HANSA-FLEX

Sealing Technology

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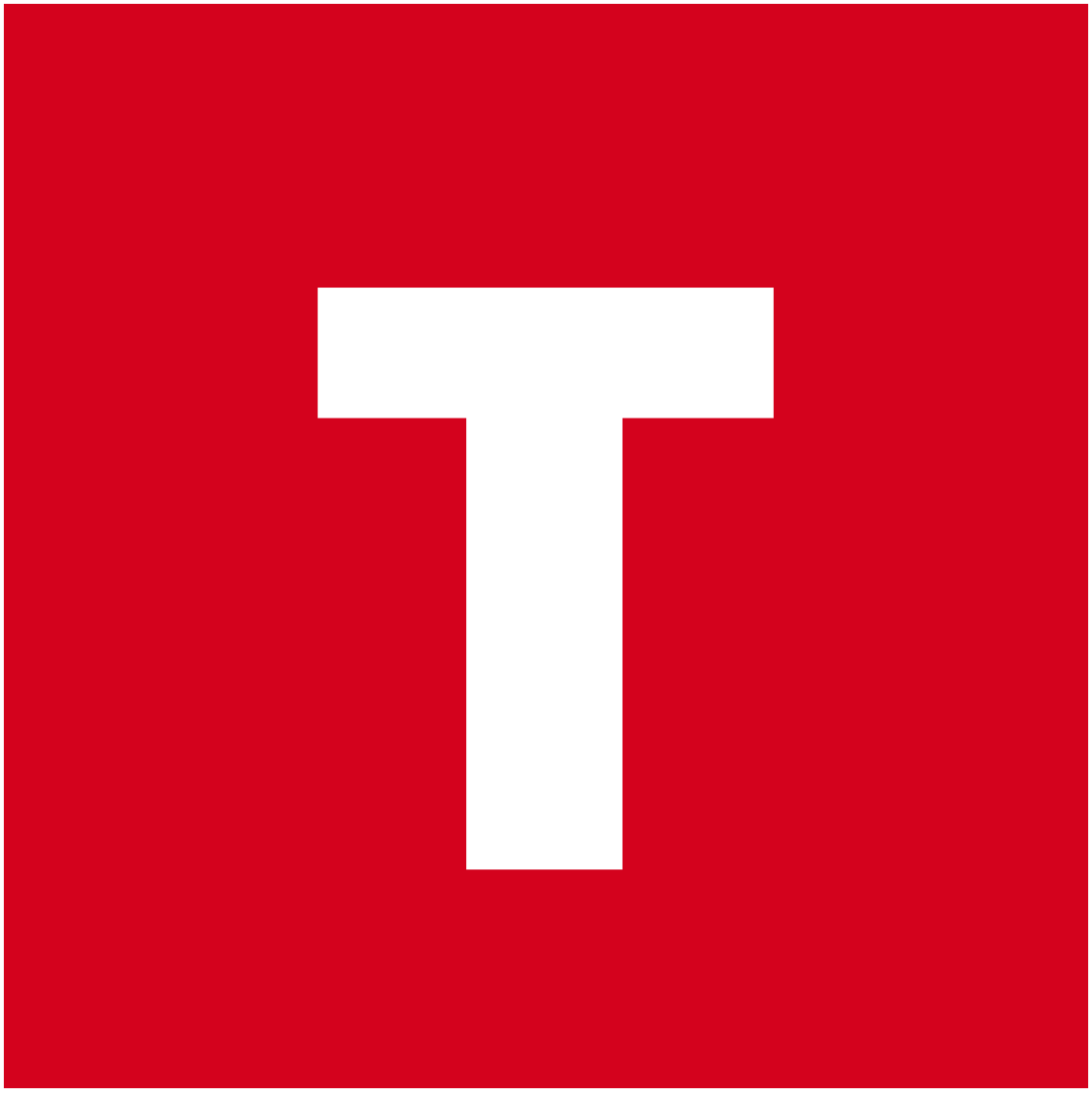


Technical information

TECHNICAL INFORMATION SEALS AND SEALING EQUIPMENT

TABLE OF CONTENTS

1. INSTALLATION INSTRUCTIONS

1.1 ROD SEALS AND WIPERS

Surface quality
The roughness values stated in table 1.1 must be observed in both the R_a and R_t areas.

Open or closed grooves
Table 1.2 can be used to establish whether a seal can be fitted in closed grooves (1). In the case of a specific cross-section B, we recommend fitting in open grooves (2) if the diameter of the rod is less than the minimum diameter (d_{min}).

Chamfers
Table 1.3 lists the chamfer lengths K to be observed.

Roundings
Sharp edges must be avoided. Table 1.4 lists the radii to be observed.

(1) closed grooves

(2) open grooves

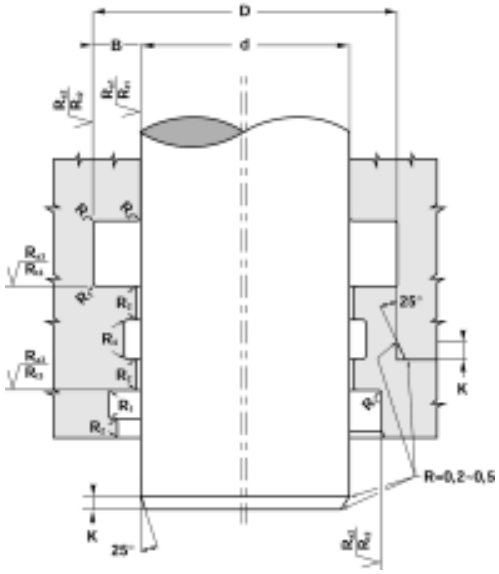


Table 1.1

R_{a1}	R_{t1}	R_{a2}	R_{t2}	R_{a3}	R_{t3}
≤ 0.3 µm	≤ 3 µm	≤ 1.8 µm	≤ 10 µm	≤ 3 µm	≤ 16 µm

Table 1.2

B (mm)	4	5	6	7.5	10	12.5	15
d_{min} (mm)	30	40	50	65	80	150	200

Table 1.3

K (mm) = 0.6 B

Table 1.4

B (mm)	R_t (mm)	R_2 (mm)	R_4 (mm)
≤ 7.5	≤ 0.3	0.2	≤ 0.2
> 7.5	≤ 0.6	0.4	

1.2 PISTON SEALS AND GUIDE RINGS

Surface quality
The roughness values stated in table 1.1 must be observed in both the R_a and R_t areas.

Single or multipart pistons
Please refer to the "Installation" instructions in this catalogue for each seal profile and each individual seal.

Chamfers
Table 1.3 lists the chamfer lengths K to be observed.

Roundings
Sharp edges must be avoided. Table 1.5 lists the radii to be observed.

(1) one-piece

(2) split

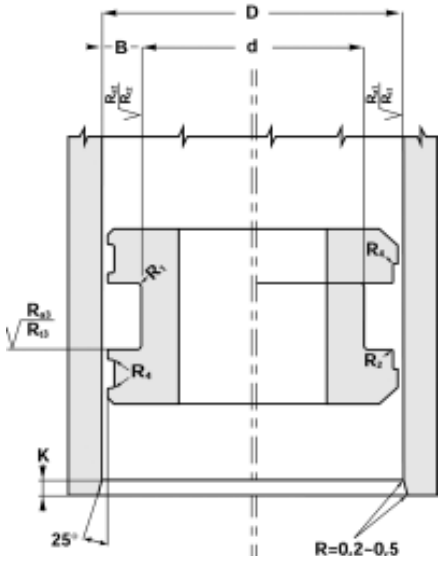
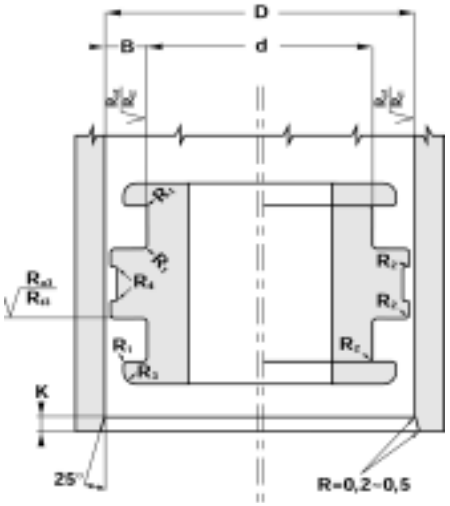


Table 1.5				
B (mm)	R_1 (mm)	R_2 (mm)	R_3 (mm)	R_4 (mm)
≤ 7.5	≤ 0.3	0.2	≤ 2	≤ 0.2
> 7.5	≤ 0.6	0.4	≤ 4	

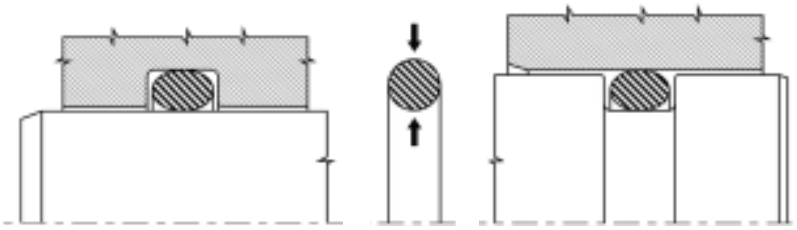
(1) one-piece

(2) split



1.3 STATIC SEALS – RADIAL INSTALLATION

The static seal is squeezed between its external and internal diameters.

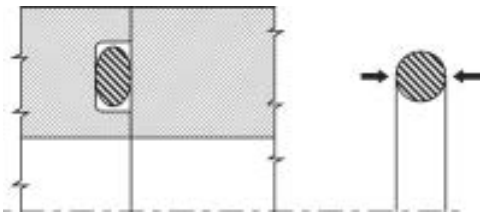


Installation in internal groove

Installation in external groove

1.4 STATIC SEALS – AXIAL INSTALLATION

The static seal is squeezed between its two side faces.



2. CORRECT INSTALLATION

Hydraulic seals can be damaged if they are not correctly installed. This can result in many problems, which can be avoided by observing the following guidelines:

- Check that the groove diameters, tolerances, surface qualities and chamfers are based on the values given in this catalogue.
- Ensure that the seal does not come in contact with sharp edges, bored holes or threads during assembly.
- All metal parts must be absolutely clean and free of swarf, weld splatter and defects.
- All seals must be lubricated before assembly with the same liquid or a liquid compatible with that which will be used in the hydraulic system.
- Do not use sharp-edged tools for installation. Do not allow seals to be deformed for a prolonged period during installation.
- Ensure the seal is correctly oriented with respect to the direction of fluid pressure. The same applies to all the other parts.

3. TABLE OF INTERNATIONAL STEEL GRADES AND THEIR EQUIVALENTS

---- Germany ----			Steel microstructure	Tensile strength	Breaking elongation	USA	France	England	Italy	Sweden	Japan
Wk.No.	DIN	Type									
1.4113	X 6 CrMo 17-1	F1	ferritic	450/630	18	434	-	434 S 17	X 8 CrMo 17	-	SUS 434
1.4016	X 8 Cr 17	F1	ferritic	450/630	20	430	Z 8 C 17	430 S 17	X 8 Cr 17	2320	SUS 430
1.4006	X 10 Cr 13	C1	martensitic	730	20	410	Z 10 C 13	410 C 21	X 10 Cr 13	2302	SUS 410
1.4021	X 20 Cr 13	C1	martensitic	800/950	12	420	Z 20 C 13	420 S 37	X 20 Cr 13	2303	SUS 420 J1
1.4028	X 30 Cr 13	C1	martensitic	850/1000	10	420 F	Z 30 C 13	420 S 45	X 30 Cr 13	2304	SUS 420 J2
1.4057	X17 CrNi 16-2	C3	martensitic	800/950	12	431	Z 15 CN 10-02	431 S 31	X 16 CrNi 16	-	SUS 431
1.4125	X 105 CrMo 17	C3	martensitic	-	-	440 C	Z 100 CD 17	-	-	-	SUS 440 C
1.4305	X 8 CrNi 18-9	A1	austenitic	500/700	35	303	Z 8 CNF 18-09	303 S 22	X 10 CrNiS 18 09	2346	SUS 303
1.4301	X 5 CrNi 18-10	A2	austenitic	540/750	45	304	Z 6 CN 18-09	304 S 17	X 5 CrNi 18 10	2332	SUS 304
1.4303	X 4 CrNi 18-12	A2	austenitic	500/650	45	305	Z 5 CN 18-11	305 S 19	X 7 CrNi 18 10	-	SUS 305
1.4306	X 2 CrNi 19-11	A2	austenitic	520/670	45	304 L	Z 2 CN 18-10	304 S 11	X 2 CrNi 18 11	2352	SUS 304 L
1.4541	X CrNiTi 18-10	A2	austenitic	520/720	40	321	Z 6 CNT 18-10	321 S 31	X 6 CrNiTi 18 11	2337	SUS 321
1.4550	X 6 CrNiNb 18-10	A2	austenitic	520/720	40	347	Z 6 CNNb 18-10	347 S 20	X 6 CrNiNb 18 11	2338	SUS 347
1.4401	X 5 CrNiMo 17-12-2	A4	austenitic	530/680	40	316	Z 7 CND 17-11-02	316 S 17	X 5 CrNi Mo 17 12	2347	SUS 316
1.4404	X 2 CrNiMo 17-12-2	A4	austenitic	530/680	40	316 L	Z 3 CND 17-11-02	316 S 11	X 2 CrNi Mo 17 12	2348	SUS 316 L
1.4435	X 2 CrNiMo 18-14-3	A4	austenitic	500/700	40	316 L	Z 3 CND 17-11-03	316 S 14	X 2 CrNi Mo 17 13	2353	SUS 316 L
1.4436	X 3 CrNi Mo 17-13-3	A4	austenitic	550/700	40	316	Z 6 CND 18-12-03	316 S 19	X 5 CrNi Mo 17 13	2343	SUS 316
1.4438	X 2 CrNiMo 18-15-4	A4	austenitic	550/700	40	317 L	Z 2 CND 19-15-04	317 S 12	X 5 CrNi Mo 17 13	2343	SUS 316
1.4539	X 1 NiCrMoCuN 25-20-5	A4	austenitic	530/730	35	904 L	Z 2 NCDU 25-20	-	-	2562	-
1.4571	X 6 Cr NiMoTi 17-12-22	A4	austenitic	450/690	40	316 Ti	Z 6 CNDT 17-12	320 S 18	X 6 CrNi MoTi 17 12	2350	SUS 316 Ti
1.4580	X 6 CrNiMoNb 17-12-2	A4	austenitic	450/690	40	316 Cb	Z 6 CNDNb 17-12	318 S 17	X 6 CrNi MoNb 17 12	-	-

