



# SEALING SOLUTIONS FOR THE HYDRAULICS INDUSTRY

 DICHTOMATIK

 FREUDENBERG  
SEALING TECHNOLOGIES

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# COMPANY

The Freudenberg Group was founded in 1849 and is still owned by the approximately 300 descendants of the company founder. The resulting financial stability and social consciousness are decisive success factors that create trust. Today, Freudenberg is a global, broadly diversified Group that is divided into Business Groups that operate in a wide variety of different sectors. The company has always been considered an innovation and technology leader, from Vileda® brand household products to technically complex sealing solutions.

Freudenberg Sealing Technologies (FST) is the largest Business Group in the Freudenberg Group and part of the Seals and Vibration Control Technology Division. It is a supplier as well as a development and service partner to customers in a wide range of market segments, such as the automotive industry, civil aviation, mechanical engineering and shipbuilding, the food and pharmaceutical industry and the agricultural and construction machinery industry.

Starting with the Simmerring® developed in 1929, FST can today offer through its Freudenberg product brand a broad, continuously customer-oriented product portfolio of premium sealing technology for moderately to high demanding applications – from tailor-made individual solutions to complete sealing packages. The Freudenberg brand globally stands for uncompromising and high quality as well as state-of-the-art sealing solutions setting market benchmarks. It benefits from FSTs more than 175 years of engineering and materials experience in the research, development and introduction of innovative product and process solutions.

In addition, Dichtomatik brand products are ideal for several moderately demanding applications in general industry. The wide range of products is characterized by a very good price-performance ratio. Manufactured by certified external suppliers, the sealing products and solutions reliably meet common industrial market standards. Additional services such as general technical support complement the range.

With a worldwide network of more than 400 seal suppliers for the Dichtomatik brand, Freudenberg Sealing Technologies is in a position to offer a suitable procurement alternative at any time and thus avoid supply bottlenecks and risk mitigation. With its sourcing service, FST makes life easier for its customers by offering a crisis-resistant source, reducing the administrative burden, and thus ensuring a carefree supply for industrial standard seals. Quality controls along the supply chain and a good negotiating position thanks to large purchasing volumes create an attractive overall package.

Freudenberg Sealing Technologies offers technical services such as the preparation of drawings, radial force measurements, comprehensive quality and material documentation as well as material modifications and testing to ensure that all seals function reliably even in individual applications. Furthermore, local availability ensures short distances and fast response times to best serve customer needs. Digital service offerings like the online-ordering platform EASY, online configurators and resistance tools enable self-service, speed and convenience.

## FREUDENBERG SEALING TECHNOLOGIES SERVES THE ENTIRE SEALING MARKET WITH THIS COMPLEMENTARY PRODUCT PORTFOLIO AND THUS MEETS ALL MARKET REQUIREMENTS – QUICKLY, RELIABLY AND FROM A SINGLE SOURCE

### FREUDENBERG Products & Know-how

-  Premium product brand for moderately to high demanding applications
-  Strong global brand recognition
-  Highest manufacturing expertise for standard and customized solutions
-  Leading Engineering and Technical Support
-  Pioneering R&D know-how in Material & Design → PFAS

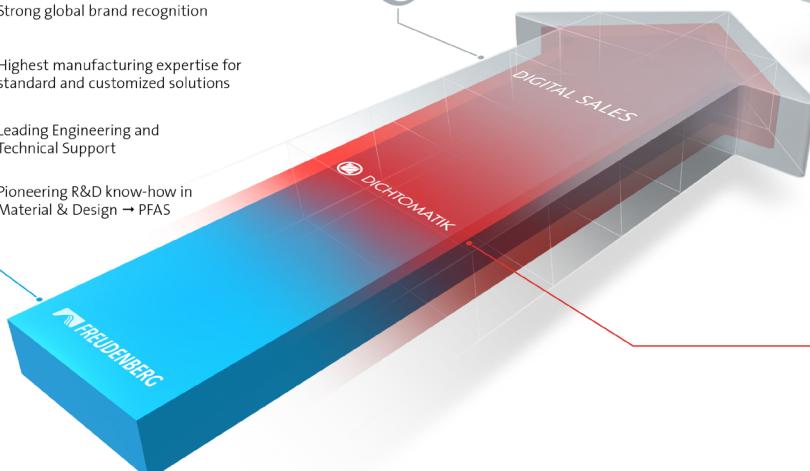
### DIGITAL SALES

-  Online offerings enabling self-service, speed and convenience
-  Reduction of transactional costs through system/data integration



### DICHTOMATIK Sourcing Service

-  Risk Mitigation
  - Supply chain → more than 400 sealing suppliers for sourcing alternatives
  - Carefree → one-stop shop for all seals, import handling, legal aspects (REACH, PFAS, ...)
  - Legislation → Part of global two-product brand strategy to always meet your sealing demands
-  Added value through local warehousing, on-site quality control, traceability, and more
-  Technical support and product-related services



# INDUSTRY-SPECIFIC AND CUSTOMIZED SERVICE CONCEPTS

## ONLINE ORDERING PLATFORM EASY

The EASY online ordering platform enables straightforward order processing and provides real time information regarding the price, delivery time and availability of stock. The primary details for each product are displayed on a summary page where drawings of the installation space and cross-section are also available for download. The EASY Business Connector is used to transfer your orders directly to your SAP system; this ensures that you are always up to date on the status of your order. Register today if you do not yet have an EASY account.



## APPLICATION KNOW-HOW

Dichtomatik brand products are also certified for special applications. This enables us to find the right solution for every application. To ensure the safe functionality of the seals, even in individual applications, our team of specialists offer technical services such as drawing preparation, radial force measurements, comprehensive quality and material documentation as well as material modifications and testing based on their extensive technical and application expertise. Customer-specific sealing solutions, kitting and single packaging are just some of the other services that can be offered (country-specific).



## LOGISTICAL SERVICES AND QUALITY STANDARDS

The 6,500 m<sup>2</sup> warehouse in Hamburg, which functions as a European logistics hub, has just one objective - delivering the uniquely high number of Dichtomatik brand products as quickly as possible to the locations they are needed at. In addition to the roughly 60,000 standard designs, around 15,000 customer-specific seals are available from stock. Additional warehouse locations around the world support the supply chain to ensure rapid delivery to our customers..

Special logistics solutions, such as Kanban or vendor-managed inventory, quality testing and simplified customs processes due to certifications, simplify order processing. The warehouse in Hamburg is certified according to DIN ISO 9001 and DIN ISO 14001, thus guaranteeing standardized processes in the quality and environmental management system. In addition, current processes are analyzed and improved in regular Kaizen workshops. Furthermore, warehouse processes are supported by new technologies.



