PTFE Diaphragms

Diaphragms are hermetical seals between two spaces with media and pressures which, typically, differ from each other. Unlike piston and rod seals, there is no drag leakage at the contacting surfaces, and the requirements to be met in terms of tolerances and surfaces are lower.

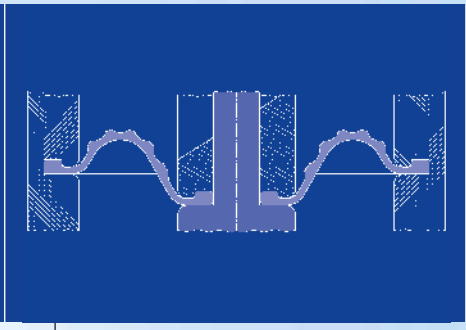
Chemical resistance to aggressive media, flexibility and long service life are major requirements made on materials and the design of membranes. For perfect service, it is indispensable that diaphragms design and selection of the respective compound be adapted specifically to the particular application conditions.

Benefits

- Good reverse bending strength
- Nearly universal chemical resistance
- Very good suitability for sterilization
- Temperature resistance –60°C to +200°C
- FDA-conformable materials
- Freedom of design
- Homogeneous structure

Applications

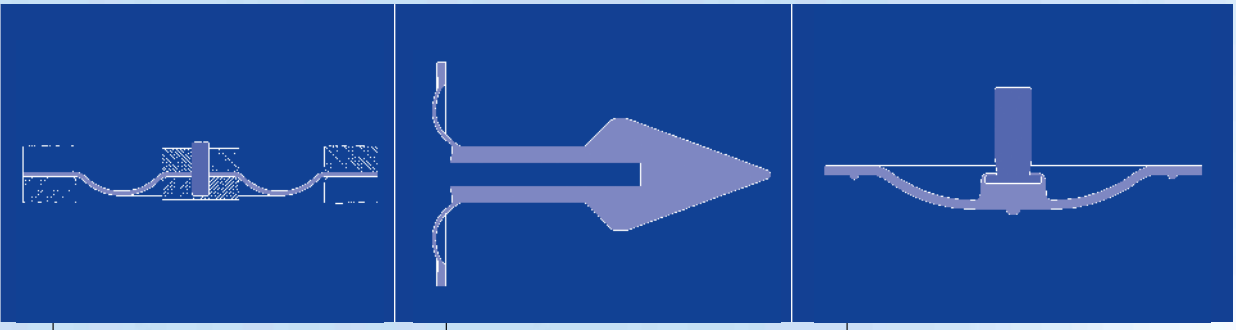
Diaphragm
with metal core for painting pumps.



Diaphragm
with grooves on the back for sterile valve with very smooth surfaces.

Fields of Applications

- Metering devices for the pharmaceutical and food industries
- Pumps for the chemical industry
- Pumps for painting technology
- Pressure regulators
- Pharmaceutical valves



Diaphragm
for fluid pumps in the chemical industry.

Piston Diaphragm
with integrated sealing cone in filling lines.

Formed Diaphragm
for actuating valves.

PTFE diaphragms are used in metering devices for the pharmaceutical and food industries as well as in pumps of the chemical industry and in painting technology.

Because of their outstanding physical and chemical properties PTFE diaphragms are being used in constantly increasing fields of application. The lift of the diaphragm is determined by its shape and design as well as the existing effective diameters.

To reduce the risk of damage, the sandwich diaphragm technology is primarily being used (principle of the double barrier, diaphragm technology with breakage sensor). This enables early detection of malfunctions for planned execution of timely repairs and appropriate corrective action which reduces production downtimes significantly. In addition, this helps prevent contamination of the media fluids to be pumped.

With multi-layered diaphragms and constant material thicknesses the actuating forces are considerably lower than those of single-layered diaphragms.

In addition to stamped diaphragms, machined diaphragms are increasingly being used. A major advantage over PTFE/elastomer composite diaphragms is the homogeneous structure and freedom of design offered by these diaphragms.

To increase service life, specially treated PTFE films and films made from modified PTFE are used.

For information on materials with good reverse bending strength and low permeation, see pages 20–23.

For your inquiry, please complete the technical questionnaire at the end of the catalog.

