V-Rings

Description

V-rings are rotary seals that can perform numerous jobs in their function of sealing rotating shafts:

- sealing against the penetration of dirt, dust, water or watery pollutants,
- combination with other sealing elements, e.g. the protection of a radial shaft sealing ring against external contamination, or
- sealing against fat leaking from a housing.

Advantages of V-rings

- diverse fields of application
- no high requirements as regards the shaft and housing designs
- low friction
- high circumferential speeds are possible as a result of reduced friction
- relatively insusceptible to coaxiality and radial eccentricity
- long service life
- easy installation

Structure and function

V-rings consist completely of elastomer. Their V-shaped profile consists of a relative-ly solid retaining part and a flexible sealing lip that are „hin-ged" together at the „V's" vertex.
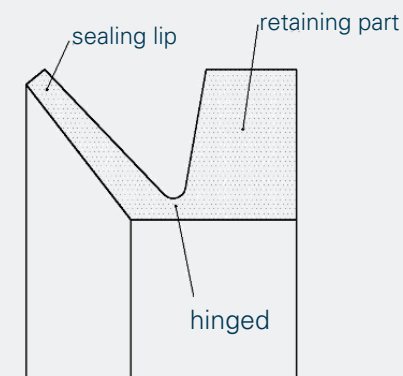

Profile of a V-ring, type VR-A10

V-rings will be expanded while being installed, moved into the intended position on the shaft and cling to the shaft surface as a result of their internal stress.

V-rings will rotate with the shaft and provide sealing in axial direction against a counter face that is positioned vertically to it. As a result of the diverse fields of application for V-rings the counter face can be formed by

- the housing itself,
- a housing cover,
- a pressed-in metal sheet,
- the face of a roller bearing's external ring,
- the metallic stiffening ring of a radial shaft sealing ring
- etc.
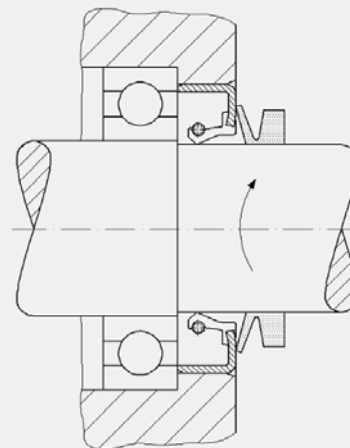
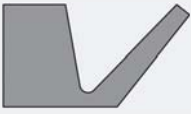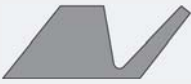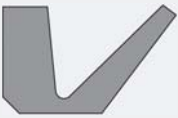Protection of a radial shaft sealing ring against external contamination

During the shaft's standstill, the sealing lip clings to the counter face due to its initial contact pressure. Once the shaft starts rotating, the centrifugal force acts in radial direction on the sealing lip, while the contact pressure drops with the increasing cir-cumferential speed.

The sealing lip starts to lift off the counter face from a circumfer-ential speed of approx. 15-20 m/s and the contact pressure drops to almost nil. The friction losses will increase with the rising circumferential speed almost linearly up to approx. 10 m/s. The friction losses will decrease to 10 ... 12 m/s and drop almost to nil in the range between 15 and 20 m/s.

A V-ring's sealing effect is based on the contact bet-ween sealing lip and counter face and, additionally, on the centrifugal effect caused by the V-ring's rotation. Once the sealing lip takes off at a very high circumferential speed, the V-ring will act as gap ring and centrifugal disk.

V-Rings

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Construction types/designs

In order to cover the wide range of possible applications, we have 3 standard designs in stock, made of 2 different materials each (NBR and FKM).

Profilskizze	Bauform	Dimensional range in stock [mm]	Remarks/comments
	VR-A10	3 - 1000 >1000 on request	most commonly used standard design with straight sealing back
	VR-S10	5 - 199	the same design as VR-A10 in the lip area, complemented by a conically extended retain-ing part, thus providing a better seat on the shaft
	VR-L10	110 - 600 >600 on request	small profile geometry for compact installation conditions uniform profile for all diameters

We can offer further construction types/designs on request, e.g.
VR-E10
VR-AX10

V-Rings

Materials
We offer V-rings from stock made of 2 different materials:

NBR 60
- standard material for a wide range of applications
- thermally resistant between -40 and +100°C
- good wear and abrasion resistance
- resistant to many media, such as mineral oil based oils and fats, water

FKM 60
- applicable under higher temperatures and in the presence of more aggressive media
- thermally resistant between -20 and +200°C
- very good resistance against many chemicals
- very good aging, ozone and weather resistance

Material	NBR	FKM
hardness [Shore A]	60	60
color	schwarz	braun
application temperature range [°C]	-40 bis +100	-20 bis +200

We can offer other elastomers, such as CR, EPDM and HNBR, on request.

