



## “What is your sealing problem?”

Actually only a simple question, but for us it is much more. This was already the slogan of our company when it was founded in 1983. We exist precisely to answer this question with a suitable solution.

From the very beginning, we have made it our responsibility to develop individual sealing solutions for a wide variety of requirements. With our high quality and exceptional solution competence, we were able to make an excellent name for ourselves in a wide range of industries after only a very short time.

Since then, we have developed into an agile and modern still family-run company, where even today the answer to the question “What is your sealing problem?” is known.

Our company name actually says the most important thing about us: We make seals! We have always seen ourselves in the diversified sealing industry as a supplier of sealing systems individually adapted to the application.

You could also say that our name speaks for itself.

We are operating in the nonstandard sealing sector and offering you an added value by reviewing every application in order to provide the best possible technical solution. It is natural for us to be in close contact with our partners. Together with you, we are happy to work on ( new ) challenging technical tasks and complete everything with an agile service around our products.

**So please do not hesitate to contact us and let us work together on your tasks.**

*Erika Löbich and  
Sebastian Löbich*



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# Mission and vision

## They are the reason why we exist.

We accept technical challenges and are enthusiastic about individual sealing solutions. We provide these in combination with the best possible service. We remain flexible for our customers and act unbureaucratically within the possible framework. As a sustainable family business, we place great value on long-term relationships based on partnership. We support our customers over the complete product life cycle. In doing so, we attach great importance to sincere and open communication.

## A close cooperation with our partners is absolutely necessary to meet the high quality and deadline requirements.

We strive for long-term relationships. In this way, processes can not only be kept stable, but also optimized in the medium and long term. To this end, we deal with our partners in a trustful manner.

We are the cross-industry reference for individual technical solutions combined with maximum agility in the special seals sector.



## We see ourselves in the responsibility to share our success with other people.

We support both local and regional associations and institutions.

We support people in need of help, but we also give something back to the region we come from.

## The most important aspect of GFD is our responsible and committed employees.

They are the source of small and big ideas in the most diverse areas. As a medium-sized company, we encourage cross-divisional thinking and teamwork in order to constantly improve our processes. By involving employees in decision-making processes, we participate from a wide range of experience and know-how.

## Quality is content in and around GFD.

We see quality as the key to our longstanding existence. Through structured processes, trained employees and modern technology we ensure our high quality standards day after day. We solve quality issues in a customer-oriented and sustainable way in combination with our know-how, our methods and our partners. For us it means making quality every day.

# Quality

## **We meet your and our quality requirements.**

We constantly optimize our processes to ensure sustainable and reproducible quality. For this purpose we use modern testing and measuring equipment in addition to the many years of experience of our qualified employees.

## **We see abnormalities as an opportunity to improve ourselves**

The avoidance of mistakes is our priority. In order to achieve this, the necessary test and process steps are already defined in the product development phase. In case of irregularities, we work closely and openly with our customers and react quickly by implementing necessary measures.

## **„For us it means making quality every day“**

From material procurement to delivery, we closely examine the interfaces and process steps. By means of material tests we ensure the quality of the materials to be procured. Where necessary, further tests are carried out on the material. Some finished parts are even subjected to pressure and/or leak tests before delivery and certified accordingly on request. We check the feasibility of application-specific tests and develop solutions together with our customers.

## **Quality assurance**

By using known and internal processes we ensure the quality of our products and meet the requirements. Our during and after production quality control enables us to quickly detect and react to conspicuous features.

Internal testing and measuring processes support us efficiently. We regularly check our measuring equipment for up-to-dateness and state of the art. Where appropriate and necessary, we invest in new equipment and tools.

## **We are certified according to ISO 9001:2015**

By means of internal audits we set ourselves a high standard of quality with regard to our products and processes. Where necessary, we examine our products and processes for topicality and definition. A reasonable and economical optimization helps us to streamline processes and to achieve a faster workflow.



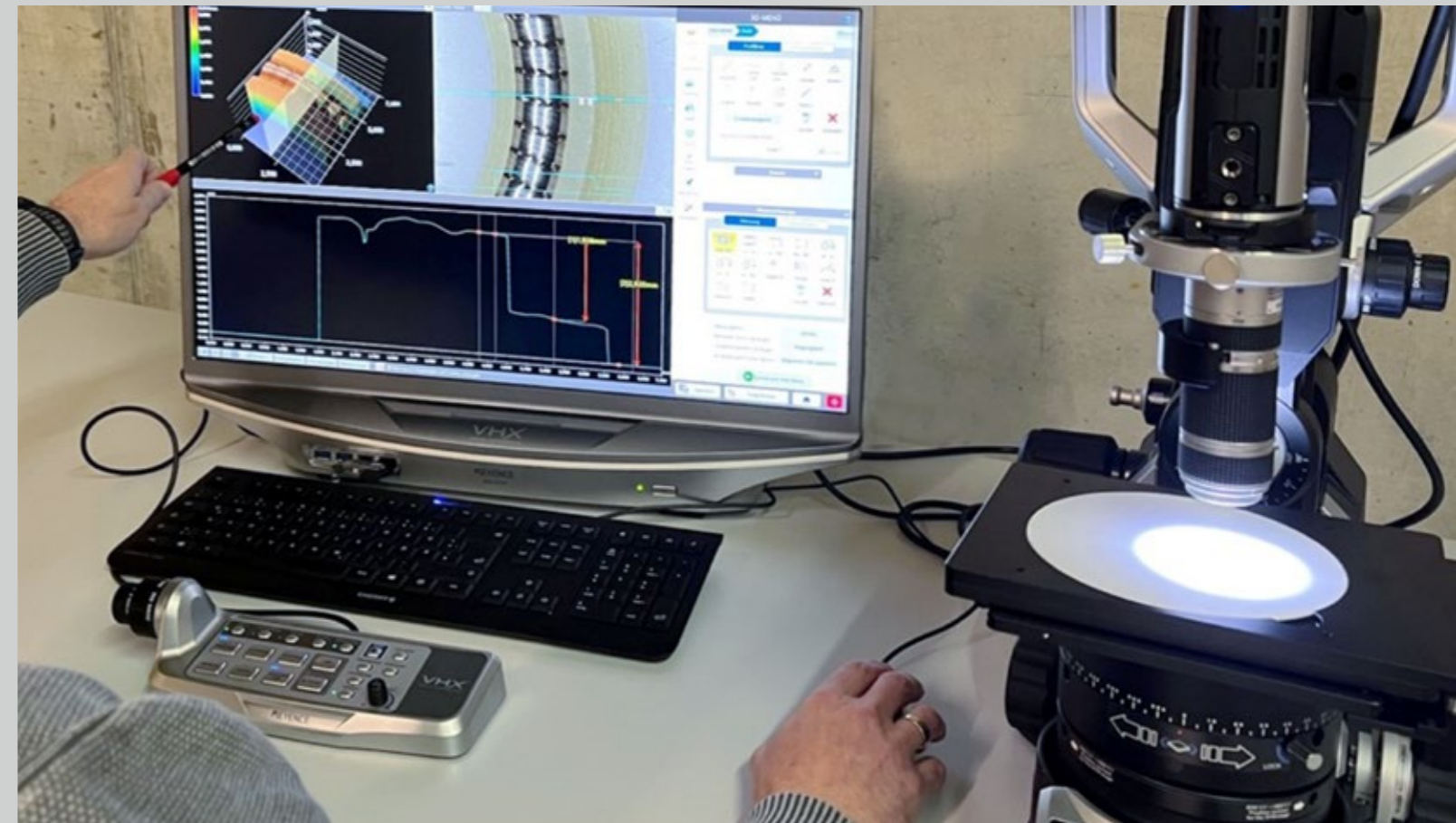
## Approval and conformities

Because our seals are used in many sensitive areas, the materials used are partly subject to legal regulations and rules. In order to meet the requirements here, we can issue appropriate certificates of conformity on request. We go even further and, if requested, have finished parts tested in accordance with applicable regulations and certify the test results for each order and/or batch.

### **If required, we can certify the following conformities for many of our materials**

- Material certificate according to EN 10204 - 2.1, 2.2 and 3.1
- Fire and explosion protection (BAM, ATEX, UL94 V-0, etc.)
- Food regulation according to EU 1935/2004, EU 10/2011, FDA, KTW, W270, 3-A, etc.
- Restrictions on the use of hazardous substances (REACH, RoHS, Dual Use etc.)
- Biocompatibility in medical applications (USP Class VI, ISO 10993, etc.)
- NORSOK M710

**...we are able to check further conformities on request, please contact us!**



## Occupational safety and environment

### **We fulfill our responsibility towards the environment,**

in which we fully comply with legal and regulatory requirements.

Using internal measures, we try to promote the environmental idea continuously and sustainably. For example, we have decided to use a packaging machine to convert cardboard packaging into filling material, which is more environmentally friendly. We closely observe changes in the market regarding environmental protection and react at short notice wherever possible

### **To meet the legal and regulatory requirements,**

we have an external service provider who supports us with regular inspections and suggestions on the subject of occupational health and safety. We react quickly and sustainably to any weak points.

We also regularly invest in ergonomic workplaces and ergonomic equipment to maintain the health of our employees.

# Research and development

We are constantly expanding our testing facilities, depending on customer requirements and our internal demands in terms of basic research on new and alternative materials.

Currently we are able to perform the following tests with our in-house test benches and test equipment:

- Pressure and crack testing on spring energized lip seals
- Determination of the friction torque
- Determination of force characteristics
- Leak test on spring energized lip seals
- Helium leakage test bench



[www.seals.de/research](http://www.seals.de/research)

## TA-Luft test

According to VDI guideline 2440 (November 2000 edition)

The technical demands on seals are constantly increasing.

More and more often, proof of density according to defined density classes is required.

In order to meet the requirements of the TA-Luft (German Clean Air Act) in particular, we have had GFD spring-energized lip seals tested and certified accordingly.

In cooperation with the company AMTEC Advanced Measurement Messtechnischer Service GmbH a specified leak test was carried out and certified.

The density requirement specified in the guideline VDI 2440 was achieved with the GFD spring-energized axial seal.

**For detailed technical advice and information on the test report, please contact us.**

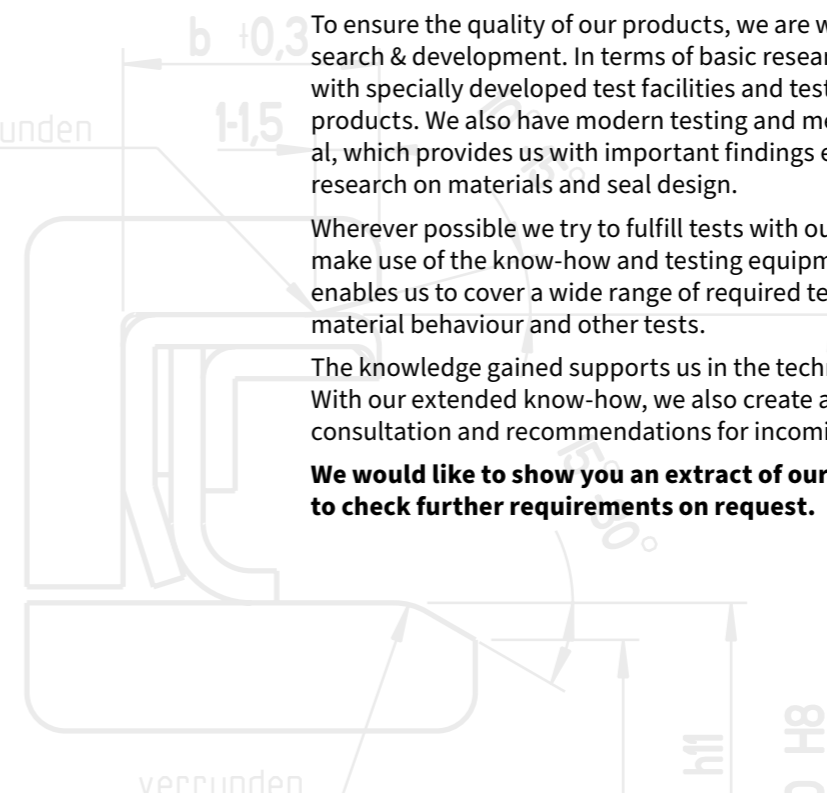


To ensure the quality of our products, we are well equipped in the area of research & development. In terms of basic research, we have established ourselves with specially developed test facilities and test benches that are tailored to our products. We also have modern testing and measuring equipment at our disposal, which provides us with important findings even for project-independent basic research on materials and seal design.

Wherever possible we try to fulfill tests with our own equipment. But we also make use of the know-how and testing equipment of our external partners. This enables us to cover a wide range of required technical information on materials, material behaviour and other tests.

The knowledge gained supports us in the technical engineering of our products. With our extended know-how, we also create a technical basis based on facts for consultation and recommendations for incoming inquiries.

**We would like to show you an extract of our possibilities here, we are able to check further requirements on request.**



# Solution competence and know-how

When developing and designing a seal or sealing system, many different parameters have to be taken into account. The solution for a seal is developed in cooperation and coordination with the customer.

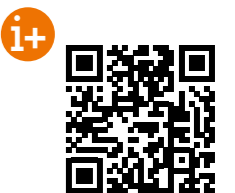
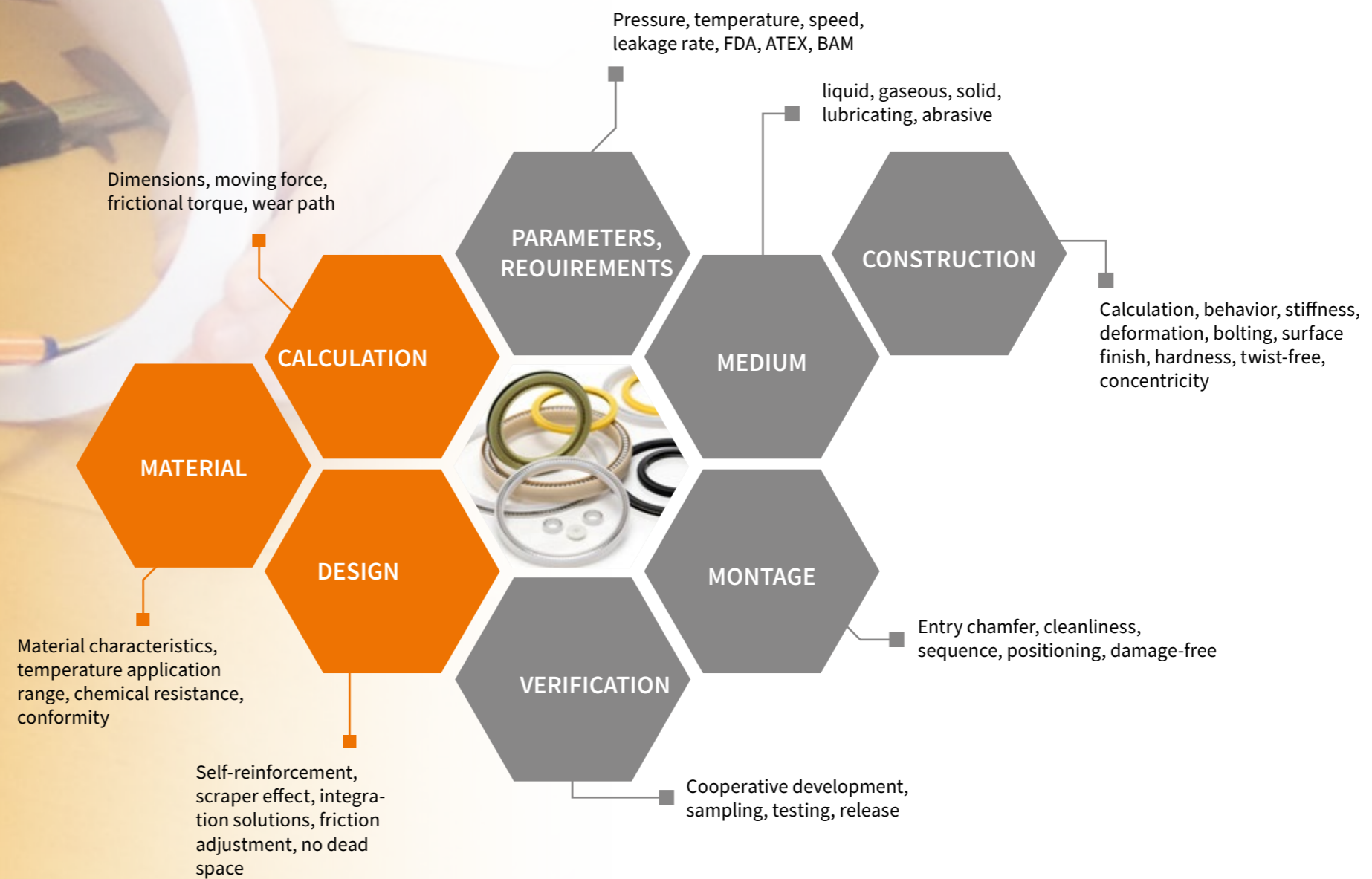
However, not only the seal should be considered. The challenge is to consider all influences and parameters of the application as far as possible.

Based on the application parameters we develop a design recommendation adapted to your requirements.

**GFD supports and accompanies you to your questions and requirements around the application.**

The following illustration is intended to provide an orientation to possible influences and parameters to be taken into account.

**We are at your disposal for any questions, please do not hesitate to contact us.**



[www.seals.de/solution-competence](http://www.seals.de/solution-competence)

# Spring Energized Lip Seals

High demands on sealing elements require extraordinary solutions. Spring energized lip seals are such an extraordinary solution. The well thought-out selection of the material and a seal design adapted to the respective conditions results in a variable sealing system that can withstand extreme operating conditions and parameters.

#### The benefits in brief:

- Temperature range from approx. -250°C to +300°C
- Chemical resistance against almost all medias
- Low friction coefficient
- No stick-slip-effect
- Diameter range from 2 mm to 3000 mm
- No tool cost

In addition to a wide range of standard products, we provide you with the right seal design for your application. There are almost no limits to the design and size.



[www.seals.de/  
spring-energized-lip-seals](http://www.seals.de/spring-energized-lip-seals)



# General information

applications and industries

## Components

Normally, **spring energized seals** consist of a jacket made of highly stressable plastic/plastic compounds and an embedded preloading element made of different materials.

Among other plastics, polytetrafluoroethylene, or PTFE for short, is the most suitable material for the seal jacket. Also known as Teflon, this polymer has special properties due to its chemical structure. The arrangement of the fluorine atoms around the carbon atoms creates a kind of protective layer, which generates almost universal chemical resistance. Only a few media, such as elementary fluorine or alkali metals, can affect the plastic. Furthermore, PTFE has a low friction coefficient, which makes it predestined for use in dynamic applications. In addition to high temperatures up to 300°C, PTFE is also used in cryogenic applications. By admixing additives, the properties of PTFE can be modified and adapted to the respective application. PTFE is a sintered material which is brought into the desired shape by machining. This allows a wide range of variants to be produced without tooling costs.

