HUTCHINSON®

X-RINGS

We make it ***possible***

1 – GENERAL INFORMATION

1.1 – Definition

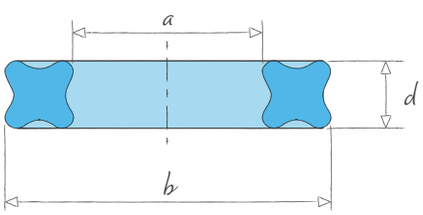
The X-ring has a cross section with 4 lobes, providing a double sealing line especially suitable for hydraulic, pneumatic and oleo-pneumatic devices.

It has no assembly orientation and is defined by two dimensions: inside diameter a and cross section d.

It is particularly suitable for dynamic applications such as:

- reciprocating movements up to 150 bar
- rotating movements up to 1m/s

Beyond these limits, certain assembly and lubrication conditions must be observed.



1.2 – Compound selection

The standard compound for X-Rings is 9PD31, a NBR 78 Sh systematically treated with Lubri PB.

Many other compounds are available in our compounds list (p. 135), subject to feasibility.

Family	Compound	Colour	Hardness (Sh.A)	Min temp.	Max continuous temp.	Temp. max peak	CS	Conditions
NBR	9PD31	black	78	-30°C	100°C	120°C	15%	24h at 100°C

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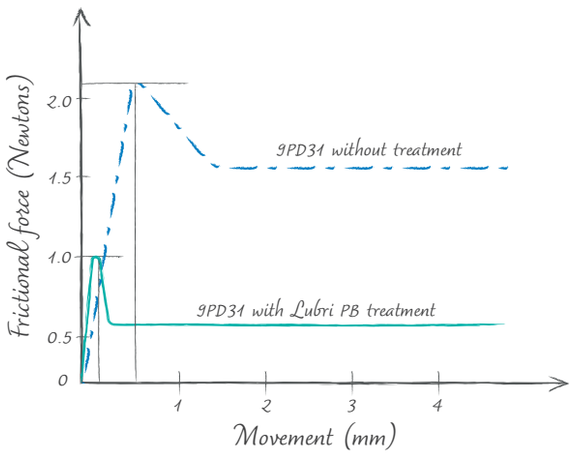
2 – TECHNICAL BENEFITS

2.1 – Reduced friction

Compared with O-Rings the friction of X-Rings is reduced for several reasons:

- Operating principle based on bending of the lobes and not on compression of the material, which reduces the sticking effect
- Presence of a reserve of lubricant trapped between the lobes
- Special LUBRI PB treatment systematically applied to our X-Rings in 9PD31



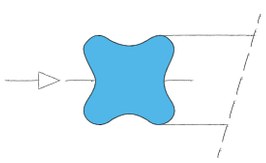
2.2 – Reduced starting torque

Some sub-assemblies require significant starting torque after prolonged downtime.

This force is reduced by about 75% compared with O-Rings.

2.3 – Position of the flash line

The friction surfaces of the X-Rings are free from any trace of flash located in the non-functional area.



Position of the flash line

2.4 – Less wear

The friction being proportional to the pressure, the wear on an X-Ring is virtually zero when there is no pressure.

2.5 – No twisting

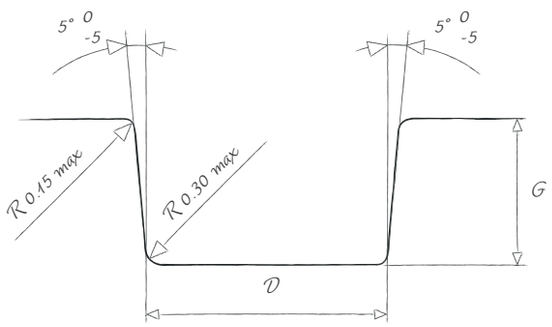
The square section of X-Rings eliminates the risk of twisting on fitting and in operation when installation requirements are observed.

3 – FITTING INSTRUCTIONS

3.1 – Static applications

An X-Ring used in a static application should be fitted in a rectangular groove, of depth and width defined according to the cross section of the ring, as shown in the table below.

The groove may have parallel walls or an angle of up to 5° that should be added to the recommended dimensions.



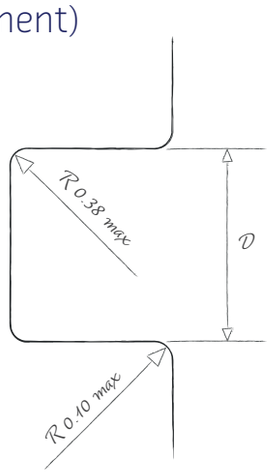
Cross section (mm)	Groove (mm)	
	Depth G	Width D
1.78	1.42	2.14
2.62	2.15	3.15
3.53	2.86	4.10
5.33	4.33	6.40
6.99	5.70	8.40

3.2 – Dynamic applications (reciprocating movement)

An X-Ring for dynamic applications is fitted in a rectangular groove, preferably in the bore.

A small radius (from 0.125 mm to 0.380 mm max) is allowed in the base of the groove. It is advisable to have lead-in angles on the friction side.

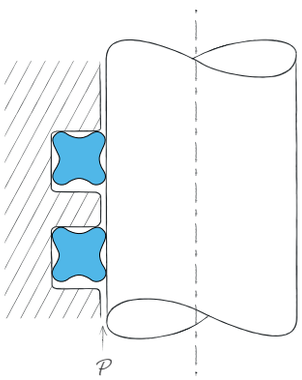
An X-Ring should not be used as a guide in a moving assembly. Moving parts must be guided using a mechanical seating.



3.3 – Double X-Ring assembly

In some applications, the pressure may come alternately from one side or the other of the X-Ring. At low pressure (up to 7 bar), the use of a single X-Ring is possible.

At medium and high pressure (> 7 bar), it is better to let the same face of the X-Ring receive the pressure. We recommend the use of two X-Rings fitted in two successive grooves.

