

# Turcon® VL Seal®



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Single-acting

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Rubber-energized plastic-faced seal

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**Material:**

Turcon®, Zurcon® and Elastomer

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## ■ Turcon® VL Seal®\*



### ■ Description

Turcon® VL Seal® is a new generation unidirectional Piston seal for the same groove dimensions as standard O-Rings, Figure 138.

The design is optimized with regard to performance, friction, leakage and service life through meticulous simulation, in-house testing and qualification in customer applications.

VL Seal® effectively provides static sealing by the O-Ring. The O-Ring is protected from damage under pressure cycles by the contoured O-Ring contact zone which supports the O-Ring and keeps it in position also at high working pressure.

VL Seal® is designed with hydrodynamic back-pumping effect which allows the seal to relieve pressure trapped between seals in tandem configuration.

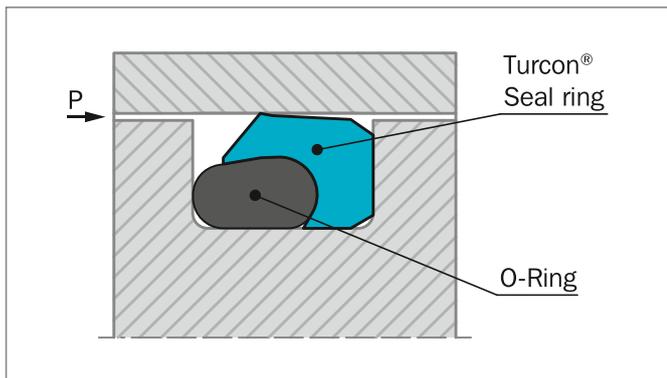


Figure 138: Turcon® VL Seal® mounted in O-Ring groove

### METHOD OF OPERATION

The sealing mechanism of VL Seal® is based on the hydrodynamic properties of the seal. The specially formed seal edge has a steep contact pressure gradient on the high pressure side and a shallow contact pressure gradient on the low pressure side. This ensures that the fluid film adhering to the cylinder bore is returned to the high pressure chamber on the return stroke of the piston minimizing the risk of leaks.

This also prevents the build-up of inter-seal pressure normally associated with tandem seal configurations. Inter-seal pressure depends on the system pressure, speed, stroke length and groove design.

\* Patent pending. (US Patent No. 6,497,415)

### ADVANTAGES

- Groove design with shallow radial depth
- Optimized leakage control and service life
- Low friction with small contact area between seal and counter surface
- Featuring the Turcon® Stepseal® 2K back pumping effect
- Utilize standard O-Ring installation groove
- Available in all diameter sizes from 10 to 2,700 mm

### APPLICATION EXAMPLES

VL Seal® is recommended for hydraulics and general machine construction as an alternative to Stepseal® 2K and other single acting seals, for example in:

- Machine tools
- Automation
- Handling devices
- Single acting cylinders
- Automobile industry
- Servo hydraulics
- Down-hole tools
- O-Ring replacement



## OPERATING CONDITIONS

<b>Pressure:</b>	Up to 60 MPa
<b>Speed:</b>	Up to 15 m/s for Turcon® materials with linear movements frequency up to 5 Hz
<b>Temperature:</b>	-45 °C to +200 °C* depending on seal and O-Ring material
<b>Media:</b>	Mineral oil-based hydraulic fluids, flame retardant hydraulic fluids, environmentally friendly hydraulic fluids (bio-oils), phosphate ester, water and others, depending on the seal and O-Ring material compatibility see Table 128
<b>Clearance:</b>	The maximum permissible radial clearance $S_{max}$ is shown in Table 129, as a function of the operating pressure and functional diameter.

## IMPORTANT NOTE

The above data are maximum values and cannot be used at the same time, e.g. the maximum operating speed depends on material type, pressure, temperature and gap value. Temperature range also depends on media.

\* In the case of unpressurized piston applications in temperatures below 0 °C please contact your local Customer Solution Center for more information!

## RADIAL NOTCH

VL Seal® can be delivered with radial notches at the low pressure side. This is an advantage if the seal is used in rotary applications. Notches can prevent the seal from rotating in the groove by avoiding pressurised fluid being trapped between seal and groove corner.