4. STORAGE CONDITIONS FOR ELASTOMERS

- Max. 25 °C
- Keep away from direct sources of heat
- Keep out of direct sunlight
- Install low-UV lighting
- Max. air humidity 60 % prevent condensation occurring
- Keep away from ionizing radiation and the effects of ozone, for example produced by welding work
- Store in a PE bag or the original packaging
- Do not store hung up on a hook or similar

Shelf lives of elastomers

Material	Initial storage	Extension storage
Polyurethane, SBR	5 years	2 years
NBR, HNBR	7 years	3 years
FPM, FFKM, EPDM, VMQ	10 years	5 years

INSPECT AFTER THE INITIAL PERIOD OF STORAGE

Visual inspection:

- Deformation, cuts, surface cracks (use a 10 x magnifying glass)
- Hardening, softening, discolouration, contamination
- Permanent deformations, creases, flat areas

5. TOLERANCES AND FITS

Table of ISO tolerances basic hole / basic shaft in accordance with **ISO 286**.
The allowances for shafts are given in accordance with **DIN 7160**; for holes the standard is **DIN 7161**.

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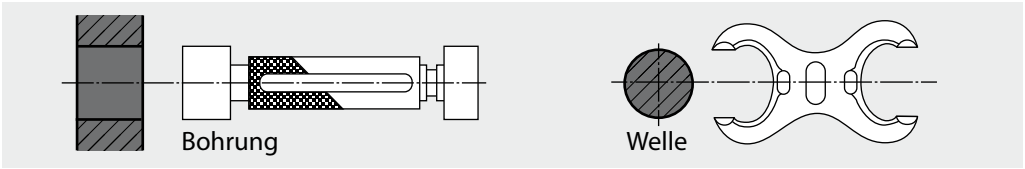
ALLOWANCES FOR HOLES AND SHAFTS



The ISO system for tolerances and fits relate to all linear parameters such as external dimensions, internal dimensions, diameters, lengths, widths, heights and thicknesses.

A reference temperature 20 °C applies to all the dimensions defined in this system. Tables 5.1, 5.2 and 5.3 contain a selection of tolerances that are used successfully in the field of tool and mould making, and are the preferred values in HASCO standards. These tolerances are used in our technical documents to precisely describe our products. These tolerances can also be used to advantage in other areas.

TOLERANCES FOR INTERNAL DIMENSIONS (HOLES)

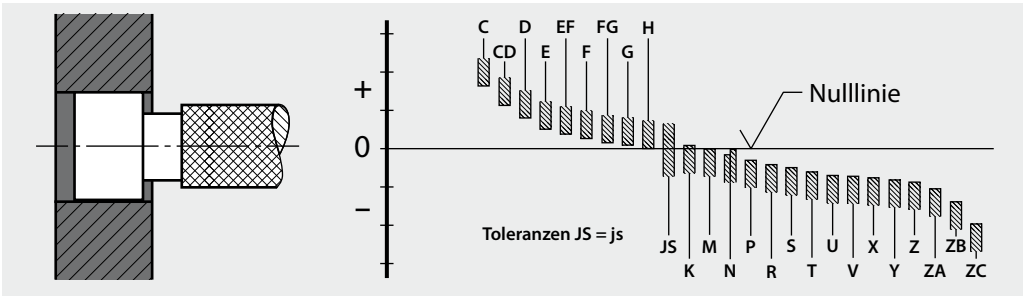


Table 5.1 – Extract from DIN 7161, allowances in µm (0.001 mm)

Nominal size range (mm)	Symbol	F6	F7	F8	G6	G7	H5	H6	H7	H8	H9	H10	H11	H12	H13	K6	K7	K8	JS
	From / to																		
	3	+12 +6	+16 +6	+20 +6	+8 +2	+12 +2	+4 0	+6 0	+10 0	+14 0	+25 0	+40 0	+60 0	+100 0	+104 0	0 -6	0 -10	0 -14	Dimensions for "JS" and "js" are identical – for values see Tables 2 and 2.1
	3 – 6	+18 +10	+22 +10	+28 +10	+12 +4	+16 +14	+5 0	+8 0	+12 0	18 0	+30 0	+48 0	+75 0	+120 0	+180 0	+2 -6	+3 -9	+5 -13	
	6 – 10	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+6 0	+9 0	+15 0	+22 0	+36 0	+58 0	+90 0	+150 0	+220 0	+2 -7	+5 -10	+6 -16	
	10 – 18	+27 +16	+34 +16	+43 +16	+17 +6	+24 +6	+8 0	+11 0	+18 0	+27 0	+43 0	+70 0	+110 0	+180 0	+270 0	+2 -9	+6 -12	+8 -19	
	18 – 30	+33 +20	+41 +20	+53 +20	+20 +7	+28 +7	+9 0	+13 0	+21 0	+33 0	+52 0	+84 0	+130 0	+210 0	+330 0	+2 -11	+6 -15	+10 -23	
	30 – 50	+41 +25	+50 +25	+64 +25	+25 +9	+34 +9	+11 0	+16 0	+25 0	+39 0	+62 0	+100 0	+160 0	+250 0	+390 0	+3 -13	+7 -18	+12 -27	
	50 – 80	+49 +30	+60 +30	+76 +30	+29 +10	+40 +10	+13 10	+19 0	+30 0	+46 0	+74 0	+120 0	+190 0	+300 0	+460 0	+4 -15	+9 -21	+14 -32	
	80 – 120	+58 +36	+71 +36	+90 +36	+34 +12	+47 +12	+15 0	+22 0	+35 0	+54 0	+87 0	+140 0	+220 0	+350 0	+540 0	+4 -18	+10 -25	+16 -38	
	120 – 180	+68 +43	+83 +43	+106 +43	+39 +14	+54 +14	+18 0	+25 0	+40 0	+63 0	+100 0	+160 0	+250 0	+400 0	+630 0	+4 -21	+12 -28	+20 -43	
	180 – 250	+79 +50	+96 +50	+122 +50	+44 +15	+61 +15	+20 0	+29 0	+46 0	+72 0	+115 0	+185 0	+290 0	+460 0	+720 0	+5 -24	+13 -33	+22 -50	
	250 – 315	+88 +56	+108 +56	+137 +56	+49 +17	+69 +17	+23 0	+32 0	+52 0	+81 0	+130 0	+210 0	+320 0	+520 0	+810 0	+5 -27	+16 -36	+25 -56	
	315 – 400	+98 +62	+119 +62	+151 +62	+54 +18	+75 +18	+25 0	+36 0	+57 0	+89 0	+140 0	+230 0	+360 0	+570 0	+890 0	+7 -29	+17 -40	+28 -61	
	400 – 500	+108 +68	+131 +68	+165 +68	+60 +20	+83 +20	+27 0	+40 0	+63 0	+97 0	+155 0	+250 0	+400 0	+630 0	+970 0	+8 -32	+18 -45	+29 -68	

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TOLERANCES FOR EXTERNAL DIMENSIONS (SHAFTS)

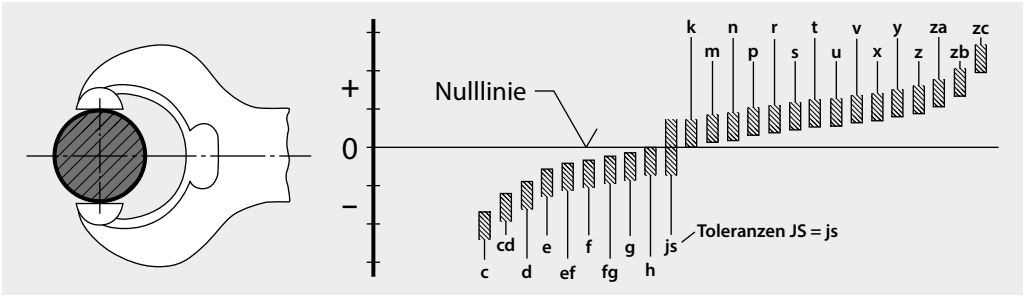

Table 5.2 – Extract from DIN 7160, allowances in µm (0.001 mm)

Nominal size range (mm)	Symbol	e6	e7	e8	f6	f7	f8	g5	g6	g7	h4	h5	h6	h7	h8	h9	h10	h11	js6
	From / to																		
3		-14	-14	-14	-6	-6	-6	-2	-2	-2	0	0	0	0	0	0	0	0	+3
		-20	-24	-28	-12	-16	-20	-6	-8	-12	-3	-4	-6	-10	-14	-25	-40	-60	-3
3 – 6		-20	-20	-20	-10	-10	-10	-4	-4	-4	0	0	0	0	0	0	0	0	+4
		-28	-32	-38	-18	-22	-28	-9	-12	-16	-4	-5	-8	-12	-18	-30	-48	-78	-4
6 – 10		-25	-25	-25	-13	-13	-13	-5	-5	-5	0	0	0	0	0	0	0	0	+4.5
		-34	-40	-47	-27	-28	-35	-11	-14	-20	-4	-6	-9	-15	-22	-36	-58	-90	-4.5
10 – 18		-32	-32	-32	-16	-16	-16	-6	-6	-6	0	0	0	0	0	0	0	0	+5.5
		-43	-50	-59	-27	-34	-43	-14	-17	-24	-5	-8	-11	-18	-27	-43	-70	-110	-5.5
18 – 30		-40	-40	-40	-20	-20	-20	-7	-7	-7	0	0	0	0	0	0	0	0	+6.5
		-53	-61	-73	-33	-41	-53	-16	-20	-28	-6	-9	-13	-21	-33	-52	-84	-130	-6.5
30 – 50		-50	-50	-50	-25	-25	-25	-9	-9	-9	0	0	0	0	0	0	0	0	+8
		-66	-75	-89	-41	-50	-64	-20	-25	-34	-7	-11	-16	-25	-39	-62	-100	-160	-8
50 – 80		-60	-60	-60	-30	-30	-30	-10	-10	-10	0	0	0	0	0	0	0	0	+9.5
		-79	-90	-106	-49	-60	-76	-23	-29	-40	-8	-13	-19	-30	-46	-74	-120	-190	-9.5
80 – 120		-72	-72	-72	-36	-36	-36	-12	-12	-12	0	0	0	0	0	0	0	0	+11
		-94	-107	-126	-58	-71	-90	-27	-34	-47	-10	-15	-22	-35	-54	-87	-140	-220	-11
120 – 180		-85	-85	-85	-43	-43	-43	-14	-14	-14	0	0	0	0	0	0	0	0	+12.5
		-110	-125	-148	-68	-83	-106	-32	-39	-54	-12	-18	-25	-40	-63	-100	-160	-250	-12.5
180 – 250		-100	-100	-100	-50	-50	-50	-15	-15	-15	0	0	0	0	0	0	0	0	+14.5
		-129	-146	-172	-79	-96	-122	-35	-44	-61	-14	-20	-29	-46	-72	-115	-185	-290	-14.5
250 – 315		-110	-110	-110	-56	-56	-56	-17	-17	-17	0	0	0	0	0	0	0	0	+16
		-142	-162	-191	-88	-108	-137	-40	-49	-69	-16	-23	-32	-52	-81	-130	-210	-320	-16
315 – 400		-125	-125	-125	-62	-62	-62	-18	-18	-18	0	0	0	0	0	0	0	0	+18
		-161	-182	-214	-98	-119	-151	-43	-54	-75	-18	-25	-36	-57	-89	-140	-230	-360	-18
400 – 500		-135	-135	-135	-68	-68	-68	-20	-20	-20	0	0	0	0	0	0	0	0	+20
		-175	-198	-232	-108	-131	-165	-47	-60	-83	-20	-27	-40	-63	-97	-155	-250	-400	-20