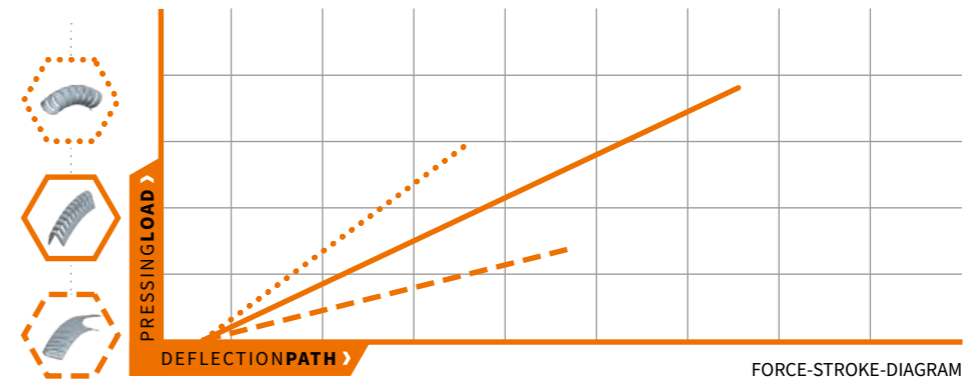
Different variants and materials are available as preloading elements or springs, which are also adapted to the respective application. In addition to corrosion-resistant stainless steel, alloys for higher requirements are available. The use of elastomeric materials is also possible. The preload elements essentially determine the force characteristics of the seal and will be adapted to the respective application. Due to the in-house production of the spring elements we have a wide range of different materials and special dimensions.

## Mode of action

The behaviour of a spring energized seal follows the functional principle of an elastomer O-ring.

During installation, the seal is compressed and creates a pressure on the sealing surfaces primarily by the spring. As a rule, the higher the force of the spring, the higher the tightness. The actual system pressure increases the contact pressure and thus the sealing effect.

Depending on the required force application, different spring variants can be selected. These differ in the ratio between the pressing stroke and the pressing load as shown in the following diagram.



## Typical applications / Industries

### Machine- & Plant Construction

- Tool turret

### Oil and gas industry

- Butterfly valve
- Ball valve
- Cryo temperature

### Sealing Technology

- Mechanical seals

### Chemical & Process Technology

- Filling systems
- Dispensing technology

### Medical & Food Technology / Pharma

- Endoscopy
- pipetting heads
- HPLC pumps

### Laser & Sensor Technology

- Optical measuring machines
- CO<sub>2</sub> laser cutting heads
- ultrashort pulse laser

### Aviation & aerospace

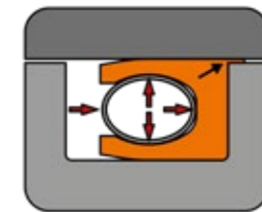
- Satellite telescopes
- Fuel tanks
- Fuel systems

## Cold flow behavior

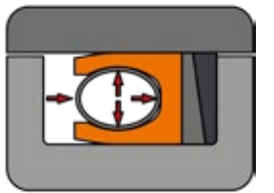
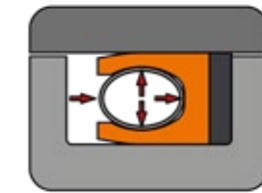
The gap behind the seal is decisive for the effect and the service life. This gap occurs primarily in radial seals or is necessary for design reasons. Since plastics tend to flow, this gap must be kept as small as possible to avoid extrusion into the gap. This phenomenon is significantly intensified with increasing pressure or temperature.

To counteract the cold flow, different arrangements of support rings made of pressure-resistant material are used.

**Our technical department will be pleased to advise you on this.**



Single backup ring



Splitted backup ring

## Surface finish

Spring energized lip seals require a comparatively high standard of surface quality for the sealing surfaces. In general, the better the surface, the better the sealing effect and also the service life of the seal due to less wear. The best possible surface quality should be aimed for, especially when sealing gases and in the cryogenic area.

In addition, the surface hardness of the sealing surfaces also determines the wear resistance of a dynamic seal. Soft sealing surfaces can be damaged by abrasive particles, which must also be considered when selecting the correct seal material. A hardness of approx. 55-60 HRC should be maintained as a guide value.

Application/Media	Surface roughness	
	static	dynamic
Helium (Gas) Nitrogen (Gas) Cryogenic temperature	0,1 to 0,3 Ra	0,1 to 0,2 Ra
Air Gas	0,1 to 0,6 Ra	0,1 to 0,4 Ra
Water Oil	0,1 to 1,6	0,1 to 0,4 Ra

## Assembly and installation



Care should be taken when installing a spring energized lip seal. Installation over sharp edges should be avoided and there should be sufficient lead-in chamfers.

Since the seals are only slightly expandable, split grooves should be used. However, installation in closed grooves is possible in individual cases.

**Please contact our technical department.**



# Materials

## Jacket material




More than 250 compounds are available for the material of the seal jacket for a wide range of applications. A selection of these can be found here in the table.

In addition, individual compounds suitable for your application are also possible.

## Preload elements

In addition to the following standard materials, other materials are also available. Please contact our technical department.

Please contact our application technology department.

			
<b>1.4310</b>	x	x	x
<b>Elgiloy 2.4711</b>	x	on request	on request
<b>Inconel 2.4669</b>		x	x
<b>Hasteloy 2.4819</b>	x	on request	on request



Besides springs as preload elements, elastomer O-rings made of FKM, NBR or silicone are also possible, depending on the application.

Material description	Compound no.	Relative wear resistance	Temperature range °C FDA	FDA	ATEX	BAM	USP Cl. VI	Norsok
<b>PTFE virgin</b> Recommended for low to medium dynamic or static applications.	01 white	3	-250°C ... +200°C		x			
<b>modified PTFE virgin</b> Recommended for low to medium dynamic or static applications. Higher pressure resistance, suitable for UHV. Low gas permeability.	01X white	3	-250°C ... +200°C	x	x	x	x	x
<b>PTFE carbon &amp; graphite reinforced</b> Very good, universal properties for higher temperatures and wear resistance. Especially suitable for hot water and steam.	03 black-grey	8	-100°C ... +290°C					
<b>PTFE graphite reinforced</b> Very good, universal properties for higher temperatures and wear resistance. Low friction and wear resistant.	12 grey	7	-100°C ... +290°C					
<b>PTFE with glass fiber and MoS<sub>2</sub></b> Highly wear resistant, very tough. Recommended for high pressure hydraulics, water and steam. At high speeds and soft contact surfaces, the material can have an abrasive effect.	06 grey	9	-150°C ... +290°C					
<b>PTFE with polymer filler</b> Excellent wear resistance. Recommended for medium and high speeds in dynamic applications. Especially suitable for soft contact surfaces.	10 creme/beige	8	-150°C ... +300°C					
<b>modified UHMW-PE</b> Extremely tough and wear resistant, but limited chemical and temperature resistance. Especially suitable for abrasive media.	08 yellow	9	-250°C ... +100°C		x			
<b>PEEK</b> Extremely hard material, very suitable as support ring in high pressure applications to prevent extrusion.	126 creme/beige		-50...+310	x				
<b>PCTFE</b> Material for seat rings and seals. Suitable for low temperatures.	132 white		-250...+180					
<b>PTFE glass fiber reinforced</b> Highly wear resistant and, due to FDA conformity, ideally suitable for use in food and medical applications. Can be abrasive at high speeds and soft contact surfaces.	150 white	9	-150...+290	x				
<b>Modified PTFE carbon reinforced</b> High pressure and high temperature resistant.	136 black	8	-100...+290	x				
<b>PTFE with carbon black + polymer filler</b> Good wear resistance.	221 black	8	-100...+290	x	x			
<b>PTFE special carbon reinforced</b> High pressure and high temperature resistant.	267 black	8	-100...+290					x
<b>sepcial modified PTFE virgin</b> Modified PTFE with BAM approval.	285 white	3	-250...+200			x		

# Radial Seals

## Design overview

Apart from the standard shapes listed below, we develop variants customized to the respective application.

**Our technical department will be pleased to advise you.**

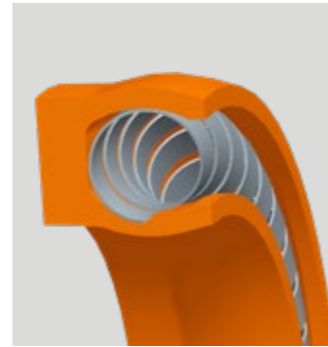
### Type 400

Standard type with inserted V-spring, symmetrical with rounded sealing lips. Particularly suitable for dynamic applications due to the high flexibility of the sealing lips and low friction



### Type 103

Standard type with inserted coil spring, symmetrical with rounded sealing lips, particularly suitable for static or slightly dynamic applications due to the high spring forces



### Other types and variants of type 400

#### Type 401

Sharp scraper edge on the inner diameter, suitable as a rod seal for translational movement of fluids



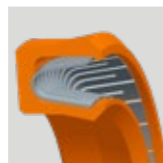
#### Type 402

Sharp scraper edge on the outer diameter, suitable as piston seal for translational movement of fluids



#### Type 4VS

Symmetrical design with chamfered sealing lips on both sides, suitable shape for dosing fluids



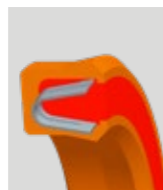
#### Type 414

With retaining flange as anti-rotation device to prevent the seal from rotating, especially suitable for rotary applications



#### Type 4FM

Spring chamber encapsulated with FDA-approved silicone sealing compound, low dead space for use in the food industry



### Other types and variants of type 103

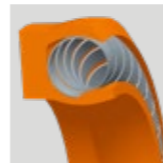
#### Type 113

Sharp scraper edge on the inner diameter, suitable as a rod seal for translational movement of fluids



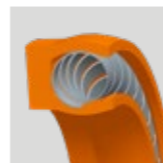
#### Type 123

Sharp scraper edge on the outer diameter, suitable as piston seal for translational movement of fluids



#### Type 103H

Seal with reinforced back and therefore suitable for high pressures



#### Type 143

With retaining flange as anti-rotation device to prevent the seal from rotating, especially suitable for rotary applications



#### Special

Encapsulated version = "Type JS": Coiled spring encapsulated for dead space free sealing primarily in the food industry (FDA), suitable for butterfly valve seals



## Installation and groove dimensions

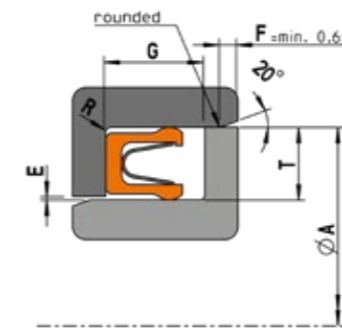
The gap "E" behind the seal is decisive for the service life of the seal. In general, this gap must be as small as possible to prevent cold flow of the material. The maximum gap depends on the application parameters, such as pressure and temperature.

**Please contact our technical department for further information.**

### Piston seals

For piston seals (dynamic surface outside) the dimension "A" is used as nominal dimension.

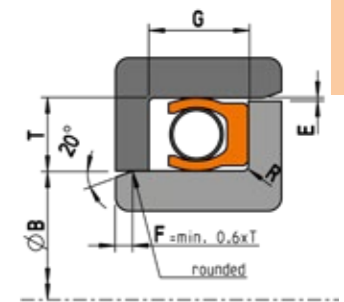
Dimension A = bore diameter.



### Rod or shaft seals

For shaft seals (dynamic surface inside) the dimension "B" is used as nominal dimension.

Dimension B = rod or shaft diameter



## Match code

The following information is generally sufficient for the seal definition of standard seals:

For special dimensions it is also sufficient to specify the groove dimensions, e.g:

Design Nominal dimension Nominal cross-section Preload element  
**113 - B 50,0 - 1/8" - 01 - C**

**103-B 250 x 270 x 15-06-E**

## Standard sizes

In addition to the following standard sizes, we are able to adapt our seals to existing groove geometries or create a solution customized to the respective application. The specified diameters are only approximate values.

**If you have any questions, please contact our technical department.**

Nominal cross-section	Piston Seal Nominal dimension A H8		Rod Seal Nominal dimension B g6		G +0,25	T +0,05 mm	max. R mm
	from Ø	to Ø	from Ø	to Ø			
1/16"	4,4	150	1,3	150	2,4	1,42	0,2
3/32"	8	300	3,5	300	3,6	2,26	0,2
1/8"	12,5	500	6,5	500	4,7	3,07	0,3
3/16"	22	800	12,5	800	7,1	4,72	0,3
1/4"	37	1200	25	1200	9,5	6,05	0,3
3/8"	95	3000	75	3000	15	9,5	0,4
1/2"	175	3000	150	3000	18	12,7	0,5

## Preload element

The abbreviations C I E R denote the last digit of the match code.

Materials		
stainless steel	C	1.4310
Inconel	I	2.4669
Elgiloy	E	2.4711
Hasteloy	R	2.4819

Other materials available on request

# Axial seals

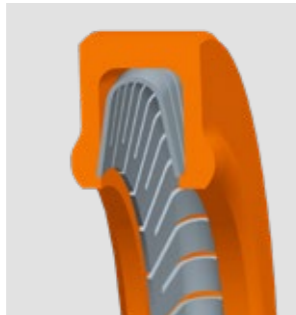
## Design overview

In addition to the standard shapes listed below, we also develop customized versions for specific applications.  
**Our technical department will be pleased to advise you.**

### For internal pressure

#### Type 403

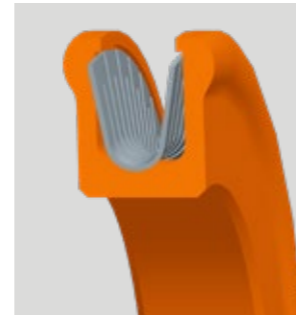
Symmetrical design with rounded sealing lips for dynamic and static applications, inserted V-spring



### For external pressure/vacuum

#### Type 404

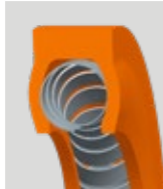
Symmetrical design with rounded sealing lips for dynamic and static applications, inserted V-spring



### Other types and variants for internal pressure

#### Type 304

Symmetrical design with rounded sealing lips for dynamic and static applications, high pressing force due to inserted coiled spring



#### Type 1100

For static to slowly dynamic applications such as swivel joints, high pressing force and large pressing stroke, full contact spring



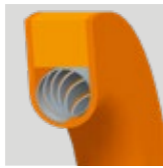
#### Type 2100

For static to slowly dynamic applications such as swivel joints, high pressing force and long pressing stroke, with inserted steel ring to increase stability



#### Encapsulated type

Coiled or V-spring encapsulated for dead space-free sealing primarily in the food sector (FDA)



### Further types and variants for external pressure/vacuum

#### Type 314

Symmetrical design with rounded sealing lips for dynamic and static applications, high pressing force due to inserted coiled spring



#### Type 1101

For static to slow dynamic applications such as swivel joints, high pressing force and large pressing stroke, full contact spring



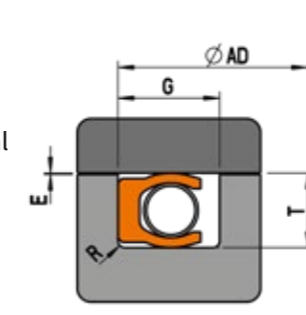
**We also supply special sizes, special profiles, different variants and special designs.**

## Installation and groove dimensions

For dynamic applications, such as a swivel joint or under certain operating conditions, a gap behind the seal may be necessary in the design or a gap may form. In general, this gap must be as small as possible to avoid cold flow of the material. The maximum gap "E" depends on the application parameters, such as pressure and temperature.  
**Please contact our technical department for further information.**

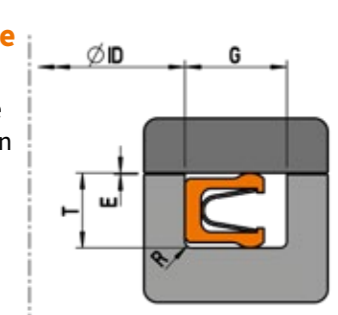
### For internal pressure

For seals for internal pressure, the outside diameter "AD" is given as the nominal diameter.



### For external pressure

For seals for external pressure and vacuum, the inner diameter "ID" is given as nominal diameter.



## Match code

The following information is generally sufficient for the seal definition of standard seals:

For special dimensions it is also sufficient to specify the groove dimensions, e.g:

Design    Nominal dimension    Nominal cross-section    Preload element  
**304-AD 50,0 - 1/8" - 01 - C**

**304-85 x 93 x 3 -06-E**

## Standard sizes

In addition to the following standard sizes, we are able to adapt our seals to existing groove geometries or create a customized solution for the respective application. The specified diameters are only approximate values.

**For questions please contact our technical department**

Nominal cross-section	Nominal dimension ID mm h11		Nominal dimension AD mm H11		G +0,25	T +0,05 mm	max. R mm
	from ø	to ø	from ø	to ø			
1/16"	5	150	10	150	2,4	1,42	0,2
3/32"	8	300	14	300	3,6	2,26	0,2
1/8"	12	500	18	500	4,7	3,07	0,3
3/16"	25	800	35	800	7,1	4,72	0,3
1/4"	55	1200	70	1200	9,5	6,05	0,3
3/8"	120	3000	150	3000	15	9,5	0,4
1/2"	175	3000	150	3000	18	12,7	0,5

## Preload element

The abbreviations C I E R denote the last digit of the match code.

Materials		
stainless steel	C	1.4310
Inconel	I	2.4669
Elgiloy	E	2.4711
Hasteloy	R	2.4819

Other materials available on request

# Individual solutions

## Solutions for valves

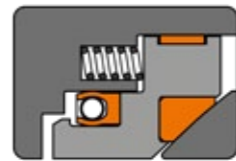
Valves that have to function at low temperatures of e.g. -196°C or in the desert, that have to be resistant to aggressive media, hot gases and pressures of several hundred bar, and at best with a long service life, require special solutions. We at GFD check your application individually and offer you a variety of solutions.

We supply solutions for a wide variety of valves such as ball valves, butterfly valves or control valves. We offer materials, which are tested and certified according to NACE/NORSOK/BAM.

**If you have any questions, please feel free to contact our technical department. We have the right solution for your application.**



Ball valve seal. Tilted sealing profile integrated into the ball.



Typical ball valve arrangement: quasistatic sealing behind the seat ring



Valve Seal with loaded sealing surface



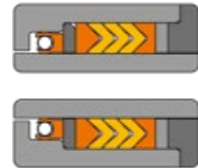
Valve seal with several spring-loaded sealing lips, for example once against the valve and once against the housing.



Valve Seal with encapsulated coiled spring for dead space free sealing. Support ring can be made of metal or plastic, depending on the application.



With two grooves manufactured seal for special dimensions or large groove dimensions



Special solution v-packaging. Sealing system consisting of several parts, such as a spring energized seal and support rings, to enable sealing at very high pressures such as over 1000 bar



## Solutions for the food and pharmaceutical industry

This area ideally combines the material properties of chemical-resistant plastics and acid-resistant spring steel. The preloading element guarantees a high and permanent elasticity, which is not affected by cleaning or sterilization processes. We offer FDA and USP Class VI certified materials.

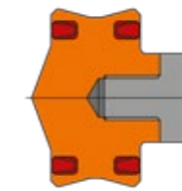
**If you have any questions, please feel free to contact our technical department. We have the right solution for your application.**



Seal with filled spring chamber for sealing without dead space in food products



Encapsulated v-spring for sealing without dead space or against very aggressive media

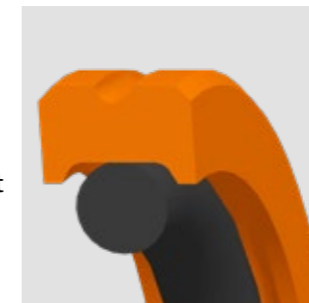


Special solution dosing piston: Sealing solution in the field of filling technology, double-acting seal, with often translatory movement

## Special designs for special requirements

### Preloaded sealing ring

Two-piece sealing element consisting of a pressure ring made of wear-resistant plastic compound and an O-ring as preload element.



