		$+ 0.10$ $- 0.05$		0.38	
225.01 - 250.00	$\pm 0.051$	0.20		$+ 0.10$ $- 0.05$		0.38	

(1) Seal O.D. - The average of a minimum three measurements to be taken of equally spaced positions.

(2) Out of Round (OOR) - The maximum variance between any of the readings used in determining seal O.D.



## MATERIAL SELECTION

### LIP MATERIAL

One of the most important components of the seal is the elastomer material. Freudenberg-SOG has specially developed elastomer blends to meet a wide variety of sealing requirements. Available are many classes of

materials with over 100 individual formulas to satisfy various sealing conditions. Table 10 and Table 11 provide general information and fluid compatibility ratings.

TABLE 10 GENERAL ELASTOMER INFORMATION

BASE POLYMER	NITRILE	POLYACRYLATE	SILICONE	FLUOROELASTOMER
TEMPERATURE* RANGE	-50°F ~ 250°F -45°C ~ 125°C	-20°F ~ 300°F -30°C ~ 150°C	-80°F ~ 400°F -60°C ~ 200°C	-30°F ~ 400°F -35°C ~ 200°C
Oil Resistance	●	●	■	●
Acid Resistance	■	▲	▲	▲
Alkali Resistance	■	◆	◆	▲
Water Resistance	■	▲	■	■
Heat Resistance	■	●	●	●
Cold Resistance	■	▲	■	▲
Wear Resistance	●	●	■	●
Ozone Resistance	■	●	●	●

	ADVANTAGES	DISADVANTAGES
NITRILE	<ul style="list-style-type: none"> <li>• Commonly referred to as Buna-N and is Copolymer of Butadiene and Acrylonitrile</li> <li>• Low cost</li> <li>• Good resistance to petroleum oils, water, silicone oils, greases, glycol base fluids</li> <li>• Good abrasion resistance, cold flow, tear resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Poor resistance to ozone and weather aging</li> </ul>
POLYACRYLATE	<ul style="list-style-type: none"> <li>• Polymerised acrylic esteresters</li> <li>• Good resistance to mineral oils, hypoid gear oils, E.P. additives, greases, aging and flex cracking</li> <li>• Higher temperature limit than Nitrile</li> </ul>	<ul style="list-style-type: none"> <li>• Fair cold temperature limit</li> <li>• Lower mechanical strength</li> <li>• Costs slightly higher than Nitrile</li> <li>• Poor dry running ability, water resistant</li> </ul>
SILICONE	<ul style="list-style-type: none"> <li>• Broad temperature range</li> <li>• Good ozone resistance</li> <li>• Resistant to compression set</li> </ul>	<ul style="list-style-type: none"> <li>• Low resistance to hydrocarbon fluids like gasoline or paraffin fluids or steam above 50 psi</li> <li>• Cost is higher than Polyacrylate</li> </ul>
FLUOROELASTOMER	<ul style="list-style-type: none"> <li>• Good temperature resistance</li> <li>• Compatible with wide range of fluids</li> <li>• Commonly chosen as high temperature replacement for Nitrile or Polyacrylate</li> </ul>	<ul style="list-style-type: none"> <li>• Fair resistance to water, dry running</li> <li>• Low temperature resistance is fair</li> <li>• Cost is high</li> </ul>

\* Maximum temperature limits dependent on other operating conditions.

● Very good.

■ Good for most applications.

▲ Fair, can be used if no other materials available but otherwise not recommended.

◆ Not recommended.

2. Phosphate Ester and Water Glycol hydraulic fluids are not included in the Table.

3. Water resistance includes steam. No material is ideally compatible as lubricity of water is very poor.

4. PTFE, Ethylene Acrylate, and other elastomers are available.

TABLE 11 FLUID COMPATIBILITY

TYPE OF FLUID TO BE SEALED	LIP MATERIAL			
	NITRILE	POLYACRYLATE	SILICONE	FLUOROELASTOMER
Engine Oil	SAE 30 Wt.	●	●	●
	SAE 10 Wt.	■	■	■
Gear Oil	Super Gear	●	●	▲
	Hypoid Gear	■	■	◆
Turbine Oil No. 2	■	■	■	●
Machine Oil No. 2	■	■	▲	●
Automatic Transmission Fluid	●	●	▲	●
Petroleum Base Lubricating Oil	●	●	▲	●
Gasoline	▲*	◆	◆	●
Light Oil/Kerosene	▲	◆	◆	■
Cutting Oil	●	■	▲	●
Grease	●	●	●	●
E.P. Lubricants	■	●	◆	●
Water-Glycol	●	◆	■	▲
Alcohol	●	◆	■	▲
20% Hydrochloric Acid Solution	▲	▲	▲	●
30% Sulfuric Acid Solution	▲	▲	◆	●

\* Special compound available.

● Very good.

■ Good for most applications.

▲ Fair, can be used if no other materials available but otherwise not recommended.

◆ Not recommended.

### METAL CASE AND SPRING

The other major components of a seal are the metal case and garter spring. Table 12 lists the material specification Freudenberg-SOG uses for its components.

TABLE 12 CASE AND SPRING SPECIFICATION

CASE		SPRING	
SAE NO.	APPLICATION	ASTM OR SAE NO.	APPLICATION
1008 ~ 1010	General	A228 ~ A227	General
30302 ~ 30304	Special Corrosion Resistance Condition	30302 ~ 30304	Special Corrosion Resistance Condition

The metal case is produced from carbon steel for general applications in oil or grease. For special applications when sealing sea water or corrosive fluids or gasses, stainless steel can be applied at an increase in price. With water applications, cost may be reduced by using a

rubber covered design with carbon steel case. For the garter spring, piano wire is used for general applications. Where corrosion resistance or extreme heat resistance is required, stainless steel is available.

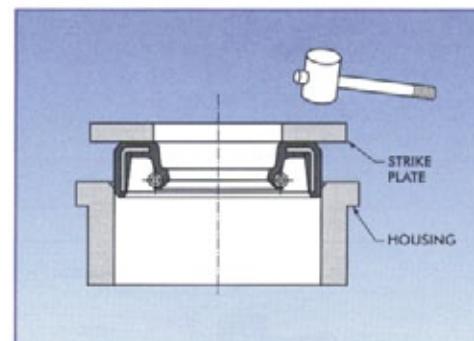
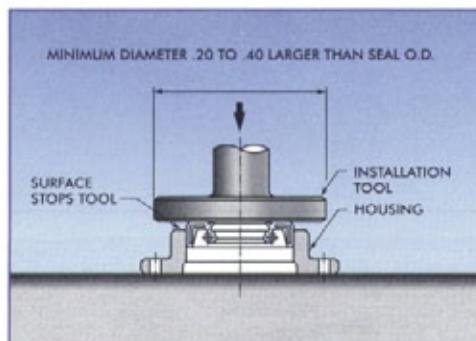
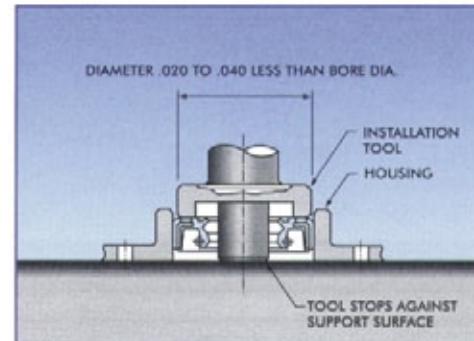
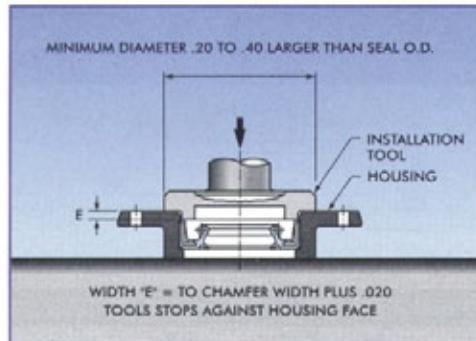


