



Varilip[®] - Turcon[®] shaft seal

VARILIP[®] - TURCON[®] SHAFT SEALS

■ Description

Standard radial shaft seals have only a limited application range with respect to pressure, temperature and media loads due to their elastomer sealing lip. Furthermore they only have a limited suitability for applications with inadequate lubrication.

Varilip[®] shaft seals from Busak+Shamban extend this application range by using modern Turcon[®] materials developed specially for rotational applications.

They are characterised in particular by the low friction and their stick-slip-free running, thus reducing the heat development and permitting higher peripheral speeds.

The Varilip[®] shaft seal fits into grooves according to ISO/DIS 16589 and is dimensionally interchangeable with the shaft seals to DIN 3760 and ISO 6194/1.

The minimal groove size required for Varilip[®] allows its use as a pressurised seal where the installation of a mechanical shaft seal would not be possible due to constructional reasons.

In contrast to the conventional shaft seals, the Varilip[®] seal requires no metallic energising spring.

As can be seen from Figure 83, dynamic sealing is effected by the radial load of the sealing lip against the shaft. Static sealing is effected on the one hand by a press fit of the metallic casing in the housing bore and, on the other, by an elastomeric flat gasket between metallic housing and Turcon[®] sealing lip.

■ Varilip[®], type A

Type A is a one-lip seal suitable for use in standard industrial applications up to $p_{max} = 0.5$ MPa where a radial shaft seal would be unable to withstand the temperature, friction, medium or poor lubrication. Type A allows high-speed shafts with peripheral speeds of up to 40 m/s to be sealed.

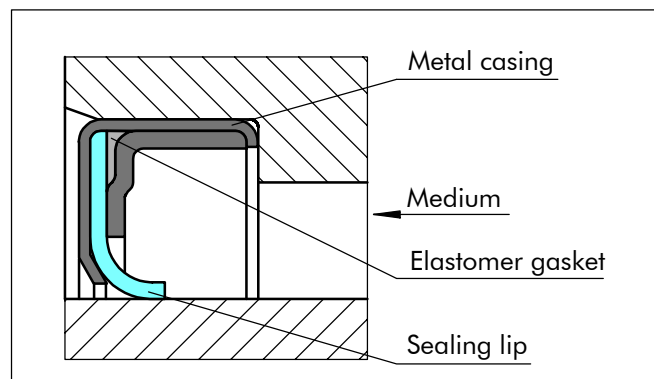


Figure 83 Type A

■ Varilip[®], type B

Type B is the preferred choice for applications in which a high sealability is demanded or where contaminated media are to be sealed. This two-lip type offers greater safety than the Type A.

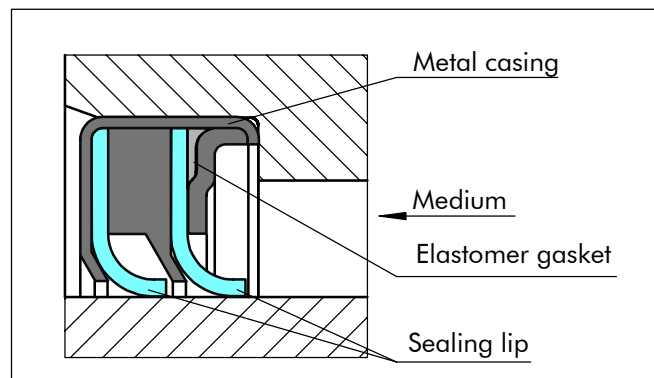


Figure 84 Type B



■ Varilip®, type C

The Varilip® Type C can be used for applications involving higher pressures for which a simple elastomer radial shaft seal can no longer be considered. Due to a reinforcement of the sealing lip, pressures of up to 2 MPa are possible, e.g. as pump, shaft or rotor seals.