For example, the forklifts have been converted into mobile workstations by using tablets and portable printers, and innovative glove scanners are used for scanning processes. Our other warehouses also meet the highest quality requirements and are part of regular certifications. Our other warehouses also meet the highest quality requirements and are regularly inspected and certified by internal and external organizations.

# PRODUCT PORTFOLIO OF THE DICHTOMATIK BRAND

## PRODUCTS FOR STATIC APPLICATIONS



The whole range of static seals – O-rings, cords, x-rings, cover seals, bolt seals, flange and profile seals, etc. – are available in large number of dimensions, in both metric and imperial units, for a wide range of international standards. The variety of materials on offer leaves nothing to be desired, with a selection of materials certified for a diverse cross section of application-specific requirements.

## PRODUCTS FOR ROTATING MOVEMENTS



Rotary shaft seals are available in standard profiles with and without protective lips and in the compounds NBR and FKM. In addition to these standard designs, the product range also includes special designs of rotary shaft seals, axial seals, shaft sleeves and radial seals for rotary and swivel movements.

## PRODUCTS FOR TRANSLATIONAL MOVEMENTS



Piston seals, rod seals, wipers, guide belts and guide rings for hydraulic applications are readily available in countless standard dimensions in the materials NBR, PTFE, TPU, hard fabric and fabric-reinforced NBR. Application-specific modifications of the design or compound can also be accommodated.

## IMPORTANT NOTE

Dichtomatik brand products meet common industrial market quality standards and are therefore suitable for moderately demanding and non-safety-critical applications. Dichtomatik products are not approved for use in the automotive industry, aerospace and other safety-critical applications. An overview of complementary premium sealing solutions can be found at [www.fst.com](http://www.fst.com).



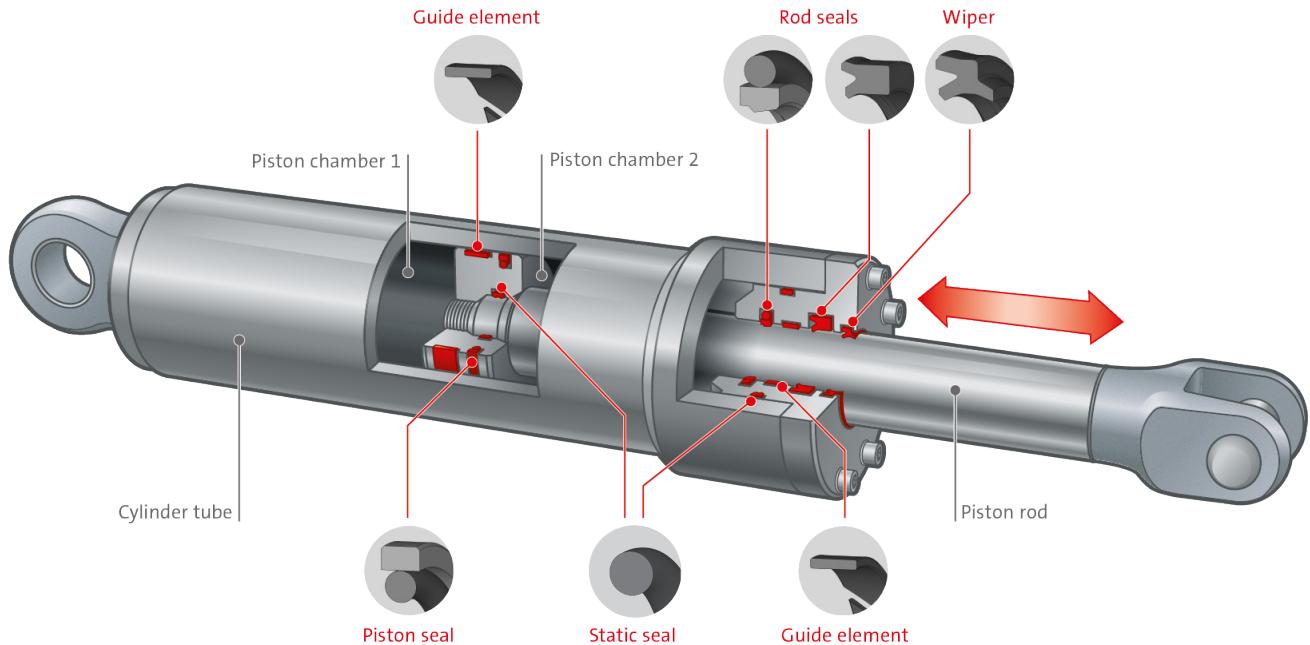
e-Catalog



## HYDRAULIC COMPONENTS

Sealing components for hydraulic applications are used to seal linear/reciprocating moving components. Sealing elements are selected according to the application at hand and its operating parameters, such as pressure, speed, hydraulic medium and operating temperature.

# STRUCTURE AND SEALING COMPONENTS OF A HYDRAULIC CYLINDER



## THE COMPONENTS USED IN HYDRAULICS INCLUDE

- Piston seals
- Piston rod seals/rod seals
- Wipers
- Guiding elements
- O-Rings

The requirements for the application are the decisive factor for selecting the seal profile and other seal components. Other factors to consider for a hydraulic seal to be effective include

- Functional reliability
- Easy assembly
- High durability
- Low friction
- Compatibility with the operating medium taking the operating temperatures into account

### Piston seals

The function of the piston seal is to seal the piston against the cylinder barrel, thus allowing pressure to build up inside the piston chamber.

### Rod seals

Rod seals have the task of sealing the retracting and extending piston rod to prevent the pressurized operating media from escaping from the cylinder.

### Wipers

Wipers “wipe off” the dirt or foreign matter on the rod, thus preventing contamination from entering the hydraulic system.

### Guide elements

Guide elements (guide bands and guide rings) are used to guide pistons and piston rods and avoid direct metal contact, which can be caused by transverse forces occurring.

