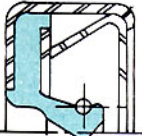
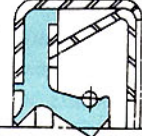
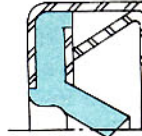
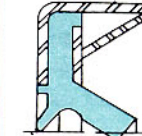
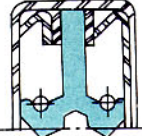
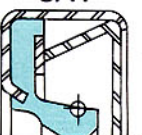
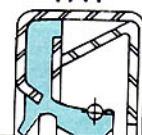
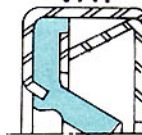
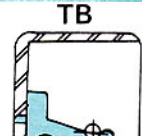
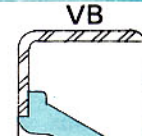
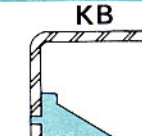
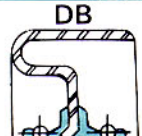
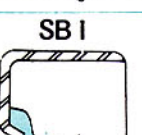
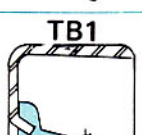
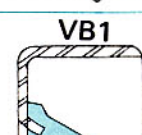
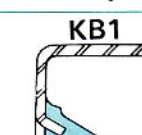
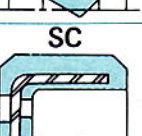
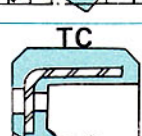
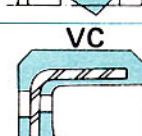
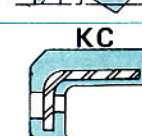
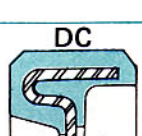
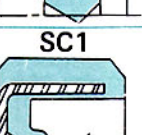
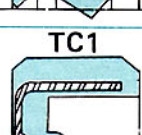
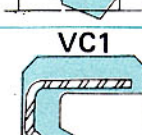
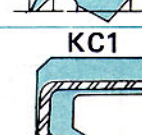


4. STANDARD SEAL DESIGNS

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 Body 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.
A	These are assembled type, Metal O.D. reinforced with an inner case for greater structural rigidity.					
A ₁	An auxiliary metal rings to prevent the root of the lip against deformation due to high pressure, others the same as A type.					
A ₂	Semi-assembled type Design for special packing materials or heavy duty outer cases necessary.					
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.					
B ₁	An auxiliary ring to prevent the root of the lip against deformation due to high pressure, others the same as B type.					
C	Rubber O.D. and an inner metal components design for excellent O.D. sealing ability.					
C ₁	An auxiliary ring to prevent the root of the lip against deformation due to high pressure, others the same as C type.					

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.

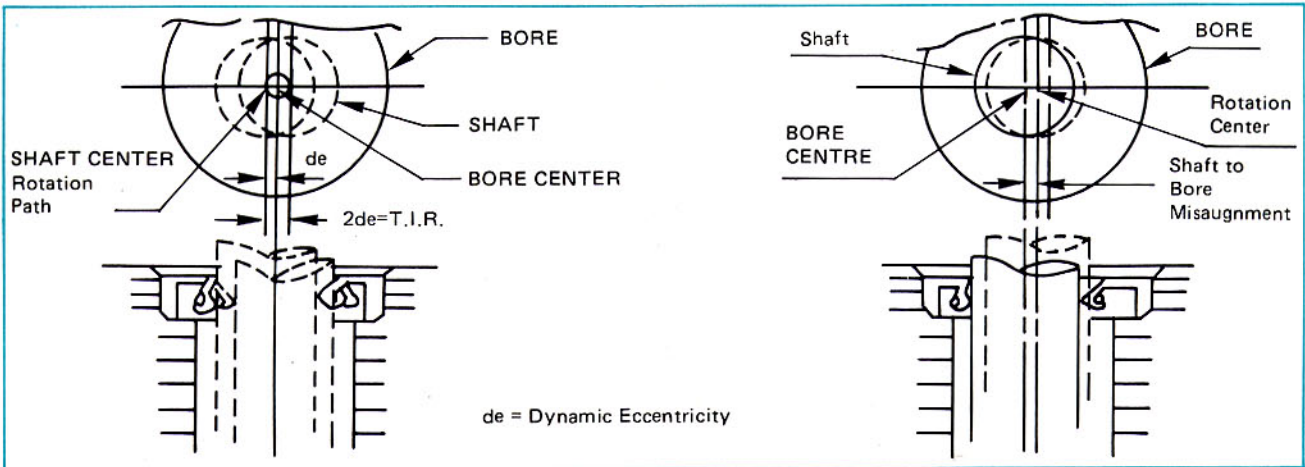
SHAFT DIAMETER	NITRILE LIP MAXIMUM CONTINUOUS SHAFT SPEED 1.	MAXIMUM CONTINUOUS PRESSURE 2.	MAXIMUM TOTAL ECCENTRICITY 3.
General	3,500 rpm	5 psi	.020"
.500	8,000 rpm	5 psi	.004"
1.000	7,000 rpm	5 psi	.006"
2.000	4,500 rpm	5 psi	.010"
3.000	3,800 rpm	5 psi	.013"
4.000	2,750 rpm	5 psi	.017"