### Lip seal without housing

Radial lip seal made of wear-resistant plastic compound. The design is freely selectable and is determined on the basis of the application parameters.



More detailed information on the wide range of possibilities can be found in the lip seals section.



[www.seals.de/individual-solutions](http://www.seals.de/individual-solutions)

# Resilient Metal Seals

Resilient metal seals from GFD have already proven themselves worldwide under the most diverse extreme operating conditions. They are used when conventional sealing products can no longer meet the parameters and requirements in new or existing applications.

For example, when the conventional seal is not suitable for the temperature range or the flat gasket cannot compensate for flange gaping or the required leakage rate cannot be achieved by the seal previously used.

## Possible applications and advantages:

- Seal for vacuum, gases and liquids under extreme operating conditions.
- Applicable in pressure ranges from UHV up to 5000bar at service temperatures from -269°C to 750°C.
- Resistant against radioactive radiation, chlorides, corrosion and other aggressive influences. No aging.
- Can be optimally adjusted to parameters and requirements in the application through a variety of possible combinations
- Achievement of lowest leakage rates through additional coating
- Maintenance of tightness even when the flange is lifted off by elastic compensation behaviour of the seal
- Resistant to explosive decompression
- Simple force calculations, since ring works in force shunt



[www.seals.de/  
resilient-metal-seals](http://www.seals.de/resilient-metal-seals)

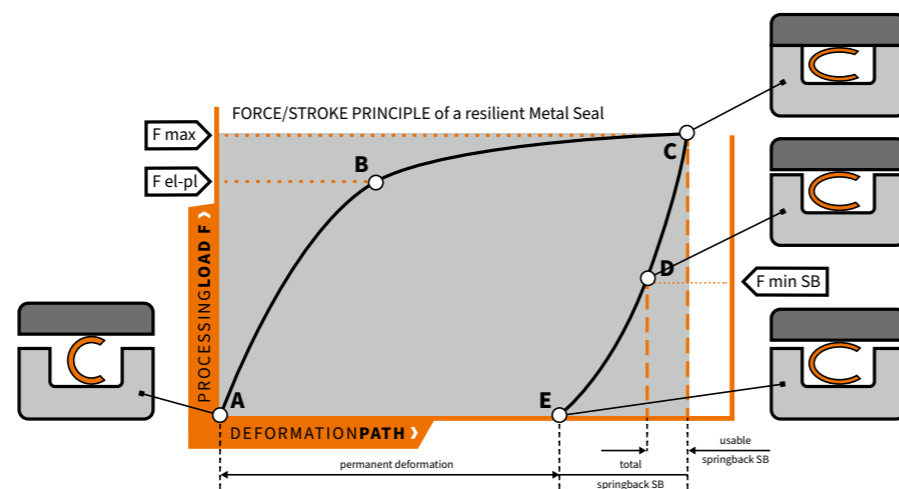
# General information

applications and industries

**Resilient metal seals from GFD are available in a variety of different types, cross sections, wall thicknesses, materials, coatings, coating thicknesses and heat treatments.**

Diameters can be defined by the customer starting with the minimum diameters, which depend on the seal type and cross section. Due to the resulting infinite combination possibilities, these sealing elements are manufactured by GFD order-related. **For the selection of the most suitable sealing element for your application you are free to contact the technical support of GFD.** Please let us know the relevant parameters, e.g. temperature, pressure, medium, surface quality, etc., as well as the requirements in the application, e.g. required leakage rate, load cycles, expected flange lift-off, etc.

By pressing the sealing element from the original cross section (A) to the required groove depth (C), the maximum press load (F max) is generated. In this process, the ring is not only deformed elastically (A-B) but also plastically (B-C). In the case of coated rings, the press load also causes the coating to flow. Microscopically small irregularities in the counter sealing surface of the groove are closed by this mechanism and the lowest possible leakage rates are ensured. Resilient metal seals have the ability to spring back in a defined manner (C-E) when relieved of load, this behavior is also known as Springback SB. The usable elastic springback (C-D) ensures that the tightness is maintained when flange lift-off occurs as a result of pressure and temperature application. In order to maintain the sealing performance, usually only a part of the total SB can be used, so that the sealing load F min SB is not undercut.



## Typical applications / Industries

### Machine and plant constructions

- Gas turbines, heat exchangers, plastic injection machines, pressure vessels, pump housings, internal combustion engines

### Oil and gas industry

- Fittings, valves, cryogenic applications

### Chemical and process technology

- High vacuum, heat exchangers, pressure vessels, fittings, valves, cryogenic applications

### Sealing Technology

### Laser and sensor technology

### Aerospace industry

- mechanics, modules, fuel system, engines

## Design recommendations

With this recommendation, we would like to give all those responsible for the components advice on how to design the construction in order to implement a successful sealing solution. Appropriate dimensioning and material selection depending on the parameters and requirements contribute as much to the reliable functioning of the sealing solution as the sealing element itself.

Contrary to complex calculations, e.g. when using flat gaskets, in the case of resilient metal seals the press load of the seal must essentially be added to the operating forces of the application.

Especially for high-temperature applications, knowledge of the strength curve of the construction materials for the stiffness of flanges as well as the design and number of bolted connections is of great importance. If a flange gap can be expected from calculations on the behaviour of the construction, please provide us with exact numerical values. **We are able to support you in the selection of a suitable GFD sealing element.**

Furthermore the surface quality of the counter sealing surface is of elementary importance. The tightness is the result of the successful interaction between the sealing element and the surface quality of the counter sealing surface.

The necessity of a coating and, if necessary, the determination of the coating thickness depends on the desired leakage rate. Rougher surfaces can be compensated within limits by a higher coating thickness in order to meet the leakage requirement.

### For rings in internal and external pressure applications:

The processing marks caused by machining must be concentric with the line of contact of the seal.

Avoid radial scoring and scratches.

Processing marks on the groove or flange surface must be free of dirt, grinding dust or other foreign matter.

### The following applies to rings in axial pressure applications:

Processing marks caused by machining must be concentric with the line of contact of the seal.

Avoid axial scoring and scratches.

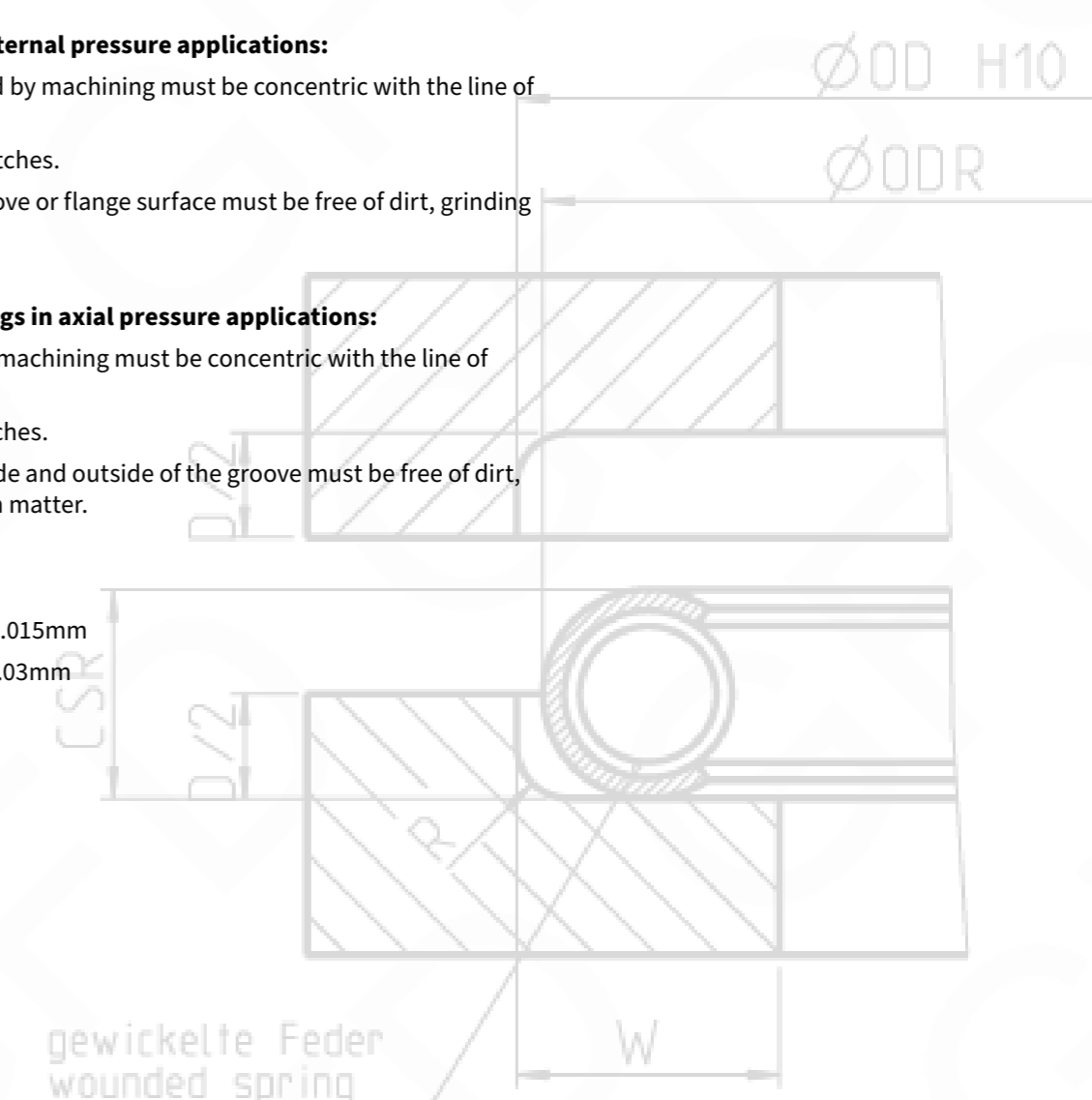
Processing marks on the inside and outside of the groove must be free of dirt, grinding dust or other foreign matter.

### Permissible eccentricity:

- up to bore  $\varnothing$  85mm = max. 0.015mm

- from bore  $\varnothing$  85mm = max. 0.03mm

Surface hardness 60 HRC



## Installation recommendations

### The GFD seal

- The seals should be kept in their original packaging until the time of installation to avoid damage.
- When opening the packaging, make sure that the seal is not damaged by sharp objects, e.g. a knife or scissors, as even the smallest scratches can have a negative effect on the sealing performance.
- After unpacking, check the seal for possible damage or other defects.
- Use only suitable tools for assembly, if at all necessary.
- Wear suitable gloves if required by the specification.
- Handle the seal with the utmost care.

### The customer design: groove and flange

- The condition of the counter sealing surfaces plays a decisive role in the subsequent sealing effect. In addition to the points mentioned in the design recommendations, it must be ensured that grooves and flanges are free of dirt, foreign particles, scratches and other damage and deformation, as any of the above-mentioned conspicuous features can lead to leakage. Cleaning, e.g. with a dust-free cloth and acetone, immediately before installation is recommended.
- Wear suitable gloves if required by the specification.
- Carry out the above mentioned tests and cleaning with the utmost care.



### Assembly

- When installing the seal in the groove, make sure that no scratches or other damage is caused.
- When using tools, if at all necessary, ensure that neither the seal nor the surrounding construction, especially the counter sealing surfaces, are damaged in any way.
- Do not use any auxiliary materials such as oil, grease or other products
- Wear suitable gloves if the specification requires it.
- After placing the seal, carefully guide the adjacent structural parts towards each other. In the case of multiple fittings, gradually tighten the flanges crosswise to achieve even compression of the seal.
- When installing MCA type seals, ensure excellent guidance of the components to be sealed to each other (see chapter Design Recommendations) to avoid damage, e.g. due to tilting. Assembly tools are available on request.
- Work with the utmost care during assembly.

### Note on reusability

- GFD recommends not to reuse resilient metal seals after disassembly. Background: The rings are not only elastically but also plastically deformed during assembly.
- In addition, there is a risk of damage and contamination. In case of repeated use, this usually leads to a (significant) decrease in sealing performance and thus to the original specification not being met.

# Materials

## Ring and spring material

Various stainless steels and nickel alloys are available for the production of rings and springs. The selection of the most suitable material depends on the application and specification.

Ring material	for O-Rings	for C-Rings	for U-Rings	Order code	Material no.
SS304		x		1	1.4306
SS321	x			3	1.4541
Inconel 600	x			4	2.4816
Inconel X-750	x	x		5	2.4669
Inconel 718		x	x	7	2.4668

other materials on request

Spring material	for O-Rings	for C-Rings	for U-Rings	Order code	Material no.
Elgiloy		x	x	E	2.4711
Inconel X-750		x	x	5	2.4669
Inconel 718		x	x	7	2.4668

other materials on request

## Heat treatment

It is possible to subject rings to different heat treatments depending on the materials and applications. A suitable heat treatment can positively influence the performance as well as the lifetime of the rings. The specification can be determined directly by the customer or by GFD if all essential parameters and requirements are present.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

other heat treatments on request

Heat treatment	HT 1	HT 2	HT 3	HT 4	HT 5	Material no.
SS304	x					1.4306
SS321	x					1.4541
Inconel 600	x					2.4816
Inconel X-750	x	x	x	x		2.4669
Inconel 718	x	x	x	x	x	2.4668
Elgiloy	x	x			x	2.4711

other heat treatments on request

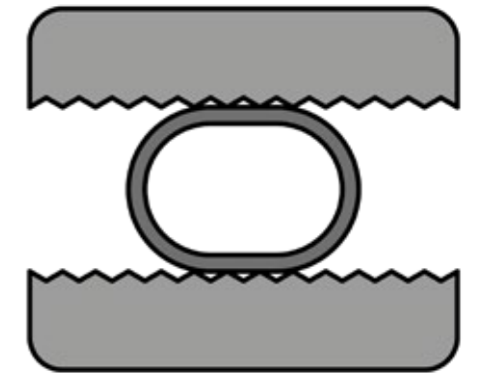
## Coating materials

The tightness of metal rings can be significantly improved with a suitable coating: When the ring is pressed, the coating flows into the microscopic unevenness of the counter sealing surface and seals it. This mechanism allows excellent sealing qualities to be achieved. The tightness specified as the leakage rate in mbar l/s is the result of the successful interaction between the ring and the surface quality of the mating sealing surface (see also chapter "Design recommendations and assembly"). The necessity of a coating and, if necessary, the determination of the coating thickness is thus dependent on the desired leakage rate and is further determined by the surface quality of the groove and flange. When selecting the coating, it is important to ensure that it harmonizes with the pressing load of the ring, so that tiling takes place reliably. Thus, a comparatively hard nickel coating should only be used in combination with a ring with high pressing load. In contrast, tin or PTFE coatings should preferably be configured with rings of low pressing force. Silver covers the widest range of applications and is therefore considered the standard coating material. Furthermore, coatings such as PTFE or gold can also be used as protection to improve the resistance against aggressive media.

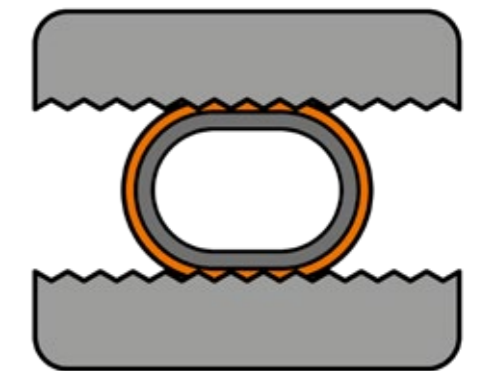
coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\*) only valid for non-oxidizing media other materials on request

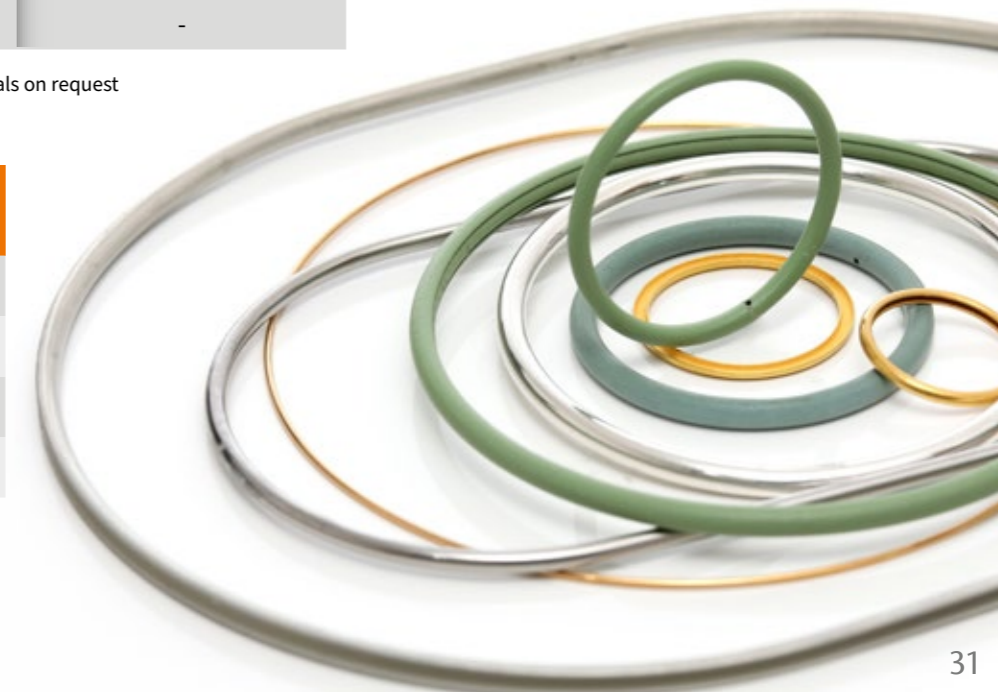
coating thickness	Code
0,01-0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H
according to specification	X