Table 5.3

Nominal size range (mm)	Symbol	js7	js8	js9	js10	js11	js12	js13	js14	js15	js16	js17	js18	k6	k7	k8	m5	m6	m7
	From / to																		
3		+5	+7	+12.5	+20	+30	+50	+70	+125	+200	+300	–	–	+6	+10	+14	+6	+8	–
		-5	-7	-12.5	-20	-30	-50	-70	-125	-200	-300			0	0	0	+2	+2	
3 – 6		+6	+9	+15	+24	+37.5	+60	+90	+150	+240	+375	–	–	+9	+13	+18	+9	+12	+16
		-6	-9	-15	-24	-37.5	-60	-90	-150	-240	-375			-1	-1	-1	+4	+4	+4
6 – 10		+7.5	+11	+18	+29	+45	+75	+110	+180	+290	+450	+750	–	+10	+16	+22	+12	+15	+21
		-7.5	-11	-18	-29	-45	-75	-110	-180	-290	-450	-750		+1	+1	0	+6	+16	+6
10 – 18		+9	+13.5	+21.5	+35	+55	+90	+135	+215	+350	+550	+900	+1350	+12	+19	+27	+12	+18	+25
		-9	-13.5	-21.5	-35	-55	-90	-135	-215	-350	-550	-900	-1350	+1	+1	0	+7	+7	+7
18 – 30		+10.5	+16.5	+26	+42	+65	+105	+165	+260	+420	+650	+1050	+1650	+15	+23	+33	+17	+21	+29
		-10.5	-16.5	-26	-42	-65	-105	-165	-260	-420	-650	-1050	-1650	+2	+2	0	+8	+8	+8
30 – 50		+12.5	+19.5	+31	+50	+80	+125	+195	+310	+500	+800	+1250	+1950	+18	+27	+39	+20	+25	+34
		-12.5	-19.5	-31	-50	-80	-125	-195	-310	-500	-800	-1250	-1950	+2	+2	0	+9	+9	+9
50 – 80		+15	+23	+37	+60	+95	+150	+230	+370	+600	+950	+1500	+2300	+21	+32	+46	+24	+30	+41
		-15	-23	-37	-60	-95	-150	-230	-370	-600	-950	-1500	-2300	+2	+2	0	+11	-11	+11
80 – 120		+17.5	+27	+43.5	+70	+110	+175	+270	+435	+700	+1100	+1750	+2700	+25	+38	+54	+28	+35	+48
		-17.5	-27	-43.5	-70	-110	-175	-270	-435	-700	-1100	-1750	-2700	+3	+3	0	+13	+13	+13
120 – 180		+20	+31.5	+50	+80	+125	+200	+315	+500	+800	+1250	+2000	+3150	+28	+43	+63	+33	+40	+55
		-20	-31.5	-50	-80	-125	-200	-315	-500	-800	-1250	-2000	-3150	+3	+3	0	+15	+15	+15
180 – 250		+23	+36	+57.5	+92.5	+145	+230	+360	+575	+925	+1450	+2300	+3600	+33	+50	+72	+37	+46	+63
		-23	-36	-57.5	-92.5	-145	-230	-360	-575	-925	-1450	-2300	-3600	+4	+4	0	+17	+17	+17
250 – 315		+26	+40.5	+65	+105	+160	+260	+405	+650	+1050	+1600	+2600	+4500	+36	+56	+81	+43	+52	+72
		-26	-40.5	-65	-105	-160	-260	-405	-650	-1050	-1600	-2600	-4500	+4	+4	0	+20	+20	+20
315 – 400		+28.5	+44.5	+70	+115	+180	+285	+445	+700	+1150	+1800	+2850	+4450	+40	+61	+89	+46	+57	+78
		-28.8	-44.8	-70	-115	-180	-285	-445	-700	-1150	-1800	-2850	-4450	+4	+4	0	+21	+21	+21
400 – 500		+31.5	+48.5	+77.5	+125	+200	+315	+485	+775	+1250	+2000	+3150	+4850	+45	+68	+97	+50	+63	+86
		-31.5	-48.5	-77.5	-125	-200	-315	-485	-775	-1250	-2000	-3150	-4850	+5	+5	0	+23	+23	+23

6. SURFACE QUALITY PARAMETERS FOR SEAL HOUSINGS

General requirements for seal housings.

Surface	Roughness Rt	Roughness Ra	Material ratio Mr
Counter surface	≤ 3 µm	0.05 ≥ **optimum value 0.2** ≤ 0.3 µm	50 % < **optimum value 80 %** ≤ 90 %
Groove bottom	≤ 10 µm	≤ 1.8 µm	
Groove sides	≤ 16 µm	≤ 3 µm	

7. ABBREVIATIONS USED FOR MATERIALS IN HF SEALS

Material	Abbreviations	Tolerance
NBR Shore A 65	N65	± 5 Shore
NBR Shore A 70	N70	± 5 Shore
NBR Shore A 80	N80	± 5 Shore
NBR Shore A 90	N90	± 5 Shore
FPM Shore A 75	V75	± 5 Shore
FPM Shore A 80	V80	± 5 Shore
FPM Shore A 90	V90	± 5 Shore
EPDM Shore A70 sulphur crosslinked	E70S	± 5 Shore
EPDM Shore A70 peroxide crosslinked	E70P	± 5 Shore
MVQ Shore 40	S40	± 5 Shore
MVQ Shore 70	S70	± 5 Shore
FEP/MVQ	F-S	
FFKM Shore A 80	K80	± 5 Shore
NBR cotton fabric	NBR-C	
FPM cotton fabric	FPM-C	
FPM aramid fabric	FPM-K	
Phenol resin/fabric	PH/GEW	
Graphite/serrated perforated plate	GRSP	
Graphite/smooth plate	GRGL	
Klinger graphite Topgraph	TGR	
Klinger C4400	C4400	
PTFE/pure	PT	
PTFE/glass	PT/GL	
PTFE/bronze	PTBR	
PTFE/glass/MOS2	PT/GM	
PTFE/carbon	PT/K	
Soft iron	WE	
Stainless steel 1.4571	INOX	
Polyurethane	PUR	
Polyurethane, hydrolysis-resistant	H-PU	
Polyamide	PA	
Polyoxymethylene	POM	
Ultra high density polyethylene	UHMW-PE	

8. BUSHES

8.1 GENERAL

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Technical data

To make things clearer, we would like to define in advance some important technical data used repeatedly in this document. For this purpose, we shall consider a bush with an internal diameter "d" and a width "L".

Specific bearing load = p (N/mm²)

For a vertically applied load "F" (N):

$$p = \frac{F}{d \cdot L}$$

Sliding speed = v (m/s)

In the case of rotation: for a rotation speed "n" (min^{-1}):

$$v = \frac{d \cdot \pi \cdot n}{60 \cdot 10^3}$$

In the case of oscillatory motion: where "n" is the frequency of the oscillatory motion (min^{-1}) and "μ" is the amplitude of the motion expressed in degrees:

$$v = \frac{d \cdot \pi}{60 \cdot 10^3} \cdot \frac{2\mu \cdot n}{360}$$

pv value = p x v (N/mm² x m/s)

Calculation of the service life

The service life of a bush depends on the specific bearing load, sliding speed, operating temperature and the shaft material (surface quality and hardness). On request, we can calculate a service life for you, but this can be no more than a guide.

Installing the bushes

Use the basic arrangement shown in Figure 8.1 to install bushes with an external diameter of up to 50 mm. By machining the bearing surface at a specific height h, the bush can be pressed an exact depth h into the hole.

Use an auxiliary ring as shown in Figure 8.2 to fit bushes with an external diameter greater than 50 mm. On request, we can calculate the press-in force FE for you.

Installation principle

We recommend protecting the bushes against dirt by using type SWP seal ends or shaft seal rings (Fig. 8.3). Finally, chamfers should preferably be machined in order to prevent stress concentrations at the edges of the bushes (Fig. 8.4), or the bushes should project above the surrounding material (Fig. 8.5).

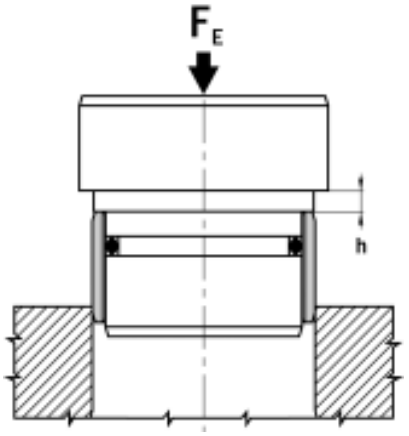

Figure 8.1:

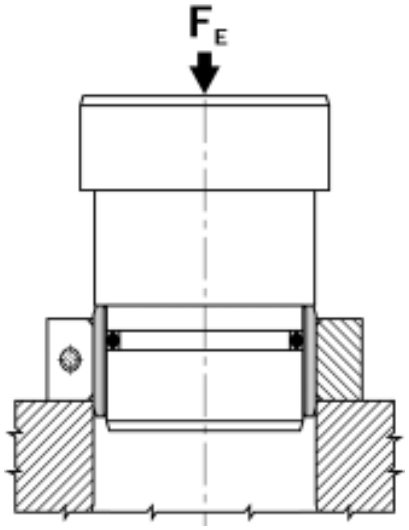

Figure 8.2:

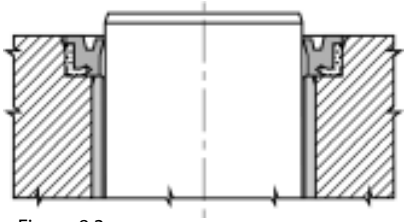
Figure 8.3:

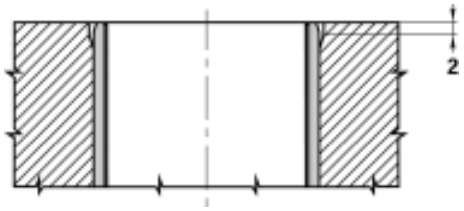

Figure 8.4:

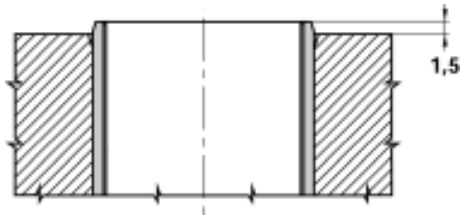

Figure 8.5:

8.2 MAINTENANCE-FREE BUSHES TYPE BK-1

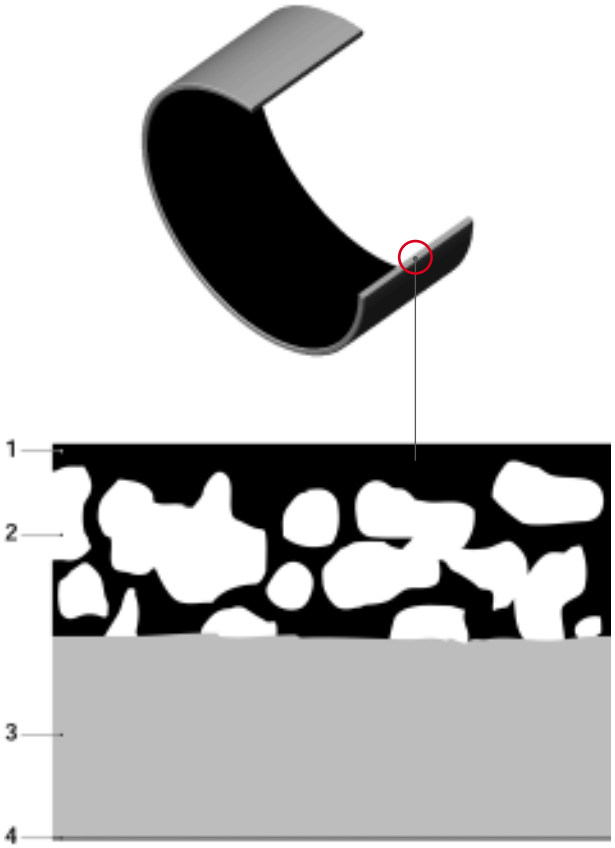

Table 8.6

Coefficient of friction	p N/mm²	v m/s
0.025	250-140	<0.001
0.04-0.07	140-60	0.001-0.005
0.07-0.1	60-10	0.005-0.05
0.1-0.15	10-1	0.05-0.5
0.15-0.2	<1	0.5-2

1 = PTFE-lead mixture: 0.01 - 0.05 mm

2 = Bronze coating: 0.20 - 0.35 mm

3 = Steel backing

4 = Surface protection: ~0.002 mm

Construction

The BK-1 bush consists of a porous bronze coating (2) sinter-fused onto a steel backing (3). A PTFE-lead mixture (1) is then rolled into the bronze coating. The steel backing is protected against corrosion by external tin- or copper-plating (4).

Properties

The BK-1 bush has many advantages:

- Suitable for dry running and maintenance-free
- Noise and frequency absorption
- Hydrodynamic operation possible
- High permissible load
- Good chemical resistance
- Good friction characteristics
- No stick-slip
- Wide temperature range
- High slide speed
- No water absorption
- Low play during operation
- Extremely space-saving

Areas of application

BK-1 bushes are suitable for translatory, rotary and oscillatory motions.

Application examples:

- Rod guide for pneumatic and hydraulic cylinders
- Attachment eyes for pneumatic and hydraulic cylinders
- Conveyor-belt systems, textile machinery, automobiles ...

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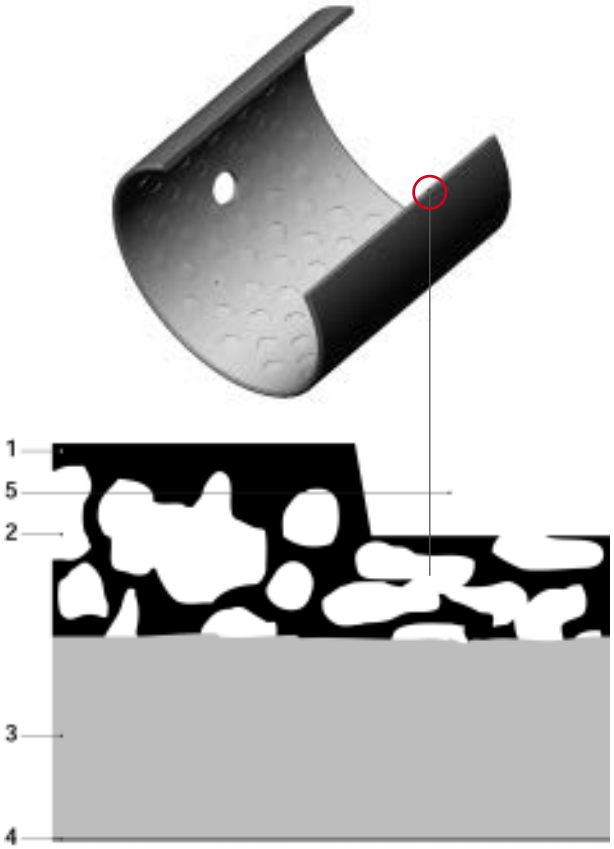
8.3 MAINTENANCE-FREE BUSHES TYPE BK-2



1 = Acetal resin: 0.30 - 0.50 mm

2 = Bronze coating: 0.20 - 0.35 mm

3 = Steel backing

4 = Surface protection: ~0.002 mm

5 = Lubrication pockets

Construction
The BK-2 bush consists of a porous bronze coating (2) sinter-fused onto a steel backing (3). An acetal resin POM (1) is then rolled into the bronze coating. The steel backing is protected against corrosion by external tin- or copper-plating (4). Finally the lubrication pockets (5) are stamped into the slide coating.

