OIL SEAL

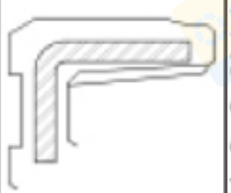
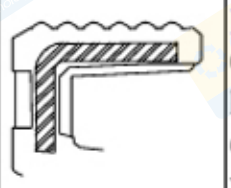
1 Definition of seal types

2 Lip design

Code	Profile Diagram	Remarks
S		**Single lip with a garter spring.** Generally used for sealing lower pressure applications up to 0.5 bar. However, if a backup ring is used this could be increased to operated at around 10 bar. Not recommended for use in applications where the surrounding environment contains any dust or dirt.
T		**Dual lip with a garter spring.** Generally used for sealing lower pressure applications up to 0.5 bar. The additional dust lip provides increased protection for the primary lip. The cavity between the two lips can also be filled with grease to limit shaft corrosion and allow brief operation without media lubrication.
D		**Double lip with garter springs.** Designed to separate two media.
V		**Single lip without a garter spring.** Generally used for sealing a non-pressure medium, especially for sealing grease or viscous fluids. These seals are also used for dust or dirt exclusion.
K		**Dual lip without a garter spring.** As type V above but the additional dust lip provides increased protection for the primary lip. The cavity between the two lips can also be filled with grease to limit shaft corrosion and allow brief operation without media lubrication.

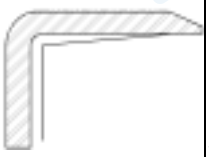
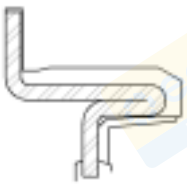
3 Case and seal O.D. design

These can be split into 5 basic types but other more specific designs are also available. The 5 basic types are as follow:

Code	Profile Diagram	Remarks	Bore surface roughness requirement
A		**Outer metal case with reinforcing plate.** This type is designed with an additional inner case providing increased structural rigidity when a more robust design is required. Particularly suitable for larger diameters or when the seal is fitted from behind.	
B		**Outer metal case.** This type is most suitable for steel or cast iron housing materials. The metal case gives a particularly firm and accurate seat in the housing but static sealing on the O.D. is partially limited.	
C		**Rubber covered O.D.** This type is preferred for soft alloy or plastic housing materials as well as cast iron or steel. It is also more suitable to use this design in a replacement environment where minor damage to the housing surface has occurred.	
F		**Rubber covered O.D.** Similar to design C but additional rubber covering fully protecting the internal steel case. Particularly suitable for applications where corrosion could be a problem.	
G		**Rubber covered O.D.** Corrugated O.D. for applications where the housing material is subject to large thermal expansion or press fitting into a housing where installation is usually difficult.	

Remark: "  " represents **Ra 2.5 µm Max.**

"  " represents **Ra 3.75 µm Max.**

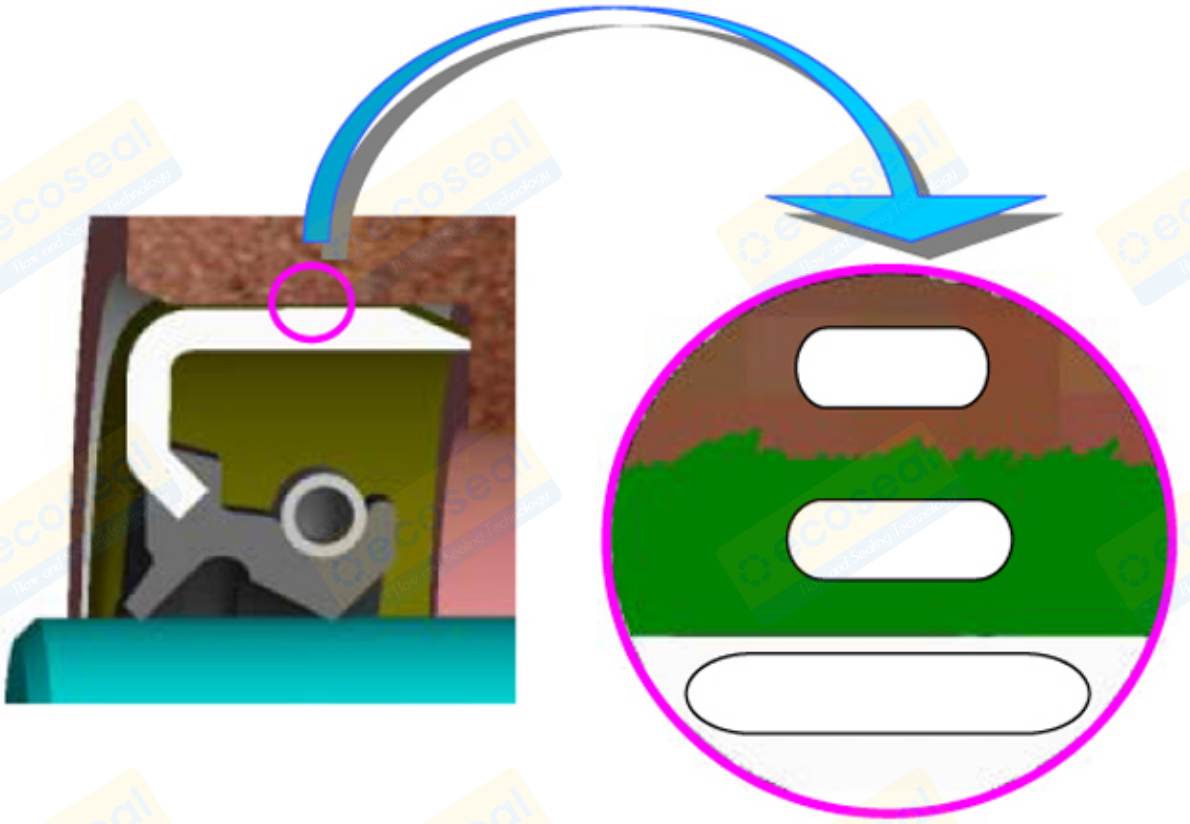
Code	Profile Diagram	Remarks	Bore surface roughness requirement
M		**Outer metal case with rubber lining.** Similar to design B but an additional rubber lining covering the internal face of the steel case. Particularly suitable for applications where corrosion could be a problem.	
BC		**Rubber and case covered O.D.** This design provides the benefit of a metal-to metal press fit and the rubber O.D. sealing ability to counter rough or worn housings.	
J		Rubber O.D. with flange This design will allow easy installation or replacement, gives additional structural rigidity and restricts the installation depth into the housing.	