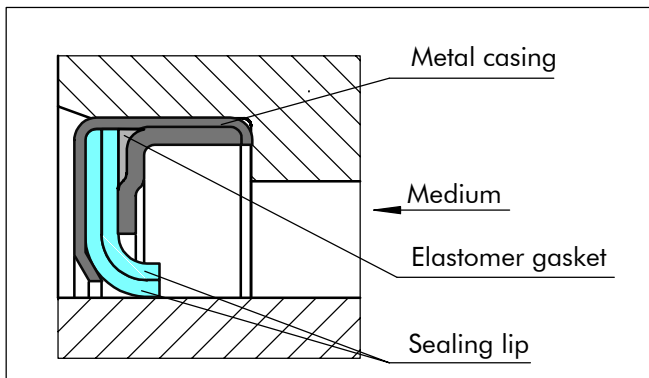


Figure 85 Type C

■ Varilip®, type D

Whilst Types A to C can be used to seal against pressures from only one side, Type D can be subjected to pressure from both sides. Pressures of up to 0.1 MPa are permissible. The separation of two different media using a single seal is possible. The second lip can also take on the function of a wiper or dust lip.

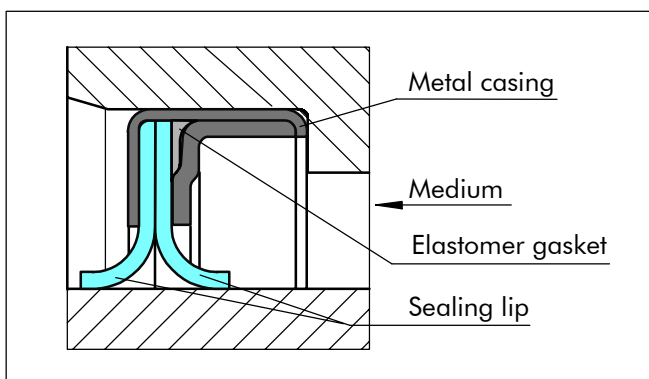


Figure 86 Type D

Table I summarises the important technical data and selection criteria for the different Varilip® types. Furthermore it gives an overview of the most significant applications in which the various Varilip® types have already proven themselves in practice.

This table is intended to allow the designer a quick preselection of the most favourable seal type and the optimum material for his specific application.

Advantages

- Low friction seal material
- Stick-slip free running
- Low and high temperature range (-60 to +200 °C)
- High pressure capability (2 MPa)
- High speed ability (40 m/s)
- Wide media compatibility
- Not affected by chemicals
- Fits standard oil seal installation groove

Technical data

Coaxiality tolerance

In order to achieve a uniform radial load of the sealing lip on the surface of the shaft, the best possible coaxiality should exist between shaft and housing bore.

The maximum permissible coaxial deviation as a function of shaft diameter is shown in Figure 87.

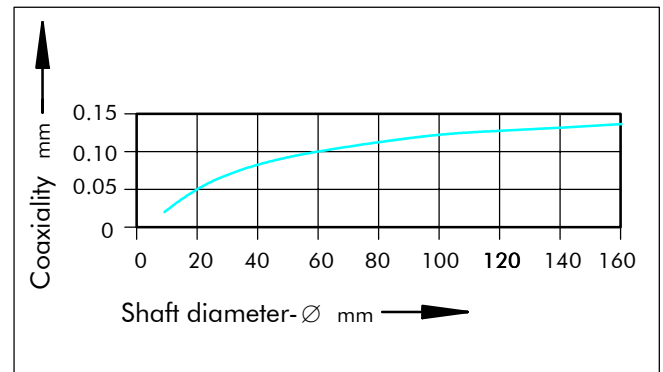


Figure 87 Coaxiality tolerance



Varilip® - Turcon® shaft seal

Shaft runout tolerance

In order to maintain the sealing function, the shaft eccentricity as a function of the speed must be limited as shown in Figure 88.

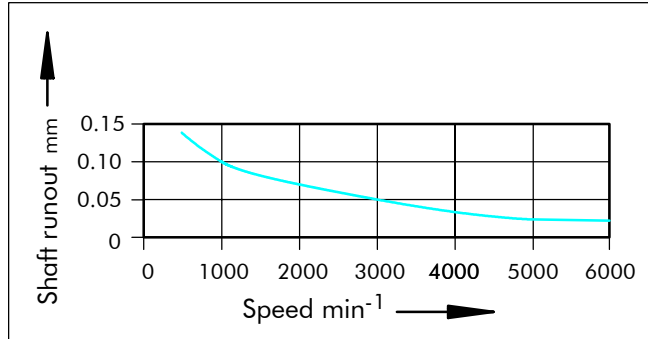


Figure 88 Max. shaft runout

Power consumption, dry running

Guide values for the frictional power consumption can be determined from the curve in Figure 89. It is plotted as a function of surface speed and operating pressure for a shaft diameter of 50 mm for a Varilip® type A and lip material T25.

