		C	B	A
		Rubber cover O.D. for improved O.D. sealing ability.	Metal O.D. with ground surface and front chamfer.	Metal O.D. with an inner case.
S	Single lip with a garter spring.	 SC	 SB	 SA
T	Dual lip with a garter spring.	 TC	 TB	 TA
V	Single lip without a garter spring.	 VC	 VB	 VA
K	Dual lip without a garter spring.	 KC	 KB	 KA

Lip Material:

It is very important to take into account the environment in which the seal will operate when you are selecting the sealing element material. The most important factors are temperature, medium being sealed, pressure, and shaft speed.

The table and figures to the right provide general information to help select the compound according to physical property.

Compound	Nitriles (Code N)	Poly Acrylates (Code P)	Silicone (Code S)	Fluoro Rubber Viton (Code V)
Temperature Range	-40˚ to 225˚F	-22˚ to 302˚F	-75˚ to 400˚F	-15˚ to 400˚F
Abrasion Resistance	2	3	4	2
Compression Set	2	3	2	2
Cracking Resistance	3	3	1	2
Cut Growth Resistance	2	2	4	4
Flex Cracking Resistance	3	3	2	2
Impact Strength	2	4	3	3
Low Temperature Resistance	2	4	1	2
Oxidation Resistance	2	1	1	1
Sun Light Resistance	3	1	1	1
Tear Resistance	2	4	4	3
Weathering resistance	2	1	1	1
Note:	1 = Excellent	2 = Good	3 = Fair	4 = Poor

*Elastomer & Rubber Compounds: Due to the number of interacting forces, it is highly recommended that your elastomer selection be rigorously tested in the actual application. Performance assumptions must be checked so that you are certain all variables have been carefully considered.

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Oil Seals

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Design Characteristics

Shaft and Bore Configurations
Shaft Material

Seals perform best on medium carbon steel or stainless steel shaft. Heat treatment or nitriding is especially recommended. To seal water at low surface velocities, stainless steel is more suitable.

The minimum hardness on the area where the sealing lip contacts the shaft should be 45 HRC. Where lubrications is doubtful, abrasive matter is present, or shaft speed is greater than 4m/sec, 55 HRC is preferred.

The shaft must be machined to the surface Roughness of Rt=1 to 4 micrometers (Ra=0.2 to 0.8 micrometers). In the areas of the contact surface, any rifling marks are not permitted.

Nominal Shaft Diameter	Tolerance
up to 4.000	+/- 0.003
over 4.000 to 6.000	+/- 0.004
over 6.000 to 10.000	+/- 0.005
over 10.000	+/- 0.006

Condition	Material	Hardness
General	Carbon Steel (Heat treatment or nitriding is especially recommended)	45 HRC min.
For sealing water with low surface velocity	Stainless Steel	55 HRC min.

Common Materials:

- Nitrile (NBR) (-40°F to +225°F)
- Ethylene-Propylene (EPDM or EPM) (-65°F to +300°F)
- Neoprene® (CR) (-65° to +250°F)
- Silicone (VMQ) (-75° to +450°F)
- Fluorosilicone (FMQ) (-75° to +400°F)
- Polyurethane (PU) (-22°F to 230°F)
- Fluoroelastomer (FPM) (Viton®) (-15°F to +400°F)

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	Rubber Covered, Single Lip w/ Garter Spring	Rubber Covered, Double Lip w/ Garter Spring	Metal OD w/ Ground Surface, Single Lip w/ Garter Spring	Metal OD w/ Ground Surface, Double Lip w/ Garter Spring	Metal OD w/ Ground Surface, Single Lip	Metal OD w/ Ground Surface & Inner Case, Single Lip w/ Garter Spring	Metal OD w/ Ground Surface & Inner Case, Double Lip w/ Garter Spring	Rubber Covered, Single Lip w/ Garter Spring (Viton)	Rubber Covered, Double Lip w/ Garter Spring (Viton)	Rubber Covered, Single Lip	Rubber Covered, Double Lip w/ Garter Spring (High Pressure)	Metal OD w/ Ground Surface & Inner Case, Single Lip	Rubber Covered, Double Lip	Metal OD w/ Ground Surface, Double Lip	Metal OD w/ Ground Surface & Inner Case, Double Lip
															
anyseal	A10	A11	B10	B11	B12	C10	C11	F10	F11	G12	N21				
Chicago Rawhide/SKF	HMS4	HMSA7	CRW1	CRWA1		CRWH1	CRWHA1			HM4					
Dichtomatik	WA	WAS	WB	WBS	WBO	WC	WCS	VIA	VIAS	WAO	WASY/VASY				
Gaco	A	FA	ABI												
Garlock	92	94	76	78	71					91					
GBSA	SC	TC	SB	TB	VB	SA	TA	SC	TC	VC	SC	VA	KC	KB	KA
Goetze	827N	827S	822N	822S		824N	824S								
Harwal	A	ADL	B	BDL	BO	C	CDL	AV	ADLV	AO	ADL-P				
INA										G					
Kaco	DG	DGS	DF	DFS		DFK	DFSK								
National/Timken	35	32	48	47	44	45	41								
NOK	SC	TC	SB	TB	VB	A2	TA2	SC	TC	VC					
Paulstra	IE	IEL	EE	EEL		EEP									
Pioneer Weston	R21	R23	R4	R6		R1									
Simrit-Freudenberg	BA	BASL	B1	B1SL	B1OF	B2	B2SL	BAUMX7	BAUMSLX7	BAOF	BABSL				
Simmerwerke	A	ASL	B	BSL		C	CSL								
Stefa	CB	CC	BB	BC		DB	DC								
Transcom	SC	TC	SB	TB	VB	SA	TA	SC	TC	VC	TCN				

Configuration of the Bore

The leading corner of the bore should be chamfered and free of burrs. The inside corner of the bore should have a maximum radius of 0.047". The tolerances for the bore are shown below.

Bore Tolerance in inches

Bore Diameter	Bore Tolerance
up to 3.000	+/- 0.001
3.001 to 6.000	+/- 0.0015
6.001 to 10.000	+/- 0.002
10.001 to 20.000	+/- 0.002/-0.004
20.001 to 40.000	+/- 0.002/-0.010
40.001 to 60.000	+/- 0.002/-0.0010

Bore Material

Steel and cast iron provide a good surface for both rubber O.D. and metal O.D. seals. For soft alloy (aluminum) bore, seals with rubber O.D. provide better sealing capacity than metal O.D.

The table below shows the recommended maximum bore roughness.

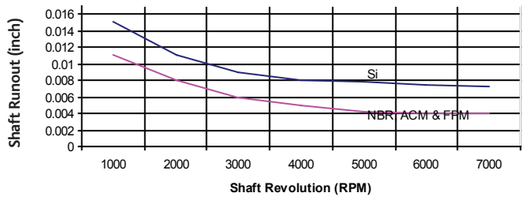
Bore I.D. Roughness	Maximum Roughness
Metal O.D.	10 micro-inches Ra
	2.50 micro-inches Ra
Rubber covered O.D.	150 micro-inches Ra
	3.75 micro-inches Ra

Shaft Eccentricity

Two types of shaft eccentricity effect seal performance. They are dynamic runout (double dynamic eccentricity) and offset (shaft to bore misalignment or static eccentricity).

The accompanying graphs show tolerance levels for each type.

Shaft Runout



Shaft Offset