Remark: “  ” represents **Ra 2.5 µm Max.**

“  ” represents **Ra 3.75 µm Max.**

4 Effects of case O.D. paining

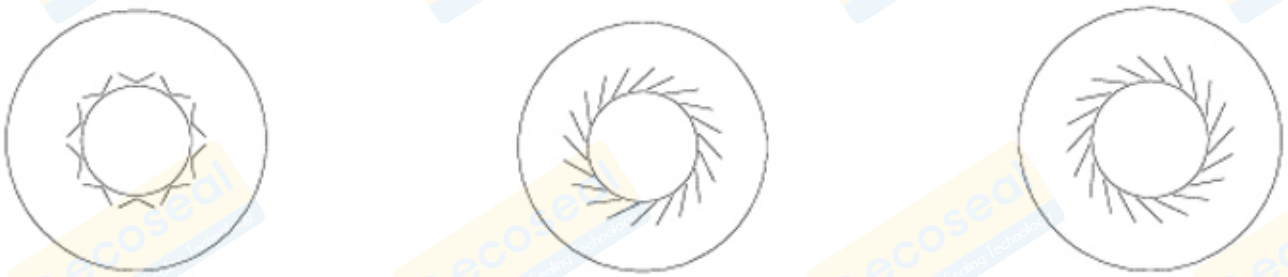
Case O.D. paining with Hypalon can increase sealing function. Hypalon is a soft sealant which can fill gaps or scratches on the housing surface to prevent oil leaking from O.D.. After paining, the O.D. size will increase 0.001”~0.03”(0.025~0.076mm).



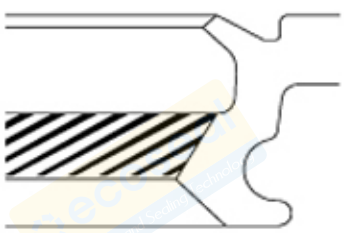
5 Hydrodynamic aid and helix designs

The use of a hydrodynamic aid or helix can improve the performance of the sealing lip. The helix is engraved on the primary lip and causes a pumping action to push any medium back towards the fluid side. There are designs available for bi-directional, left and right and hand shaft rotations.

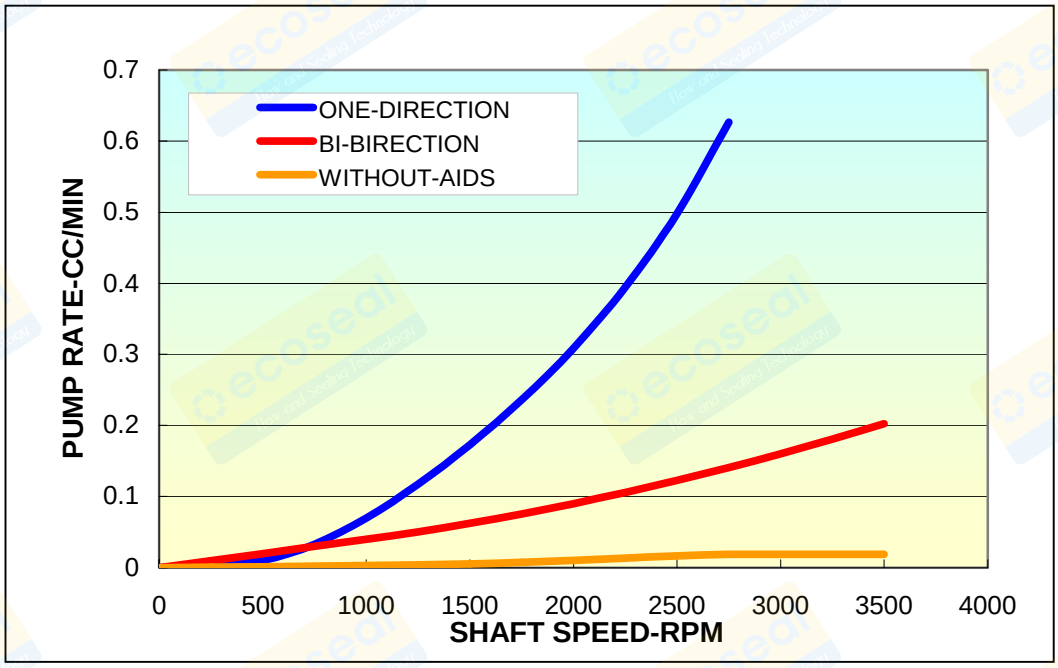
W type (Bi-directional) ⇔ L type(Left-Hand) ⇐ R type(Right-Hand) ⇒



Configuration:

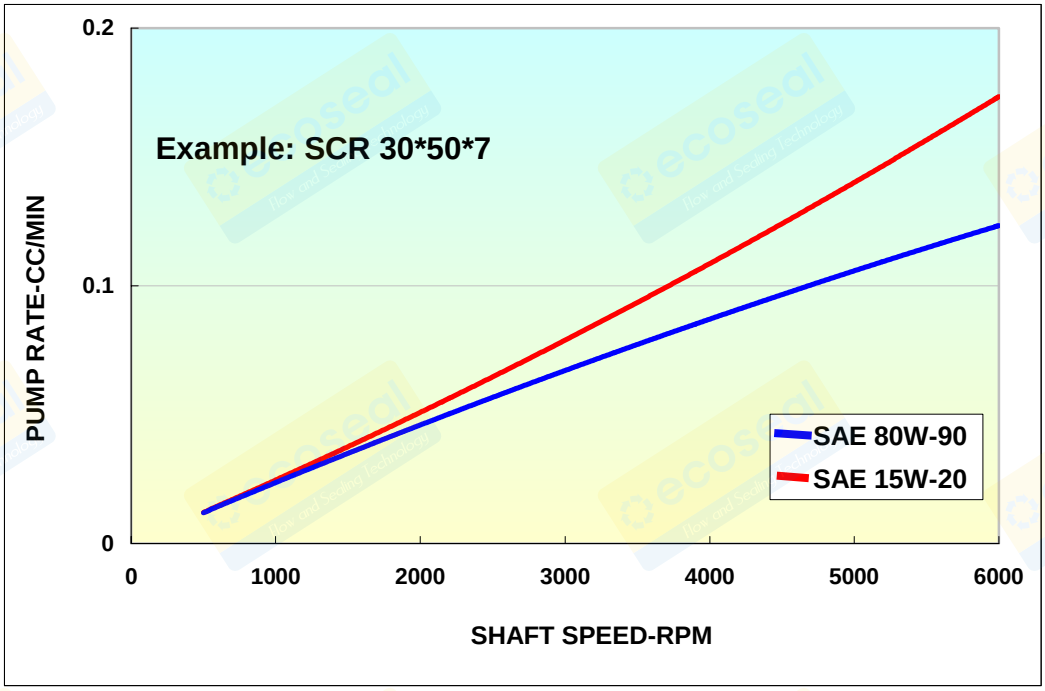


Seal lip with hydrodynamic aid design have greater pumping rate than normal seal lip design (Figure 4-1).



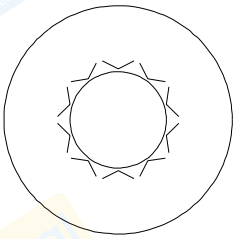
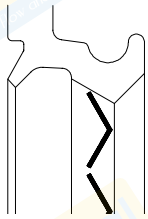
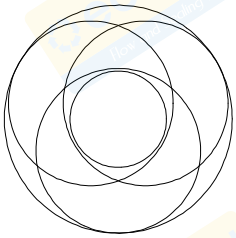
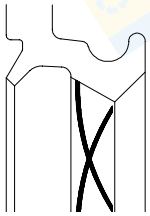
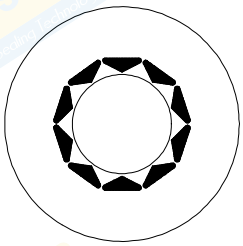
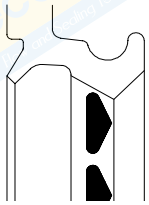
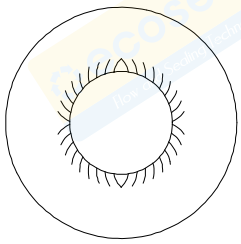
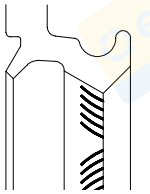
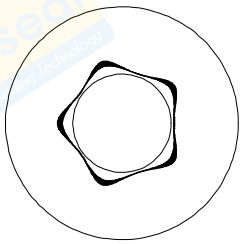
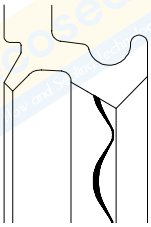
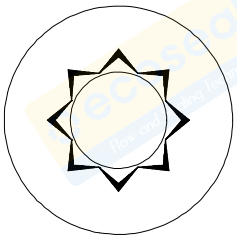
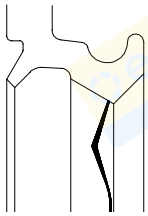
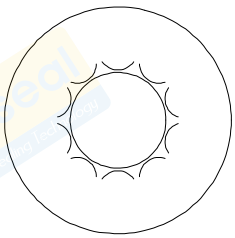
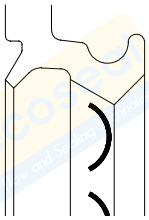
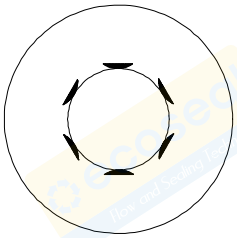
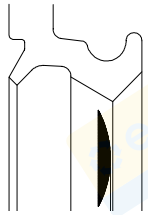
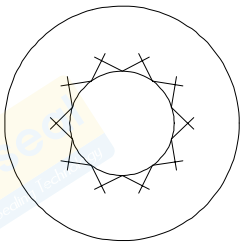
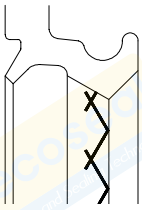
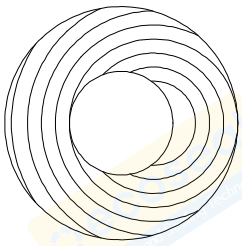
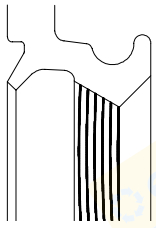
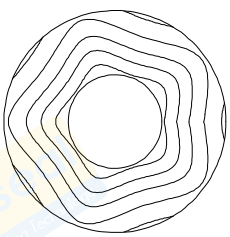
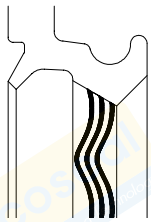
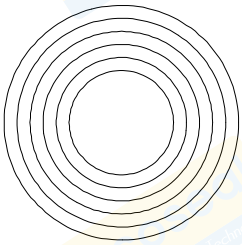
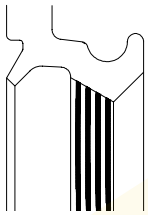
<Figure 4-1> Measured pump rate for various hydrodynamic design.

