DESIGN HANDBOOK

Spring Energized PTFE-Seals

High Performance Seal Technology
General Information

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)

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.

GFD Gesellschaft für Dichtungstechnik mbH, Hofwiesenstr. 7, D-74336 Brackenheim, Phone +49 (0) 71 35 95 11-0, Fax 95 11-11
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 capsule 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.
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

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.

### Seal Selection and Operation Range

### Surface Finish

(Rod and Housing)

<table>
<thead>
<tr>
<th>Applications</th>
<th>Sealing Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gases and Cryogenics</td>
</tr>
<tr>
<td>Dynamic</td>
<td>0,2…0,3 µm Ra (N3…N4)</td>
</tr>
<tr>
<td></td>
<td>0,5…1,2 µm Rt</td>
</tr>
<tr>
<td>Static</td>
<td>0,3…0,8 µm Ra (N4…N6)</td>
</tr>
<tr>
<td></td>
<td>1,2…3,2 µm Rt</td>
</tr>
</tbody>
</table>

Other non-sealing surfaces approximately 0,4…6,3 µm Ra (depending on dimension)
Materials

Seal Jacket Materials

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Ordering Code</th>
<th>Relative Wear Resistance 1 = low, 9 = high</th>
<th>Temperature Range Degrees [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTFE-virgin</td>
<td>01</td>
<td>3</td>
<td>-250...+205°C</td>
</tr>
<tr>
<td>Recommended for low to moderate dynamic or static service. Low gas permeability.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDA approved. Good cryogenic (low temperature) properties.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTFE-virgin modified</td>
<td>1X</td>
<td>3</td>
<td>-250...+215°C</td>
</tr>
<tr>
<td>Recommended for low to moderate dynamic or static service. Lowest gas permeability.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDA approved. Higher creep resistance, very high chemical resistance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTFE-reinforced with Carbon and Graphite</td>
<td>03</td>
<td>8</td>
<td>-130...+290°C</td>
</tr>
<tr>
<td>Very good universal properties for higher temperatures and resistance to wear.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Especially suitable for hot water and steam service as well as for poor lubrications.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTFE-filled with Graphite</td>
<td>12</td>
<td>7</td>
<td>-130...+290°C</td>
</tr>
<tr>
<td>Excellent general purpose material with low friction, good wear and heat resistance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-abrasive. Good for water service, dry or poorly lubricated applications.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTFE- filled with Glass fiber and MoS$_2$</td>
<td>06</td>
<td>9</td>
<td>-155...+290°C</td>
</tr>
<tr>
<td>Extremely abrasion resistant, recommended for high pressure hydraulic, water and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>steam service. At high speeds and with soft metal surfaces may be abrasive wear possible.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTFE-reinforced with special filler</td>
<td>10</td>
<td>8</td>
<td>-155...+316°C</td>
</tr>
<tr>
<td>Superior wear and heat resistance. May also be used for soft metals. No abrasive wear.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended for static and dynamic service, high temperatures and high speeds.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UHMW-PE modified</td>
<td>08</td>
<td>9</td>
<td>-240...+104°C</td>
</tr>
<tr>
<td>Excellent wear resistant, but limited chemical and heat resistance. Especially suitable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for abrasive media and water based liquids. FDA approved.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Ordering Code</th>
<th>Description</th>
<th>UNS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>301 Stainless Steel (1.4310)</td>
<td></td>
</tr>
</tbody>
</table>

Standard spring material

Additionally available spring materials

E  Elgiloy (2.4711)  R 30003
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 Nominal dimension.

Dimension B = rod diameter

Piston Seals

For piston seals use the dimension „A“ for Nominal dimension.

Dimension A = cylinder bore diameter

Groove Dimensions – Radial Seals

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

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

GFD Gesellschaft für Dichtungstechnik mbH, Hofwiesenstr. 7, D-74336 Brackenheim, Phone +49 (0) 71 35 95 11-0, Fax 95 11-11
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**