## POSSIBLE APPLICATIONS IN HYDRAULICS

- Construction machinery
- Agricultural machinery
- Mining machinery
- Mechanical and apparatus engineering

# INTRODUCTION TO THE DESIGNATIONS

## Designations of our hydraulic seals

### Our nomenclature

N = U-Cup  
K = Piston seal  
S = Rod seal  
A = Wiper  
F = Guide elements

### Types

Within the assemblies listed above, we distinguish between the following types:

Assembly	Description
N05, N21, N25, N36	(N) U-Cup symmetrical
KNA	(K) Piston Seal (N) U-Cup asymmetrical (A) Outer sealing (S) Rod Seal
SNI	(N) U-Cup asymmetrical (I) Sealing inside
KK	(K) Piston seal compact
KPOR; SPOR	(K;SPOR) Pistons; Rod PTFE seal with an O-Ring preload element
KPUOR	(KPUOR) Piston polyurethane seal with an O-Ring preload element
KDS;SDS	(K;SDS) Pistons; Rods roof cuff set
AE	(AE) Wiper single-acting
AM	(AM) Wiper with a metal reinforcement (metal seat/metal-reinforced)
AD	(AD) Wiper double acting
ADM	(ADM) Wiper double-acting with a metal reinforcement (metal seat/ metal-reinforced)
GS	(GS) Guide strip
FRK	(FRK) Guide ring piston
FRS	(FRS) Guide ring rod

## DIMENSIONS

Rod seals, piston seals, wipers and guide elements are always defined according to the installation space dimension. This means that the size specifications of the seal correspond to the sizes of the installation space and that the installation space and not the seal is always measured.

We also provide the H dimension (measured width of the seal) for many of our piston and rod seals.

For piston seals and piston guide rings, the outside diameter AD (cylinder barrel diameter) is always listed as the first dimension (reference dimension); the inside diameter ID (rod diameter) is always listed for rod seals, rod guide rings and wipers.

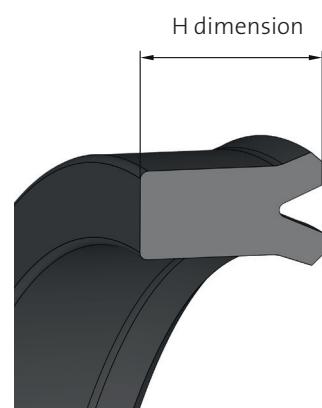
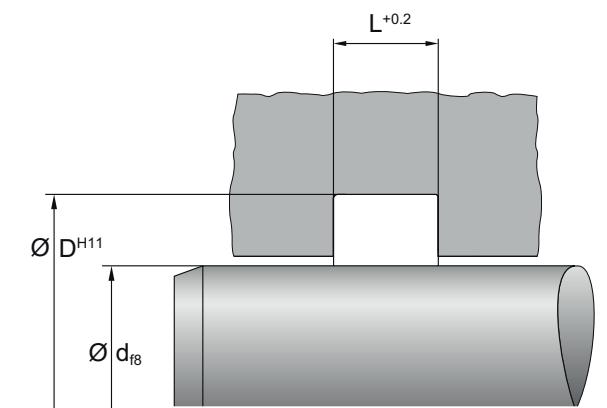
### Examples:

KNA28:

AD x ID x L 50 x 40 x 8 piston seal

SNI30:

ID x AD x L 40 x 50 x 9 rod seal





## SEALING FUNCTIONS

Hydraulic seals are manufactured with a so-called “profile preload” and radially compressed in the installation space. Hydraulic seals are therefore tight at rest due to the oversize and the resulting precompression  $p_v$ . If the seal is then pressurized with the operating pressure  $p$ , this pressure is

added to the existing precompression pressure. The pressure at the sealing surface  $p_d$  is therefore always greater than the pressure to be sealed:

$$p_d = p_v + p$$

## THE SEALING MECHANISM OF ROD SEALS – DYNAMIC SEALING MECHANISM

The critical point of a hydraulic system is the rod seal. Leakage of hydraulic fluid from the cylinder would prevent trouble-free operation and lead to environmental damage, among other things.

The sealing mechanism between the dynamic sealing lip and the rod is based on the hydrodynamic processes in the sealing gap. When the sealing system starts to move, the liquid film is drawn off by the sealing lip. The resulting drag flow and hydrodynamic pressure buildup create the dynamic sealing gap. What remains is a thin lubricating film, the so-called residual oil film. This remaining but necessary liquid film, which is only a few  $\mu$  thick, ensures low-friction operation and thus a long service life for the seal.

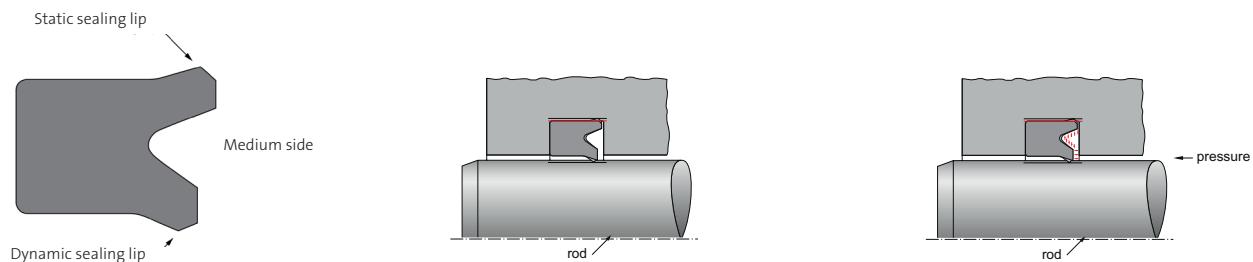
Experts speak of dynamic tightness when the oil film that has been dragged out is completely returned to the pressure chamber.

### Rod seals

A rod seal must be both internally sealing (sealing to the rod) and externally sealing (on the outside diameter to the groove base, purely static) to prevent hydraulic fluid from escaping from the hydraulic system.

When arranging the rod seals, a distinction is usually made between a primary seal and a secondary seal. The primary seal's main task is to withstand the operating pressure, while the secondary seal, subjected to the lower interspace pressure ( $< 5$  MPa), reduces the residual oil film to a minimum.

Example: U-Cups can only be pressurized on one side. As a rule, pressurization on one side is sufficient to meet the requirements of a rod seal.



### Rod seal uninstalled

### Static installation situation

- the static sealing lip seals towards the installation space
- the dynamic sealing lip also seals against the rod in the stationary state

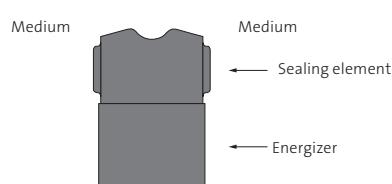
### Dynamic installation situation

- the sealing effect is increased by means of pressurization
- both sealing lips are pressed "outwards"

## THE SEALING MECHANISM OF PISTON SEALS – STATIC SEALING MECHANISM

A piston seal provides dynamic and static sealing on the outside to the cylinder wall and statically to the groove base in the inner diameter. If the piston seal is subjected to system pressure, the sealing effect will also increase and the dynamic sealing lip will be pressed against the cylinder wall.