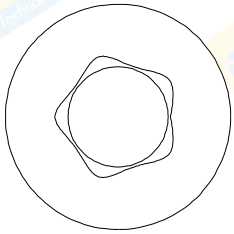
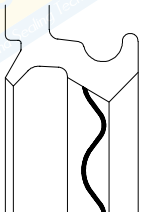
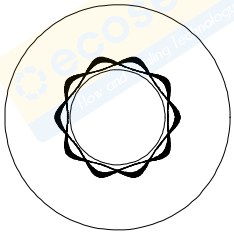
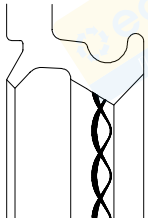
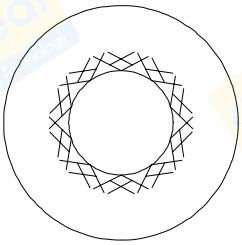
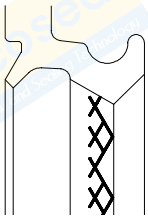
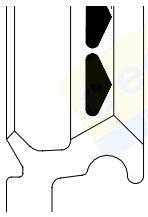
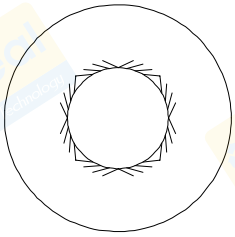
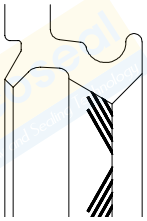
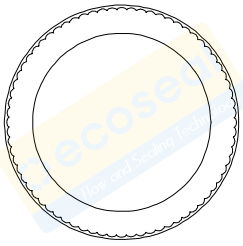
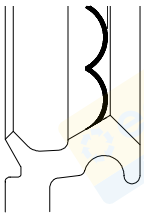
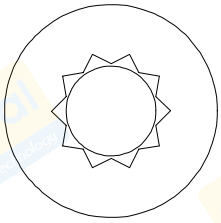
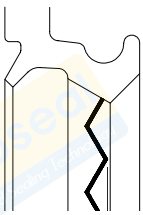
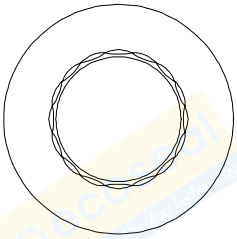
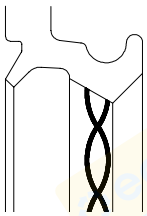
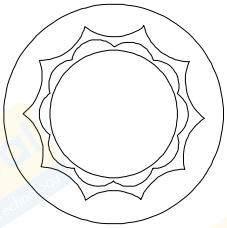
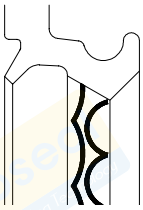
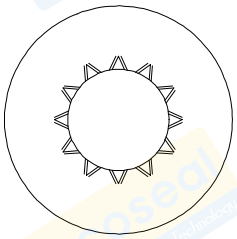
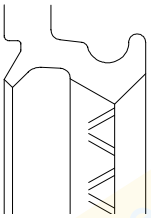
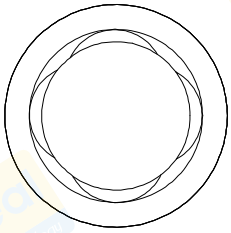
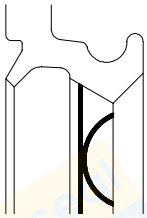
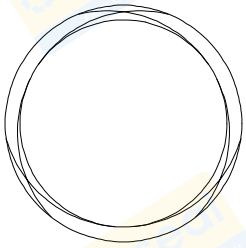
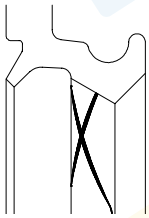
Fluid viscosities have influence on the pumping rate. (Figure 4-2)

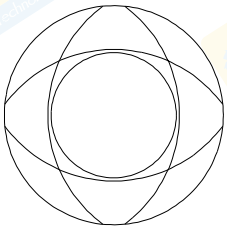
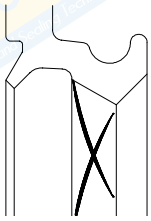


<Figure 4-2> Pump rate versus fluid viscosity.

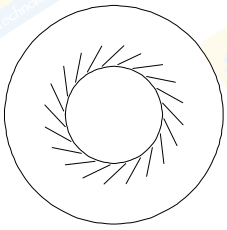
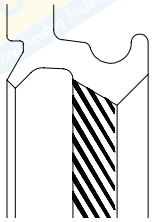
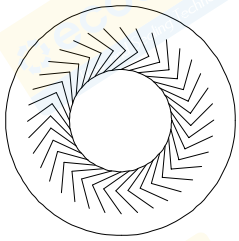
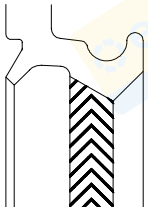
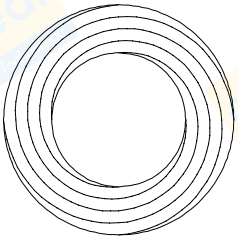
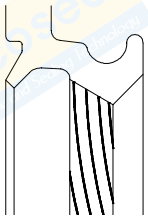
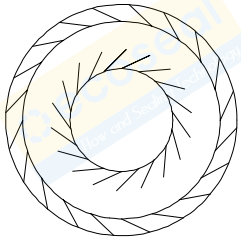
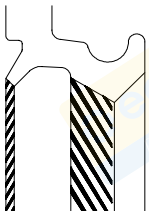
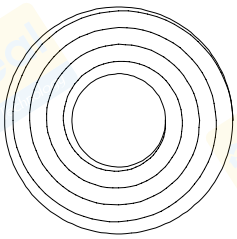
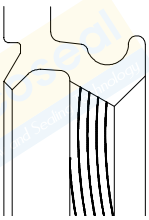
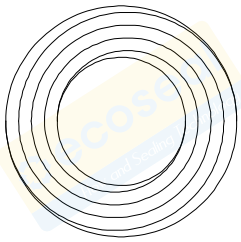
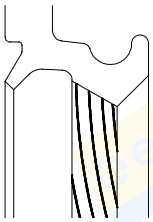
(1). Bi-directional：W type ⇔

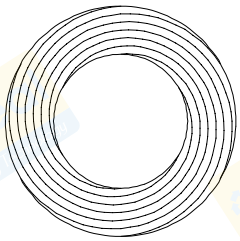
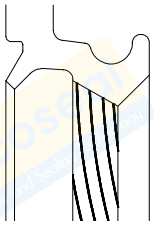
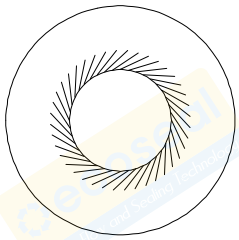
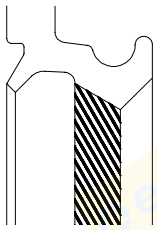
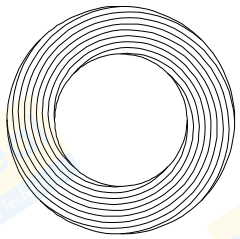
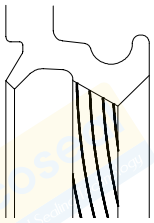
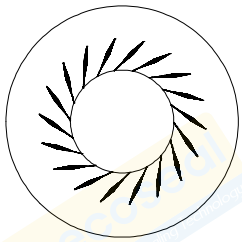
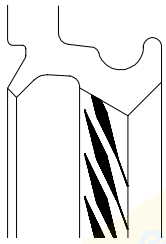
Type	Helix Profile Diagram	Lip Profile Diagram	Type	Helix Profile Diagram	Lip Profile Diagram
W			W6		
W1			W7		
W2			W8		
W3			W9		
W4			W10		
W5			W11		

