Seals and Guides Made from PTFE.

For Reliable Service and Top Performance

elringklinger
Kunststofftechnik

Seals and Guides made from PTFE: The Product Range

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Shaft Seals with PTFE Sealing Lip
Non-wearing – low friction – chemically resistant

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Spring-Energized Seals
Compact – universal – predictable

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Memory Packings
Groove sealing rings with excellent sliding properties

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Piston Rings
Oil-free – the environmental challenge to industry

Innovations Made from Plastics

With its seals and engineering design elements ElringKlinger Kunststofftechnik has been one of the technology leaders in its field for over 50 years. We develop tailored solutions from PTFE, PTFE compounds and other high-performance plastics as well as composite parts combining PTFE with other plastics or metals for customers around the world. Our solutions meet the toughest demands to be found in the field – with economy and reliability guaranteed.

Top Performance and Functional Reliability

Seals and guides made from extremely wear-resistant PTFE compounds: the right choice when it comes to high sliding speeds and high thermal stress – even in low-lube and oil-free applications. In addition to their outstanding tribological properties, these compounds offer excellent chemical resistance to aggressive media. For applications in the food and pharmaceutical industry our special compounds are used.

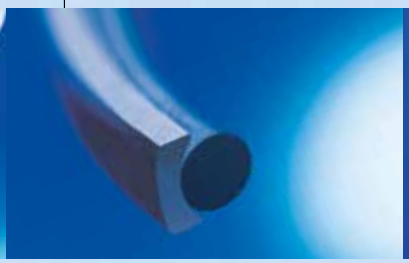
Technical Consulting Support

We will be happy to support you in designing your seals. Please complete and return the technical questionnaire (p. 63). Our application engineers will provide you with an installation/assembly proposal and/or a quotation as quickly as possible.

Pages 48 – 51

Guide Rings and Bands, Lamination
Stick-slip-free – low friction

Pages 52 – 59



Miscellaneous Seals, e.g. Composite Seals, V-Packings

Pages 60 – 63

Compound Table Technical Questionnaire

Quality and Environmental Policy

Top quality and an active commitment to environmental protection are key to ElringKlinger's sustained success in the marketplace. That is why we are certified according to ISO/TS 16949 and DIN EN ISO 14001.

(1) Limit Values
Limit values have been compiled with great care based on years of experience. Values, however, will not be deemed binding and are provided without guarantee. Please note that the desired sealing performance is only assured when considering the specific conditions of a particular application. Data pertaining to peripheral speeds and pressure loads refer to applications involving lubricating media. In any event, we recommend prior sampling and testing. Our development team will be happy to assist you with requisite expertise and in-house test rigs.

(2)) Diagrams
The information provided in these diagrams is based on comparative values determined by ElringKlinger. These values have been obtained under specifically defined conditions and may not be transferred exactly to other applications. The diagrams, however, allow you to draw a basic comparison between our seal designs and compounds.

(3)
Hastelloy® is a registered trademark of Cabot Corporation.
Elgiloy® is a registered trademark of Elgiloy Company.

(4)
Nominal cross-sections matched with rod diameters and, respectively, cylinder diameters are recommendations only. Variances are possible, and diameters between 2 mm and 3000 mm are available.

Sealing elements for rotary applications

Sealing elements for reciprocating applications

Rotary Shaft Seals with PTFE Sealing Lips

Rotary shaft seals with PTFE sealing lips are sealing elements – ready for assembly – which produce the desired sealing effect through radial contact pressure on the shaft. Sealing performance in the receiving hole is achieved by compression fit according to ISO 16589-1. Radial seals with PTFE sealing lips are ideally suited for sealing rotating shafts.

The requisite radial contact pressure is assured by selecting the suitable PTFE compound and sealing lip geometry as well as a special manufacturing process.

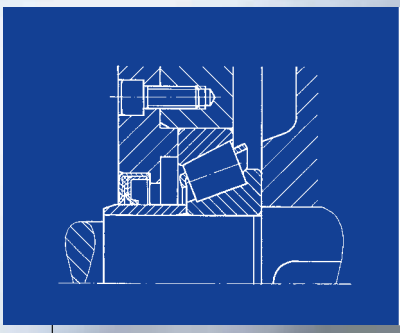
To cover a wide range of application requirements, standard ranges have been developed. Type HN 2580 is primarily used for pressureless service and/or with pressures slightly above atmospheric. Type HN 2390 is used with pressurized media.

Benefits

- Outstanding chemical resistance to corrosive media
- Suitable for applications with high thermal loads from –60 °C to +200 °C
- Suitable for use in low-lube and oil-free conditions
- Suitable even for use with unhardened shafts
- High wear resistance of the sealing lip compound
- Friction-optimized designs for minimum power loss
- Suitable for high peripheral speeds
- Low breakaway forces after prolonged down times (no stick-slip)
- Anti-adhesive behavior of the sealing lip
- Special types for the food processing and pharmaceutical industries available

Applications

Application Examples



Shaft seal in a spur gear type HN 2580.

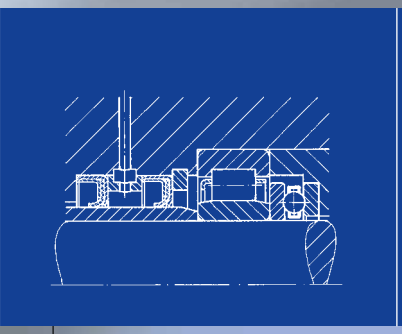
Fields of Application

Shaft seals with PTFE sealing lips are suitable for sealing applications involving the following media:

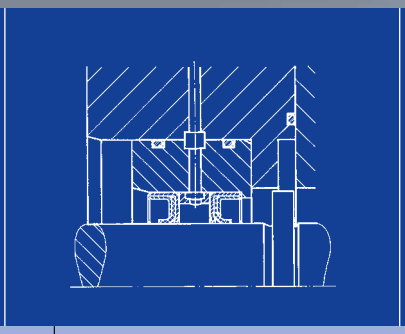
- Mineral-based and synthetic lubricants
- Pharmaceutical products and foodstuffs (FDA recommendations for certain PTFE compounds)
- Chemical waste water and wash water
- Corrosive, fluid and gaseous media
- Powders and granulates
- Coolant and lubricant fluids
- Water and steam
- Resins, glues and pastes
- Air/oxygen (BAM tests for certain PTFE compounds
- Heat transfer fluids (oils)

Typical Applications

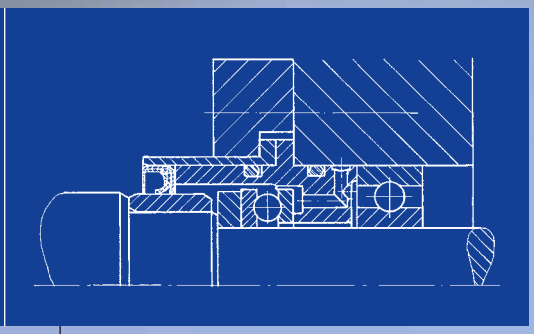
- Rotary compressors
- Screw-type compressors
- Transmissions/gearboxes
- Blower systems
- Mills/crushers/grinders
- Machine tools
- Stirring systems/agitators
- Pumps
- Handling systems
- Centrifuges/hydroextractors



Shaft seal in a rotary compressor with oil drainage, type HN 2390.

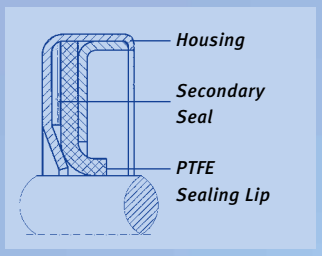


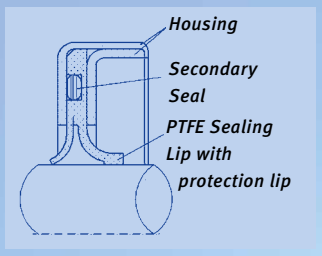
Shaft seal in a radial-flow fan with nitrogen scavenging, type HN 2390.



Shaft seal in a spindle boring head type HN 2390, friction-optimized.

Shaft Seal Design and Action Principle





Housing Materials

Standard:	1.4301/Aisi 304
Special versions:	1.4571/Aisi 316 Ti
	Free-cutting steel
	Mild steel (unalloyed sheet metal for deep drawing)
	Aluminum

Secondary Seal

The following materials are used for the secondary seal between the PTFE lip and the housing:

Standard:	FPM (–20 °C to +200 °C)
Special versions:	NBR (–30 °C to +110 °C)
	EPDM (–60 °C to +150 °C)
	PTFE/metal-special composite (–20 °C to +250 °C)

Sealing Lip

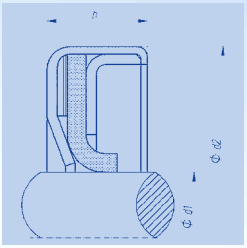
PTFE compound

Standard compound HS 21037 for type HN 2390

Standard compound HS 21059 for type HN 2580

Additional compound versions are available for special operating conditions. See compound table Pages 60 – 62.

Type HN 2390



Stock List

Designation example: rotary shaft seal with PTFE sealing lip for shaft diameter d_1 = 75, locating hole d_2 = 100 and width w = 10:

RWDR HN 2390 75 x 100 x 10

Standard

Thanks to its high wear and pressure resistance this standard design is suitable for a wide range of applications, such as pumps, blowers and compressors.

Sealing lip compound:

- PTFE compound HS 21037

Design features:

- Single lip
- Reinforced sealing lip
- Lip is effectively supported to resist deformation under pressure

Properties:

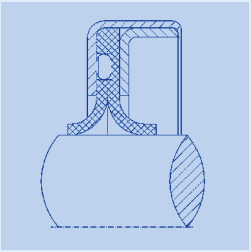
- Good sealing performance with pressurized media
- Suitable for both lubricated or oil-free service
- Suitable for unhardened shafts as well

Operating Limits[1]

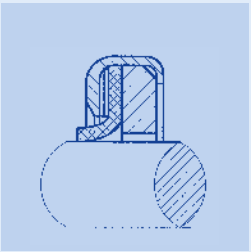
Max. peripheral speed	m/s	20
Temperature range	°C	–60 to +200
Max. pressure	bar	10
Vacuum	mbar	to 10^{-3}
Center offset	mm	≤ 0.1
Concentricity tolerance	mm	≤ 0.05

d_1 mm	*d_2 mm*	*b mm*	*Part-No.*
10	22	7	682.314
12	24	7	681.431
15	30	7	677.558
17	35	7	657.433
18	30	7	674.494
20	30	7	787.280
20	35	7	679.410
22	35	7	654.671
25	35	7	680.311
25	42	7	779.954
25	47	7	659.606
28	40	7	677.329
28	47	7	836.257
30	42	7	786.632
30	47	7	779.962
32	47	8	677.957
35	47	8	678.422
35	47	7	779.970
35	50	8	779.032
35	62	8	384.771
40	52	8	682.691
40	55	8	387.266
40	60	8	677.345
40	62	8	779.261
40	65	8	109.380
42	60	8	781.991
42	62	8	785.385
45	62	8	678.899
48	65	8	261.920
50	72	8	779.989
55	72	8	678.007
60	75	8	678.430
60	80	8	677.337
62	80	8	778.826
65	85	8	779.997
70	90	10	678.341
70	100	10	783.390
75	100	10	658.502
80	100	10	680.583
85	110	10	677.612
90	110	10	679.771
90	120	12	682.616
100	120	12	778.834
100	130	12	778.176
105	130	12	677.779
110	130	12	783.811
110	140	12	653.837
120	150	12	676.071

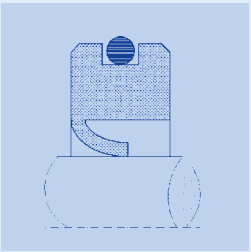
Other Special Versions Type HN 2390



Dual lip, counter-rotating, for separating two media, e.g. for centrifuges and decanters.



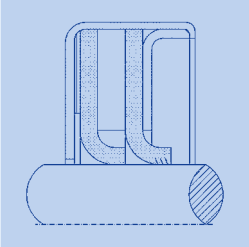
Sealing lip, negative. Small clearances, for food processing and medical technology, e.g. for mixers/blenders, meat processing machines and cutters.



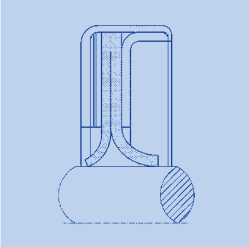
Shaft sealing ring without housing. Small and special dimensions/ geometries available.

Other Special Versions

Type HN 2390



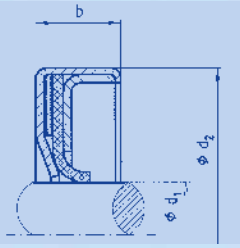
Dual lip, rotating in same direction, with or without hydrodynamic return feed spiral groove, good sealing performance, higher operational reliability, e.g. for pumps, screw-type and rotating compressors.



With protection sealing lip for use in dirty conditions, e.g. construction sites, and underfloor assemblies of screw and rotating compressors.

High-pressure version. Good pressure and temperature resistance, e.g. for machine tools and rotary transmissions.

Type HN 2390



Friction-Optimized Special Type

Vis-à-vis the standard version of type HN 2390 the friction-optimized special type has a significantly lower coefficient of friction.

Sealing lip compound:

- PTFE compound HS 21037

Design features:

- Sealing lip supported to resist pressure
- Low radial pre-loading of sealing lip

Properties:

- Suitable for non-hardened shafts as well
- Lower generation of frictional heat
- Suitable for high peripheral speeds
- Suitable for small assembly spaces
- Long service life

Operating Limits[1]

Max. peripheral speed	m/s	30
Temperature range	°C	–60 to +200
Max. pressure load	bar	3
Center offset	mm	≤ 0.1
Concentricity tolerance	mm	≤ 0.05

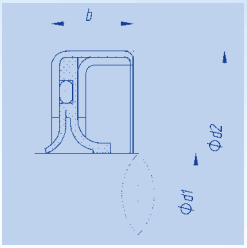
Stock List

Designation example: rotary shaft seal with PTFE sealing lip for shaft diameter d_1 = 70, locating hole d_2 = 78 and width w = 6:

RWDR HN 2390 Special Type, Friction-Optimized 70 x 78 x 6

d_1 mm	d_2 mm	w mm	Part-No.
8	18	5	779.210
10	22	7	781.703
12	22	7	681.741
20	28	5	786.357
20	30	5	786.322
22	30	5	781.681
22	35	7	786.888
25	32	5	682.713
30	37	5	682.721
30	40	5	781.711
30	45	7	681.776
35	45	5	781.738
37	47	5	780.375
40	47	5	682.438
40	50	5	780.383
45	55	5	780.367
50	60	5	675.280
50	62	6	780.146
55	63	6	682.748
55	80	8	782.858
60	80	8	205.840
65	75	6	841.110
65	85	8	677.574
70	78	6	682.756
80	100	10	922.692
100	120	10	786.152

Type HN 2580



Standard

Standard version for pressureless applications and/or pressures slightly above atmospheric. This version features a highly flexible sealing lip and an additional protective lip. Suitable applications include transmissions/gearboxes, machine tools and pumps.

Standard compound:

- PTFE-compound HS 21059

Design features:

- Single-part sealing and protective lip
- Sealing lip with wear protection
- Low radial pre-loading of sealing lip

Properties:

- Suitable for unhardened shafts as well
- High flexibility of the sealing lip
- Good friction behavior
- Pre-defined width of contact surface
- Suitable for oil-free and lubricated applications

Stock List

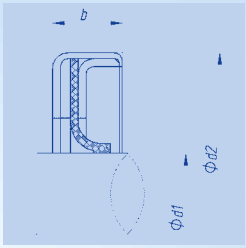
Designation example: rotary shaft seal with PTFE sealing lip for shaft diameter d_1 = 80, locating hole d_2 = 100 and width w = 10:

RWDR HN 2580 80 x 100 x 10

d_1 mm	d_2 mm	w mm	Part-No.
10	22	7	205.800
12	24	7	205.380
15	30	7	205.810
18	30	7	205.430
20	35	7	205.440
25	42	7	205.450
30	47	7	205.460
35	47	8	205.470
35	50	8	205.480
40	55	8	205.510
40	62	8	205.570
45	62	8	205.590
48	65	8	086.070
50	72	8	205.610
55	72	8	205.620
60	80	8	205.630
65	85	8	205.660
70	90	10	205.680
80	100	10	205.700
85	110	10	205.750
90	110	10	205.770
100	130	12	205.780
110	140	12	205.790

Operating Limits[1]

Max. peripheral speed	m/s	30
Temperature range	°C	–60 to +200
Max. pressure load	bar	0.5
Center offset	mm	≤ 0.2
Concentricity tolerance	mm	≤ 0.1



Special Type, Friction-Optimized

for low-pressure applications, e.g. centrifugal machines and blowers.

Standard compound:

- PTFE-compound HS 21059

Design features:

- Wear protection for prolonged service life
- Highly flexible sealing lip

Properties:

- Suitable for unhardened shafts as well
- Suitable for high peripheral speeds
- Low generation of frictional heat
- Suitable for small assembly spaces
- Long service life

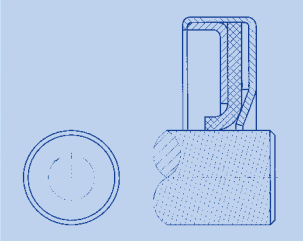
Operating Limits[1]

Max. peripheral speed	m/s	35
Temperature range	°C	–60 to +200
Max. pressure load	bar	0.5
Center offset	mm	≤ 0.2
Concentricity tolerance	mm	≤ 0.1

Hydrodynamic Return Feed Spiral Groove

In case of higher sealing performance requirements to be met by PTFE rotary shaft seals we recommend a spiral groove for hydrodynamic return feed either on the shaft surface or in the sealing lip. In this case, only one rotational direction of the shaft is permissible.