## INSTALLATION INSTRUCTIONS

VL Seal® is dimensionally interchangeable with seals for O-Ring housings, like Turcon® Double Delta® and Turcon® Variseal® M2. Groove dimensions, radial clearances and recommended seal series in relation to diameter are as illustrated in Table 129.

VL Seal® is preferably installed in closed grooves according to Figure 100 page 250. Depending on type and size installation in split grooves is also possible. Recommended minimum diameters for installation in closed grooves, see Table 82 page 250.

## RECOMMENDED MATERIALS

The following material combinations have proven effective for hydraulic applications:

### Turcon® VL Seal® in Turcon® M12

All round material for light to heavy hydraulic applications with linear, short stroke or helical movements in mineral oils, flame retardant hydraulic fluids, phosphate ester, bio-oils or fluids having less satisfactory lubricating properties:

O-Ring:	NBR 70 Shore A	N
	FKM 70 Shore A	V

Set code: M12N or M12V

### Turcon® VL Seal® in Turcon® T46

For medium to heavy applications with linear movements in mineral oils and other media with good lubrication:

O-Ring:	NBR 70 Shore A	N
	FKM 70 Shore A	V

Set code: T46N or T46V

Zurcon® Z54 is recommended for VL Seal® as alternative to polyurethane U-Cups especially outside the size range of these products.

For specific applications, all Turcon® materials are available.

Other material combinations are listed in Table 128.

**Table 128: Turcon® and Zurcon® Materials for VL Seal®**

Material, Applications, Properties	Code	O-Ring Material Shore A	Code	O-Ring Operating Temp.* °C	Mating Surface Material	MPa max. Dynamic
<b>Turcon® M12</b> First material choice for seals in linear motion Overall improved properties For new constructions and updating For all commonly applied hydraulic fluids including fluids with low lubrication performance Lowest friction and best sliding properties Lowest wear on seals Improved absorption of abrasive contaminants Low wear or abrasion of counter surface BAM tested Mineral fiber and Additives filled Color: Dark gray	M12	NBR 70	N	-30 to +100	Steel	50
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Cast iron	
		FKM 70	V	-20 to +200	Stainless steel Titanium	
<b>Turcon® T05</b> For lubricating fluids Also for gas service Very low friction Very good sliding and sealing properties Color: Turquoise	T05	NBR 70	N	-30 to +100	Steel	20
		NBR 70 Low temp.	T	-45 to +80	Steel hardened	
		FKM 70	V	-10 to +200		
<b>Turcon® T08</b> For lubricating fluids and linear motion Very high compressive strength and extrusion resistance Hard counter surfaces is recommended Bronze filled Color: Light to dark brown, which may have variations in shading	T08	NBR 70	N	-30 to +100	Steel hardened	60
		NBR 70 Low temp.	T	-45 to +80	Cast iron	
		FKM 70	V	-10 to +200		
<b>Turcon® T10</b> For hydraulic and pneumatic For linear motion in lubricating and non-lubricating fluids High extrusion resistance Good chemical resistance Not for electrically conducting fluids BAM tested Carbon, graphite filled Color: Black	T10	NBR 70	N	-30 to +100	Steel	40
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Stainless steel	
		FKM 70	V	-10 to +200		
		EPDM 70	E**	-45 to +145		
<b>Turcon® T29</b> For lubricating and non-lubricating fluids Good extrusion resistance Surface texture is not suitable for gas sealing Not for electrically conducting fluids Carbon fiber filled Color: Gray	T29	NBR 70	N	-30 to +100	Steel	30
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Cast iron	
		FKM 70	V	-10 to +200	Stainless steel	
		EPDM 70	E**	-45 to +145		

