



## DESIGN HANDBOOK



Spring Energized PTFE-Seals

High Performance Seal Technologie





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# General Information

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The GFD spring energized PTFE seal is the newest generation of spring actuated Teflon seals. These seals consist of a special precision jacket/lip made of Teflon (or other high performance polymers) and a corrosion resistant stainless steel spring.

In this combination, the spring is forcing the seal lips against the gland and the rod walls. The pressure assists the spring force.

The spring compensates the lip wear, hardware tolerances, eccentricities and provides permanent resilience to the seal lips. The GFD design with sealing lip and spring arrangement guarantees more leakage protection than conventional lip seals.

More than 50 different PTFE compounds (and other high performance polymers) are available or can be composed for jacket fabrication within a very short time.

The standard designs cover radial and axial seals for dynamic as well as static applications.

In addition to standard designs, we are also able to produce designs made to specification for special applications (silicone filled, sanitary seals, ultra low friction seals, etc.).

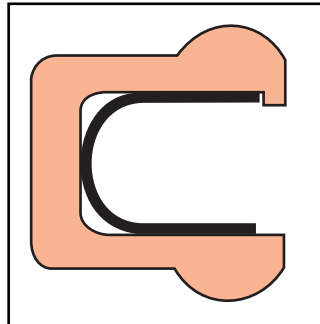
A wide variety of materials, dimensions, and designs provide the opportunity to solve difficult sealing problems.



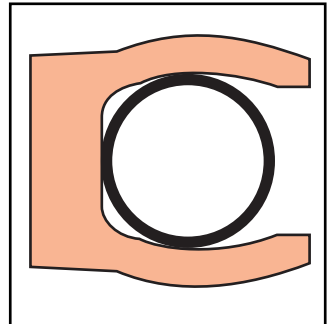
# Standard-Radial Seals

(Piston- and Rod Seals)

**Type 400**



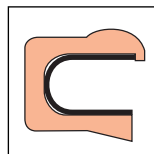
**Type 103**



**Some Design Variations of Type 400**

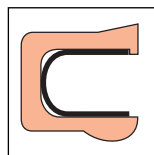
**Type 401**

sharp scraper-lip on the inside-diameter



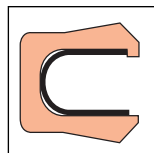
**Type 402**

sharp scraper-lip on the outside-diameter



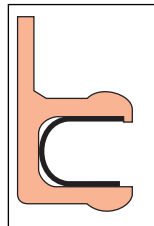
**Type 4VS**

chamfered seal-lips



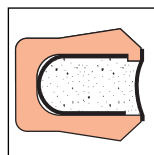
**Type 414**

type 400 with flange



**Type 4FM**

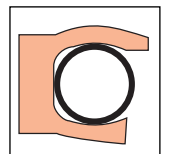
with silicone filled spring cavity for food processing and sanitary applications  
FDA-approved



**Some Design Variations of Type 103**

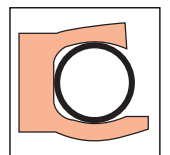
**Type 113**

sharp scraper-lip on the inside-diameter



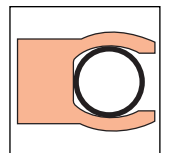
**Type 123**

sharp scraper-lip on the outside-diameter



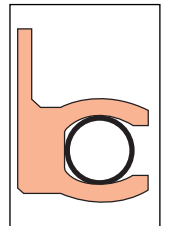
**Type 103H**

extended seal-back for high pressure



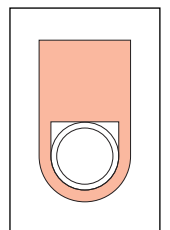
**Type 143**

type 103 with flange



**Special**

completely encapsulated spring



In addition to these listed standard sizes, we can ship special designs in each sizes and cross sections. Please send us back the application data form. We will make recommendations by our Engineering Department.



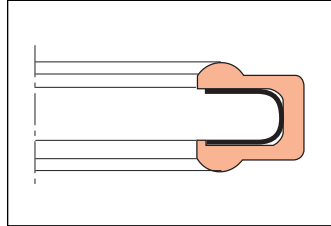
# Standard-Axial Seals

(Face Seals for Static and Rotary Service)

## For Internal Pressure

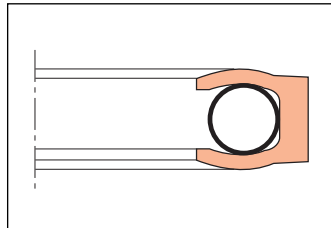
### Type 403

Dynamic and static applications.  
Low seal friction.