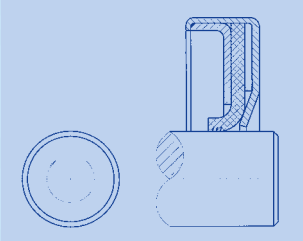
Return Feed Spiral Groove in the Shaft Surface/Protection Sleeve



The hydrodynamic return feed spiral groove should have the following characteristics:

- **Spiral angle to the plane surface: 5 – 10°**
- **Spiral groove depth: Rz 3 – 5 µm**
- **Spacing of the spiral groove must be uniform across the whole contacting surface, with individual grooves located close to each other**
- **Individual grooves in other angular directions should be avoided**

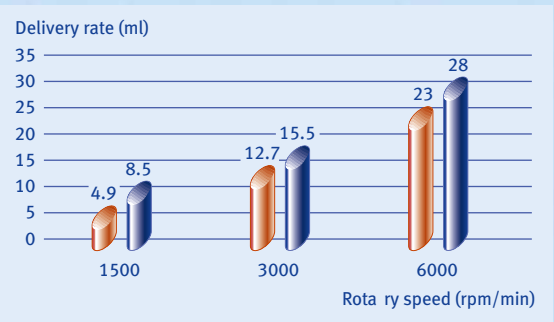
Return Feed Spiral Groove in the Sealing Lip



The hydrodynamic return feed spiral groove is worked into the PTFE sealing lip. To prevent dirt from being carried into the system and to optimize sealing performance a second sealing or dust lip should be used.

Return Feed Delivery Rates of Various Types of Spiral Grooves [2]

Oil seal (RWDR) dimensions:	65 x 85 x 8 mm
Sealing lip compound:	HS 21037
Sealing lip thickness:	1.0 mm
Oil level:	20 mm above bottom edge of shaft
Oil type:	SHELL MYRINA 15 W 20
Oil temperature:	80 °C
Operating period:	30 minutes



Spiral groove in sealing lip
Depth of spiral groove: 0.2 mm
Spiral groove ground into shaft protection sleeve, Rz = 3 µm, spiral angle 10°

Long-Term Wear in Dry-Running (Oil-Free) Conditions [2]

Test conditions:

Test atmosphere: air

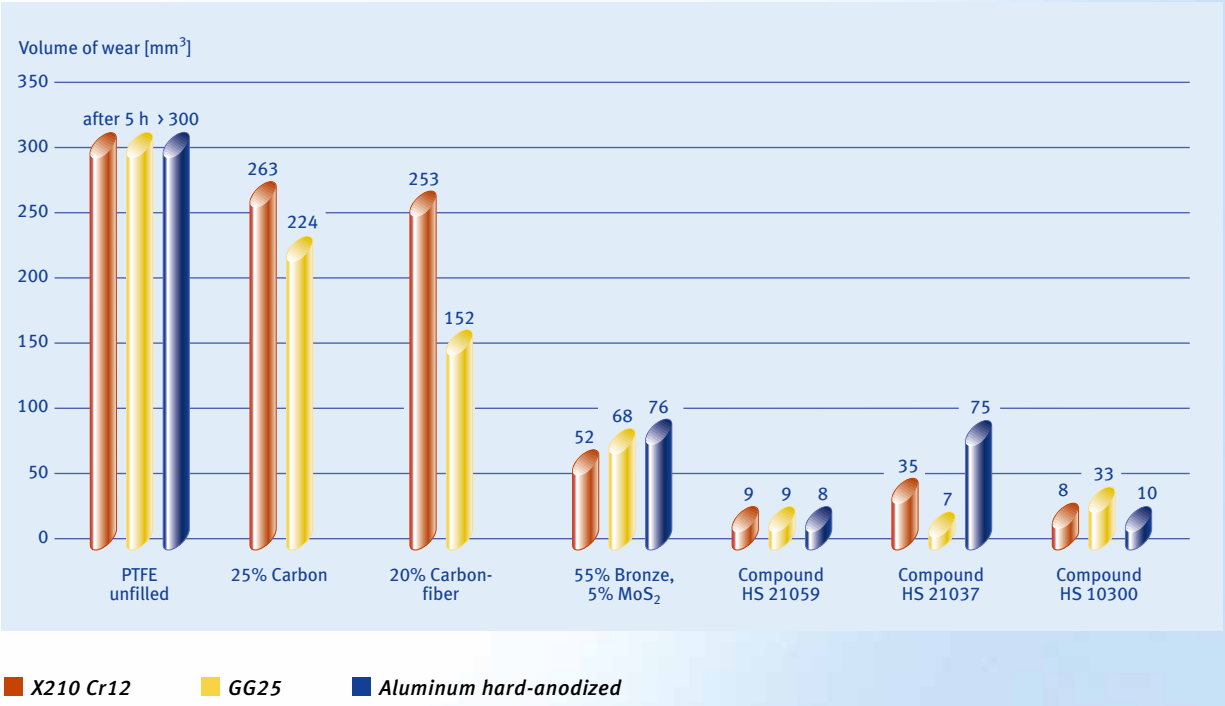
T = 100 °C

v = 4 m/s

p = 0.42 N/mm²

Rz = 2 µm

Test period: 100 h

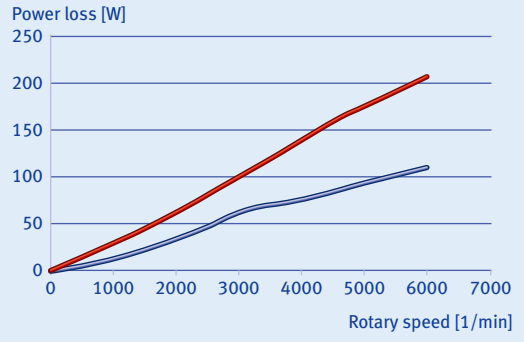


Power Losses and Friction Torques

Type HN 2390 standard and HN 2390 special, friction-optimized [2]

Test conditions:

Medium:	engine oil 15W-40
Oil level:	center of shaft
Oil temperature:	100 °C pressureless
Sealing lip compound:	HS 21037
Shaft diameter:	50 mm
Surface roughness of shaft:	Rz = 2 to 3 µm

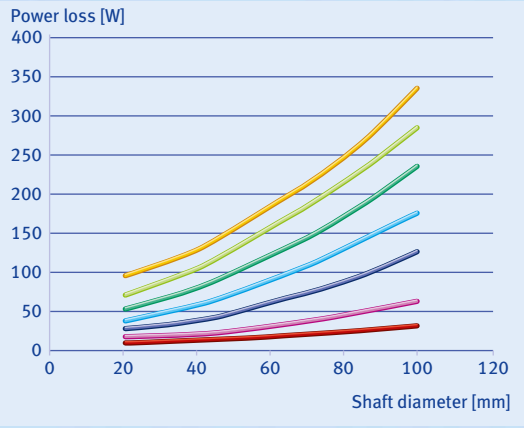


HN 2390 (friction-optimized) *HN 2390*

Type HN 2580 standard [2]

Test conditions:

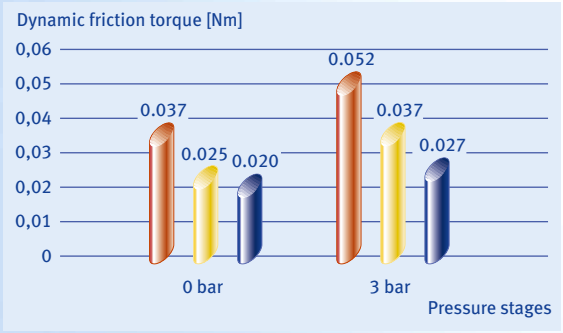
Medium:	engine oil 15W-40
Oil level:	center of shaft
Oil temperature:	100 °C pressureless
Sealing lip compound:	HS 21059
Surface roughness of shaft:	Rz = 2 to 3 µm



500 1/min *1000 1/min* *2000 1/min*
3000 1/min *4000 1/min* *5000 1/min*
6000 1/min

Dynamic friction torque [2]

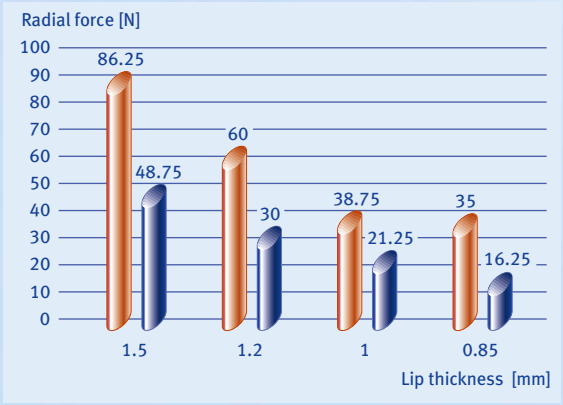
Type HN 2390 special, friction-optimized, Dimensions: 15 x 30 x 7, PTFE compound HS 21037, dry-running, n = 1500 min^{-1}.
Temperature = room temperature/self-heating



Lip thickness 1 mm
Lip thickness 0.7 mm
Lip thickness 0.5 mm

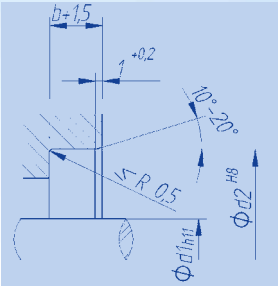
Radial force [2]

The radial force is determined according to the two-jaw measuring method. Measuring instrument according to DIN 3761. Shaft Ø 60 mm, Compound: HS 21037



HS 21037 (RT) *HS 21037 (100 °C)*

Engineering Design Instructions



Design of Locating Hole

Surface roughness:

Ra	≤ 1.6 µm
Rz	≤ 6.3 µm
Rmax	≤ 10 µm

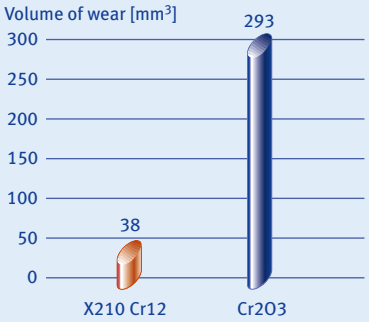
Contact Surface

PTFE shaft seals may be used on both hard and soft contact surfaces. Relevant criteria are the sealing lip compound, pressure conditions and peripheral speeds. Generally, hard contact surfaces are recommended.

Hardened steel is the most commonly used shaft material. Compared to other shaft materials and coatings, the use of hardened steel achieves very good service life of the sealing lip.

In case of soft shafts or special applications it is possible to coat the shaft. Due to the large number of coating methods and manufacturers of coating materials a general recommendation cannot be made. Cr_2O_3-coatings on high-grade/ stainless steel shafts, though, have been found to work well. However, the heat-insulating surface usually results in slightly higher wear of the sealing lip.

Wear test of compound HS 21037 on different contact surfaces [2]



Test conditions: p = 0.42 N/mm²
v = 4 m/s
T = 100 °C (Temperature contact surface)
Test atmosphere: air
Test period: 50 h

Hardness

The required hardness of the contact surface depends on a number of application parameters. For some applications with low demands on the shaft sealing ring (pressures slightly above atmospheric and low peripheral speeds) soft shafts may be suitable as well. This, however, also depends on the PTFE compound used. In case of more exacting requirements and pressurized applications, we recom-mend that the shaft has a hardness of ≥ 58 HRC.

Quality Condition of the Contact Surface

The quality/condition of the contact surface influences sealing performance (tightness) and service life of the shaft seal.

To achieve optimum sealing performance the surface roughness values recommended should be complied with to the extent possible. Machining grooves, scratches and cavities/piping have a negative impact on sealing performance. We recommend grinding the shaft in the recess of the sealing area. Another option is the application of a hydrodynamic return feed spiral groove.

Recommended surface roughness of the contact surface:

Ra	= 0.2 – 0.63 µm
Rz	= 1 – 3 µm
Rmax	= 1 – 4 µm

The material content M_r should be 50 – 75%, measured in a cut depth c = 25% of the Rz value based on a reference value of 5%.

In case of very hard surfaces, such as chromium oxide, roughness levels of Rz = 1 – 1.5 µm and Ra = 0.15 – 0.2 µm have been successfully used.

Fitting

Fitting Instructions

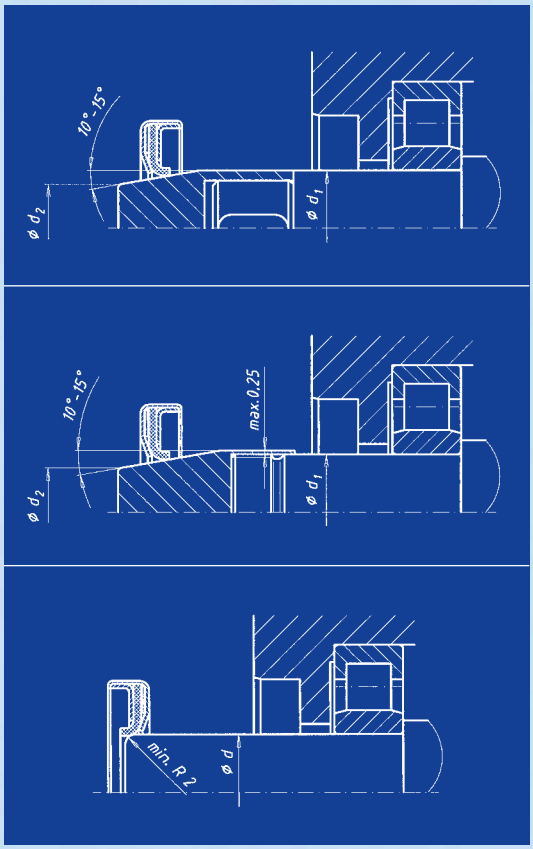
PTFE shaft seals are press-fitted into the receiving hole. We recommend that the sealing rings be glued into the receiving hole and/or use of a sealing/joining compound (e.g. Loctite 601, 641). In case of critical applications this prevents the risk of potential leakage occurring at the outer diameter.

Recommended Diameters of Lead-In Chamfers

Shaft-Ø d_1 [mm]	*Taper-Ø d_2 [mm]*
≤ 10	d_1 – 1.5
11 – 30	d_1 – 2
31 – 60	d_1 – 3
61 – 100	d_1 – 4
101 – 150	d_1 – 6
151 – 200	d_1 – 7

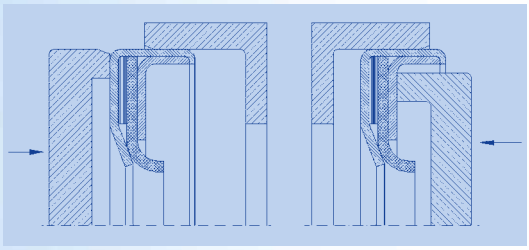
When fitting shaft seals absolute care must be taken to protect the PTFE sealing lip from damage. We recommend use of a conical fitting tool. When fitting the seal in the direction of the molded sealing lip a radius at the shaft may suffice in exceptional cases.

The surface of the fitting tool must be free from scoring. All edges must be rounded off, and sharp edge transitions avoided. When fitting across grooves or threads, the conical fitting tool must be used with a thin-walled extension. Temporary over-stretching of the PTFE lip during the assembly process is permissible.