Table continues on next page



Material, Applications, Properties	Code	O-Ring Material Shore A	Code	O-Ring Operating Temp.* °C	Mating Surface Material	MPa max. Dynamic
<b>Turcon® T40</b> For lubricating and non-lubricating fluids High frequency and short strokes Water hydraulics Surface texture is not suitable for gas sealing Carbon fiber filled Color: Gray	T40	NBR 70	N	-30 to +100	Steel	25
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Cast iron	
		FKM 70	V	-10 to +200	Stainless steel	
		EPDM 70	E**	-45 to +145	Aluminum	
<b>Turcon® T46</b> For lubricated hydraulics in linear motion High compressive strength High extrusion resistance Very good sliding and wear properties BAM tested Bronze filled Color: Light to dark brown, which may have variations in shading	T46	NBR 70	N	-30 to +100	Steel hardened	50
		NBR 70 Low temp.	T	-45 to +80	Cast iron	
		FKM 70	V	-10 to +200		
<b>Zurcon® Z53***</b> For mineral oil based fluids Very high abrasion and extrusion resistance For counter surface with rougher surface finish Limited chemical resistance Max. working temperature 110 °C Cast polyurethane Color: Yellow to light-brown	Z53	NBR 70	N	-30 to +100	Steel	60
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Steel chrome plated (rod) Cast iron Stainless steel Ceramic coating	
<b>Zurcon® Z54***</b> For mineral oil based fluids Linear and slowly turning movements High abrasion resistance For counter surface with rougher surface finish Good extrusion resistance Limited chemical resistance Max. working temperature 110 °C Cast polyurethane Color: Turquoise	Z54	NBR 70	N	-30 to +100	Steel	25
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Steel chrome plated (rod) Cast iron Stainless steel Ceramic coating	
<b>Zurcon® Z80</b> For lubricating and non-lubricating fluids Water based fluids, air and gases Dry air pneumatics High abrasion and extrusion resistance For service in abrasive conditions and media with particles Good chemical resistance Limited temperature capability (-60 to +80 °C) UHMWPE (Ultra High Molecular Weight Polyethylene) Color: White to off-white	Z80	NBR 70	N	-30 to (+100)	Steel	35
		NBR 70 Low temp.	T	-45 to +80	Steel hardened Stainless steel	
		EPDM 70	E**	-45 to (+145)	Aluminum Ceramic coating	

\* The O-Ring Operation Temperature is only valid in mineral hydraulic oil (except EPDM).

\*\* Material not suitable for mineral oils.

\*\*\* Max. diameter 2,300 mm.

BAM: Tested by "Bundesanstalt Materialprüfung, Germany".

□ Highlighted materials are recommended.