Versions

Film Diaphragms

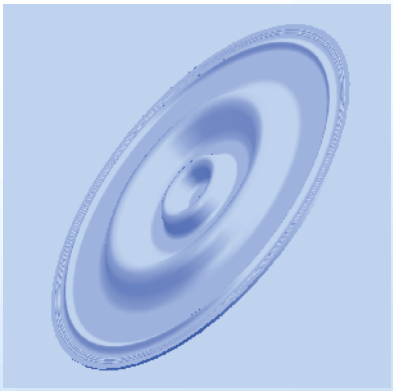
- For large volumes
- For medium requirements regarding lift, service life, pressure
- More sophisticated design of clamping surfaces

Flat Diaphragms

- Only for very small lifts
- Lowest tooling and manufacturing costs
- Low assembly height

Diaphragms with Stamped Contour

- High performance capability
- Low restoring forces
- Multi-layered designs (for evacuation of leakage, higher pressure strength)



Machined Diaphragms

- For maximum requirements regarding lift, service life, pressure ($H_{max} \leq 0{,}30 \times Ø$ eff)
- For specified installation spaces

Versatile Design Options

- No dead space in clamping areas
- Leakage evacuation with multi-layered designs
- Reinforcement grooves, beads, cuts to avoid radial creasing
- Sealing elements to close openings
- Core/disc design for mechanical articulation

Assembly and Design Instructions

In the clamping zone, the diaphragm is fastened between the housing flanges under sufficient pressure (thread-fastening, clamping). The diaphragm in this case acts like a static seal. Deformation damage caused by excessive clamping pressures must be avoided through flange stops and/or specified torque levels. Depending on the diaphragm material and diaphragm thickness, additional flat or profile seals may be used for sealing.

With PTFE diaphragms, sealing performance can be improved by a V-profile surface structure of the respective assembly components, meaning the V-profile structure of the housing or supporting parts is pushed into the PTFE, resulting in improved sealing performance.

For mechanical articulation, the diaphragm is typically clamped between the supporting and the pressure disc. The individual components are joined by a threaded connection, riveting or vulkanized. When designing the support, it must be ensured that the surfaces contacting the diaphragm are burr-free and that there are sufficiently dimensioned transition radii.

General rule: $R \geq 4 \cdot s$

R = radius; s = diaphragm thickness

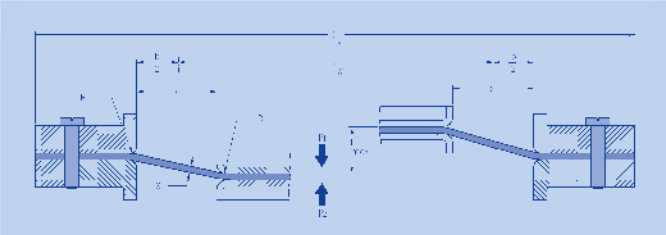
For perfect service, it is indispensable that diaphragm design and selection of the respective compound be adapted specifically to the particular application conditions.

We will be pleased to provide you with respective consulting support.

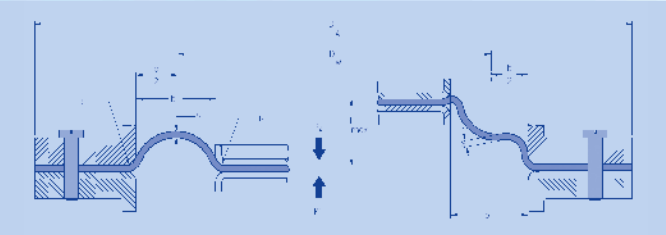
Dimensioning Legend for Engineering Drawings

- D_A Ø outside
- D_W Ø eff
- b (radial bead width)
- S (membrane thickness in the bead area)
- P (pressure)
- H_{max} (maximum lift)
- R (radii at the transition points)