Fitting Tools

To avoid deformations of the shaft seal, the seals must press-fitted as follows:

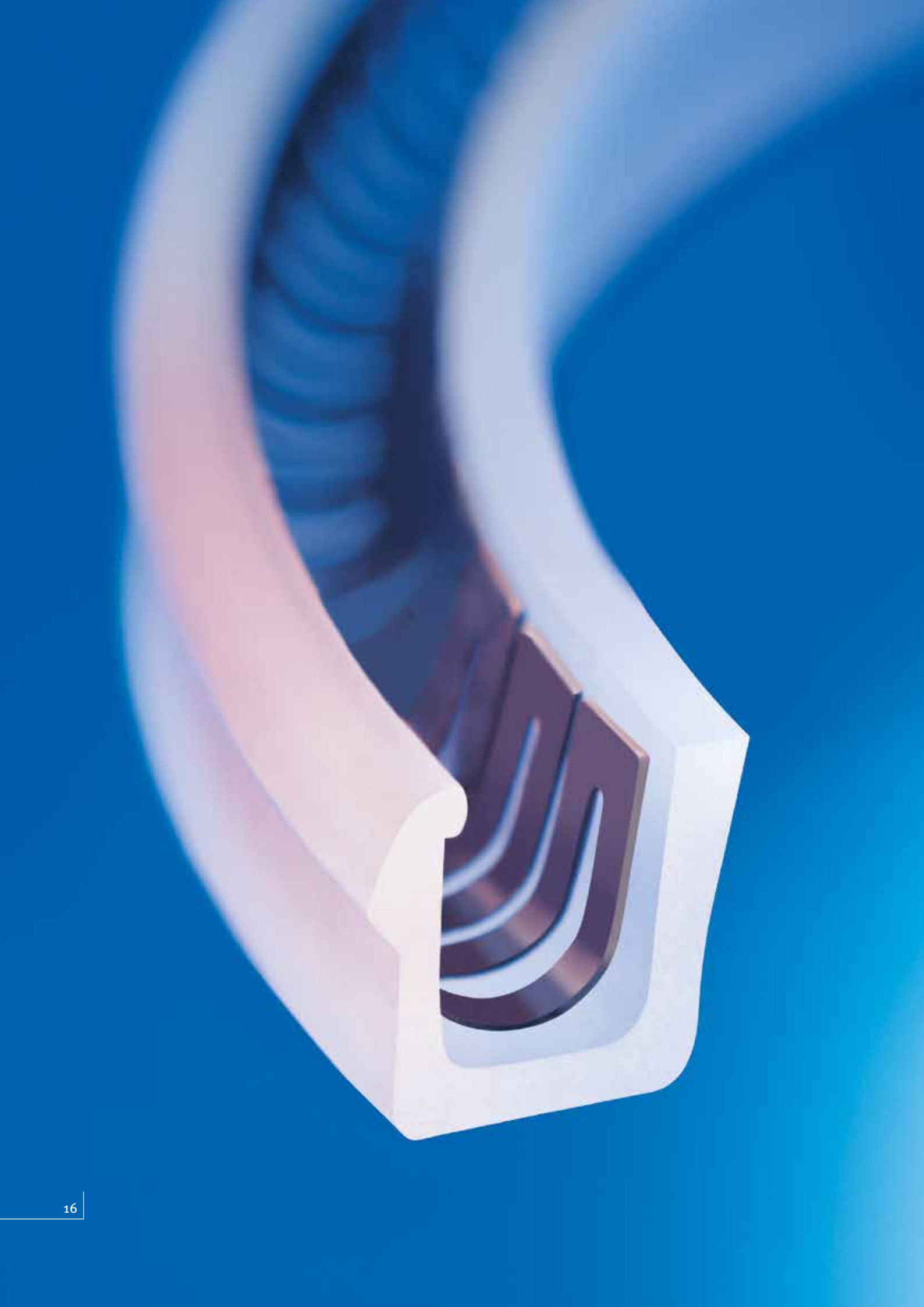


Additional Fitting Instructions

- Prior to starting the seal-fitting process, the sealing lip must be inspected for cleanliness and possible damage
- The sealing lips must not be deformed
- Seals may be fitted without lubrication. Other specifications may be coordinated with us

Storage Instructions

- Recommended storage temperature: –10° to +25 °C; humidity 40% to 70%
- Do not store in direct sunlight
- First-in-First-out storage system
- Protect seals from dirt and deformation



Spring-Energized Seals

Spring-energized seals are single-acting sealing elements primarily used for sealing reciprocating pistons and rods. Other uses include rotary, swiveling and static applications.

The seal consists of two components:

- an outer sealing element made of high-strength plastic (e.g. PTFE, PE-UHMW)
- and an integrated spring (e.g. high-grade/stainless steel, Hastelloy®(3) and Elgiloy®(3))

After installation in the groove, the seal is pre-energized by the spring. The inherent pre-loading of the plastic groove seal (memory effect) and pre-loading of the spring assure the desired sealing performance even in case of low system pressures.

Since the seal is installed with the open side towards the higher system pressure, the sealing effect increases as system pressure rises. The steel spring has the additional purpose of compensating wear of the sealing lips to assure that a predefined contact pressure is maintained at constant levels throughout the seal's service life.

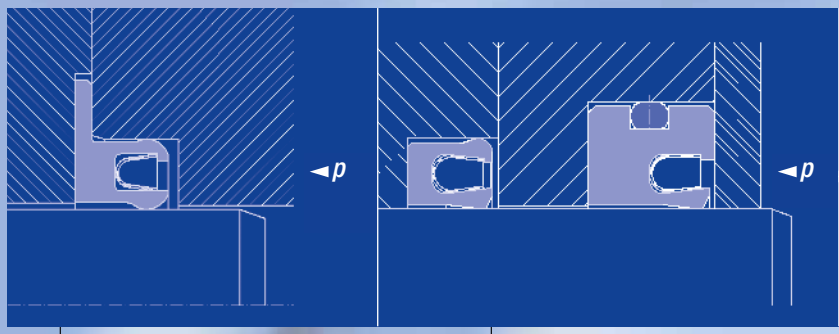
To cover the widest possible range of pressures and temperatures two basic seal types have been developed. These differ in terms of their housing geometries and, in particular, in terms of spring design and spring characteristics.

Benefits

- Outstanding dry-running characteristics
- Low wear
- Low friction
- Variable friction conditions through choice of spring characteristics
- Extremely low breakaway forces even after prolonged down times
- No stick-slip even with low sliding speeds
- High dimensional stability
- High chemical and thermal resistance
- No volumetric change by swelling or shrinkage
- Compact seal, suitable for O-ring assembly spaces acc. to ARP 568 A, DIN 3771 and ISO 3601/1
- Good cost-benefit ratio
- Dimensions from Ø 2 to Ø 3000 mm available
- Very good wiping effect with abrasive media such as paints and lacquers

Applications

Application Examples

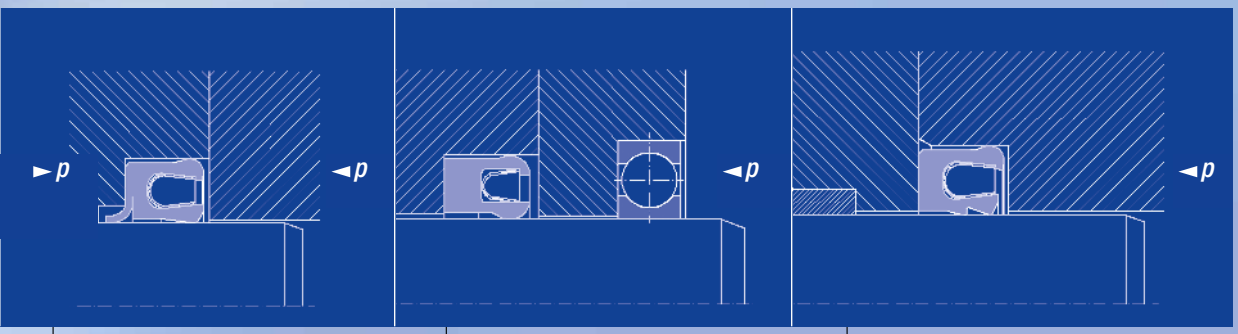


Lab Technology
Piston pump in liquid chromatography equipment up to 300 bar for different chemical media and substances.

Hydraulics
High-pressure axial piston pump for cleaning equipment up to 280 bar of water pressure and cleaning additives.

Spring-energized seals are used in a wide range of industrial applications:

- Automotive industry, e.g. direct fuel injection systems
- General manufacturing/ mechanical engineering, e.g. CNC machines, compressors and vacuum pumps as well as tank systems
- Aerospace industry, e.g. in landing gear systems
- Food processing industry, e.g. in packaging machines and metering systems
- Medical and laboraty/analytical technology, e.g. in chromatography and endoscopy
- Painting technology, e.g. in paint valves
- Adhesives industry, e.g. as needle valve seals
- Hydraulics/pneumatics, e.g. in valves, solenoid valves, cylinders and pumps of all types
- Offshore technology, e.g. as petroleum and natural gas seals
- Chemical plant and equipment technology, e.g. in apparatus and container engineering

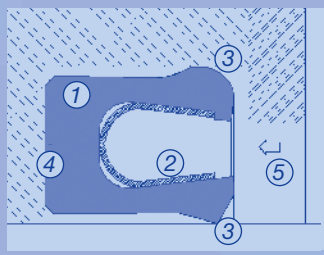


Automotive Industry
Piston pump for media separation of gasoline/ engine oil in gasoline direct injection system.

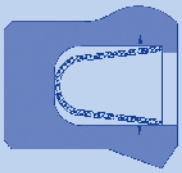
Mechanical Engineering
CNC machine turret serving as rotary transmission for coolant/lubricant pressures up to 80 bar and as bearing seal.

Painting Technology
Valve needle seal for paint pressures up to 20 bar; special seal geometry and special PE compounds ensure long service life and good wiping effect.

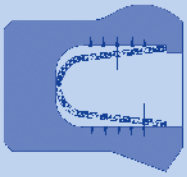
Seal Design and Action Principle



① *Plastic casing with high thermal and chemical resistance*
② *Stainless steel spring for defined sealing forces*
③ *Sealing lips*
④ *Back of seal – crucial for stable positioning in installation space*
⑤ *Pressure/fluid side*



Memory effect and spring pre-loading



System pressure

The action principle of all seal types and shapes is identical. The seals differ merely in terms of their profiles and the shape of the springs.

The sealing effect is achieved by the inherent pre-loading pressure of the plastic casing (memory effect of the compound) and the mechanical pre-loading force of the spring. The radial contact pressures are sufficient to effectively seal a pressureless application. In the event of additional system pressure, which may amount to some 100 bar, the contact pressure forces will rise along with the total sealing pressure.

Standard Type URI

URI – Rod Seal

For fluids.

With sharp-edged sealing lip on the internal diameter for good wiping effect with rod seals.

Operating Limits [1]

T = –75 °C to +300 °C

p = up to 250 bar

v = 15 m/s ⇔

Preferential Range

Ordering example: URI – B12 – 332 – HS 21059 – C

URI = Seal type "Rod Seal"

B12 = Rod Ø 12

332 = Nominal cross-section

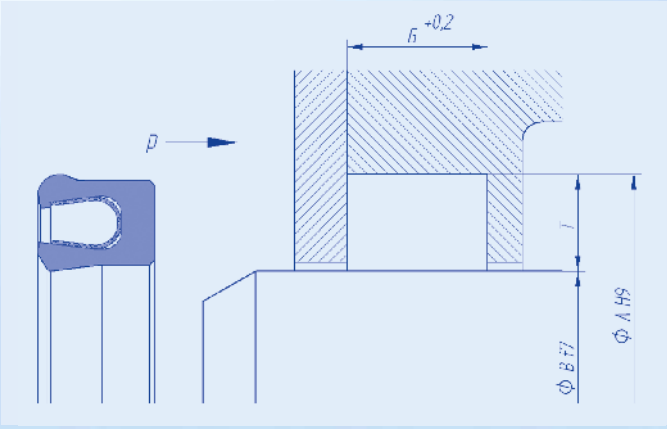
HS 21059 = Casing material (for other compounds see compound table  pages 60 – 62)

C = Spring material (see page 29)

Rod Ø B_{f7}	*Groove Base-Ø* A^{H9}	*Groove Width* $G^{+0.2}$	*Rod Ø* B_{f7}	*Groove Base-Ø* A^{H9}	*Groove Width* $G^{+0.2}$
3	5.84	2.4	32	38.14	4.7
4	6.84	2.4	36	42.14	4.7
5	7.84	2.4	40	49.44	7.1
6	8.84	2.4	45	54.44	7.1
8	10.84	2.4	50	59.44	7.1
8	12.52	3.6	56	65.44	7.1
10	14.52	3.6	63	72.44	7.1
12	16.52	3.6	70	79.44	7.1
14	18.52	3.6	80	89.44	7.1
16	20.52	3.6	90	99.44	7.1
18	22.52	3.6	100	109.44	7.1
19	23.52	3.6	110	119.44	7.1
20	24.52	3.6	125	137.10	9.5
20	26.14	4.7	140	152.10	9.5
22	28.14	4.7	160	172.10	9.5
24	30.14	4.7	180	192.10	9.5
25	31.14	4.7	200	212.10	9.5
28	34.14	4.7			

Installation Dimensions

Additional diameters/sizes from 2 mm to 3000 mm available on request.



Rod Ø B_{f7}	*Nominal Cross-Section* [4]	*Groove Base Ø* A^{H9}	*Groove Depth T*	*Groove Width* $G^{+0.2}$
2 – 10	116	Ø B +2.84	1.42	2.4
10 – 20	332	Ø B +4.52	2.26	3.6
20 – 40	108	Ø B +6.14	3.07	4.7
40 – 120	316	Ø B +9.44	4.72	7.1
120 – 1000	104	Ø B +12.10	6.05	9.5
1000 – 3000	308	Ø B +19.00	9.50	15.0

Standard Type URA

URA – Piston Seal

For fluids.

With sharp-edged sealing lip on the external diameter for good wiping effect with rod seals.

Operating Limits [1]

T = –75 °C to +300 °C

p = up to 250 bar

v = 15 m/s ⇔

Preferential Range

Ordering example: URA – A50 – 316 – HS 21037 – C

URA = Type, "Piston Seal"

A50 = Cylinder Ø 50

316 = Nominal cross-section

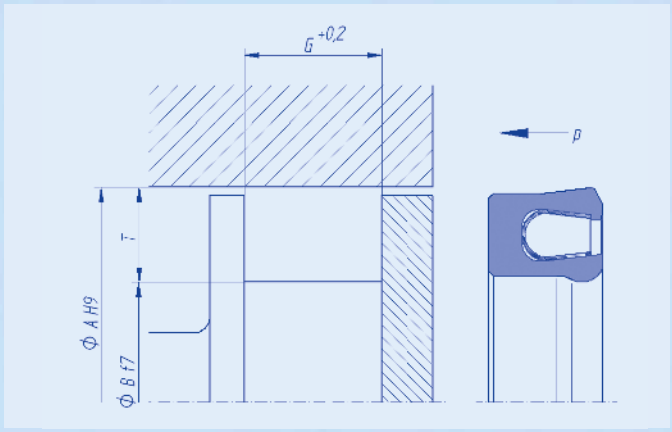
HS 21037 = Casing material (for other compounds see compound table pages 60 – 62)

C = Spring material (see page 29)

Cylinder Ø A^{H9}	*Groove Base Ø* B_{f7}	*Groove Width* $G^{+0.2}$	*Cylinder Ø* A^{H9}	*Groove Base Ø* B_{f7}	*Groove Width* $G^{+0.2}$
8	5.16	2.4	36	29.86	4.7
10	7.16	2.4	40	33.86	4.7
12	9.16	2.4	50	40.56	7.1
14	9.48	3.6	60	50.56	7.1
16	11.48	3.6	63	53.56	7.1
18	13.48	3.6	70	60.56	7.1
20	15.48	3.6	80	70.56	7.1
22	17.48	3.6	100	90.56	7.1
24	19.48	3.6	125	112.90	9.5
25	20.48	3.6	140	127.90	9.5
25	18.86	4.7	160	147.90	9.5
28	21.86	4.7	180	167.90	9.5
30	23.86	4.7	200	187.90	9.5
32	25.86	4.7			

Additional diameters/sizes from 2 mm to 3000 mm available on request.

Installation Dimensions



Cylinder Ø A^{H9}	*Nominal Cross-Section* [4]	*Groove Base Ø* B_{f7}	*Groove Depth T*	*Groove Width* $G^{+0.2}$
6 – 14	116	Ø A –2.84	1.42	2.4
14 – 25	332	Ø A –4.52	2.26	3.6
25 – 45	108	Ø A –6.14	3.07	4.7
45 – 125	316	Ø A –9.44	4.72	7.1
125 – 1000	104	Ø A –12.10	6.05	9.5
1000 – 3000	308	Ø A –19.00	9.50	15.0

Standard Type URF

URF – Shaft and Rod Seal

With clamping flange for sealing rotary and swiveling applications.

Operating Limits [1]

T = –75 °C to +300 °C

p = up to 200 bar

v = 15 m/s ⇔

v = 2.5 m/s ↻

Preferential Range

Ordering example: URF – B20 – 108 – HS 21037 – C

URF = Seal type “Shaft Seal“

B20 = Shaft Ø 20

108 = Nominal cross-section

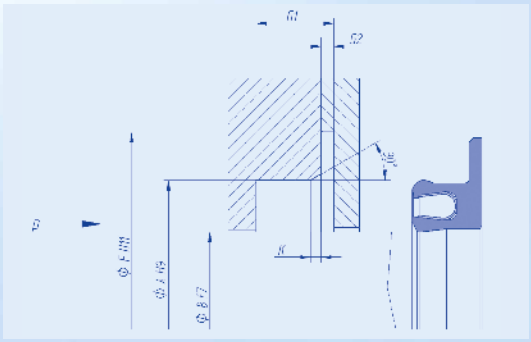
HS 21037 = Casing material (for other compounds see compound table pages 60 – 62)

C = Spring material (see page 29)

Shaft Diameter Ø B_{f7}	*Groove Base Ø A^{H9}*	*Groove Width G1 min*	*Shaft Diameter Ø B_{f7}*	*Groove Base Ø A^{H9}*	*Groove Width G1 min*
3	5.84	2.4	42	51.44	7.1
5	9.52	3.6	45	54.44	7.1
6	10.52	3.6	50	59.44	7.1
8	12.52	3.6	56	65.44	7.1
10	14.52	3.6	60	69.44	7.1
12	16.52	3.6	63	72.44	7.1
14	18.52	3.6	70	79.44	7.1
16	20.52	3.6	80	89.44	7.1
18	22.52	3.6	90	99.44	7.1
20	26.14	4.7	100	109.44	7.1
22	28.14	4.7	110	119.44	7.1
24	30.14	4.7	120	129.44	7.1
25	31.14	4.7	125	137.10	9.5
28	34.14	4.7	130	142.10	9.5
30	36.14	4.7	140	152.10	9.5
32	38.14	4.7	160	172.10	9.5
35	41.14	4.7	180	192.10	9.5
36	42.14	4.7	200	212.10	9.5
40	49.44	7.1			

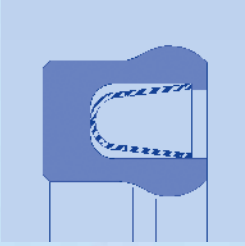
Installation Dimensions

Additional diameters/sizes from 2 mm to 3000 mm available on request.