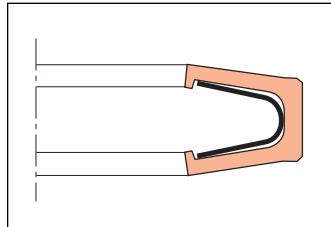
### Type 304

Dynamic and static applications.  
Higher spring force.  
For higher pressure.



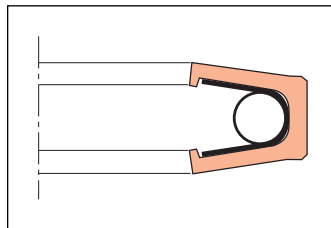
### Type 1100

Static and slow dynamic service. High loaded spring for lowest leakage and low temperatures.



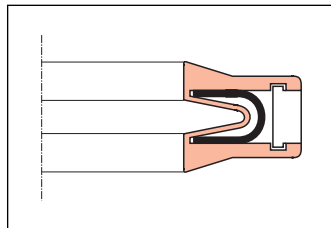
### Type 2100

Static and slow dynamic service.  
Extra large deflection range of spring.



### Special

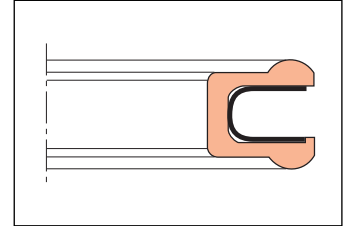
with a capsulate spring,  
for food and drug.  
FDA-approved.



## For External Pressure/Vacuum

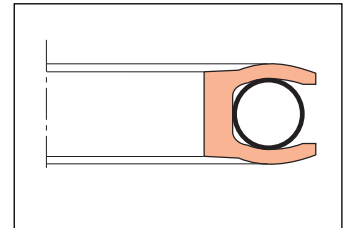
### Type 404

Dynamic and static applications.  
Low seal friction.



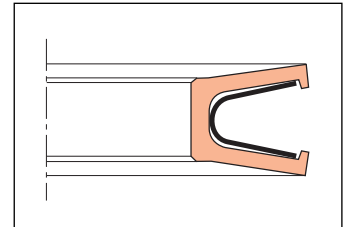
### Type 314

Dynamic and static applications.  
Higher spring force.  
For higher pressure.



### Type 1101

Static and slow dynamic service. High loaded spring for lowest leakage and low temperatures.  
Good vacuum seal, low gas permeability.



In addition to these listed standard sizes, we can ship special designs in each sizes and cross sections. Please send us back the application data form. We will make recommendations by our Engineering Department.



# Seal Selection and Operation Range

The wide variety of types provide the opportunity to meet all sealing requirements for axial and radial seals. Not all maximum stresses can be applied to the seal at one time.

The variety of designs, jacket and spring materials, together with several springs and dimensions allow sealing applications within the following working ranges:

- Temperatures from -250°C to +316°C
- For rotation and reciprocating movement up to 5 m/s
- For static applications up to 3500 bar pressure
- For dynamic applications up to 550 bar pressure
- Universal chemical-resistant
- For vacuum and UHV applications
- Diameter from 2 mm up to 3000 mm



# Surface Finish (Rod and Housing)

The life expectancy of the seal and the sealing quality is also directly dependent upon the quality of the sealing surface.

We recommend the following surface finish.

Applications	Sealing Medium	
	Gases and Cryogenics	Fluids
Dynamic	0,2...0,3 µm Ra (N3...N4) 0,5...1,2 µm Rt	0,2...0,4 µm Ra (N3...N5) 0,8...1,6 µm Rt
Static	0,3...0,8 µm Ra (N4...N6) 1,2...3,2 µm Rt	0,4...1,6 µm Ra (N5...N7) 1,6...6,3 µm Rt
Other non-sealing surfaces approximately 0,4...6,3 µm Ra (depending on dimension)		



