

# Turcon® Stepseal® V



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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® Stepseal® V\*



### ■ Introduction

First invented by Trelleborg Sealing Solutions, a build-in check valve function eliminates pressure trap between seals in tandem sealing systems.

Stepseal® V has the efficient seal performance of the Turcon® Stepseal® range and the reliable prevention of pressure build-up brought by a refined check valve function. In dynamic applications Stepseal® V brings efficient, reliable sealing performance under even the most demanding service conditions.

Stepseal® V offers a uniform, low friction characteristic of the sealing system throughout its whole life, by preventing undefined pressurization of the secondary seal element.

### CHARACTERISTICS

- Primary seal with hydrostatic ventilation
- Check valve function
- Hydrodynamic back-pumping
- Stabilised position in the groove
- Prolonged seal life
- Increased leakage control
- Only usable with a secondary seal

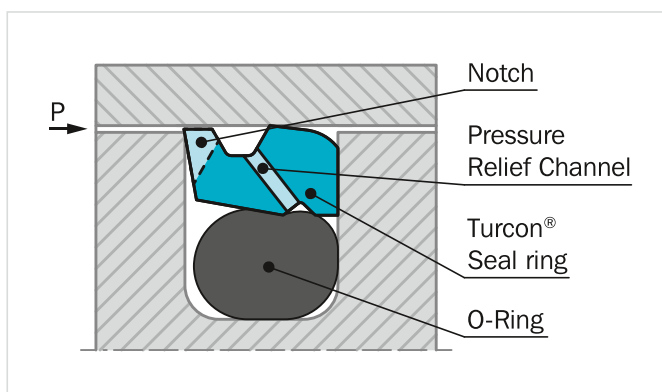


Figure 123: Turcon® Stepseal® V with tight axial groove fit

\* Patent DE 9654357; 24. 2. 996

### DESCRIPTION

Stepseal® V is a new generation primary seal designed for use in seal systems based on the dynamic, unidirectional Stepseal® sealing concept. Applied as a piston seal, Stepseal® V is preferably used with a double-acting seal from the Turcon® range of piston seals. Under extreme performance requirements Stepseal® V offers improved leakage control, extended service life and increased reliability.

The sealing performance of the patented Stepseal® V design – Figure 123 – results from a combination of the hydrodynamic properties of the seal and the O-Ring and the hydrostatic pressure relief check valve function.

The classic Stepseal® operation ensures a controlled pressure gradient that minimizes fluid adherence to the cylinder bore during the stroke, and enables residual fluid film on the bore to be returned under the seal on the return stroke.

The O-Ring check valve function controls the operation of the pressure relief channel: When the seal is pressurized by the system pressure the O-Ring keeps the channel closed to ensure that the hydraulic fluid is not passing through the channel and further between the groove wall and the Turcon® Seal Ring.

If the pressure is higher than the actual system pressure, appears between Stepseal® V and the secondary seal, the O-Ring opens the relief groove and the inter-seal pressure is immediately relieved.

Stepseal® V is available in high-grade Turcon® or Zurcon® materials with outstanding sliding and wear resistance properties.



### ADVANTAGES:

- No pressure build-up on secondary sealing element and Excluder®
- Check valve function of O-Ring eliminates risk of fluid bypassing the seal during pressure loading when pressurised
- Independent of any speed relation of counter surface
- Independent of stroke length
- High tolerance to hardware non-concentricity and radial play
- Minimum contribution of friction of secondary sealing element
- Minimum wear of secondary sealing element
- Increased leakage control
- Prolonged seal life
- Increased operational reliability
- Fits standard Turcon® Stepseal® 2K groove dimensions as well as ISO 7425-1 seal housings

### APPLICATION EXAMPLES

- Piston accumulators
- Single acting hydraulic cylinders
- Pistons with tandem sealing system
- Mobile crane boom cylinders
- Hydro plant cylinders
- Storm barrier cylinders
- Long stroke cylinders
- Gas spring suspension
- Piling Barges
- Theater hydraulics
- Safety systems

### OPERATING CONDITIONS

<b>Pressure:</b>	Up to 50 MPa (Turcon® M12) Up to 60 MPa (Turcon® T08 and Zurcon® Z53)
<b>Speed:</b>	Up to 15 m/s with linear movements, frequency up to 15 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 110.
<b>Clearance:</b>	The maximum permissible radial clearance $S_{max}$ is shown in Table 111, 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 applications in temperatures below 0 °C please contact your local Customer Solution Center for more information!

### SERIES

Different cross section sizes are recommended as a function of the seal diameters.