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

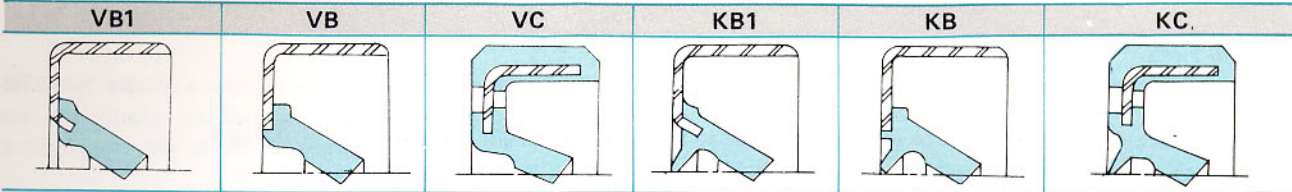
Figure 1. Eccentricity



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.

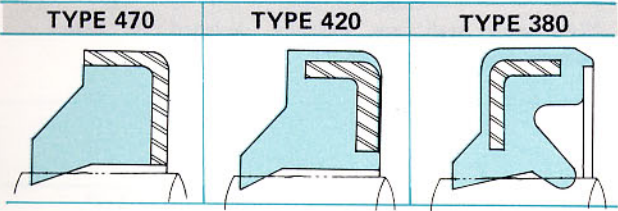
SHAFT DIAMETER	MAXIMUM SHAFT SPEED	MAXIMUM CONTINUOUS PRESSURE	MAXIMUM TOTAL ECCENTRICITY 1.
General	2,000 rpm	4 psi	.005"
.500	4,000 rpm	4 psi	.003"
1.000	3,000 rpm	4 psi	.005"
2.000	2,300 rpm	4 psi	.006"
3.000	1,700 rpm	4 psi	.008"
4.000	1,400 rpm	4 psi	.010"

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



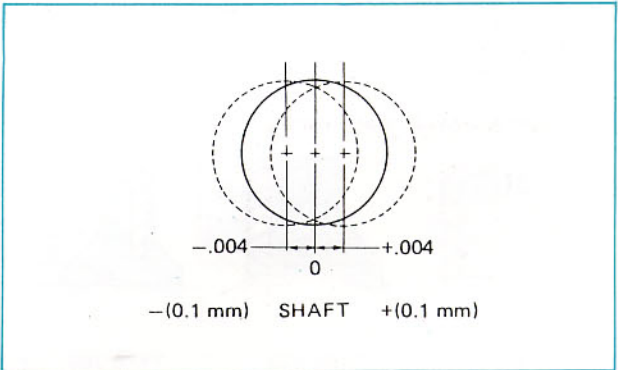
WIPER SEAL design was developed as a dust wiper (scraper) for reciprocating applications such as hydraulic cylinder rods. As a result, the operating limits for the design are slightly different from "V" and "K" types.