Design of the shaft
There are comparatively few requirements concerning the design of the shaft, since the V-ring rotates together with the shaft and is only statically sealed towards the shaft.

Diameter tolerance
A V-ring can be used for a wide range of nominal diameters of the shaft. The observance of specific tolerance for the chosen nominal diameter therefore does not matter.

It should be noted, though, when selecting the shaft diameters, or the size of the V-ring for an existing shaft diameter, that the sealing lip's contact pressure against the counter face also rises with increasing expansion. Hence, an ex-pansion as small as possible should be selected (within the dimensional ranges stated in the measurement charts), in order to reduce the wear and tear and to prolong the service life.

Surface roughness
A shaft surface of Ra ≤ 6.3 µm is sufficient for most of the applications. A roughness value of Ra ≤ 3.2 µm should be observed for sealing liquids of low viscosity.

Design of the counter face
The sealing between the sealing lip and the counter face is dynamic. The V-ring's sealing function therefore depends largely on the design of the counter face.

Flatness tolerance
The deviation from the ideal plain counter face should not exceed 0.4 mm on 100 mm.

Surface roughness
The roughness is to be selected depending on the circumferential speed and the media to be sealed.

Liquid media in combination with high circumferential speeds (from 10 m/s) require a high surface quality of Ra = 0.4 … 0,8 µm.

In the case of a sealing against fat and dust at a low circumferential speed (up to 1 m/s) a value of Ra ≤ 2.5 µm will be sufficient.

Materials of the counter face
Possible are the types of steel commonly used in machine construction, stain-less steel and cast materials, such as gray cast iron or die cast aluminum. The selection of the material depends primarily on the medium to be sealed and on the circumferential speed.

When sealing water or other corrosive media, either the surface must be protected accordingly (e.g. by chrome-plating) or a type of stainless steel must be selected.

A hardness of >120 HB will be sufficient for standard applications. Harder materials should be used in the case of higher circumferential speeds and/or where abrasive particles are in the medium.

Design/installation instructions

Axial fastening

It is necessary under certain operating conditions to prop up the V-ring axially on the shaft, so as to prevent it from „creeping"

- at higher circumferential speeds (NBR >8 m/s / FKM > 6 m/s),
- at a very low expansion of the V-ring,
- when sealing oil, or
- to ease the installation (by simply complying with the specified size B after the installation)
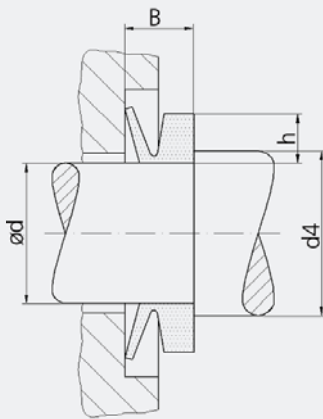
Axial fastening
d4 min. = $\varnothing d + 0{,}5 \times h$

Radial fastening

The V-ring needs to be radially fastened on the shaft in the case of higher circumfer-ential speeds (depending on the pre-tension, NBR >12 m/s / FKM > 10 m/s). In order to do so, the V-ring can be chambered in the area of the retaining part.

vent hole
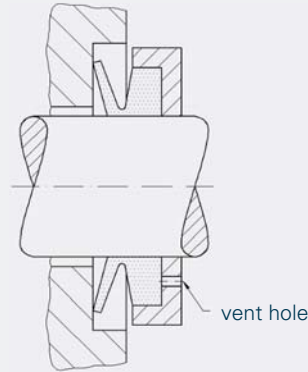
Radial fastening

Stationary application

When being used under stationary conditions, the V-ring will be installed/mounted on a non-moving part of the housing, where it seals off a surface rotating with the shaft. In such case, no centrifugal forces will act on the V-ring, thus facilitating its use above 10/12 m/s … 20 m/s. The friction will be higher under stationary condi-tions, since the contact pressure of the sealing lip does not decrease while the speed rises. As compared with a rotating V-ring, the service life will therefore be limited.