Table 109 shows the relationship between the series number according to the seal diameter range and the different application class sizes:

Standard application:	General applications without exceptional operating conditions.
Light application:	Applications with demands for reduced friction or for smaller grooves.
Heavy-duty application:	For exceptional operating loads such as high pressures, pressure peaks, etc.

**Table 109: Available Range**

Series No.	Piston Diameter D <sub>N</sub> H9
PSV20	15.0 - 200.0
PSV30	27.0 – 256.0
PSV40	60.0 – 700.0
PSV80	133.0 - 999.9
PSV50	250.0 - 999.9
PSV5X	1,000.0 - 1,200.0
PSV60	670.0 - 999.9
PSV6X	1,000.0 - 2,700.0

For the recommended Standard Application range see Table 111

### REDUNDANT SEALING SYSTEM

In many applications a secondary seal is needed e.g. for safety requirements. Figure 124 shows such a tandem configuration with Stepseal® V.

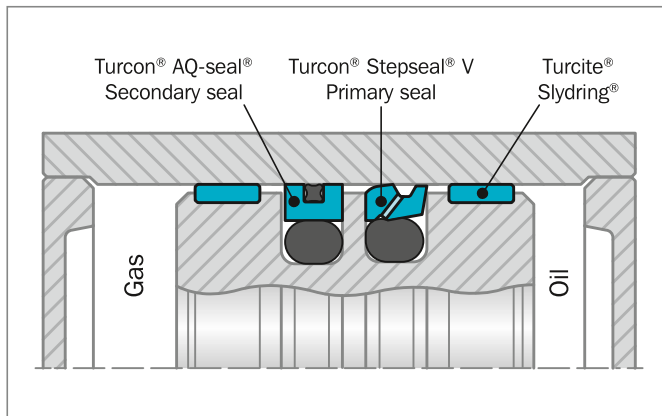


Figure 124: Tandem Turcon® Stepseal® V and Turcon® AQ-Seal® configuration in piston accumulator

When utilizing Stepseal® V, with valve function, there will be no pressure trap between the primary and secondary seals and no extra space between them is required to accumulate hydraulic fluid.

### INSTALLATION INSTRUCTIONS

Stepseal® V is installed according to information on page 247 to page 249.

Closed groove installation according to dimensions in Table 81 page 249.

### RECOMMENDED MATERIALS

The following material combinations have proven effective for hydraulic applications:

#### Turcon® Stepseal® V 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 low lubricating properties:

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

Set code: M12N or M12V

#### Turcon® Stepseal® V 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

For specific applications, all Turcon® materials are available.

Other material combinations are listed in Table 110.



**Table 110: Turcon® and Zurcon® Materials for Stepseal® V**

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	-10 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		



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® 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