# Materials

## Seal Jacket Materials

Material Description	Ordering Code	Relative Wear Resistance 1 = low, 9 = high	Temperature Range Degrees [°C]
<b>PTFE-virgin</b> Recommended for low to moderate dynamic or static service. Low gas permeability. FDA approved. Good cryogenic (low temperature) properties.	01	3	-250...+205°C
<b>PTFE-virgin modified</b> Recommended for low to moderate dynamic or static service. Lowest gas permeability. FDA approved. Higher creep resistance, very high chemical resistance.	1X	3	-250...+215°C
<b>PTFE-reinforced with Carbon and Graphite</b> Very good universal properties for higher temperatures and resistance to wear. Especially suitable for hot water and steam service as well as for poor lubrications.	03	8	-130...+290°C
<b>PTFE-filled with Graphite</b> Excellent general purpose material with low friction, good wear and heat resistance. Non-abrasive. Good for water service, dry or poorly lubricated applications.	12	7	-130...+290°C
<b>PTFE- filled with Glass fiber and MoS<sub>2</sub></b> Extremely abrasion resistant, recommended for high pressure hydraulic, water and steam service. At high speeds and with soft metal surfaces may be abrasive wear possible.	06	9	-155...+290°C
<b>PTFE-reinforced with special filler</b> Superior wear and heat resistance. May also be used for soft metals. No abrasive wear. Recommended for static and dynamic service, high temperatures and high speeds.	10	8	-155...+316°C
<b>UHMW-PE modified</b> Excellent wear resistant, but limited chemical and heat resistance. Especially suitable for abrasive media and water based liquids. FDA approved.	08	9	-240...+104°C
Additional sealing materials in stock. We can compound seal jacket materials for optimal performance. This is why we are able to offer a wide variety of sealing materials. We can offer more than 50 different compounds. Only the most frequently used compounds have been listed above.			

## Spring Energizer Materials

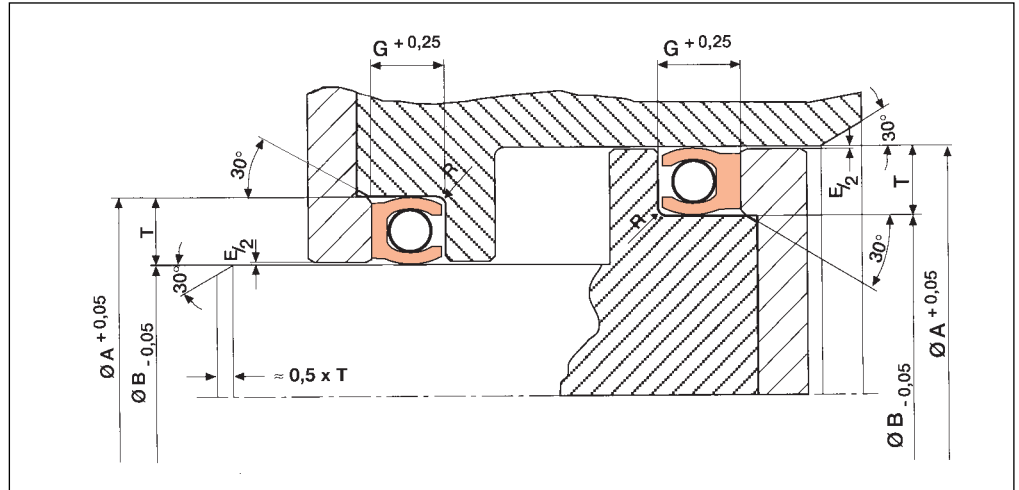
	Ordering Code	Description	UNS No.
<b>Standard spring material</b>	C	301 Stainless Steel (1.4310)	
<b>Additionally available spring materials</b>	E	Elgiloy( 2.4711)	R 30 003
	I	Inconel (2.4669)	N 07750
	R	Hastelloy (2.4602)	N 06022
	For other Stainless Steels, such as 316, 302, 17-7PH ask Technical Service		



# Hardware and Groove Dimensions

## Radial Seals

For Types 400, 401, 402, 4VS, 4FM, RP, RS, 103, 113, 123, 103H, etc.



## Rod Seals

For rod seals use the dimension „B” for Nominaldimension.

Dimension B = rod diameter

## Piston Seals

For piston seals use the dimension „A” for Nominaldimension.