Guide values for other shaft diameters can be calculated from the formula

$$p \approx p_{50} \times \left(\frac{d}{50 \text{ mm}}\right)^2 \text{ [W]}$$

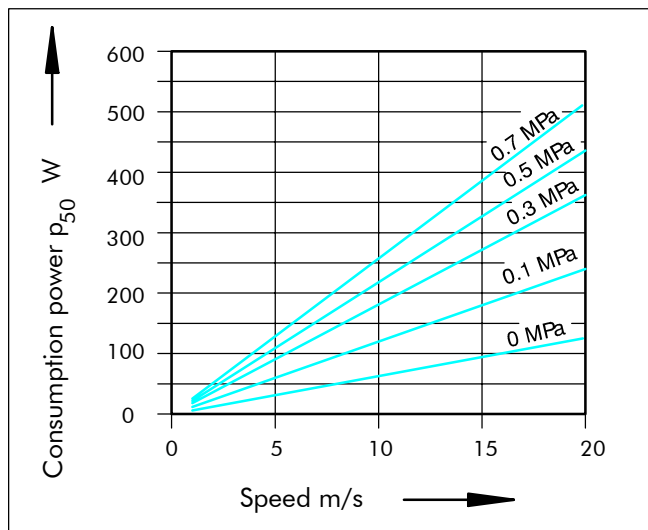


Figure 89 Power consumption on a 50 mm shaft-Ø

Torque

Figure 90 shows the torque as a function of the operating pressure for various Varilip® types and Turcon® materials for a shaft diameter of 50 mm. The torque for other shaft diameters can be roughly calculated from the formula

$$M \approx M_{50} \times \left(\frac{d}{50 \text{ mm}}\right)^2 \text{ [Nm]}$$

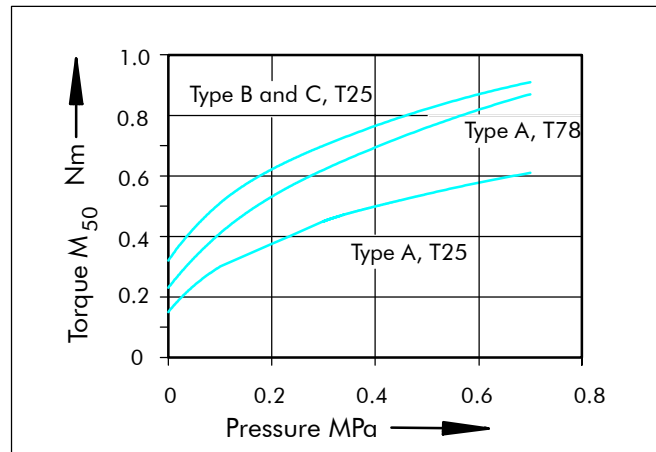


Figure 90 Torque on a 50 mm shaft-Ø



Application examples

Varilip® is preferably used as a single acting seal for rotating hydraulic and pneumatic equipment in sectors such as:

- Pumps
- Separators
- Blowers
- Centrifuges
- Gearboxes
- Machine tools
- Hubs
- Mixers
- Bearings
- Marine

Application Limits

The limits for temperature, pressure and speed given in this catalogue cannot be fully exploited at the same time.

Furthermore, the lubrication properties, the media, the heat dissipation and the condition of the shaft surface affects the application limits.

The following $p \times v$ values can be used as general guidelines:

For shaft diameter from 30 mm to 170 mm:

up to 1.5 (MPa x m/s) with poor lubrication

up to 3.0 (MPa x m/s) with good lubrication

up to 10.0 (MPa x m/s) with very good cooling

For smaller shaft diameters, the values must be reduced.