Properties
The BK-2 bush has many advantages:

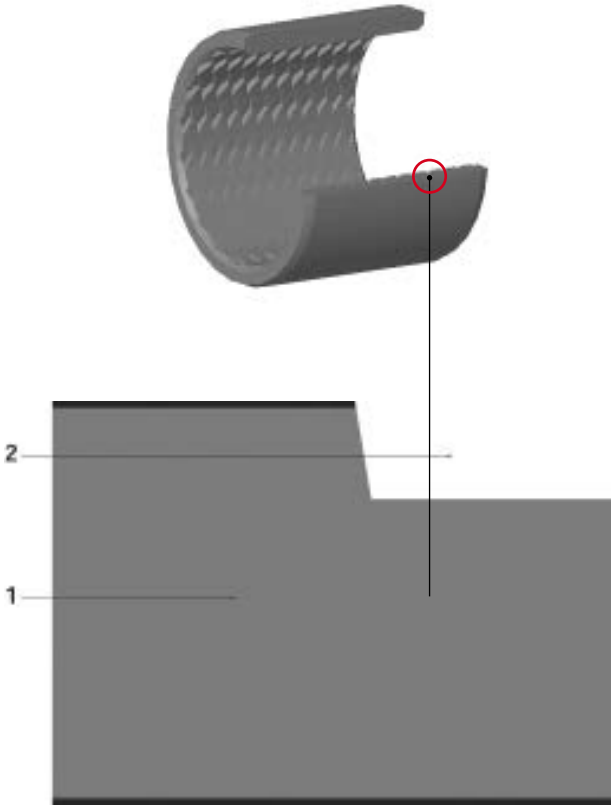
- Maintenance-free operation
- Noise and frequency absorption
- Relubricatable
- Hydrodynamic operation possible
- High permissible load
- Good friction characteristics
- High slide speed
- No water absorption
- Can be used where oil film formation is difficult
- Low play during operation
- Extremely space-saving

Areas of application
BK-2 bushes are suitable for rotary and oscillatory motions. Initial lubrication with grease is advisable, and continual lubrication substantially lengthens the service life of the slide bearing.

Application examples:

- Attachment eyes for pneumatic and hydraulic cylinders
- Agricultural equipment
- Material handling equipment
- Construction machinery, ...

8.4 BRONZE BUSHES TYPE BK090



1 = Bronze

2 = Lubrication pockets

Construction

The BK090 bush is made entirely out of CuSn8 bronze and manufactured from calibrated rolled strips. The entire sliding surface is covered with diamond-shaped lubrication pockets. Lubricant is introduced into these pockets, which then function as reservoirs, releasing the lubricant progressively during operation. Drill holes to allow relubrication.

Properties

The BK090 bush has many advantages:

- Maintenance-free operation
- Relubricatable
- Suitable for dirty conditions
- Shock and vibration resistant
- High permissible load
- Good friction characteristics
- No water absorption
- Low play during operation
- Extremely space-saving

Areas of application

BK090 bushes are suitable for rotary and oscillatory motions. Initial lubrication with grease is advisable, and continual lubrication substantially lengthens the service life of the slide bearing.

Application examples:

- Attachment eyes for hydraulic cylinders
- Forestry machinery
- Agricultural equipment
- Conveyors and elevators
- Construction machinery, ...

9. O-RINGS

9.1 DESCRIPTION OF O-RINGS

O-rings are ring-shaped seals with a round cross-section (a torus) defined by the inside diameter (D) and the cross-sectional diameter (d). It is the most common seal type for hydraulic and pneumatic applications.

O-rings have the following advantages:

- The groove is simple and easy to machine
- Large choice of compounds: NBR, FPM, EPDM, silicone, PTFE, PUR, ...
- Easy to install due to its symmetry
- Attractive price thanks to new production techniques
- Extremely wide variety of applications: static, dynamic (both linear and rotary), ...
- Compact design

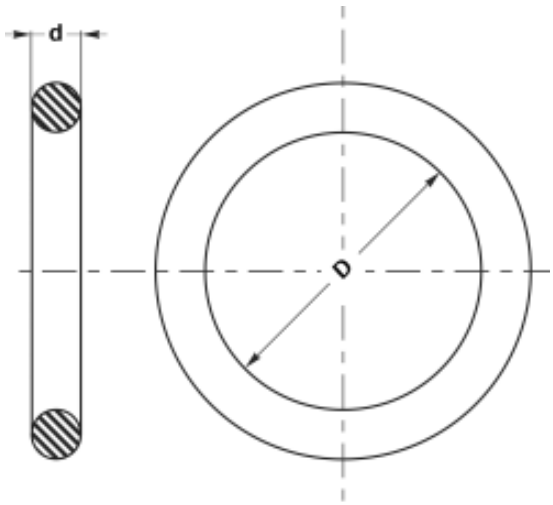


Figure 9.1:

9.2 PRINCIPLE OF O-RINGS

The functional principle is summarised in Figure 9.2:

- The O-ring is installed in a groove with a depth g smaller than the diameter d of the cross-section (Fig. 9.2).
- After installation, the O-ring seal is squeezed andthis creates a pressing action (Fig. 9.3).
- The media exerts pressure on the O-ring and intensifies the initial pressing action (Fig. 9.4).

The initial precompression (Fig. 9.3) is very important! Depending on the application and material, the compression of the elastomer will change as follows:

- From 3 to 20 % dynamic seal (pneumatic and hydraulic). In this catalogue, the initial pressure fluctuates between 12 and 14 % for a dynamic seal
- From 15 to 30 % static seal. In this catalogue, the initial pressure used for a static seal fluctuates between 17 and 27 %.

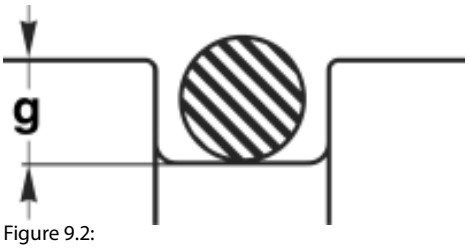


Figure 9.2:

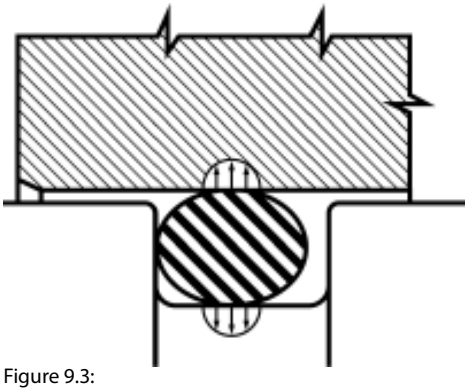


Figure 9.3:

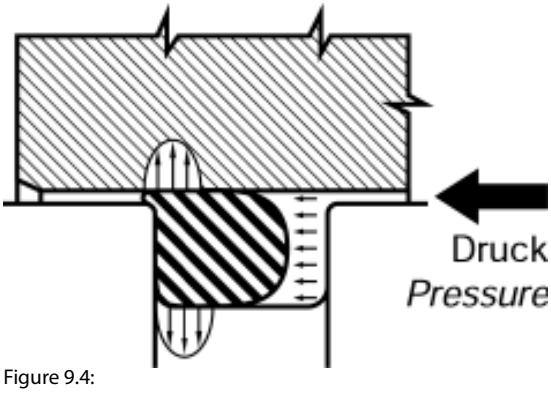


Figure 9.4:

9.3 TECHNICAL FEATURES OF O-RINGS

Static working pressure
- up to 150 bar for NBR 70 shore A without back-up ring
- up to 500 bar for NBR 70 shore A with back-up ring

Linear speed
Up to 0.5 m/s

Speed with rotational movements
Up to 2 m/s

C.S.: compression set
Compression set is a very important property because it expresses the time-related elasticity of the elastomer used.

Figures 9.5, 9.6 and 9.7 show an O-ring with cross-sectional diameter (d) compressed with a force (F) resulting in a value (C) for a specified time and temperature.

The value R is measured after the specified time has elapsed:

$$\text{C. S. (\%)} = \frac{d - R}{d - C} \cdot 100$$

A completely elastic material has a C.S. of 0 %, while a completely inelastic material has a C.S. of 100 %.

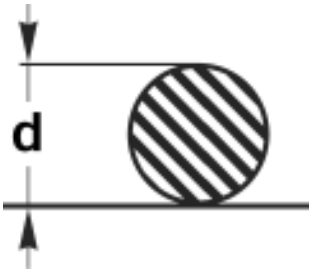


Figure 9.5:

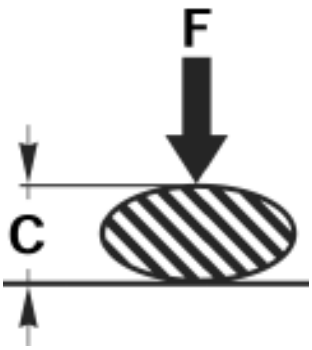


Figure 9.6:

Figure 9.7:

9.4 PERMISSIBLE CLEARANCE GAP OF O-RINGS

The highest permissible clearance gap **e** can be determined from the chart in Figure 9.8. The clearance gap must be less than the value shown left of the relevant curve and depends on the pressure used.

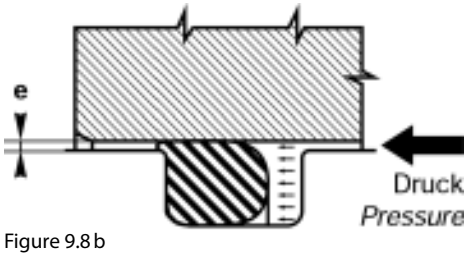


Figure 9.8 b

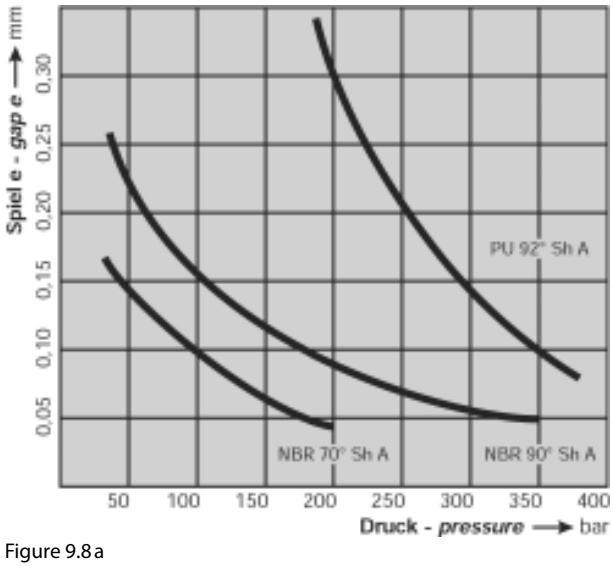


Figure 9.8 a

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9.5 DIMENSIONAL TOLERANCES FOR O-RINGS IN ACCORDANCE WITH ISO 3601-1:2008 CLASS B

The tolerances for the cord diameters d_2 are shown in Table 9.9.
The tolerances for the internal diameter d_1 are calculated **in accordance with ISO 3601-1:2008, Class B** using the following formula:

$$d_1 = (d_1^{0.95} \cdot 0.009) + 0.11 \text{ [mm]}$$

This formula is for use only with metric dimensions. The tolerances for internal diameters d_1 up to 600 mm are listed in Table 9.10.