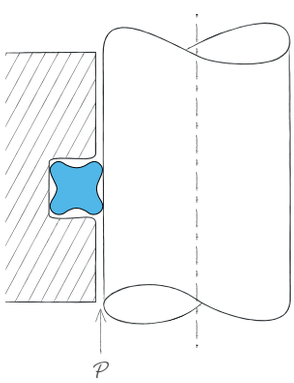


3.4 – Rotary applications

An X-Ring used in rotary applications should be fitted in the fixed part.

A peripheral compression of 5% and radial compression of 3% on the cross section is essential.

The volume of the groove must be approximately 5% greater than that of the seal.



4 – ADDITIONAL TECHNICAL INFORMATION

4.1 – Tolerances and fit

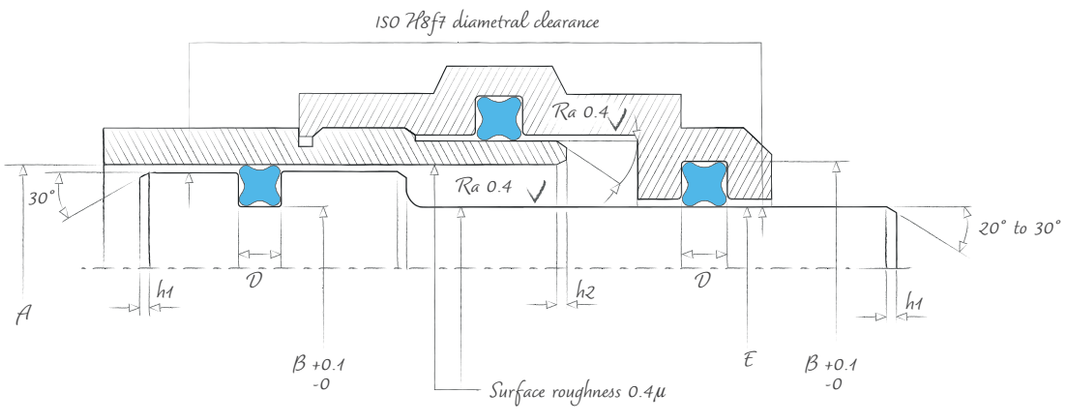
Pressure ≥ 10 bar

Restrict machining tolerances to a strict minimum, ISO H8f7 tolerances are recommended.

For large diameters do not exceed a diametral clearance of 0.12 mm.

Pressure ≤ 10 bar

Slightly wider tolerances up to H8e8 can be allowed.



ISO H8f7 diametral clearance

4.2 – Extrusion

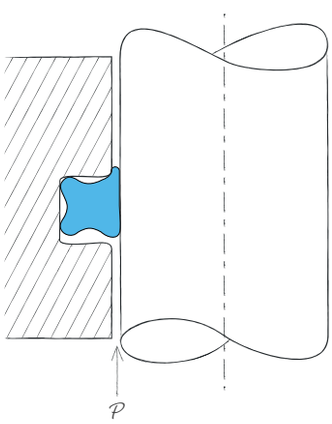
Extrusion is the passage of material into the mechanical clearance.

Pressure pulses, high temperatures, chemical incompatibility of the rubber, rapid translational motion and long strokes – and a combination of these factors – can exacerbate X-Ring extrusion.

There are several ways to prevent extrusion:

- Reduce the clearance fit: the risk of extrusion is zero if there is no clearance
- Increase the hardness of the rubber
- Improve the cylindricity and coaxiality
- Use an anti-extrusion washer (back-up ring)

The higher the pressure, the more the clearance needs to be reduced, the more the hardness needs to be increased.



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4.3 – Surface roughness

The surface roughness determines the wear on the X-Ring and hence its lifespan.

We recommend an Ra of 0.4µ.

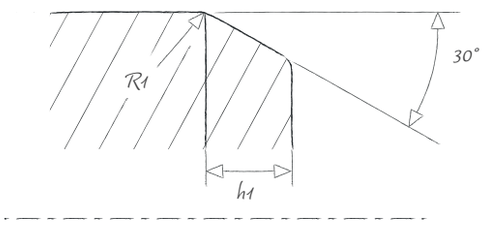
It is recommended to filter all engine fluids and avoid any abrasive deposits on moving parts, as the latter affect the surfaces and lead to rapid deterioration of the seals.

4.4 – Chamfers

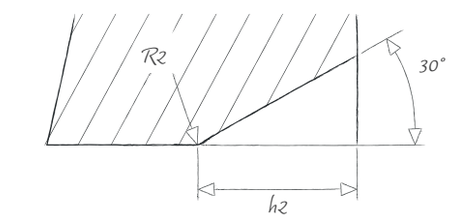
Lead-in chamfers are essential to avoid damaging the X-Ring during installation. An angle of 20 to 30° represents the best compromise.

The dimensions are dependent on the cross section of the X-Ring, as shown in the table below.

Cross section	On shaft		In the bore	
	h1 (mm)	R1 (mm)	h2 (mm)	R2 (mm)
1.78	1.50	3.00	2.50	5.00
2.62	1.50	3.00	2.50	5.00
3.53	1.50	3.00	2.50	5.00
5.33	2.50	5.00	3.00	6.00
6.99	3.00	6.00	4.00	8.00



Chamfer on shaft



Chamfer in the bore

5 – SIZE CHARTS

Custom development on request

The selection of an X-Ring can be made directly from the list below according to the assembly recommendations for the usual conditions of use.

The choice of A and B (shaft) or E and H (bore) within the specified limits must lead to the indicated depth of groove G.