Varilip® - Turcon® shaft seal

Materials

An important factor for the proper function of rotational seals is the material. For this reason, Busak+Shamban has developed a range of specially modified materials for rotational applications on the basis of the proven Turcon® materials. Particular importance was attached to the optimisation of friction and wear properties, even at high peripheral speeds.

Figure 91 shows the standard materials used for Varilip® seals.

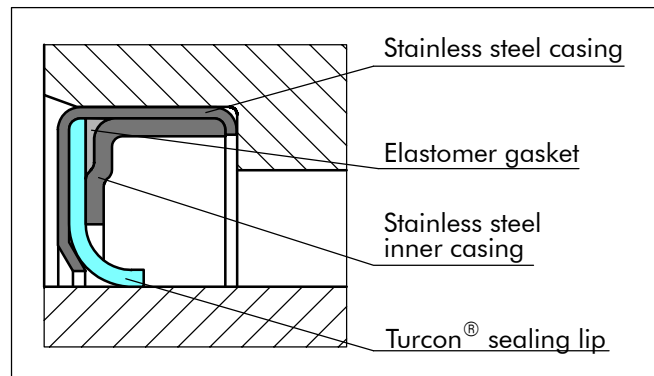


Figure 91 Materials for Varilip® seals

Table LVIII Turcon® materials for Varilip®

Material, Applications, Properties	Code	Operating temp. °C	Mating surface hardness	MPa max.
Turcon® T25 Standard material with exceptional wear and friction characteristics. For lubricated or dry running. Glass fiber, lubricant Colour: Grey	T25	-60 to +200	Min. 55 HRC At low pressure and speeds up to 4 m/s, a hardness of 45 HRC is acceptable	2
Turcon® T40 For all lubricating and non-lubricating fluids. Used for medium hard shafts in applications where a risk for shaft wear exist. Carbon fiber Colour: Grey	T40	-60 to +200	Min. 30 HRC	2
Turcon® T78 Characterized by particular good running behaviour. This permits use in dry running applications, applications with poor lubrication and in conjunction with soft shaft surfaces e.g. in applications where stainless steel is standard, like food stuff, pharmaceutical and chemical industries. Aromatic polymer Colour: Tan to dark brown	T78	-60 to +200	Min. 170 HB	0.2

Other Turcon® lip materials are available, simply by using the relevant Turcon® material code when ordering.

Highlighted materials are standard.

Table LIX Casing materials

Medium	Material	Material Code
Oils, greases, air/gases, water, vapour, solvents, foodstuffs	Stainless steel Material No. 1.4301 AISI 304	1
Acids, caustics, seawater	Acid-resistant stainless steel Material No. 1.4436 AISI 316	2
	Acid-resistant stainless steel Material No. 1.4571 AISI 316 Ti	3*)

*) Only for type **A, C** and **D** up to max. 90 mm outside diameter.

Table LX Materials for gasket elastomers

Medium	Temperature	Material	Code
Air, water, oils/greases	Nitrile-Elastomer - 30 to + 110°C	NBR	N
Air, water, vapour, foodstuffs, alcohols	Ethylene-propylene-elastomer - 60 to + 150°C	EPDM	E
Air, water, oils, greases, solvents, acids, caustics	Fluoroelastomer - 20 to + 200°C	FKM	V



■ Design Instructions

Groove design

Varilip® shaft seals in Table LXII fit into grooves according to ISO/DIS 16589 and also to DIN 3760 or ISO 6194/1.

Table LXI Surface roughness

Surface roughness μm		
	Shaft surface	Housing bore
R_{max}	1.00 - 4.00	< 10.0
R_z	0.63 - 2.50	< 6.3
R_a	0.10 - 0.40	< 1.6

The material contact area R_{mr} should be approx. 50 to 70%, determined at a cut depth $c = 0.25 \times R_z$, relative to a reference line c_{ref} . 5%.