## Installation Recommendation

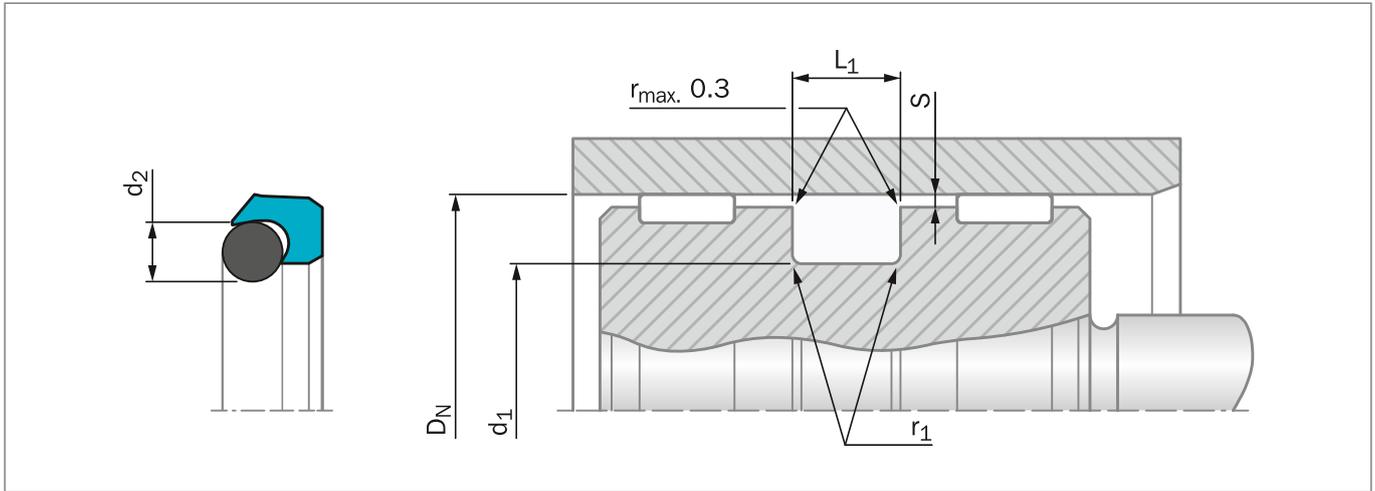


Figure 139: Installation Drawing

**Table 129: Installation Dimensions - Standard Recommendations**

Series No.	Bore Diameter $D_N$ H9		Groove Diameter $d_1$ h9	Groove Width $L_1$ +0.2	Radius $r_1$ max	Radial Clearance $S_{max}$			O-Ring Cross Section $d_2$
	Standard Application	Available Range				10 MPa	20 MPa	30 MPa	
PEL10	14 - 24.9	10 - 100.0	$D_N - 4.5$	3.6	0.4	0.40	0.25	0.15	1.78
PEL20	25 - 45.9	16 - 200.0	$D_N - 6.2$	4.8	0.6	0.40	0.25	0.20	2.62
PEL30	46 - 124.9	28 - 400.0	$D_N - 9.4$	7.1	0.8	0.50	0.30	0.20	3.53
PEL40	125 - 399.9	45 - 650.0	$D_N - 12.2$	9.5	0.8	0.60	0.35	0.25	5.33
PEL50	400 - 649.9	125 - 999.9	$D_N - 15.9$	12.2	0.8	0.70	0.50	0.30	7.00
PEL60	650 - 999.9	400 - 999.9	$D_N - 19.0$	15.0	0.8	1.00	0.70	0.60	8.40
PEL6X	1,000 - 2,700		$D_N - 19.0$	15.0	0.8	1.00	0.70	0.60	8.40

\* At pressures > 40 MPa use diameter tolerance H8/f8 (bore/piston) in the area behind seal or consult your local Customer Solution Center for alternative material or profiles.

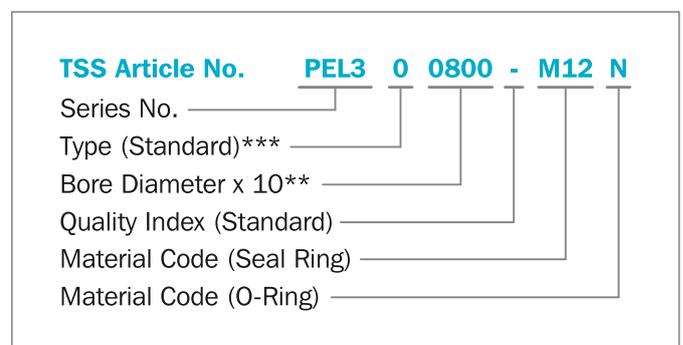
Slydring® / Wear Rings are not applicable at very small radial clearances please consult the Slydring® section in this catalog.  
For minimum diameter installation in closed grooves, see Table 82 page 250

### ORDERING EXAMPLE

Turcon® VL Seal® complete with O-Ring, standard application:

<b>Series:</b>	PEL30 from Table 129
<b>Bore Diameter:</b>	$D_N = 80.0$ mm
<b>TSS Part No.:</b>	PEL300800 from Table 130

Select the material from Table 128. The corresponding code numbers are appended to the TSS Part No. Together these form the TSS Article Number. The TSS Article Number for all intermediate sizes can be determined by following the example:



\*\* For diameters  $D_N \geq 1,000.0$  mm multiply only by factor 1.  
Example: PEL6X for diameter  $D_N = 1,200.0$  mm  
TSS Article No.: PEL6X1200 - M12N

\*\*\* Use suffix "N" for seals with radial notches, for diameter  $D_N < 1,000$  mm. (Radial notches for diameter  $D_N \geq 1,000$  mm, special part number is required).