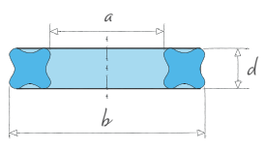
$$G = \frac{A - B}{2} \text{ or } G = \frac{H - E}{2}$$

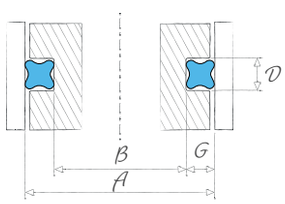
Code in 9PD31	Dimensions				Shaft application			
					Shaft ø		Base of groove	
	No.	a	b	d	Min A	Max A	Min B	Max B
200000	1	2.90	6.46	1.78	6.10	6.20	2.95	3.05
200001	2	3.68	7.24	1.78	6.90	7.00	3.75	3.85
200002	3	4.47	8.03	1.78	7.70	7.80	4.55	4.65
200003	3 A	4.62	8.18	1.78	7.85	8.00	4.70	4.85
200004	4	5.28	8.84	1.78	8.50	8.65	5.35	5.50
200005	4 A	5.70	9.26	1.78	8.95	9.10	5.80	5.95
200006	5	6.07	9.63	1.78	9.30	9.50	6.15	6.35
200007	5 A	6.65	10.21	1.78	9.90	10.15	6.75	7.00
200008	6	7.65	11.21	1.78	10.90	11.15	7.75	8.00
200009	6 A	8.70	12.26	1.78	11.95	12.25	8.80	9.10
200010	7	9.25	12.81	1.78	12.50	12.85	9.35	9.70
200011	7 A	9.70	13.26	1.78	12.95	13.30	9.80	10.15
200232	113	10.82	14.38	1.78	14.10	14.45	10.95	11.30
200738	114	12.42	15.98	1.78	15.70	16.15	12.55	13.00
200728	115	14.00	17.56	1.78	17.35	17.85	14.20	14.60
200729	116	15.60	19.16	1.78	18.90	19.50	15.75	16.35
200730	117	17.17	20.73	1.78	20.60	21.10	17.45	17.95
200739	118	18.77	22.33	1.78	22.30	22.75	19.05	19.60
200731	119	20.35	23.91	1.78	23.45	24.35	20.60	21.20
200732	120	21.95	25.51	1.78	25.05	26.00	22.20	22.85
200740	121	23.52	27.08	1.78	26.50	27.60	23.75	24.45
201264	122	25.12	28.68	1.78	28.55	29.40	25.40	26.25
201265	123	26.70	30.26	1.78	30.15	31.05	27.00	27.90
201266	124	28.30	31.86	1.78	31.80	32.75	28.65	29.60
201267	125	29.87	33.43	1.78	33.35	34.35	30.20	31.20
201687	137	63.22	66.78	1.78	67.15	69.20	64.00	66.05
200012	8	9.19	14.43	2.62	14.00	14.45	9.20	9.65
200013	8 A	9.80	15.04	2.62	14.70	15.05	9.90	10.25
200014	9	10.77	16.01	2.62	15.70	16.10	10.90	11.30
200015	9 A	11.70	16.94	2.62	16.60	17.05	11.80	12.25
200500	10	12.37	17.61	2.62	17.30	17.75	12.50	12.95
200501	10 A	12.80	18.04	2.62	17.70	18.20	12.90	13.40
200502	10 B	13.70	18.94	2.62	18.60	18.60	13.80	14.30
200503	11	13.94	19.18	2.62	19.15	19.40	14.35	14.60
200504	11 A	14.70	19.94	2.62	19.65	20.20	14.85	15.40
200505	12	15.54	20.78	2.62	20.50	21.05	15.70	16.25
200506	13	17.12	22.36	2.62	22.00	22.55	17.20	17.75

Functional validation by testing remains the user's responsibility.

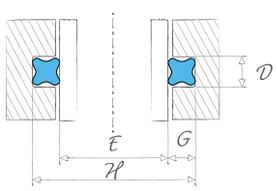
Standard X-Rings from stock are in NBR 78 Sh. - 9PD31 compound.
Other compounds are also available on request.

		Bore application			
		Shaft ø		Base of groove	
Groove Width D	Groove Height G	Min E	Max E	Min H	Max H
2.00	1.58	3.25	-	6.40 ◁	-
2.00	1.58	4.00	4.05	7.15 ◁	7.20 ◁
2.00	1.58	4.75	4.80	7.90 ◁	7.95 ◁
2.00	1.58	4.95	5.00	8.10 ◁	8.15 ◁
2.00	1.58	5.55	5.60	8.70	8.75
2.00	1.58	6.00	6.05	9.15	9.20
2.00	1.58	6.35	6.40	9.50	9.55
2.00	1.52	6.90	7.00	10.05	10.15
2.00	1.58	7.90	8.00	11.05	11.25
2.00	1.58	8.95	9.05	12.10	12.20
2.00	1.58	9.50	9.60	12.65	12.75
2.00	1.58	9.90	10.05	13.05	13.20
2.00	1.58	11.05	11.15	14.20	14.30
2.00	1.58	12.60	12.75	15.75	15.90
2.00	1.58	14.15	14.30	17.30	17.45
2.00	1.58	15.75	15.90	18.90	19.05
2.00	1.58	17.30	17.45	20.45	20.60
2.00	1.58	18.85	19.05	22.00	22.20
2.00	1.58	20.40	20.65	23.55	23.80
2.00	1.58	22.00	22.25	25.15	25.40
2.00	1.58	23.55	23.80	26.70	26.95
2.00	1.58	25.10	25.40	28.25	28.55
2.00	1.58	26.65	26.95	29.80	30.10
2.00	1.58	28.25	28.55	31.40	31.70
2.00	1.58	29.80	30.10	32.95	33.25
2.00	1.58	62.65	63.30	65.80	66.45
2.90	2.40	9.45	9.55	14.25	14.35
2.90	2.40	10.00	10.15	14.80	14.95
2.90	2.40	11.00	11.10	15.80	15.90
2.90	2.40	11.90	12.05	16.70	16.85
2.90	2.40	12.50	12.70	17.30	17.50
2.90	2.40	12.95	13.15	17.75	17.95
2.90	2.40	13.80	14.00	18.60	18.80
2.90	2.40	14.10	14.25	18.90	19.05
2.90	2.40	14.85	15.00	19.65	19.80
2.90	2.40	15.65	16.00	20.45	20.80
2.90	2.40	17.20	17.40	22.00	22.20