## OIL SEAL INSTALLATION PROCEDURES

The subject of installation represents an area commonly overlooked when selecting an oil seal for an application. Studies have shown this area to be one of the major causes of premature seal failure. To assist the installation, the seal should be prelubricated with grease or oil to reduce sliding friction of contact surfaces. This will also help protect the seal lips during initial run-in. An installa-

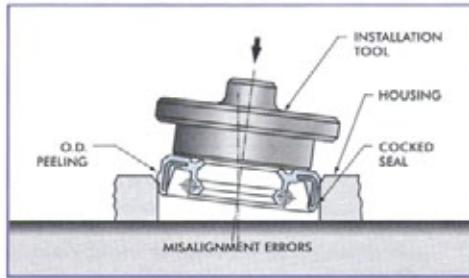
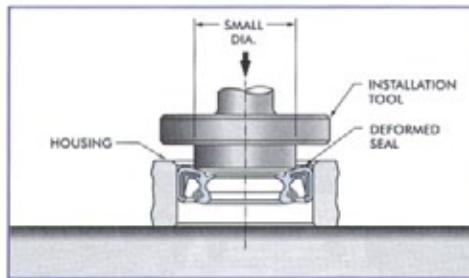
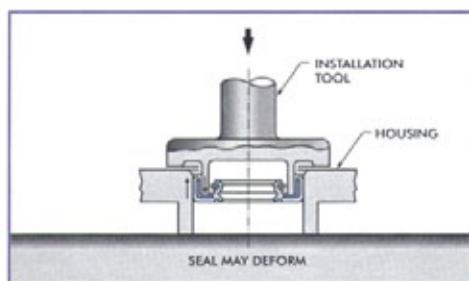
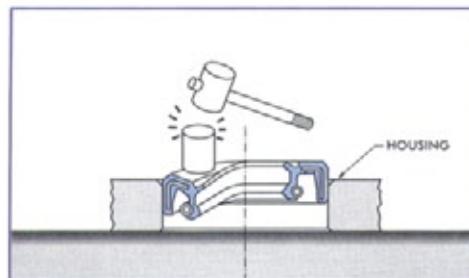
tion tool should always be used when installing an oil seal. The use of a tool improves ease of installation and reduces the possibility of seal cocking (non-perpendicular to shaft). A hydraulic or pneumatic press is advised to supply necessary force to install the seal. Following are examples of both recommended and improper installation methods.

## ACCEPTABLE METHOD



In each preferred method, installation load is absorbed by either housing or bottom plate to prevent seal damage and to assist in locating the seal properly within the bore.

## IMPROPER METHOD



## SHAFT INSTALLATION

The advisable sequence of installation is to install the seal over the shaft and then into the housing bore. Care should be exercised not to damage or deform the seal lip. The proper chamfer angle will minimize this problem. When installing over a keyway or spine, a sleeve or bullet should be employed to protect the seal lip from cuts (refer figure 6).

Where the shaft must be installed through the seal, centering guides for the shaft will prevent lip deformation and dislodging of the spring. When possible, the shaft should be rotated as it passes through the seal to reduce sliding friction.

Figure 6. Seal Installation Over Shaft Splines

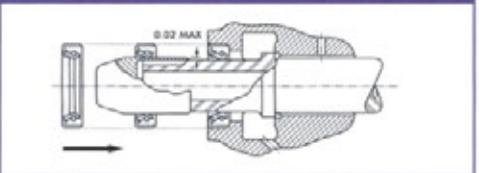


Figure 7. Heavy Weight Housing

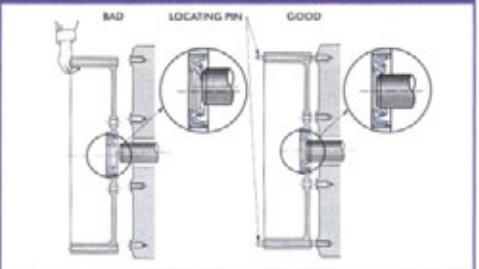
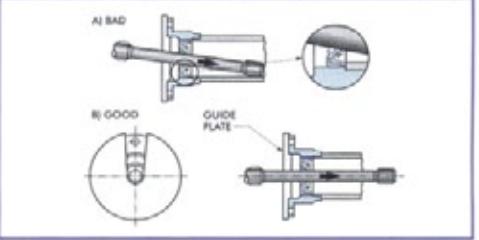


Figure 8. Long Shaft





# STANDARD SEAL DESIGNS

Table 1 illustrates the 31 MFC standard designs, usually used for a variety of application conditions.

TABLE 1. MFC Standard seals

	S	T	V	K	D
Lip Symbol	With single lip design for general nonpressure fluid sealing applications and heavy grease sealing conditions	With dust lip added capable are the same as S, type and dust lip can exclude light foreign materials	With single lip non-spring loaded design for sealing grease or viscous fluid	Dust lip added capable functions are the same as V type and dust lip can exclude light foreign materials	With double garter spring loaded lips specially designed for the separation of two different fluids.
Body Symbol					
A	These are assembled type. Metal O.D. reinforced with an inner case for greater structural rigidity.	SA 	TA 	VA 	KA 
A <sub>1</sub>	An auxiliary metal ring to prevent the root of the lip against deformation due to high pressure, others the same as A type.	SA1 	TA1 	VA1 	KA1 
A <sub>2</sub>	Semi-assembled type Design for special packing materials or heavy duty outer case necessary.	SA2 	TA2 	VA2 	KA2 
B	Metal O.D. This is one of the popular designs. The root of sealing lip is bonded to the I.D. of the metal case.	SB 	TB 	VB 	KB 
B <sub>1</sub>	An auxiliary ring to prevent the root of the lip against deformation due to high pressure, others the same as B type.	SB1 	TB1 	VB1 	KB1 
C	Rubber O.D. and an inner metal components design for excellent O.D. sealing ability.	SC 	TC 	VC 	KC 
C <sub>1</sub>	An auxiliary ring to prevent the root of the lip against deformation due to high pressure, others the same as C type.	SC1 	TC1 	VC1 	KC1 

NOTE:

Metal encased seals are most suitable for steel or cast iron housing materials, with low coefficient of thermal expansion and fine bore finishes.

Rubber covered O.D. seals are most suitable for soft alloy or plastic housing materials and also suitable for steel or cast iron housings materials, with high coefficient of thermal expansion and rough bore finishes.