Table 9.9

Cord diameter d_2 (mm)	Tolerances ±
$d_2 \leq 0.80$	on request
$0.80 < d_2 \leq 2.25$	0.08
$2.25 < d_2 \leq 3.15$	0.09
$3.15 < d_2 \leq 4.50$	0.10
$4.50 < d_2 \leq 6.30$	0.13
$6.30 < d_2 \leq 8.40$	0.15
$8.40 < d_2 \leq 10.00$	0.21
$10.00 < d_2 \leq 12.00$	0.25
$d_2 \leq 12.00$	on request

Table 9.10

Internal diameter d_1 (mm)	Tolerances ±
$d_1 \leq 1.71$	0.12
$1.71 < d_1 \leq 2.93$	0.13
$2.93 < d_1 \leq 4.17$	0.14
$4.17 < d_1 \leq 5.44$	0.15
$5.44 < d_1 \leq 6.72$	0.16
$6.72 < d_1 \leq 8.01$	0.17
$8.01 < d_1 \leq 9.31$	0.18
$9.31 < d_1 \leq 10.62$	0.19
$10.62 < d_1 \leq 11.94$	0.20
$11.94 < d_1 \leq 13.27$	0.21
$13.27 < d_1 \leq 14.61$	0.22
$14.61 < d_1 \leq 15.95$	0.23
$15.95 < d_1 \leq 17.29$	0.24
$17.29 < d_1 \leq 18.64$	0.25
$18.64 < d_1 \leq 20.00$	0.26
$20.00 < d_1 \leq 21.36$	0.27
$21.36 < d_1 \leq 22.73$	0.28
$22.73 < d_1 \leq 24.10$	0.29
$24.10 < d_1 \leq 25.47$	0.30
$25.47 < d_1 \leq 26.85$	0.31
$26.85 < d_1 \leq 28.23$	0.32
$28.23 < d_1 \leq 29.61$	0.33
$29.61 < d_1 \leq 31.00$	0.34
$31.00 < d_1 \leq 32.39$	0.35
$32.39 < d_1 \leq 33.78$	0.36
$33.78 < d_1 \leq 35.18$	0.37
$35.18 < d_1 \leq 36.58$	0.38
$36.58 < d_1 \leq 37.98$	0.39
$37.98 < d_1 \leq 39.38$	0.40
$39.38 < d_1 \leq 40.79$	0.41
$40.79 < d_1 \leq 42.20$	0.42
$42.20 < d_1 \leq 43.61$	0.43
$43.61 < d_1 \leq 45.02$	0.44
$45.02 < d_1 \leq 46.44$	0.45
$46.44 < d_1 \leq 47.86$	0.46
$47.86 < d_1 \leq 49.28$	0.47
$49.28 < d_1 \leq 50.70$	0.48
$50.70 < d_1 \leq 52.12$	0.49
$52.12 < d_1 \leq 53.55$	0.50
$53.55 < d_1 \leq 54.98$	0.51
$54.98 < d_1 \leq 56.41$	0.52
$56.41 < d_1 \leq 57.84$	0.53
$57.84 < d_1 \leq 59.27$	0.54
$59.27 < d_1 \leq 60.71$	0.55
$60.71 < d_1 \leq 62.14$	0.56
$62.14 < d_1 \leq 63.58$	0.57

Table 9.10

Internal diameter d_1 (mm)	Tolerances ±
$63.58 < d_1 \leq 65.02$	0.58
$65.02 < d_1 \leq 66.47$	0.59
$66.47 < d_1 \leq 67.91$	0.60
$67.91 < d_1 \leq 69.35$	0.61
$69.35 < d_1 \leq 70.80$	0.62
$70.80 < d_1 \leq 72.25$	0.63
$72.25 < d_1 \leq 73.70$	0.64
$73.70 < d_1 \leq 75.15$	0.65
$75.15 < d_1 \leq 76.60$	0.66
$76.60 < d_1 \leq 78.05$	0.67
$78.05 < d_1 \leq 79.51$	0.68
$79.51 < d_1 \leq 80.97$	0.69
$80.97 < d_1 \leq 82.42$	0.70
$82.42 < d_1 \leq 83.88$	0.71
$83.88 < d_1 \leq 85.34$	0.72
$85.34 < d_1 \leq 86.80$	0.73
$86.80 < d_1 \leq 88.27$	0.74
$88.27 < d_1 \leq 89.73$	0.75
$89.73 < d_1 \leq 91.20$	0.76
$91.20 < d_1 \leq 92.66$	0.77
$92.66 < d_1 \leq 94.13$	0.78
$94.13 < d_1 \leq 95.60$	0.79
$95.60 < d_1 \leq 97.07$	0.80
$97.07 < d_1 \leq 98.54$	0.81
$98.54 < d_1 \leq 100.01$	0.82
$100.01 < d_1 \leq 101.48$	0.83
$101.48 < d_1 \leq 102.96$	0.84
$102.96 < d_1 \leq 104.43$	0.85
$104.43 < d_1 \leq 105.91$	0.86
$105.91 < d_1 \leq 107.39$	0.87
$107.39 < d_1 \leq 108.86$	0.88
$108.86 < d_1 \leq 110.34$	0.89
$110.34 < d_1 \leq 111.82$	0.90
$111.82 < d_1 \leq 113.30$	0.91
$113.30 < d_1 \leq 114.79$	0.92
$114.79 < d_1 \leq 116.27$	0.93
$116.27 < d_1 \leq 117.75$	0.94
$117.75 < d_1 \leq 119.24$	0.95
$119.24 < d_1 \leq 120.72$	0.96
$120.72 < d_1 \leq 122.21$	0.97
$122.21 < d_1 \leq 123.70$	0.98
$123.70 < d_1 \leq 125.19$	0.99
$125.19 < d_1 \leq 126.68$	1.00
$126.68 < d_1 \leq 128.17$	1.01
$128.17 < d_1 \leq 129.66$	1.02
$129.66 < d_1 \leq 131.15$	1.03

Table 9.10	
Internal diameter d_1 (mm)	Tolerances ±
131.15 < d_1 ≤ 132.64	1.04
132.64 < d_1 ≤ 134.14	1.05
134.14 < d_1 ≤ 135.63	1.06
135.63 < d_1 ≤ 137.13	1.07
137.13 < d_1 ≤ 138.62	1.08
138.62 < d_1 ≤ 140.12	1.09
140.12 < d_1 ≤ 141.62	1.10
141.62 < d_1 ≤ 143.12	1.11
143.12 < d_1 ≤ 144.62	1.12
144.62 < d_1 ≤ 146.12	1.13
146.12 < d_1 ≤ 147.62	1.14
147.62 < d_1 ≤ 149.12	1.15
149.12 < d_1 ≤ 150.62	1.16
150.62 < d_1 ≤ 152.13	1.17
152.13 < d_1 ≤ 153.63	1.18
153.63 < d_1 ≤ 155.13	1.19
155.13 < d_1 ≤ 156.64	1.20
156.64 < d_1 ≤ 158.15	1.21
158.15 < d_1 ≤ 159.65	1.22
159.65 < d_1 ≤ 161.16	1.23
161.16 < d_1 ≤ 162.67	1.24
162.67 < d_1 ≤ 164.18	1.25
164.18 < d_1 ≤ 165.69	1.26
165.69 < d_1 ≤ 167.20	1.27
167.20 < d_1 ≤ 168.71	1.28
168.71 < d_1 ≤ 170.22	1.29
170.22 < d_1 ≤ 171.73	1.30
171.73 < d_1 ≤ 173.25	1.31
173.25 < d_1 ≤ 174.76	1.32
174.76 < d_1 ≤ 176.28	1.33
176.28 < d_1 ≤ 177.79	1.34
177.79 < d_1 ≤ 179.31	1.35
179.31 < d_1 ≤ 180.82	1.36
180.82 < d_1 ≤ 182.34	1.37
182.34 < d_1 ≤ 183.86	1.38
183.86 < d_1 ≤ 185.38	1.39
185.38 < d_1 ≤ 186.89	1.40
186.89 < d_1 ≤ 188.41	1.41
188.41 < d_1 ≤ 189.93	1.42
189.93 < d_1 ≤ 191.45	1.43
191.45 < d_1 ≤ 192.98	1.44
192.98 < d_1 ≤ 194.50	1.45
194.50 < d_1 ≤ 196.02	1.46
196.02 < d_1 ≤ 197.54	1.47
197.54 < d_1 ≤ 199.07	1.48
199.07 < d_1 ≤ 200.59	1.49
200.59 < d_1 ≤ 202.12	1.50
202.12 < d_1 ≤ 203.64	1.51
203.64 < d_1 ≤ 205.17	1.52
205.17 < d_1 ≤ 206.69	1.53
206.69 < d_1 ≤ 208.22	1.54
208.22 < d_1 ≤ 209.75	1.55
209.75 < d_1 ≤ 211.28	1.56
211.28 < d_1 ≤ 212.81	1.57
212.81 < d_1 ≤ 214.34	1.58
214.34 < d_1 ≤ 215.87	1.59
215.87 < d_1 ≤ 217.40	1.60
217.40 < d_1 ≤ 218.93	1.61
218.93 < d_1 ≤ 220.46	1.62
220.46 < d_1 ≤ 221.99	1.63
221.99 < d_1 ≤ 223.52	1.64
223.52 < d_1 ≤ 225.06	1.65

Table 9.10	
Internal diameter d_1 (mm)	Tolerances ±
225.06 < d_1 ≤ 226.59	1.66
226.59 < d_1 ≤ 228.12	1.67
228.12 < d_1 ≤ 229.66	1.68
229.66 < d_1 ≤ 231.19	1.69
231.19 < d_1 ≤ 232.73	1.70
232.73 < d_1 ≤ 234.27	1.71
234.27 < d_1 ≤ 235.80	1.72
235.80 < d_1 ≤ 237.34	1.73
237.34 < d_1 ≤ 238.88	1.74
238.88 < d_1 ≤ 240.42	1.75
240.42 < d_1 ≤ 241.95	1.76
241.95 < d_1 ≤ 243.49	1.77
243.49 < d_1 ≤ 245.03	1.78
245.03 < d_1 ≤ 246.57	1.79
246.57 < d_1 ≤ 248.11	1.80
248.11 < d_1 ≤ 249.66	1.81
249.66 < d_1 ≤ 251.20	1.82
251.20 < d_1 ≤ 252.74	1.83
252.74 < d_1 ≤ 254.28	1.84
254.28 < d_1 ≤ 255.82	1.85
255.82 < d_1 ≤ 257.37	1.86
257.37 < d_1 ≤ 258.91	1.87
258.91 < d_1 ≤ 260.46	1.88
260.46 < d_1 ≤ 262.00	1.89
262.00 < d_1 ≤ 263.55	1.90
263.55 < d_1 ≤ 265.09	1.91
265.09 < d_1 ≤ 266.64	1.92
266.64 < d_1 ≤ 268.18	1.93
268.18 < d_1 ≤ 269.73	1.94
269.73 < d_1 ≤ 271.28	1.95
271.28 < d_1 ≤ 272.83	1.96
272.83 < d_1 ≤ 274.38	1.97
274.38 < d_1 ≤ 275.92	1.98
275.92 < d_1 ≤ 277.47	1.99
277.47 < d_1 ≤ 279.02	2.00
279.02 < d_1 ≤ 280.57	2.01
280.57 < d_1 ≤ 282.12	2.02
282.12 < d_1 ≤ 283.68	2.03
283.68 < d_1 ≤ 285.23	2.04
285.23 < d_1 ≤ 286.78	2.05
286.78 < d_1 ≤ 288.33	2.06
288.33 < d_1 ≤ 289.88	2.07
289.88 < d_1 ≤ 291.44	2.08
291.44 < d_1 ≤ 292.99	2.09
292.99 < d_1 ≤ 294.54	2.10
294.54 < d_1 ≤ 296.10	2.11
296.10 < d_1 ≤ 297.65	2.12
297.65 < d_1 ≤ 299.21	2.13
299.21 < d_1 ≤ 300.76	2.14
300.76 < d_1 ≤ 302.32	2.15
302.32 < d_1 ≤ 303.88	2.16
303.88 < d_1 ≤ 305.43	2.17
305.43 < d_1 ≤ 306.99	2.18
306.99 < d_1 ≤ 308.55	2.19
308.55 < d_1 ≤ 310.11	2.20
310.11 < d_1 ≤ 311.66	2.21
311.66 < d_1 ≤ 313.22	2.22
313.22 < d_1 ≤ 314.78	2.23
314.78 < d_1 ≤ 316.34	2.24
316.34 < d_1 ≤ 317.90	2.25
317.90 < d_1 ≤ 319.46	2.26
319.46 < d_1 ≤ 321.02	2.27

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Table 9.10	
Internal diameter d_1 (mm)	Tolerances ±
321.02 < d_1 ≤ 322.58	2.28
322.58 < d_1 ≤ 324.15	2.29
324.15 < d_1 ≤ 325.71	2.30
325.71 < d_1 ≤ 327.27	2.31
327.27 < d_1 ≤ 328.83	2.32
328.83 < d_1 ≤ 330.39	2.33
330.39 < d_1 ≤ 331.96	2.34
331.96 < d_1 ≤ 333.52	2.35
333.52 < d_1 ≤ 335.09	2.36
335.09 < d_1 ≤ 336.65	2.37
336.65 < d_1 ≤ 338.21	2.38
338.21 < d_1 ≤ 339.78	2.39
339.78 < d_1 ≤ 341.35	2.40
341.35 < d_1 ≤ 342.91	2.41
342.91 < d_1 ≤ 344.48	2.42
344.48 < d_1 ≤ 346.04	2.43
346.04 < d_1 ≤ 347.61	2.44
347.61 < d_1 ≤ 349.18	2.45
349.18 < d_1 ≤ 350.75	2.46
350.75 < d_1 ≤ 352.31	2.47
352.31 < d_1 ≤ 353.88	2.48
353.88 < d_1 ≤ 355.45	2.49
355.45 < d_1 ≤ 357.02	2.50
357.02 < d_1 ≤ 358.59	2.51
358.59 < d_1 ≤ 360.16	2.52
360.16 < d_1 ≤ 361.73	2.53
361.73 < d_1 ≤ 363.30	2.54
363.30 < d_1 ≤ 364.87	2.55
364.87 < d_1 ≤ 366.44	2.56
366.44 < d_1 ≤ 368.01	2.57
368.01 < d_1 ≤ 369.58	2.58
369.58 < d_1 ≤ 371.16	2.59
371.16 < d_1 ≤ 372.73	2.60
372.73 < d_1 ≤ 374.30	2.61
374.30 < d_1 ≤ 375.87	2.62
375.87 < d_1 ≤ 377.45	2.63
377.45 < d_1 ≤ 379.02	2.64
379.02 < d_1 ≤ 380.59	2.65
380.59 < d_1 ≤ 382.17	2.66
382.17 < d_1 ≤ 383.74	2.67
383.74 < d_1 ≤ 385.32	2.68
385.32 < d_1 ≤ 386.89	2.69
386.89 < d_1 ≤ 388.47	2.70
388.47 < d_1 ≤ 390.05	2.71
390.05 < d_1 ≤ 391.62	2.72
391.62 < d_1 ≤ 393.20	2.73
393.20 < d_1 ≤ 394.78	2.74
394.78 < d_1 ≤ 396.35	2.75
396.35 < d_1 ≤ 397.93	2.76
397.93 < d_1 ≤ 399.51	2.77
399.51 < d_1 ≤ 401.09	2.78
401.09 < d_1 ≤ 402.66	2.79
402.66 < d_1 ≤ 404.24	2.80
404.24 < d_1 ≤ 405.82	2.81
405.82 < d_1 ≤ 407.40	2.82
407.40 < d_1 ≤ 408.98	2.83
408.98 < d_1 ≤ 410.56	2.84
410.56 < d_1 ≤ 412.14	2.85
412.14 < d_1 ≤ 413.72	2.86
413.72 < d_1 ≤ 415.30	2.87
415.30 < d_1 ≤ 416.89	2.88
416.89 < d_1 ≤ 418.47	2.89