Dimension A = cylinder bore diameter

## Groove Dimensions – Radial Seals

Nominal cross section	A mm		B mm		G+0,25 mm	T+0,05 mm	R mm	E max mm
	from	to	from	to				
1/16"	4,4	150	1,3	150	2,4	1,42	0,2	0,1
3/32"	8	300	3,5	300	3,6	2,26	0,2	0,13
1/8"	12,5	500	6,5	500	4,7	3,07	0,25	0,13
3/16"	22	800	12,5	800	7,1	4,72	0,3	0,15
1/4"	37	1200	25	1200	9,5	6,05	0,3	0,2
3/8"	95	3000	75	3000	15	9,5	0,4	0,3
1/2"	175	3000	150	3000	18	12,7	0,5	0,4
3/4"	340	3000	300	3000	25	19,05	0,8	0,5

We can also ship special sizes, special designs, each diameter and dimensions between 2 mm and 3000 mm diameter

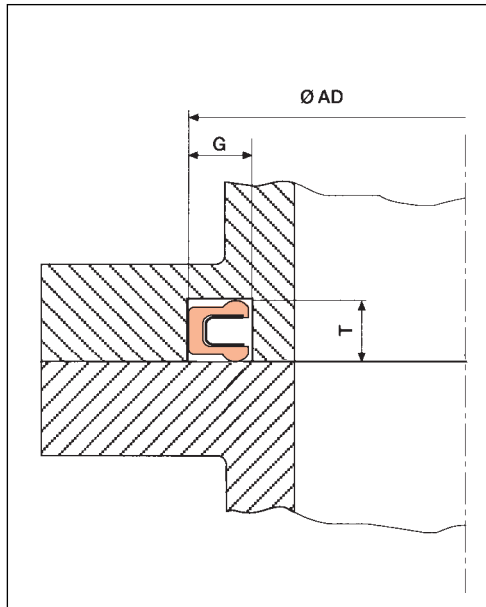




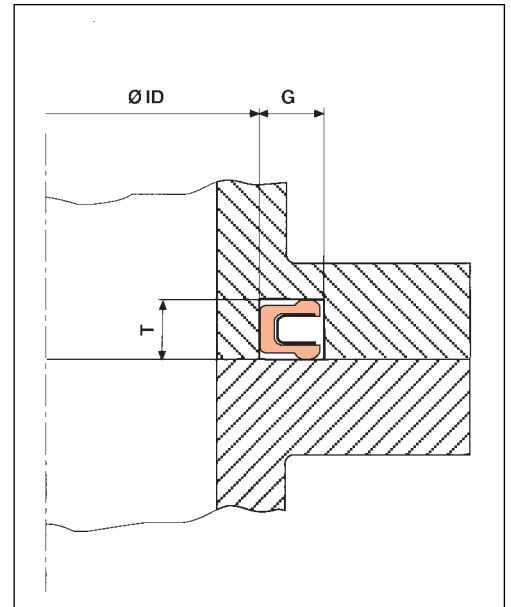
# Hardware and Groove Dimensions

## Axial Seals

For Types 403, 304, 1100 and 2100 for internal pressure, and Types 404, 314, 1101 for external pressure and vacuum



Seals for internal pressure use the outside diameter „OD” as Nominal diameter. (Nominal diameter = groove outside diameter)



Seals for external pressure and vacuum use the inside diameter „ID” as Nominal diameter. (Nominal diameter = groove inside diameter)

## Groove Dimensions – Axial Seals

Nominal cross section	ID mm - 0,25		OD mm + 0,25		G+0,25 mm	T+0,05 mm	R mm	E max mm
	from	to	from	to				
1/16"	5	150	10	150	2,4	1,42	0,25	0,1
3/32"	8	300	14	300	3,6	2,26	0,25	0,13
1/8"	12	500	18	500	4,7	3,07	0,4	0,13
3/16"	25	800	35	800	7,1	4,72	0,6	0,15
1/4"	55	1200	70	1200	9,5	6,05	0,6	0,2
3/8"	120	3000	150	3000	15	9,5	0,6	0,3
1/2"	215	3000	250	3000	18	12,7	0,8	0,4
3/4"	300	3000	350	3000	25	19,05	1,0	0,5

We can also ship special sizes, special designs, each diameter and dimensions between 2 mm and 3000 mm diameter