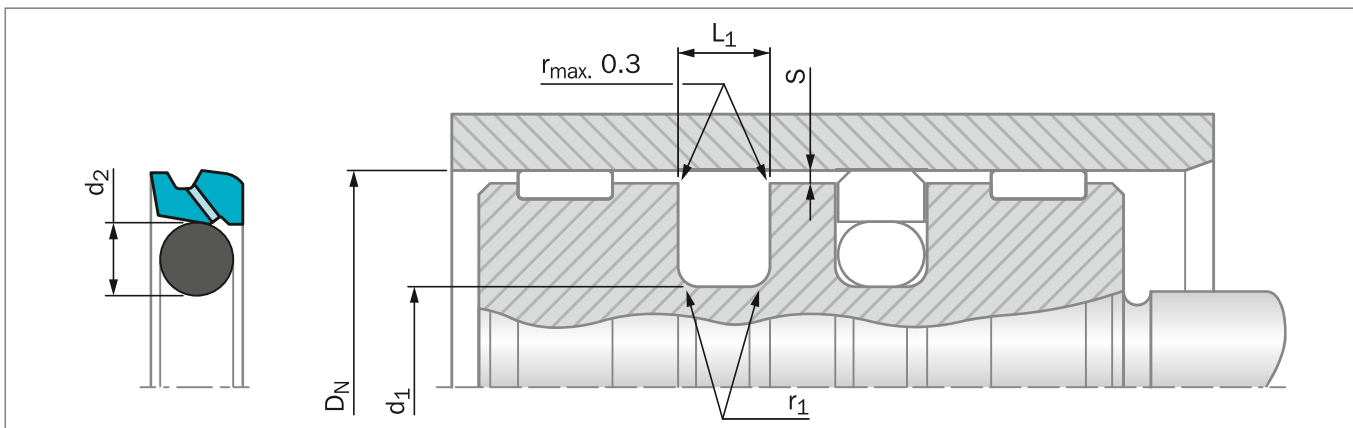


Figure 125: Installation Drawing

**Table 111: 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	Light Application	Heavy Duty Application				10 MPa	20 MPa	40 MPa	
PSV2	25 - 59.9	60 - 199.9	15 - 24.9	$D_N - 10.7$	4.2	1.0	0.50	0.30	0.20	3.53
PSV3	60 - 199.9	200 - 255.9	25 - 59.9	$D_N - 15.1$	6.3	1.3	0.70	0.40	0.25	5.33
PSV4	200 - 255.9	256 - 669.9	60 - 199.9	$D_N - 20.5$	8.1	1.8	0.80	0.60	0.35	7.00
PSV8	256 - 669.9	670 - 999.9	200 - 255.9	$D_N - 24.0$	8.1	1.8	0.90	0.70	0.40	7.00
PSV5	670 - 999.9	-	256 - 669.9	$D_N - 27.3$	9.5	2.5	1.00	0.80	0.50	8.40
PSV5X	-	1,000 - 1,200	-	$D_N - 27.3$	9.5	2.5	1.00	0.80	0.50	8.40
PSV6**	-	-	670 - 999.9	$D_N - 38.0$	13.8	3.0	1.20	0.90	0.60	12.00
PSV6X**	1,000 - 2,700	-	-	$D_N - 38.0$	13.8	3.0	1.20	0.90	0.60	12.00

\* 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.

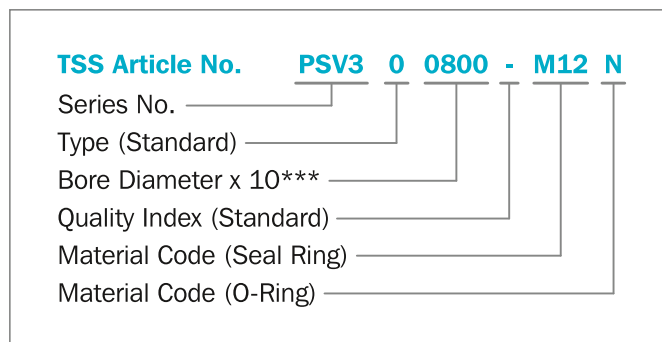
\*\* All O-Rings with 12 mm cross section are delivered as special profile ring.

### ORDERING EXAMPLE

Turcon® Stepseal® V complete with O-Ring, standard application:

<b>Series:</b>	PSV3 from Table 111
<b>Bore Diameter:</b>	$D_N = 80.0$ mm
<b>TSS Part No.:</b>	PSV300800 from Table 112

Select the material from Table 110. 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:      PSVK6 for diameter  $D_N = 1,200.0$  mm  
 TSS Article No.:      PSV6**X1200** - M12N