**Table 130: Installation Dimensions / Part No.**

Bore Dia.	Groove Dia.	Groove Width	TSS Part No.	O-Ring Dimensions	Bore Dia.	Groove Dia.	Groove Width	TSS Part No.	O-Ring Dimensions
$D_N$ H9	$d_1$ h9	$L_1$ +0.2			$D_N$ H9	$d_1$ h9	$L_1$ +0.2		
<b>10.0</b>	<b>5.5</b>	<b>3.6</b>	<b>PEL100100</b>	<b>4.80 x 1.80</b>	70.0	60.6	7.1	PEL300700	59.92 x 3.53
11.0	6.5	3.6	PEL100110	6.07 x 1.78	75.0	65.6	7.1	PEL300750	63.09 x 3.53
<b>12.0</b>	<b>7.5</b>	<b>3.6</b>	<b>PEL100120</b>	<b>7.10 x 1.80</b>	<b>80.0</b>	<b>70.6</b>	<b>7.1</b>	<b>PEL300800</b>	<b>69.44 x 3.53</b>
14.0	9.5	3.6	PEL100140	8.75 x 1.80	<b>80.0</b>	<b>67.8</b>	<b>9.5</b>	<b>PEL400800</b>	<b>66.04 x 5.33</b>
<b>16.0</b>	<b>11.5</b>	<b>3.6</b>	<b>PEL100160</b>	<b>11.20 x 1.80</b>	85.0	75.6	7.1	PEL300850	75.79 x 3.53
<b>16.0</b>	<b>9.8</b>	<b>4.8</b>	<b>PEL200160</b>	<b>9.19 x 2.62</b>	85.0	72.8	9.5	PEL400850	72.39 x 5.33
18.0	13.5	3.6	PEL100180	13.20 x 1.80	90.0	80.6	7.1	PEL300900	78.97 x 3.53
18.0	11.8	4.8	PEL200180	10.77 x 2.62	90.0	77.8	9.5	PEL400900	75.57 x 5.33
20.0	15.5	3.6	PEL100200	14.00 x 1.78	95.0	85.6	7.1	PEL300950	85.32 x 3.53
20.0	13.8	4.8	PEL200200	12.37 x 2.62	95.0	82.8	9.5	PEL400950	81.92 x 5.33
22.0	17.5	3.6	PEL100220	17.17 x 1.78	<b>100.0</b>	<b>90.6</b>	<b>7.1</b>	<b>PEL301000</b>	<b>88.49 x 3.53</b>
22.0	15.8	4.8	PEL200220	14.50 x 2.65	<b>100.0</b>	<b>87.8</b>	<b>9.5</b>	<b>PEL401000</b>	<b>88.27 x 5.33</b>
25.0	20.5	3.6	PEL100250	20.35 x 1.78	105.0	95.6	7.1	PEL301050	94.84 x 3.53
25.0	18.8	4.8	PEL200250	18.00 x 2.65	105.0	92.8	9.5	PEL401050	91.44 x 5.33
28.0	21.8	4.8	PEL200280	20.29 x 2.62	106.0	96.6	7.1	PEL301060	94.84 x 3.53
28.0	18.6	7.1	PEL300280	17.04 x 3.53	110.0	100.6	7.1	PEL301100	101.19 x 3.53
30.0	25.5	3.6	PEL100300	25.12 x 1.78	110.0	97.8	9.5	PEL401100	97.79 x 5.33
30.0	23.8	4.8	PEL200300	23.47 x 2.62	115.0	105.6	7.1	PEL301150	104.37 x 3.53
<b>32.0</b>	<b>27.5</b>	<b>3.6</b>	<b>PEL100320</b>	<b>26.70 x 1.78</b>	115.0	102.8	9.5	PEL401150	100.97 x 5.33
<b>32.0</b>	<b>25.8</b>	<b>4.8</b>	<b>PEL200320</b>	<b>25.07 x 2.62</b>	120.0	110.6	7.1	PEL301200	110.72 x 3.53