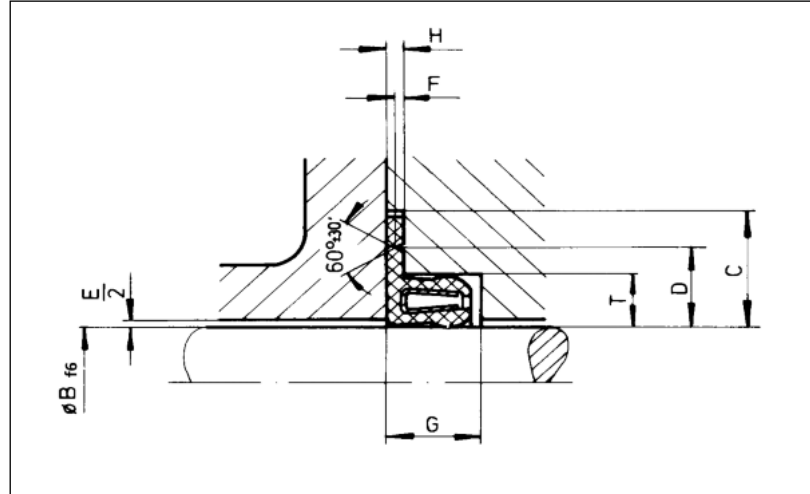


# Groove dimensions PTFE seals type 414 und 143

## Radial und Axial Dimension

### Rotary seals

The seals type 414 and 143 respectively are designed with flange for the axial fixation and/or securing of rotation with rotary seals. Other dimensions are possible as well.



### Groove dimensions seals with flange

Profil	øB f6	T	D-0,25	C+0,15	E max.	F+0,1	G+0,25	H-0,1
3/32"	*	2,25	3,4	5,2	0,1	0,25	3,6	0,65
1/8"	*	3,1	5,0	6,9	0,1	0,35	4,7	0,75
3/16"	*	4,75	7,1	10,1	0,15	0,40	7,1	1,00
1/4"	*	6,1	9,9	13,2	0,2	0,50	9,5	1,25
3/8"	*	9,5+/-0,05	15,0	20,0	0,3	0,80	15,0	2,50
1/2"	*	12,5+/-0,1	20,0	26,0	0,4	1,00	18,0	3,00

\* Dimension B will be specified by the customer

### Quality of finish for rotary seals

Application	Media to be sealed	
	Gas- and cryogentechnology	Liquids
Dynamic	0,1...0,8 µm Ra	0,2...0,4 µm Ra
Static	0,3...0,8 µm Ra	0,4...1,6 µm
Surfaces and flanks without sealing function approx. 0,4...6,3 µm Ra. (depending on dimension)		

The sealing surfaces should possess a material portion  $M_r$  (in former times bearing portion  $tp$ ) of approx. 50 to 70 % measured in a cutting depth  $c = 0,25 \times R_z$

### Hardness of finish for rotary seals

With rotary sealing cases we recommend a hardness of finish of at least 55 HRC. The depth of hardness should amount at least to 0,3 - 0,4 mm.

