Benefits

- PTFE – even without lubrication – excels at offering an exceptionally low coefficient of friction in combination with metals and plastics
- PTFE is highly anti-adhesive, without any stick-slip effect
- PTFE has high elongation properties enabling easy fitting of sealing and guide elements to one-piece pistons
- PTFE – when subjected to moderate stress – offers an exceptionally wide (for plastics) thermal operating range from –200 °C to +260 °C
- PTFE is chemically resistant to nearly all solid, liquid and gaseous media
- PTFE is age-resistant, non-combustible and physiologically neutral in the stated temperature range

PTFE piston rings have been manufactured and used in oil-free compressors for many years. The demand for seals suitable for oil-free applications has grown considerably in recent years. This development has largely been driven by increased awareness of environmental concerns, more stringent regulations and the constant need to achieve further cost reductions.

By fine-tuning filler contents and manufacturing processes we have developed a system range of PTFE special compounds enabling us to offer the optimum compound even for extreme application conditions.

Piston Rings

Fields of Application

Meanwhile, our solutions have established themselves as essential elements in numerous industrial, engineering and consumer goods sectors.

Selected examples include:

- Compressors operating under full and low-lube conditions
- Gas rotary pumps
- Expansion machinery
- Liquid gas and vacuum pumps
- Wobble piston compressors
- Rotation compressors for loading/unloading of silos
- Generation of oil-free compressed air for the food processing industry, pharmaceutical industry and dentistry
- Compressed air for the crafts and do-it-yourself market
- Pneumatic hammer drills
- Automotive technology, including ride leveling and air-conditioning systems

Types

Straight Joint
Piston rings with straight joints are used for sealing pressure differences above 15 bar. With this gap, leakage is slightly higher than with piston rings that have a scarf joint. Due to the high compressor speeds (rpm) typically achieved today, the loss of gas from leakage has a minor impact on compressor performance. The amount of gas leakage is negligible.

Scarf Joint
Piston rings with scarf joints are used for sealing pressure differences above 15 bar. During the run-in period the sealing effect (tightness) of scarf joints is slightly better than that of piston rings with a straight joint.

Overlapped Joint
The overlapped joint achieves a favorable sealing effect. For this reason, it is primarily used for sealing gases with a specific light weight. Due to the occurrence of bending stress and the resulting risk of breakage in the overlapping areas, piston rings with overlapped joints should only be used in compressors operating with pressure differences of a maximum of 15 bar.

Gas-tight Joint
Our gas-tight piston rings achieve the best sealing effect. The special design of the joint reduces leakage to a minimum. As with the overlapping joint the level of differential pressure is limited to a maximum of 15 bar. With regard to assembly please note that the piston ring achieves its good sealing effect only in one direction of pressure.

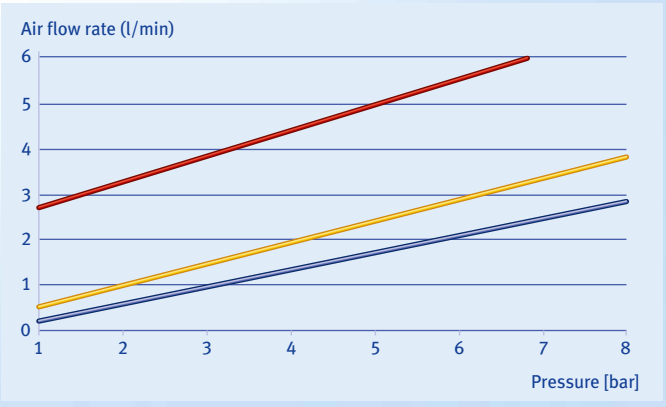
A piston ring always seals two surfaces. It is pressed against the cylinder wall and the groove flank by the pressure load and its inherent pre-loading force.

PTFE piston rings are self-clamping. Consequently, in most cases, there is no need to back the ring by a clamping spring. For compressors with upright cylinders self-clamping piston rings up to app. 700 mm can be manufactured.

Limit Values, PTFE Piston Rings [1]

Median piston speed up to	m/s	5.2
Temperature	°C	–60 to +200
Max. pressure differences to be sealed	bar	100

Efficiency of the different types of piston ring cut [2]



Test Conditions:
Piston rings made of PTFE,
dimensions:
Ø 48 x Ø 60 x 6
Piston rings not run in
Static test
T = 100 °C
Medium: Air

- *Scarf Joint*
- *Overlapped Joint*
- *Gas-tight Joint*

Technical Details

Compounds

The selection of the suitable compound is largely affected by the contact surface, medium used and a number of other factors. Please contact our application engineers to discuss your requirements.