The surface roughness of the counter face and the expansion of the V-ring at the inner diameter should therefore be selected accordingly low.

Stationary use

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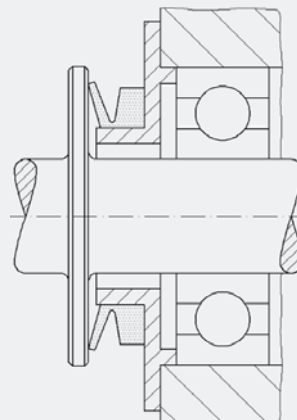
Installation dimensions VR-A10
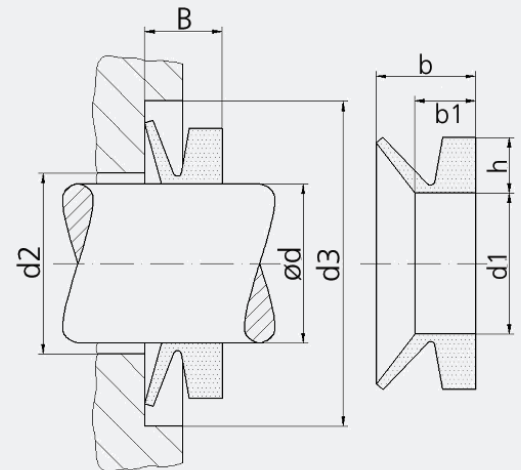
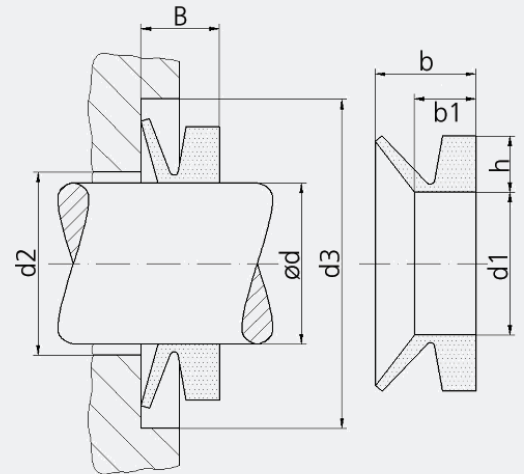| Type	Suitable for shaft - ø d	Dimensions in unstressed conditions				Specified size after installation		d2 max	d3 max
		d1	h	b1	b	B			
VR-A10-3	2.7-3.5	2.5	1.5	2.1	3	2.5	±0.3	d+1	d+4
VR-A10-4	3.5-4.5	3.2	2	2.4	3.7	3.0	±0.4	d+1	d+6
VR-A10-5	4.5-5.5	4	2	2.4	3.7	3.0	±0.4	d+1	d+6
VR-A10-6	5.5-6.5	5	2	2.4	3.7	3.0	±0.4	d+1	d+6
VR-A10-7	6.5-8	6	2	2.4	3.7	3.0	±0.4	d+1	d+6
VR-A10-8	8-9.5	7	2	2.4	3.7	3.0	±0.4	d+1	d+6
VR-A10-10	9.5-11.5	9	3	3.4	5.5	4.5	±0.6	d+2	d+9
VR-A10-12	11.5-12.5	10.5	3	3.4	5.5	4.5	±0.6	d+2	d+9
VR-A10-14	13.5-15.5	12.5	3	3.4	5.5	4.5	±0.6	d+2	d+9
VR-A10-16	15.5-17.5	14	3	3.4	5.5	4.5	±0.6	d+2	d+9
VR-A10-18	17.5-19	16	3	3.4	5.5	4.5	±0.6	d+2	d+9
VR-A10-20	19-21	18	4	4.7	7.5	6.0	±0.8	d+2	d+12
VR-A10-22	21-24	20	4	4.7	7.5	6.0	±0.8	d+2	d+12
VR-A10-25	24-27	22	4	4.7	7.5	6.0	±0.8	d+2	d+12
VR-A10-28	27-29	25	4	4.7	7.5	6.0	±0.8	d+3	d+12
VR-A10-30	29-31	27	4	4.7	7.5	6.0	±0.8	d+3	d+12
VR-A10-32	31-33	29	4	4.7	7.5	6.0	±0.8	d+3	d+12
VR-A10-35	33-36	31	4	4.7	7.5	6.0	±0.8	d+3	d+12
VR-A10-38	36-38	34	4	4.7	7.5	6.0	±0.8	d+3	d+12
VR-A10-40	38-43	36	5	5.5	9	7.0	±1.0	d+3	d+15
VR-A10-45	43-48	40	5	5.5	9	7.0	±1.0	d+3	d+15
VR-A10-50	48-53	45	5	5.5	9	7.0	±1.0	d+3	d+15
VR-A10-55	53-58	49	5	5.5	9	7.0	±1.0	d+3	d+15
VR-A10-60	58-63	54	5	5.5	9	7.0	±1.0	d+3	d+15
VR-A10-65	63-68	58	5	5.5	9	7.0	±1.0	d+3	d+15
VR-A10-70	68-73	63	6	6.8	11	9.0	±1.2	d+4	d+18
VR-A10-75	73-78	67	6	6.8	11	9.0	±1.2	d+4	d+18
VR-A10-80	78-83	72	6	6.8	11	9.0	±1.2	d+4	d+18
VR-A10-85	83-88	76	6	6.8	11	9.0	±1.2	d+4	d+18