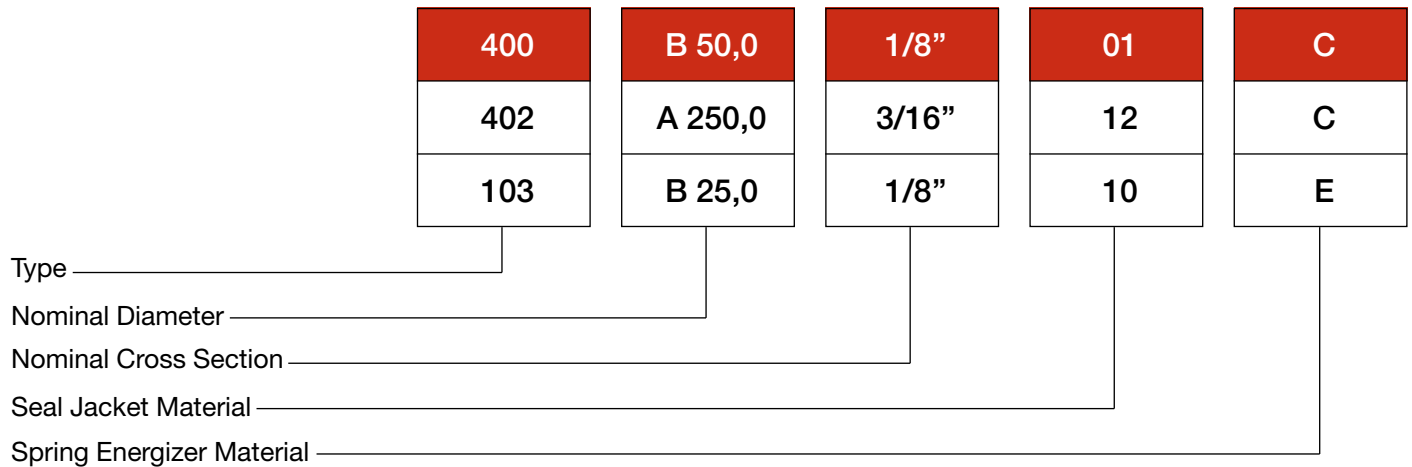


# Seal Numbering System and Part Number Examples

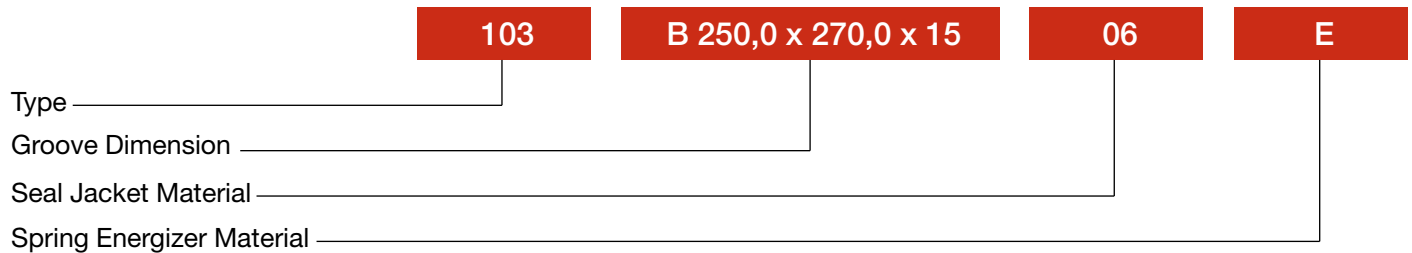
In general the following data suffice for seal definition and ordering:

- |                                     |   |
|-------------------------------------|---|
| <b>1) Type</b>                      | See page 2 and 3  |
| <b>2) Nominal Diameter</b>          | Rod-, shaft-, cylinder-, bore-diameter or the groove and hardware dimensions            |
| <b>3) Nominal Cross Section</b>     | 1/16", 3/32", 1/8", 3/16", 1/4", 3/8", 1/2", 3/4" or the groove and hardware dimensions |
| <b>4) Seal Jacket Material</b>      | See page 5  |
| <b>5) Spring Energizer Material</b> | See page 5  |

## Seal Numbering System/Part Number Examples



For special designs suffice the groove or hardware dimensions.  
For example:





# Information for Installation

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The installation in split grooves is the easiest way. Seals can usually be installed in partially closed grooves (with retainer) without any problems. Depending on diameters and cross sections, the type 103 seals can be installed in closed (non-split design) grooves. In such cases, we recommend contacting our Technical Service.

We will help you to work out the best solution for your assembly problem.

The mating surfaces should be smooth, free of burrs and sharp edges. Lead-in chamfers should be available for shafts and cylinders.

When assembling over grooves and threads, a sleeve should be used to protect the seal.

Light oiling or greasing makes the assembly easier.

All recommendations and data provided in this catalogue are based on the experience gained over decades of using such seals.

Unknown factors and special conditions may restrict the generally valid promises.

We are not able to guarantee every individual application.

We suggest tests with samples.

Our application engineers are always at your disposal for design and consultation.

Don't hesitate to use our experience.

Please call or write to us.

**For additional  
questions, please  
contact  
our  
Technical Service**



# Product Lines

## Spring Energized PTFE-Seals

or made of other high performance plastics with a stainless steel spring for lasting elasticity

## Metallic O-Rings and Metallic C-Rings

use as static seals for gases and fluids under extreme conditions, temperatures from  $-269^{\circ}\text{C}$  to  $+980^{\circ}\text{C}$  and UHV-vacuum to 6800 bar pressure.

## PTFE-Seals

universal chemical resistance, sterilisable, suitable for food and drug.

## PTFE-Parts

according to drawings and specifications of clients.

## Metallic-Etched Parts

parts from 0,01 to 1 mm thickness, from 2 x 2 mm up to 500 x 2000 mm.

## Rotary Lip Seals of PTFE

for high shaft velocity, poor lubricated conditions, long life time, almost universal chemical resistance.

## Metallic Seals and Laser Parts

for small series, individual parts and experiments, without any tooling costs.

## Seals made of Fluor-Elastomers and Perfluor-Elastomers

(Teflon, Kalrez and Vitron)\* are registered trademark of Du Pont



Seals

Seal Elements

Seal Systems