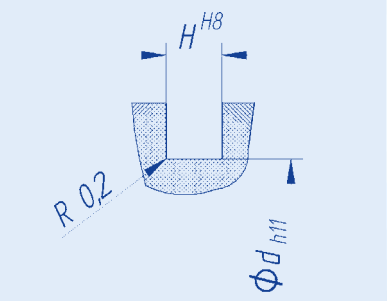
Contact Surfaces

In wear tests to determine the most favorable wear resistance of PTFE compounds with sealing and guide elements for compressors gray cast iron (e.g. fine-laminar gray cast iron) has found to be a particularly favorable contact surface. However, whenever there is a risk of corrosion due to the humidity contained in the gas, high-alloyed chrome steels, hard-anodized aluminum or Nikasil are normally used. The best wear results have been obtained with the following surface roughnesses:

	Gray cast iron	*chrome steels and hard-anodized aluminum*
Rz	2.0 to 4.0 µm	1.0 to 2.0 µm
Ra µm	0.4 to 0.8 µm	0.1 to 0.25

Design and Fitting Instructions

Design of installation space



Surface Quality

	Groove base	*Groove flank*
Rz	10 µm	4 µm
Ra	1.6 µm	0.8 µm

Piston rings should be installed by keeping elongation to an absolute minimum.

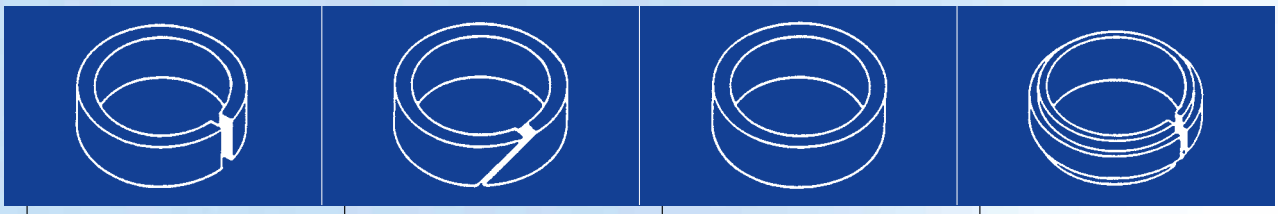
Benefits

- Chemical and thermal resistance to virtually all media used in hydraulics and pneumatics
- Suitable for use with non-hardened contact surfaces
- High bearing capacity, pressure resistance and low wear
- No stick-slip even with low sliding speeds and high transverse loads
- Minimal lubrication required
- Extremely low breakaway forces even after prolonged downtimes
- Large compound selection, e.g. wear-resistant PTFE compounds for oil-free applications
- Easy installation due to cut grooves

Guide rings and bands serve to prevent any contact of the piston and/or rod with the cylinder wall in order to avoid subsequent damage to these parts. Usually, guides with straight or scarf joints are used. The scarf joint is the most commonly used joint.

Guide Rings and Bands

Guide Ring Versions



Straight Joint | *Scarf Joint* | *Continuous* | *Shouldered with straight Joint*

Guide rings with scarf joints provide the advantage of fully running across the cylinder contact surface, thus causing no “markings” on the surface unlike the straight joint.

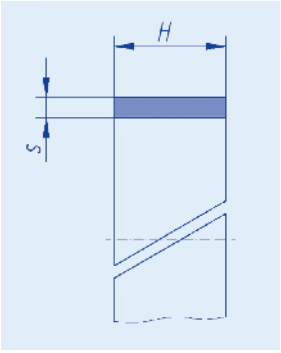
Guide rings with straight or scarf joints can only be fitted if no more than $^1/_3$ of the guide ring width overruns the valve nests inside the cylinder. If several valve nests are overrun, one-piece shrink-fitted guide rings are used. Depending on the respective application, piston guide rings with axial and/or radial balancing grooves may be used as well. The dimensions of the guide ring depend on the particular application.