Table 9.10	
Internal diameter d_1 (mm)	Tolerances ±
418.47 < d_1 ≤ 420.05	2.90
420.05 < d_1 ≤ 421.63	2.91
421.63 < d_1 ≤ 423.21	2.92
423.21 < d_1 ≤ 424.80	2.93
424.80 < d_1 ≤ 426.38	2.94
426.38 < d_1 ≤ 427.96	2.95
427.96 < d_1 ≤ 429.55	2.96
429.55 < d_1 ≤ 431.13	2.97
431.13 < d_1 ≤ 432.71	2.98
432.71 < d_1 ≤ 434.30	2.99
434.30 < d_1 ≤ 435.88	3.00
435.88 < d_1 ≤ 437.47	3.01
437.47 < d_1 ≤ 439.05	3.02
439.05 < d_1 ≤ 440.64	3.03
440.64 < d_1 ≤ 442.22	3.04
442.22 < d_1 ≤ 443.81	3.05
443.81 < d_1 ≤ 445.40	3.06
445.40 < d_1 ≤ 446.98	3.07
446.98 < d_1 ≤ 448.57	3.08
448.57 < d_1 ≤ 450.16	3.09
450.16 < d_1 ≤ 451.75	3.10
451.75 < d_1 ≤ 453.33	3.11
453.33 < d_1 ≤ 454.92	3.12
454.92 < d_1 ≤ 456.51	3.13
456.51 < d_1 ≤ 458.10	3.14
458.10 < d_1 ≤ 459.69	3.15
459.69 < d_1 ≤ 461.28	3.16
461.28 < d_1 ≤ 462.87	3.17
462.87 < d_1 ≤ 464.46	3.18
464.46 < d_1 ≤ 466.05	3.19
466.05 < d_1 ≤ 467.64	3.20
467.64 < d_1 ≤ 469.23	3.21
469.23 < d_1 ≤ 470.82	3.22
470.82 < d_1 ≤ 472.41	3.23
472.41 < d_1 ≤ 474.00	3.24
474.00 < d_1 ≤ 475.59	3.25
475.59 < d_1 ≤ 477.19	3.26
477.19 < d_1 ≤ 478.78	3.27
478.78 < d_1 ≤ 480.37	3.28
480.37 < d_1 ≤ 481.96	3.29
481.96 < d_1 ≤ 483.56	3.30
483.56 < d_1 ≤ 485.15	3.31
485.15 < d_1 ≤ 486.74	3.32
486.74 < d_1 ≤ 488.34	3.33
488.34 < d_1 ≤ 489.93	3.34
489.93 < d_1 ≤ 491.52	3.35
491.52 < d_1 ≤ 493.12	3.36
493.12 < d_1 ≤ 494.71	3.37
494.71 < d_1 ≤ 496.31	3.38
496.31 < d_1 ≤ 497.90	3.39
497.90 < d_1 ≤ 499.50	3.40
499.50 < d_1 ≤ 501.10	3.41
501.10 < d_1 ≤ 502.69	3.42
502.69 < d_1 ≤ 504.29	3.43
504.29 < d_1 ≤ 505.89	3.44
505.89 < d_1 ≤ 507.48	3.45
507.48 < d_1 ≤ 509.08	3.46
509.08 < d_1 ≤ 510.68	3.47
510.68 < d_1 ≤ 512.27	3.48
512.27 < d_1 ≤ 513.87	3.49
513.87 < d_1 ≤ 515.47	3.50
515.47 < d_1 ≤ 517.07	3.51

Table 9.10	
Internal diameter d_1 (mm)	Tolerances ±
517.07 < d_1 ≤ 518.67	3.52
518.67 < d_1 ≤ 520.27	3.53
520.27 < d_1 ≤ 521.87	3.54
521.87 < d_1 ≤ 523.46	3.55
523.46 < d_1 ≤ 525.06	3.56
525.06 < d_1 ≤ 526.66	3.57
526.66 < d_1 ≤ 528.26	3.58
528.26 < d_1 ≤ 529.86	3.59
529.86 < d_1 ≤ 531.46	3.60
531.46 < d_1 ≤ 533.07	3.61
533.07 < d_1 ≤ 534.67	3.62
534.67 < d_1 ≤ 536.27	3.63
536.27 < d_1 ≤ 537.87	3.64
537.87 < d_1 ≤ 539.47	3.65
539.47 < d_1 ≤ 541.07	3.66
541.07 < d_1 ≤ 542.68	3.67
542.68 < d_1 ≤ 544.28	3.68
544.28 < d_1 ≤ 545.88	3.69
545.88 < d_1 ≤ 547.48	3.70
547.48 < d_1 ≤ 549.09	3.71
549.09 < d_1 ≤ 550.69	3.72
550.69 < d_1 ≤ 552.29	3.73
552.29 < d_1 ≤ 553.90	3.74
553.90 < d_1 ≤ 555.50	3.75
555.50 < d_1 ≤ 557.11	3.76
557.11 < d_1 ≤ 558.71	3.77
558.71 < d_1 ≤ 560.32	3.78
560.32 < d_1 ≤ 561.92	3.79
561.92 < d_1 ≤ 563.53	3.80
563.53 < d_1 ≤ 565.13	3.81
565.13 < d_1 ≤ 566.74	3.82
566.74 < d_1 ≤ 568.34	3.83
568.34 < d_1 ≤ 569.95	3.84
569.95 < d_1 ≤ 571.56	3.85
571.56 < d_1 ≤ 573.16	3.86
573.16 < d_1 ≤ 574.77	3.87
574.77 < d_1 ≤ 576.38	3.88
576.38 < d_1 ≤ 577.98	3.89
577.98 < d_1 ≤ 579.59	3.90
579.59 < d_1 ≤ 581.20	3.91
581.20 < d_1 ≤ 582.81	3.92
582.81 < d_1 ≤ 584.42	3.93
584.42 < d_1 ≤ 586.02	3.94
586.02 < d_1 ≤ 587.63	3.95
587.63 < d_1 ≤ 589.24	3.96
589.24 < d_1 ≤ 590.85	3.97
590.85 < d_1 ≤ 592.46	3.98
592.46 < d_1 ≤ 594.07	3.99
594.07 < d_1 ≤ 595.68	4.00
595.68 < d_1 ≤ 597.29	4.01
597.29 < d_1 ≤ 598.90	4.02
598.90 < d_1 ≤ 600.00	4.03
d_1 > 600	using a formula

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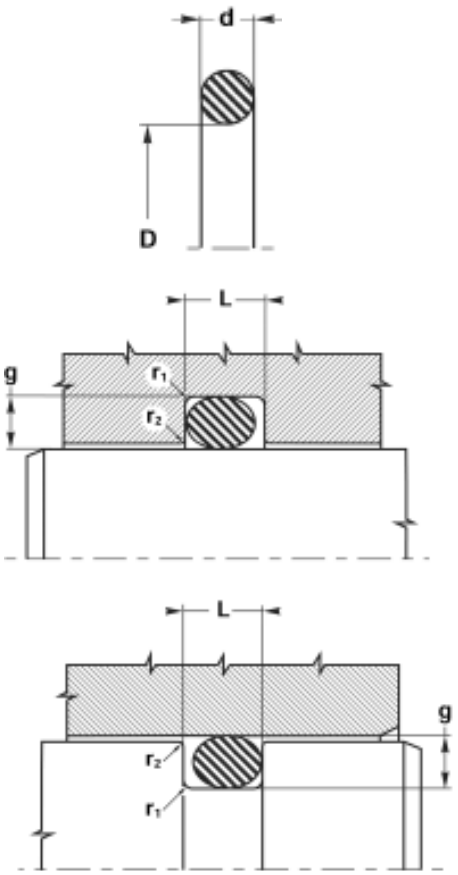
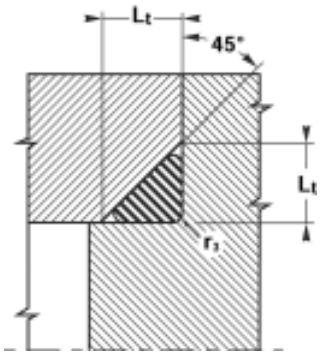
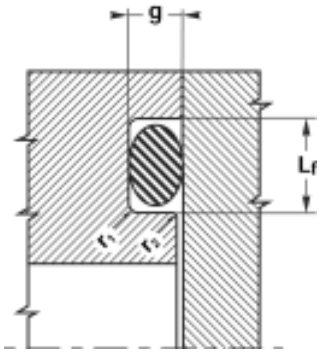
9.6 STATIC SEAL OF O-RINGS



Radial pressing action



Three-sided pressing action



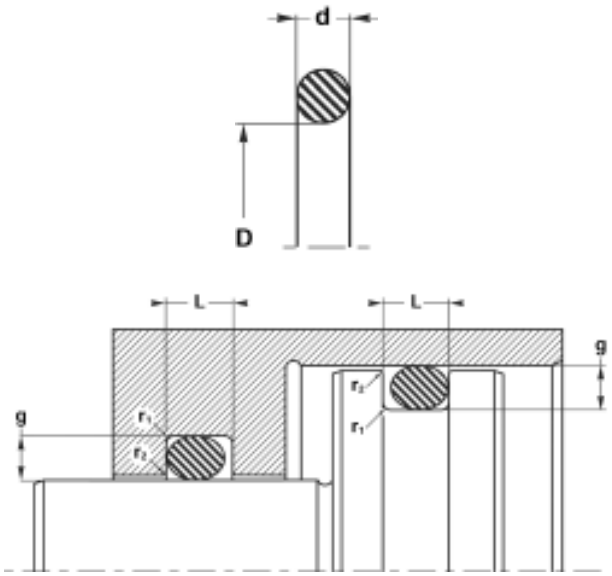
Axial pressing action

Table 9.11

Calculation of grooves and static seal in accordance with DIN 3771/Part 5 (ISO standard in bold)

d O-ring		g 0 / +0.0	L 0 / +0.20	Lf 0 / +0.20	Lt	tol. Lt	r1	r2	r3
1.00	1.02	0.70	1.40	1.40	1.35	0 / +0.10	0.20	0.10	0.20
1.50	1.52	1.10	2.00	2.10	2.00	0 / +0.10	0.20	0.10	0.20
1.60	1.63	1.20	2.10	2.20	2.15	0 / +0.10	0.30	0.10	0.30
1.78	**1.80**	**1.30**	**2.40**	**2.60**	**2.40**	**0 / +0.10**	**0.40**	**0.10**	**0.30**
1.90		1.40	2.60	2.70	2.55	0 / +0.10	0.40	0.10	0.40
2.00	1.98	1.50	2.70	2.80	2.70	0 / +0.10	0.40	0.10	0.40
2.40		1.80	3.20	3.30	3.20	0 / +0.15	0.50	0.10	0.40
2.50		1.85	3.30	3.40	3.40	0 / +0.15	0.50	0.10	0.60
2.62	**2.65**	**2.00**	**3.60**	**3.80**	**3.50**	**0 / +0.15**	**0.60**	**0.10**	**0.60**
2.70		2.05	3.60	3.80	3.65	0 / +0.15	0.60	0.10	0.60
3.00		2.30	4.00	4.00	4.00	0 / +0.20	0.60	0.15	0.60
3.10		2.40	4.10	4.10	4.10	0 / +0.20	0.60	0.15	0.60
3.50		2.65	4.60	4.70	4.70	0 / +0.20	0.60	0.15	0.90
3.53	**3.55**	**2.70**	**4.80**	**5.00**	**4.80**	**0 / +0.20**	**0.80**	**0.15**	**0.90**
3.60		2.80	4.80	5.10	4.90	0 / +0.20	0.80	0.15	0.90
4.00		3.10	5.20	5.30	5.40	0 / +0.20	0.80	0.15	1.20
4.50		3.50	5.80	5.90	6.10	0 / +0.20	0.80	0.15	1.20
5.00		4.00	6.60	6.70	6.70	0 / +0.25	0.80	0.15	1.20
5.34	**5.30**	**4.30**	**7.10**	**7.30**	**7.10**	**0 / +0.25**	**1.20**	**0.20**	**1.50**
5.50		4.50	7.10	7.30	7.40	0 / +0.25	1.20	0.20	1.50
5.70		4.60	7.20	7.40	7.60	0 / +0.25	1.20	0.20	1.50
6.00		4.90	7.40	7.60	8.00	0 / +0.30	1.20	0.20	1.50
7.00	**6.99**	**5.80**	**9.50**	**9.70**	**9.40**	**0 / +0.30**	**1.50**	**0.20**	**2.00**
8.00		6.70	9.80	10.00	10.80	0 / +0.30	1.50	0.20	2.00
8.40		7.10	10.00	10.30	11.30	0 / +0.30	1.50	0.20	2.00

9.7 DYNAMIC SEAL FOR PNEUMATIC CYLINDERS

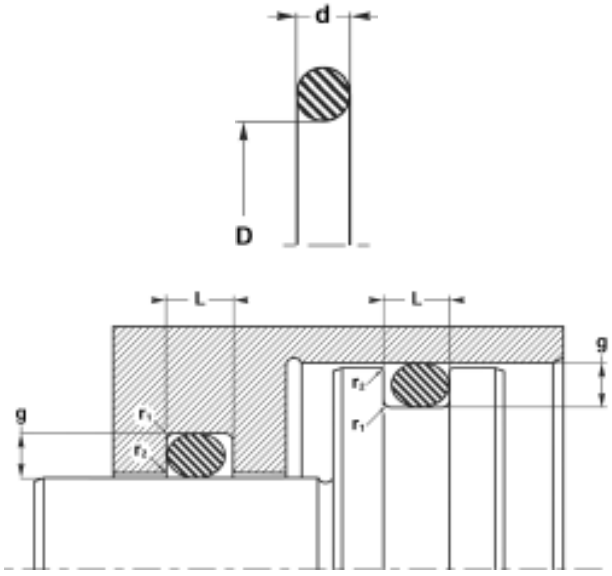


We recommend that the surface finishes, chamfers and radii shown are observed (see 9.9 Installation instructions for O-rings).