<b>32.0</b>	<b>22.6</b>	<b>7.1</b>	<b>PEL300320</b>	<b>21.82 x 3.53</b>	120.0	107.8	9.5	PEL401200	107.32 x 5.33
35.0	28.8	4.8	PEL200350	28.24 x 2.62	<b>125.0</b>	<b>115.6</b>	<b>7.1</b>	<b>PEL301250</b>	<b>113.89 x 3.53</b>
<b>40.0</b>	<b>35.5</b>	<b>3.6</b>	<b>PEL100400</b>	<b>34.65 x 1.78</b>	<b>125.0</b>	<b>112.8</b>	<b>9.5</b>	<b>PEL401250</b>	<b>110.49 x 5.33</b>
<b>40.0</b>	<b>33.8</b>	<b>4.8</b>	<b>PEL200400</b>	<b>32.99 x 2.62</b>	<b>125.0</b>	<b>109.1</b>	<b>12.2</b>	<b>PEL501250</b>	<b>107.35 x 7.00</b>
<b>40.0</b>	<b>30.6</b>	<b>7.1</b>	<b>PEL300400</b>	<b>29.75 x 3.53</b>	130.0	120.6	7.1	PEL301300	120.24 x 3.53
42.0	35.8	4.8	PEL200420	34.59 x 2.62	130.0	117.8	9.5	PEL401300	116.84 x 5.33
45.0	38.8	4.8	PEL200450	37.77 x 2.62	135.0	122.8	9.5	PEL401350	123.19 x 5.33
45.0	32.8	9.5	PEL400450	31.12 x 5.33	140.0	127.8	9.5	PEL401400	126.37 x 5.33
48.0	41.8	4.8	PEL200480	40.94 x 2.62	140.0	124.1	12.2	PEL501400	123.19 x 7.00
<b>50.0</b>	<b>43.8</b>	<b>4.8</b>	<b>PEL200500</b>	<b>42.52 x 2.62</b>	145.0	132.8	9.5	PEL401450	132.72 x 5.33
<b>50.0</b>	<b>40.6</b>	<b>7.1</b>	<b>PEL300500</b>	<b>40.87 x 3.53</b>	150.0	137.8	9.5	PEL401500	135.89 x 5.33
<b>50.0</b>	<b>37.8</b>	<b>9.5</b>	<b>PEL400500</b>	<b>37.47 x 5.33</b>	155.0	145.6	7.1	PEL301550	145.64 x 3.53
52.0	45.8	4.8	PEL200520	45.69 x 2.62	<b>160.0</b>	<b>150.6</b>	<b>7.1</b>	<b>PEL301600</b>	<b>148.82 x 3.53</b>
55.0	48.8	4.8	PEL200550	48.90 x 2.62	<b>160.0</b>	<b>147.8</b>	<b>9.5</b>	<b>PEL401600</b>	<b>145.42 x 5.33</b>
60.0	50.6	7.1	PEL300600	50.39 x 3.53	<b>160.0</b>	<b>144.1</b>	<b>12.2</b>	<b>PEL501600</b>	<b>142.24 x 7.00</b>
63.0	56.8	4.8	PEL200630	56.82 x 2.62	165.0	155.6	7.1	PEL301650	151.99 x 3.53
63.0	53.6	7.1	PEL300630	53.57 x 3.53	165.0	152.8	9.5	PEL401650	151.77 x 5.33
63.0	50.8	9.5	PEL400630	50.17 x 5.33	170.0	157.8	9.5	PEL401700	158.12 x 5.33
65.0	55.6	7.1	PEL300650	53.57 x 3.53	175.0	165.6	7.1	PEL301750	164.69 x 3.53
70.0	63.8	4.8	PEL200700	63.17 x 2.62	180.0	170.6	7.1	PEL301800	171.04 x 3.53