V-Rings

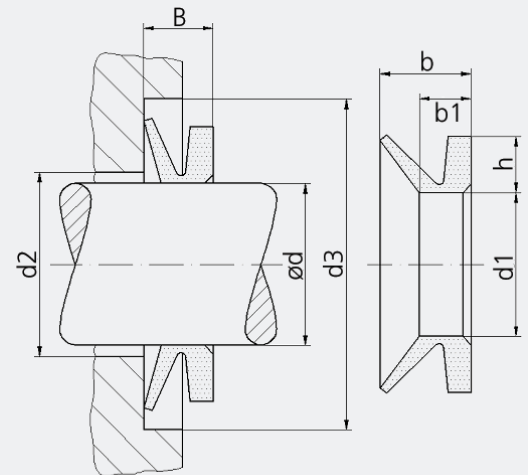| Type	Suitable for shaft - ø d	Dimensions in unstressed conditions				Specified size after installation		d2 max	d3 max
		d1	h	b1	b	B			
VR-A10-90	88-93	81	6	6.8	11	9.0	±1.2	d+4	d+18
VR-A10-95	93-98	85	6	6.8	11	9.0	±1.2	d+4	d+18
VR-A10-100	98-105	90	6	6.8	11	9.0	±1.2	d+4	d+18
VR-A10-110	105-115	99	7	7.9	12.8	10.5	±1.5	d+4	d+21
VR-A10-120	115-125	108	7	7.9	12.8	10.5	±1.5	d+4	d+21
VR-A10-130	125-135	117	7	7.9	12.8	10.5	±1.5	d+4	d+21
VR-A10-140	135-145	126	7	7.9	12.8	10.5	±1.5	d+4	d+21
VR-A10-150	145-155	135	7	7.9	12.8	10.5	±1.5	d+4	d+21
VR-A10-160	155-165	144	8	9	14.5	12.0	±1.8	d+5	d+24
VR-A10-170	165-175	153	8	9	14.5	12.0	±1.8	d+5	d+24
VR-A10-180	175-185	162	8	9	14.5	12.0	±1.8	d+5	d+24
VR-A10-190	185-195	171	8	9	14.5	12.0	±1.8	d+5	d+24
VR-A10-199	195-210	180	8	9	14.5	12.0	±1.8	d+5	d+24
VR-A10-200	190-210	180	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-220	210-235	198	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-250	235-265	225	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-275	265-290	247	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-300	290-310	270	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-325	310-335	292	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-350	335-365	315	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-375	365-390	337	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-400	390-430	360	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-450	430-480	405	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-500	480-530	450	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-550	530-580	495	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-600	580-630	540	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-650	630-665	600	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-700	665-705	630	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-725	705-745	670	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-750	745-785	705	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-800	785-830	745	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-850	830-875	785	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-900	875-920	825	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-950	920-965	865	15	14.3	25	20	±4.0	d+10	d+45
VR-A10-1000	965-1015	910	15	14.3	25	20	±4.0	d+10	d+45