Selection of an oil seal design is dependent on whether the operating conditions exceed the limits of the design. The three operating parameters that mainly affect the design's

ability to function are eccentricity, pressure, and shaft speed. In this section, these limits are reviewed.

## 5.1 "S" AND "T" LIP DESIGNS

SB1	SB	SC	TB1	TB	TC

Table 5.1 illustrates standard seal designs, beginning with "S" and "T" lip symbols for general nonpressure applications. The "S" design is a single lip oil seal with a garter spring to provide a consistent radial load against the shaft.

The "T" design uses the same primary lip configuration, with an auxiliary dust lip to provide effective light duty dust exclusion. Below is a table listing approximate limits of the "S" and "T" lip designs.

TABLE 2.

SHAFT DIAMETER	NITRILE LIP MAXIMUM CONTINUOUS SHAFT SPEED 1.	MAXIMUM CONTINUOUS PRESSURE 2.	MAXIMUM TOTAL ECCENTRICITY 3.
General	3,500 rpm	5 psi	.020"
.500	8,000 rpm	5 psi	.004"
1.000	7,000 rpm	5 psi	.006"
2.000	4,500 rpm	5 psi	.010"
3.000	3,800 rpm	5 psi	.013"
4.000	2,750 rpm	5 psi	.017"

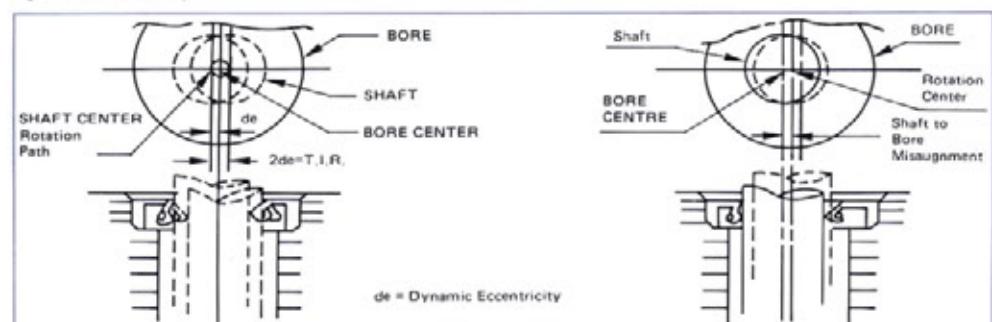
Notes: 1. Higher shaft speeds possible using high temperature materials such as polyacrylate, silicone or fluorobelastomer.

2. Slightly higher continuous pressure possible for shaft speeds below 200 ft./min.

3. Higher eccentricity is allowable if shaft speed is reduced.

Total eccentricity consists of two components, shaft runout and shaft to bore misalignment (offset). The eccentricity is determined as follows:

Figure 1. Eccentricity

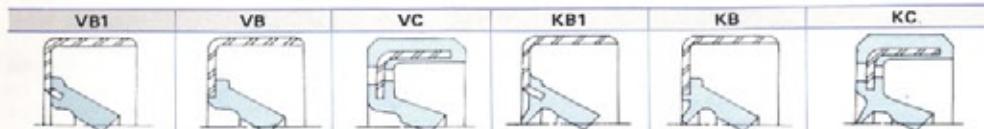


Combining the two results in maximum eccentricity which the seal lip must follow to function effectively. As

eccentricity increases or shaft speed increases, it becomes more difficult for the lip to follow.



## 5.2 "V" AND "K" LIP DESIGNS



The "V" and "K" type designs are low cost seals designed primarily for retention of grease or similar viscous fluids.

The "V" type is a single lip seal. The "K" type has an auxiliary lip for light dust exclusion.

TABLE 3.

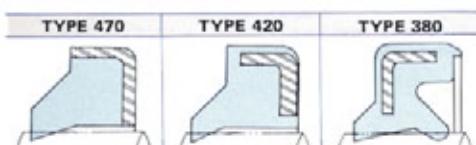
SHAFT DIAMETER	MAXIMUM SHAFT SPEED	MAXIMUM CONTINUOUS PRESSURE	MAXIMUM TOTAL ECCENTRICITY 1.
General	2,000 rpm	4 psi	.005"
.500	4,000 rpm	4 psi	.003"
1.000	3,000 rpm	4 psi	.008"
2.000	2,300 rpm	4 psi	.006"
3.000	1,700 rpm	4 psi	.008"
4.000	1,400 rpm	4 psi	.010"

Note: 1. Higher eccentricity is allowable if maximum shaft speed is reduced.

In comparison with the "S" and "T" lip design, the major reduction in design limits of the "V" and "K" type is the result of the absence of a garter spring. However, for

grease applications where lubricant's ability to flow is reduced, these nongarter spring seals are very cost effective designs to use.

## 5.3 WIPER SEALS DESIGNS



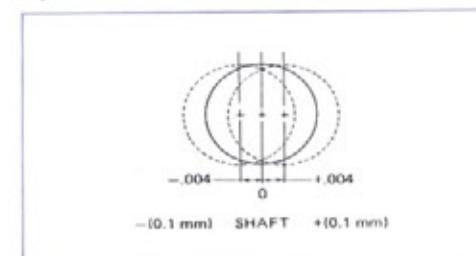
WIPER SEAL design was developed as a dust wiper (scraper) for reciprocating applications such as hydraulic cylinder rods. As a result, the operating limits for the design are slightly different from "V" and "K" types.

Maximum shaft motion is linear velocity of 200 ft./min. (1M/sec.).

Maximum pressure capability is 4 psi (.28 Kg/cm<sup>2</sup>). Stroke length should be limited to 78 inches (1.98m) maximum.

Eccentricity considerations involve only shaft-to-bore misalignment. Maximum allowable is  $\pm 0.004$  inch (0.1 mm).

Figure 2. MISALIGNMENT



## 5.4 NONSTANDARD DESIGNS

Special applications which cannot be adequately satisfied by standard designs are illustrated on Table 4.

TABLE 4.

SPECIAL DESIGN	DESIGN CHARACTERISTICS
"TCN" (High Pressure)	Type "TCN" is designed for high pressure applications where continuous pressure may reach 150 psi (10.6 Kg/cm <sup>2</sup> ). Maximum pressure limit is dependent on shaft speed.
"H" Style	The helical ribs added on air side of sealing lips can help slight oil leakage pump back. Under the seal lip, the main lip design is the same as standard seal. H style lips designs are available for both clockwise and counter clockwise directions.
"T4" (Reciprocating)	"T4" style seals are specially designed for severe reciprocating shaft applications.
"OL" (Sleeve Oil Seals)	The "OL" seals are specially designed for application in the environment as mud or very dirty fluid. But maximum shaft speed should be limited under 10 ft/sec (3M/sec).
WIPER SEALS (Reciprocating)	Dust wiper for hydraulic cylinders. Not recommended for pressures above 5 psi (.35 Kg/cm <sup>2</sup> ).



MFC can supply a number of other special seals which are not usually standard in application nature. Table 5 illustrates a few of these designs.

TABLE 5.