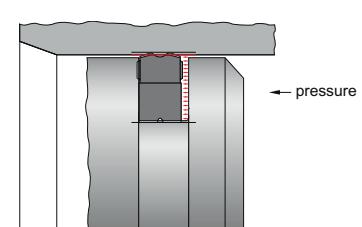
The requirement for a piston seal is usually pressurization on both sides. Compact seals, here using the K84 as an example, can be pressurized on both sides. The pressure load is applied alternately from both sides.



### Piston seal unassembled

### Static installation situation

- the sealing element seals radially to the cylinder wall
- the contact pressure element creates the sealing effect and seals to the groove base



### Dynamic installation situation

- pressure load compresses the seal according to the pressure direction
- the sealing effect increases



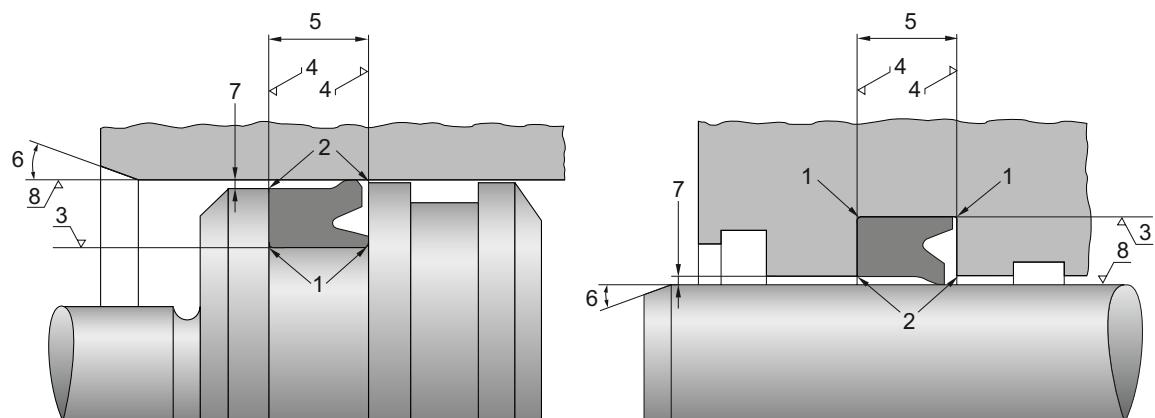
## INSTALLATION SPACES AND CONSTRUCTIVE RECOMMENDATIONS

The parameters of installation spaces, e.g. dimensions, curves, tolerances, installation chamfers and surface finishes (surface roughness), are defined by the respective cylinder manufacturer. When replacing a seal, you must check whether the installation space has changed as a

result of operation. The required surface finishes in particular must be observed and compared with our specifications. Notches on the piston rod or traces of wear caused by abrasive substances must be assessed and, if necessary, repaired.

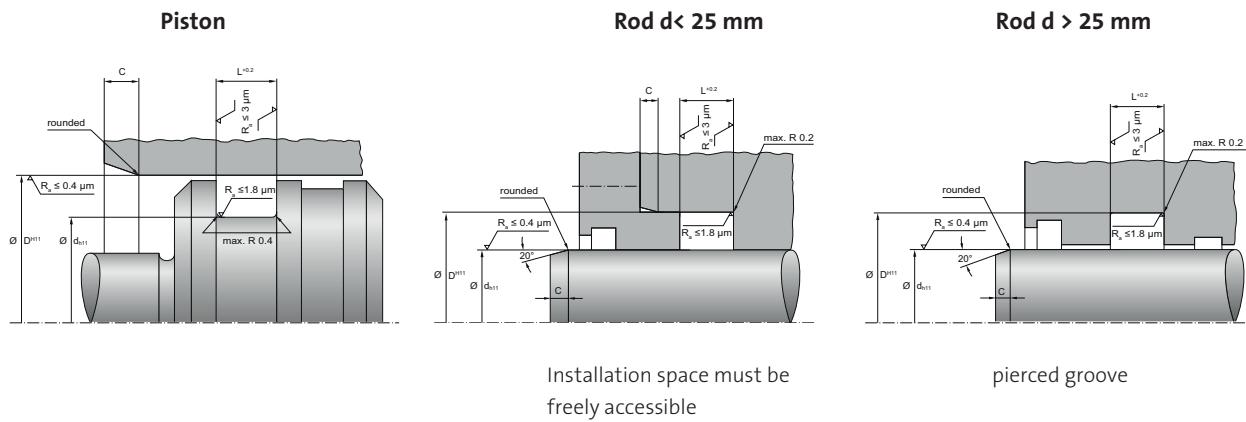
The following principles apply to the design of the installation space and should be strictly observed for trouble-free operation and a long service life of the seal:

- rounded corners in the groove base (1) ensure correct seating of hydraulic seals
- rounded groove flank transitions (2) reduce the risk of gap extrusion
- the surface finish of the groove base (3) and the groove flanks (4) ensure a good sealing function
- compliance with the tolerances for the groove width (5), the installation chamfer (6) and the correct dimensions of the sealing gap on the non-pressure side (7)
- the surface condition of the mating surfaces (8) is largely responsible for a stable sealing function