Installation recommendation

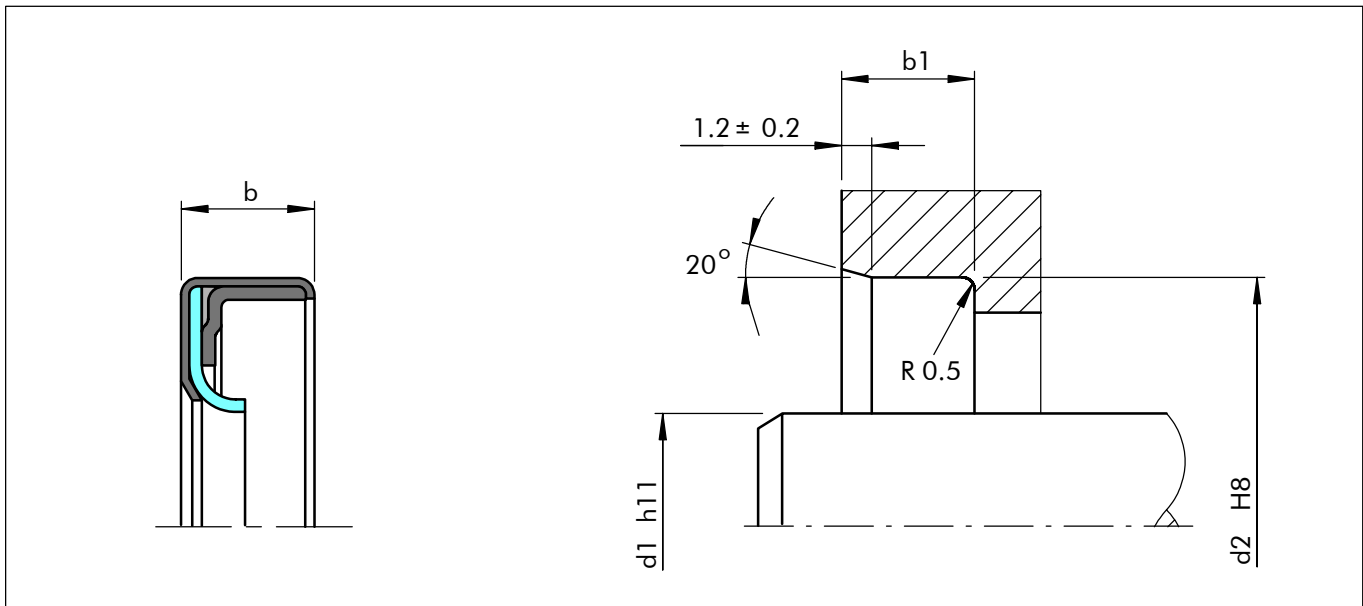


Figure 92 Installation drawing for pressure up to 0.2 MPa

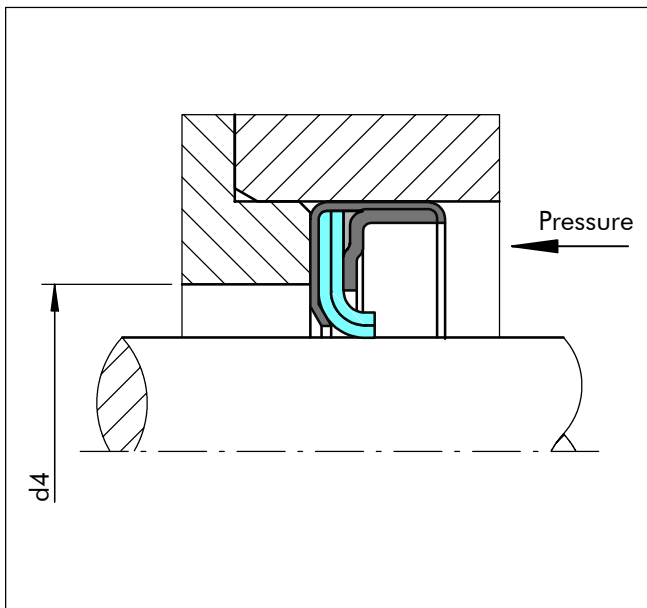


Figure 93 Installation for pressure from 0.2 MPa up to 2 MPa

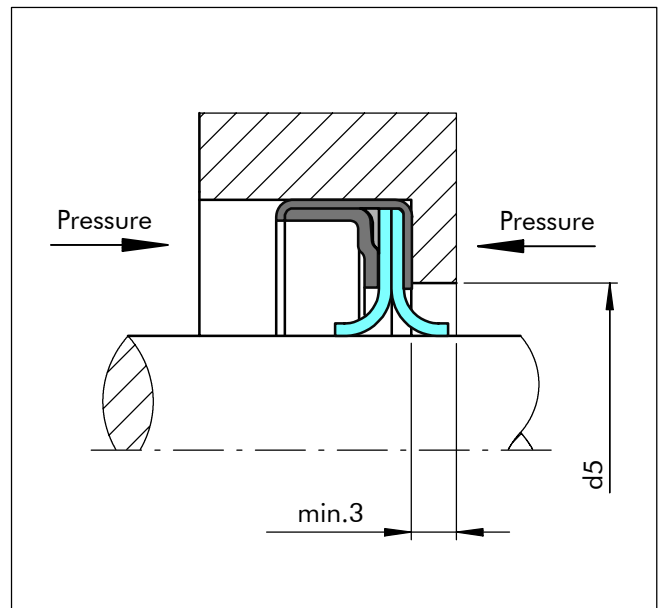


Figure 94 Installation type D

Remark: The installation for Varilip® follows the same rules as for oil seals. See Fig. 6, page 15.



Table LXII Standard sizes

d ₁	Sizes		Part no.	b ₁ min.	d ₄ max.	d ₅ min.
	d ₂	b				
6	16	7	TP_100060	7.3	10	9.6
6	22	7	TP_200060	7.3	10	9.6
7	22	7	TP_100070	7.3	11	10.6
8	22	7	TP_100080	7.3	12	11.6
8	24	7	TP_200080	7.3	12	11.6
9	22	7	TP_100090	7.3	13	12.6
9	24	7	TP_200090	7.3	13	12.6
9	26	7	TP_300090	7.3	13	12.6
10	22	7	TP_100100	7.3	14	13.6
10	24	7	TP_200100	7.3	14	13.6
10	25	7	TP_300100	7.3	14	13.6
10	26	7	TP_400100	7.3	14	13.6
11	22	7	TP_100110	7.3	15	14.6