DESIGN TYPE	APPLICATION	EXAMPLE
VS	Valve Stem Seal	
Y	Special Mud Seal	
"S"	Flange Seals	
"9"	Side Lip Seals	
"UJ"	Universal Joint Seals	
"RJ"	PTFE Seals	
"O"	Rotating Bore	

## LISTINGS OF AVAILABLE TYPES AND SIZES

### SHAFT SIZE LISTING (INCH SIZE)

TABLE 12. BORE DIAMETER IN INCH SIZES

BORE DIAMETER	BORE TOLERANCE	NOMINAL PRESSFIT		O. D. - TOLERANCE (1)	ECCENTRICITY (2)	
		SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.	SEALS O.D.	SEALS WITH METAL O.D.	SEALS WITH RUBBER O.D.
Up to 1,000	.±.001	BORE DIA + .004	BORE DIA + .006	.±.002	.005	.010
1,001 - 2,000	.±.001	BORE DIA + .004	BORE DIA + .007	.±.002	.006	.010
2,001 - 3,000	.±.001	BORE DIA + .004	BORE DIA + .008	.±.002	.008	.015
3,001 - 4,000	.±.0015	BORE DIA + .005	BORE DIA + .010	.±.002	.010	.020
4,001 - 6,000	.±.0015	BORE DIA + .005	BORE DIA + .010	.±.003	.010	.020
6,001 - 8,000	.±.002	BORE DIA + .006	BORE DIA + .010	.±.003	.012	.025
8,001 - 10,000	.±.002	BORE DIA + .008	BORE DIA + .010	.±.004	.015	.030
10,001 - 20,000	.±.002	BORE DIA + .008	BORE DIA + .010	.±.006	.020	.040

(1) Seal O.D. — The average of minimum three measurements to be taken at equally spaced positions.

(2) Eccentricity — The maximum variance between any of readings used in determining Seal O.D.



## LISTINGS OF AVAILABLE TYPES AND SIZES

### SHAFT SIZE LISTING (METRIC SIZE)

TABLE 13. BORE DIAMETER IN METRIC SIZES

BORE DIAMETER	BORE TOLERANCE	NOMINAL PRESSFIT		O.D. TOLERANCE		ECCENTRICITY	
		METAL O.D.	RUBBER O.D.	METAL O.D.	RUBBER O.D.	METAL O.D.	RUBBER O.D.
6.1 - 50	+0.025	+0.15	+0.23	+0.05	+0.07	0.12	0.25
50.1 - 80	+0.025	+0.18	+0.28	+0.05	+0.07	0.18	0.35
80.1 - 120	+0.040	+0.20	+0.28	+0.05	+0.07	0.25	0.50
120.1 - 180	+0.040	+0.23	+0.35	+0.05	+0.10	0.33	0.65
180.1 - 300	+0.050	+0.25	+0.35	+0.05	+0.10	0.40	0.80
300.1 - 500	+0.070	+0.29	+0.43	+0.06	+0.12	0.50	1.00

(1) Seal O.D. — The average of minimum three measurements to be taken at equally spaced positions.

(2) Eccentricity — The maximum variance between any of the readings used in determining Seal O. D.

STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER				
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO
SA	3.00	10.00	6.0	VC	CF003EZ06
	3.80	9.30	3.5	VC	CF003GS35
SA1	4.00	5.00	0.375	DB	ED004ZURH
		5.00	0.4375	DB	ED004ZURB
SA2	11.00	6.0		SC	AF004EE06
	12.00	6.0		SC	AF004ER06
SB	13.00	4.0		VC	CF004ES04
	5.00	15.00	6.0	SC	AF005EU06
SB1	15.00	7.0		SC	AF005EU07
	16.00	7.0		SC	AF005EL07
SC	18.00	7.0		SB	AD005EB07
	18.00	7.0		SC	AF005EB07
SC1	18.00	7.0		TC	BF005EB07
	22.00	7.0		TC	BF005RR07
TA	5.50	16.00	7.0	SC	AF05HEL07
		16.00	8.0	KC	DF005EL08
TA1	6.00	12.00	5.5	SC	AF006ER5H
		14.00	4.0	VC	CF006EH04
TA2	14.00	4.0		SC	AF006EU04
		15.00	4.0	VC	CF006EU04
TB	15.00	7.0		SC	AF006EU07
	16.00	7.0		SC	AF006EL07
TB1	16.00	7.0		TC	BF006EB07
	18.00	7.0		KC4	DJ006EB07
TC	18.00	7.0		KC4	DFH06EB07
	18.00	7.0		SC	AF006EB07
TC1	19.00	6.0		SC	AF006EG06
	19.00	7.0		SC	AF006EG07
AV	22.00	7.0		SC	AF006RR07
	22.00	7.0		VC	CF006RR07
VA1	24.00	7.0		SC	AF006RH07
	22.00	7.0		TC	BF6P3RR07
VA2	7.00	17.00	7.0	VC	CF007EC07
		17.20	8.0	VC	CF007EC08
VA	19.00	6.0		SC	AF007EG06
	22.00	7.0		SC	AF007RR07
TC1	22.00	7.0		TC	BF007RR07
	12.00	6.0		VC	CF008ER06
TC	15.00	5.0		SC	AF008EU05
	16.00	5.0		SC	AF008EL05
TC1	16.00	6.0		SC	AF008EL06
	16.00	7.0		SA	AA008EL07
AV	16.00	7.0		SC	AF008EL07
	16.00	7.0		TC	BF008EL07
VA1	18.00	5.0		SC	AF008EB05
	18.00	8.0		VCY	VCY08EB08
VA2	20.00	5.0		TC	BF008RZ05
	22.00	6.5		TC	BF008RR65
VA	22.00	7.0		SC	AF008RR07
	22.00	7.0		TC	BF008RR07
VA1	22.00	8.0		SC	AF008RR08
	22.00	8.0		TC	BF008RR08
VA2	25.00	5.0		TC	BF008RU05