Shaft



Bore

Key

Tolerance B: +0.1 / - 0

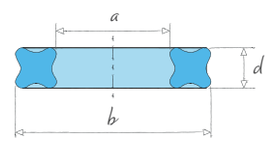
Tolerance H: +0 / - 0.1

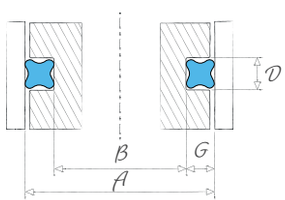
Tolerance D: +0.1 / - 0

◁ Fitting the parts in a two-part groove

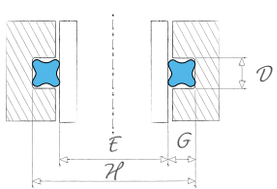
Code in 9PD31	Dimensions				Shaft application			
					Shaft ø		Base of groove	
	No.	a	b	d	Min A	Max A	Min B	Max B
200507	13 A	17.75	22.99	2.62	22.70	23.40	17.90	18.60
200508	14	18.72	23.96	2.62	23.70	24.40	18.90	19.60
200509	14 A	19.60	24.84	2.62	24.60	25.35	19.80	20.55
200733	217	20.30	25.54	2.62	25.30	26.00	20.50	21.20
200734	218	21.89	27.13	2.62	26.90	27.70	22.10	22.90
200735	219	23.47	28.71	2.62	28.50	29.35	23.70	24.55
201259	220	25.07	30.31	2.62	30.10	31.00	25.30	26.20
201260	221	26.64	31.88	2.62	31.70	32.65	26.90	27.85
201261	222	28.24	33.48	2.62	33.30	34.30	28.50	29.50
201268	223	29.82	35.06	2.62	34.90	35.95	30.10	31.15
201269	224	31.42	36.66	2.62	36.75	37.65	31.75	32.85
201270	225	32.99	38.23	2.62	38.10	39.30	33.30	34.50
201271	226	34.60	39.84	2.62	39.75	40.95	34.95	36.15
201272	227	36.17	41.41	2.62	40.35	42.60	35.55	37.80
201273	228	37.77	43.01	2.62	42.95	44.25	38.14	39.45
201274	229	39.34	44.58	2.62	44.55	45.90	39.75	41.10
201275	230	40.94	46.18	2.62	46.15	47.60	41.35	42.80
201688	231	42.52	47.76	2.62	47.75	49.25	42.95	44.45
203105	261	139.37	144.61	2.62	145.55	150.45	140.75	145.65
200510	15	18.64	25.70	3.53	25.40	26.10	18.85	19.55
200511	16	20.22	27.28	3.53	27.00	27.65	20.45	21.10
200512	16 A	20.90	27.96	3.53	27.70	28.40	21.15	21.85
200513	17	21.82	28.88	3.53	28.50	29.35	21.95	22.80
200514	18	23.39	30.45	3.53	30.00	30.80	23.45	24.25
200515	18 A	23.99	31.05	3.53	30.85	31.55	24.30	25.00
201000	19	24.99	32.05	3.53	31.85	32.55	25.30	26.00
201001	19 A	25.90	32.96	3.53	32.75	33.20	26.20	26.65
201002	20	26.57	33.63	3.53	33.40	34.10	26.85	27.55
201003	20 A	27.57	34.63	3.53	34.40	34.85	27.85	28.30
201004	21	28.17	35.23	3.53	34.95	36.10	28.40	29.55
201005	22	29.74	36.80	3.53	36.50	37.75	29.95	31.20
201006	23	31.34	38.40	3.53	38.00	39.00	31.45	32.45
201007	23 A	32.04	39.10	3.53	39.05	39.60	32.50	33.05
201008	24	32.92	39.98	3.53	39.75	40.50	33.20	33.95
201009	24 A	33.80	40.86	3.53	40.65	41.20	34.10	34.65
201010	25	34.52	41.58	3.53	41.35	42.65	34.80	36.10
201011	26	36.09	43.15	3.53	42.95	44.30	36.40	37.75
201012	27	37.69	44.75	3.53	44.50	46.10	37.95	39.55
201262	323	40.87	47.93	3.53	47.75	49.15	41.20	42.60
201689	324	44.05	51.11	3.53	50.95	52.50	44.40	45.95
201690	325	47.22	54.28	3.53	54.15	55.80	47.60	49.25
201693	326	50.39	57.45	3.53	57.35	59.10	50.80	52.55
201694	327	53.57	60.63	3.53	60.55	62.40	54.00	55.85
201691	328	56.75	63.81	3.53	63.75	65.75	57.20	59.20
201692	329	59.92	66.98	3.53	66.95	69.05	60.40	62.50

		Bore application			
		Shaft ø		Base of groove	
Groove Width D	Groove Height G	Min E	Max E	Min H	Max H
2.90	2.40	17.80	18.05	22.60	22.85
2.90	2.40	18.80	19.00	23.60	23.80
2.90	2.40	19.65	20.00	24.45	24.80
2.90	2.40	20.35	20.60	25.15	25.40
2.90	2.40	21.90	22.15	26.70	26.95
2.90	2.40	23.50	23.75	28.30	28.55
2.90	2.40	25.30	25.55	30.10	30.35
2.90	2.40	26.60	26.90	31.40	31.70
2.90	2.40	28.15	28.45	32.95	33.25
2.90	2.40	29.75	30.05	34.55	34.85
2.90	2.40	31.30	31.65	36.10	36.45
2.90	2.40	32.85	33.20	37.55	38.00
2.90	2.40	34.45	34.80	39.25	39.60
2.90	2.40	36.00	36.35	40.80	41.15
2.90	2.40	37.55	37.95	42.35	42.75
2.90	2.40	39.10	39.50	43.90	44.30
2.90	2.40	40.70	41.10	45.50	45.90
2.90	2.40	42.25	42.70	47.05	47.50
2.90	2.40	137.50	138.95	142.30	143.75
3.90	3.28	18.70	19.00	25.25	25.55
3.90	3.28	20.30	20.60	26.85	27.15
3.90	3.28	21.00	21.20	27.55	27.75
3.90	3.28	21.85	22.15	28.40	28.70
3.90	3.28	23.45	23.70	30.00	30.25
3.90	3.28	24.00	24.30	30.55	30.85
3.90	3.28	25.00	25.40	31.55	31.95
3.90	3.28	25.85	26.20	32.40	32.75
3.90	3.28	26.50	27.00	33.05	33.55
3.90	3.28	27.50	28.00	34.05	34.55
3.90	3.28	28.15	28.45	34.70	35.00
3.90	3.28	29.60	30.05	36.15	36.60
3.90	3.28	31.25	31.65	37.80	38.20
3.90	3.28	31.90	32.35	38.45	38.90
3.90	3.28	32.80	33.25	39.35	39.80
3.90	3.28	33.65	34.10	40.20	40.65
3.90	3.28	34.40	35.00	40.95	41.55
3.90	3.28	36.00	36.40	42.55	42.95
3.90	3.28	37.50	38.00	44.05	44.55
3.90	3.28	40.65	41.15	47.20	47.70
3.90	3.28	43.80	44.30	50.35	50.85
3.90	3.28	46.92	47.45	53.45	54.00
3.90	3.28	50.05	50.60	56.60	57.15
3.90	3.28	53.15	53.80	59.70	60.35
3.90	3.28	56.30	59.95	62.85	63.50
3.90	3.28	59.45	60.10	66.00	66.65