Uncoated sealing ring



















Coated sealing ring





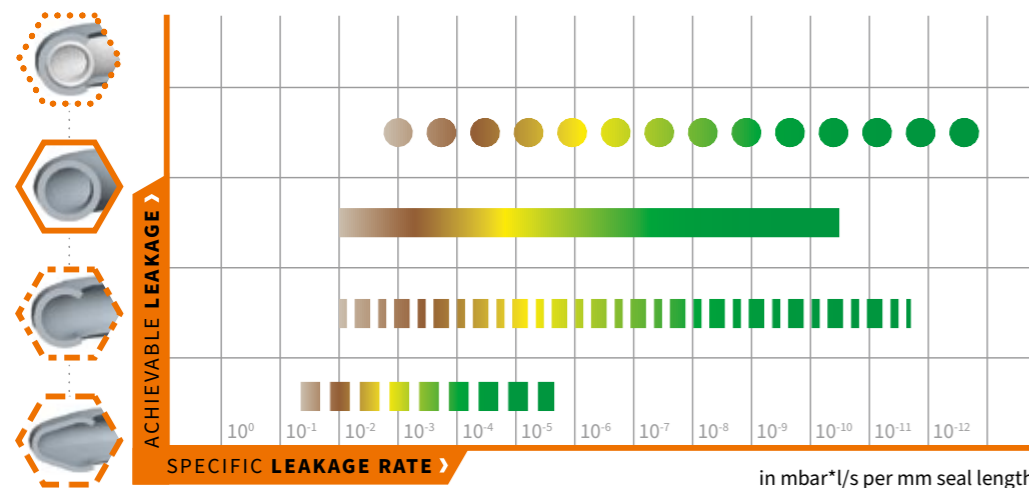
# Overview

Functional principle, properties and performance

	Metal O-Ring			Metal C-Ring					Metal U-Ring
	normal	self energizing	pressure filled	normal	spring energized	Highflex spring energized	for axial pressure	for axial pressure spring energized	normal
<b>INTERNAL PRESSURE</b>	 Type MOR Design NP	 Type MOR Design SI	 Type MOR Design PF	 Type MCI	 Type MCI-F	 Type MCI-HF			 Type MUI
<b>EXTERNAL PRESSURE</b>	 Type MOR Design NP	 Type MOR Design SO	 Type MOR Design PF	 Type MCO	 Type MCO-F	 Type MCO-HF			 Type MUO
<b>AXIAL PRESSURE</b>							 Type MCA	 Type MCA-F	
<b>Description</b>	for low to moderate pressure and vacuum conditions	has a self energizing effect by a drilling hole at the ID or AD	Pressure filling is effective from temperatures of approx. 425°C	Metal C-rings have a higher elasticity than metal O-rings. The open side of the metal C-ring points in the direction of the higher pressure. It therefore has a self energizing effect. The spring reinforcement further improves the sealing effect and springback.					has high springback with low pressing load
<b>available as moulded seal</b>	X	X	X	X	X	X			
<b>available as segment seal</b>	X	X		X	X	X			

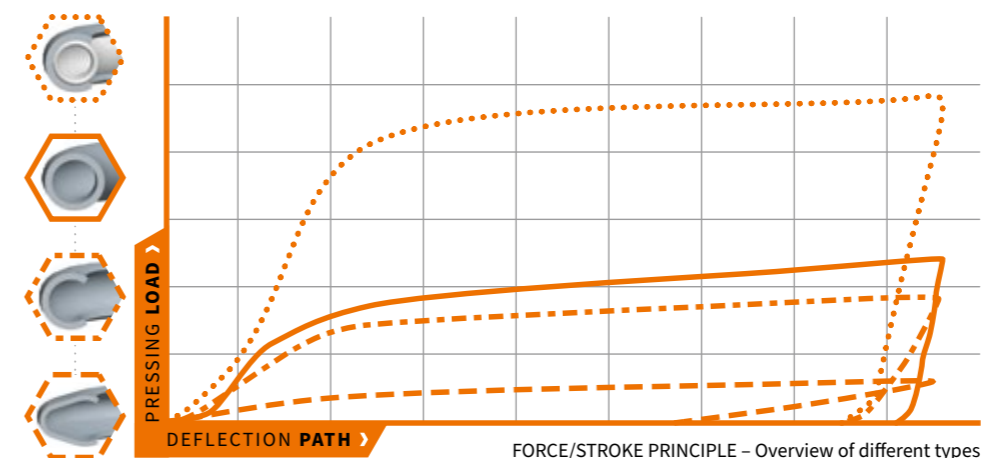
Resilient Metal Seals

## Achievable leakage rate



The above mentioned reference values are classically based on helium at room temperature and 1 bar pressure difference. To determine equivalent leakage rates of other gases, the following correction factors apply:  
 hydrogen: 1,42 // oxygen: 0,35 // nitrogen: 0,37 // air: 0,37

## Force/stroke principle – Overview of different type



# What is behind the match code?

With the help of a match code, at best every metallic seal from GFD can be specified.

The match code defines individual property characteristics which result from the sealing requirements. These include type, material, cross-section, wall thickness, diameter and other characteristics.

The match code is made up of several components, as shown below:

MOR - 0 - 0,00 x - 0000,00 - XX X X

On the following pages you will find everything you need to create a suitable match code for our different seal types. In addition, you can also use our unique **online match code generator** online. You will find the links to this in the respective chapters in this catalog.

The following is an example of an Metal O-Ring:

MOR - 5 - 2,39 s - 0054,70 - SI S L

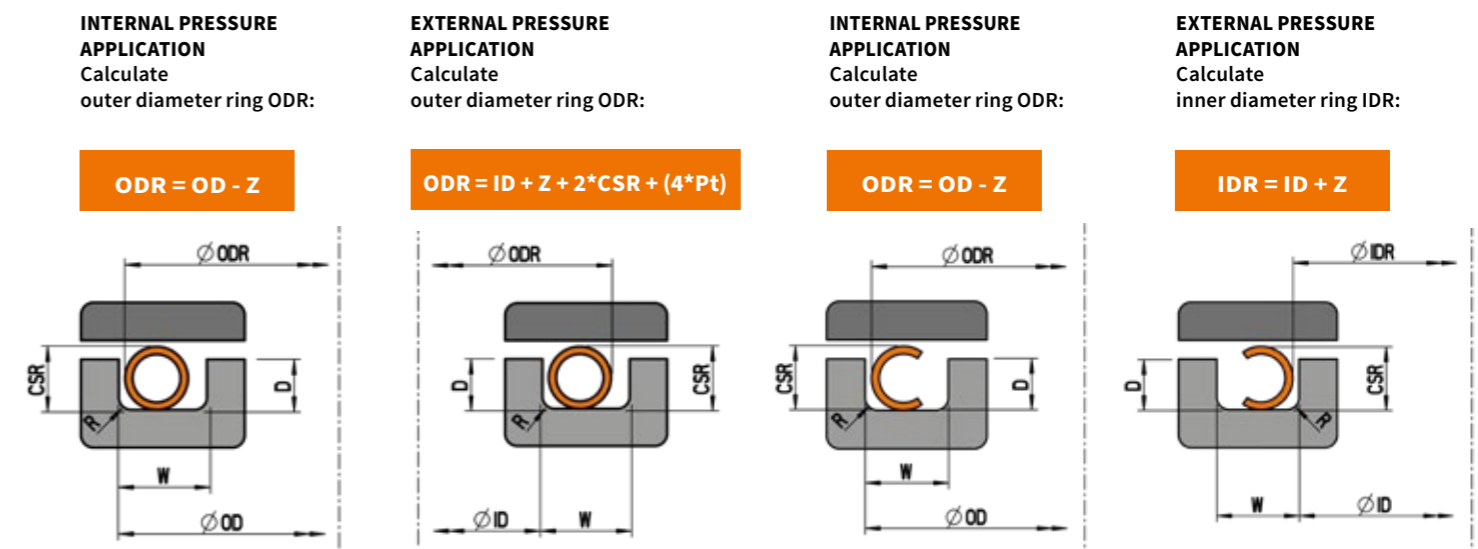
**Das Bestellbeispiel beschreibt einen Metall-O-Ring in**

5	Material Inconel X-750
2,39	cross section 2.39 mm
s	wall thickness 0.46 mm
0054,70	Ring outer diameter ODR54.7 mm incl. Coating (suitable for groove outer diameter OD 55.0 mm)
SI	self-energizing inside
S	Silver coated
L	0.01-0.03 mm thick

Often, of course, the interrelationships for the selection of the appropriate sealing element are very complex and depend on the application. **For this purpose, please contact our experienced and competent engineering department. We will be happy to assist you, especially when it comes to special solutions.**

## Key for match code

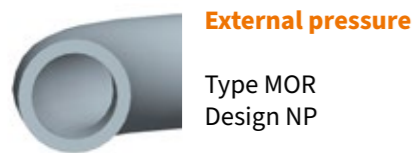
<b>CSR</b>	<b>Nominal cross-section:</b> cross-sectional dimension (without coating) e.g. similar to the cord thickness of elastomer O-rings
<b>Code</b>	<b>Performance Index:</b> shows characteristics of the ring (e.g. pressing load, springback)
<b>D</b>	<b>Groove depth:</b> axial design dimension to which the ring is pressed from the original cross-section CSR.
<b>F</b>	<b>Pressing load:</b> the mentioned guide values refer to 1mm seal length. To obtain the total load of the seal for the design of the construction, this value must be multiplied by the circumferential length of the seal.
<b>ID</b>	<b>Inner diameter of the groove:</b> reference dimension for external pressure applications.
<b>OD</b>	<b>Outside diameter of groove:</b> reference dimension for internal pressure applications.
<b>ODR</b>	<b>Outside diameter of the ring:</b> The outside diameter of the ring is freely selectable from the mentioned minimum dimension ODR min. and is at the same time the corresponding dimension to the outside or inside diameter of the groove.
<b>Pt</b>	<b>coating thickness</b>
<b>R</b>	<b>Radius:</b> Design dimension that improves the support of the ring under pressure
<b>SB</b>	<b>Springback:</b> maximum possible measure by which the ring can spring back elastically overall. Important value in connection with possible flange gaps.
<b>W</b>	<b>groove width:</b> radial design minimum dimension. The specified minimum dimension Wmin. must not be undercut.
<b>Wt</b>	<b>Wall thickness:</b> sheet thickness of the ring.
<b>Z</b>	<b>diametric clearance</b> between ring and groove.



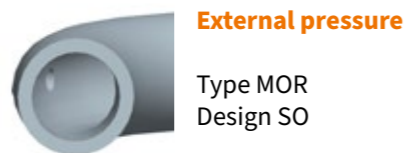
# MOR

## Metal O-Rings

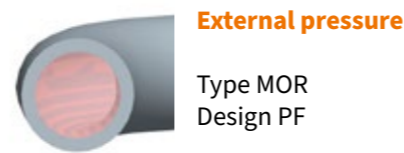
### Metal O-Ring normal



### Metal O-Ring self energizing



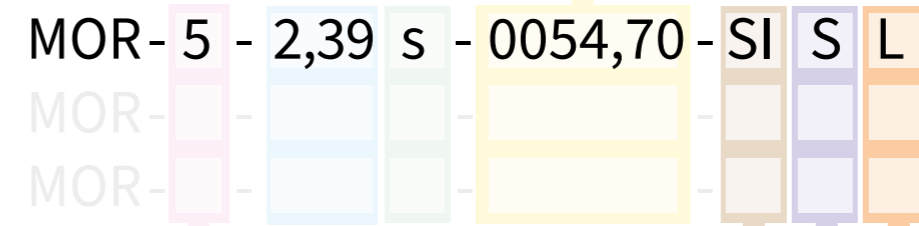
### Metal O-Ring pressure filled



Metal O-Ring MOR					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
<b>0,89</b>	<b>w</b>	<b>0,15</b>	<b>6</b>	<b>0,20</b>	<b>0,65</b>	<b>+0,05</b>	<b>1,40</b>	<b>0,25</b>	<b>70</b>	<b>0,01</b>
1,19	w	0,20	10	0,25	0,95	+0,05	1,80	0,30	80	0,02
<b>1,57</b>	<b>w</b>	<b>0,25</b>	<b>15</b>	<b>0,25</b>	<b>1,15</b>	<b>+0,10</b>	<b>2,30</b>	<b>0,35</b>	<b>110</b>	<b>0,03</b>
<b>1,57</b>	<b>s</b>	<b>0,36</b>	<b>15</b>	<b>0,25</b>	<b>1,15</b>	<b>+0,10</b>	<b>2,30</b>	<b>0,35</b>	<b>230</b>	<b>0,03</b>
<b>2,39</b>	<b>w</b>	<b>0,25</b>	<b>25</b>	<b>0,30</b>	<b>1,90</b>	<b>+0,10</b>	<b>3,20</b>	<b>0,50</b>	<b>60</b>	<b>0,05</b>
<b>2,39</b>	<b>s</b>	<b>0,46</b>	<b>25</b>	<b>0,30</b>	<b>1,90</b>	<b>+0,10</b>	<b>3,20</b>	<b>0,50</b>	<b>210</b>	<b>0,03</b>
<b>3,18</b>	<b>w</b>	<b>0,25</b>	<b>45</b>	<b>0,40</b>	<b>2,55</b>	<b>+0,10</b>	<b>4,20</b>	<b>0,75</b>	<b>40</b>	<b>0,07</b>
<b>3,18</b>	<b>s</b>	<b>0,51</b>	<b>45</b>	<b>0,40</b>	<b>2,55</b>	<b>+0,10</b>	<b>4,20</b>	<b>0,75</b>	<b>170</b>	<b>0,04</b>
<b>3,96</b>	<b>w</b>	<b>0,51</b>	<b>70</b>	<b>0,60</b>	<b>3,20</b>	<b>+0,10</b>	<b>5,20</b>	<b>1,25</b>	<b>115</b>	<b>0,08</b>
<b>3,96</b>	<b>s</b>	<b>0,64</b>	<b>70</b>	<b>0,60</b>	<b>3,20</b>	<b>+0,10</b>	<b>5,20</b>	<b>1,25</b>	<b>195</b>	<b>0,06</b>
<b>4,78</b>	<b>w</b>	<b>0,51</b>	<b>100</b>	<b>0,70</b>	<b>3,85</b>	<b>+0,15</b>	<b>6,40</b>	<b>1,30</b>	<b>95</b>	<b>0,10</b>
<b>4,78</b>	<b>s</b>	<b>0,64</b>	<b>100</b>	<b>0,70</b>	<b>3,85</b>	<b>+0,15</b>	<b>6,40</b>	<b>1,30</b>	<b>160</b>	<b>0,08</b>
<b>6,35</b>	<b>w</b>	<b>0,64</b>	<b>160</b>	<b>0,75</b>	<b>5,05</b>	<b>+0,20</b>	<b>8,50</b>	<b>1,50</b>	<b>110</b>	<b>0,15</b>
<b>6,35</b>	<b>s</b>	<b>0,81</b>	<b>160</b>	<b>0,75</b>	<b>5,05</b>	<b>+0,20</b>	<b>8,50</b>	<b>1,50</b>	<b>190</b>	<b>0,10</b>
9,53	w	0,97	300	1,00	8,20	+0,30	12,70	1,50	170	0,15
9,53	s	1,24	300	1,00	8,20	+0,30	12,70	1,50	290	0,12
12,7	w	1,27	800	1,25	11,10	+0,30	16,50	1,50	200	0,20
12,7	s	1,65	800	1,25	11,10	+0,30	16,50	1,50	370	0,18

\*Mentioned performance guide values are valid for seals made from Inconel X-750 work hardened.  
**Preferred sizes are shown in bold.** Other sizes not listed in table available on request.

## Match code



Ring material	Code	Material no.
SS321	3	1.4541
Inconel 600	4	2.4816
Inconel X-750	5	2.4669

Other materials on request.

Design	Code
normal	NP
self-energizing inside	SI
self-energizing outside	SO
pressure filled	PF

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

Other coating thicknesses on request.

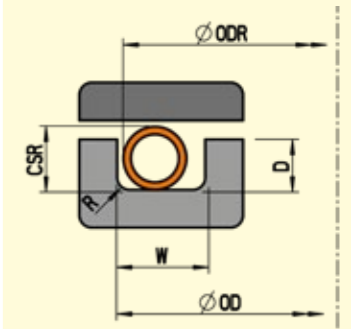
### The following ordering example describes a metal O-ring in

- 5 Material Inconel X-750
- 2,39 Cross section 2,39 mm
- s with wall thickness 0,46 mm
- 0054,70 Ring outer diameter ODR 54.7mm incl. coating (suitable for groove outer diameter OD 55.00mm)
- SI self energizing inside (internal pressure application)
- S Silver Coating
- L 0.01 - 0.03mm thick

### INTERNAL PRESSURE APPLICATION

Calculate outer diameter ring ODR:

$$ODR = OD - Z$$



### Match code online erstellen

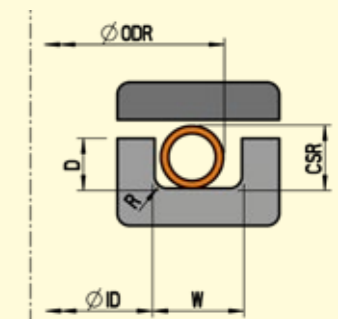
[www.seals.de/matchcode-mor-internal-pressure](http://www.seals.de/matchcode-mor-internal-pressure)



### EXTERNAL PRESSURE APPLICATION

Calculate outer diameter ring ODR:

$$ODR = ID + Z + 2*CSR + (4*Pt)$$



(4\*Pt) only valid for rings with coating. For the calculation, the largest value of the selected value range must be used.

### Create match code online

[www.seals.de/matchcode-mor-external-pressure](http://www.seals.de/matchcode-mor-external-pressure)



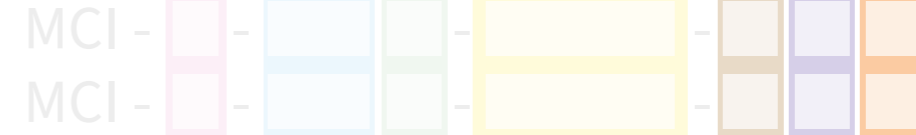


Metal C-Ring MCI					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
<b>0,79</b>	<b>w</b>	<b>0,13</b>	<b>6</b>	<b>0,08</b>	<b>0,65</b>	<b>+0,05</b>	<b>1,10</b>	<b>0,25</b>	<b>35</b>	<b>0,04</b>
<b>0,79</b>	<b>s</b>	<b>0,18</b>	<b>6</b>	<b>0,08</b>	<b>0,65</b>	<b>+0,05</b>	<b>1,10</b>	<b>0,25</b>	<b>70</b>	<b>0,03</b>
1,19	w	0,13	8	0,12	0,94	+0,05	1,40	0,30	20	0,05
1,19	s	0,20	8	0,12	0,94	+0,05	1,40	0,30	50	0,04
<b>1,57</b>	<b>w</b>	<b>0,15</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,00</b>	<b>0,35</b>	<b>25</b>	<b>0,08</b>
<b>1,57</b>	<b>s</b>	<b>0,25</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,00</b>	<b>0,35</b>	<b>65</b>	<b>0,06</b>
2,00	w	0,25	10	0,20	1,60	+0,10	2,30	0,45	45	0,06
2,20	w	0,25	10	0,22	1,75	+0,10	2,50	0,45	40	0,08
<b>2,39</b>	<b>w</b>	<b>0,25</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>2,70</b>	<b>0,50</b>	<b>50</b>	<b>0,12</b>
<b>2,39</b>	<b>s</b>	<b>0,38</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>2,70</b>	<b>0,50</b>	<b>100</b>	<b>0,08</b>
2,60	s	0,38	18	0,26	2,10	+0,10	2,85	0,50	80	0,10
2,79	w	0,38	18	0,28	2,23	+0,10	3,10	0,55	70	0,11
<b>3,18</b>	<b>w</b>	<b>0,38</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>3,50</b>	<b>0,75</b>	<b>60</b>	<b>0,15</b>
<b>3,18</b>	<b>s</b>	<b>0,51</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>3,50</b>	<b>0,75</b>	<b>110</b>	<b>0,12</b>
3,50	s	0,51	25	0,35	2,85	+0,10	3,85	0,75	50	0,14
<b>3,96</b>	<b>w</b>	<b>0,41</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>4,50</b>	<b>1,25</b>	<b>50</b>	<b>0,20</b>
<b>3,96</b>	<b>s</b>	<b>0,61</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>4,50</b>	<b>1,25</b>	<b>120</b>	<b>0,17</b>
<b>4,78</b>	<b>w</b>	<b>0,51</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>5,10</b>	<b>1,30</b>	<b>65</b>	<b>0,23</b>
<b>4,78</b>	<b>s</b>	<b>0,76</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>5,10</b>	<b>1,30</b>	<b>150</b>	<b>0,18</b>
5,00	w	0,51	75	0,51	4,00	+0,15	5,30	1,30	55	0,27
5,20	w	0,51	75	0,52	4,15	+0,15	5,50	1,30	55	0,28
5,60	w	0,51	80	0,56	4,50	+0,15	5,90	1,30	55	0,30
<b>6,35</b>	<b>w</b>	<b>0,64</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>6,60</b>	<b>1,50</b>	<b>70</b>	<b>0,35</b>
<b>6,35</b>	<b>s</b>	<b>0,97</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>6,60</b>	<b>1,50</b>	<b>180</b>	<b>0,30</b>
7,00	w	0,64	100	0,70	5,60	+0,20	7,65	1,50	70	0,35
7,90	w	0,97	100	0,79	6,35	+0,20	8,25	1,50	130	0,35
9,53	w	0,97	100	0,95	7,70	+0,30	9,70	1,50	110	0,50
9,53	s	1,27	100	0,95	7,70	+0,30	9,70	1,50	190	0,32
12,7	w	1,27	500	1,25	10,20	+0,30	12,70	1,50	130	0,55
12,7	s	1,65	500	1,25	10,20	+0,30	12,70	1,50	240	0,46

\*Mentioned performance guide values are valid for seals made from Inconel 718 solution annealed + precipitation hardened Std. Preferred sizes are shown in bold. Other sizes not listed in table available on request.