## OIL SEAL SIZES AND TYPE BY SHAFT DIAMETER

SHAFT	BORE	HEIGHT	TYPE	CODE-NO	STANDARD DESIGNS
8.00	25.00	8.0	TC	BF008RU08	
9.00	16.00	3.0	VB	CD009EL03	
	16.00	7.0	TC	BF009EL07	
	18.00	5.0	SC	AF009EB05	
	20.00	5.0	SC	AF009RZ05	
	22.00	7.0	SC	AF009RR07	
	22.00	8.0	SC	AF009RR08	
	24.00	7.0	SC	AF009RH07	
9.53	14.29	2.39	VB	CD009EH02	
10.00	14.00	3.0	VA2	CC010EH03	
	15.00	3.0	VC	CF010EU03	
	16.00	4.0	SB	AD010EL04	
	16.00	4.0	SC	AF010EL04	
	16.00	4.0	VB	CD010EL04	
	16.00	4.0	VC	CF010EL04	
	17.50	8.0	VC	CF010EC08	
	18.00	4.0	SC	AF010EB04	
	18.00	5.0	SC	AF010EB05	
	18.00	5.0	TC	BF010EB05	
	18.00	6.0	SC	AF010EB06	
	18.00	6.0	TC	BF010EB06	
	19.00	7.0	DB	ED010EG07	
	19.00	7.0	SB	AD010EG07	
	19.00	7.0	SC	AF010EG07	
	19.00	7.0	TC	BF010EG07	
	20.00	5.0	TC	BF010RZ05	
	20.00	6.0	SC	AF010RZ06	
	20.00	7.0	TC	BF010RZ07	
	21.00	5.0	SC	AF010RE05	
	22.00	6.0	SC	AF010RR06	
	22.00	7.0	SC	AF010RR07	
	22.00	7.0	TC	BF010RR07	
	22.00	8.0	SA	AA010RR08	
	22.00	8.0	SC	AF010RR08	
	22.00	8.0	TC	BF010RL07	
	24.00	7.0	SC	AF010RH07	
	25.00	7.0	TC	BF010RU07	
	25.00	8.0	SC	AF010RU08	
	26.00	7.0	SC	AF010RL07	
	26.00	7.0	TC	BF010RL07	
	28.00	7.0	SC	AF010RB07	
	30.00	7.0	SC	AF010SZ07	
11.00	30.00	10.00	SC	AF010SZ10	
	17.00	4.0	SC	AF011EC04	
	17.00	4.0	VC	CF011EC04	
	19.00	7.0	SC	AF011EG07	
	22.00	7.0	SC	AF011RR07	
	22.00	7.0	TC	BF011RR07	
	26.00	7.0	SC	AF011RL07	
11.11	17.60	3.4	VB	CD11ECL34	
11.60	24.00	7.0	SC	AF11PRH07	
	24.00	10.0	SC	AF11PRH10	
12.00	16.00	4.50	SC	AF012EL45	
	18.00	4.50	SC	AF012EB4H	
	18.00	4.5	TB	BD012EB45	

STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER				
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO
SA	12.00	19.00	5.0	SC	AF012EG05
SA	20.00	4.0	SC	AF012RZ04	
SA	20.00	5.0	SB	AD012RZ05	
SA	20.00	5.0	SC	AF012RZ05	
SA1	20.00	5.0	TB	BD012RZ05	
SA2	20.00	7.0	SC	AF012RZ07	
SB	21.00	4.0	SC	AF012RE04	
SB	21.00	5.0	SC	AF012RE05	
SB	21.00	7.0	TC	BF012RE07	
SB1	22.00	4.0	SC	AF012RR04	
SB1	22.00	5.0	SC	AF012RR05	
SB1	22.00	7.0	TC	BF012RR05	
SC	22.00	7.0	BAFU2TC	BF012RR07	
SC	22.00	7.0	SC	AF012RR07	
SC	22.00	7.0	TC	BF012RR07	
SC	22.00	6.5/8.0	TC	BF012RR8L	
SC	24.00	6.0	TC	BF012RH06	
SC	24.00	7.0	SB	AD012RH07	
SC	24.00	7.0	TC	BF012RH07	
SC	25.00	4.5	TC	BF012RU45	
SC	25.00	5.0	SC	AF012RU05	
SC	25.00	7.0	TC	BF012RU07	
SC	25.00	7.8/5	TC	BF012RU92	
TA	26.00	7.0	SC	AF012RL07	
TA	26.00	7.0	TC	BF012RL07	
TA	26.00	8.0	SC	AF012RL08	
TA1	27.00	5.0	TC	BF012RC05	
TA1	28.00	7.0	SB	AD012RB07	
TA1	28.00	7.0	SC	AF012RB07	
TA2	28.00	7.0	TC	BF012RB07	
TA2	28.00	8.0	TC	BF012RB08	
TB	30.00	5.0	SB	AD012S205	
TB	30.00	5.0	SC	AF012S205	
TB	30.00	6.0	TC	BF012S206	
TB	30.00	7.0	SC	AF012S207	
TB1	30.00	8.0	SC	AF012S208	
TB1	32.00	5.0	SB	AD012SR05	
TB1	32.00	7.0	SC	AF012SR07	
TC	32.00	10.0	TC	BF012SR10	
TC	35.00	7.0	SC	AF012SU07	
TC	35.00	7.0	TC	BF012SU07	
TC	35.00	10.0	SC	AF012SU10	
TC	52.00	5.0	SC	AF012UR05	
AV	12.70	17.46	2.38	VB	CD012EC02
AV	13.00	19.00	3.0	VC	CF013EG03
VA1	22.00	5.0	SC	AF013RR05	
VA1	22.00	6.0	SC	AF013RR06	
VA1	25.00	7.0	TC	BF013RL07	
VA2	26.00	7.0	SC	AF013RL07	
VA2	28.00	7.0	TC	BF013RB07	
VA2	30.00	7.0	SC	AF013S207	




**OIL SEAL SIZES AND TYPE BY SHAFT DIAMETER**

SHAFT	BORE	HEIGHT	TYPE	CODE-NO	STANDARD DESIGNS
16.00	30.00	7.0	SC	AF016SZ07	
	30.00	7.0	TC	BF016SZ07	
	30.00	8.0	SC	AF016SZ08	
	30.00	8.0	TC	BF016SZ08	
	30.00	10.0	SC	AF016SZ10	
	32.00	6.5	TC	BF016SR65	
	32.00	7.0	SB	AD016SR07	
	32.00	7.0	SC	AF016SR07	
	32.00	9.0	VC	CF016SR09	
	32.00	9.0	VB	CD016SR09	
	35.00	7.0	SC	AF016SU07	
	35.00	7.0	TC	BF016SU07	
	35.00	8.0	SC	AF016SU08	
	38.00	7.0	TC	BF016SB07	
	40.00	8.0	SC	AF016HZ08	
	40.00	10.0	SC	AF016HZ10	
	42.00	8.0	TC	BF016HR08	
	47.00	7.0	SC	AF016HC07	
16.20	34.10	3.98	TC	BF16PSH3G	
16.50	27.00	8.0	SC	AF16HRC08	
16.90	28.00	5.0	SC	AF16PRB05	
17.00	25.00	4.0	SC	AF017RU04	
	26.00	6.0	SC	AF017RL06	
	28.00	5.0	TB	BD017RB05	
	28.00	6.0	SC	AF017RB06	
	28.00	6.0	TC	BF017RB06	
	28.00	7.0	DC	EF017RB07	
	28.00	7.0	SB	AD017RB07	
	28.00	7.0	SC	AF017RB07	
	28.00	7.0	TB	BD017RB07	
	28.00	7.0	TC	BF017RB07	
	28.00	8.0	TC	BF017RB08	
	28.50	6.0	SC	AF17RBU06	
	28.65	7.0	TC	BF17RBL07	
	29.00	5.0	SC	AF017RG05	
	29.00	5.0	TC	BF017RG05	
	30.00	6.5	SC	AF017SZ06	
	30.00	6.0	TC	BF017SZ06	
	30.00	7.0	SB	AD017SZ07	
	30.00	7.0	SC	AF017SZ07	
	30.00	7.0	TC	BF017SZ07	
	30.00	8.0	TC	BF017SZ08	
	32.00	7.0	SC	AF017SR07	
	32.00	7.0	TC	BF017SR07	
	32.00	7.5	SB	AD017SR75	
	34.00	7.0	SC	AF017SH07	
	35.00	5.0	SC	AF017SU05	
	35.00	6.0	SC	AF017SU06	
	35.00	7.0	SC	AF017SU07	
	35.00	7.0	TB	BD017SU07	
	35.00	7.0	TC	BF017SU07	
	35.00	8.0	SC	AF017SU08	
	35.00	8.0	TC	BF017SU08	
	35.00	10.0	SC	AF017SU10	

STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER				
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO
SA	17.00	37.00	7.0	SC	AF017SC07
	37.00	8.0	TC	BF017SC08	
	37.00	10.0	TB	BD017SC10	
	38.00	7.0	SC	AF017SB07	
	38.00	7.0	TC	BF017SB07	
SA1	40.00	7.0	SC	AF017HZ07	
	40.00	7.0	TC	BF017HZ07	
	40.00	8.0	SC	AF017HZ08	
SA2	40.00	8.0	TC	BF017HZ08	
	40.00	10.0	SC	AF017HZ10	
SB	47.00	3.0	TB	BD018RH03	
	24.00	3.0	VC	CF018RH03	
	24.00	4.0	SB	AD018RH04	
	24.00	4.0	V8	CD018RH04	
SB1	25.00	6.0	SB	AD018RU06	
	27.00	5.0	SC	AF018RC05	
	27.00	5.0	VC	CF018RC05	
SC	28.00	4.0	SC	AF018RB04	
	28.00	5.0	SC	AF018RB05	
	28.00	6.0	SC	AF018RB06	
	28.00	7.0	SB	AD018RB07	
	28.00	7.0	TC	BF018RB07	
TA	28.00	8.0	SC	AF018RB08	
	28.00	8.0	TC	BF018RB08	
	28.00	6.5/8.0	TC	BF018RB08	
TA1	30.00	7.0	SC	AF018SZ07	
	30.00	7.0	TC	BF018SZ07	
	30.00	8.0	TC	BF108SZ08	
TA2	32.00	5.0	SB	AD018SR05	
	32.00	7.0	SC	AF018SR07	
	32.00	7.0	TC	BF018SR07	
TB	32.00	8.0	SC	AF018SR08	
	32.00	7/8	TC	BF018SR87	
	35.00	7.0	SC	AF018SU07	
	35.00	7.0	TC	BF018SU07	
TB1	35.00	8.0	SC	AF018SU08	
	35.00	10.0	SC	AF018SU10	
	35.00	10.0	TC	BF018SU10	
TC	37.00	8.0	SC	AF018SC08	
	38.00	5.0	SC	AF018SB05	
	38.00	7.0	TC	BF018SB07	
	40.00	7.0	SC	AF018HZ07	
	47.00	10.0	TC	BF018HC10	
TC1	47.00	9.0	VC	CF018SR09	
	32.00	5.0	SC	AF18PSZ05	
	32.00	6.0	SC	BFY18SE11	
AV	32.00	9.0	VC	CF018SR09	
	30.00	5.0	SC	AF019RC06	
	31.37	11.5	TCY	BFY18SE11	
VA1	31.37	11.5	TCY	BFY18SE11	
	27.00	6.0	SC	AF019RC06	
	30.00	7.0	SC	AF019SZ07	
	30.00	8.0	SC	AF019SZ08	
VA2	31.00	8.5/12	TCY	BFY18SE12	









OIL SEAL SIZES AND TYPE BY SHAFT DIAMETER					STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER				
SHAFT	BORE	HEIGHT	TYPE	CODE-NO		SHAFT	BORE	HEIGHT	TYPE	CODE-NO
28.00	42.00	7.0	SC	AF028HR07		30.00	45.00	8.0	SC	AF030HU08
	42.00	7.0	TC	BF028HR07			45.00	8.0	TC	BF030HU08
	42.00	8.0	TC	BF028HR08			45.00	9.5	SC	AF030HU95
	42.00	10.0	SC	AF028HR10			45.00	10.0	SC	AF030HU10
	42.00	10.0	TC	BF028HR10			45.00	10.0	TC	BF030HU10
	43.00	8.0	SC	AF028HS08			45.00	11.0	TC	BF030HU11
	44.50	8.0	SC	AF28HHU08			46.00	12.0	DC	EF030HU12
	45.00	7.0	TC	BF028HU07			46.00	5.0	TC	BF030HL05
	45.00	8.0	SC	AF028HU08			46.00	7.0	SC	AF030HL07
	45.00	8.0	TC	BF028HU08			46.00	7.0	TC	BF030HL07
	45.00	10.0	TC	BF028HU10			46.00	8.0	TC	BF030HL08
	47.00	7.0	SC	AF028HC07			47.00	5.0	SC	AF030HC05
	47.00	7.0	TC	BF028HC07			47.00	6.0	TC	BF030HC06
	47.00	10.0	SC	AF028HC10			47.00	7.0	SB	AD030HC07
	47.00	10.0	TC	BF018HC10			47.00	7.0	SC	AF030HC07
	48.00	7.0	SC	AF028HB07			47.00	8.0	SC	AF030HC08
	50.80	10.0	TB	BD028UZ10			47.00	8.0	TC	BF030HC08
	52.00	6.0	TC	BF028UR06			47.00	10.0	DC	EF030HC10
	52.00	7.0	SC	AF028UR07			47.00	10.0	SA2	AC030HC10
	52.00	7.0	TC	BF028UR07			47.00	10.0	SC	AF030HC10
	52.00	10.0	TC	BF028UR10			47.00	10.0	TB	BD030HC10
	62.00	12.0	SA2	AC028LR12			48.00	8.0	SC	AF030HB08
	72.00	10.0	SC	AF028CR10			48.00	8.0	TC	BF030HB08
28.50	44.53	10.0	TC	BF28UHH10			48.00	10.0	TC	BF030HB10
28.60	43.60	5.0	TB	BD028HS05			48.00	10.0	SC	AF030UZ07
	43.60	5.0	TB3	BDS28HS05			50.00	7.0	SC	AF030UZ08
29.00	40.00	7.0	SC	AF029HZ07			50.00	8.0	SC	BF030UZ08
	43.00	8.0	TC	BF029HS08			50.00	8.0	TC	BFH30UZ08
30.00	45.00	10.0	SC	AF029HU10			50.00	8.0	TC4	BFH30UZ08
	35.00	2.9	SB	AD030SU29			50.00	10.0	SA2	AC030UZ10
	35.00	2.9	VB	CD030SU02			50.00	10.0	SC	AF030UZ10
	40.00	5.0	SC	AF030HZ05			50.00	10.0	TC	BF030UZ10
	40.00	7.0	SB	AD030HZ07			50.00	11.0	TC	BF030UZ11
	40.00	7.0	SC	AF030HZ07			50.00	11.0	TC4	BFH30UZ11
	40.00	7.0	TC	BF030HZ07			50.00	12.0	SC	AF030UZ12
	40.00	8.0	DC	EF030HZ08			50.00	12.0	TC	BF030UZ12
	40.00	8.0	SC	AF030HZ08			52.00	5.0	SC	AF030UR05
	40.00	8.0	TC	BF030HZ08			52.00	7.0	SC	AF030UR07
	40.00	6.5/8.0	TC	BF030HZ87			52.00	7.0	TC	BD030UR07
	42.00	4.5	SC	AF030HR45			52.00	7.0	SC	BF030UR07
	42.00	5.0	TC	BF030HR05			52.00	8.0	SC	AF030UR08
	42.00	6.0	TC	BF030HR06			52.00	8.0	TB	BD030UR08
	42.00	7.0	DC	EF030HR07			52.00	8.0	TC	BF030UR08
	42.00	7.0	SC	AF030HR07			52.00	10.0	SB	AD030UR10
	42.00	7.0	TB	BD030HR07			52.00	10.0	SC	AF030UR10
	42.00	7.0	TC	BF030HR07			52.00	10.0	TB	BD030UR10
	42.00	8.0	SC	AF030HR08			52.00	10.0	TC	BF030UR10
	42.00	8.0	TC	BF030HR08			52.00	12.0	SC	AF030UR12
	42.00	10.0	SC	AF030HR10			52.00	12.0	TC	BF030UR12
	42.00	10.5	TC4	BFH30HR10			53.60	10.0	TC	BF30USL10
44.53	10.0	TC	BF30HU10			55.00	6.0	SC	AF030UU06	
	45.00	5.0	SC	AF030HU05			55.00	7.0	SC	AF030UU07
	45.00	7.0	SC	AF030HU07			55.00	7.0	TC	BF030UU07
	45.00	7.0	TC	BF030HU07			55.00	10.0	SC	AF030UU10





























STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER					STANDARD DESIGNS
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO	
SA	0.8750	1.5000	0.25	SC	AFZ56SR16	VB
		1.5000	0.375	SC	AFZ56SR24	
		1.5000	0.375	TB	BDZ56SR24	
		1.5000	0.375	TC	BFZ56SR24	
SA1	1.1250	1.5000	0.3906	SC	AFZ56SR25	VB1
		1.6250	0.25	SC	AFZ56HZ16	
		1.6250	0.375	SC	AFZ56HZ24	
		1.6250	0.375	TC	BFZ56HZ24	
SA2	0.9110	1.3750	0.25	SC	AFZ91RH16	VC
		1.3880	0.25	TC	BFZP9PS16	
		1.5000	0.375	SC	AFZ60SR24	
		1.5000	0.375	TB	BDZ60SR24	
SB	1.0000	1.6250	0.375	SC	AFZ60HZ24	VC1
		1.2500	0.125	VCY	VYE00EL08	
		1.3250	6.0	TB	BDE00PS16	
		1.3750	0.1875	SC	AFE00RH12	
SB1	1.0625	1.3750	0.25	SC	AFE00RH16	KA
		1.3750	0.5625	TB	BDE00RH36	
		1.4375	0.25	SC	AFE00RB16	
		1.4990	0.25	TC	BFE00PH16	
SC	1.0625	1.5000	0.1875	S8	ADE00SR12	KA1
		1.5000	0.1875	SC	AFE00SR12	
		1.5000	0.25	SC	AFE00SR16	
		1.5000	0.25	TC	BFE00SR16	
TA	1.0625	1.5000	0.3125	SC	AFE00SR20	KA2
		1.5000	0.3125	TB	BDE00SR20	
		1.5000	0.375	SC	AFE00SR24	
		1.5000	0.375	TC	BFE00SR24	
TA1	1.0625	1.5030	0.25	TC	BFE00PU16	KB
		1.5030	0.39	SA2	ACE00SR25	
		1.5040	0.312	TC	BFE00PUP3	
		1.5625	0.375	SC	AFE00SL24	
TA2	1.0625	1.5670	0.1875	V CY	VYE00SC12	KB1
		1.6250	0.25	SC	AFE00HZ16	
		1.6250	0.2969	TB	BDE00HZ19	
		1.6250	0.3125	SC	AFE00HZ20	
TB	1.0625	1.6250	0.375	SC	AFE00H224	KC
		1.6250	0.375	SC	AFE00HB16	
		1.7500	0.25	SC	AFE00HB24	
		1.7500	0.375	SC	AFE00CU24	
TB1	1.0625	1.7500	0.375	SC	ACE00UZ28	KC1
		1.7500	0.439	SA2	ACE00UZ28	
		1.8280	0.4375	SC	AFE00BR28	
		1.8750	0.25	SC	AFE00UL16	
TC	1.0625	2.0000	0.25	SC	AFE00ZZ16	DA
		2.0000	0.375	SA2	ACE00ZZ24	
		2.0000	0.375	SC	AFE00ZZ24	
		2.0000	0.375	TB	BDE00LH24	
TC1	1.0625	2.0000	0.5	SC	AFE00ZZ32	DB
		2.0625	0.1875	SC	AFE00ZH12	
		1.5000	0.25	SC	AFE04SR16	
		1.5625	0.3125	SC	AFE04SL20	
AV	1.0625	1.6250	0.375	S8	ADE04HZ24	DC
		1.6250	0.375	SC	AFE04HZ24	
		1.7500	0.4375	SC	AFE04HB28	
		1.7500	0.4375	SC	AFE04HB28	
VA1	1.0625	1.0625	0.1875	SC	AFE00Z24	470
		1.5000	0.25	SC	AFE04SR16	
		1.5625	0.3125	SC	AFE04SL20	
		1.6250	0.375	S8	ADE04HZ24	
VA2	1.0625	1.6250	0.375	SC	AFE04HZ24	420
		1.7500	0.4375	SC	AFE04HB28	