Shaft Ø B_{f7}	*Nominal Cross-Section* [4]	*Groove Base A^{H9}*	*Flange Ø F^{H11}*	*Groove Width G1 min*	*G2 $_{-0.1}$*	*Lead-In Chamfer K*
3 – 5	116	Ø B +2.84	Ø B +6.5	2.4	0.70	0.6
5 –	20	332Ø B +	4.52Ø B +	8.5	3.6	0.85 0.8
20 –	40	108Ø B +	6.14Ø B +	12.0	4.7	1.35 1.1
40 –	120	316Ø B +	9.44Ø B +	16.5	7.1	1.80 1.4
120 –	1000	104Ø B +	12.10Ø B +	21.0	9.5	2.80 1.7
1000 –	3000	308Ø B +	19.00Ø B +	27.5	15.0	3.80 2.0

Standard Types URS | CRS



URS – Piston and Rod Seal | Shaft Seal

For gaseous media.

Chamfered sealing lip with large wear reserve; even with rotary and swiveling applications.

Operating Limits [1]

T = –75 °C to +300 °C

p = up to 250 bar

v = 15 m/s ⇔

v = 1 m/s ↻

CRS – Piston and Rod Seal | Static Seal

Very good sealing performance with high pressures. Static sealing action and/or for slow-moving applications.

Operating Limits [1]

T = –95 °C to +300 °C

p = up tp 700 bar

v = 0.5 m/s ⇔

Special Versions URV | CRV | Piston and Rod Seal

URV Rod Seal | Shaft Seal
For fluids.

With shortened, sharp-lipped interior sealing lip for good wiping effect; also suitable for sealing rotary and swiveling applications.

CRV Rod Seal
For fluids.

With sharp-edged interior sealing lip for good sealing effect with high pressures; very good wiping effect.

Piston and Rod Seal
For critical fluids
(paint, lacquers, gasoline, etc.).

Double sealing edge for improved sealing performance.

Rod Seal
For separating two media.

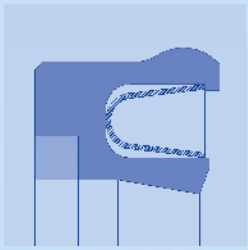
Groove seal with integrated memory sealing lip.

Piston and Rod Seal

For extra-large installation dimensions.

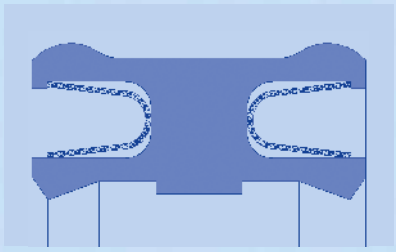
Rod Seal | Shaft Seal
With O-ring as static seal.

Very good static sealing effect at the external diameter and/or with rough housing surfaces.



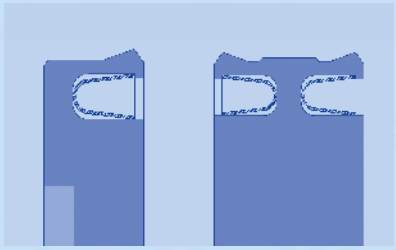
Piston and Rod Seal

For high pressure loads with special design and reinforced back of seal.



Rod Seal
(Could also be designed as a piston seal.)

For separating two media.



Complete Piston/Complete Package Solution
Design available on request.

Benefits:

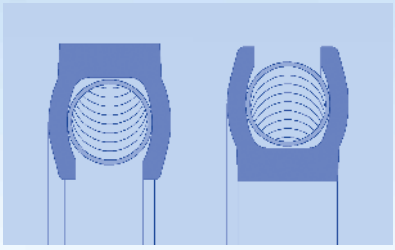
- One-part piston
- Replaces metal piston by plastic piston
- Ready-/easy-to assemble versions with favorable cost-benefit ratio
- No damage to seals during assembly process
- Complete package solution, incl. seal and integrated guidance, available

Type Static Flange Seals

Standard Version

UAI for internal pressure (left).
UAA for external pressure (right).
Rotary seal for rotating and swiveling motions.

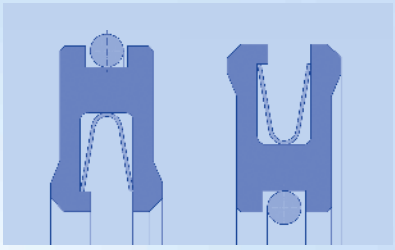
Operating Limits [1]
T = –75 °C to +300 °C
p = up to 250 bar
v = 2.5 m/s ↻



Standard Version

CAI for internal pressure (left).
CAA for external pressure (right).
Rotary seal for rotating and swiveling motions.

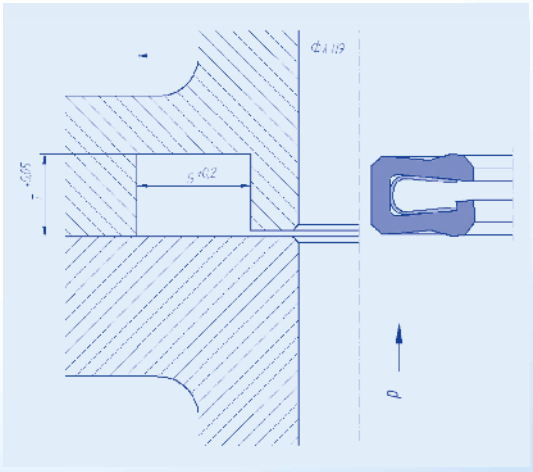
Operating Limits [1]
T = –95 °C to +300 °C
p = up to 700 bar
v = 0.5 m/s



Special Version

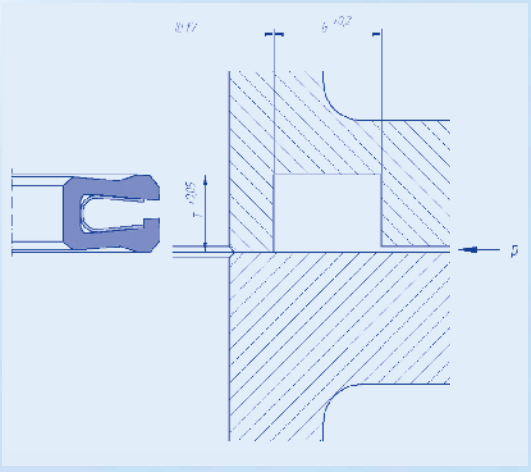
Internal pressure (left).
External pressure (right).
Rotary seal for rotating and swiveling motions.

Installation Dimensions
for internal pressure



Groove Ext Ø A^{H9}	*Nominal Cross-Section* [4]	*Groove Depth* $T^{+0.05}$	*Groove Width* $G^{+0.2}$
10 – 70	116	1.42	2.4
12 – 180	332	2.26	3.6
24 – 480	108	3.07	4.7
46 – 700	316	4.72	7.1
125 – 1000	104	6.05	9.5
1000 – 3000	308	9.50	15.0

for external pressure



Groove Int Ø ID_{f7}	*Nominal Cross-Section* [4]	*Groove Depth* $T^{+0.05}$	*Groove Width* $G^{+0.2}$
3 – 60	116	1.42	2.4
8 – 160	332	2.26	3.6
20 – 380	108	3.07	4.7
40 – 460	316	4.72	7.1
100 – 1000	104	6.05	9.5
1000 – 3000	308	9.50	15.0

Technical Details

Spring Types | Spring Characteristics | Spring Materials

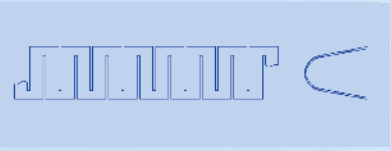
To assure that the sealing lips are permanently pressed against the contact surfaces, spring-energized seals made from PTFE and PE compounds require metal spring elements that are integrated in the plastic casings. In special cases, these may be elastomer O-rings as well. Most seals, however, have metal springs.

The spring assures constantly even contact pressure of the sealing lip across the entire temperature range.

For the different types of seals different types of springs are available with particular spring characteristics. These spring characteristics and properties have a major influence on sealing performance, friction and wear behavior of the groove seal.

Spring Types

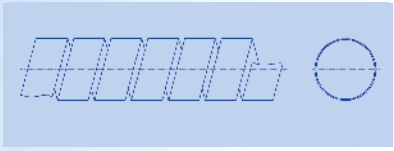
U- and/or V-Spring



These standardized spring types are used in all U-shaped versions, such as the standard URI, URA, URS rod and piston seals and the URF shaft seals.

Both types are primarily used in dynamic sealing applications, as relatively low spring forces are achieved with large spring travel. In high-speed applications this results in low wear of the dynamic sealing lips. With their maximum pre-loading force, the spring ends directly act on the sealing edges of the sealing lips, thus generating optimum compression development. The highly flexible springs are capable of providing better compensation for larger groove tolerances, coaxiality flaws and misalignments.

C-Spring



The C-spring is a spiral type wound from metallic tape and excels at offering high spring forces even at low rates of spring travel. These springs are recommended primarily for use in static and/or slow-moving and high-pressure sealing applications.

The high pre-loading forces ensure excellent sealing performance both with fluid and gaseous media. This spring type is particularly well suited for low-temperature applications.

Special Springs

Additional special spring types available on request.

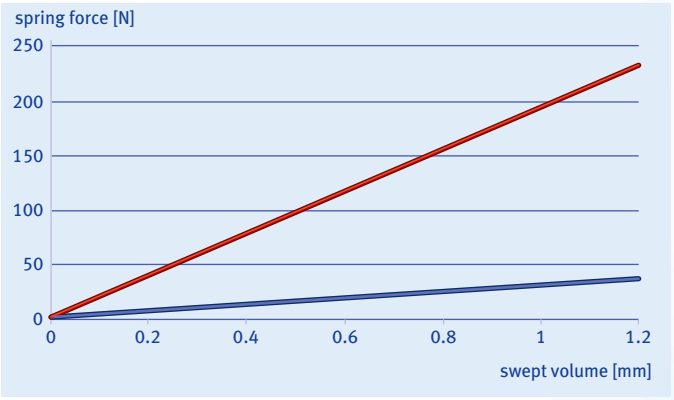
Technical Details

Spring Characteristics

This map shows the various spring characteristics related to the individual nominal cross-sections, clearly revealing the differences between U-, V- and/or C-springs. This data based on a 20 mm length of spring.

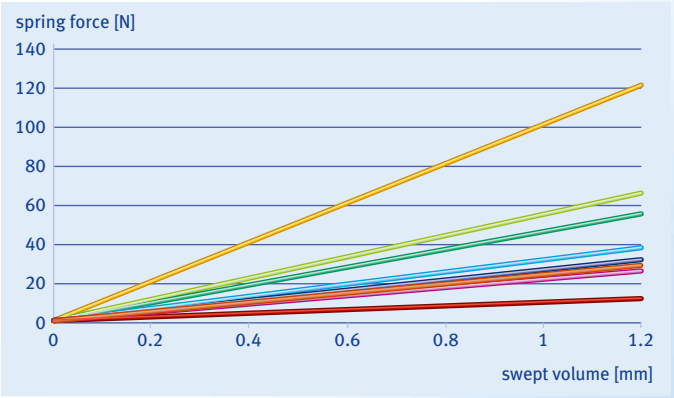
Purpose-manufactured special springs for friction-optimized seals assure minimum contact pressures with large rates of spring travel. This enables us to make pinpoint calculations and proposals for seals offering high wear reserves and thus prolonged service life.

U-Spring compared to C-Spring [2]



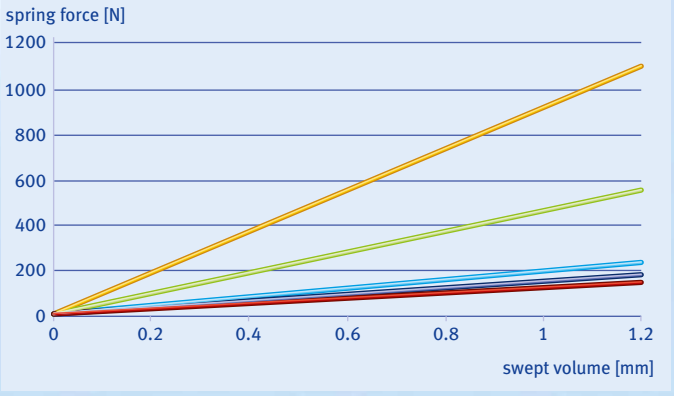
- *C-Spring*
- *U-Spring*

Spring Characteristics U-Spring [2]



- *U 332 (spring thickness 0.10 mm)*
- *U 116 (spring thickness 0.08 mm)*
- *U 104 (spring thickness 0.25 mm)*
- *U 108 (spring thickness 0.12 mm)*
- *U 308 (spring thickness 0.20 mm)*
- *U 316 (spring thickness 0.20 mm)*
- *U 104 (spring thickness 0.15 mm)*
- *U 316 (spring thickness 0.10 mm)*

Spring Characteristics C-Spring [2]



- *C 116 (spring thickness 0.08 mm)*
- *C 332 (spring thickness 0.08 mm)*
- *C 108 (spring thickness 0.08 mm)*
- *C 316 (spring thickness 0.12 mm)*
- *C 104 (spring thickness 0.15 mm)*

Spring Materials

Standard spring material C: Stainless steel
Material: 1.4310
X12Cr Ni 177
A ISI 301

Special materials:

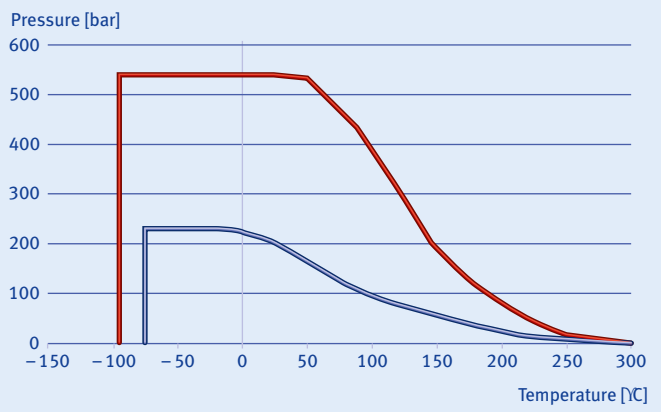
Hastelloy®(3) C 276 H: Hastelloy® C-276
Material: 2.4819
Ni Mo 16Cr 15W
UNS N 10276

Elgiloy®(3) E: Elgiloy®
Material: 2.4711
Co Cr 20 Ni 15 Mo
UNSR 30003

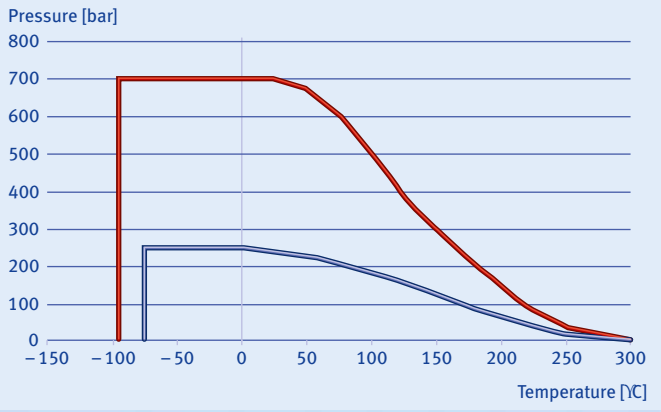
Other special spring materials available on request.

Operating Limits(1)

Dynamic Seals(2)



Static Seals(2)

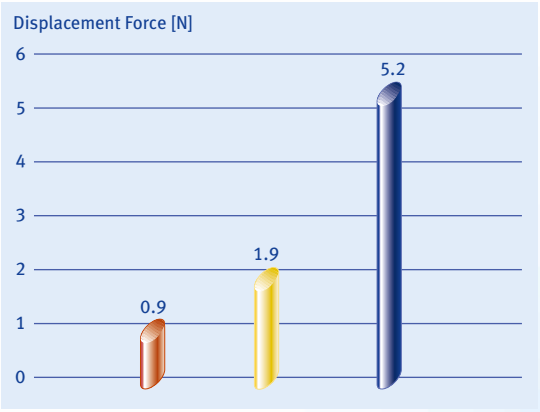


Technical Details

Displacement Force [2]

The diagram shows the different displacement forces of spring-energized seals with a U/V-spring, C-spring compared to the conventional hydraulic seal, which is an O-ring-pre-loaded PTFE stepped seal (SRI). The differences in displacement forces are the result of different levels of radial contact pressures of the seal against the rod.

The CRS type with the wound spiral spring tape produces significantly higher contact pressure and thus displacement force than the URI type.