11	26	7	TP_200110	7.3	15	14.6
12	22	7	TP_100120	7.3	16	15.6
12	24	7	TP_200120	7.3	16	15.6
12	25	7	TP_300120	7.3	16	15.6
12	28	7	TP_400120	7.3	16	15.6
12	30	7	TP_500120	7.3	16	15.6
14	24	7	TP_100140	7.3	18	17.6
14	28	7	TP_200140	7.3	18	17.6
14	30	7	TP_300140	7.3	18	17.6
14	35	7	TP_400140	7.3	18	17.6
15	26	7	TP_100150	7.3	19	18.6
15	30	7	TP_200150	7.3	19	18.6
15	32	7	TP_300150	7.3	19	18.6
15	35	7	TP_400150	7.3	19	18.6
16	28	7	TP_100160	7.3	20	19.6
16	30	7	TP_200160	7.3	20	19.6
16	32	7	TP_300160	7.3	20	19.6
16	35	7	TP_400160	7.3	20	19.6
17	28	7	TP_100170	7.3	21	20.6
17	30	7	TP_200170	7.3	21	20.6
17	32	7	TP_300170	7.3	21	20.6
17	35	7	TP_400170	7.3	21	20.6
17	40	7	TP_500170	7.3	21	20.6
18	30	7	TP_100180	7.3	22	21.6
18	32	7	TP_200180	7.3	22	21.6
18	35	7	TP_300180	7.3	22	21.6
18	40	7	TP_400180	7.3	22	21.6

The sizes printed in bold type should be preferred.

Other sizes are available on request.