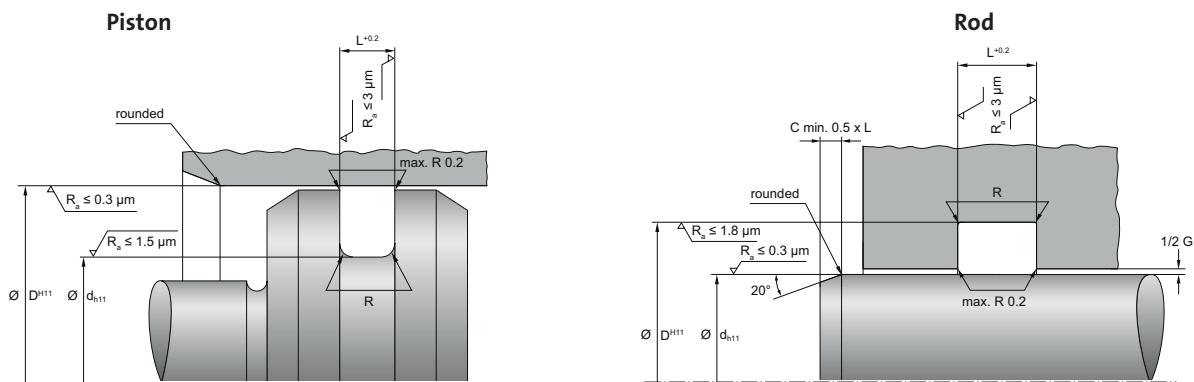


## EXAMPLES FOR USE IN SPECIFIED INSTALLATION SPACES

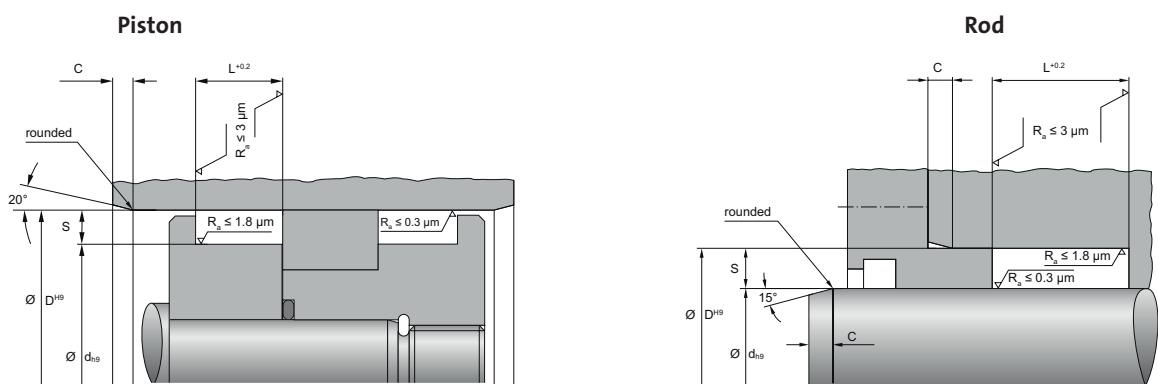
### U-Cups type N, NA, NI



### Type POR, PUOR

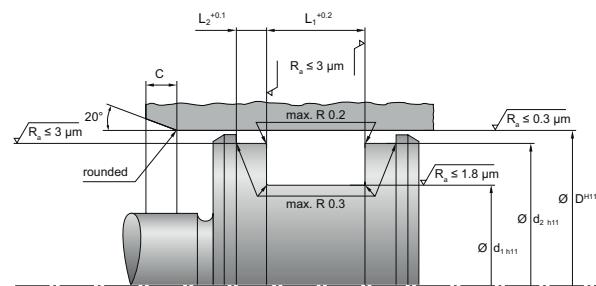


### V-packing type KDS 01, SDS 01



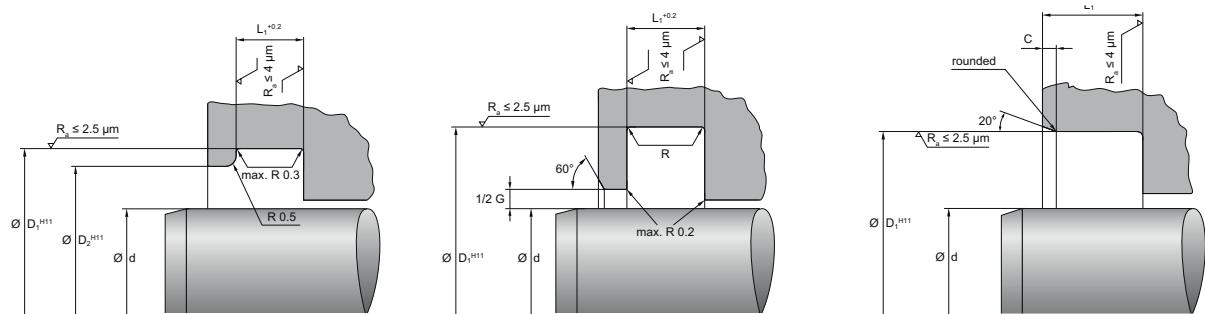
## Compact seal type K

### Piston



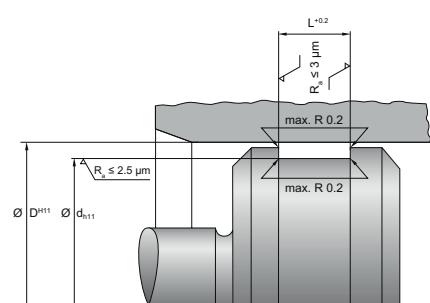
## Wiper type AE, AD

## Wiper type AM, ADM

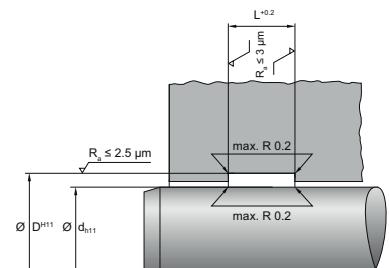


## Guide elements type GS, FRK, FRS

### Piston



### Rod



## ASSEMBLY – WHAT NEEDS TO BE CONSIDERED

Even though the materials used for Dichtomatik brand hydraulic seals deliver excellent performance and are robust, special care is required during installation. Mechanical damage, especially to the sealing edge, can lead to leakage. In addition, each seal must be checked before installation for damage or aging that may have already occurred during transport or storage.

### Instructions for mounting:

1. In the case of single-acting seals, the seal must be installed with the preload side facing the pressure side
2. Insertion chamfers are absolutely necessary on the cylinder barrel and piston rod. The chamfer should have an angle of 20°. The recommended length C depends on the profile width S. This profile width results from  $S = (D-d)/2$
3. Edges must be free from burrs. Radii and chamfers must be manufactured according to the installation specifications
4. Dust, dirt and metal chips must be removed carefully
5. Thread tips, installation grooves for guide elements and rough surfaces etc. should be covered using a mounting cone, otherwise the seal runs the risk of being damaged
6. The cylinder barrel, piston rod and seal must be greased or oiled before assembly. Make sure that the seal is compatible with the medium (see resistance tool, QR code below)
7. Heating in oil or hot water to approx. +80 °C (please pay attention to resistance) makes materials more pliable and easier to expand for assembly. At a temperature of +80 °C to +120 °C, PTFE seals can be expanded much more easily in oil or hot water and then formed back (calibrated)
8. Any assembly tools used, such as expanding mandrels, assembly sleeves or calibration sleeves or calibration mandrels, should be made of soft material (e.g. POM) and be free from sharp edges
9. When mounting type N and NI rod seals in closed grooves, the minimum diameter  $d_{min}$  depends on the profile width S:  $S = (D-d)/2$

Profile width S [mm]	Length of the installation chamfer C [mm]
4	2
5	2.5
7.5	4
10	5
12.5	6.5
15	7.5
20	10
25	10

For the installation of wipers in open installation spaces, the following installation slopes C are recommended in relation to the installation space height H for trouble-free installation:

H [mm]	C [mm]
< 5	0.5
5 to 12	0.7 to 1

S [mm]	4	5	6	7.5	10	12.5	15
$d_{min}$	25	30	40	50	80	100	120

For rod seals  $d < 25$  mm, we recommend mounting in axially open installation spaces.