Spring-energized seal, type URI
Stepped seal, SRI with O-ring
Spring-energized seal, type CRS

Test Conditions:

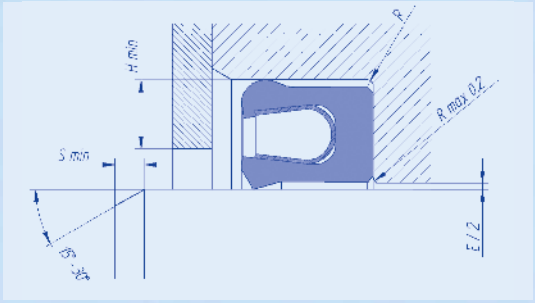
Hydraulic cylinder rod Ø 11 mm, hard-chrome-plated, Rz 0.2 µm, v = 60 mm/min, pressureless, oil-lubricated, room temperature.

Design and Fitting Instructions

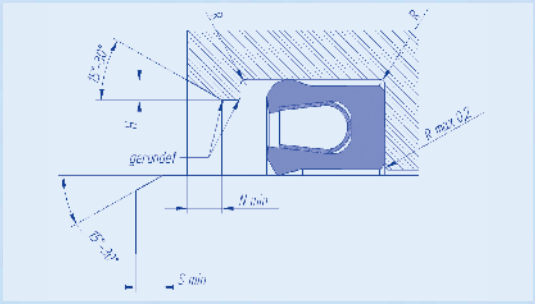
- Assure good surface finish of fitting tapers/lead-in chamfers on cylinder barrel and piston rod
- Debur and round off all sharp edges
- In special cases, heating of the sealing ring is recommended
- Cover crest of threads
- Carefully remove dust, dirt, chips, swarf, etc.
- Do not use any sharp-edged fitting tools
- We recommend snap-in assembly into the semi-closed groove as shown in sketch on page 31 using a conical fitting tool and an expanding sleeve. These instructions should be observed particularly with small seal diameters
- Do not deform seals
- Greasing/oiling of sliding surfaces and seals during assembly facilitates fitting and is recommended. Do not use any greases with solid additives
- Installation into closed grooves is only possible in some cases and requires special prerequisites to be met, such as minimum diameter, axial distance of the groove, heating of the seal ring. Please contact us for assistance

Design and Fitting Instructions

Rod Seal

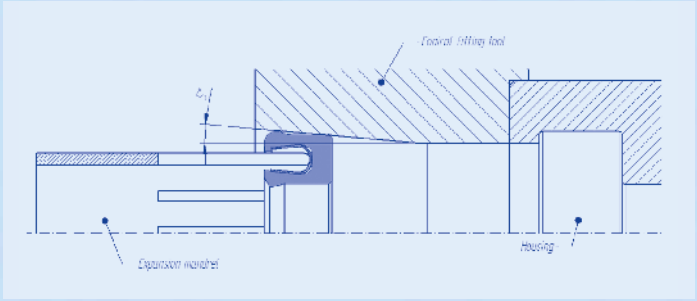


Installation into split groove



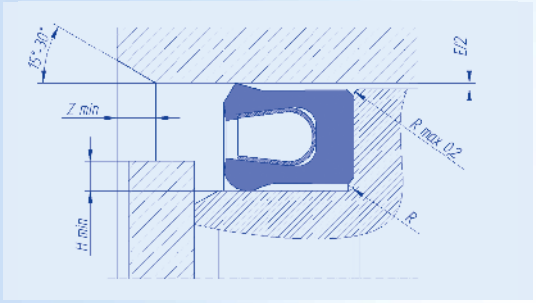
Installation into semi-closed groove
(Snap-in assembly)

Snap-in assembly

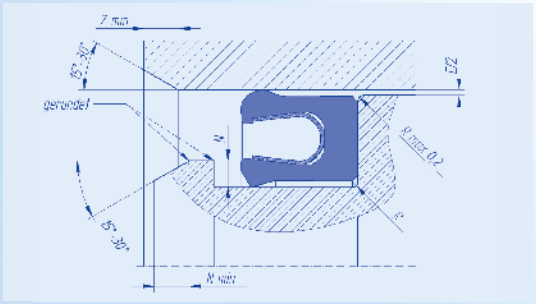


Nominal Cross-Section[4]	*Lead-in Chamfer Rod S_{min} at 15° Phase*	*30° Phase*	*Retainer H or H_{min}*	*Fitting Taper-Housing N_{min} at 15° Phase*	*30° Phase*	*Radius R*	*Radial-Clearance $_{max}$ E/2*
116	2.6	1.2	0.4	1.5	0.7	0.20	0.05
332	4.1	1.9	0.5	2.3	1.0	0.20	0.07
108	5.2	2.4	0.6	3.0	1.4	0.25	0.08
316	7.5	3.5	0.8	4.5	2.1	0.30	0.10
104	10.4	4.8	1.0	5.6	2.6	0.35	0.12
308	12.0	6.0	1.2	7.0	3.2	0.35	0.15

Piston Seal

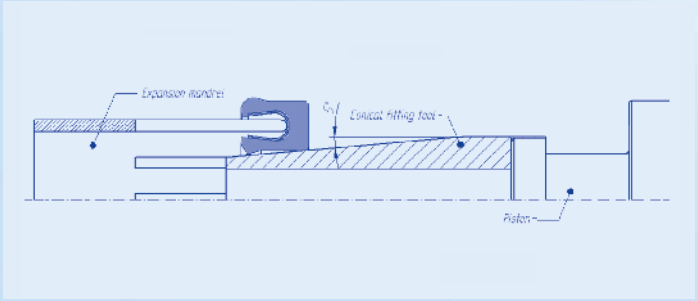


Installation into split groove



Installation into semi-closed groove
(Snap-in assembly)

Snap-in assembly



Nominal Cross-Section[4]	*Lead-in Chamfer Cylinder S_{min} at 15° Phase*	*30° Phase*	*Retainer H or H_{min}*	*Fitting Taper-Piston N_{min} at 15° Phase*	*30° Phase*	*Radius R*	*Radial-Clearance $_{max}$ E/2*
116	2.6	1.2	0.4	1.5	0.7	0.20	0.05
332	4.1	1.9	0.5	2.3	1.0	0.20	0.07
108	5.2	2.4	0.6	3.0	1.4	0.25	0.08
316	7.5	3.5	0.8	4.5	2.1	0.30	0.10
104	10.4	4.8	1.0	5.6	2.6	0.35	0.12
308	12.0	6.0	1.2	7.0	3.2	0.35	0.15

Surface Quality

The crucial factor affecting the sealing function, sealing performance and service life of the seal is the surface quality of the contact surface.

Grooving, scoring, scratching and traces of machining must be avoided. In a sealing system, any of these will lead to leakage as well as damage to the sealing lips.

The following surface roughness values of the dynamic and static sealing surface are recommended:

Dynamic sealing surface

	Piston and rod seals e.g. URI, URA, URS	*Shaft seals e.g. URF*
Ra	≤ 0.1 µm	≤ 0.2 µm
Rz	≤ 1.0 µm	≤ 1.6 µm
Rmax	≤ 2.0 µm	≤ 2.0 µm

Static sealing surface

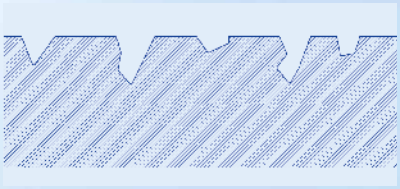
	Piston and rod seals e.g. URI, URA, URS	*Shaft seals e.g. URF*
Ra	≤ 0.4 µm	≤ 0.4 µm
Rz	≤ 2.5 µm	≤ 2.5 µm
Rmax	≤ 6.3 µm	≤ 6.3 µm

Surface hardness of shaft seals ≥ 58 HRC non-twisting.

Particularly with piston and rod seals, e.g. types URI, URA and URS, the material content/bearing content of the surface is crucial. As such, even roller-burnished or ground/polished stainless steel rods or needles achieve a high material content of ≥ 75% measured at a cut depth of c = 25% of the Rz-value based on a reference value of 5%.

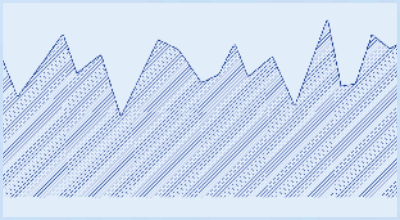
The following surface structures illustrate this point:

Ideal contact surface for piston and rod seals, e.g. achieved by roller-burnishing, honing, grinding/polishing.



Material content 75% at Rz-value 1.0 µm
→ good sealing effect
→ long service life

Cracked contact surface, not optimally suited.



Material content 20% at same Rz-value of 1.0 µm
→ lower sealing effect
→ wear of sealing lip

For shaft seals, e.g. type URF, we recommend hardened steel shafts ground without twists. Many applications also use coatings such as chromium oxide, tungsten carbide, carbon coatings, etc. When such coatings are used, a very good surface quality (Rz £ 1.0 µm) must be assured. Otherwise, these extremely hard coatings cause excessive wear of the sealing lip. We also recommend you consider having our development department perform respective wear tests in such cases.

Compounds

As a specialist in the field of PTFE we offer a wide range of different PTFE compounds for virtually any application requirement. A selection of the major compounds has been compiled in the compound chapter on pages 61 – 63.

Storage Instructions

As a general rule, seals must be stored in such a way that any damage resulting from external shock or pressure is precluded. Sealing lips must be protected from deformation under all circumstances. Spring-energized seals made from PTFE compounds have a virtually unlimited shelf life.

PTFE-based seals should be placed and picked using the First-in-First-out principle. Maximum storage period is app. 1 year, provided the seals are stored in dry conditions and protected from exposure to UV light.

Memory Packings

Memory packings are single-acting sealing elements with excellent sliding properties. They are used primarily for sealing reciprocating pistons and rods as well as for rotary and swiveling applications. The one-piece seal is manufactured from the high-strength fluoroplastic, PTFE or PE-UHMW, with its memory effect resulting from a special manufacturing technique. The memory effect allows the required contact pressure to be achieved without an additional spring element.

This means that preload can be kept very low, thus providing the memory packing with outstanding friction properties. In conjunction with the special PTFE compounds HS 21059 and HS 21029 developed for this product this translates into low wear of the sealing lip and thus long service life with low breakaway and displacement forces. Since the seal is installed with the open side facing toward the higher system pressure, the sealing effect increases with rising pressure.

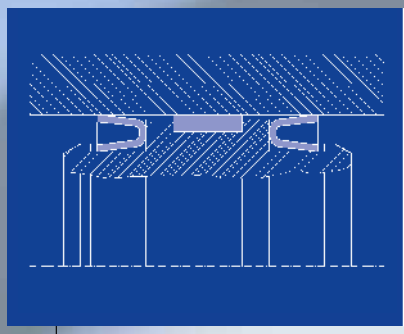
Memory packings are used in any application placing particularly high demands on the friction behavior of the seal.

Benefits

- Extremely low friction, constant across a wide temperature range
- Outstanding dry-running characteristics
- No stick-slip effects even at low sliding speeds
- Extremely low breakaway forces even after prolonged downtimes
- High chemical and thermal resistance
- No volumetric changes by swelling or shrinkage
- Compact design
- Very good cost/benefit ratio
- Suitable for sterilizing
- Easy to flush
- Dimensions from 3 mm to 140 mm available
- Special dimensions available on request

Fields of Application

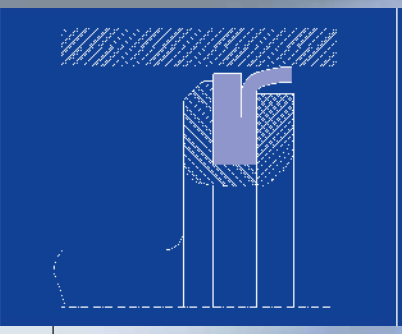
Application Examples



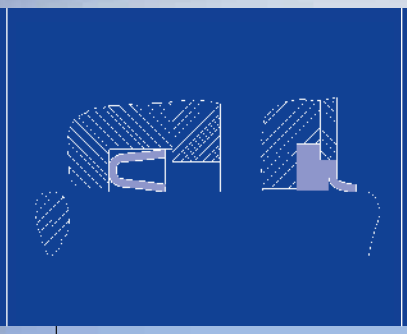
Pneumatics
Cylinder seal with low displacement force for stick-slip-free operation.

Memory packings are used in a wide range of industrial applications:

- Automotive industry, e.g. in headlight washer systems, small compressors for pneumatic suspensions, ride leveling systems, vibration dampers
- General manufacturing and mechanical engineering, e.g. valves and solenoid valves
- Pneumatics, e.g. in cylinders and other pneumatic components
- Compressors and vacuum pumps, e.g. oil-free compressors/applications
- Food processing industry, e.g. metering devices and packaging/filling equipment
- Medical and pharmaceutical industry, e.g. in dental technology piston compressors
- Tank system engineering, e.g. vacuum pumps for fuel vapor suction systems
- Painting technology, e.g. in paint valves



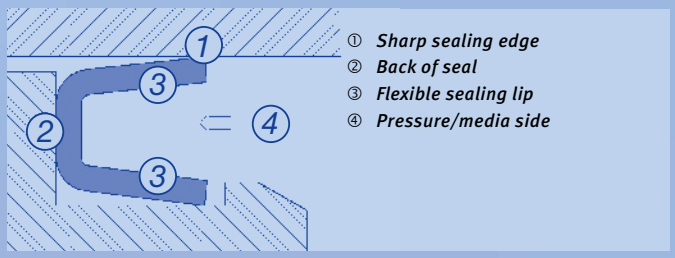
Compressors and Vacuum Pumps
Wobble piston compressor with cup seal serving as a piston seal in non-lubricated operation (oil-free application).

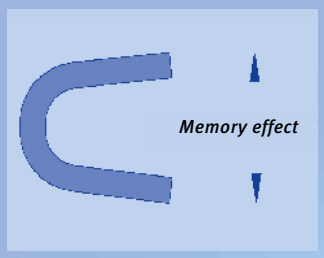


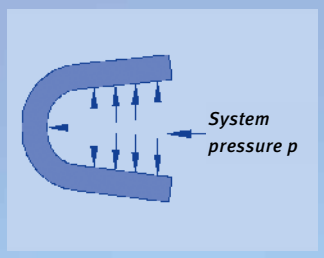
Food Processing Industry
Rod seal used in valves for bottling plants. With minimum clearance space and good flushing properties (aseptic applications).

Painting Technology
Valve needle seal for paint valves in automotive painting lines.

Seal Design and Action Principle

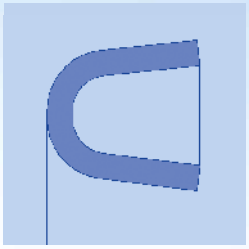






The action principle of all seal types and shapes is identical. The seals differ merely in terms of their geometries and applications. The sealing effect is achieved by the inherent preload of the plastic casing (memory effect of the compound). The radial contact pressures are sufficient to effectively seal a pressureless application. In the event of additional system pressure the contact pressure forces will rise along with the total sealing pressure.

Standard Type EMS



EMS – Piston and Rod Seal;
and as Shaft Seal

Operating Limits [1]

T = –40 °C to +220 °C

p = up to 20 bar

v = 15 m/s ⇔

v = 1.0 m/s ↻

Stock Range, Standard Dimensions, Basic Type: EMS

Ordering example: EMS – 12 x 6 x 3.6 – HS 21029

EMS = Type

12 = Hole Ø

6 = Rod Ø

3.6 = Groove width

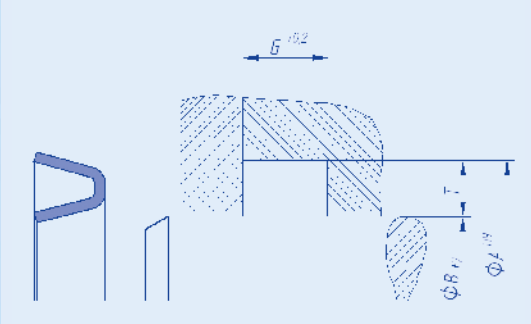
HS 21029 = Standard compound PTFE special compound HS 21029, the advanced, second-generation compound is HS 21059. To find the compound combinations best suiting the respective applications see compound table pages 60 – 62.

Hole Ø A^{H9}	*Rod Ø* B_{f7}	*Groove Depth* *T*	*Groove Width* $G^{+0,2}$	*Part-No.*
12	6	3	3,6	386.480
13	7	3	3,6	206.070
14	8	3	3,6	403.687
16	10	3	3,6	785.881
18	12	3	3,6	785.903
20	14	3	3,6	785.911
22	16	3	3,6	785.938
24	18	3	3,6	786.012
25	19	3	3,6	783.765
26	20	3	3,6	092.100
28	20	4	5,0	785.954
30	22	4	5,0	786.020
32	24	4	5,0	785.962
33	25	4	5,0	786.039
36	28	4	5,0	786.047
38	30	4	5,0	787.515
40	32	4	5,0	785.970
44	36	4	5,0	786.055
50	40	5	6,3	785.989
55	45	5	6,3	403.970
60	50	5	6,3	785.997
63	53	5	6,3	786.004
66	56	5	6,3	780.960
70	60	5	6,3	090.980
73	63	5	6,3	840.327
80	70	5	6,3	786.063
100	88	6	7,5	786.071

Special dimensions and other compounds available on request.