### Match code

MCI - 7 - 3,18 w - 0079,68 - 2 Z M



Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

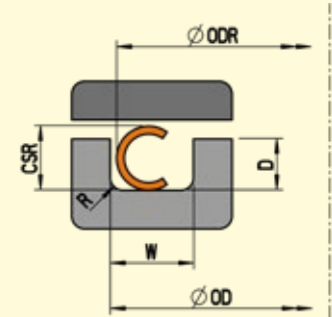
Other coating thicknesses on request.

The following ordering example describes a metal C-Ring for internal pressure application Type MCI in

- 7 Material Inconel 718
- 3,18 Cross section 3,18 mm
- w with wall thickness 0,38 mm
- 0079,68 Ring outer diameter ODR 79,68mm incl. coating (suitable for groove outer diameter OD 80,0mm)
- 2 age hardened
- Z Tin coating
- M 0.03 - 0.05 mm thick

INTERNAL PRESSURE APPLICATION  
Calculate outer diameter ring ODR:

$$ODR = OD - Z$$



Create match code online  
[www.seals.de/matchcode-mci/e](http://www.seals.de/matchcode-mci/e)

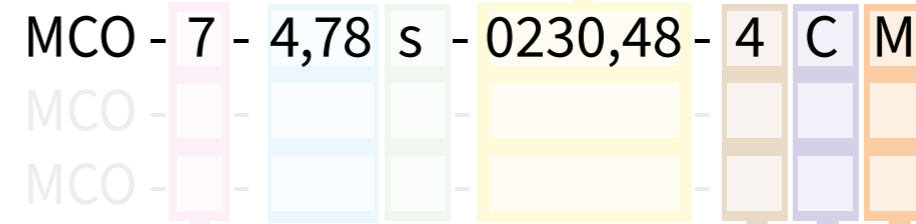




Metal C-Ring MCO					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
<b>0,79</b>	<b>w</b>	<b>0,13</b>	<b>6</b>	<b>0,08</b>	<b>0,65</b>	<b>+0,05</b>	<b>1,10</b>	<b>0,25</b>	<b>35</b>	<b>0,04</b>
<b>0,79</b>	<b>s</b>	<b>0,18</b>	<b>6</b>	<b>0,08</b>	<b>0,65</b>	<b>+0,05</b>	<b>1,10</b>	<b>0,25</b>	<b>70</b>	<b>0,03</b>
1,19	w	0,13	8	0,12	0,94	+0,05	1,40	0,30	20	0,05
1,19	s	0,20	8	0,12	0,94	+0,05	1,40	0,30	50	0,04
<b>1,57</b>	<b>w</b>	<b>0,15</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,00</b>	<b>0,35</b>	<b>25</b>	<b>0,08</b>
<b>1,57</b>	<b>s</b>	<b>0,25</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,00</b>	<b>0,35</b>	<b>65</b>	<b>0,06</b>
2,00	w	0,25	10	0,20	1,60	+0,10	2,30	0,45	45	0,06
2,20	w	0,25	10	0,22	1,75	+0,10	2,50	0,45	40	0,08
<b>2,39</b>	<b>w</b>	<b>0,25</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>2,70</b>	<b>0,50</b>	<b>50</b>	<b>0,12</b>
<b>2,39</b>	<b>s</b>	<b>0,38</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>2,70</b>	<b>0,50</b>	<b>100</b>	<b>0,08</b>
2,60	s	0,38	18	0,26	2,10	+0,10	2,85	0,50	80	0,10
2,79	w	0,38	18	0,28	2,23	+0,10	3,10	0,55	70	0,11
<b>3,18</b>	<b>w</b>	<b>0,38</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>3,50</b>	<b>0,75</b>	<b>60</b>	<b>0,15</b>
<b>3,18</b>	<b>s</b>	<b>0,51</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>3,50</b>	<b>0,75</b>	<b>110</b>	<b>0,12</b>
3,50	s	0,51	25	0,35	2,85	+0,10	3,85	0,75	50	0,14
<b>3,96</b>	<b>w</b>	<b>0,41</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>4,50</b>	<b>1,25</b>	<b>50</b>	<b>0,20</b>
<b>3,96</b>	<b>s</b>	<b>0,61</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>4,50</b>	<b>1,25</b>	<b>120</b>	<b>0,17</b>
<b>4,78</b>	<b>w</b>	<b>0,51</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>5,10</b>	<b>1,30</b>	<b>65</b>	<b>0,23</b>
<b>4,78</b>	<b>s</b>	<b>0,76</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>5,10</b>	<b>1,30</b>	<b>150</b>	<b>0,18</b>
5,00	w	0,51	75	0,51	4,00	+0,15	5,30	1,30	55	0,27
5,20	w	0,51	75	0,52	4,15	+0,15	5,50	1,30	55	0,28
5,60	w	0,51	80	0,56	4,50	+0,15	5,90	1,30	55	0,30
<b>6,35</b>	<b>w</b>	<b>0,64</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>6,60</b>	<b>1,50</b>	<b>70</b>	<b>0,35</b>
<b>6,35</b>	<b>s</b>	<b>0,97</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>6,60</b>	<b>1,50</b>	<b>180</b>	<b>0,30</b>
7,00	w	0,64	100	0,70	5,60	+0,20	7,65	1,50	70	0,35
7,90	w	0,97	100	0,79	6,35	+0,20	8,25	1,50	130	0,35
9,53	w	0,97	100	0,95	7,70	+0,30	9,70	1,50	110	0,50
9,53	s	1,27	100	0,95	7,70	+0,30	9,70	1,50	190	0,32
12,7	w	1,27	500	1,25	10,20	+0,30	12,70	1,50	130	0,55
12,7	s	1,65	500	1,25	10,20	+0,30	12,70	1,50	240	0,46

\*Mentioned performance guide values are valid for seals made from Inconel 718 solution annealed + precipitation hardened Std. Preferred sizes are shown in bold. Other sizes not listed in table available on request.

### Match code



Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Weitere Werkstoffe auf Anfrage.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

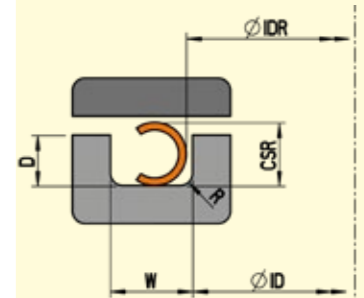
Other coating thicknesses on request.

### The following ordering example describes a metal C-Ring for external pressure application Type MCO in

- 7 Material Inconel 718
- 4,78 Cross section 4,78 mm
- s with wall thickness 0,76 mm
- 0230,48 Ring inner diameter IDR 230,48mm incl. coating (suitable for groove inner diameter ID 230,00mm)
- 4 solution annealed and precipitation hardened
- C Copper coating
- M 0.03 - 0.05 mm stark

EXTERNAL PRESSURE APPLICATION  
Calculate inner diameter ring IDR:

$$IDR = ID + Z$$

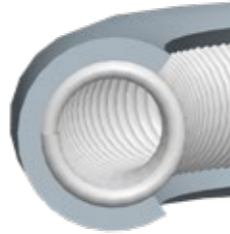


Create match code online  
[www.seals.de/matchcode-mco/e](http://www.seals.de/matchcode-mco/e)



# MCI-F

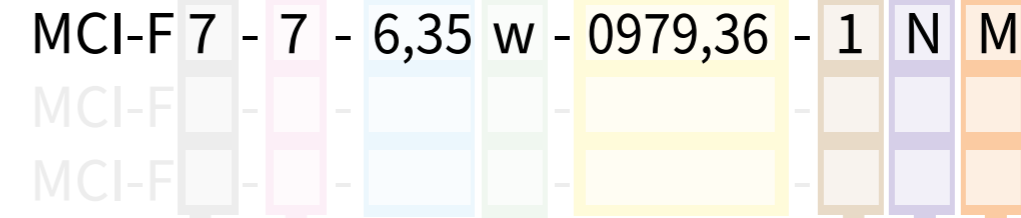
Metal C-Ring spring energized for internal pressure application



Metal C-Ring MCI-F					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
<b>1,57</b>	<b>w</b>	<b>0,15</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,30</b>	<b>0,35</b>	<b>80</b>	<b>0,08</b>
<b>1,57</b>	<b>s</b>	<b>0,15</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,30</b>	<b>0,35</b>	<b>180</b>	<b>0,07</b>
2,00	w	0,25	20	0,20	1,60	+0,10	2,60	0,45	160	0,08
2,20	w	0,25	10	0,22	1,75	+0,10	2,90	0,45	155	0,09
<b>2,39</b>	<b>w</b>	<b>0,25</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>3,20</b>	<b>0,50</b>	<b>150</b>	<b>0,11</b>
<b>2,39</b>	<b>s</b>	<b>0,25</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>3,20</b>	<b>0,50</b>	<b>320</b>	<b>0,10</b>
2,60	w	0,25	18	0,26	2,10	+0,10	3,40	0,50	200	0,11
2,79	w	0,38	18	0,28	2,23	+0,10	3,60	0,55	220	0,11
<b>3,18</b>	<b>w</b>	<b>0,38</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>4,20</b>	<b>0,75</b>	<b>145</b>	<b>0,12</b>
<b>3,18</b>	<b>s</b>	<b>0,38</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>4,20</b>	<b>0,75</b>	<b>290</b>	<b>0,12</b>
3,50	s	0,41	25	0,35	2,85	+0,10	4,60	0,75	160	0,12
<b>3,96</b>	<b>w</b>	<b>0,41</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>5,20</b>	<b>1,25</b>	<b>150</b>	<b>0,19</b>
<b>3,96</b>	<b>s</b>	<b>0,41</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>5,20</b>	<b>1,25</b>	<b>320</b>	<b>0,15</b>
<b>4,78</b>	<b>w</b>	<b>0,51</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>6,40</b>	<b>1,30</b>	<b>190</b>	<b>0,20</b>
<b>4,78</b>	<b>s</b>	<b>0,51</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>6,40</b>	<b>1,30</b>	<b>420</b>	<b>0,18</b>
5,00	w	0,51	75	0,51	4,00	+0,15	6,60	1,30	180	0,28
5,20	w	0,51	75	0,52	4,15	+0,15	6,80	1,30	240	0,29
5,60	w	0,51	75	0,56	4,50	+0,15	7,30	1,30	220	0,29
<b>6,35</b>	<b>w</b>	<b>0,64</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>8,50</b>	<b>1,50</b>	<b>330</b>	<b>0,37</b>
<b>6,35</b>	<b>s</b>	<b>0,64</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>8,50</b>	<b>1,50</b>	<b>560</b>	<b>0,27</b>
7,00	w	0,64	100	0,70	5,60	+0,20	9,40	1,50	320	0,37
7,90	w	0,97	100	0,79	6,35	+0,20	10,40	1,50	335	0,40
<b>9,53</b>	<b>w</b>	<b>0,97</b>	<b>100</b>	<b>0,95</b>	<b>7,70</b>	<b>+0,30</b>	<b>12,70</b>	<b>1,50</b>	<b>510</b>	<b>0,43</b>
<b>9,53</b>	<b>s</b>	<b>0,97</b>	<b>100</b>	<b>0,95</b>	<b>7,70</b>	<b>+0,30</b>	<b>12,70</b>	<b>1,50</b>	<b>810</b>	<b>0,35</b>
12,7	w	1,27	500	1,25	10,20	+0,30	16,50	1,50	640	0,50
12,7	s	1,27	500	1,25	10,20	+0,30	16,50	1,50	920	0,40

\*Mentioned performance guide values are valid for seals made from Inconel 718 work hardened. Preferred sizes are shown in bold. Other sizes not listed in table available on request.

## Match code



Spring material	Code	Material no.
Elgiloy	E	2.4711
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

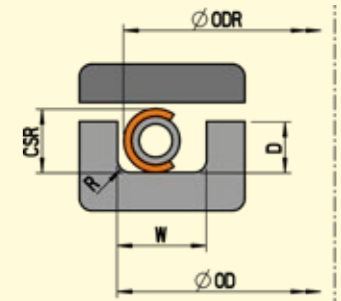
Other coating thicknesses on request.

The following ordering example describes a metal C-Ring for internal pressure application Type MCI-F in

- F7 Spring Inconel 718
- 7 Material Inconel 718
- 6,35 Cross section 6,35 mm
- w with wall thickness 0,64 mm
- 0979,36 Ring outer diameter ODR 979,36mm incl. coating (suitable for groove outer diameter OD 980,00mm)
- 1 work hardened
- N Nickel coating
- M 0.03 - 0.05 mm thick

INTERNAL PRESSURE APPLICATION  
Calculate outer diameter ring ODR:

$$ODR = OD - Z$$



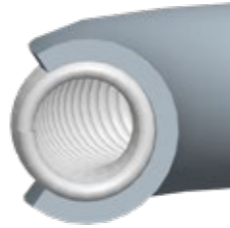
Resilient Metal Seals

Create match code online  
[www.seals.de/matchcode-mci-f/e](http://www.seals.de/matchcode-mci-f/e)



# MCO-F

Metal C-Ring spring energized for external pressure application



Metal C-Ring MCO-F					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
<b>1,57</b>	<b>w</b>	<b>0,15</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,30</b>	<b>0,35</b>	<b>80</b>	<b>0,08</b>
<b>1,57</b>	<b>s</b>	<b>0,15</b>	<b>10</b>	<b>0,16</b>	<b>1,25</b>	<b>+0,10</b>	<b>2,30</b>	<b>0,35</b>	<b>180</b>	<b>0,07</b>
2,00	w	0,25	20	0,20	1,60	+0,10	2,60	0,45	160	0,08
2,20	w	0,25	10	0,22	1,75	+0,10	2,90	0,45	155	0,09
<b>2,39</b>	<b>w</b>	<b>0,25</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>3,20</b>	<b>0,50</b>	<b>150</b>	<b>0,11</b>
<b>2,39</b>	<b>s</b>	<b>0,25</b>	<b>10</b>	<b>0,24</b>	<b>1,90</b>	<b>+0,10</b>	<b>3,20</b>	<b>0,50</b>	<b>320</b>	<b>0,10</b>
2,60	w	0,25	18	0,26	2,10	+0,10	3,40	0,50	200	0,11
2,79	w	0,38	18	0,28	2,23	+0,10	3,60	0,55	220	0,11
<b>3,18</b>	<b>w</b>	<b>0,38</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>4,20</b>	<b>0,75</b>	<b>145</b>	<b>0,12</b>
<b>3,18</b>	<b>s</b>	<b>0,38</b>	<b>25</b>	<b>0,32</b>	<b>2,55</b>	<b>+0,10</b>	<b>4,20</b>	<b>0,75</b>	<b>290</b>	<b>0,12</b>
3,50	s	0,41	25	0,35	2,85	+0,10	4,60	0,75	160	0,12
<b>3,96</b>	<b>w</b>	<b>0,41</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>5,20</b>	<b>1,25</b>	<b>150</b>	<b>0,19</b>
<b>3,96</b>	<b>s</b>	<b>0,41</b>	<b>35</b>	<b>0,40</b>	<b>3,20</b>	<b>+0,10</b>	<b>5,20</b>	<b>1,25</b>	<b>320</b>	<b>0,15</b>
<b>4,78</b>	<b>w</b>	<b>0,51</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>6,40</b>	<b>1,30</b>	<b>190</b>	<b>0,20</b>
<b>4,78</b>	<b>s</b>	<b>0,51</b>	<b>45</b>	<b>0,48</b>	<b>3,85</b>	<b>+0,15</b>	<b>6,40</b>	<b>1,30</b>	<b>420</b>	<b>0,18</b>
5,00	w	0,51	75	0,51	4,00	+0,15	6,60	1,30	180	0,28
5,20	w	0,51	75	0,52	4,15	+0,15	6,80	1,30	240	0,29
5,60	w	0,51	75	0,56	4,50	+0,15	7,30	1,30	220	0,29
<b>6,35</b>	<b>w</b>	<b>0,64</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>8,50</b>	<b>1,50</b>	<b>330</b>	<b>0,37</b>
<b>6,35</b>	<b>s</b>	<b>0,64</b>	<b>100</b>	<b>0,64</b>	<b>5,05</b>	<b>+0,20</b>	<b>8,50</b>	<b>1,50</b>	<b>560</b>	<b>0,27</b>
7,00	w	0,64	100	0,70	5,60	+0,20	9,40	1,50	320	0,37
7,90	w	0,97	100	0,79	6,35	+0,20	10,40	1,50	335	0,40
9,53	w	0,97	100	0,95	7,70	+0,30	12,70	1,50	510	0,43
9,53	s	0,97	100	0,95	7,70	+0,30	12,70	1,50	810	0,35
12,7	w	1,27	500	1,25	10,20	+0,30	16,50	1,50	640	0,50
12,7	s	1,27	500	1,25	10,20	+0,30	16,50	1,50	920	0,40

\*Mentioned performance guide values are valid for seals made from Inconel 718 work hardened. Preferred sizes are shown in bold. Other sizes not listed in table available on request.

## Match code

MCO-F 7 - 7 - 3,96 w - 0300,40 - 1 S L

Spring material	Code	Material no.
Elgiloy	E	2.4711
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

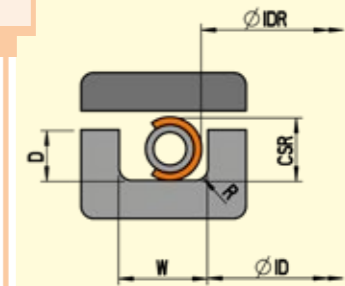
Other coating thicknesses on request.