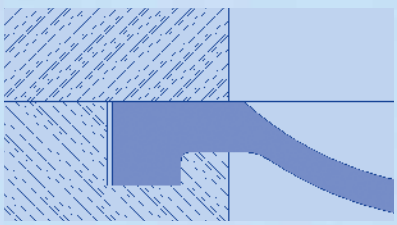
Flat Diaphragms

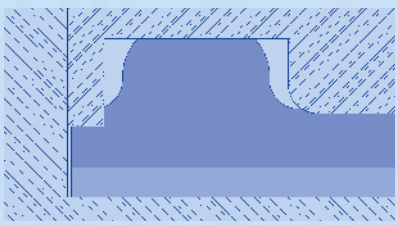


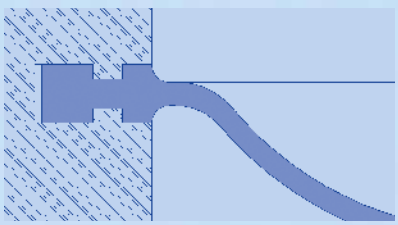
Diaphragm with Bead



Other Clamping Options







New Materials and their Properties

In the past, with applications requiring the utilization of modified PTFE, certain limitations regarding reverse bending properties had to be accepted. Now ElringKlinger has managed to launch a new product on the market, HS 22121, which combines all the advantages of modified PTFE.

Benefits

- **Higher permeation density**
- **Low cold flow**
- **Lower porosity**
- **Smoother surfaces**
- **Lower Stretch Void Index**
- **Weldability**
- **FDA-conformance**

In certain aspects, the new material extent even significantly surpasses the excellent reverse bending properties of non-modified standard PTFE types. The combination of these properties was not possible in the past.

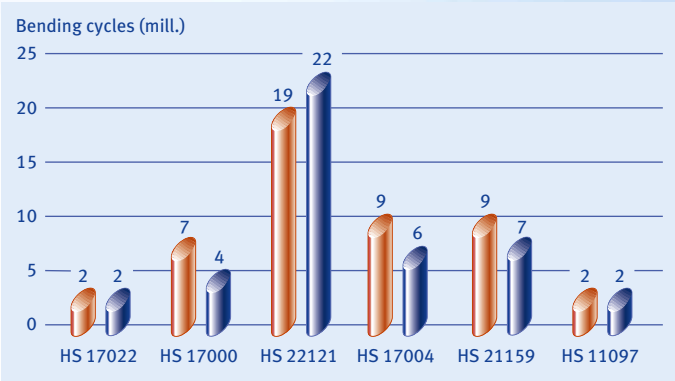
HS 22121 is equally suitable for use as a diaphragms or bellows.

In addition to the high reverse bending resistance, the material's reduced cold flow improves the retention of the diaphragm and/or bellows in the clamping area; another plus in terms of sealing performance and service life.

The results of the reverse bending test were determined by bending a test rod with a 1-mm thickness at a frequency of 4 Hz without media contact by 180° respectively.

Reverse Bending Test 180° [2]

SPI test rod, 1 mm thick, average value

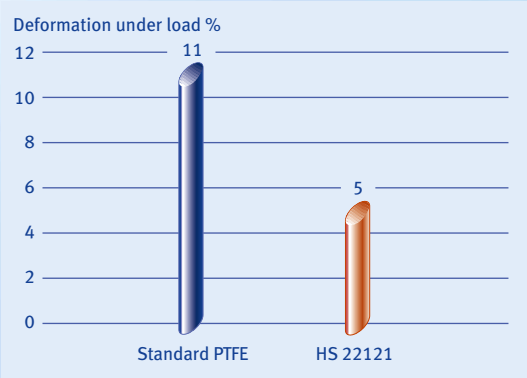


Parallel to peeling direction
Perpendicular to peeling direction

HS 22121 is also available as an anti-static version specifically for use in applications involving contact with solvents.

Cold Flow Benefits [2]

Measuring conditions: 15 N/mm², 100 hrs of pressure loading, 24 hrs of pressure relief, results in permanent deformation



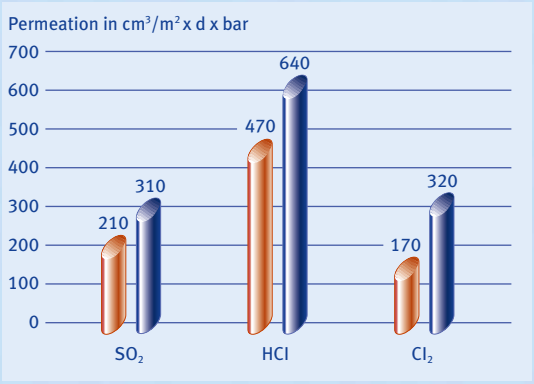
For long service life, bellows and/or diaphragms should be designed with thin walls. Consequently, it is all the more important that the material used have a high barrier effect with regard to permeation. This is the case with modified PTFE materials and applies to aggressive, gaseous chemicals such as SO_2, HCl or Cl_2 as well as to water. The latter poses a challenge for fluoropolymers particularly at high temperatures and/or in the vapor phase or in the form of aqueous, aggressive chemicals.