V-Rings

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Installation dimensions VR-S10

Type	Suitable for shaft - ø d	Dimensions in unstressed conditions				Specified size after installation		d2 max	d3 max
		d1	h	b1	b	B			
VR-S10-5	4.5-5.5	4	2	3.9	5.2	4.5	±0.4	d+1	d+6
VR-S10-6	5.5-6.5	5	2	3.9	5.2	4.5	±0.4	d+1	d+6
VR-S10-7	6.5-8	6	2	3.9	5.2	4.5	±0.4	d+1	d+6
VR-S10-8	8-9.5	7	2	3.9	5.2	4.5	±0.4	d+1	d+6
VR-S10-10	9.5-11.5	9	3	5.6	7.7	6.7	±0.6	d+2	d+9
VR-S10-12	11.5-12.5	10.5	3	5.6	7.7	6.7	±0.6	d+2	d+9
VR-S10-14	13.5-15.5	12.5	3	5.6	7.7	6.7	±0.6	d+2	d+9
VR-S10-16	15.5-17.5	14	3	5.6	7.7	6.7	±0.6	d+2	d+9
VR-S10-18	17.5-19	16	3	5.6	7.7	6.7	±0.6	d+2	d+9
VR-S10-20	19-21	18	4	7.9	10.5	9.0	±0.8	d+2	d+12
VR-S10-22	21-24	20	4	7.9	10.5	9.0	±0.8	d+2	d+12
VR-S10-25	24-27	22	4	7.9	10.5	9.0	±0.8	d+2	d+12
VR-S10-28	27-29	25	4	7.9	10.5	9.0	±0.8	d+3	d+12
VR-S10-30	29-31	27	4	7.9	10.5	9.0	±0.8	d+3	d+12
VR-S10-32	31-33	29	4	7.9	10.5	9.0	±0.8	d+3	d+12
VR-S10-35	33-36	31	4	7.9	10.5	9.0	±0.8	d+3	d+12
VR-S10-38	36-38	34	4	7.9	10.5	9.0	±0.8	d+3	d+12
VR-S10-40	38-43	36	5	9.5	13	11.0	±1.0	d+3	d+15
VR-S10-45	43-48	40	5	9.5	13	11.0	±1.0	d+3	d+15
VR-S10-50	48-53	45	5	9.5	13	11.0	±1.0	d+3	d+15
VR-S10-55	53-58	49	5	9.5	13	11.0	±1.0	d+3	d+15
VR-S10-60	58-63	54	5	9.5	13	11.0	±1.0	d+3	d+15
VR-S10-65	63-68	58	5	9.5	13	11.0	±1.0	d+3	d+15
VR-S10-70	68-73	63	6	11.3	15.5	13.5	±1.2	d+4	d+18
VR-S10-75	73-78	67	6	11.3	15.5	13.5	±1.2	d+4	d+18
VR-S10-80	78-83	72	6	11.3	15.5	13.5	±1.2	d+4	d+18
VR-S10-85	83-88	76	6	11.3	15.5	13.5	±1.2	d+4	d+18
VR-S10-90	88-93	81	6	11.3	15.5	13.5	±1.2	d+4	d+18
VR-S10-95	93-98	85	6	11.3	15.5	13.5	±1.2	d+4	d+18

V-Rings

Type	Suitable for shaft - ø d	Dimensions in unstressed conditions				Specified size after installation		d2 max	d3 max
		d1	h	b1	b	B			
VR-S10-100	98-105	90	6	11.3	15.5	13.5	±1.2	d+4	d+18
VR-S10-110	105-115	99	7	13.1	18	15.5	±1.5	d+4	d+21
VR-S10-120	115-125	108	7	13.1	18	15.5	±1.5	d+4	d+21
VR-S10-130	125-135	117	7	13.1	18	15.5	±1.5	d+4	d+21
VR-S10-140	135-145	126	7	13.1	18	15.5	±1.5	d+4	d+21
VR-S10-150	145-155	135	7	13.1	18	15.5	±1.5	d+4	d+21
VR-S10-160	155-165	144	8	15	20.5	18.0	±1.8	d+5	d+24
VR-S10-170	165-175	153	8	15	20.5	18.0	±1.8	d+5	d+24
VR-S10-180	175-185	162	8	15	20.5	18.0	±1.8	d+5	d+24
VR-S10-190	185-195	171	8	15	20.5	18.0	±1.8	d+5	d+24
VR-S10-199	195-210	180	8	15	20.5	18.0	±1.8	d+5	d+24