Type	Helix Profile Diagram	Lip Profile Diagram	Type	Helix Profile Diagram	Lip Profile Diagram
W12			W18		
W13			W19		
W14			W20		
W15			W21		
W16			W22		
W17			W23		

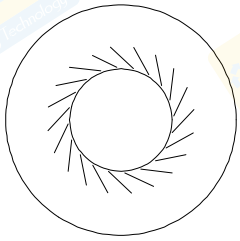
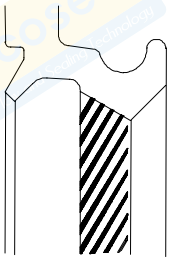
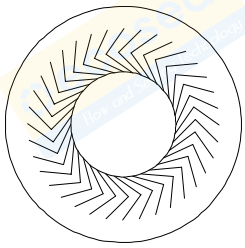
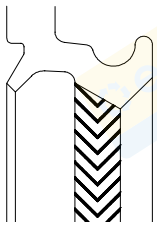
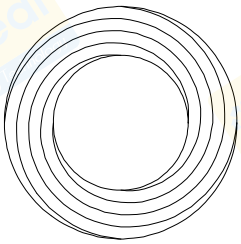
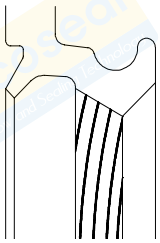
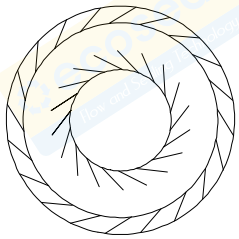
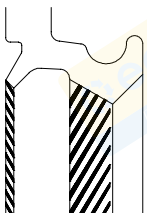
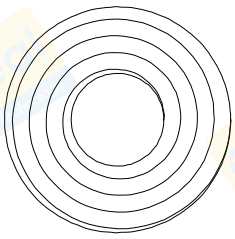
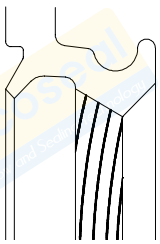
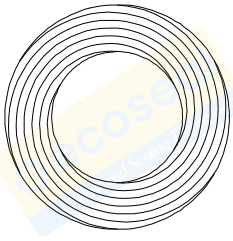
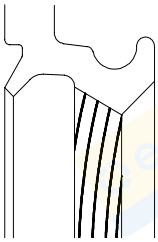
Type	Helix Profile Diagram	Lip Profile Diagram
W24		

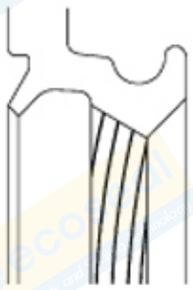
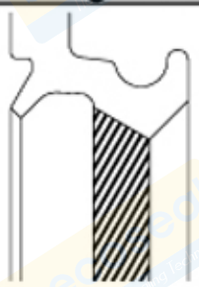
(2). One-directional：L type ⇐

Type	Helix Profile Diagram	Lip Profile Diagram	Type	Helix Profile Diagram	Lip Profile Diagram
L			L3		
L1			L4		
L2			L5		

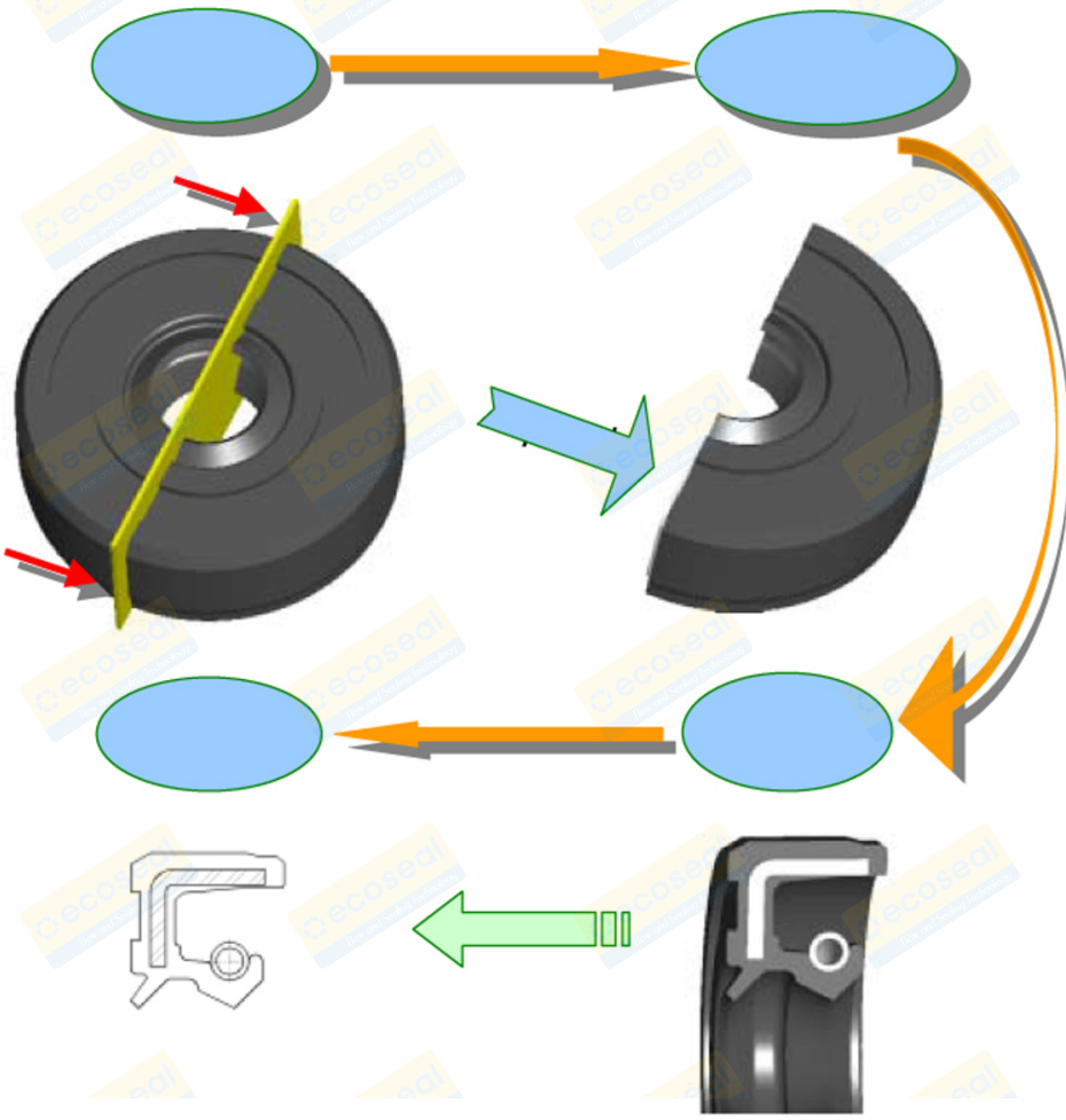
Type	Helix Profile Diagram	Lip Profile Diagram	Type	Helix Profile Diagram	Lip Profile Diagram
L6			L9		
L8			L10		