Table 112: Installation Dimensions / TSS 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 <sub>N</sub> H9	d <sub>1</sub> h9	L <sub>1</sub> +0.2			D <sub>N</sub> H9	d <sub>1</sub> h9	L <sub>1</sub> +0.2		
15.0	4.3	4.2	PSV200150	3.47 x 3.53	115.0	99.9	6.3	PSV301150	97.79 x 5.33
<b>20.0</b>	<b>9.3</b>	<b>4.2</b>	<b>PSV200200</b>	<b>8.47 x 3.53</b>	115.0	94.5	8.1	PSV401150	93.00 x 7.00
<b>25.0</b>	<b>14.3</b>	<b>4.2</b>	<b>PSV200250</b>	<b>13.87 x 3.53</b>	120.0	104.9	6.3	PSV301200	104.14 x 5.33
28.0	17.3	4.2	PSV200280	15.47 x 3.53	120.0	99.5	8.1	PSV401200	98.00 x 7.00
30.0	19.3	4.2	PSV200300	18.66 x 3.53	<b>125.0</b>	<b>109.9</b>	<b>6.3</b>	<b>PSV301250</b>	<b>107.32 x 5.33</b>
<b>32.0</b>	<b>21.3</b>	<b>4.2</b>	<b>PSV200320</b>	<b>20.22 x 3.53</b>	<b>125.0</b>	<b>104.5</b>	<b>8.1</b>	<b>PSV401250</b>	<b>103.00 x 7.00</b>
35.0	24.3	4.2	PSV200350	23.40 x 3.53	130.0	114.9	6.3	PSV301300	113.67 x 5.33
<b>40.0</b>	<b>29.3</b>	<b>4.2</b>	<b>PSV200400</b>	<b>28.17 x 3.53</b>	130.0	109.5	8.1	PSV401300	108.00 x 7.00
42.0	31.3	4.2	PSV200420	29.75 x 3.53	135.0	114.5	8.1	PSV401350	113.67 x 7.00
45.0	34.3	4.2	PSV200450	32.92 x 3.53	140.0	119.5	8.1	PSV401400	116.84 x 7.00
48.0	37.3	4.2	PSV200480	36.09 x 3.53	145.0	124.5	8.1	PSV401450	123.19 x 7.00
<b>50.0</b>	<b>39.3</b>	<b>4.2</b>	<b>PSV200500</b>	<b>37.69 x 3.53</b>	150.0	129.5	8.1	PSV401500	126.37 x 7.00
<b>50.0</b>	<b>34.9</b>	<b>6.3</b>	<b>PSV300500</b>	<b>32.69 x 5.33</b>	155.0	139.9	6.3	PSV301550	135.89 x 5.33
52.0	41.3	4.2	PSV200520	40.87 x 3.53	<b>160.0</b>	<b>144.9</b>	<b>6.3</b>	<b>PSV301600</b>	<b>142.24 x 5.33</b>
55.0	44.3	4.2	PSV200550	44.04 x 3.53	<b>160.0</b>	<b>139.5</b>	<b>8.1</b>	<b>PSV401600</b>	<b>135.89 x 7.00</b>
55.0	39.9	6.3	PSV300550	37.47 x 5.33	165.0	149.9	6.3	PSV301650	148.49 x 5.33
60.0	44.9	6.3	PSV300600	43.82 x 5.33	165.0	144.5	8.1	PSV401650	142.24 x 7.00
62.0	51.3	4.2	PSV200620	50.39 x 3.53	170.0	149.5	8.1	PSV401700	145.42 x 7.00
<b>63.0</b>	<b>52.3</b>	<b>4.2</b>	<b>PSV200630</b>	<b>50.39 x 3.53</b>	175.0	159.9	6.3	PSV301750	158.12 x 5.33
<b>63.0</b>	<b>47.9</b>	<b>6.3</b>	<b>PSV300630</b>	<b>46.99 x 5.33</b>	180.0	164.9	6.3	PSV301800	164.47 x 5.33
65.0	49.9	6.3	PSV300650	46.99 x 5.33	180.0	159.5	8.1	PSV401800	158.12 x 7.00
70.0	59.3	4.2	PSV200700	56.74 x 3.53	190.0	174.9	6.3	PSV301900	170.82 x 5.33
70.0	54.9	6.3	PSV300700	53.34 x 5.33	190.0	169.5	8.1	PSV401900	164.47 x 7.00
70.0	49.5	8.1	PSV400700	48.00 x 7.00	195.0	174.5	8.1	PSV401950	170.82 x 7.00
75.0	59.9	6.3	PSV300750	56.52 x 5.33	<b>200.0</b>	<b>184.9</b>	<b>6.3</b>	<b>PSV302000</b>	<b>183.52 x 5.33</b>
<b>80.0</b>	<b>64.9</b>	<b>6.3</b>	<b>PSV300800</b>	<b>62.87 x 5.33</b>	<b>200.0</b>	<b>179.5</b>	<b>8.1</b>	<b>PSV402000</b>	<b>177.17 x 7.00</b>
<b>80.0</b>	<b>59.5</b>	<b>8.1</b>	<b>PSV400800</b>	<b>58.00 x 7.00</b>	205.0	184.5	8.1	PSV402050	183.52 x 7.00
85.0	69.9	6.3	PSV300850	69.22 x 5.33	210.0	189.5	8.1	PSV402100	183.52 x 7.00
85.0	64.5	8.1	PSV400850	63.00 x 7.00	220.0	204.9	6.3	PSV302200	202.57 x 5.33
90.0	74.9	6.3	PSV300900	72.39 x 5.33	220.0	199.5	8.1	PSV402200	196.22 x 7.00
90.0	69.5	8.1	PSV400900	68.00 x 7.00	230.0	209.5	8.1	PSV402300	208.90 x 7.00
95.0	79.9	6.3	PSV300950	78.74 x 5.33	240.0	219.5	8.1	PSV402400	215.27 x 7.00
95.0	74.5	8.1	PSV400950	73.00 x 7.00	<b>250.0</b>	<b>229.5</b>	<b>8.1</b>	<b>PSV402500</b>	<b>227.97 x 7.00</b>
<b>100.0</b>	<b>84.9</b>	<b>6.3</b>	<b>PSV301000</b>	<b>81.92 x 5.33</b>	<b>250.0</b>	<b>226.0</b>	<b>8.1</b>	<b>PSV802500</b>	<b>227.97 x 7.00</b>
<b>100.0</b>	<b>79.5</b>	<b>8.1</b>	<b>PSV401000</b>	<b>78.00 x 7.00</b>	260.0	236.0	8.1	PSV802600	227.97 x 7.00
105.0	89.9	6.3	PSV301050	88.27 x 5.33	270.0	246.0	8.1	PSV802700	240.67 x 7.00
105.0	84.5	8.1	PSV401050	83.00 x 7.00	280.0	256.0	8.1	PSV802800	253.37 x 7.00
106.0	90.9	6.3	PSV301060	88.27 x 5.33	300.0	276.0	8.1	PSV803000	266.07 x 7.00
110.0	94.9	6.3	PSV301100	91.44 x 5.33	306.0	285.5	8.1	PSV403060	278.77 x 7.00
110.0	89.5	8.1	PSV401100	88.00 x 7.00	310.0	286.0	8.1	PSV803100	278.77 x 7.00