Varilip® - Turcon® shaft seal

Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
20	30	7	TP_100200	7.3	24	23.6
20	32	7	TP_200200	7.3	24	23.6
20	35	7	TP_300200	7.3	24	23.6
20	40	7	TP_400200	7.3	24	23.6
20	47	7	TP_500200	7.3	24	23.6
22	32	7	TP_100220	7.3	26	25.6
22	35	7	TP_200220	7.3	26	25.6
22	40	7	TP_300220	7.3	26	25.6
22	47	7	TP_400220	7.3	26	25.6
24	35	7	TP_100240	7.3	28	27.6
24	37	7	TP_200240	7.3	28	27.6
24	40	7	TP_300240	7.3	28	27.6
24	47	7	TP_400240	7.3	28	27.6
25	35	7	TP_100250	7.3	29	28.6
25	40	7	TP_200250	7.3	29	28.6
25	42	7	TP_300250	7.3	29	28.6
25	47	7	TP_400250	7.3	29	28.6
25	52	7	TP_500250	7.3	29	28.6
26	37	7	TP_100260	7.3	30	29.6
26	42	7	TP_200260	7.3	30	29.6
26	47	7	TP_300260	7.3	30	29.6
28	40	7	TP_100280	7.3	32	31.6
28	47	7	TP_200280	7.3	32	31.6
28	52	7	TP_300280	7.3	32	31.6
30	40	7	TP_100300	7.3	34	33.6
30	42	7	TP_200300	7.3	34	33.6
30	47	7	TP_300300	7.3	34	33.6
30	52	7	TP_400300	7.3	34	33.6
30	62	7	TP_500300	7.3	34	33.6
32	45	7	TP_100320	7.3	36	35.6
32	45	8	TP_200320	8.3	36	35.6
32	47	7	TP_300320	7.3	36	35.6
32	47	8	TP_400320	8.3	36	35.6
32	52	7	TP_500320	7.3	36	35.6
32	52	8	TP_600320	8.3	36	35.6
35	47	7	TP_100350	7.3	39	38.6
35	50	7	TP_200350	7.3	39	38.6
35	50	8	TP_300350	8.3	39	38.6
35	52	7	TP_400350	7.3	39	38.6
35	52	8	TP_500350	8.3	39	38.6
35	55	8	TP_600350	8.3	39	38.6
35	62	7	TP_700350	7.3	39	38.6

The sizes printed in bold type should be preferred.

Other sizes are available on request.

Varilip® - Turcon® shaft seal



d ₁	Sizes		Part no.	b ₁ min.	d ₄ max.	d ₅ min.
	d ₂	b				
36	47	7	TP_100360	7.3	40	39.6
36	50	7	TP_200360	7.3	40	39.6
36	52	7	TP_300360	7.3	40	39.6
36	62	7	TP_400360	7.3	40	39.6
38	52	7	TP_100380	7.3	42	41.6
38	55	7	TP_200380	7.3	42	41.6
38	55	8	TP_300380	8.3	42	41.6
38	58	8	TP_400380	8.3	42	41.6
38	62	7	TP_500380	7.3	42	41.6
38	62	8	TP_600380	8.3	42	41.6
40	52	7	TP_100400	7.3	44	43.6
40	55	7	TP_200400	7.3	44	43.6
40	55	8	TP_300400	8.3	44	43.6
40	62	7	TP_400400	7.3	44	43.6
40	62	8	TP_500400	8.3	44	43.6
40	72	7	TP_600400	7.3	44	43.6
42	55	8	TP_100420	8.3	46	45.6
42	62	8	TP_200420	8.3	46	45.6
42	72	8	TP_300420	8.3	46	45.6
45	60	8	TP_100450	8.3	49	48.6
45	62	8	TP_200450	8.3	49	48.6
45	65	8	TP_300450	8.3	49	48.6
45	72	8	TP_400450	8.3	49	48.6
48	62	8	TP_100480	8.3	52	51.6
48	72	8	TP_200480	8.3	52	51.6
50	65	8	TP_100500	8.3	54	53.6
50	68	8	TP_200500	8.3	54	53.6
50	72	8	TP_300500	8.3	54	53.6
50	80	8	TP_400500	8.3	54	53.6
52	68	8	TP_100520	8.3	56	55.6
52	72	8	TP_200520	8.3	56	55.6
55	70	8	TP_100550	8.3	59	58.6
55	72	8	TP_200550	8.3	59	58.6
55	80	8	TP_300550	8.3	59	58.6
55	85	8	TP_400550	8.3	59	58.6
56	70	8	TP_100560	8.3	60	59.6
56	72	8	TP_200560	8.3	60	59.6
56	80	8	TP_300560	8.3	60	59.6
56	85	8	TP_400560	8.3	60	59.6
58	72	8	TP_100580	8.3	62	61.6
58	80	8	TP_200580	8.3	62	61.6

The sizes printed in bold type should be preferred.