(3). One-directional：L type ⇒

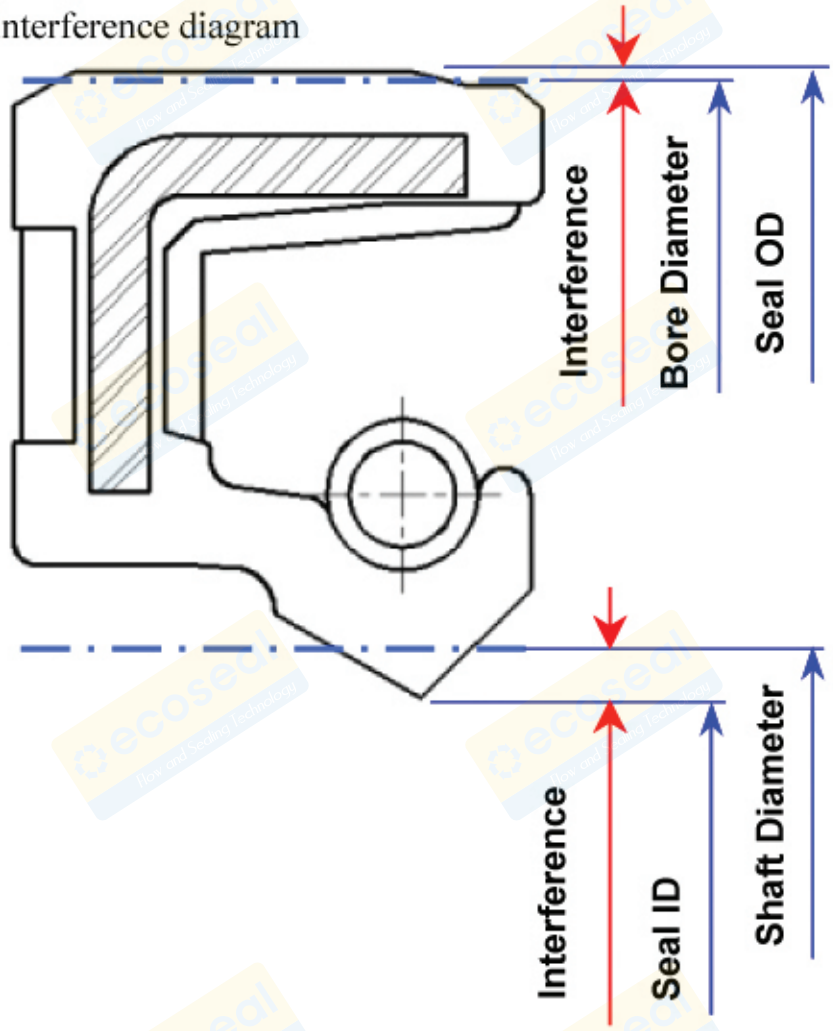
Type	Helix Profile Diagram	Lip Profile Diagram	Type	Helix Profile Diagram	Lip Profile Diagram
R			R3		
R1			R4		
R2			R6		

Type	Helix Profile Diagram	Lip Profile Diagram	Type	Helix Profile Diagram	Lip Profile Diagram
R8			R9		

6 Seal cross-section:



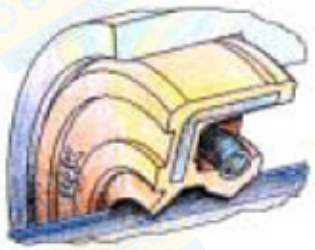
7 Seal interference diagram



Remark:

- ✧ **Interference**
- ✧ **Bore Diameter**
- ✧ **Seal O.D.**
- ✧ **Shaft Diameter**
- ✧ **Seal I.D.**

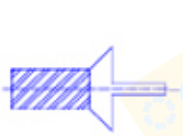
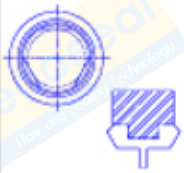
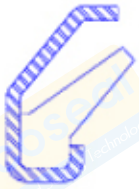
Principal Seal Designs

	Lip Style	S	T	V	K
OD Style		**Single lip, Single spring** Low-pressure single lip with garter spring without protection from contaminates.	**Dual lip, Single spring** Low-pressure dual lip with protection from contaminates.	**Single lip, No spring** Non-pressure single lip without protection from contaminates.	**Dual lip, No spring** Non-pressure dual lip without garter spring with protection from contaminates
C	Rubber cover O.D for improving O.D. sealing ability	**SC** 	**TC** 	**VC** 	**KC** 
B	Precision ground O.D. surface with a lead-in chamfer for ease of installation.	**SB** 	**TB** 	**VB** 	**KB** 
A	Precision ground O.D. surface with a inner case providing increased structural rigidity.	**SA** 	**TA** 	**VA** 	**KA** 
F	Rubber cover O.D. for improving O.D. sealing ability, with additional rubber fully protecting the inner case.	**SF** 	**TF** 	**VF** 	**KF** 
M	Precision ground O.D. surface with a led-in chamfer with an additional inner rubber lining.	**SM** 	**TM** 	**VM** 	**KM** 