# OIL SEAL



STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER					STANDARD DESIGNS
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO	
SA	1.2500	1.8750	0.4375	TC	BFE16UL28	VB
		1.9375	0.4375	SC	AFE16LZ28	
SA1	2.0000	1.9830	0.25	VA2	CCE16LS16	VB1
		2.0000	0.25	SB	ADE16ZZ16	
SA2	2.0000	2.0000	0.375	SC	AFE16ZZ24	VC
		2.0000	0.437	TA3	BSE16ZZ28	
SB	2.1250	2.0000	0.4375	SB	ADE16ZZ28	VC1
		2.1250	0.5	SC	AFE16ZZ32	
SB1	2.1875	2.1875	0.3125	SC	AFE16ER20	KA
		2.1875	0.375	SC	AFE16ER24	
SC	2.2500	2.1960	0.375	TC	BFE16PR24	KA1
		2.2500	0.25	SC	AFE16EL16	
SC1	1.3125	2.2500	0.3125	SC	AFE16EL20	KA2
		2.2500	0.375	SC	AFE16EL24	
TA	1.3281	2.2500	0.375	TC	BFE16EL24	KB
		2.0625	0.375	SC	AFE21ZH24	
TA1	1.3438	2.0625	0.375	SC	AFE21ZH24	KB1
		2.0625	0.5	SA	AAE21EU32	
TA2	1.3750	2.6875	0.375	SC	AFE21HH24	KC
		1.8750	0.5	TC	BFE22ZH32	
TB	1.8750	1.8750	0.3125	SB	ADE24UL20	KC1
		1.8750	0.375	SC	AFE24UL20	
TB1	1.9669	1.8750	0.4375	SC	AFE24UL24	DA
		1.9669	0.3307	TB	BDE24UL28	
TC	2.0000	2.0000	0.3125	SB	ADE24LR21	DB
		2.0000	0.3125	SC	ADE24ZZ20	
TC1	2.1250	2.0000	0.3125	SC	ADE24ZZ20	DC
		2.1250	0.375	TC	BFE24ZZ24	
AV	2.1250	2.0000	0.5	SC	AFE24ZZ32	470
		2.1250	0.25	SC	AFE24ZH16	
VA1	2.1250	2.0625	0.625	TC	BFE24ZH40	420
		2.1250	0.3125	SC	AFE24ZB20	
VA2	2.1250	2.1250	0.375	SB	ADE24ZB24	380
		2.1250	0.375	TC	BFE24ZB24	
VA3	2.1350	2.1350	0.3125	SC	AFE24PE20	380
		2.2500	0.375	SC	AFE24EL24	
VA4	2.2500	2.2500	0.5	SC	AFE24EL32	380
		2.2500	0.375	SC	AFE24PR24	
VA5	2.2590	2.3750	0.375	SC	AFE24RH24	380
		2.3750	0.5	SC	AFE24RH32	
VA6	2.5000	2.5000	0.5	SC	AFE24SR32	380
		2.5000	0.6875	TB	BDE24SR44	
VA7	2.5000	2.5000	0.6875	TB		380
		2.5000	0.6875	TB		



STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER					STANDARD DESIGNS
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO	
SA	1.6250	2.3750	0.375	TC	BFE40RH24	VB
		2.5000	0.3125	SC	AFE40SR20	
SA1	2.5000	0.4688	0.5	SC	AFE40SR30	VB1
		2.6000	0.4375	TB	BDE40HZ28	
SA2	2.6250	0.5	0.5	SB	ADE40HZ32	VC
		2.6250	0.5	SC	AFE40HZ32	
SB	2.7500	0.5	0.5	SC	AFE40HB32	VC1
		2.8750	0.6250	DC	EFE40UL40	
SB1	1.6560	2.6330	0.394	TCY	BYE42HE25	KA
		1.6875	2.5000	0.375	SC	AFE44SR24
SC	2.6250	0.5	0.5	TB	BDE44HZ32	KA1
		2.6875	0.5	SC	AFE44HH32	
SC1	1.7500	2.1250	0.1875	VCY	VYE48ZB12	KA2
		2.1875	0.5	SC	AFE48ER32	
TA	2.2500	0.3125	0.5	SC	AFE48EL20	KB
		2.2500	0.375	SC	AFE48EL24	
TA1	2.2500	0.5	0.5	TB	BDE48EL32	KB1
		2.3125	0.25	SC	AFE48RZ16	
TA2	2.3750	0.25	0.5	SC	ADE48RH16	KC
		2.3750	0.375	SC	AFE48RH24	
TB	2.3750	0.375	0.5	TC	BFE48RH24	KC1
		2.3750	0.625	SC	AFE48RH40	
TB1	2.3800	0.5	0.5	TC	BFE48PS32	DA
		2.4130	0.394	HTB	BDE48RC25	
TC	2.4375	0.375	0.5	SC	AFE48RB24	DB
		2.4410	0.312	TB	BDE48PHP3	
TC1	2.5000	0.3125	0.5	SC	AFE48SR20	DC
		2.5000	0.375	SB	ADE48SR24	
VA	2.5000	0.3750	0.5	DC	EFE48SR24	470
		2.5000	0.375	SC	AFE48SR32	
VA1	2.5000	0.5	0.5	SC	AFE48HB32	420
		2.5000	0.375	TB	BDE48HB32	
VA2	2.6406	0.4375	0.5	SC	AFE52HE28	380
		2.7188	0.2813	SC	AFE52HL18	
	1.8200	2.6250	0.375	SC	AFE82HZ24	
				2.0625	2.8750	0.375
					2.9375	0.3438

# OIL SEAL



STANDARD DESIGNS	OIL SEAL SIZES AND TYPES BY SHAFT DIAMETER					STANDARD DESIGNS
	SHAFT	BORE	HEIGHT	TYPE	CODE-NO	
SA	2.0625	2.9375	0.3438	TC	BFR04LZ22	VB
		3.0000	0.375	SC	AFR04ZZ24	
SA1	2.1250	2.6920	0.3125	SC	AFR08LG20	VB1
		2.8750	0.375	SC	AFR08UL24	
SA2	2.8750	0.4375	0.5	SC	AFR08UL28	VC
		3.0000	0.375	SC	AFR08ZZ24	
SB	2.8750	3.0000	0.5	SC	AFR08ZZ32	VC1
		3.0000	0.5	SC	AFR08ZB32	
SB1	3.1875	3.1875	0.375	TB	BDR08ER24	KA
		3.2500	0.5	SC	AFR08EL32	
SC	2.1800	3.1940	0.698	TC	BFR11PRP6	KA1
	2.1875	3.0000	0.375	SC	AFR12Z224	
SC1	2.2343	3.1300	0.3583	SB	ADR15ZG23	KA2
	2.2400	3.1940	0.646	TB	BDR16PRP6	
TA	2.2500	3.0000	0.375	SC	AFR16Z224	KB
		3.0000	0.5	SC	AFR16ZB32	
TA1	3.3750	3.1250	0.5	SC	AFR16ZB32	KC
	3.1250	3.2500	0.2813	SC	AFR16EL18	
TA2	2.3125	3.0050	0.5	SA2	ACR20Z224	KC1
	3.0625	3.0625	0.375	SC	AFR20ZH24	
TB	3.1250	3.1250	0.375	SC	AFR20ZB24	DA
	3.1620	3.3438	0.5	SC	AFR20PE32	
TB1	2.3300	3.3550	0.3125	SB	ADR20RR20	DB
	2.3750	3.0050	0.375	SB	ADR21Z224	
TC	3.3550	3.3550	0.3125	TC	BFR20PS20	DC
	3.0130	3.0130	0.437	SB	VYR24UL13	
TC1	3.1250	3.1250	0.375	SC	AFR24UL24	470
	3.1250	3.3750	0.375	TC	BFR24ZB24	
AV	3.2500	3.2500	0.4	SB	ADR24EL26	420
	3.3750	3.3750	0.3125	SC	AFR24RH20	
VA1	2.4375	3.7500	0.5	SC	OCR24RH24	380
	3.0625	3.2500	0.375	SC	AFR24RH32	
VA2	2.5000	3.2810	0.375	SC	BFR24RH32	
	3.0000	3.0000	0.375	TC	BFR32ZZ24	
	3.2500	3.2500	1.5	SC	AFR32ZZ32	
	3.2500	3.2500	0.375	TB	BDR32EL24	
	3.2500	3.2500	0.375	SC	AFR32EL24	
	3.3750	3.3750	0.5	SC	AFR32EL32	
		0.5	DC	EFR32RH32		