Bore Dia.	Groove Dia.	Groove Width	TSS Part No.	O-Ring Dimensions
$D_N$ H9	$d_1$ h9	$L_1$ +0.2		
<b>320.0</b>	<b>299.5</b>	<b>8.1</b>	<b>PSV403200</b>	<b>291.47 x 7.00</b>
<b>320.0</b>	<b>296.0</b>	<b>8.1</b>	<b>PSV803200</b>	<b>291.47 x 7.00</b>
330.0	306.0	8.1	PSV803300	304.17 x 7.00
340.0	316.0	8.1	PSV803400	316.87 x 7.00
345.0	324.5	8.1	PSV403450	316.87 x 7.00
350.0	326.0	8.1	PSV803500	316.87 x 7.00
360.0	336.0	8.1	PSV803600	329.57 x 7.00
370.0	346.0	8.1	PSV803700	342.27 x 7.00
380.0	356.0	8.1	PSV803800	354.97 x 7.00
<b>400.0</b>	<b>376.0</b>	<b>8.1</b>	<b>PSV804000</b>	<b>367.67 x 7.00</b>
420.0	396.0	8.1	PSV804200	393.07 x 7.00
430.0	406.0	8.1	PSV804300	405.26 x 7.00
440.0	416.0	8.1	PSV804400	405.26 x 7.00
450.0	426.0	8.1	PSV804500	417.96 x 7.00
480.0	456.0	8.1	PSV804800	456.06 x 7.00
<b>500.0</b>	<b>476.0</b>	<b>8.1</b>	<b>PSV805000</b>	<b>468.76 x 7.00</b>
520.0	499.5	8.1	PSV405200	494.16 x 7.00
540.0	516.0	8.1	PSV805400	506.86 x 7.00
600.0	576.0	8.1	PSV806000	557.66 x 7.00
650.0	626.0	8.1	PSV806500	608.08 x 7.00

Bore Dia.	Groove Dia.	Groove Width	TSS Part No.	O-Ring Dimensions
$D_N$ H9	$d_1$ h9	$L_1$ +0.2		
700.0	672.7	9.5	PSV507000	670.00 x 8.40
780.0	752.7	9.5	PSV507800	750.00 x 8.40
800.0	772.7	9.5	PSV508000	770.00 x 8.40
820.0	792.7	9.5	PSV508200	790.00 x 8.40
860.0	832.7	9.5	PSV508600	830.00 x 8.40
900.0	872.7	9.5	PSV509000	870.00 x 8.40
920.0	892.7	9.5	PSV509200	890.00 x 8.40
1,000.0	972.7	9.5	PSV5X1000	970.00 x 8.40
1,000.0	962.0	13.8	PSV6X1000	960.00 x 12.00
1,200.0	1,172.7	9.5	PSV5X1200	1,171.00 x 8.40
1,200.0	1,162.0	13.8	PSV6X1200	1,160.00 x 12.00
1,500.0	1,462.0	13.8	PSV6X1500	1,460.00 x 12.00
2,000.0	1,962.0	13.8	PSV6X2000	1,960.00 x 12.00
2,650.0	2,612.0	13.8	PSV6X2650	2,610.00 x 12.00
2,700.0	2,662.0	13.8	PSV6X2700	2,660.00 x 12.00

The bore diameters in **bold** type comply 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.

All O-Rings with 12 mm cross section are delivered as special profile ring.