Table 9.12 (ISO standard in bold)

d		g	L	r1	r2
1.00	1.02	0.95	1.30	0.20	0.10
1.50	1.52	1.35	1.90	0.20	0.10
1.60	1.63	1.45	2.00	0.30	0.10
1.78	**1.80**	**1.55**	**2.30**	**0.30**	**0.10**
1.90		1.75	2.40	0.40	0.10
2.00	1.98	1.80	2.50	0.40	0.10
2.40		2.15	2.90	0.50	0.10
2.50		2.25	3.00	0.50	0.10
2.62	**2.65**	**2.35**	**3.10**	**0.60**	**0.10**
2.70		2.45	3.30	0.60	0.10
3.00		2.75	3.60	0.60	0.15
3.10		2.85	3.70	0.60	0.15
3.50		3.25	4.20	0.60	0.15
3.53	**3.55**	**3.25**	**4.20**	**0.80**	**0.15**
3.60		3.35	4.30	0.80	0.15
4.00		3.70	4.80	0.80	0.15
4.50		4.20	5.40	0.80	0.15
5.00		4.65	6.00	0.80	0.15
5.34	**5.30**	**4.95**	**6.40**	**1.20**	**0.20**
5.50		5.15	6.60	1.20	0.20
5.70		5.35	6.90	1.20	0.20
6.00		5.65	7.20	1.20	0.20
7.00	**6.99**	**6.60**	**8.40**	**1.50**	**0.20**
8.00		7.60	9.60	1.50	0.20
8.40		7.90	10.10	1.50	0.20

9.8 DYNAMIC SEAL FOR HYDRAULIC CYLINDERS



We recommend that the surface finishes, chamfers and radii shown are observed (see 9.9 Installation instructions for O-rings).

Table 9.13 (ISO standard in bold)

d		g	L	r1	r2
1.00	1.02	0.90	1.40	0.20	0.10
1.50	1.52	1.25	2.00	0.20	0.10
1.60	1.63	1.30	2.10	0.30	0.10
1.78	**1.80**	**1.55**	**2.40**	**0.40**	**0.10**
1.90		1.55	2.60	0.40	0.10
2.00	1.98	1.65	2.70	0.40	0.10
2.40		2.05	3.20	0.50	0.10
2.50		2.15	3.30	0.50	0.10
2.62	**2.65**	**2.25**	**3.60**	**0.60**	**0.10**
2.70		2.30	3.60	0.60	0.10
3.00		2.60	4.00	0.60	0.15
3.10		2.70	4.10	0.60	0.15
3.50		3.05	4.60	0.60	0.15
3.53	**3.55**	**3.10**	**4.80**	**0.80**	**0.15**
3.60		3.15	4.80	0.80	0.15
4.00		3.50	5.20	0.80	0.15
4.50		4.00	5.80	0.80	0.15
5.00		4.40	6.60	0.80	0.15
5.34	**5.30**	**4.70**	**7.10**	**1.20**	**0.20**
5.50		4.80	7.10	1.20	0.20
5.70		5.00	7.20	1.20	0.20
6.00		5.30	7.40	1.20	0.20
7.00	**6.99**	**6.10**	**9.50**	**1.50**	**0.20**
8.00		7.10	9.80	1.50	0.20
8.40		7.50	10.00	1.50	0.20

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9.9 INSTALLATION INSTRUCTIONS FOR O-RINGS

Installation and clearance gap

We give advice on the tolerances H7 / f6 for installation. The highest permissible clearance gap **e** can be determined from the chart in Figure 9.8 and 9.4 "Permissible clearance gap of O-rings". The clearance gap **e** must be less than the value read from axis to the left of the relevant curve and depends on the pressure used.

Surface quality

The roughness values stated in table 9.15 must be observed in both the R_a and R_t areas.

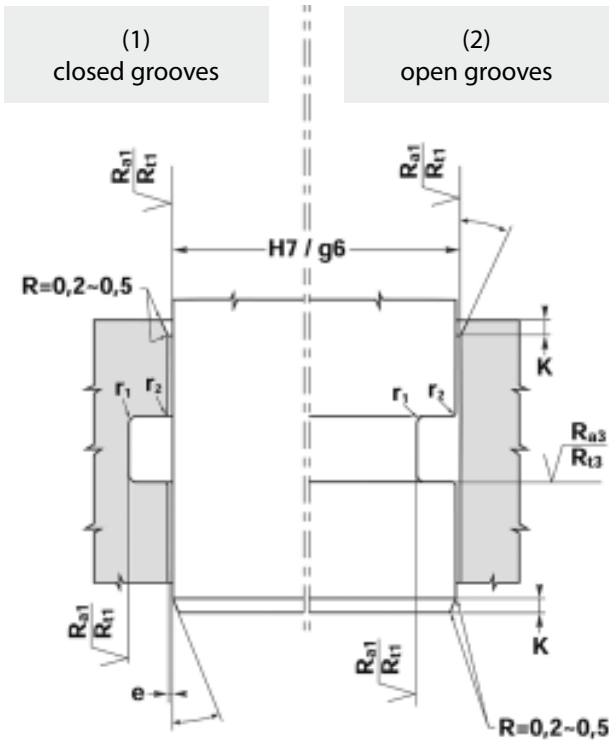
Chamfers

Table 9.14 lists the chamfer lengths K to be observed.

Roundings

Sharp edges must be avoided. The radii to be observed are shown on the following pages.

Radial installation



Axial installation

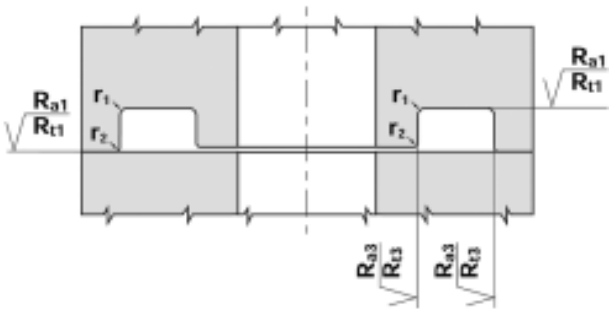


Table 9.14

d O-ring	K (mm) α = 20°	K (mm) α =30°
≤ 1.78	2.0	1.5
≤ 2.65	2.5	2.0
≤ 3.55	3.0	2.5
≤ 5.34	4.0	3.5
≤ 7.00	5.0	4.0
≤ 8.40	5.5	4.5

Table 9.15

R_{a1}	R_{t1}	R_{a3}	R_{t3}
≤ 0.8 µm	≤ 4 µm	≤ 3 µm	≤ 16 µm

10. BACK-UP RINGS

10.1 EXTRUSION

Extrusion problems occur when **the clearance gap e** between the parts in relation to the pressure deforming the O-ring is too large. The O-ring becomes gradually worn at the edges and wears out completely over time (Fig. 10.1).

The groove is widened by the value **E (thickness of the back-up ring)**. This back-up ring is installed on the side facing the direction of pressure. This supports the O-ring and solves extrusion problems (Fig. 10.2).
Back-up rings are used similarly for double-acting sealing systems. In this case, two back-up rings are required (Fig. 10.3).

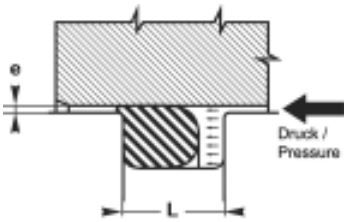


Figure 10.1:

10.2 PROFILES AND MATERIALS

We recommend solid back-up rings for internal and external grooves. PTFE must be used in applications with high temperatures and special fluids. For external grooves, the back-up rings have to be cut through to allow installation.

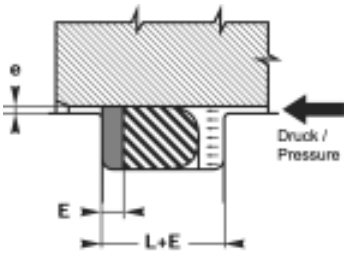


Figure 10.2:

10.3 FURTHER INFORMATION

Although a back-up ring is a very simple product, its choice and dimensions can be very complex, as we will demonstrate below.

A The problem of **replacing existing parts**: there is an enormous difference in the depth of the grooves used. The initial compression can vary between 10 and 30 % (see page 228).

Example: our standard rings BU and PBK. For an O-ring d = 2.62 mm, the section of the ring will be 2.25 mm for the PBK and 2.18 mm for the BU. Therefore the determination of the dimensions of the existing pieces must be done very carefully, because any dimension is possible; **every manufacturer uses different standards**.

Incorrectly determined dimensions can have disastrous consequences. If the ring is a poor fit for the groove, it can cause the following problems:

- If the cross-section of the ring is too large, installation will be difficult, if not impossible and the ring will inevitably wear out (see Fig. 10.4).
- On the other hand, if the cross-section is too small, there is no point in installing it: the extrusion problem is as bad as ever, as can be seen in Figure 10.5.

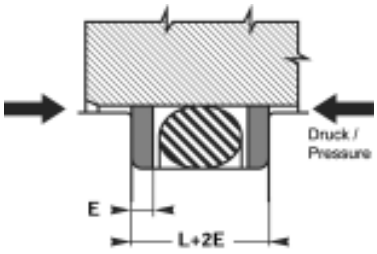


Figure 10.3:

B With respect to the **new versions**, the seal manufacturers' standard ranges are very often limited. The same ring is used for static and dynamic sealing.

Example: our PBK rings are often used for static sealing. However, they are more suitable for dynamic applications (see Table 9.13 in "9.8 Dynamic seal for hydraulic cylinders"). PBK rings are used in static applications mainly on the grounds of economy. However this conflicts with the groove depth we recommend in "9.9 Installation instructions for O-rings". For dimensions corresponding to those in Table 9.14, we recommend a DST 108 in H-PU.

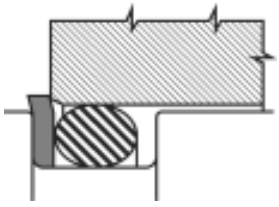


Figure 10.4:

Selecting a back-up ring for a new design is completely different to selecting one as a replacement.