Shaft



Bore

Key

Tolerance B: +0.1 / - 0

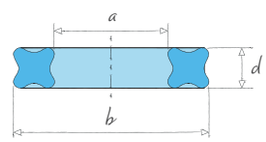
Tolerance H: +0 / - 0.1

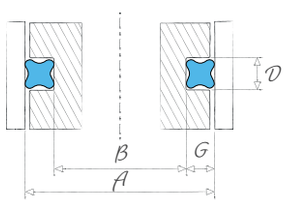
Tolerance D: +0.1 / - 0

◁ Fitting the parts in a two-part groove

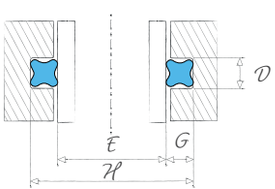
Code in 9PD31	Dimensions				Shaft application			
					Shaft ø		Base of groove	
	No.	a	b	d	Min A	Max A	Min B	Max B
201695	330	63.09	70.15	3.53	70.15	72.35	63.60	65.80
202159	331	66.27	73.33	3.53	73.35	75.65	66.80	69.10
202160	332	69.44	76.50	3.53	76.55	78.95	70.00	72.40
202161	333	72.62	79.68	3.53	79.75	82.30	73.20	75.75
202162	334	75.80	82.86	3.53	82.95	85.60	76.40	79.05
202163	335	78.97	86.03	3.53	86.15	88.90	79.60	82.35
202157	336	82.15	89.21	3.53	89.35	92.20	82.80	85.65
202164	337	85.32	92.38	3.53	92.55	95.50	86.00	88.95
202165	338	88.49	95.55	3.53	95.75	98.85	89.20	92.30
202166	339	91.67	98.73	3.53	98.95	102.15	92.40	95.60
202635	340	94.84	101.90	3.53	102.15	105.45	95.60	98.90
202632	341	98.02	105.08	3.53	105.35	108.75	98.80	102.20
202633	342	101.20	108.26	3.53	108.55	112.10	102.00	105.55
202634	348	120.25	127.31	3.53	127.75	131.95	121.20	125.40
203596	363	183.74	190.80	3.53	191.75	198.15	185.21	191.60
201013	28	37.47	48.13	5.33	47.75	49.20	37.75	39.20
201014	28 A	39.64	50.30	5.33	50.00	50.70	40.00	40.70
201015	29	40.64	51.30	5.33	51.00	52.00	41.00	42.00
201500	29 A	41.80	52.46	5.33	52.10	53.80	42.10	43.80
201501	30	43.82	54.48	5.33	54.00	55.20	44.00	45.20
201502	30 A	45.04	55.70	5.33	55.35	57.00	45.35	47.00
201503	30 B	45.84	56.50	5.33	57.15	57.40	47.15	47.40
201504	31	46.99	57.65	5.33	57.50	58.50	47.50	48.50
201505	31 A	47.80	58.46	5.33	58.70	60.00	48.70	50.00
201506	32	50.17	60.83	5.33	60.50	62.00	50.50	52.00
201507	32 A	52.00	62.66	5.33	62.40	63.50	52.40	53.50
201508	33	53.34	64.00	5.33	63.75	64.70	53.75	54.70
201509	33 A	54.50	65.16	5.33	65.00	66.50	55.00	56.50
201510	34	56.52	67.18	5.33	67.00	67.50	57.00	57.50
201511	34 A	57.52	68.18	5.33	68.00	69.50	58.00	59.50
201512	35	59.69	70.35	5.33	70.00	71.70	60.00	61.70
201513	35 A	61.54	72.20	5.33	72.00	73.00	62.00	63.00
201514	36	62.87	73.53	5.33	73.40	74.80	63.40	64.80
201515	36 A	64.59	75.25	5.33	75.00	76.50	65.00	66.50
202000	37	66.04	76.70	5.33	76.60	77.80	66.60	67.80
202001	37 A	67.64	78.30	5.33	78.00	79.20	68.00	69.20
202002	38	69.22	79.88	5.33	79.80	81.00	69.80	71.00
202003	38 A	70.64	81.30	5.33	81.50	82.50	71.50	72.50
202004	39	72.39	83.05	5.33	83.00	84.40	73.00	74.40
202005	39 A	73.84	84.50	5.33	84.50	85.70	74.50	75.70
202006	40	75.57	86.23	5.33	86.00	89.00	76.00	79.00
202007	41	78.74	89.40	5.33	89.50	90.80	79.50	80.80
202008	41 A	80.09	90.75	5.33	91.00	92.70	81.00	82.70
202009	42	81.92	92.58	5.33	92.80	94.30	82.80	84.30
202010	42 A	83.39	94.05	5.33	94.50	95.75	84.50	85.75