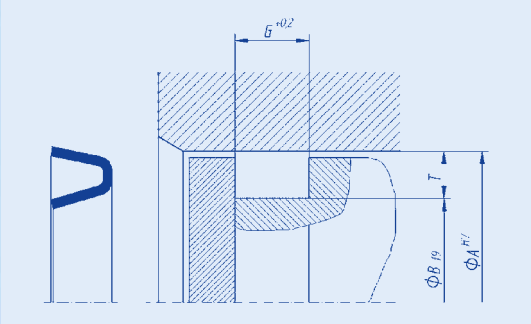
Installation Dimensions

Rod Seal



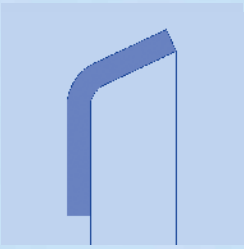
Rod Ø B^{f7}	*Groove Depth* *T*	*Groove Width* $G^{+0.2}$
6 – 20	3	3.6
20 – 40	4	5.0
40 – 88	5	6.3
88 – 113	6	7.5

Piston Seal



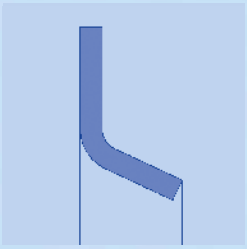
Clinder Ø A^{H9}	*Groove Depth* *T*	*Groove Width* $G^{+0,2}$
12 – 28	3	3.6
28 – 50	4	5.0
50 – 100	5	6.3
100 – 125	6	7.5

Standard Types EMT | EMTX | EMH | EMHX (without stock range)



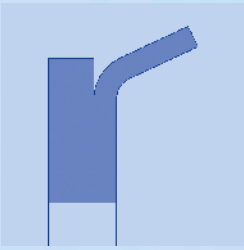
EMT – Piston Seal

Cup packing used as piston seal.



EMH – Rod Seal | Wiper | Shaft Seal

Cap packing used as rod seal/wiper as well as shaft seal.



EMTX – Piston Seal

Cup packing, with integrated guide, used as piston seal.

EMHX – Rod Seal | Wiper | Shaft Seal

Cap packing with integrated guide.

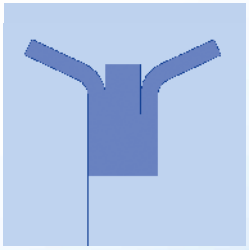
Special Versions

For certain application requirements different versions of ready-/easy-to-assemble **complete solutions** are available as well.

Benefits:

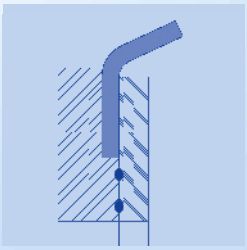
- **One-piece piston**
- **Replaces metal piston by plastic piston**
- **Ready-/easy-to assemble versions offering favorable cost-benefit ratio**
- **No damage to seals during assembly/installation**
- **Complete package solutions, including seal and integrated guide, available**

Complete Piston with Standard Memory Packing EMS
Single-acting; piston can be made from aluminum, plastic or steel.

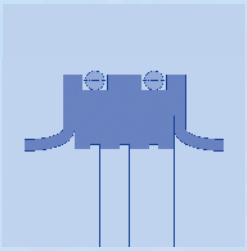


Complete Piston

Double-acting with guide.



Complete Piston with Memory Cup Packing in Plastic Piston – Ultra-Sonic-Welded
PA or POM plastic piston.



Sealing Bush as Rod and Guide Bush
Double-acting.

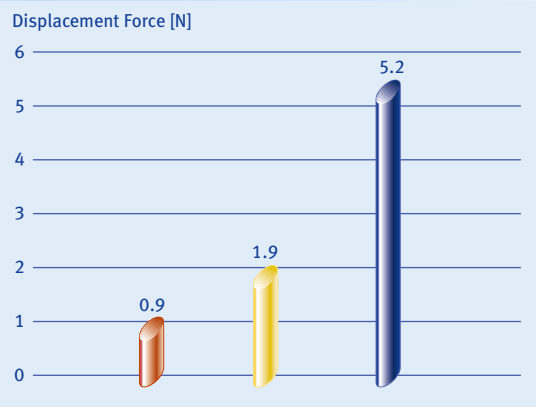
Technical Details

The memory effect is dependent on a number of different influencing factors, such as manufacturing parameters, tool/mold design, sealing compound, etc.

When it comes to designing a memory packing, you can trust us to draw on years of experience. All you need to do is to provide us with your technical operating conditions. To do so, simply complete our technical questionnaire at the end of the catalog.

Displacement Force [2]

This diagram shows the low displacement force of a memory packing compared to spring-energized seals and a hydraulic seal, a so-called O-ring-pre-loaded PTFE stepped ring (SRI). The low displacement force results from the low preload of the memory packing. It offers extremely favorable friction behavior.



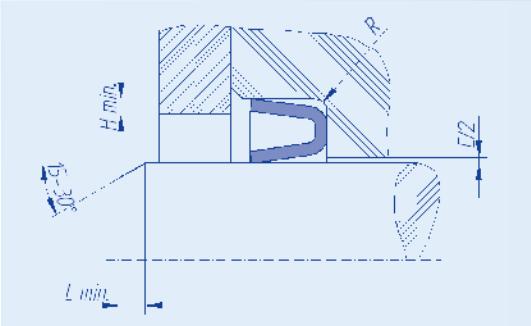
Memory packing type EMS
Spring-energized seal type URI
Stepped seal SRI with O-ring

Test Conditions:

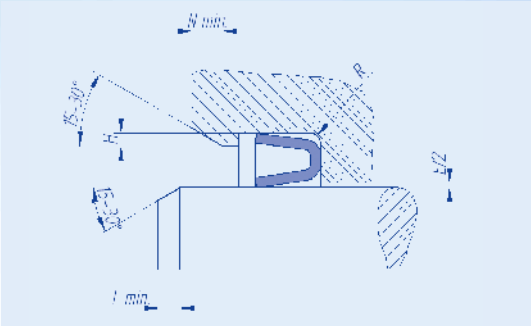
Hydraulic cylinder rod Ø 11 mm, hard-chromium-plated, Rz 0.2 µm, v = 60 mm/min, pressureless, oil-lubricated, room temperature

Design and Fitting Instructions (see Spring-Energized Seals chapter, page 30)

Rod Seal

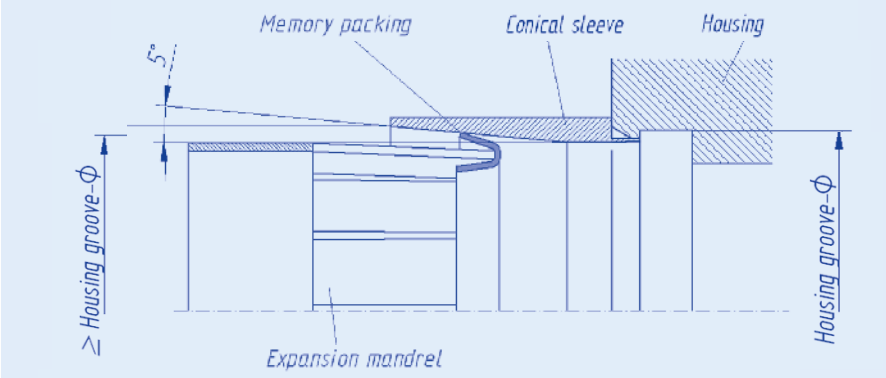


Assembly with split groove.



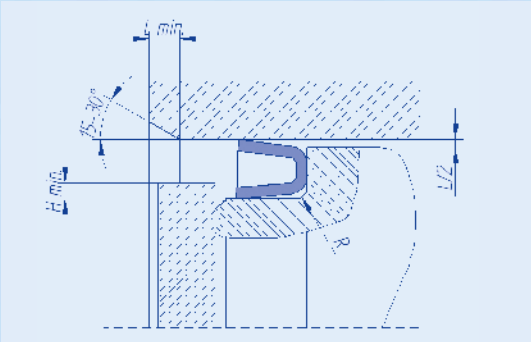
Assembly with semi-closed groove (snap-in assembly).

Snap-in assembly

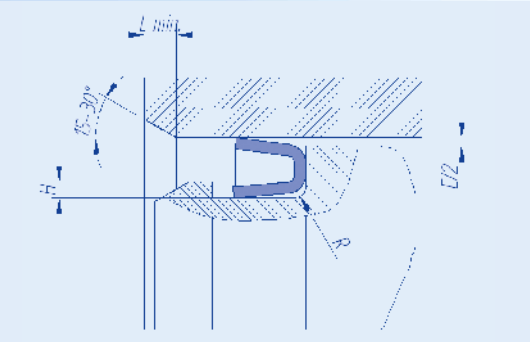


Nominal Cross-Section[a] T x G	*Lead-in Chamfer L_{min} at*		*Retainer H or H_{min}*	*Fitting Taper N_{min} at*		*Radius R*	*Radial Clearance $_{max}$ E/2*
	15° Phase	*30° Phase*		*15° Phase*	*30° Phase*		
3 x 3.6	4.8	2.3	0.4	3.7	1.7	0.25	0.05
4 x 5.0	4.8	2.3	0.5	4.5	2.1	0.25	0.07
5 x 6.3	4.8	2.3	0.6	4.5	2.1	0.30	0.08
6 x 7.5	4.8	2.3	0.7	5.2	2.4	0.30	0.10

Piston Seal

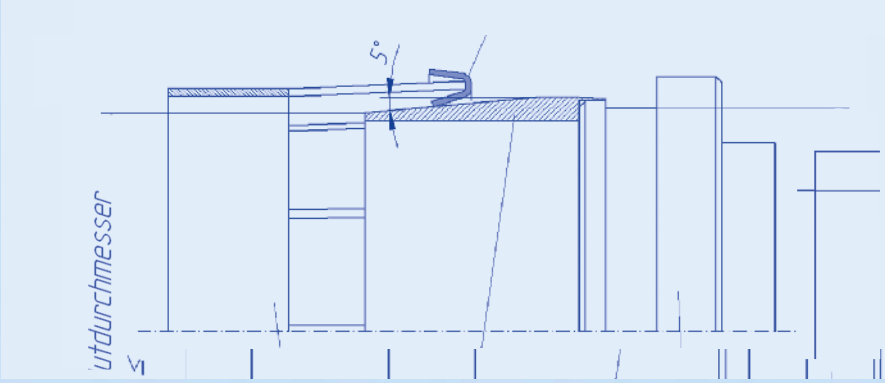


Assembly with split groove.



Assembly with semi-closed groove (snap-in assembly).

Snap-in assembly



Nominal Cross-Section[4] T x G	*Lead-in Chamfer L_{min} at*		*Retainer H or H_{min}*	*Fitting Taper N_{min} at*		*Radius R*	*Radial Clearance $_{max}$ E/2*
	15° Phase	*30° Phase*		*15° Phase*	*30° Phase*		
3 x 3.6	4.8	2.3	0.4	3.7	1.7	0.25	0.05
4 x 5.0	4.8	2.3	0.5	4.5	2.1	0.25	0.07
5 x 6.3	4.8	2.3	0.6	4.5	2.1	0.30	0.08
6 x 7.5	4.8	2.3	0.7	5.2	2.4	0.30	0.10

Surface Quality

See Spring-Energized Seals chapter.

Storage Instructions

See Spring-Energized Seals chapter.

Benefits

- PTFE – even without lubrication – excels at offering an exceptionally low coefficient of friction in combination with metals and plastics
- PTFE is highly anti-adhesive, without any stick-slip effect
- PTFE has high elongation properties enabling easy fitting of sealing and guide elements to one-piece pistons
- PTFE – when subjected to moderate stress – offers an exceptionally wide (for plastics) thermal operating range from –200 °C to +260 °C
- PTFE is chemically resistant to nearly all solid, liquid and gaseous media
- PTFE is age-resistant, non-combustible and physiologically neutral in the stated temperature range

PTFE piston rings have been manufactured and used in oil-free compressors for many years. The demand for seals suitable for oil-free applications has grown considerably in recent years. This development has largely been driven by increased awareness of environmental concerns, more stringent regulations and the constant need to achieve further cost reductions.

By fine-tuning filler contents and manufacturing processes we have developed a system range of PTFE special compounds enabling us to offer the optimum compound even for extreme application conditions.

Piston Rings

Fields of Application

Meanwhile, our solutions have established themselves as essential elements in numerous industrial, engineering and consumer goods sectors.

Selected examples include:

- Compressors operating under full and low-lube conditions
- Gas rotary pumps
- Expansion machinery
- Liquid gas and vacuum pumps
- Wobble piston compressors
- Rotation compressors for loading/unloading of silos
- Generation of oil-free compressed air for the food processing industry, pharmaceutical industry and dentistry
- Compressed air for the crafts and do-it-yourself market
- Pneumatic hammer drills
- Automotive technology, including ride leveling and air-conditioning systems

Types

Straight Joint
Piston rings with straight joints are used for sealing pressure differences above 15 bar. With this gap, leakage is slightly higher than with piston rings that have a scarf joint. Due to the high compressor speeds (rpm) typically achieved today, the loss of gas from leakage has a minor impact on compressor performance. The amount of gas leakage is negligible.

Scarf Joint
Piston rings with scarf joints are used for sealing pressure differences above 15 bar. During the run-in period the sealing effect (tightness) of scarf joints is slightly better than that of piston rings with a straight joint.

Overlapped Joint
The overlapped joint achieves a favorable sealing effect. For this reason, it is primarily used for sealing gases with a specific light weight. Due to the occurrence of bending stress and the resulting risk of breakage in the overlapping areas, piston rings with overlapped joints should only be used in compressors operating with pressure differences of a maximum of 15 bar.

Gas-tight Joint
Our gas-tight piston rings achieve the best sealing effect. The special design of the joint reduces leakage to a minimum. As with the overlapping joint the level of differential pressure is limited to a maximum of 15 bar. With regard to assembly please note that the piston ring achieves its good sealing effect only in one direction of pressure.

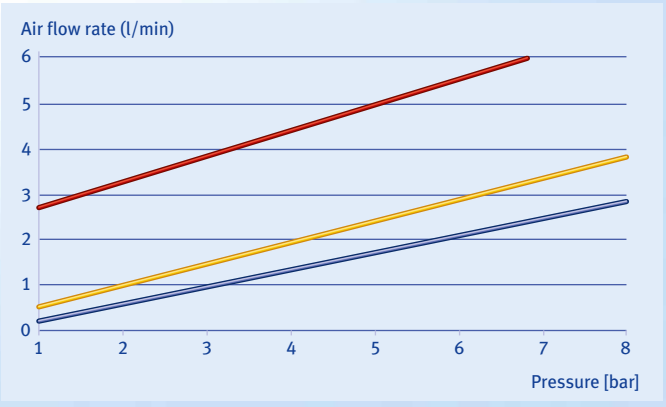
A piston ring always seals two surfaces. It is pressed against the cylinder wall and the groove flank by the pressure load and its inherent pre-loading force.

PTFE piston rings are self-clamping. Consequently, in most cases, there is no need to back the ring by a clamping spring. For compressors with upright cylinders self-clamping piston rings up to app. 700 mm can be manufactured.

Limit Values, PTFE Piston Rings [1]

Median piston speed up to	m/s	5.2
Temperature	°C	–60 to +200
Max. pressure differences to be sealed	bar	100

Efficiency of the different types of piston ring cut [2]



Test Conditions:
Piston rings made of PTFE,
dimensions:
Ø 48 x Ø 60 x 6
Piston rings not run in
Static test
T = 100 °C
Medium: Air

- *Scarf Joint*
- *Overlapped Joint*
- *Gas-tight Joint*

Technical Details

Compounds

The selection of the suitable compound is largely affected by the contact surface, medium used and a number of other factors. Please contact our application engineers to discuss your requirements.

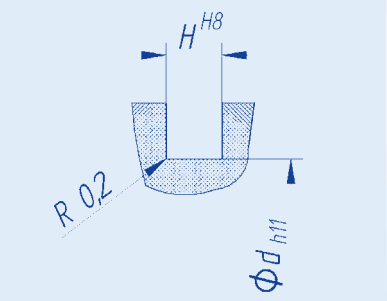
Contact Surfaces

In wear tests to determine the most favorable wear resistance of PTFE compounds with sealing and guide elements for compressors gray cast iron (e.g. fine-laminar gray cast iron) has found to be a particularly favorable contact surface. However, whenever there is a risk of corrosion due to the humidity contained in the gas, high-alloyed chrome steels, hard-anodized aluminum or Nikasil are normally used. The best wear results have been obtained with the following surface roughnesses:

	Gray cast iron	*chrome steels and hard-anodized aluminum*
Rz	2.0 to 4.0 µm	1.0 to 2.0 µm
Ra µm	0.4 to 0.8 µm	0.1 to 0.25

Design and Fitting Instructions

Design of installation space



Surface Quality

	Groove base	*Groove flank*
Rz	10 µm	4 µm
Ra	1.6 µm	0.8 µm

Piston rings should be installed by keeping elongation to an absolute minimum.