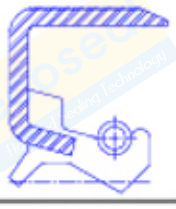
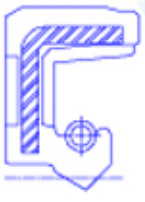
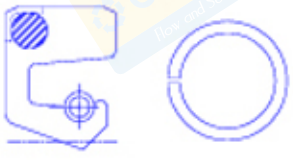
Other Shaft Seal Designs

Type	Design Characteristics	Seal Style			
D	Two opposing spring loaded lips, designed for applications where the separation of two medias is required.	DA 	DB 	DC 	DM 
G	Corrugated O.D. for applications where the housing material is subject to large thermal expansion or press fitting into a housing where installation is usually difficult.	SG 	TG 	VG 	KG 
H	Precision ground O.D. with added structural rigidity particularly when there is a large radial seal width. It also allows installation from both sides.	SH 	VH 	SH1 	VH1 
J	Rubber O.D. with flange will allow easy installation or replacement, gives additional structural rigidity and restricts the installation depth into the housing.	SBJ 	TBJ 	VBJ 	KBJ 
	Precision ground O.D. with flange will allow easy installation or replacement, gives additional structural rigidity and restricts the installation depth into the housing.	SCJ 	TCJ 	VCJ 	KCJ 
L	Precision ground O.D. with a rolled leading edge to aid in the alignment during installation.	SL 	TL 	VL 	KL 
P	Precision ground, reinforced O.D. with minimum clearance flange that will allow easy installation or replacement and restricts the installation depth into the housing.	SAP 	TAP 	VAP 	KAP 
	Precision ground, with minimum clearance flange that will allow easy installation or replacement and restricts the installation depth into the housing.	SBP 	TBP 	VBP 	KBP 

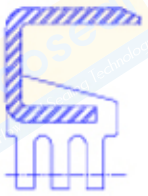
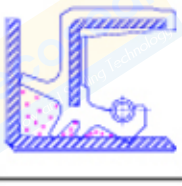
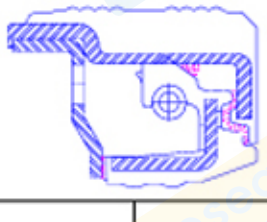
Shaft Seal Designs

Type	Design Characteristics	Seal Style			
X	The cavity will allow pre-lubrication of the seal to combat initial dry running or where space is limited and a secondary lip for dust exclusion is required.	TXA 	TXB 	TXC 	TXM 
X1	Similar to the "X" type, but with a larger cavity to pre-lubrication of the seal to combat initial dry running or where space is limited and a secondary lip for dust exclusion is required.	TX1A 	TX1B 	TX1C 	TX1M 
Z	Precision ground O.D. and a rubber covered top face for improved sealing ability.	SZ 	TZ 	VZ 	KZ 
BC/ BG	This design provides the benefits of a mental-to-mental press fit and the rubber O.D. sealing ability to counter rough or worn housings.	SBC 	TBC 	SBG 	TBG 
EC/ WS/ KDS	**End Cap**-Designed for static applications to act as a plug or barrier. **WS / KDS**- Designed for sealing washer.	EC 	WS 	WS1 	KDS1 
RE/ VA/ VS	**RE**-Designed to seal axial face dust. **VA / VS**-Designed to be fixed on the shaft sealing axially against a perpendicular counter face.	RE 	RE1 	VA 	VS 
PL	**Teflon Lined Seals**-Designed for low friction, high speed applications, or when the reductions of under lip running temperature are required.	TA-PL 	TB-PL 	TC-PL 	TM-PL 
PA	**Teflon Seals**-Designed for drying, low friction applications, also can handle certain pressure applications.	PA1 	PA2 	PA4 	PA6 

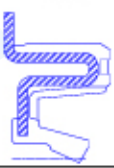
Shaft Seal Designs

Type	Design Characteristics	Seal Style			
E	The mental case reinforcement of the lip flex section makes this type suitable for low to medium pressure applications depending on the shaft speed and run-out.	TEA 	TEB 	TEC 	TEM 
N	The shortest flex section of the N type series makes it suitable for higher pressure applications depending on the shaft speed and run-out.	SCN 	TCN 	SDN 	TDN 
N1	The shorter flex section makes this type suitable for lower pressure applications depending on the shaft speed and run-out.	SCN1 	TCN1 	SGN1 	TGN1 
N2	The shorter flex section makes this type suitable for medium pressure applications depending on the shaft speed and run-out.	SCN2 	TCN2 	SGN2 	TGN2 
O	**External Seals**-This external lip type performs and has the same design characteristics as the standard radial lip seals, but these are designed for a press fit on the shaft and to seal in a housing.	OTA 	OTB 	OTC 	OTM 
TH/ G1	**TH**-For heavy-duty dirt exclusion, and O.D. sealing ability in the housing is required. **G1**-"G" type O.D., and a lip profile for limited radial space applications	TBH 	TCH 	VG1 	KG1 
SQ	For use where radial space is limited and can be supplied with a split for ease of installation.	SQ 		SQ1 	
SQS	Same as the SQ type, with an addition of a spring inset for added rigidity	SQS 		SQS1 	

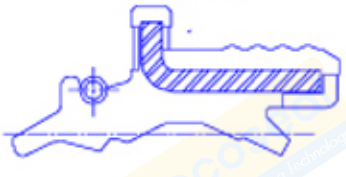
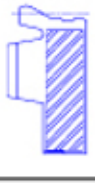
Shaft Seal Designs

Type	Design Characteristics	Seal Style			
U	Triple flat lip design for use in heavy dirt applications, commonly used in agriculture equipment.	UA 	UB 	UC 	UM 
2/ 6	**Type 2**-Used when a secondary dust lip is needed. **Type 6**-Used for added dust or fine contaminate protection.	TB2 	TC2 	TB6 	TC6 
9	**Type 9**-Has the ability to act as a rotary shaft and an axial face seal.	TB9 	TC9 	TC29 	TBCJ9 
VA	Grease retention seals with variations depending on the application or installation conditions.	VA1 	VA2 	VA4 	VA6 
AP	**AP Product Line**-This patented AP series seal is designed for heavy dirt exclusion. With a press fit on the shaft and also in the housing makes this series easily replaceable without damage to the shaft of housing.	AJ 	AO 	AP 	AP1 
		AP3 	AP4 	AP5 	AP7 
ST	Hub seal.	ST5 		ST11 	
VGA	Used for air conditional compressor.	VGA2 	VGA3 	VGA5 	VGA6 