		Bore application			
		Shaft ø		Base of groove	
Groove Width D	Groove Height G	Min E	Max E	Min H	Max H
3.90	3.28	62.55	63.25	69.10	69.80
3.90	3.28	65.70	66.40	72.25	72.95
3.90	3.28	68.80	69.55	75.35	76.10
3.90	3.28	71.95	72.75	78.50	79.30
3.90	3.28	75.05	75.90	81.60	82.45
3.90	3.28	78.20	79.05	84.75	85.60
3.90	3.28	81.30	82.20	87.85	88.75
3.90	3.28	84.45	85.35	91.00	91.90
3.90	3.28	87.55	88.50	94.10	95.05
3.90	3.28	90.70	91.70	97.25	98.25
3.90	3.28	93.80	94.85	100.35	101.40
3.90	3.28	96.95	98.00	103.50	104.55
3.90	3.28	100.10	101.15	106.65	107.70
3.90	3.28	118.85	120.10	125.40	126.65
3.90	3.28	181.40	183.30	187.95	189.85
6.10	5.00	37.45	38.00	47.45	48.00
6.10	5.00	39.50	40.10	49.50	50.10
6.10	5.00	40.50	41.10	50.50	51.10
6.10	5.00	41.65	42.25	51.65	52.25
6.10	5.00	43.65	44.30	53.65	54.30
6.10	5.00	44.90	45.50	54.90	55.50
6.10	5.00	45.60	46.25	55.60	56.25
6.10	5.00	46.90	47.40	56.90	57.40
6.10	5.00	47.50	48.20	57.50	58.20
6.10	5.00	50.00	50.60	60.00	60.60
6.10	5.00	51.90	52.40	61.90	62.40
6.10	5.00	53.00	53.75	63.00	63.75
6.10	5.00	54.00	55.00	64.00	65.00
6.10	5.00	56.00	57.00	66.00	67.00
6.10	5.00	57.40	58.00	67.40	68.00
6.10	5.00	59.30	60.00	69.30	70.00
6.10	5.00	61.00	62.00	71.00	72.00
6.10	5.00	62.50	63.20	72.50	73.20
6.10	5.00	64.00	65.00	74.00	75.00
6.10	5.00	65.50	66.40	75.50	76.40
6.10	5.00	67.00	68.00	77.00	78.00
6.10	5.00	68.60	69.50	78.60	79.50
6.10	5.00	70.00	71.00	80.00	81.00
6.10	5.00	72.00	72.70	82.00	82.70
6.10	5.00	73.00	74.20	83.00	84.20
6.10	5.00	74.90	76.00	84.90	86.00
6.10	5.00	78.00	79.00	88.00	89.00
6.10	5.00	79.50	80.35	89.50	90.35
6.10	5.00	81.00	82.20	91.00	92.20
6.10	5.00	82.50	83.50	92.50	93.50





Shaft



Bore

Key

Tolerance B: +0.1 / - 0

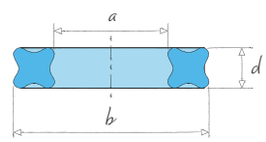
Tolerance H: +0 / - 0.1

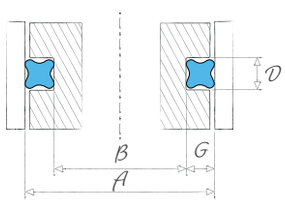
Tolerance D: +0.1 / - 0

◁ Fitting the parts in a two-part groove

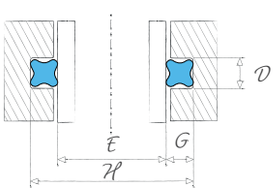
Code in 9PD31	Dimensions				Shaft application			
					Shaft ø		Base of groove	
	No.	a	b	d	Min A	Max A	Min B	Max B
202011	43	85.09	95.75	5.33	96.00	97.40	86.00	87.40
202012	43 A	86.64	97.30	5.33	97.50	98.90	87.50	88.90
202013	44	88.27	98.93	5.33	99.00	100.40	89.00	90.40
202014	44 A	89.59	100.25	5.33	100.50	102.00	90.50	92.00
202015	45	91.44	102.10	5.33	102.30	105.00	92.30	95.00
202500	46	94.62	105.28	5.33	105.50	108.50	95.50	98.50
202501	47	97.99	108.65	5.33	109.00	111.70	99.00	101.70
202502	48	100.97	111.63	5.33	112.00	113.30	102.00	103.30
202503	48 A	102.34	113.00	5.33	113.50	114.90	103.50	104.90
202504	49	104.14	114.80	5.33	115.00	116.00	105.00	106.00
202505	49 A	105.80	116.46	5.33	116.50	118.50	106.50	108.50
202506	50	107.32	117.98	5.33	119.00	121.00	109.00	111.00
202507	51	110.49	121.15	5.33	121.50	124.50	111.50	114.50
202508	52	113.67	124.33	5.33	124.70	127.00	114.70	117.00
202636	450	116.84	127.50	5.33	128.00	130.45	118.00	120.45
202637	451	120.02	130.68	5.33	131.20	133.75	121.20	123.75
202638	452	123.19	133.85	5.33	134.40	137.00	124.40	127.00
202639	453	126.37	137.03	5.33	137.65	140.30	127.65	130.30
202640	454	129.54	140.20	5.33	140.85	143.55	130.85	133.55
203106	455	132.72	143.38	5.33	144.05	146.85	134.05	136.85
203107	456	135.89	146.55	5.33	147.25	150.10	137.25	140.10
203108	457	139.07	149.73	5.33	150.45	153.40	140.45	143.40
202509	+88	113.67	127.65	6.99	127.70	129.60	114.70	116.60
202510	52 A	115.84	129.82	6.99	129.80	130.60	116.80	117.60
202511	+53	116.84	130.82	6.99	130.80	133.50	117.80	120.50
202512	+54	120.02	134.00	6.99	134.00	137.00	121.00	124.00
202513	+55	123.19	137.17	6.99	137.20	140.00	124.20	127.00
202514	+56	126.37	140.35	6.99	140.50	143.50	127.50	130.50
202515	+57	129.54	143.52	6.99	143.75	146.50	130.75	133.50
203000	+58	132.72	146.70	6.99	147.00	149.50	134.00	136.50
203001	+59	135.89	149.87	6.99	150.00	153.00	137.00	140.00
203002	+60	139.07	153.05	6.99	153.20	156.00	140.20	143.00
203003	+61	142.24	156.22	6.99	156.50	159.50	143.50	146.50
203004	+62	145.42	159.40	6.99	159.70	162.90	146.70	149.90
203005	+63	148.59	162.57	6.99	163.00	166.30	150.00	153.30
203006	+64	151.77	165.75	6.99	166.40	168.40	153.40	155.40
203007	64 A	155.02	169.00	6.99	169.00	172.50	156.00	159.50
203008	+65	158.12	172.10	6.99	172.70	175.40	159.70	162.40
203009	65 A	161.02	175.00	6.99	175.50	178.80	162.50	165.80
203010	+66	164.47	178.45	6.99	179.00	181.50	166.00	168.50
203011	66 A	167.02	181.00	6.99	181.70	185.00	168.70	172.00
203012	+67	170.82	184.80	6.99	185.30	187.80	172.30	174.80
203013	67 A	173.52	187.50	6.99	188.00	191.00	175.00	178.00
203014	+68	177.17	191.15	6.99	191.40	194.00	178.40	181.00
203015	68 A	180.52	194.50	6.99	195.00	197.80	182.00	184.00