Standard dimensions of piston seals type N and NA can generally be mounted in closed or half-open installation spaces for sizes  $d > 25$  mm using a snap-on assembly. Fabric-reinforced piston seals and roof collar sets can only be mounted in axially open installation spaces.

Use our resistance tools to find out the compatibility of chemicals and cleaning agents



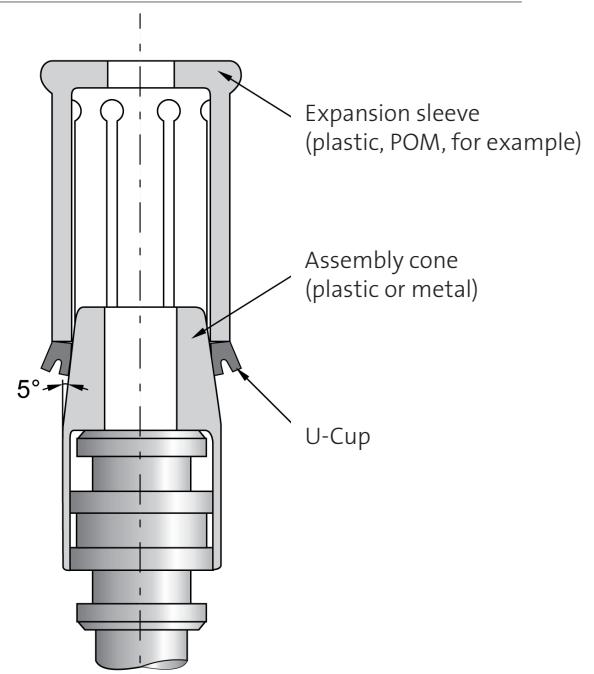
Resistance Tools

## APPLICATION OF ASSEMBLY TOOLS FOR U-CUPS

For easier assembly and to prevent damage to the seal during assembly, we recommend using assembly sleeves/assemblies cones. The sleeve is pushed over the area to be covered.

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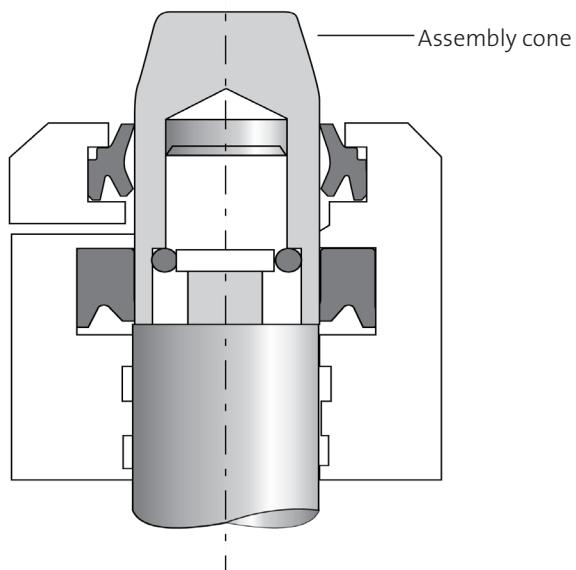
### Installation of a piston seal



The piston seal is then positioned over the cone in the installation space with the aid of an expanding sleeve.

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### Installation of a rod seal



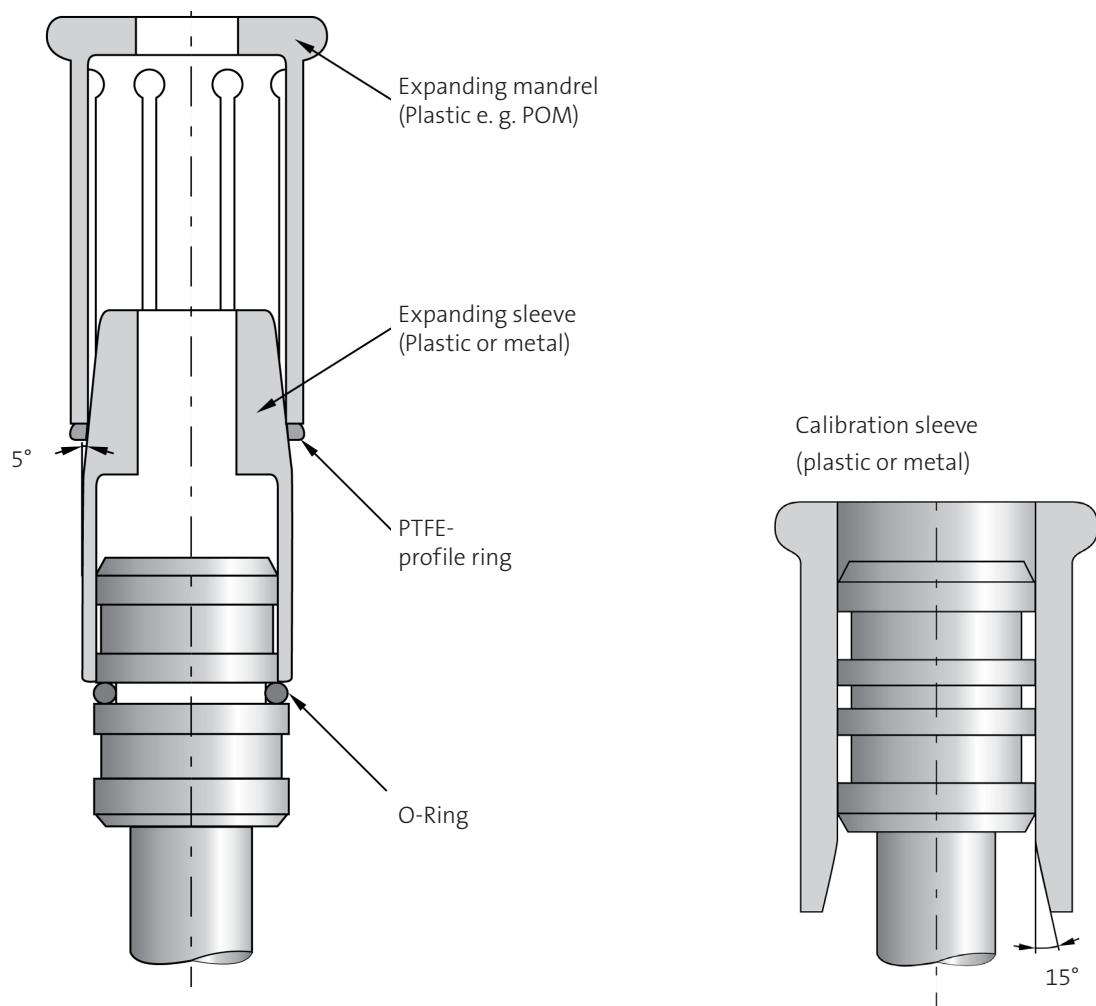
After installing the rod seal, the mounting sleeve prevents damage to the seal and wiper when inserting the rod.