The following ordering example describes a metal C-Ring for external pressure application Type MCO-F in

- F7 Spring Inconel 718
- 7 Material Inconel 718
- 3,96 Cross section 3,96mm
- w with wall thickness 0,41 mm
- 0300,40 Ring inner diameter IDR 300,40mm incl. coating (suitable for groove inner diameter ID 300,00mm)
- 1 work hardened
- S Silver coating
- L 0.01 - 0.03 mm thick

EXTERNAL PRESSURE APPLICATION  
Calculate inner diameter ring IDR:

$$IDR = ID + Z$$

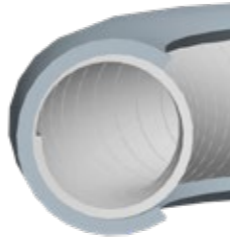


Create match code online  
[www.seals.de/matchcode-mco-f/e](http://www.seals.de/matchcode-mco-f/e)



# MCI-HF

Metal C-Ring highflex spring energized for internal pressure application



Metal C-Ring MCI-HF				Installation space				*Performance	
Nominal cross-section	Performance index	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
6,35	x	100	0,64	5,05	+0,20	8,90	1,50	110	0,60
11,00	x	500	1,10	8,80	+0,30	15,00	3,00	120	1,10
15,00	x	700	1,50	12,20	+0,30	19,50	4,00	160	1,50

\*Mentioned performance guide values are valid for seals made from Inconel 718 work hardened. Other sizes not listed in table available on request.

## Match code

MCI - HF 7 - 7 - 6,35 x - 0525,36 - 1 S H

Spring material	Code	Material no.
Elgiloy	E	2.4711
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

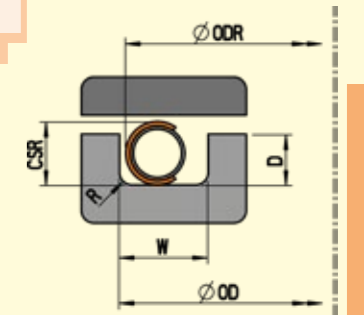
Other coating thicknesses on request.

The following ordering example describes a metal C-Ring for internal pressure application Type MCI-HF in

F7	Spring Inconel 718
7	Material Inconel 718
6,35	Cross section 6,35mm
x	
0525,36	Ring outer diameter ODR 525,36mm incl. coating (suitable for groove outer diameter OD 526,00mm)
1	work hardened
S	Silver coating
L	0.01 - 0.03 mm thick

INTERNAL PRESSURE APPLICATION  
Calculate outer diameter ring ODR:

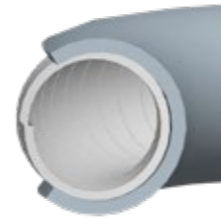
$$\text{ODR} = \text{OD} - Z$$





# MCO-HF

Metal C-Ring highflex spring energized for external pressure application



Metal C-Ring MCO-HF				Installation space				*Performance	
Nominal cross-section	Performance index	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
6,35	x	100	0,64	5,05	+0,20	8,90	1,50	110	0,60
11,00	x	500	1,10	8,80	+0,30	15,00	3,00	120	1,10
15,00	x	700	1,50	12,20	+0,30	19,50	4,00	160	1,50

\*Mentioned performance guide values are valid for seals made from Inconel 718 work hardened. Other sizes not listed in table available on request.

## Match code

MCO-HF 7 - 7 - 11,00 x - 1591,10 - 1 S M

Spring material	Code	Material no.
Elgiloy	E	2.4711
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

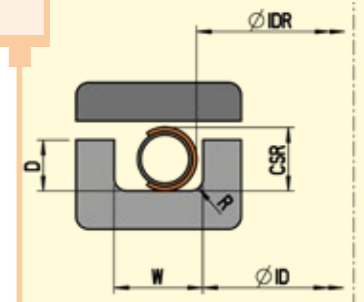
Other coating thicknesses on request.

The following ordering example describes a metal C-Ring for external pressure application Type MCO-HF in

F7	Spring Inconel 718
7	Material Inconel 718
11,00	Cross section 11,00mm
x	
1591,10	Ring inner diameter IDR 1591,10mm incl. coating (suitable for groove inner diameter ID 1590,00mm)
1	work hardened
S	Silver coating
M	0.03 - 0.05 mm thick

EXTERNAL PRESSURE APPLICATION  
Calculate inner diameter ring IDR:

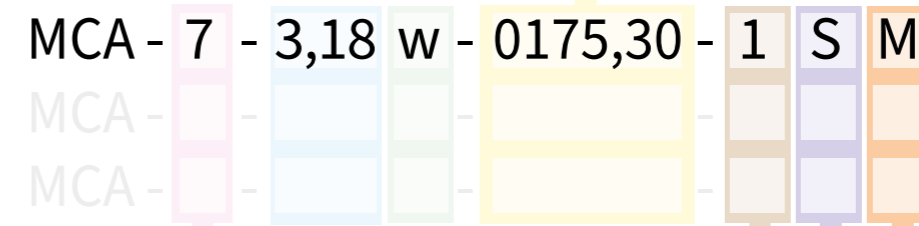
$$IDR = ID + Z$$





Metal C-Ring MCA				Installation space						
Nominal cross-section	Performance Index	Wall thickness	Outer diameter ring	Outer diameter groove		Inner diameter groove		Groove width	Radius	
				Range	Tolerance	Range	Tolerance			
CSR mm	Code	Wt mm	Ø ODR mm	Ø OD mm von	Ø OD mm bis	Tol. OD mm	Ø ID mm von	Tol. ID mm	W min. mm	R max. mm
1,57	w	0,15	OD + 0,08	12,00	37,99	+0,03	OD - 3,12	-0,03	1,50	0,25
1,57	w	0,15	OD + 0,10	38,00	45,00	+0,03	OD - 3,07	-0,03	1,50	0,25
2,39	w	0,25	OD + 0,08	30,00	37,99	+0,03	OD - 4,70	-0,03	2,20	0,25
2,39	w	0,25	OD + 0,10	38,00	85,00	+0,03	OD - 4,65	-0,03	2,20	0,25
3,18	w	0,38	OD + 0,10	50,00	84,99	+0,03	OD - 6,25	-0,03	2,80	0,35
3,18	w	0,38	OD + 0,15	85,00	149,99	+0,05	OD - 6,15	-0,05	2,80	0,35
3,18	w	0,38	OD + 0,20	150,00	200,00	+0,05	OD - 6,05	-0,05	2,80	0,35
3,96	w	0,38	OD + 0,15	85,00	149,99	+0,05	OD - 7,72	-0,05	3,50	0,5
3,96	w	0,38	OD + 0,20	150,00	250,00	+0,05	OD - 7,62	-0,05	3,50	0,5
4,78	w	0,51	OD + 0,15	100,00	149,99	+0,05	OD - 9,32	-0,05	4,20	0,5
4,78	w	0,51	OD + 0,20	150,00	300,00	+0,05	OD - 9,22	-0,05	4,20	0,5
6,35	w	0,64	OD + 0,20	150,00	300,00	+0,05	OD - 12,4	-0,05	5,50	0,75

### Match code



Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

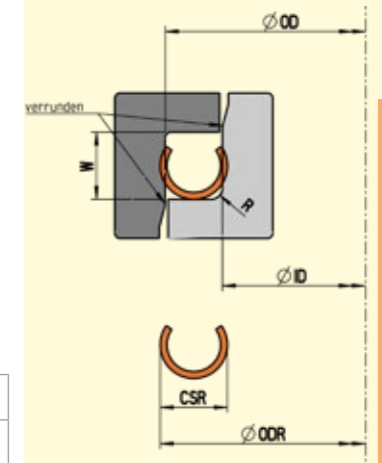
Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

Other coating thicknesses on request.

### The following ordering example describes a metal C-Ring for axial pressure application Type MCA in

- 7 Material Inconel 718
- 3,18 Cross section 3,18 mm
- w with wall thickness 0,38 mm
- 175,30 Ring outer diameter ODR 175,30 incl. coating suitable for groove outer diameter OD 175,00mm x groove inner diameter ID 168,95mm)
- 1 work hardened
- S Silver coating
- M 0.03 - 0.05 mm thick

### AXIAL PRESSURE APPLICATION



The diameter in the match code always refers to the outside diameter of the ring including the coating.

# MCA-F

Metal C-Ring spring energized for axial pressure application



Metal C-Ring MCA-F				Installation space						
Nominal cross-section	Performance Index	Wall thickness	Outer diameter ring	Outer diameter groove			Inner diameter groove		Groove width	Radius
				Range	Tolerance	Range	Tolerance			
CSR mm	Code	Wt mm	Ø ODR mm	Ø OD mm von	Ø OD mm bis	Tol. OD mm	Ø ID mm von	Tol. ID mm	W min. mm	R max. mm
1,57	w	0,15	OD + 0,08	12,00	37,99	+0,03	OD - 3,12	-0,03	2,00	0,25
1,57	w	0,15	OD + 0,10	38,00	45,00	+0,03	OD - 3,07	-0,03	2,00	0,25
2,39	w	0,25	OD + 0,08	30,00	37,99	+0,03	OD - 4,70	-0,03	2,70	0,25
2,39	w	0,25	OD + 0,10	38,00	85,00	+0,03	OD - 4,65	-0,03	2,70	0,25
3,18	w	0,38	OD + 0,10	50,00	84,99	+0,03	OD - 6,25	-0,03	3,50	0,35
3,18	w	0,38	OD + 0,15	85,00	149,99	+0,05	OD - 6,15	-0,05	3,50	0,35
3,18	w	0,38	OD + 0,20	150,00	200,00	+0,05	OD - 6,05	-0,05	3,50	0,35
3,96	w	0,38	OD + 0,15	85,00	149,99	+0,05	OD - 7,72	-0,05	4,30	0,5
3,96	w	0,38	OD + 0,20	150,00	250,00	+0,05	OD - 7,62	-0,05	4,30	0,5
4,78	w	0,51	OD + 0,15	100,00	149,99	+0,05	OD - 9,32	-0,05	5,00	0,5
4,78	w	0,51	OD + 0,20	150,00	300,00	+0,05	OD - 9,22	-0,05	5,00	0,5
6,35	w	0,64	OD + 0,20	150,00	300,00	+0,05	OD - 12,4	-0,05	6,50	0,75

## Match code

MCA-F E - 7 - 3,18 w - 0175,30 - 1 S M

Spring material	Code	Material no.
Elgiloy	E	2.4711
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Ring material	Code	Material no.
SS304	1	1.4306
Inconel X-750	5	2.4669
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

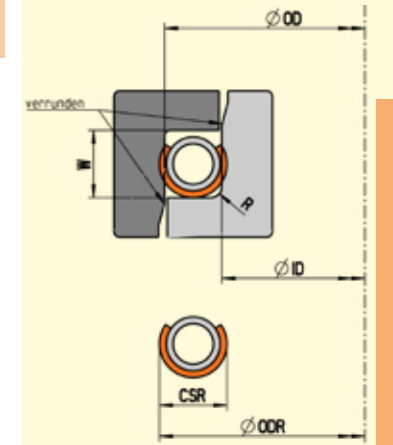
Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

Other coating thicknesses on request.

The following ordering example describes a metal C-Ring for axial pressure application Type MCA-F in

- FE Spring Elgiloy
- 7 Material Inconel 718
- 3,18 Cross section 3,18 mm
- w with wall thickness 0,38 mm
- 0175,30 Ring outer diameter ODR 175,30 incl. coating (suitable for groove outer diameter OD 175,00mm x groove inner diameter ID 168,95mm)
- 1 work hardened
- S Silver coating
- M 0.03 - 0.05 mm thick

## AXIAL PRESSURE APPLICATION



The diameter in the match code always refers to the outside diameter of the ring including the coating.



Metal U-Ring MUI					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Outer diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
2,39	w	0,25	30	0,15	1,90	+0,10	3,20	0,50	25	0,28
3,18	w	0,38	45	0,20	2,55	+0,10	4,20	0,75	30	0,35
3,96	w	0,41	65	0,25	3,20	+0,10	5,20	1,25	25	0,46
4,78	w	0,51	70	0,30	3,85	+0,15	6,40	1,30	25	0,70
5,60	w	0,51	80	0,35	4,50	+0,15	7,30	1,30	20	0,80
6,35	w	0,64	120	0,40	5,05	+0,20	8,50	1,50	30	0,85
9,53	w	0,97	300	0,58	7,70	+0,30	12,70	1,50	45	0,90
12,70	w	1,27	600	1,77	10,20	+0,30	16,50	1,50	60	1,20

\*Mentioned performance guide values are valid for seals made from Inconel 718 work hardened. Other sizes not listed in table available on request.

### Match code

MUI - 7 - 3,18 w - 0093,80 - 1 S M

Ring material	Code	Material no.
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

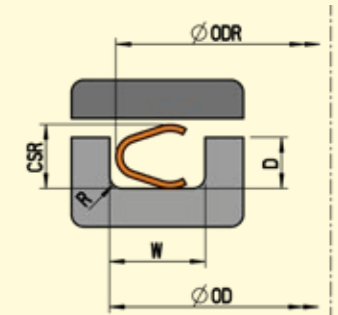
Other coating thicknesses on request.

The following ordering example describes a metal U-Ring for internal pressure application Type MUI in

- 7 Material Inconel 718
- 3,18 Cross section 3,18 mm
- w with wall thickness 0,38 mm
- 0093,80 Ring outer diameter ODR 93,80 incl. coating (suitable for groove outer diameter OD 94,00mm)
- 1 work hardened
- S Silver coating
- M 0.03 - 0.05 mm thick

INTERNAL PRESSURE APPLICATION  
Calculate outer diameter ring ODR:

$$ODR = OD - Z$$



Create match code online  
[www.seals.de/matchcode-mui/e](http://www.seals.de/matchcode-mui/e)

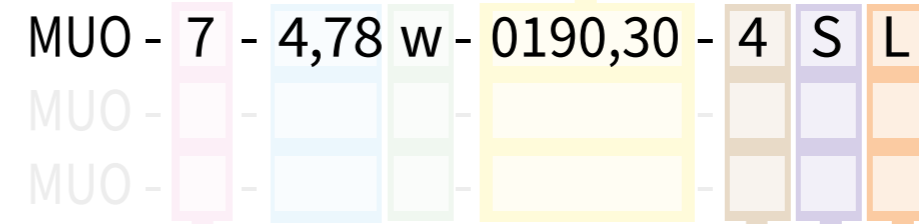




Metal U-Ring MUO					Installation space				*Performance	
Nominal cross-section	Performance index	Wall thickness	Inner diameter ring	diametrical clearance	Groove depth		Groove width	Radius	Pressing load (Guide values)	Springback (Guide values)
CSR mm	Code	Wt mm	Ø ODR min. mm	Z mm	D mm	Tol. mm	W min. mm	R max. mm	F ca. N/mm	SB ca. mm
2,39	w	0,25	30	0,15	1,90	+0,10	3,20	0,50	25	0,28
3,18	w	0,38	45	0,20	2,55	+0,10	4,20	0,75	30	0,35
3,96	w	0,41	65	0,25	3,20	+0,10	5,20	1,25	25	0,46
4,78	w	0,51	70	0,30	3,85	+0,15	6,40	1,30	25	0,70
5,60	w	0,51	80	0,35	4,50	+0,15	7,30	1,30	20	0,80
6,35	w	0,64	120	0,40	5,05	+0,20	8,50	1,50	30	0,85
9,53	w	0,97	300	0,58	7,70	+0,30	12,70	1,50	45	0,90
12,70	w	1,27	600	1,77	10,20	+0,30	16,50	1,50	60	1,20

\*Mentioned performance guide values are valid for seals made from Inconel 718 work hardened. Other sizes not listed in table available on request.

### Match code



Ring material	Code	Material no.
Inconel 718	7	2.4668

Other materials on request.

Heat treatment	Code	Description
HT 1	1	work hardened
HT 2	2	age hardened
HT 3	3	Solution annealing + precipitation hardened SC
HT 4	4	Solution annealing + precipitation hardened Std
HT 5	5	Heat treatment NACE MR 0175

Other treatments on request.

Coating	Code	max. temperature
Tin	Z	200°C
PTFE	P	290°C
Silver	S	430°C (650°C*)
Copper	C	930°C
Gold	G	930°C
Nickel	N	1200°C
without	O	-

\* Only valid for non-oxidizing media. Other materials on request.

Coating thickness Pt	Code
0,01 - 0,03 mm	L
0,03 - 0,05 mm	M
0,05 - 0,07 mm	H

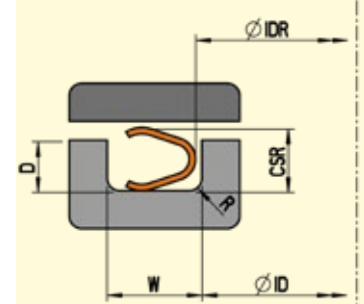
Other coating thicknesses on request.

The following ordering example describes a metal U-Ring for external pressure application Type MUO in

- 7 Material Inconel 718
- 4,78 Cross section 4,78 mm
- w with wall thickness 0,51 mm
- 0190,30 Ring inner diameter IDR 190,30mm incl. coating (suitable for groove inner diameter ID 190,00mm)
- 4 solution annealed and precipitation hardened
- S Silver coating
- L 0.01 - 0.03 mm thick

EXTERNAL PRESSURE APPLICATION  
Calculate inner diameter ring IDR:

$$IDR = ID + Z$$



Create match code online  
[www.seals.de/matchcode-muo/e](http://www.seals.de/matchcode-muo/e)



# Customized designs

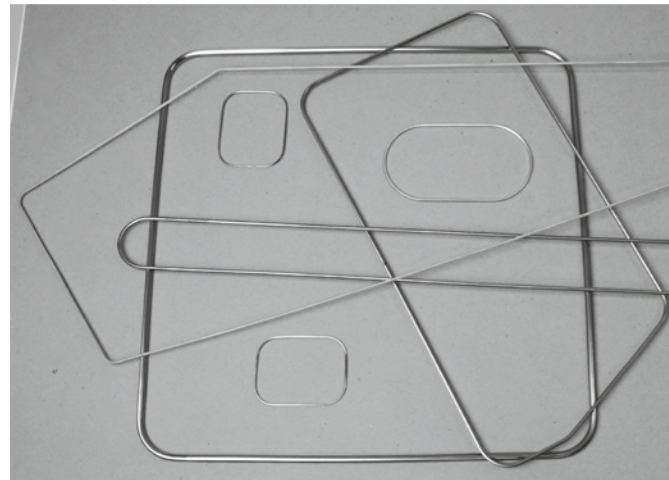
## Segment seals and custom sized shaped seals

In addition to the circular version, many of the seal types listed in the catalog are also available as shaped and segment seals for a wide variety of applications.

The minimum radii that can be implemented are based on the minimum diameters specified in the table for the respective type and are formed from ODRmin/2 for internal

pressure applications, IDRmin/2 applies for external pressure applications.

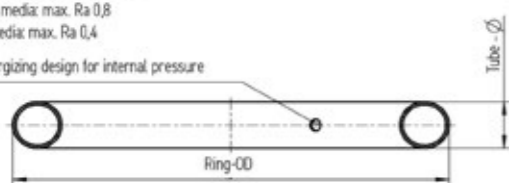
A detailed representation of the groove contour incl. dimensioning and tol. with reference to internal or external pressure application is required for the assessment of feasibility.