		Bore application			
		Shaft ø		Base of groove	
Groove Width D	Groove Height G	Min E	Max E	Min H	Max H
6.10	5.00	84.00	85.40	94.00	95.40
6.10	5.00	86.00	87.00	96.00	97.00
6.10	5.00	87.80	89.00	97.80	99.00
6.10	5.00	89.00	90.50	99.00	100.50
6.10	5.00	91.00	93.00	101.00	103.00
6.10	5.00	94.00	96.00	104.00	106.00
6.10	5.00	97.00	99.50	107.00	109.50
6.10	5.00	100.00	101.50	110.00	111.50
6.10	5.00	101.70	103.00	111.70	113.00
6.10	5.00	103.50	104.50	113.50	114.50
6.10	5.00	105.00	107.00	115.00	117.00
6.10	5.00	107.00	109.00	117.00	119.00
6.10	5.00	109.50	112.20	119.50	122.20
6.10	5.00	112.60	115.50	122.60	125.50
6.10	5.00	115.85	118.80	125.85	128.80
6.10	5.00	119.00	122.00	129.00	132.00
6.10	5.00	122.10	125.20	132.10	135.20
6.10	5.00	125.25	128.40	135.25	138.40
6.10	5.00	128.40	131.60	138.40	141.60
6.10	5.00	131.50	134.80	141.50	144.80
6.10	5.00	134.65	138.00	144.65	148.00
6.10	5.00	137.80	141.25	147.80	151.25
7.90	6.50	112.50	115.50	125.50	128.50
7.90	6.50	115.60	117.00	128.60	130.00
7.90	6.50	117.00	119.00	130.00	132.00
7.90	6.50	119.50	122.00	132.50	135.00
7.90	6.50	122.50	125.00	135.50	138.00
7.90	6.50	125.50	128.50	138.50	141.50
7.90	6.50	129.00	131.50	142.00	144.50
7.90	6.50	132.00	135.00	145.00	148.00
7.90	6.50	135.50	138.00	148.50	151.00
7.90	6.50	138.50	141.00	151.50	154.00
7.90	6.50	141.50	144.00	154.50	157.00
7.90	6.50	144.50	147.00	157.50	160.00
7.90	6.50	147.50	150.50	160.50	163.50
7.90	6.50	151.00	153.50	164.00	166.50
7.90	6.50	154.00	156.50	167.00	169.50
7.90	6.50	157.00	159.50	170.00	172.50
7.90	6.50	160.00	162.50	173.00	175.50
7.90	6.50	163.00	166.00	176.00	179.00
7.90	6.50	166.50	168.50	179.50	181.50
7.90	6.50	169.00	172.50	182.00	185.50
7.90	6.50	173.00	175.50	186.00	188.50
7.90	6.50	176.00	178.50	189.00	191.50
7.90	6.50	179.00	182.50	192.00	195.50