## SPECIAL FEATURES FOR THE MATERIAL PTFE

Since PTFE has virtually no elastic properties, PTFE-pre-loaded sealing elements (SPOR30, SPOR31, KPOR30, KPOR31) must be installed with particular care and then be calibrated. Observe the following installation instructions:

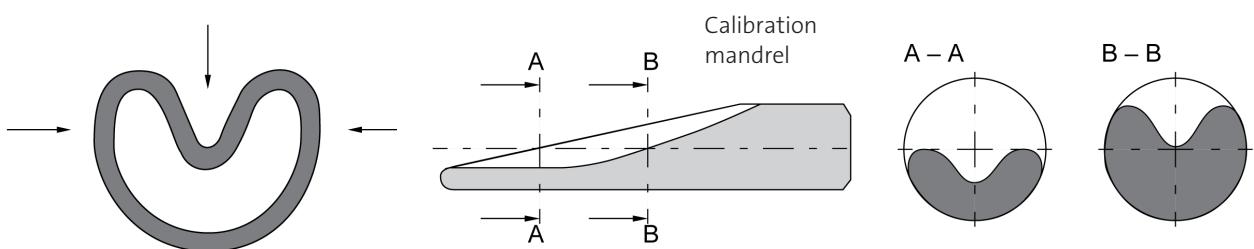
### Installation of piston seals in an enclosed groove

Insert the O-Ring into the groove without torsion: We recommend the procedure already described for PTFE seals. In this case, the PTFE ring is pushed over a conical assembly aid with an expansion sleeve until it snaps into the groove to expand the ring. The deformation of the expanded PTFE ring is accelerated with a calibration sleeve or calibration pliers, the inside diameter of which corresponds to the cylinder barrel diameter.



### Installation of rod seals in a closed groove

Insert the O-Ring into the groove without twisting: Press the PTFE ring together in a kidney shape. No sharp kinks may be created while doing so. Insert the compressed PTFE ring into the groove. Calibrate with a mandrel..



SMALLEST MOUNTABLE NOMINAL GASKET SIZES  
IN AXIALLY CLOSED INSTALLATION SPACES [MM]

Seal type	Series*					
	000	001	002	003	004	005
SPOR30	>12	>16	>19	>38	>70	>200
SPOR31	>12	>16	>19	>38	>70	>200
KPOR30	>8	>15	>25	>40	>60	>133
KPOR31	>8	>15	>25	>40	>60	>133

SMALLEST MOUNTABLE NOMINAL GASKET SIZES  
IN SEMI-ENCLOSED INSTALLATION SPACES [MM]

Seal type	Series				
	000	001	002	003	004
SNI43	>20	>20	>30	>40	>55
KNA44	>6	>10	>16	>28	>45
Seg height of the semi- enclosed installation	0.4	0.6	0.7	0.8	0.9

\*Series depends on the L-dimension of the seal, please ask us for the series.



## MATERIALS

Dichtomatik brand hydraulic seals are offered in elastomers, rubber-fabric materials, thermoplastic elastomers (TPEs), thermoplastics, and hard-fabric materials.

## NBR – ACRYLONITRILE BUTADIENE RUBBER

NBR is widely used in the hydraulic industry due to its good mechanical properties and resistance to mineral oil-based lubricating oils and greases. The material shows good mechanical-technological parameters, e.g. high abrasion resistance, low gas permeability and good resistance to lubricating oils and greases based on mineral oil, hydraulic oils H, HL, HLP, flame-retardant pressure fluids HFA, HFB, HFC, aliphatic hydrocarbons, silicone oils and greases, water up to approx. +60 °C. NBR, on the other hand, is generally not resistant to aromatic and chlorinated hydrocarbons, fuels with a high aromatics content, polar solvents, glycol-based brake fluids and HFD flame-retardant pressure fluids. Ozone, weathering and aging resistance are low. However, this does not affect most hydraulic applications because the hydraulic seals are used in the hydraulic components.

## TPU – THERMOPLASTIC POLYURETHANE

TPU materials belong to the group of thermoplastic elastomers (TPEs). The strength of TPUs lies in the combination of their good properties, both physical and chemical, as well as processing and economic. TPU materials stand out from classic elastomers due to their significantly higher mechanical strength. Other excellent material properties include high abrasion, wear and extrusion resistance, high compressive strength, high tear and tear propagation resistance, and very good resistance to aging and ozone. TPU is well suited for use in mineral oils and greases, hydraulic oils H, HL, HLP, silicone oils and greases, flame-retardant hydraulic fluids HFA and HFB and water up to +50 °C, as well as pure aliphatic hydrocarbons.

## PTFE – POLYTETRAFLUOROETHYLENE

PTFE is a fluorinated plastic. PTFE has a wide range of positive properties that have become indispensable in sealing technology. It is characterized by its virtually universal chemical resistance, the wide temperature application range from -100 °C to +250 °C, an extremely low coefficient of friction and the resulting very good sliding properties, no stick-slip effect, special rigidity and the nearly unlimited resistance to ozone, weathering and aging. Virtually all known hydraulic media, lubricants, chemicals and solvents cannot harm PTFE. Disadvantages of PTFE are the tendency to cold flow or creep of the pure PTFE under pressure load.

## HARD FABRIC MATERIALS

Hard fabric materials are manufactured from various fabric/resin combinations, such as synthetic fiber fabric + phenolic resin, cotton fabric + phenolic resin or polyester fabric + polyester resin. Hard fabric materials are selected for applications in hydraulics with high loads and transverse forces.