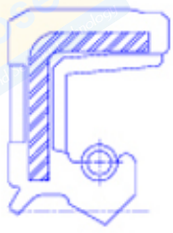
Other Shaft Seal Designs

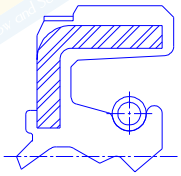
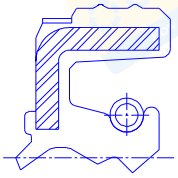
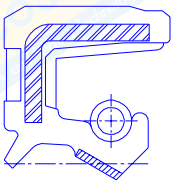
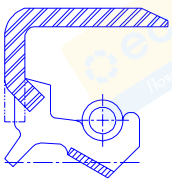
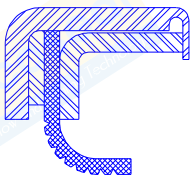
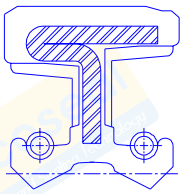
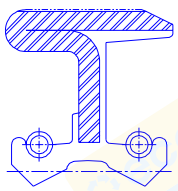
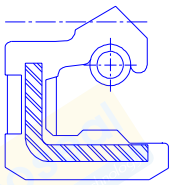
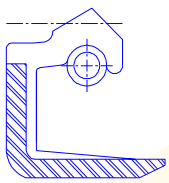
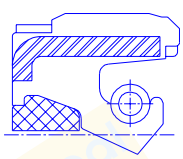
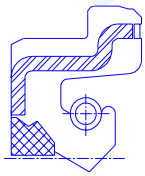
Type	Design Characteristics	Seal Style			
D	Two opposing spring loaded lips, designed for applications where the separation of two medias is required.	DA 	DB 	DC 	DM 
G	Corrugated O.D. for applications where the housing material is subject to large thermal expansion or press fitting into a housing where installation is usually difficult.	SG 	TG 	VG 	KG 
H	Precision ground O.D. with added structural rigidity particularly when there is a large radial seal width. It also allows installation from both sides.	SH 	VH 	SH1 	VH1 
J	Rubber O.D. with flange will allow easy installation or replacement, gives additional structural rigidity and restricts the installation depth into the housing.	SBJ 	TBJ 	VBJ 	KBJ 
	Precision ground O.D. with flange will allow easy installation or replacement, gives additional structural rigidity and restricts the installation depth into the housing.	SCJ 	TCJ 	VCJ 	KCJ 
L	Precision ground O.D. with a rolled leading edge to aid in the alignment during installation.	SL 	TL 	VL 	KL 
P	Precision ground, reinforced O.D. with minimum clearance flange that will allow easy installation or replacement and restricts the installation depth into the housing.	SAP 	TAP 	VAP 	KAP 
	Precision ground, with minimum clearance flange that will allow easy installation or replacement and restricts the installation depth into the housing.	SBP 	TBP 	VBP 	KBP 

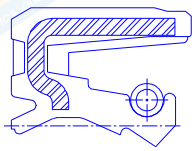
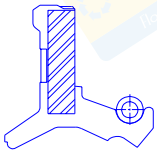
Shaft Seal Designs

Type	Design Characteristics	Seal Style			
ECA	Used for oil gauge seal.	ECA1 	ECA3 	ECA4 	ECA5 
RO	Flexible lip design, used in high run-out application.	SBRO 	SLRO 	TCRO 	TC2RO 
VSS	**Valve Stem Seal**-Designed for valve guides.	VSB2 		VSC2 	
PS	**Power Steering Seal**-Designed for vehicle power steering.	TC4P 	SCAP 	CNB 	CNB2 
4	**Type 4**-Used for linear applications such as motorcycle forks.	TC4 	TM4 	DC4 	DC41 
		TC4S 	DC4S 	TG4JB 	
Piston Seals	Designed for reciprocating ram type applications.	PDV 	PSV 	PSV2 	PVC1 
TCA	Used for washing machine to seal water and washing powder.	TCA3 		TGA6 	

9 Seal function capacity

Type		Capacity			
		Speed (m/s)	Pressure (bar)	Run-out (mm)	STBM (mm)
SC 	SB 	Refer to <Appendix G>	**0.30 Max.**	Refer to Chapter 6 <Figure6-4>	Refer to Chapter 6 <Figure6-5>
TC 	TB 				
VC 	VB 	**7.0 Max.**	**Atmosphere**	**0.20 Max.**	**0.20 Max.**
KC 	KB 				
TCN1 		**1.0 Max.**	**3.5 Max.**	**0.05 Max.**	**0.10 Max.**
		3.0 Max.	**3.0 Max.**		
		5.0 Max.	**2.0 Max.**		
AP1 	AP3 	**3.5 Max.**	**0.3 Max.**	**0.25 Max.**	**0.25 Max.**

Type		Capacity			
		Speed (m/s)	Pressure (bar)	Run-out (mm)	STBM (mm)
TC4P 	**TC4P** 	**0.28 Max.**	**25 Max.**	**--**	**0.30 Mx.**
TC-PL 	**TB-PL** 	**30 Max.**	**0.5 Max.**	**0.25 Max.**	**0.25 Max.**
PA1 	**PA2** 	**15 Max.**	**3 Max.**	**0.20 Max.**	**0.40 Max.**
		5 Max.	**1 Max.**		
DC 	**DM** 	**10 Max.**	**0.3 Max.**	**0.25 Max.**	**0.25 Max.**
OSC 	**OSM** 	**10 Max.**	**0.3 Max.**	**0.25 Max.**	**0.25 Max.**
CNB 	**CNB2** 	**0.075 Max.**	**98 Max. (NBR) 157 Max. (HNBR)**	**--**	**0.30 Max.**

Type		Capacity			
		Speed (m/s)	Pressure (bar)	Run-out (mm)	STBM (mm)
TC4 	**TC4S** 	**0.2 Max.**	**6.5 Max.**	--	**0.20 Max.**
		0.6 Max.	**4.4 Max.**		
		1.0 Max.	**2.5 Max.**		
		1.5 Max.	**1.6 Max.**		