Other sizes are available on request.



Varilip® - Turcon® shaft seal

d ₁	Sizes		Part no.	b ₁ min.	d ₄ max.	d ₅ min.
	d ₂	b				
60	75	8	TP_100600	8.3	64	63.6
60	80	8	TP_200600	8.3	64	63.6
60	85	8	TP_300600	8.3	64	63.6
60	90	8	TP_400600	8.3	64	63.6
62	85	10	TP_100620	10.3	68	66.4
62	90	10	TP_200620	10.3	68	66.4
63	85	10	TP_100630	10.3	69	67.4
63	90	10	TP_200630	10.3	69	67.4
65	85	10	TP_100650	10.3	71	69.4
65	90	10	TP_200650	10.3	71	69.4
65	100	10	TP_300650	10.3	71	69.4
68	90	10	TP_100680	10.3	74	72.4
68	100	10	TP_200680	10.3	74	72.4
70	90	10	TP_100700	10.3	76	74.4
70	95	10	TP_200700	10.3	76	74.4
70	100	10	TP_300700	10.3	76	74.4
72	95	10	TP_100720	10.3	78	76.4
72	100	10	TP_200720	10.3	78	76.4
75	95	10	TP_100750	10.3	81	79.4
75	100	10	TP_200750	10.3	81	79.4
78	100	10	TP_100780	10.3	84	82.4
80	100	10	TP_100800	10.3	86	84.4
80	110	10	TP_200800	10.3	86	84.4
85	110	12	TP_100850	12.4	91	89.4
85	120	12	TP_200850	12.4	91	89.4
90	110	12	TP_100900	12.4	96	94.4
90	120	12	TP_200900	12.4	96	94.4
95	120	12	TP_100950	12.4	101	99.4
95	125	12	TP_200950	12.4	101	99.4
100	120	12	TP_101000	12.4	106	104.4
100	125	12	TP_201000	12.4	106	104.4
100	130	12	TP_301000	12.4	106	104.4
105	130	12	TP_101050	12.4	111	109.4
105	140	12	TP_201050	12.4	111	109.4
110	130	12	TP_101100	12.4	116	114.4
110	140	12	TP_201100	12.4	116	114.4
115	140	12	TP_101150	12.4	121	119.4
115	150	12	TP_201150	12.4	121	119.4
120	150	12	TP_101200	12.4	126	124.4
120	160	12	TP_201200	12.4	126	124.4
125	150	12	TP_101250	12.4	131	129.4
125	160	12	TP_201250	12.4	131	129.4

The sizes printed in bold type should be preferred.

Other sizes are available on request.



Sizes			Part no.	b ₁ min.	d ₄ max.	d ₅ min.
d ₁	d ₂	b				
130	160	12	TP_101300	12.4	136	134.4
130	170	12	TP_201300	12.4	136	134.4
135	170	12	TP_101350	12.4	141	139.4
140	170	15	TP_101400	15.4	148	147.0
145	175	15	TP_101450	15.4	153	152.0
150	180	15	TP_101500	15.4	158	157.0
160	190	15	TP_101600	15.4	168	167.0
170	200	15	TP_101700	15.4	178	177.0

The sizes printed in bold type should be preferred.

Other sizes are available on request.

Ordering example

Varilip®, type A

Shaft diameter d₁ = 30 mm

Outside diameter d₂ = 47 mm

Width b = 7 mm

Table LXII: Part no. TP_300300

The material is selected from Tables LVIII to LX.

The type is inserted as the 3rd digit.

Order-No.	TP	A	3	0	0300	-	T25	1	V
Type+cross sec.									
Type (Standard)									
Shaft-Ø x 10									
Quality Index (Standard)									
Material code - sealing lip									
Material code - casing									
Material code - gasket									

For other types by analogy:

Order no.: TP **B** 300300 - T 25 1V

TP **C** 300300 - T 25 1V

TP **D** 300300 - T 25 1V