Operating Limits[1]	
Sliding speeds	≤ 4 m/s
Temperature range	–100 °C to +200 °C
Specific pressure load	at 20 °C max. 10.0 N/mm²
	at 100 °C max. 5.0 N/mm²
	at 180 °C max. 2.5 N/mm²

Guide Band Versions

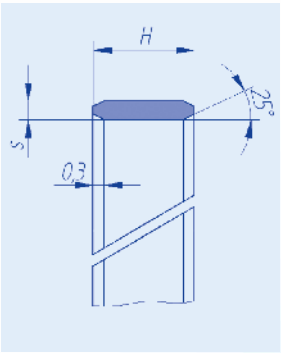
Preferential Ranges, Guide Bands

a) Hydraulics (PTFE-bronze)



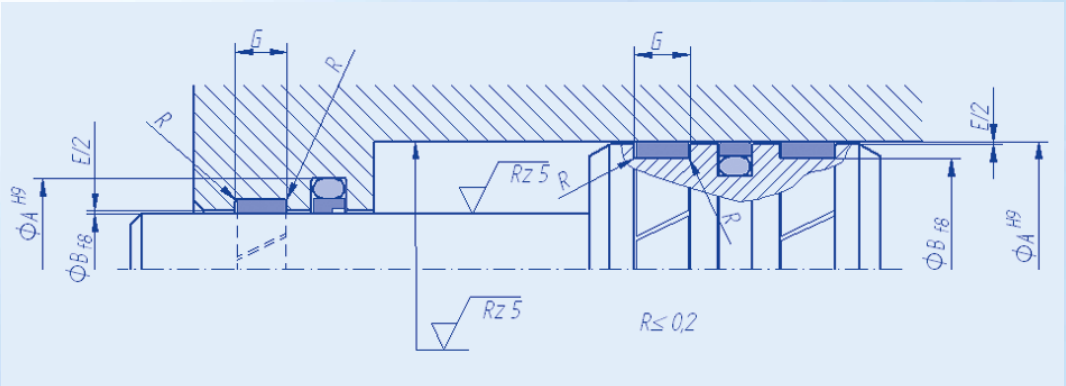
Nominal Dimensions Width H	Thickness s	Groove Width G	Groove Base Gauge w/rod guide A^{H9}	w/piston guide B_{f8}	Radial-Clearance max. E/2
4,0	1,55	4,1 + 0,1	B + 3,1	A – 3,1	0,3
5,5	2,50	5,6 + 0,1	B + 5,0	A – 5,0	0,3
8,0	2,00	8,1 + 0,1	B + 4,0	A – 4,0	0,4
9,5	2,50	9,6 + 0,1	B + 5,0	A – 5,0	0,4
10,0	2,50	10,1 + 0,1	B + 4,0	A – 4,0	0,4
15,0	2,50	15,3 + 0,2	B + 5,0	A – 5,0	0,5
20,0	2,50	20,3 + 0,2	B + 5,0	A – 5,0	0,5
25,0	2,50	25,3 + 0,2	B + 5,0	A – 5,0	0,5

b) Pneumatics (PTFE-carbon)



Nominal Dimensions Width H	Thickness s	Groove Width G	Groove Base Gauge w/rod guide A^{H9}	w/piston guide B_{f8}	Radial-Clearance max. E/2
4,0	1,55	4,1 + 0,1	B + 3,1	A – 3,1	0,3
8,0	1,55	8,1 + 0,1	B + 3,1	A – 3,1	0,3
10,0	1,55	10,2 + 0,1	B + 3,1	A – 3,1	0,3
15,0	1,55	15,2 + 0,2	B + 3,1	A – 3,1	0,3

Installation Example



Surface Quality

See Spring-Energized Seals chapter.

PTFE Laminated Piston

The PTFE laminated piston is a gapless enclosure of the piston skirt made from aluminum or gray cast iron with a PTFE film.

Characteristics:

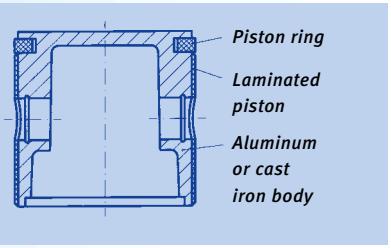
- Maximum use of the available guide surface
- High-temperature-resistant PTFE metal composite
- Minimal thickness of the PTFE guide band casing

Applications and Typical Uses

- In dry-running compressors as plunger piston guide for compressing 100% oil-free air
- To achieve minimum friction and to serve as an optimum guide for low-lube operations
- Armature plating for solenoid valves
- Piston plating for gas meters

Limit Values of the Permanent PTFE Composite [1]

Max. median piston speed	m/s	5.2
Max. temperature load of the permanent composite	°C	+200



Benefits of the lamination vis-à-vis standard guide rings and bands

- The specific surface pressure is reduced by plating the piston skirt all the way to the seal groove, thus resulting in very long service life
- Reduced running clearance of the piston due to small radial thickness of the PTFE laminated piston and the resulting low thermal expansion
- Reduced running clearance largely prevents piston slap, resulting in significantly smoother operation
- Improved thermal transition from the metal piston to the cylinder wall due to the minimal thickness of PTFE laminated piston and the large contact surface

Take our plastics know-how to the test.

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