V-Rings

Installation dimensions VR-L10

Type	Suitable for shaft - ø d	Dimensions in unstressed conditions				Specified size after installation B		d2 max	d3 max
		d1	h	b1	b				
VR-L10-110	105-115	99	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-120	115-125	108	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-130	125-135	117	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-140	135-145	126	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-150	145-155	135	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-160	155-165	144	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-170	165-175	153	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-180	175-185	162	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-190	185-195	171	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-200	195-210	182	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-220	210-233	198	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-250	233-260	225	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-275	260-285	247	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-300	285-310	270	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-325	310-335	292	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-350	335-365	315	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-375	365-385	337	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-400	385-410	360	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-425	410-440	382	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-450	440-475	405	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-500	475-510	450	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-525	510-540	472	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-550	540-575	495	6.5	6	10.5	8	±1.5	d+5	d+20
VR-L10-600	575-625	540	6.5	6	10.5	8	±1.5	d+5	d+20

V-Rings

Installation

Compared with other rotary seals the installation of V-rings is relatively easy. The following rules should be complied with:

- All components involved must be cleaned.
- There should be no lubricant between V-ring and shaft, especially not in the case of applications without axial fastening.
- The V-ring can be expanded manually on the shaft and shifted there into the right position.
- The V-ring ought to be expanded uniformly all over the circumference. It may be helpful, especially where large dimensions are concerned, to slide a round blunt auxiliary tool (made of POM or wood) between V-ring and shaft and to let it rotate several times around the shaft.
- It is important to uniformly keep the distance B after the installation.
- When installing a large number of V-rings, a mounting sleeve can be used.
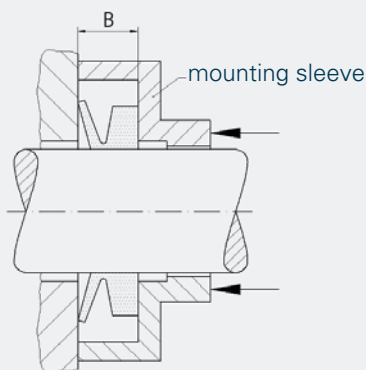
V-ring installation with mounting sleeve

Storage of elastomer

The optimal storage conditions for products made of elastomer are described in DIN standards 7716 and ISO 2230. When complying with these instructions, elastomer can be stored over several years without any deterioration in quality.

The most detrimental factors for accelerating the aging of elastomers are:
mechanical stress (compression, tension, bending, ...), the exposure to oxygen, ozone, light, heat, moisture and solvents. The following principles should therefore be adhered to:

Store room

The store room ought to be cool, dry, almost dust-free and slightly ventilated. The relative air moisture should not exceed 65 %. No ozone-generating electrical appliances should be put up in the store room. Nor should it be used for the storage of solvents, fuels, lubricants, chemicals or other gas emitting substances at the same time.

Storage temperature

There should be a temperature of approx. 15°C, with fluctuations between +20°C und -10°C being admissible. Heat sources, such as radiators, should be kept at a minimum distance of 1 m to the stored goods; they should not be directly exposed to the radiation.

Lighting

Elastomers must be protected against direct sun radiation and artificial lighting with a high UV content. Room lighting with conventional light bulbs is recommended.

Packaging

Closed packaging, e.g. in air-tight containers or polyethylene bags, will protect the stored goods against any air exchange and thus against oxygen and ozone. The packaging materials most not contain any softeners or substances that can damage the elastomer.

Mechanical stress

Products made of elastomer should be stored stress-free, which means no tension, compression or bending and other forces should impact them.

Storage of components

The storage of components, where seals have already been installed, requires par-ticular care, since their aging can be immensely accelerated due to the tensile stress in an expanded sealing. The expansion should therefore be kept as low as possible under design aspects.

Even if optimal storage conditions are complied with, such components should not be stored longer than absolutely necessary and be further processed on the principle of „first-in first-out" (FIFO).