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

Maximum pressure capability is 4 psi (.28 Kg/cm²). Stroke length should be limited to 78 inches (1.98m) maximum.

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

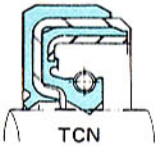
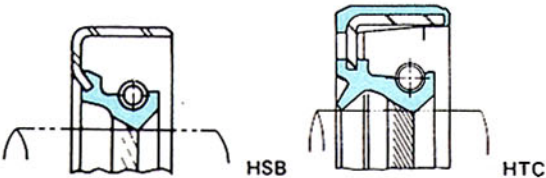
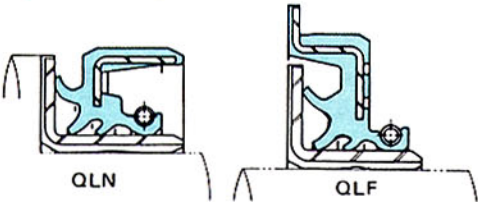
Figure 2. MISALIGNMENT



5.4 NONSTANDARD DESIGNS

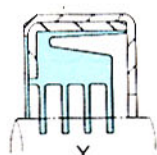
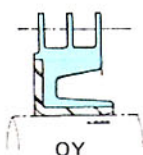
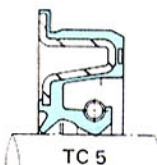
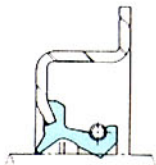
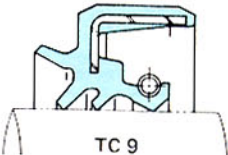
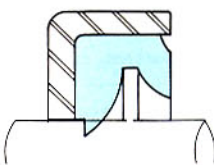
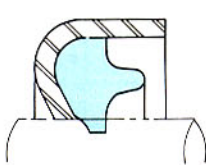
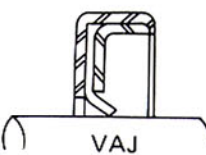
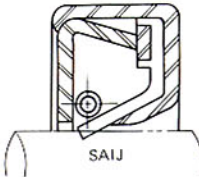
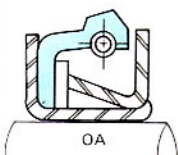
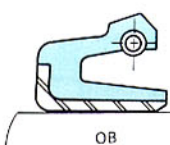
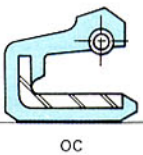
Special applications which cannot be adequately satisfied by standard designs are illustrated on Table 4.

TABLE 4.

SPECIAL DESIGN	DESIGN CHARACTERISTICS
"TCN" (High Pressure)  TCN	Type "TCN" is designed for high pressure applications where continuous pressure may reach 150 psi (10.6 Kg/cm²). Maximum pressure limit is dependent on shaft speed.
"H" Style  HSB HTC	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)  TB4 TC4	"T4" style seals are specially designed for severe reciprocating shaft applications.
"QL" (Sleeve Oil Seals)  QLN QLF	The "QL" 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)  TYPE 470 TYPE 420 TYPE 380	Dust wiper for hydraulic cylinders. Not recommended for pressures above 5 psi (.35 Kg/cm²).

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	 VSW  VSB  VSB5
Y	Special Mud Seal	 Y  OY
"5"	Flange Seals	 TC 5  TB 5
"9"	Side Lip Seals	 TC 9
"UJ"	Universal Joint Seals	 
"RJ"	PTFE Seals	 VAJ  SAIJ
"O"	Rotating Bore	 OA  OB  OC

9. LISTINGS OF AVAILABLE TYPES AND SIZES

9.1 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	.005	.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 -.002	.010	.020
6.001 — 8.000	±.002	BORE DIA + .006	BORE DIA + .010	+.003 -.002	.012	.025
8.001 — 10.000	±.002	BORE DIA + .008	BORE DIA + .010	+.004 -.002	.015	.030
10.001 — 20.000	±.002	BORE DIA + .008	BORE DIA + .010	+.006 -.002	.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

9.2 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.