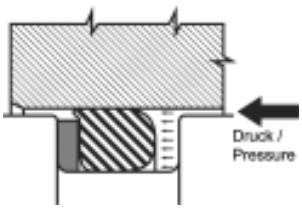


Figure 10.5:

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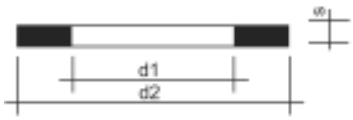
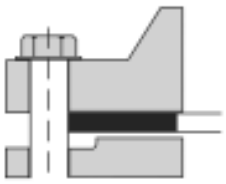
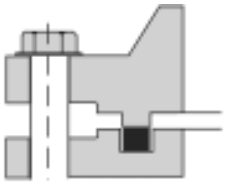
11. FLAT SEALS

11.1 FLAT SEALS IN ACCORDANCE WITH EN1514-1 (DIN 2690, 2691, 2692)

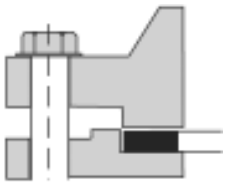




EN1514-1 IBC (DIN 2690)



EN1514-1 TG (DIN 2691)



EN1514-1 SR (DIN 2692)

Standard:		DIN 2690						DIN 2691		DIN 2692	
Flange shape:		A-B smooth seal surface without/with sealing lip						C-D tongue/groove		E-F projection/recess	
Nominal pressure:		PN 2.5	PN 6	PN 10	PN 16	PN 25	PN 40	PN 10-160		PN 10-100	
DN	d1	d2	d2	d2	d2	d2	d2	d1	d2	d1	d2
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
4	6	–	–	–	–	30	–	20	30	–	–
6	10	28	28	38	38	38	38	20	30	–	–
8	14	33	33	43	43	43	43	22	32	–	–
10	18	38	38	45	45	45	45	24	34	18	34
15	22	43	43	50	50	50	50	29	39	22	39
20	28	53	53	60	60	60	60	36	50	28	50
25	35	63	63	70	70	70	70	43	57	35	57
32	43	75	75	82	82	82	82	51	65	43	65
40	49	85	85	92	92	92	92	61	75	49	75
50	61	95	95	107	107	107	107	73	87	61	87
60	–	–	–	–	–	–	–	–	–	–	–
65	77	115	115	127	127	127	127	95	109	77	109
80	90	132	132	142	142	142	142	106	120	90	120
100	115	152	152	162	162	168	168	129	149	115	149
125	141	182	182	192	192	195	195	155	175	141	175
150	169	207	207	218	218	225	225	183	203	169	203
(175)	195	237	237	248	248	255	267	213	233	195	233
200	220	262	262	273	273	285	292	239	259	220	259
250	274	318	318	328	330	342	353	292	312	274	312
300	325	373	373	378	385	402	418	343	363	325	363
350	368	423	423	438	445	458	475	395	421	368	421
400	420	473	473	490	497	515	547	447	473	420	473
(450)	470	528	528	540	557	565	572	–	–	–	–
500	520	578	578	595	618	625	628	549	575	520	575
600	620	680	680	695	735	730	745	649	675	620	675
700	720	785	785	810	805	830	850	751	777	720	777
800	820	890	890	915	910	940	970	856	882	820	882
900	920	990	990	1015	1010	1040	1080	961	987	920	987
1000	1020	1090	1090	1120	1125	1150	1190	1062	1092	1020	1091
1100	–	–	–	–	–	–	–				
1200	1220	1290	1305	1340	1340	1360	1395				
1400	1420	1490	1520	1545	1540	1575	1615				
1500	–	–	–	–	–	–	–				
1600	1620	1700	1720	1770	1760	1795	1830				
1800	1820	1900	1930	1970	1960	2000					
2000	2020	2100	2138	2182	2168	2230					
2200	2220	2307	2384	2384							
2400	2420	2507	2558	2594							
2600	2620	2707	2762	2794							
2800	2820	2924	2972	3014							
3000	3020	3124	3172	3228							
3200	3220	3324	3382								
3400	3420	3524	3592								
3600	3620	3734	3804								
3800	3820	3931									
4000	4020	4131									
Flange standard:		DIN 2630	DIN 2631	DIN 2632	DIN 2633	DIN 2634	DIN 2635	DIN 2512	DIN 2512	DIN 2513	DIN 2513

11.2 DIMENSIONS AND TOLERANCES FOR SEALING PLATES, CUT PLATES AND PUNCHED ARTICLES

Tolerances for plates, cut plates and punched articles in accordance with DIN 7715 Part 5			
Nominal size	Class P1 Tolerances in mm	Class P2 Tolerances in mm	Class P3 Tolerances in mm
0.0 – 1.6	± 0.20	± 0.20	± 0.40
> 1.6 – 4.0	± 0.20	± 0.30	± 0.40
> 4.0 – 6.3	± 0.20	± 0.40	± 0.50
> 6.3 – 10.0	± 0.30	± 0.50	± 0.60
> 10.0 – 25.0	± 0.30	± 0.60	± 0.80
25.0 – 40.0	± 0.40	± 0.80	± 1.00
40.0 – 63.0	± 0.50	± 1.00	± 1.50
> 63.0 – 100.0	± 0.60	± 1.20	± 2.00
> 100.0 – 160.0	± 0.80	± 1.40	± 2.50
> 160.0 – 250.0	± 1.00	± 1.60	± 3.00
> 250.0 – 400.0	± 1.60	± 2.50	± 5.00
	Tolerances in %	Tolerances in %	Tolerances in %
> 400.0	± 0.50	± 0.80	± 1.50

Abbreviations used for materials in HANSA-FLEX articles	
Material	Abbreviations
Graphite/serrated perforated plate	GRSP
Graphite/smooth plate	GRGL
Klinger graphite Topgraph	TGR
Klinger C4400	C4400
PTFE/pure	PT
PTFE/glass	PT / GL
PTFE/glass/MOS2	PT / GM
PTFE/carbon	PT / K
Soft iron	WE
Stainless steel 1.4571	INOX

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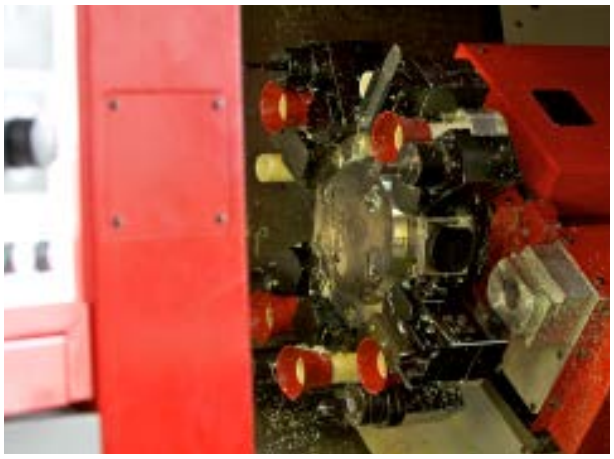
12 ON-DEMAND SEAL PRODUCTION



The HANSA-FLEX seal production centre
With two SEAL-MASTER CNC manufacturing facilities we are able to produce precision seals and special turned parts immediately in plastic or aluminium from 5 – 520 mm using computer-assisted manufacturing techniques. We store thousands of seals as datasets in the production centre's computer ready for just-in-time manufacture of seals from 5 – 520 mm directly to order. We offer same-day supply of almost any seal, whether standard or special profile.

The advantages of seal production
All seals and special turned parts can be produced as custom parts or standard parts in a mass series or individually with the highest level of precision. Our production software has over one hundred pre-programmed standard profiles. Hence, we are capable of adapting to the specific needs of our customers.

Furthermore, we maintain a standard seal stock with over 11,000 different seal types and dimensions ready and waiting for our customers.

13. SEAL PROFILES

SUPPORT RINGS


Profile DST 108


Profile DST 109


Profile DST 110


Profile DST 111


Profile DST 112


Profile DST 113

PISTON SEALS


Profile DK 101


Profile DK 102


Profile DK 102 R


Profile DK 103


Profile DK 104


Profile DK 104 R


Profile DK 105


Profile DK 106


Profile DK 107


Profile DK 108


Profile DK 109


Profile DK 109 D


Profile DK 109 H


Profile DK 109 N


Profile DK 110-112


Profile DK 116


Profile DK 117


Profile DK 118


Profile DK 119


Profile DK 120

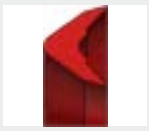

Profile DK 122


Profile DK 123

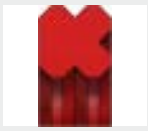

Profile DK 123 D

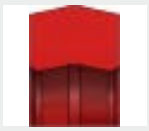

Profile DK 123 H


Profile DK 123 N


Profile DK 124


Profile DK 125


Profile DK 126


Profile DK 127


Profile DK 138


Profile DK 139


Profile DK 140


Profile DK 141


Profile DK 142

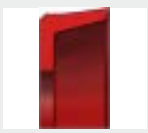

Profile DK 143


Profile DK 144


Profile DK 145


Profile DK 199


Profile DK 205


Profile DK 216

Profile DK 222

Profile DK 238

Important information: Profiles DK 105 – Pneumatic

FLAT SEALS

Profile DFL 101

Profile DFL 102

Profile DFL 103

Profile DFL 104

Profile DFL 105

Profile DFL 106

Profile DFL 107

Profile DFL 108

Profile DFL 109

Profile DFL 110

Profile DFL 111

T

WIPERS


Profile DA 101


Profile DA 103


Profile DA 105


Profile DA 107


Profile DA 108


Profile DA 111


Profile DA 112


Profile DA 113


Profile DA 114


Profile DA 115


Profile DA 116


Profile DA 117


Profile DA 118


Profile DA 211


Profile DA 212


Profile DA 213


Profile DA 102


Profile DA 104


Profile DA 106


Profile DA 119

Important information:
Profiles DA 103, DA 106, DA 114 – not snap in wiper
Profiles DA 104, DA 105, DA 106 – Pneumatic

ROTARY SEALS


Profile DR 101


Profile DR 102


Profile DR 103


Profile DR 104


Profile DR 105


Profile DR 106


Profile DR 107


Profile DR 108


Profile DR 109


Profile DR 110


Profile DR 111


Profile DR 112


Profile DR 115


Profile DR 116


Profile DR 117


Profile DR 118


Profile DR 119


Profile DR 201


Profile DR 202


Profile DR 203

Profile DR 204

Profile DR 205

Profile DR 206

Profile DR 207

ROD SEALS


Profile DS 101


Profile DS 102


Profile DS 102 R


Profile DS 103


Profile DS 104


Profile DS 104 R


Profile DS 105


Profile DS 106


Profile DS 107


Profile DS 108


Profile DS 109


Profile DS 110-112

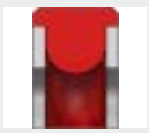

Profile DS 116


Profile DS 117


Profile DS 117 R

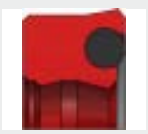

Profile DS 118


Profile DS 119


Profile DS 120

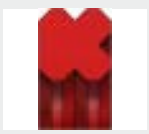

Profile DS 121


Profile DS 124


Profile DS 125

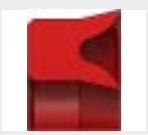

Profile DS 126-128


Profile DS 129


Profile DS 130


Profile DS 131


Profile DS 138

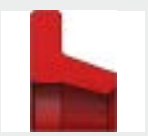

Profile DS 139


Profile DS 141


Profile DS 142


Profile DS 199


Profile DS 205


Profile DS 216


Profile DS 238

Important information:
Profiles DS 105 – Pneumatic

GUIDE RINGS


Profile DF 101


Profile DF 102


Profile DF 103


Profile DF104


Profile DF 105


Profile DF 106


Profile DF 107

Profile DF 108

Profile DFB 102

Should you have special requirements e.g. pressure, temperature, velocity, medium, please contact our sealing technology department. We would be pleased to optimise design and materials to suit your particular application.

14. MATERIAL DATASHEET

Material:			CH-PU	H-PU	H-PU D55	NBR	H-NBR
Colour:			Red	Red	Red	Black	Green
Properties							
Hardness	DIN 53505	Shore A	95	95	97	85	85
Hardness	DIN 53505	Shore D	48	48	55		
Tensile strength	DIN 53504 DIN 53455	N/mm²	50	55	55	17	20
Breaking elongation	DIN 53504 DIN 53455	%	450	350	330	150	200
Modulus 100 %	DIN 53504	N/mm²	14	16	18	11	10
Modulus 300 %	DIN 53504	N/mm²	28	35	39		
Rebound resilience	DIN 53512	%	35	35		20	26
Tear strength	DIN 53507 DIN 53515	N/mm	140	100	100	9	6
Spec. gravity	DIN 53479	g/cm³	1.2	1.2	1.22	1.32	1.32
Abrasion	DIN 53516	mm³	24	18		130	130
Compression set	DIN 53517	%	27	24	27	6	12
70° / 24 h 20 % Defo.							
Compression set	DIN 53517	%	35	33	35	5	14
100° / 24 h 20 % Defo.							
Compression set	DIN 53517	%					22
150° / 24 h 20 % Defo.							
Compression set	DIN 53517	%					
175° / 24 h 20 % Defo.							
Min. temperature		°C	-35	-25	-20	-35	-20
Max. temperature		°C	110	110	110	120	150
Temp. max water/steam		°C		80	80		120
Temp. max. hot air		°C					180 short
Modulus of elasticity	DIN 53457	N/mm²					
Approval for food use							
Special manufacture with approval for food use			x	x			

ALL MATERIALS AVAILABLE FOR SEAL MANUFACTURE:

DMH HPU 55D
DMH C-HPU 96A
DMH C-HPU 57D
DMH C-HPU 72D
DMH LT-PU 95A
DMH LT-PU plus 96A
DMH SL-PU 96A
DMH PU 93A
DMH NBR
DMH NBR white
DMH T-NBR 85
DMH H-NBR
DMH H-NBR 90 black
DMH H-NBR ED
DMH EPDM
DMH EPDM white FDA
DMH EPDM KTW / FDA
DMH FPM
DMH FPM FDA
DMH FPM black
DMH FPM ED
DMH Aflas 85
DMH MVQ 85 blue
DMH MVQ nature FDA

	T-NBR Black	EPDM Black	VMQ Blue	FPM Brown	PTFE Virgin White	PTFE Glass/MoS2 Grey	PTFE Bronze Brown	POM White	PA Natural
	80	85	85	85					
					55	63	69	85	85
	14	12	7.5	10	27	15	14	70	80
	160	80	130	200	350	280	170	40	40
	9		6.5	8					
	50	37	35	7					
	5	9	12	6					
	1.28	1.23	1.6	2.51	2.16	2.3	3.2	1.41	1.13
		140		200					
	6	5	8	7					
	9	7	9	8					
			35	9					
	-46	-45	-60	-20	-200	-200	-200	-45	-40
	100	150	220	200	260	260	260	100	110
		150	120	150					
		180 short	300 short	300 short					
					540	1320	1375	3000	3000
					x			x	
		x	x	x					

DMH MVQ white FDA	PTFE D05	PTFE II	PTFE E-Carbon
DMH POM	PTFE TFM	PTFE D46	PTFE Graphite)
DMH PA	PTFE I	PTFE PEEK	
DMH UHMW-PE	PTFE D05 glass	PTFE Ekonol	
DMH ALU	PTFE D08	PTFE Cond	
PTFE virgin	PTFE 25% glass	PTFE Carbon	

The test results are average results measured from test specimens and cannot be transferred to seal applications. The Seal Technology Department is not liable for products manufactured from our raw material