Bore Dia.	Groove Dia.	Groove Width	TSS Part No.	O-Ring Dimensions
D <sub>N</sub> H9	d <sub>1</sub> h9	L <sub>1</sub> +0.2		
180.0	167.8	9.5	PEL401800	164.47 x 5.33
180.0	164.1	12.2	PEL501800	164.47 x 7.00
190.0	180.6	7.1	PEL301900	177.39 x 3.53
190.0	177.8	9.5	PEL401900	177.17 x 5.33
<b>200.0</b>	<b>190.6</b>	<b>7.1</b>	<b>PEL302000</b>	<b>190.09 x 3.53</b>
<b>200.0</b>	<b>187.8</b>	<b>9.5</b>	<b>PEL402000</b>	<b>189.87 x 5.33</b>
<b>200.0</b>	<b>184.1</b>	<b>12.2</b>	<b>PEL502000</b>	<b>183.52 x 7.00</b>
205.0	192.8	9.5	PEL402050	189.87 x 5.33
210.0	197.8	9.5	PEL402100	196.22 x 5.33
220.0	210.6	7.1	PEL302200	209.14 x 3.53
220.0	207.8	9.5	PEL402200	208.92 x 5.33
220.0	204.1	12.2	PEL502200	202.57 x 7.00
230.0	217.8	9.5	PEL402300	215.27 x 5.33
240.0	227.8	9.5	PEL402400	227.97 x 5.33
<b>250.0</b>	<b>237.8</b>	<b>9.5</b>	<b>PEL402500</b>	<b>234.32 x 5.33</b>
<b>250.0</b>	<b>234.1</b>	<b>12.2</b>	<b>PEL502500</b>	<b>227.97 x 7.00</b>
300.0	284.1	12.2	PEL503000	278.77 x 7.00
306.0	293.8	9.5	PEL403060	291.47 x 5.33
<b>320.0</b>	<b>307.8</b>	<b>9.5</b>	<b>PEL403200</b>	<b>304.17 x 5.33</b>
<b>320.0</b>	<b>304.1</b>	<b>12.2</b>	<b>PEL503200</b>	<b>304.17 x 7.00</b>
345.0	332.8	9.5	PEL403450	329.57 x 5.33
350.0	334.1	12.2	PEL503500	329.57 x 7.00
<b>400.0</b>	<b>384.1</b>	<b>12.2</b>	<b>PEL504000</b>	<b>380.37 x 7.00</b>
<b>400.0</b>	<b>381.0</b>	<b>15.0</b>	<b>PEL604000</b>	<b>379.00 x 8.40</b>
440.0	424.1	12.2	PEL504400	430.66 x 7.00
450.0	431.0	15.0	PEL604500	429.00 x 8.40
<b>500.0</b>	<b>484.1</b>	<b>12.2</b>	<b>PEL505000</b>	<b>481.38 x 7.00</b>
<b>500.0</b>	<b>481.0</b>	<b>15.0</b>	<b>PEL605000</b>	<b>479.00 x 8.40</b>
520.0	507.8	9.5	PEL405200	506.78 x 5.33
540.0	524.1	12.2	PEL505400	532.26 x 7.00
540.0	521.0	15.0	PEL605400	519.00 x 8.40
600.0	584.1	12.2	PEL506000	582.68 x 7.00
600.0	581.0	15.0	PEL606000	579.00 x 8.40
650.0	634.1	12.2	PEL506500	633.48 x 7.00
650.0	631.0	15.0	PEL606500	629.00 x 8.40
700.0	684.1	12.2	PEL507000	658.88 x 7.00
700.0	681.0	15.0	PEL607000	679.00 x 8.40
800.0	784.1	12.2	PEL508000	782.00 x 7.00
800.0	781.0	15.0	PEL608000	779.00 x 8.40
860.0	844.1	12.2	PEL508600	842.00 x 7.00

Bore Dia.	Groove Dia.	Groove Width	TSS Part No.	O-Ring Dimensions
D <sub>N</sub> H9	d <sub>1</sub> h9	L <sub>1</sub> +0.2		
900.0	884.1	12.2	PEL509000	882.00 x 7.00
900.0	881.0	15.0	PEL609000	879.00 x 8.40
920.0	904.1	12.2	PEL509200	902.00 x 7.00
1,000.0	981.0	15.0	PEL6X1000	979.00 x 8.40
1,200.0	1,181.0	15.0	PEL6X1200	1,179.00 x 8.40
1,500.0	1,481.0	15.0	PEL6X1500	1,479.00 x 8.40
2,000.0	1,981.0	15.0	PEL6X2000	1,979.00 x 8.40
2,700.0	2,681.0	15.0	PEL6X2700	2,679.00 x 8.40

The bore diameters in **bold** type are in accordance with the recommendations of ISO 3320.

Other dimensions and all intermediate sizes up to 2,700 mm diameter including imperial (inch) sizes can be supplied.