14	19610	35.23	1.6	0.25	35.30	1.15...1.25	2.3
13	5458	30.18	1.6	0.25	30.25	1.15...1.25	2.3
12	3022	28.58	1.6	0.25	28.68	1.15...1.25	2.3
11	5457	26.97	1.6	0.25	27.04	1.15...1.25	2.3
10	3023	25.40	1.6	0.25	25.60	1.15...1.25	2.3
9	5736	24.14	1.6	0.25	24.20	1.15...1.25	2.3
8	3624	22.23	1.6	0.25	22.30	1.15...1.25	2.3
7	3021	20.62	1.6	0.25	20.73	1.15...1.25	2.3
6	1119	19.05	1.6	0.25	19.15	1.15...1.25	2.3
5	3020	17.45	1.6	0.25	17.53	1.15...1.25	2.3
4	12009	15.87	1.6	0.25	16.07	1.15...1.25	2.3
3	1610	14.27	1.6	0.25	14.34	1.15...1.25	2.3
2	1845	12.70	1.6	0.25	12.75	1.15...1.25	2.3
1	3557	6.40	0.9	0.15	6.60	0.60...0.68	1.4
Pos.	GFD item	Ring-OD	Tube-Ø	wall thickness	Groove-OD	Groove depth	min. groove width

Recommendation surface finish  
Viscous media: max. Ra 0,8  
liquid media: max. Ra 0,4

self-energizing design for internal pressure



## Hot Runner seals

### Metal O-rings in hot runner systems of plastic injection molding machines

Seals for hot runner systems are available from stock in many sizes, as the groove dimensions from different manufacturers are often identical.

The seals are used, for example, in the nozzles, connectors and component separations of HK systems.

The seal is a "one-time" item and is exchanged when the components are changed.

## Space Limiter

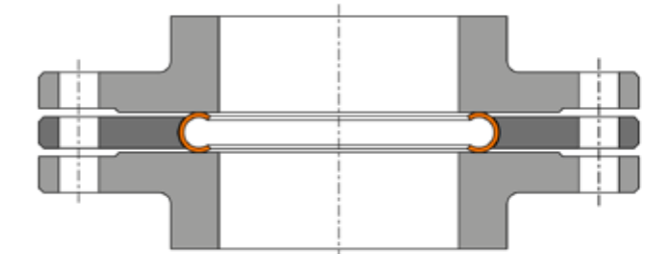
The Space Limiter enables the use of resilient metal seals when there is no groove geometry between two flanges. It limits the compression of the gasket to the required height and supports the seal when pressurized.

The surface finish of the flange pairs in the area of the counter sealing surface should follow GFD recommendations.

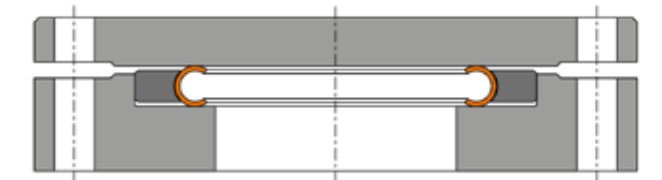
Space Limiters can be designed, for example, with a bolt circle corresponding to that of the bolted connections of the flanges.

If there is a shoulder in the flange connection, this can be used as a form fit.

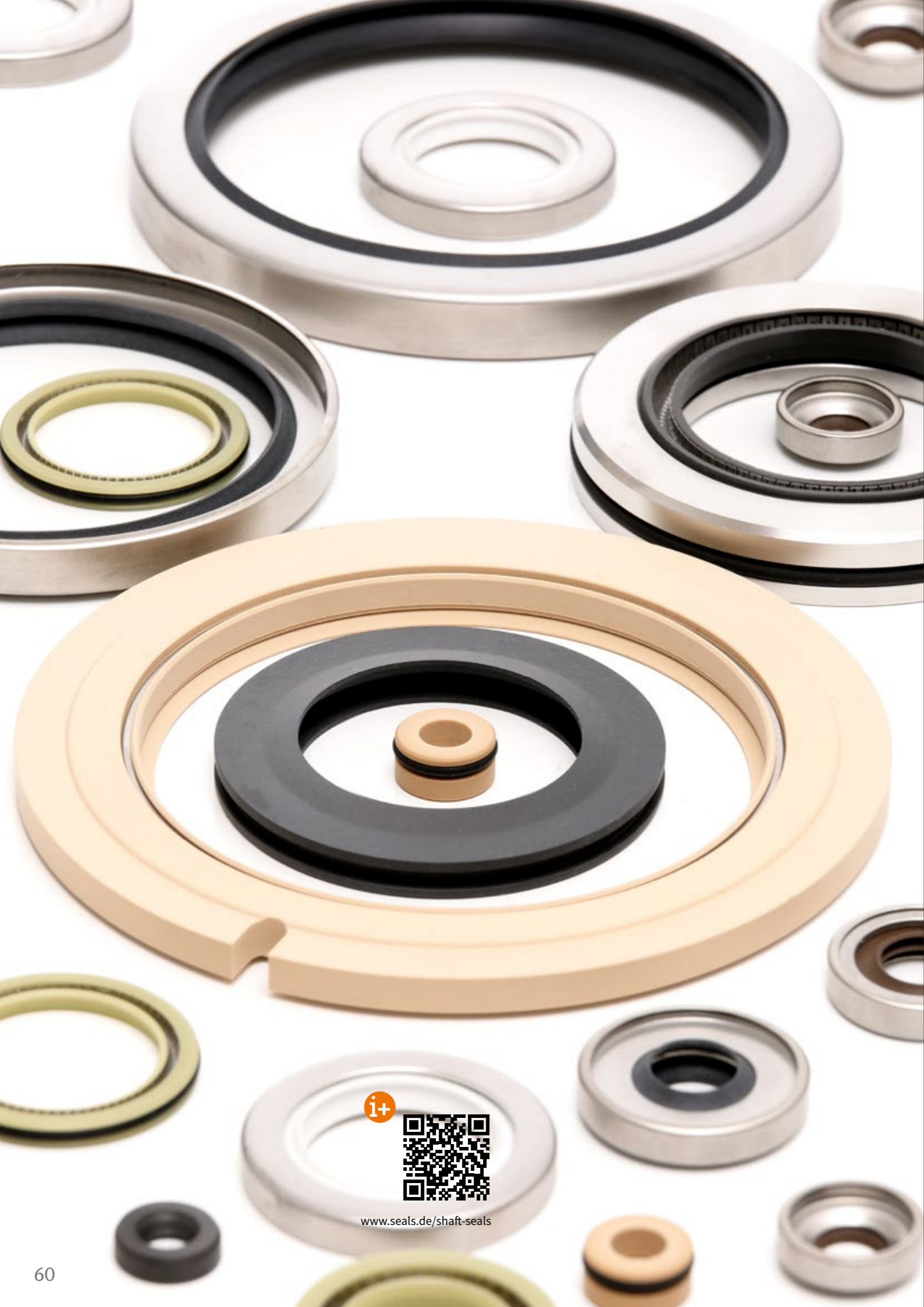
Space Limiters can be manufactured for both internal and external pressure. A detailed flange drawing incl. dimensions and tol. with reference to internal or external pressure application is required for checking feasibility.



Space Limiter with bolt circle



Space Limiter with form closure



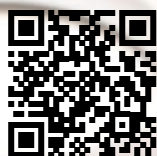
# Shaft seals

Shaft seals with PTFE sealing lip have been specially developed for use in difficult and extreme conditions. They are used when shaft seals with classic elastomer lips reach their performance limits.

Due to the almost universal chemical resistance of PTFE compounds, seals with PTFE sealing lip are particularly suitable for use with chemical, aggressive and corrosive media, pharmaceutical products, various coolants, synthetic oils, heat transfer oils, water and steam.

**Thanks to the outstanding properties of PTFE materials and the optimized lip designs, shaft seals with PTFE sealing lip have the following advantages:**

- Applicable in a wide temperature range from  $-70^{\circ}\text{C}$  to  $+260^{\circ}\text{C}$
- Lowest friction and power consumption due to favorable sliding properties
- Almost universal chemical resistance
- Can be used for dry running and lack of lubrication
- No stick-slip effect, thus low breakaway torque even after longer interruptions
- High circumferential speeds, up to 30 m/s possible
- Pressure load up to 10bar possible
- Use in the food and pharmaceutical industry



[www.seals.de/shaft-seals](http://www.seals.de/shaft-seals)

# General information

Applications and industries

## Shaft seals with PTFE sealing lip

The sealing quality and service life of a shaft seal depend to a large extent on the surface condition of the countersealing surface. The countersealing surfaces must not show any scratches or dents. The same applies to the shaft areas over which the seal is drawn until it is positioned. The areas to be sealed must be free of dust. The shaft may be greased for assembly if the application permits. The grease must be free of solids, e.g. MoS<sub>2</sub> or ZnS, and have the appropriate temperature resistance (incl. the resulting frictional heat).

### Note:

The operating parameters such as pressure, temperature and speed influence each other. A simultaneous occurrence of the maximum parameters mentioned is therefore not permissible.

**Please contact our engineering department in such cases.**

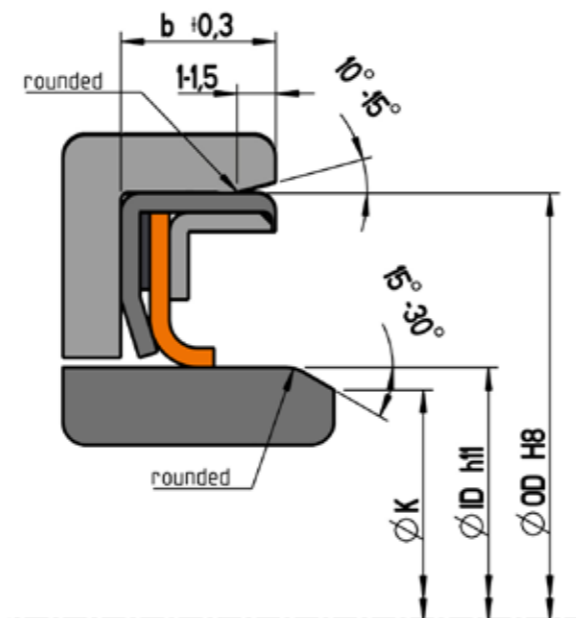
## The locating bore

The shaft seal ring with PTFE sealing lip is pressed into the locating bore.

Bore tolerance H8

Ra < 1.6 μm

Insertion chamfer 1.5 ± 0.2 x 20° (- 25°)



## The shaft

Shaft seals with PTFE sealing lip ideally run on hard mating surfaces to prevent run-in marks in the shaft. An ideal mating surface is for example the hard chrome-plated running surface. To generate a better match between sealing and mating surfaces, we recommend subjecting these surfaces to a short running-in process.

### Our recommendations for the design of the running surface:

Shaft tolerance: h11

Hardness: ideally at least 60 HRC

Surface finish: Ra 0.2 - 0.4

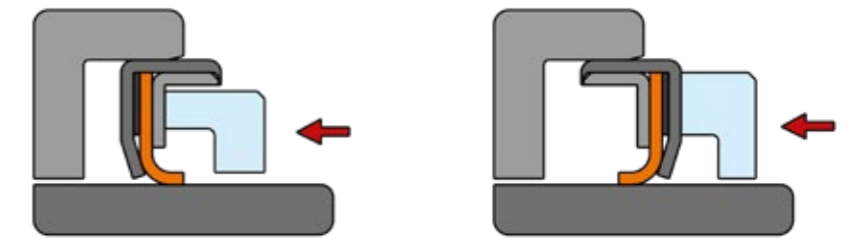
Twist-free groove ground

Lead-in chamfers at shaft end

Shaft diameter ØID	Ø 10 - 49 mm	Ø 51 - 150 mm	Ø 151 - 800 mm
Cone diameter ØK	Ø w - 4 mm	Ø w - 5 mm	Ø w - 6 mm

Shaft sealing rings must be fitted extremely gently to avoid damage to the sealing lips.

We recommend using press-fit rings for assembly. We are also happy to offer the matching press-fit rings for the shaft seals.



Mounting shaft seal

## Mounting tools



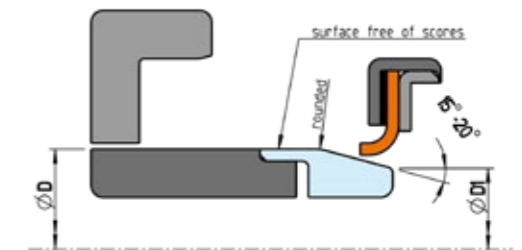
If shaft seals are mounted against the sealing lip on shafts without sufficient lead-in chamfer, or if they have to be pushed over grooves or transverse bores, we recommend using suitable mounting tools.

These tools must not have any sharp edges or transitions. They must have the same surface quality as the recommended mating surface.

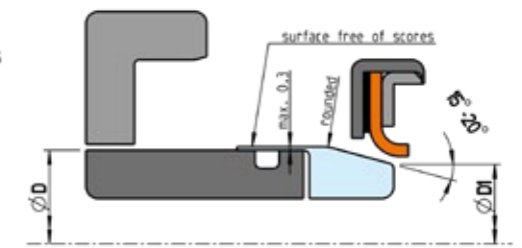
We are also pleased to offer the appropriate mounting tools for the shaft seals..

Shaft - ØD		Mountingsleeves - ØD1	
from ø	to ø	from ø	to ø
0	24	D	-3,0
25	49	D	-4,0
50	99	D	-5,0
100	149	D	-6,0
150	199	D	-7,0
200	400	D	-8,0

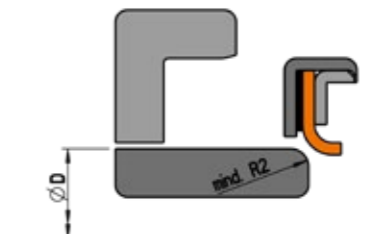
Mounting against forming direction with Sleeve



Mounting in forming direction about grooves or transverse bores



Mounting in forming direction



## Typical applications / Industries

They can be found for example in:

- Compressors
- Shaft and pump sealings
- Mixers
- Agitators
- Gearboxes
- Centrifuges
- Machine tools or in blowers



# Materials

## Material selection

In addition to the correct choice of design and sealing lip geometry, the correct selection of the lip material is also decisive for the service life. PTFE materials are used as standard and their advantages can cover a wide range of applications.

## Sealing lip materials

The following PTFE materials are available as standard for shaft seals in stainless steel housings:

Material Description	Code	Relative wear resistance (1 low ... 9 high)	Temperature range	ATEX	FDA Conformity
PTFE + glasfiber / graphite	186	9	-130°C ... +260°C		
PTFE + carbonfiber	187	8	-130°C ... +260°C		
PTFE + glasfiber / MoS <sub>2</sub>	188	9	-130°C ... +260°C		
PTFE + polymerfiller	171	7	-130°C ... +260°C		x
PTFE + carbon	242	8	-130°C ... +260°C	x	
PTFE + carbon / graphite	190	8	-130°C ... +260°C		

## Housing material

The housing is made of stainless steel 1.4301 (ss 304). Alternatively it is also possible in 1.4401 (ss 316)

## Match code for rotary shaft seals with stainless steel housing

The following information is required for the seal definition of the shaft seal:

Example  
RWDR - (type) - (groove dimension) - PTFE material



## Eccentricity

To prevent the sealing lip from lifting off the shaft, the shaft runout must be low.

We therefore recommend a concentricity tolerance of maximum 0.05 mm.

## Coaxiality

There must be uniform radial contact pressure over the entire circumference of the sealing lip on the shaft to prevent uneven wear.

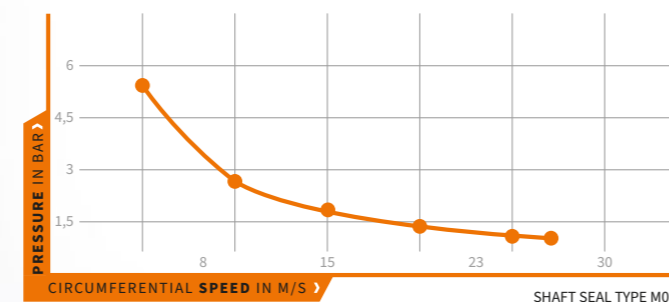
We recommend a maximum coaxiality of 0.1 mm.

## Load

The load on the shaft seal during operation depends mainly on the pressure and the circumferential speed of the shaft. How far the shaft seal is from its load limit, or whether this has been reached or exceeded, can be determined by looking at the pv value. The permissible pv value is shown by the curve in the diagram.

In the case of dry running/lack of lubrication, the value can be greatly reduced.


**In this case, please contact our technical department.**




The curve shown is valid for type M01 in oil bath

# Shaft seal types with stainless steel housing


The sealing lips are set in a corrosion-resistant stainless steel housing which is pressed into the location bore. The bore should therefore be made of steel or cast iron. The dimensions of the sealing rings are comparable with shaft seals to DIN 3760 and can therefore be easily replaced.




**Type M01**  
Standard seal with supported sealing lip  
**Application limits:**  
Temperatures: -40°C - +260°C  
Max. Pressure: 10 bar  
Max. Peripheral speed: 30 m/s  
**Example:** Compressors, mixers, agitators, gearboxes, vacuum pumps




**Type M**  
With straight metal housing.  
**Example:** Compressors, agitators, planetary gearboxes, compressors




**Type M04**  
With negatively shaped sealing lip. Ideal for applications where no dead spaces are permitted, for example in the food and pharmaceutical industries.  
**Example:** Planetary gearboxes, filter centrifuges, dryers, centrifuges, agitators




**Type MOD**  
Shaft seal pressed onto shaft, seals at the bore.  
**Example:** Centrifuges




**Type MD**  
For applications where a higher sealing effect is required, such as e.g. gaseous or critical media. Also offers the possibility to fill the gap with a disposable lubricant.  
**Example:** Vacuum pumps



**Type MF**  
Spring-energized sealing lip for increased tightness requirements to allow better lip tracking at low shaft runout. The spring increases the standstill tightness in pressureless condition.  
**Example:** Pumps




**Type MW**  
With scraper lip, which prevents abrasive particles from depositing under the sealing lip. Ideal for dusty and dirty environments.  
**Example:** Radial piston pumps, granulating systems, mixers




**Type MD12**  
Two opposing sealing lips for separation of two different media with support disc between the lips.  
**Example:** Grinding machines, agitators

In addition, we offer further **individual solutions** to shaft seals with PTFE sealing lip in stainless steel housing in order to be able to offer an even better adaptation to customer-specific applications. The following is an excerpt from our range of designs:



**Type MS Scraper seal**  
Scraper seal with a scraper lip made of stainless steel or brass and a sealing lip made of wear-resistant PTFE. Removes adhering dirt or ice particles.  
**Example:** Lifting rod seal

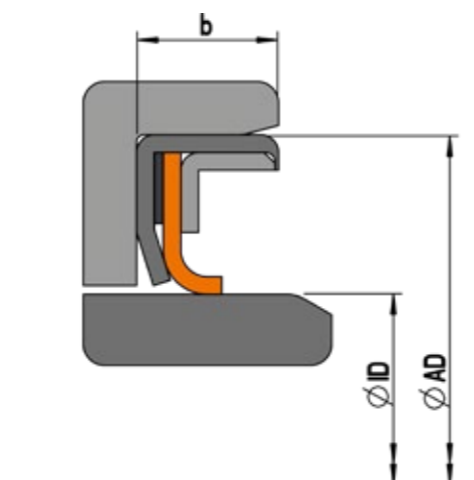


**Type MPS**  
Shaft seal with inserted packing cord made of PTFE (also FDA compliant possible).  
**Example:** Shaft bushings on industrial furnaces, crankshafts and gearbox shafts, protection for bearings and drive units, as a special design up to 430°C for high-temperature applications.