## NBR F – RUBBER FABRIC MATERIALS

Cotton or synthetic fiber fabrics can be used as the basis for rubber fabric materials. As standard, Dichtomatik brand products are made of cotton fabric for hydraulic seals. They have high wear resistance, very good friction and sliding properties (due to the lubricant embedded in the fabric lubrication pockets), good low-temperature resistance, and high resistance to pressure and extrusion.

You can find further material information  
on our website



FST-  
Website

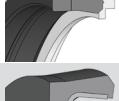
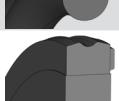
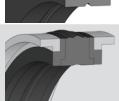
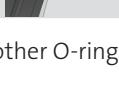
## PROFILE OVERVIEW

### ROD SEALS

Profile	Type	Material	Hardness [Shore A]	Sliding Speed [m/s]	Pressure [MPa (bar)]	Temperature [°C]
	N21	NBR	90	0,5	16 (160)	-30 bis +100
	N25	TPU	95	0,5	30 (300)	-30 bis +100
	N36	TPU	95	0,5	40 (400)	-30 bis +100
	N05	NBR	80	0,5	20 (200)	-30 bis +100
	SNI24	NBR	90	0,5	16 (160)	-30 bis +100
	SNI30	TPU	95	0,5	40 (400)	-30 bis +100
	SNI35	TPU	95	0,5	40 (400)	-30 bis +100
	SNI39	TPU	95	0,5	40 (400)	-30 bis +100
	SNI07	NBR	80	0,5	40 (400)	-30 bis +100
	S72	TPU	95	0,5	40 (400)	-30 bis +100
	SNI43	PTFE Kohle + Grafit		15	35 (350)	-150 bis +250
	SPOR06	PTFE-Bronze mit NBR O-Ring**		2	16 (160)	-30 bis +100
	SPOR30	PTFE-Bronze mit NBR O-Ring**		15	40 (400)	-30 bis +100
	SPOR31	PTFE-Bronze mit NBR O-Ring**		15	40 (400)	-30 bis +100
	SDS01 3/2	NBR F*/NBR	90	0,5	40 (400)	-30 bis +100

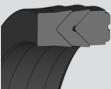
\* F: fabric (fabric-reinforced material)

## PISTON SEALS

Profile	Type	Material	Hardness [Shore A]	Max. Speed [m/s]	Max. Pressure [MPa (bar)]	Temperature [°C]
	N21	NBR	90	0,5	16 (160)	-30 to +100
	N25	TPU	95	0,5	30 (300)	-30 to +100
	N36	TPU	95	0,5	40 (400)	-30 to +100
	N05	NBR	80	0,5	20 (200)	-30 to +100
	KNA23	NBR	90	0,5	16 (160)	-30 to +100
	KNA28	TPU	95	0,5	40 (400)	-30 to +100
	KNA16	NBR	80	0,5	50 (500)	-30 to +100
	KNA44	PTFE carbon + graphite		15	35 (350)	-150 to +250
	KPOR04	PTFE-bronze with NBR O-ring*		2	16 (160)	-30 to +100
	KPOR30	PTFE-bronze with NBR O-ring*		15	40 (400)	-30 to +100
	KPOR31	PTFE-bronze with NBR O-ring*		15	40 (400)	-30 to +100
	K70	TPU	95	0,5	25 (250)	-30 to +100
	K84	TPU	98	0,5	40 (400)	-30 to +100
	KK03	NBR	80	0,5	40 (400)	-30 to +100

\* other O-ring compounds available upon request

## PISTON SEALS

Profile	Type	Material	Hardness [Shore A]	Max. Speed [m/s]	Max. Pressure [MPa (bar)]	Temperature [°C]
	KK22	NBR F*	90	0,5	40 (400)	-30 to +100
	KDS01	NBR F*	90	0,5	40 (400)	-30 to +100
	KDS01	FKM F*	75	0,5	40 (400)	-15 to +150

\* F: fabric (fabric-reinforced material)

## GUIDE

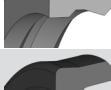
Profile	Type	Material	Sliding speed [m/s]	Dyn. surface pressure [N/mm <sup>2</sup> ]	Temperature [°C]	Delivery condition	Surface
	GS01	PTFE bronze filled	≤ 15	dyn. ≤ 15	-60 to +200	Roll	structured
	GS10	PTFE bronze filled	≤ 15	dyn. ≤ 15	-60 to +200	Roll	smooth
	FRK01	PTFE bronze filled	≤ 15	dyn. ≤ 15	-60 to +200	Strips, cut 30°	structured
	FRS01	PTFE bronze filled	≤ 15	dyn. ≤ 15	-60 to +200	Strips, cut 30°	structured
	GS05	Hard fabric with PTFE	≤ 1	dyn. ≤ 100	-50 to +120	Roll	smooth
	FRK05	Hard fabric with PTFE	≤ 1	dyn. ≤ 100	-50 to +120	Ring, bevel cut 45°	smooth
	FRS05	Hard fabric with PTFE	≤ 1	dyn. ≤ 100	-50 to +120	Ring, bevel cut 45°	smooth

## RADIAL SEALS

Profil	Type	Material	Sliding speed [m/s]	Max. pressure [MPa(bar)]	Temperatur [°C]
	RPORI32	PTFE carbon + graphite woth NBR O-ring*	≤ 2	30 (300)	-30 to +100
	RPORA32	PTFE carbon + graphite woth NBR O-ring*	≤ 2	30 (300)	-30 to +100

\* other O-Ring materials on request

## WIPERS

Profil	Type	Material	Hardness [Shore A]	Sliding Speed [m/s]	Temperatur [°C]
	AE40	NBR	90	1	-30 bis +100
	AE42	TPU	90	2	-30 bis +100
	AE41	NBR	90	1	-30 bis +100
	AE47	TPU	90	2	-30 bis +100
	AM43	NBR	90	1	-30 bis +100
	AM44	TPU	95	2	-30 bis +100
	AM45	NBR	90	1	-30 bis +100
	AM54	TPU	95	1	-30 bis +100
	AE80	PTFE-Bronze mit NBR O-Ring*		15	-30 bis +100
	AD60	PTFE-Bronze mit NBR O-Ring*		15	-30 bis +100
	AD61	PTFE-Bronze mit NBR O-Ring*		15	-30 bis +100
	AD48	TPU	95	1	-30 bis +100
	AD51	NBR	90	1	-30 bis +100
	ADM55	TPU	95	1	-30 bis +100

\* other O-Ring materials on request

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