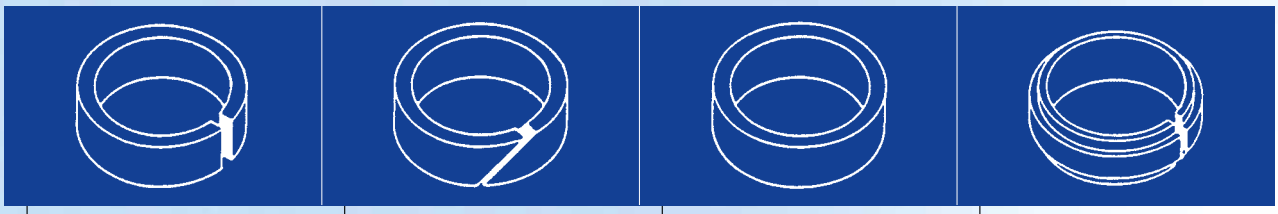
Benefits

- Chemical and thermal resistance to virtually all media used in hydraulics and pneumatics
- Suitable for use with non-hardened contact surfaces
- High bearing capacity, pressure resistance and low wear
- No stick-slip even with low sliding speeds and high transverse loads
- Minimal lubrication required
- Extremely low breakaway forces even after prolonged downtimes
- Large compound selection, e.g. wear-resistant PTFE compounds for oil-free applications
- Easy installation due to cut grooves

Guide rings and bands serve to prevent any contact of the piston and/or rod with the cylinder wall in order to avoid subsequent damage to these parts. Usually, guides with straight or scarf joints are used. The scarf joint is the most commonly used joint.

Guide Rings and Bands

Guide Ring Versions



Straight Joint | *Scarf Joint* | *Continuous* | *Shouldered with straight Joint*

Guide rings with scarf joints provide the advantage of fully running across the cylinder contact surface, thus causing no “markings” on the surface unlike the straight joint.

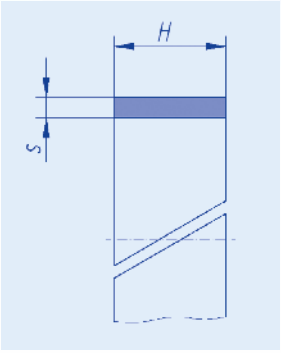
Guide rings with straight or scarf joints can only be fitted if no more than $^1/_3$ of the guide ring width overruns the valve nests inside the cylinder. If several valve nests are overrun, one-piece shrink-fitted guide rings are used. Depending on the respective application, piston guide rings with axial and/or radial balancing grooves may be used as well. The dimensions of the guide ring depend on the particular application.

Operating Limits[1]	
Sliding speeds	≤ 4 m/s
Temperature range	–100 °C to +200 °C
Specific pressure load	at 20 °C max. 10.0 N/mm²
	at 100 °C max. 5.0 N/mm²
	at 180 °C max. 2.5 N/mm²

Guide Band Versions

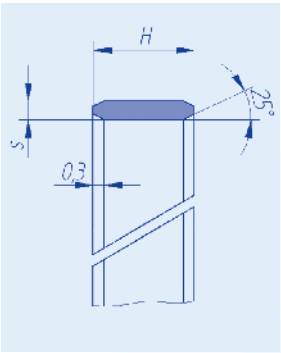
Preferential Ranges, Guide Bands

a) Hydraulics (PTFE-bronze)



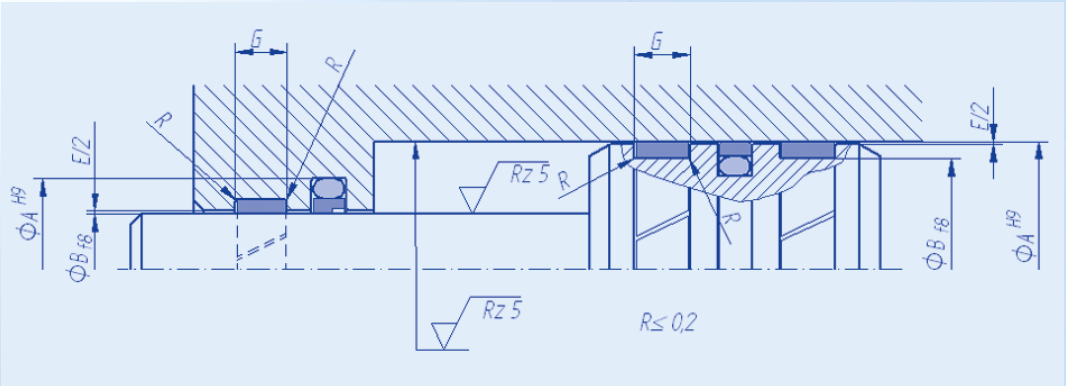
Nominal Dimensions Width H	Thickness s	Groove Width G	Groove Base Gauge w/rod guide A^{H9}	w/piston guide B_{f8}	Radial-Clearance max. E/2
4.0	1.55	4.1 + 0.1	B + 3.1	A – 3.1	0.3
5.5	2.50	5.6 + 0.1	B + 5.0	A – 5.0	0.3
8.0	2.00	8.1 + 0.1	B + 4.0	A – 4.0	0.4
9.5	2.50	9.6 + 0.1	B + 5.0	A – 5.0	0.4
10.0	2.50	10.1 + 0.1	B + 4.0	A – 4.0	0.4
15.0	2.50	15.3 + 0.2	B + 5.0	A – 5.0	0.5
20.0	2.50	20.3 + 0.2	B + 5.0	A – 5.0	0.5
25.0	2.50	25.3 + 0.2	B + 5.0	A – 5.0	0.5

b) Pneumatics (PTFE-carbon)



Nominal Dimensions Width H	Thickness s	Groove Width G	Groove Base Gauge w/rod guide A^{H9}	w/piston guide B_{f8}	Radial-Clearance max. E/2
4.0	1.55	4.1 + 0.1	B + 3.1	A – 3.1	0.3
8.0	1.55	8.1 + 0.1	B + 3.1	A – 3.1	0.3
10.0	1.55	10.2 + 0.1	B + 3.1	A – 3.1	0.3
15.0	1.55	15.2 + 0.2	B + 3.1	A – 3.1	0.3

Installation Example



Surface Quality

See Spring-Energized Seals chapter.

PTFE Laminated Piston

The PTFE laminated piston is a gapless enclosure of the piston skirt made from aluminum or gray cast iron with a PTFE film.

Characteristics:

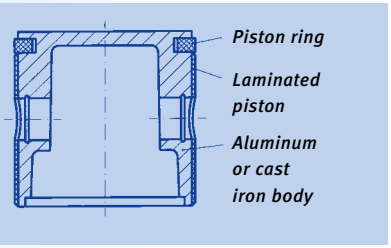
- Maximum use of the available guide surface
- High-temperature-resistant PTFE metal composite
- Minimal thickness of the PTFE guide band casing

Applications and Typical Uses

- In dry-running compressors as plunger piston guide for compressing 100% oil-free air
- To achieve minimum friction and to serve as an optimum guide for low-lube operations
- Armature plating for solenoid valves
- Piston plating for gas meters

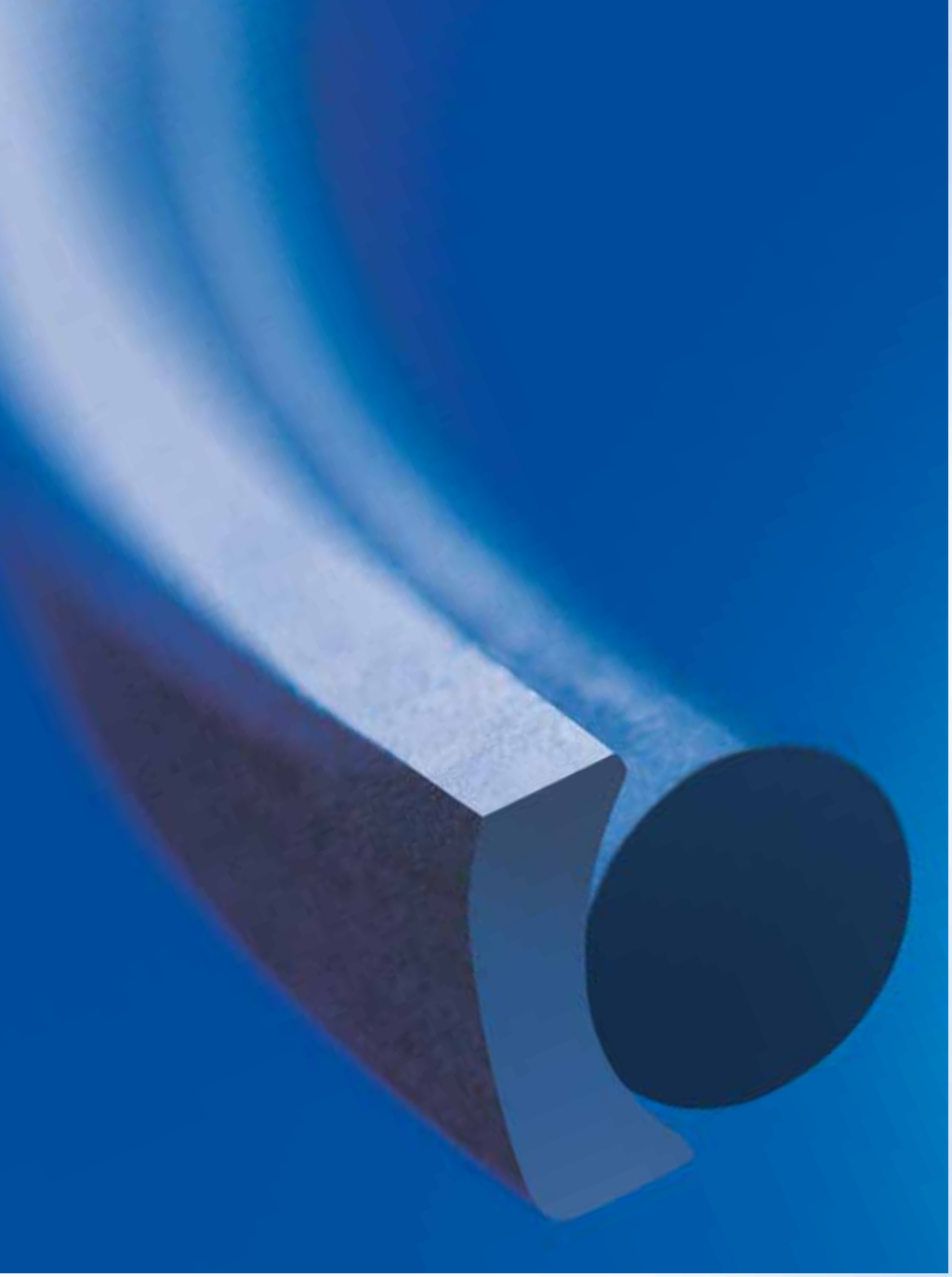
Limit Values of the Permanent PTFE Composite [1]

Max. median piston speed	m/s	5.2
Max. temperature load of the permanent composite	°C	+200



Benefits of the lamination vis-à-vis standard guide rings and bands

- The specific surface pressure is reduced by plating the piston skirt all the way to the seal groove, thus resulting in very long service life
- Reduced running clearance of the piston due to small radial thickness of the PTFE laminated piston and the resulting low thermal expansion
- Reduced running clearance largely prevents piston slap, resulting in significantly smoother operation
- Improved thermal transition from the metal piston to the cylinder wall due to the minimal thickness of PTFE laminated piston and the large contact surface



Benefits

- No stick-slip even with low sliding speeds and even after prolonged downtimes
- Low wear
- Good dry-running properties
- Simple design of installation grooves
- Low friction
- Ø 3 mm to Ø 3000 mm available
- High pressure stability
- Small installation spaces
- Lubrication depot
- For internally and externally sealing functions

Type MRA and MRI are **double-acting** composite seals. They are primarily used with alternating directions of pressure (e.g. piston seals).

Type SRI and SRA are **single-acting** composite seals. They have proven to be particular effective for sealing piston rods. The sealing effect is produced by the inherent preload of the PTFE profile ring vis-à-vis the rod and the preload of the rubber-elastic O-ring in the groove area.
With rising system pressure the radial contact pressures increase as well.

Rotary composite seals are particularly well suited for sealing rotating shafts, such as in rotary transmissions, rotary distributors, rotary joints and swiveling motors in mobile hydraulics and machine tools. A specially designed slide ring based on PTFE or PE is pressed against the surface by an elastomer O-ring and additionally activated by the system pressure.

Composite Seals

Fields of Application

Composite seals are particularly well suited for sealing pistons and rods in hydraulic and pneumatic working cylinders.

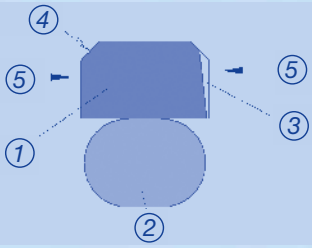
Versions and Operating Limits [1]

Sliding speed	max. 4 m/s ⇔
Temperature range	–45 °C bis +200 °C
Service pressure	max. 400 bar

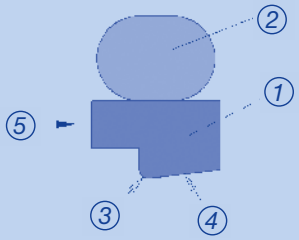
They consist of two components:

- a profile ring made of the high-strength fluoro-plastic, PTFE, or alternatively from an ultra-high-molecular PE for dynamic sealing of the sliding surface (primary seal)
- an O-ring for static sealing in the groove area (secondary seal)

Design and Action Principle



① *MRA composite seal*
② *O-ring serving as elastic pre-loading element*
③ *Relief groove prevents "sticking" to groove flank*
④ *Phase facilitates assembly*
⑤ *Direction of pressure*



① *SRI composite seal*
② *O-ring serving as elastic pre-loading element*
③ *Sealing edge generates nearly linear sealing compression*
④ *Wedge angle promotes return of drag film into compression area*
⑤ *Direction of pressure*

Fitting Instructions

- Use lead-in chamfers/fitting tapers for cylinder barrel and piston rod
- Debur and chamfer sharp edges
- Cover crests of thread
- Carefully remove dust, dirt, swarf, chips, etc.
- Do not use sharp-edged fitting tools

To facilitate assembly we recommend:

Greasing and/or oiling of sliding surfaces and seals (do not use lubricants with solid additives). Heating of externally sealing PTFE rings in oil or hot water up to 80 °C to 120 °C.

Surface Quality

	Dynamic contact surface/rod	*Static groove diameter/ housing*
Rz	≤ 1.0 µm	≤ 6.3 µm
Rmax	≤ 2.0 µm	≤ 12.5 µm

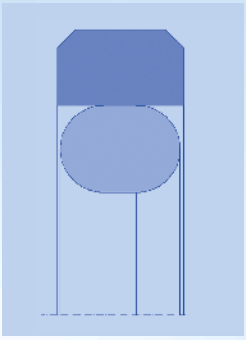
Compounds

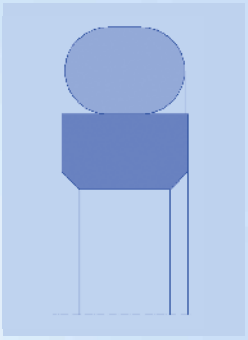
On request, depending on application.

Type MRA | MRI

Groove Dimensions

*Depending on installation conditions, other profiles – differing from the standard dimensions provided – may be selected for **composite seal type MRA** (externally sealing) and **type MRI** (internally sealing). The respective groove dimensions are listed in the table below.



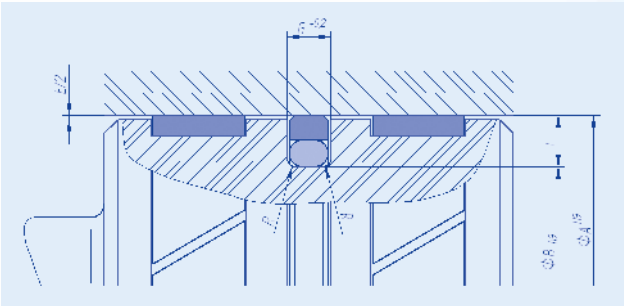


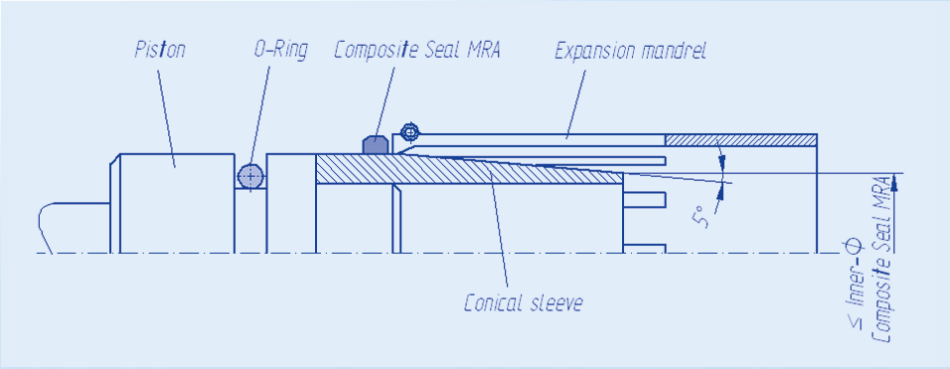
*Profile Designation**	*Groove Depth T*	*Groove Width $G^{+0.2}$*	*Radius R max*	*Radial Clearance max E/2*
8 – 15	2.45	2.2	0.4	0.15
15 – 40	3.75	3.2	0.6	0.15
40 – 80	5.50	4.2	1.0	0.20
80 – 133	7.75	6.3	1.3	0.20
133 – 330	10.50	8.1	1.8	0.25
330 – 670	12.25	8.1	1.8	0.25
670 – 1000	14.00	9.5	2.5	0.30
≥ 1000	19.00	13.80	3.0	0.40

Fitting Instructions

- Insert O-ring into groove
- Slide composite seals onto fitting shell using expander
- Let composite seal snap into groove
- If necessary, we recommend subsequent calibration using a sleeve
- To assist with making the fitting tools, we will be happy to provide respective drawings

Installation Example MRA

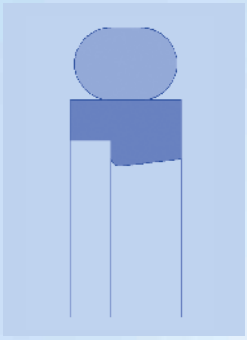


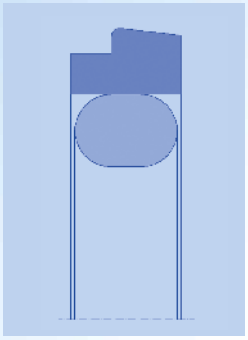


Type SRI | SRA

Groove Dimensions

*Depending on installation conditions, other profiles – differing from the standard dimensions provided – may be selected for **composite seal type SRI** (internally sealing) and **type SRA** (externally sealing). The respective groove dimensions are listed in the table below.