Further information about material you will find in our catalog “Compounds and Semi-Finished Products Made from PTFE”

Higher Barrier Effect of HS 22121

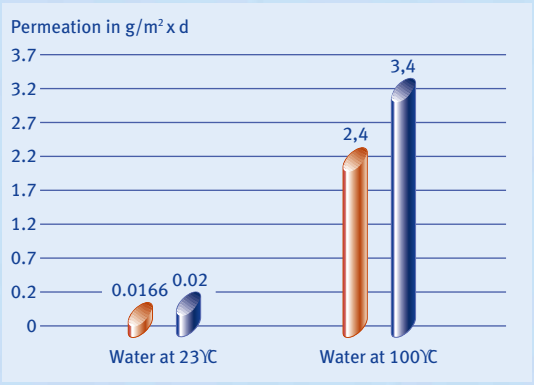
a) Aggressive Media[2]

Measuring method: According to DIN 53380, film thickness: 1 mm



b) Water and vapor [2]

Medium: Water, measuring temperature: 23°C or 100°C, film thickness: 1 mm



The Most Commonly Used Fillers and their Influences on Compound Properties

PTFE-Type	*Influence of Fillers*	*Filler Content in % of Weight*	*Limits of Use*
PTFE filled with glass fibers	• higher pressure and wear resistance as well as better thermal conductivity • very good chemical resistance • good dielectric properties	up to 40%	resistant to organic solvents, non-resistant to alkaline solutions and acids
PTFE filled with carbon fibers	• very low deformation under load • good wear resistance, even in water • higher thermal conductivity and lower thermal expansion than glass fibers • very good chemical resistance	up to 25%	carbon fibers are chemically inert
PTFE filled with carbon	• high pressure resistance and hardness • good sliding properties and wear behavior • good thermal conductivity • good chemical resistance • low volume and surface resistivity • electrically conductive	up to 35%, also in combination with graphite	compound is brittle, filler may be attacked by oxidizing media
PTFE filled with graphite	• good lubricating effect • low friction coefficient • no static charging • good thermal conductivity • very good chemical resistance	typically up to 5%, in exceptional cases up to 15%, also in combination with glass fibers or carbon	high abrasion when used with hard metals, is attacked by oxidizing media
PTFE filled with molybdenum disulfite (MoS_2)	• good sliding properties and wear behavior • good no-lube operation in combination with bronze	up to 10%, also in combination with glass fibers or bronze	not resistant when used with hot, concentrated sulfuric acid
PTFE filled with bronze	• good sliding properties and wear behavior • low cold flow • good thermal conductivity • lower chemical resistance • high pressure resistance	up to 60%, also in combination with MoS_2	may be attacked by acids and water
PTFE filled with organic fillers (high-performance thermoplastics)	• outstanding sliding properties and wear behavior • good chemical resistance • high pressure resistance in some cases • suitable for soft mating surfaces, e.g. aluminum • non-abrasive	up to 20%, may be higher in combination with different fillers	depending on the respective filler

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

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

Technical Questionnaire
Diaphragms/Bellows
Please complete and return by fax to:
+49 7142 583-200

elringklinger
Engineered Plastics

1.1. Pressure Conditions, Diaphragm

Pressure (bar): _____

Differential pressure (bar): _____

1.2. Pressure Conditions, Bellows

Pressure interior (bar): _____

Pressure exterior (bar): _____

2. Operating Conditions

Permanent temperature (°C): _____

Peak temperature (°C): _____

Frequency/# of strokes/lifts: _____

Medium: _____

Stroke/lift (mm): _____

Diaphragm feeding volume (cm^3): _____

Required service life: _____

Application: _____

_____

_____

3.1. Dimensions, Diaphragm

Clamping dimensions D (mm): _____

Type of retention/fixing: _____

_____

3.2. Dimensions, Bellows

Inner Ø (mm): _____

Outer Ø (mm): _____

Length min/max (mm): _____

4. Special Needs/Design

_____

_____

_____

_____

5. Requirement

Once-off (pieces): _____

Monthly (pieces): _____

Anually (pieces): _____

_____

_____

Company (Address)

_____ _____

Contact person Fax

_____ _____

Phone E-Mail

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