**Note:**  
All shaft seals can also be manufactured in a low-friction version. Likewise the respective medium lip can be equipped with a return thrust. However the running direction of the shaft must be known beforehand.

## Dimensions list, standard type M01

We stock many common dimensions of the standard type M01. In addition, we manufacture these rings in any intermediate dimensions. Seals up to shaft diameter  $\varnothing$  470 mm are possible.



Dimensions: $\varnothing$ ID x $\varnothing$ AD x b	Dimensions: $\varnothing$ ID x $\varnothing$ AD x b	Dimensions: $\varnothing$ ID x $\varnothing$ AD x b	Dimensions: $\varnothing$ ID x $\varnothing$ AD x b
8 x 22x 7	42 x 62 x 8	60 x 80 x 8	145 x 165 x 10
15 x 26 x 7	44 x 60 x 10	62 x 80 x 8	150 x 180 x 12
15 x 32 x 7	45 x 62 x 8	64 x 80 x 8	155 x 185 x 12
16 x 28 x 7	45 x 62 x 8	65 x 85 x 8	160 x 185 x 12
20 x 30 x 7	46 x 64 x 8	65 x 90 x 10	160 x 190 x 12
20 x 35 x 7	48 x 65 x 8	70 x 90 x 10	170 x 200 x 15
22 x 35 x 7	50 x 65 x 10	72 x 95 x 10	180 x 210 x 15
25 x 42 x 7	50 x 68 x 8	75 x 100 x 10	200 x 230 x 15
28 x 40 x 7	50 x 72 x 8	80 x 100 x 10	220 x 245 x 12
28 x 47 x 7	54 x 72 x 10	85 x 100 x 10	220 x 250 x 12
30 x 42 x 7	55 x 70 x 8	90 x 110 x 10	230 x 260 x 12
30 x 47 x 7	55 x 72 x 8	95 x 120 x 12	230 x 260 x 15
32 x 47 x 7	55 x 75 x 8	100 x 125 x 12	250 x 280 x 15
35 x 47 x 7	55 x 80 x 8	105 x 130 x 12	260 x 280 x 10
35 x 52 x 8	58 x 72 x 8	110 x 130 x 12	260 x 280 x 10
35 x 55 x 8	58 x 75 x 8	120 x 140 x 13	400 x 440 x 20
35 x 62 x 8	58 x 80 x 8	125 x 150 x 12	470 x 510 x 20
36 x 50 x 8	60 x 72 x 8	130 x 160 x 12	
40 x 60 x 8	60 x 75 x 8	140 x 160 x 15	

# Shaft seals without housing

Shaft seals without housing are individual solutions that do not require a stainless steel housing. This allows a larger diameter range from Ø 1.5 - Ø 3000 mm.

Furthermore, the production of smaller lot sizes is possible and can also be manufactured in many special compounds at short term.

In addition to the classic formed sealing lip, the lip can also be equipped with a spring which, among other things, ensures that the contact pressure of the lip on the shaft remains constant even in the event of temperature fluctuations.

For designs without dead space, the spring space is filled with red silicone (FDA) after spring assembly. Some applications even allow the use of an O-ring as a preload element of the sealing lip and simultaneous dead space solution.

This type of seal without a stainless steel housing is also pressed into a location hole. Unlike the shaft seal with stainless steel housing, however, this does not always have to be made of steel or cast iron. The locating bore can also be made of plastic.

An elastomer O-ring is fitted to the outer diameter of the sealing ring, which provides the static seal between the sealing element and the bore.

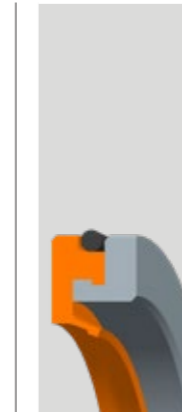
We recommend clamping the shaft seals axially to prevent them from rotating.

The areas of application conform to the shaft sealing rings with stainless steel housing.

In addition, we offer further **individual solutions** to shaft seals with PTFE sealing lip without stainless steel housing, in order to be able to offer an even better adaptation to the customer-specific applications. Excerpt from our range of types:



Solution with steel band insert  
Prevents sinking of the pressing load in the bore, in cold environment.



Solution with a clipped-in steel ring to hold the shaft seal in the bore by press fit.



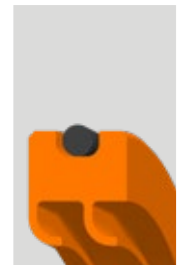
Solution with an outer and inner jacket made of steel. This allows an interference fit to be realized on the outside. The inner ring prevents the PTFE material from shrinking onto the shaft in a cryogenic environment.



## RWDR oG M

Standard type, suitable for a wide range of applications.

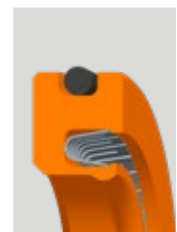
**Example:** Rotating unions, pumps



## RWDR oG MD

The double-lipped design offers more safety with more critical media.

**Example:** Screw conveyors, mixers, agitators



## RWDR oG 400

This version has a spring-energized sealing lip.

**Example:** Drum motor, parts cleaning machines



## RWDR oG 4VSSR

The spring space is additionally filled with red silicone. This prevents product from accumulating in the groove or germs from entering the spring spaces.

**Example:** Mixers, agitators for the food industry



## RWDR oG MW400

This design has a spring-energized main seal lip with a dust lip to prevent ingress of debris.

**Example:** Back-up roller seal, mixers, agitators



# Materials

Material description	Compound no.	Relative wear resistance	Temperature range °C FDA	FDA	ATEX	BAM	USP Cl. VI	Norsok
<b>PTFE virgin</b> Recommended for low to medium dynamic or static applications.	01 white	3	-250°C ... +200°C		x			
<b>modified PTFE virgin</b> Recommended for low to medium dynamic or static applications. Higher pressure resistance, suitable for UHV. Low gas permeability.	01X white	3	-250°C ... +200°C	x	x	x	x	x
<b>PTFE carbon &amp; graphite reinforced</b> Very good, universal properties for higher temperatures and wear resistance. Especially suitable for hot water and steam.	03 black-grey	8	-100°C ... +290°C					
<b>PTFE graphite reinforced</b> Very good, universal properties for higher temperatures and wear resistance. Low friction and wear resistant.	12 grey	7	-100°C ... +290°C					
<b>PTFE with glass fiber and MoS<sup>2</sup></b> Highly wear resistant, very tough. Recommended for high pressure hydraulics, water and steam. At high speeds and soft contact surfaces, the material can have an abrasive effect.	06 grey	9	-150°C ... +290°C					
<b>PTFE with polymer filler</b> Excellent wear resistance. Recommended for medium and high speeds in dynamic applications. Especially suitable for soft contact surfaces.	10 creme/beige	8	-150°C ... +300°C					
<b>modified UHMW-PE</b> Extremely tough and wear resistant, but limited chemical and temperature resistance. Especially suitable for abrasive media.	08 yellow	9	-250°C ... +100°C		x			
<b>PEEK</b> Extremely hard material, very suitable as support ring in high pressure applications to prevent extrusion.	126 creme/beige		-50...+310	x				
<b>PCTFE</b> Material for seat rings and seals. Suitable for low temperatures.	132 white		-250...+180					
<b>PTFE glass fiber reinforced</b> Highly wear resistant and, due to FDA conformity, ideally suitable for use in food and medical applications. Can be abrasive at high speeds and soft contact surfaces.	150 white	9	-150...+290	x				
<b>Modified PTFE carbon reinforced</b> High pressure and high temperature resistant.	136 black	8	-100...+290	x				

Material description	Compound no.	Relative wear resistance	Temperature range °C FDA	FDA	ATEX	BAM	USP Cl. VI	Norsok
<b>PTFE with carbon black + polymer filler</b> Good wear resistance.	221 black	8	-100...+290	x	x			
<b>PTFE special carbon reinforced</b> High pressure and high temperature resistant.	267 black	8	-100...+290					x
<b>sepcial modified PTFE virgin</b> Modified PTFE with BAM approval.	285 white	3	-250...+200			x		

## O-Ring description

Elastomer	GFD description
NBR	NBR
Viton	Vi
EPDM	EP
Silicone	Si

## Spring material

Materials		
<b>stainless steel</b>	C	1.4310
<b>Inconel</b>	I	2.4669
<b>Elgiloy</b>	E	2.4711
<b>Hasteloy</b>	R	2.4819

The abbreviations C I E R refer to the last digit of the match code.



# Construction parts

Based on our many years of experience in the field of sealing technology, we have also established ourselves as experts for precision parts made of high-performance plastics. Since not all plastic materials and parts can be produced by injection moulding, GFD produce construction parts by different innovative manufacturing processes. From simple to complex - our own machinery and in cooperation with partners allow us to precisely machine high-performance plastics.

Precision begins long before production. Our CAD experts convert your data models and drawings exactly on our machines.



# General information

For the production of your precision parts, we have CNC milling / CNC turning centers, water jet cutting systems, and automatic punching machines. In combination with our modern measuring technology we are the ideal partner for your precision parts made of high-performance plastics. From small quantities to large series - **we look forward to your inquiry.**

## Material selection

We have numerous compounds available for your precision parts made of high-performance plastics. The following is an excerpt of the materials we offer:

Material	Temperature range
PCTFE Cpd. 132	-240°C ... +205°C
PEEK Cpd. 126	-60°C ... +230°C
PVDF Cpd. 288	-30°C ... +150°C
UHMW PE natur Cpd. 110	-200°C ... +80°C

You can find further materials in our material list (**page 70/71**)  
**Further materials on request.**  
**Please contact us.**

## Production possibilities

The following manufacturing options are available:  
 We would be pleased to check your drawing.

<b>Lathing</b> Possible dimensions*	Till ø3000mm x 500mm
<b>Milling</b> Possible dimensions*	Till 450mm x 320mm x 170mm
<b>Waterjet cutting</b> Possible dimensions*	Till 3000mm x 2000mm x 10mm
<b>Stamping</b> Possible dimensions*	Till 2000mm x 1150mm x 3mm

\*Depending on the material



Switching disk made of PCTFE



Contour ring made of PTFE



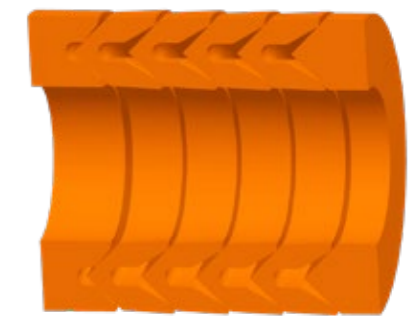
Scraper ring made of UHMW-PE

## Examples of products

We have already proven our precision many times. For this purpose we provide you with a small overview.

We would be pleased to check your drawing and create an individual offer for you.

**Give us a challenge!**



Sleeve made of PTFE



Dispensing ring made of PEEK



# Industries

- Machine and plant constructions
- Oil and gas industry
- Medical- and Food Technology, Pharma
- Sealing Technology
- Chemical and process technology
- Laser and sensor technology
- Aviation and Aerospace



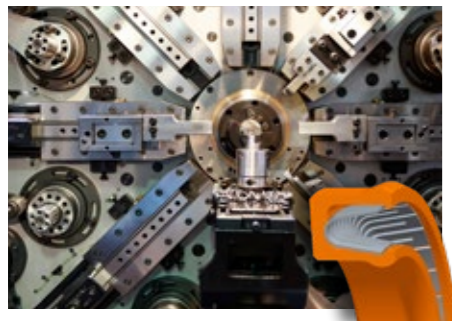
[www.seals.de/industries](http://www.seals.de/industries)



## Machinery and Plant Construction

- Tool Turret
- Hydraulics and Pneumatics
- Injection Moulding Technologie
- Compressors

Whether machine tools, vacuum systems or robotics: there is no area in which our sealing solutions have not established themselves. Both our spring-energized PTFE and metal seals and our rotary shaft seals are used in this broad field.



### Rotary turret for cutting machines

- + **Medium:** dirt, oil, microparticles
- + **Temperature:** up to 75°C
- + **Pressure:** low
- + **Special characteristics:** diameter from 30mm to 600mm, low friction coefficients required.
- + **Solution:** elastic lip seal with V-spring for optimum ratio between friction and tightness



### Rolling bearing seals

- + up to 4500 rpm
- + from -30°C to +230°C
- + with reduced frictional force
- + **Medium:** oil, grease
- + **Solution:** Shaft seal without housing, Type 400

## Oil & Gas

- LNG
- Valves and Fittings
- Turbines
- Pumps

For many years now, we have been an established player in the oil and gas industry. Both high pressure and cryogenic temperature applications are no problem for us. Our sealing solutions can be found in control valves and butterfly valves around the world. Thanks to our enormous experience and the versatile conformities of our material compounds, such as NORSOK and Nace, we are your predestined partner.



### Swivel joint seal for sea and loading arms

- + **Medium:** Liquefied natural gas (LNG), nitrogen
- + **Temperature:** Low temperature range -164 °C
- + **Special characteristics:** dynamic and static application
- + **Solution:** highly wear-resistant lip seal with high compression load and flexibility due to a full-contact spring



### Low temperature ball valve

- + **Medium:** various
- + **Temperature:** low temperature range down to -193°C
- + **Pressure:** up to 500 bar
- + **Special characteristics:** as housing or seat seal; from smallest sizes up to 2500mm diameter
- + **Solution:** spring-energized lip seal made of special low-temperature material and with strong compression load



### Turbocharger and turbine housing seals, combustion chamber seals

- + Maintaining tightness under highly dynamic temperature and pressure cycling conditions
- + Excellent suitability of the sealing elements in terms of adjustment behavior and flexural fatigue strength required
- + Use of segment seals possible



### Radial sealing for fittings, valves and controls

- + Sealing of components moving axial to each other in fittings, valves and controls for temperatures up to approx. 650°C with low leakage rates at a high number of cycles





## Medical and Food Technology / Pharma

- Endoscopy
- Pipetting heads
- HPLC Pumps
- Centrifuges

From filling machines to endoscopy and centrifuges. Our sealing solutions are used successfully everywhere. Due to the excellent properties of our food-compatible materials (FDA, USP Class VI), our spring-energized lip seals and our radial shaft seals are particularly suitable for this purpose, especially in HPLC applications.



### Endoscopy

- + **Medium:** dirt, body fluids
- + **Temperature:** room temperature
- + **Pressure:** low
- + **Special characteristics:** very small diameters and cross sections, low friction values required
- + **Solution:** permanently elastic lip seal with defined and long-lasting force application



### Pipette seal

for manual or automated (laboratory) processes

- + **Medium:** various
- + **Temperature:** room temperature
- + **Pressure:** low
- + **Special characteristics:** very small diameters and cross sections
- + **Solution:** Spring-energized lip seal made of highly wear-resistant material approved for medical use



### Shaft seal for food application

- + Jacket in wear-resistant and FDA-compliant PTFE compounds
- + Spring in stainless steel / silicone filling (FDA)
- + O-ring (FDA compliant, USP class VI)

#### Requirements:

- CIP cleaning
- 20 double lifts/min
- from pressureless to 5 bar
- lifting movement 180mm
- various foodstuffs, liquid, pasty

**Note:** Can also be used for rotary applications.



### Shaft seal with stainless steel housing

Sealing point: Fan drive shaft lead-through into the furnace chamber

- + up to 2000 rpm
- + from +30 to +250°C
- + dry run
- + unpressurized
- + low deadspace design
- + FDA-compliant sealing lip

## Sealing Technology

- Mechanical seals

Our seals as a core element: As an elementary component of mechanical seals, our sealing solutions are used worldwide with the best possible success. Not only our end customers benefit from our solutions expertise. We have also worked successfully with our technical trading partners for many years.



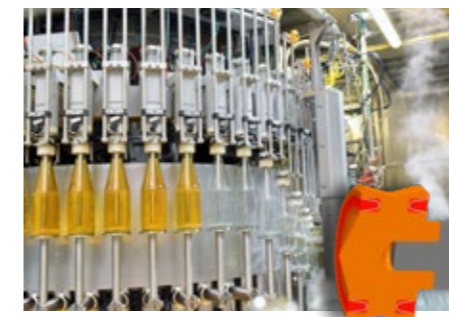
### Secondary sealing element in mechanical seals

- + **Medium:** fluids, gases
- + **Temperature:** up to 250°C
- + **Pressure:** 100 bar
- + **Special characteristics:** static or light dynamic
- + **Solution:** elastic lip seal with spring force adapted to the application to develop the optimum sealing effect

## Chemistry and Process Technology

- Hydrogen Applications
- Paper
- Filling Systems
- Dispensing Technology

Our material compounds, together with their universal chemical resistance and BAM conformity, make our spring-energized lip seals the ideal solution for water and oxygen applications. The paper and cardboard industry, petrochemicals, dispersion technology and many more have also benefited from our reliable seals for many years.



### Dosing pistons for filling lines

- + **Medium:** liquid or solid food, for example yogurt
- + **Temperature:** above 120° C during cleaning or sterilization
- + **Pressure:** up to 5 bar
- + **Special characteristics:** separation of two media rooms, stroke movement
- + **Solution:** spring-energized double-acting piston solution designed as a one-piece element, made of wear-resistant FDA-approved materials



## Laser- and Sensor Technology

- Optical Measuring Machines
- Co<sub>2</sub>-Laser Cutting Heads
- Ultrashort Pulse Laser

Both our spring-energized lip seals and our resilient metal seals have been consistently convincing in this area for many years with their extremely low leakage rates. Optical measuring machines, CO<sub>2</sub> laser cutting heads and ultrashort pulse lasers are only a few examples for which we offer our extremely efficient solutions.



### Dust seal Laser devices

- + **Medium:** dirt, dust
- + **Temperature:** up to 70°C
- + **Pressure:** low
- + **Special characteristics:** insert in removable cassette
- + **Solution:** permanently elastic lip seal made of highly wear-resistant material for low-maintenance use



### Housing seal

- + Component housing seals in laser modules
- + Maintenance of defined pressure ratios over long periods of time
- + Protection against contamination
- + Achieving the lowest leakage rates with low pressing loads
- + **Solution:** Resilient Metal Seals

## Aviation and Aerospace

- Satellite Telescopes
- Fuel Tanks
- Fuel Systems

We do not draw the line at the sky - we go beyond it. Our sealing solutions can withstand even these extreme conditions and are used, for example, in satellite telescopes, fuel tanks and fuel systems.



### Thruster fuel seal

- + Sealing of fuel-carrying components
- + reliable sealing performance under highly variable environmental conditions (pressure, temperature, vibration ...)
- + Achieving the lowest leakage rates with low pressing loads
- + **Solution:** Resilient Metal Seals



### Housing seal

- + Component housing seals in modules for space projects
- + Maintenance of defined pressure ratios over years
- + Protection against contamination
- + strongly changing environmental conditions (pressure, temperature ...)
- + Achieving the lowest leakage rates with low pressing loads
- + **Solution:** Resilient Metal Seals



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