*Profile Designation**	*Groove Depth T*	*Groove Width G$^{+0.2}$*	*Radius R max*	*Radial Clearance max E/2*
3 – 8	2.45	2.2	0.4	0.15
8 – 19	3.65	3.2	0.6	0.15
19 – 38	5.35	4.2	1.0	0.20
38 – 200	7.55	6.3	1.3	0.20
200 – 256	10.25	8.1	1.8	0.25
256 – 650	12.00	8.1	1.8	0.25
650 – 1000	13.65	9.5	2.5	0.30
≥ 1000	19.00	13.80	3.0	0.40

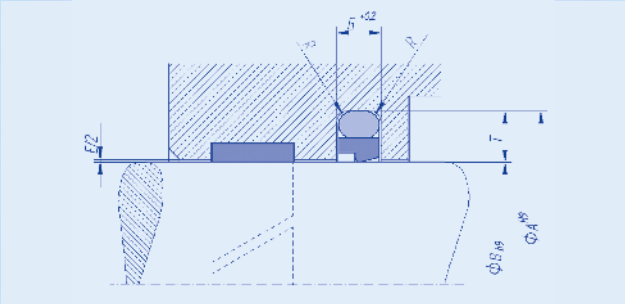
Fitting Instructions

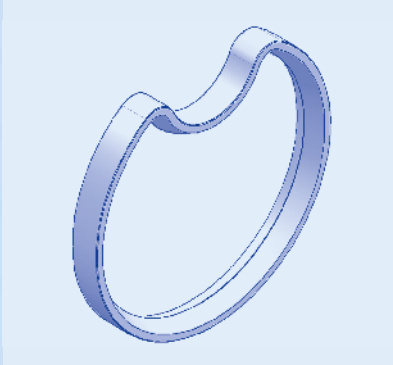
For rod diameters below 30 mm use axially accessible grooves.

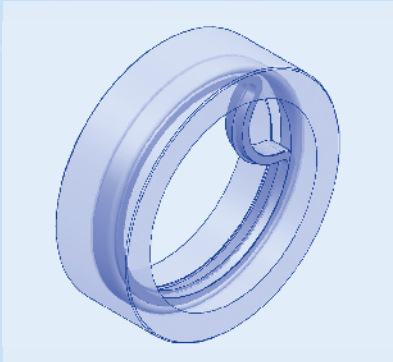
For rod diameters above 30 mm the seals may be installed in the closed grooves.

- **Inset O-ring into groove**
- **Compress composite seal into a “kidney” shape and insert into groove**
- **If necessary, we recommend subsequent calibration, using a mandrel**

Installation Example, Rod Seal SRI





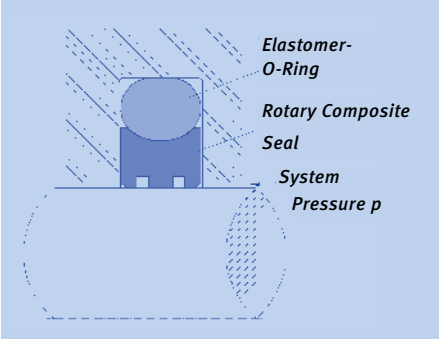


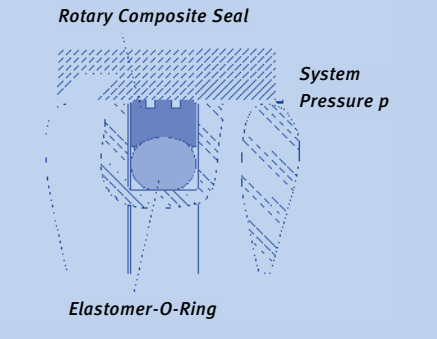
Type MRR

Groove Dimensions

*Depending on installation conditions, other profiles – differing from the standard dimensions provided – may be selected for **Rotary composite seal type MRR** (internally and externally sealing). The respective groove dimensions are listed in the table below.

Design and Action Principle





MRR internally sealing

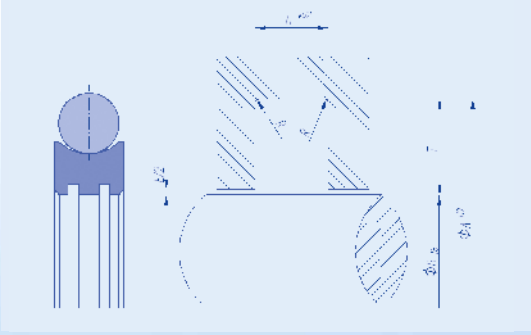
*Profile Designation**	*Groove Depth T*	*Groove Width $G^{+0.2}$*	*Radius R max*	*Radial Clearance max E/2*
6 – 19	2.45	2.2	0.4	0.15
19 – 38	3.75	3.2	0.6	0.15
38 – 200	5.50	4.2	1.0	0.20
200 – 256	7.75	6.3	1.3	0.20
256 – 650	10.50	8.1	1.8	0.25
650 – 1000	14.00	9.5	1.8	0.25

MRR externally sealing

*Profile Designation**	*Groove Depth T*	*Groove Width $G^{+0.2}$*	*Radius R max*	*Radial Clearance max E/2*
8 – 40	2.45	2.2	0.4	0.15
40 – 80	3.75	3.2	0.6	0.15
80 – 133	5.50	4.2	1.0	0.20
133 – 330	7.75	6.3	1.3	0.20
330 – 670	10.50	8.1	1.8	0.25
670 – 1000	14.00	9.5	1.8	0.25

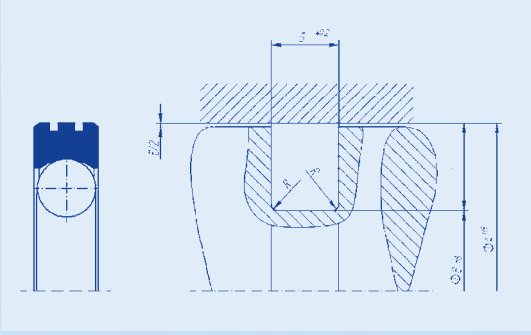
Groove Dimensions

Shaft seal internally sealing



Groove Dimensions

Shaft seal externally sealing



Operating Limits [1]

Rotation speed	max 2.5 m/s ↻
Temperature range	–45 °C to +200 °C
Service pressure	max 300 bar

Fitting Instructions

See table, page 54 and 55.

Surface Quality

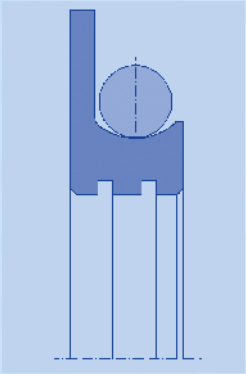
	Contact surface, dynamic	*Groove base diameter, static*
Rz	≤ 1.6 µm	≤ 6.3 µm
Rmax	≤ 2.0 µm	≤ 12.5 µm
Ra	≤ 0.2 µm	≤ 0.4 µm
Hardness	≤ 58 HRC	–

Compounds

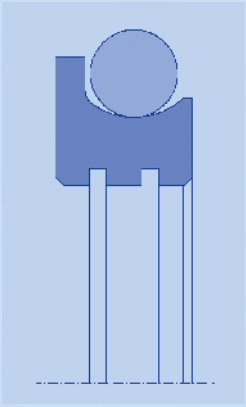
On request, depending on application.

Special Versions

With clamp-in flange



With compression support



Benefits

- No stick-slip even with low sliding speeds
- Extremely low breakaway forces even after prolonged downtimes
- Low wear and long service life
- Good sealing performance due to several sequentially located sealing edges
- High operating reliability thanks to multicomponent sealing kit
- Simple design of installation spaces
- Very good chemical and thermal resistance
- Extensive product line tailored to field application requirements
- No special maintenance requirements

V-packings and V-packing kits are primarily used for sealing rods subjected to axial motion. A packing kit consists of the number of V-packings needed for the particular application requirements as well as a base and end ring. In case there is a risk of gap extrusion under high pressure loads, the base and end rings may also be made of metallic materials. To achieve pre-defined sealing forces and adjustment of the packing in case of thermal expansion, installation of an axially acting spring (compression spring or cup spring) is necessary.

V-Packings | Kits

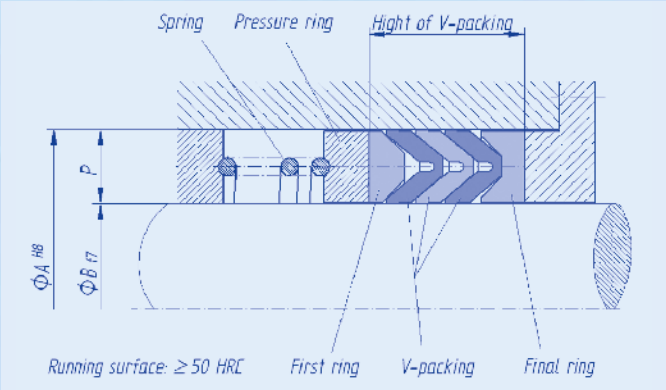
Fields of Application

- Equipment such as plunger piston pumps, metering pumps, hydraulic cylinders, control and shut-off fittings and valve stems
- Industrial sectors, such as chemical, petrochemical, flue gas purification, pharmaceutical, food processing, painting, steel, fittings

Versions and Operating Limits (1)

HN 7001 and		
HN 7002	Sliding speed	max 0.5 m/s ⇔
	Temperature range	–200 °C to +240 °C
HN 7001	Service pressure	max 300 bar
HN 7002	Service pressure	max 100 bar

Design and Action Principle



Pre-Loading by Axially Acting Spring

Based on experience, the specific surface compression of both springs should be between 0.2 and 0.4 N/mm².

With the slightly stiffer type HN 7001 it may be necessary to increase preload to 0.8 N/mm².

Fitting Instructions

- Always install packings with sealing lips facing towards the pressure side
- Spring is normally installed on the pressure side of the packing
- In case of aggressive media and installation of the spring on the pressureless side, spring compression must be adapted to the maximum media pressure which might be generated
- Prior to fitting, the installation space of the packing must be cleaned from dirt, swarf, etc.
- Rod and housing bore must be provided with lead-in chamfers between 15° and 30° to avoid damaging the sealing edges

Surface Quality

	Dynamic contact surface/ rod	*Static groove base diameter/ housing*
Rz	≤ 1.0 µm	≤ 4.0 µm
Rmax	≤ 2.0 µm	≤ 10.0 µm

Compounds

On request, depending on application.

Compound Table

PTFE compounds can be tailored to exactly meet the needs of the particular application based on our in-house compound development and compounding expertise. By means of specifically adapted fillers and filler combinations compound characteristics can be subjected to pinpoint optimization.

Compound No.	*Fillers*	*Fields of Application/Operating Conditions*	*Seal Type*
			 Shaft seals Spring-energized seals Memory packings Piston and Guide Rings Composite Seals V-Packings
HS000RW	Unfilled	• With low sliding speeds and pressures • With highly lubricating media • Suitable for soft contact surfaces made of metals and plastics • Use in food processing and pharmaceutical industry • Very good diffusion sealing effect • Used for static sealing needs • FDA-approved	
HS 10300	Special compound	• High abrasion resistance with lubricated and non-lubricated conditions • Universal uses • For medium sliding speeds, pressures and temperatures	
HS 11018	Glass fibers/ graphite	• Standard for process gas compressors • Pressure differences up to 200 bar • Very good chemical resistance • BGVV-approved	
HS 11030 HS 11031	Special compound	• Pressure-stable PTFE compound • Good wear resistance under high pressure loads and oil lubrication, also in water and steam/vapor • Very good chemical resistance • Not suitable for soft contact surfaces	
HS 11035	Special compound	• Highly pressure-stable PTFE compound • Good wear resistance under high pressure loads and oil lubrication, also in water and steam/vapor • Good electrical conductivity • Very good chemical resistance • Higher thermal conductivity and lower thermal expansion than glass fibers • Not suitable for soft contact surfaces	
HS 11041	Special compound	• Temperature stable PTFE compound with low wear in oil-free conditions • For soft mating surfaces • Non-abrasive fillers	
HS 17019	Graphite	• Good sliding property • Low coefficient of friction • Good electric conductivity • Good thermal conductivity • Very good chemical resistance • BGVV-approved	

Compound No.	*Fillers*	*Fields of Application/Operating Conditions*	*Seal Type*
			Shaft seals Spring-energized seals Memory packings Piston and Guide Rings Composite Seals V-Packings
HS 17020 HS 17021	Carbon	• Low-cost PTFE standard compound • High pressure resistance and hardness • Good sliding and wear properties • Good thermal conductivity • Largely resistant to chemicals • Electric conductivity • Low volume resistance and surface resistance	
HS 17027	Carbon/ graphite	• For dry gases in piston compressors • Very high pressure resistance and hardness • Good sliding and wear properties • Good thermal conductivity • Largely resistant to chemicals • Electric conductivity • Low volume resistance and surface resistance	
HS 17034	Glass fibers	• Use in medical and food processing technology • Better thermal conductivity, pressure and wear resistance compared to PTFE without fillers • Very good chemical resistance • Good dielectric properties • Not for soft contact surfaces • BGVV-approved and FDA-conformant	
HS 21027	Carbon/ graphite	• For dry gases in piston compressors • High pressure resistance and hardness • Good sliding and wear properties • Good thermal conductivity • Largely resistant to chemicals • Electric conductivity	
HS 21029	Special compound	• For high temperatures • Excellent sliding and wear properties with dry-running conditions and medium sliding speeds • Suitable for soft contact surfaces made of metals and plastics with minimal surface compression	Standard compound

Compound No.	*Fillers*	*Fields of Application/Operating Conditions*	*Seal Type*
			 Shaft seals  Spring-energized seals  Memory packings  Piston and Guide Rings  Composite Seals  V-Packings
HS 21037	Special compound	• Very high abrasion resistance with non-lubricated and lubricated operation • Universal use • For high sliding speeds, pressures and temperatures • Dimensionally stable compound • BAM-tested	 Standard compound  Type HN 2390
HS 21059	Special compound	• Excellent sliding and wear properties • Also with oil-free conditions • Suitable for soft contact surfaces made of metals and plastics with minimal surface compression	  Standard compound Type HN 2580  Standard compound
HS 21054	Bronze/ MOS_2	• Minimal cold flow • High pressure resistance • Good thermal conductivity • Good sliding and wear properties	
HS 21060	Special compound	• For soft contact surfaces • Very good wear properties in oil-free operations	
HS 22105	Special compound	• Good wear resistance with fuel applications • Suitable for high-frequency motions • Good diffusion sealing effect	
HS 22111	Special compound	• High pressure stability • Good wear resistance in oil-free conditions • Suitable for high operating temperatures • For dry gases in piston compressors	
HS 4080 PE-UHMW	Unfilled	• Dimensionally stable compound for high pressures • Particularly high wear resistance with abrasive media, e.g. paints, lacquers • Highly suitable for use in water • Suitable for food and pharmaceutical industry applications • Good sliding properties • Good chemical resistance (with slight limitations compared to PTFE) • Temperatures up to max 100 °C • Lowest gas permeability • BGVV-approved and FDA-conformant	

Technical Questionnaire

Please complete and return it via Fax: +49 7142 583-200

1. *Brief description of application*

_____

_____

_____

_____

_____

2. *Contact surface*

Diameter (mm): _____

Material: _____

Surface quality/finish (µm): _____

Hardness (HRC): _____

3. *Installation space*

Groove dimension (mm): _____

Material: _____

Surface quality/finish (HRC): _____

4. *Operating conditions*

Medium: _____

Normal pressure (bar): _____

Peak pressure (bar): _____

Temperature range (°C): _____

Stroke frequency: _____

Stroke length (mm): _____

Stroke speed (m/s): _____

Speed range (RPM) (min^{-1}): _____

Rotating direction: _____

Concentric tolerance (mm): _____

Center offset (mm): _____

Other details: _____

_____

5. *Special needs*

e.g. approvals, friction,
service life, etc.: _____

_____

_____

6. *Requirement*

Once-off (quantity/pieces): _____

Monthly (quantity/pieces): _____

Annually (quantity/pieces): _____

_____

Company (address)

_____

Contact

_____

Phone

_____

Fax

_____

email

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