<table>
<thead>
<tr>
<th>Nominal cross section</th>
<th>ID mm - 0,25</th>
<th>OD mm + 0,25</th>
<th>G+0,25 mm</th>
<th>T+0,05 mm</th>
<th>R mm</th>
<th>E max mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/16&quot;</td>
<td>5</td>
<td>150</td>
<td>10</td>
<td>150</td>
<td>2,4</td>
<td>1,42</td>
</tr>
<tr>
<td>3/32&quot;</td>
<td>8</td>
<td>300</td>
<td>14</td>
<td>300</td>
<td>3,6</td>
<td>2,26</td>
</tr>
<tr>
<td>1/8&quot;</td>
<td>12</td>
<td>500</td>
<td>18</td>
<td>500</td>
<td>4,7</td>
<td>3,07</td>
</tr>
<tr>
<td>3/16&quot;</td>
<td>25</td>
<td>800</td>
<td>35</td>
<td>800</td>
<td>7,1</td>
<td>4,72</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>55</td>
<td>1200</td>
<td>70</td>
<td>1200</td>
<td>9,5</td>
<td>6,05</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>120</td>
<td>3000</td>
<td>150</td>
<td>3000</td>
<td>15</td>
<td>9,5</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>215</td>
<td>3000</td>
<td>250</td>
<td>3000</td>
<td>18</td>
<td>12,7</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>300</td>
<td>3000</td>
<td>350</td>
<td>3000</td>
<td>25</td>
<td>19,05</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Profil</th>
<th>øB fl6</th>
<th>T</th>
<th>D-0,25</th>
<th>C+0,15</th>
<th>E max.</th>
<th>F+0,1</th>
<th>G+0,25</th>
<th>H-0,1</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/32&quot;</td>
<td>*</td>
<td>2,25</td>
<td>3,4</td>
<td>5,2</td>
<td>0,1</td>
<td>0,25</td>
<td>3,6</td>
<td>0,65</td>
</tr>
<tr>
<td>1/8&quot;</td>
<td>*</td>
<td>3,1</td>
<td>5,0</td>
<td>6,9</td>
<td>0,1</td>
<td>0,35</td>
<td>4,7</td>
<td>0,75</td>
</tr>
<tr>
<td>3/16&quot;</td>
<td>*</td>
<td>4,75</td>
<td>7,1</td>
<td>10,1</td>
<td>0,15</td>
<td>0,40</td>
<td>7,1</td>
<td>1,00</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>*</td>
<td>6,1</td>
<td>9,9</td>
<td>13,2</td>
<td>0,2</td>
<td>0,50</td>
<td>9,5</td>
<td>1,25</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>*</td>
<td>9,5+/-0,05</td>
<td>15,0</td>
<td>20,0</td>
<td>0,3</td>
<td>0,80</td>
<td>15,0</td>
<td>2,50</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>*</td>
<td>12,5+/-0,1</td>
<td>20,0</td>
<td>26,0</td>
<td>0,4</td>
<td>1,00</td>
<td>18,0</td>
<td>3,00</td>
</tr>
</tbody>
</table>

* Dimension B will be specified by the customer

Quality of finish for rotary seals

<table>
<thead>
<tr>
<th>Application</th>
<th>Media to be sealed</th>
<th>Ra (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic</td>
<td>Gas- and cryogentechnology</td>
<td>0,1…0,8µm</td>
</tr>
<tr>
<td>Static</td>
<td>Liquids</td>
<td>0,2…0,4µm</td>
</tr>
<tr>
<td>Surfaces and flanks without sealing function approx. 0,4…6,3µm</td>
<td>Ra (µm)</td>
<td>0,3…1,6µm</td>
</tr>
</tbody>
</table>

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

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:

1) Type
   See page 2 and 3

2) Nominal Diameter
   Rod-, shaft-, cylinder-, bore-diameter or the groove and hardware dimensions

3) Nominal Cross Section

4) Seal Jacket Material
   See page 5

5) Spring Energizer Material
   See page 5

Seal Numbering System/Part Number Examples

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal Diameter</th>
<th>Nominal Cross Section</th>
<th>Seal Jacket Material</th>
<th>Spring Energizer Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>B 250,0</td>
<td>3/16&quot;</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>B 250,0 x 270,0 x 15</td>
<td>1/8&quot;</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Groove Dimension</th>
<th>Seal Jacket Material</th>
<th>Spring Energizer Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>B 250,0 x 270,0 x 15</td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>
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.
In order to work out a design proposal for seals, the following information is required or useful:

A sketch showing the fitting conditions of the seals.
Detailed drawing of all parts coming into contact with the seals.

The following details are necessary:
a) Installation dimensions and tolerances
b) Dimensions of lead-in chamfer and groove radius
c) Shaft/rod dynamic runout
d) Shaft/rod misalignment
e) Mating material
f) Surface roughness
g) Hardness of the dynamic hardware surface

Description of the medium to be sealed as well as the outside medium.

Temperature conditions and pressure in the medium as well as on the outside of the medium.

Description of motion conditions:
a) Static    □ Yes    □ No
    b) Rotation movement
       1) Operating speed  ......................................................
       2) Maximum speed  ......................................................
       3) □ Continuous operation
           □ Intermittent operation
       4) Permitted frictional moment  ...........................................
    c) Axial motion
       1) Stroke length  ......................................................
       2) Frequency  ......................................................
       3) Gliding speed  ......................................................
       4) Permitted frictional force  ............................................
    d) Oscillating movement
       1) Angle of rotation  ..................................................
       2) Frequency  ......................................................
       3) Gliding speed  ......................................................
       4) Permitted frictional moment  ..........................................

Life expectancy  ......................................................
Allowable leakage  ......................................................

Quantities needed □ .............................................pieces immediately
□ .............................................pieces in the future

Will the seal be used in a new development? ...................................
Which seal was used up to now? ............................................

Remarks: ........................................................................

For offer: Please make us an offer for the following quantities: ...........

Customer’s name ........................................................................

Date..............................................................Name ............................................
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°C to +980°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
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Seal Systems
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