Shaft



Bore

Key

Tolerance B: +0.1 / - 0

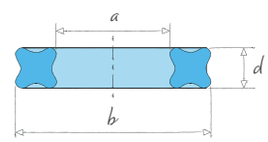
Tolerance H: +0 / - 0.1

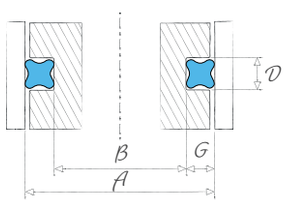
Tolerance D: +0.1 / - 0

◁ Fitting the parts in a two-part groove

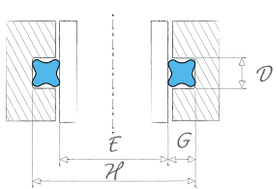
Code in 9PD31	Dimensions				Shaft application			
					Shaft ø		Base of groove	
	No.	a	b	d	Min A	Max A	Min B	Max B
203500	+69	183.52	197.50	6.99	198.00	200.30	185.00	187.30
203501	69 A	186.02	200.00	6.99	200.50	204.00	187.50	191.00
203502	+70	189.87	203.85	6.99	204.20	206.40	191.20	193.40
203503	70 A	192.02	206.00	6.99	206.50	210.50	193.50	197.50
203504	+71	196.22	210.20	6.99	210.75	213.30	197.75	200.30
203505	71 A	199.02	213.00	6.99	213.50	217.00	200.50	204.00
203506	+72	202.57	216.55	6.99	217.50	221.00	204.50	208.00
203507	72 A	206.80	220.78	6.99	221.30	226.00	208.30	213.00
203508	72 B	211.02	225.00	6.99	226.50	229.50	213.50	216.50
203509	+73	215.27	229.25	6.99	230.00	233.50	217.00	220.50
203510	73 A	219.02	233.00	6.99	233.70	238.30	220.70	225.30
203511	73 B	223.50	237.48	6.99	238.00	242.00	225.00	229.00
203512	+74	227.97	241.95	6.99	242.50	245.00	229.50	232.00
203513	74 A	231.02	245.00	6.99	245.50	249.50	232.50	236.50
203514	74 B	235.00	248.98	6.99	250.00	255.00	237.00	242.00
203515	+75	240.67	254.65	6.99	255.50	257.50	242.50	244.50
204000	75 A	243.02	257.00	6.99	258.00	261.00	245.00	248.00
204001	75 B	248.00	261.98	6.99	262.00	268.00	249.00	255.00
204002	+76	253.37	267.35	6.99	268.50	273.50	255.50	260.50
204003	76 A	259.00	272.98	6.99	274.00	280.00	261.00	267.00
204004	+77	266.07	280.05	6.99	280.50	287.50	267.50	274.50
204005	77 A	273.10	287.08	6.99	288.00	293.00	275.00	280.00
204006	+78	278.77	292.75	6.99	293.50	299.50	280.50	286.50
204007	78 A	284.00	297.98	6.99	300.00	303.00	287.00	290.00
204008	78 B	287.50	301.48	6.99	303.50	306.00	290.50	293.00
204009	+79	291.47	305.45	6.99	306.50	312.50	293.50	299.50
204010	79 A	298.00	311.98	6.99	313.00	318.50	300.00	305.50
204011	+80	304.17	318.15	6.99	319.00	325.50	306.00	312.50
204012	80 A	310.00	323.98	6.99	326.00	332.00	313.00	319.00
204013	+81	316.87	330.85	6.99	332.50	338.50	319.50	325.50
204014	81 A	323.50	337.48	6.99	339.00	344.50	326.00	331.50
204015	+82	329.57	343.55	6.99	345.00	351.50	332.00	338.50
204500	82 A	336.50	350.48	6.99	352.00	357.00	339.00	344.00
204501	+83	342.27	356.25	6.99	357.50	363.00	344.50	350.00
204502	83 A	348.50	362.48	6.99	363.50	370.00	350.50	357.00
204503	+84	354.97	368.95	6.99	370.50	377.50	357.50	364.50
204504	84 A	362.50	376.48	6.99	378.00	383.00	365.00	370.00
204505	+85	367.67	381.65	6.99	383.50	389.50	370.50	376.50
204506	85 A	374.00	387.98	6.99	390.00	396.00	377.00	383.00
204507	+86	380.37	394.35	6.99	396.50	403.00	383.50	390.00
204508	86 A	387.50	401.48	6.99	403.50	408.50	390.50	395.50
204509	+87	393.07	407.05	6.99	409.00	415.00	396.00	402.00
204510	87 A	401.00	414.98	6.99	416.00	423.00	403.00	410.00

		Bore application			
		Shaft ø		Base of groove	
Groove Width D	Groove Height G	Min E	Max E	Min H	Max H
7.90	6.50	183.00	185.50	196.00	198.50
7.90	6.50	186.00	188.00	199.00	201.00
7.90	6.50	189.00	192.00	202.00	205.00
7.90	6.50	192.50	194.00	205.50	207.00
7.90	6.50	195.00	198.50	208.00	211.50
7.90	6.50	199.00	201.00	212.00	214.00
7.90	6.50	202.00	205.00	215.00	218.00
7.90	6.50	205.50	209.00	218.50	222.00
7.90	6.50	209.50	213.50	222.50	226.50
7.90	6.50	214.00	218.00	227.00	231.00
7.90	6.50	218.50	221.00	231.50	234.00
7.90	6.50	222.00	226.00	235.00	239.00
7.90	6.50	226.50	230.50	239.50	243.50
7.90	6.50	231.00	233.50	244.00	246.50
7.90	6.50	234.00	238.00	247.00	251.00
7.90	6.50	239.00	243.00	252.00	256.00
7.90	6.50	244.00	246.00	257.00	259.00
7.90	6.50	247.00	251.00	260.00	264.00
7.90	6.50	252.00	256.50	265.00	269.50
7.90	6.50	257.00	262.00	270.00	275.00
7.90	6.50	264.50	269.00	277.50	282.00
7.90	6.50	271.50	276.00	284.50	289.00
7.90	6.50	277.00	282.00	290.00	295.00
7.90	6.50	283.00	287.00	296.00	300.00
7.90	6.50	288.00	290.50	301.00	303.50
7.90	6.50	291.00	295.00	304.00	308.00
7.90	6.50	296.00	301.00	309.00	314.00
7.90	6.50	302.00	307.00	315.00	320.00
7.90	6.50	308.00	313.00	321.00	326.00
7.90	6.50	315.00	320.00	328.00	333.00
7.90	6.50	322.00	327.00	335.00	340.00
7.90	6.50	328.00	333.00	341.00	346.00
7.90	6.50	334.00	340.00	347.00	353.00
7.90	6.50	341.00	346.00	354.00	359.00
7.90	6.50	347.00	352.00	360.00	365.00
7.90	6.50	353.00	359.00	366.00	372.00
7.90	6.50	360.00	366.00	373.00	379.00
7.90	6.50	367.00	372.00	380.00	385.00
7.90	6.50	373.00	378.00	386.00	391.00
7.90	6.50	379.00	384.00	392.00	397.00
7.90	6.50	385.00	392.00	398.00	405.00
7.90	6.50	393.00	397.00	406.00	410.00
7.90	6.50	398.00	405.00	411.00	418.00





Shaft



Bore

Key

Tolerance B: +0.1 / - 0

Tolerance H: +0 / - 0.1

Tolerance D: +0.1 / - 0

◁ Fitting the parts in a two-part groove