Sealing Technology
PERTEC®

Engineering Plastics

High-Performance Sealing and Engineering Plastics Solutions for Valve Applications

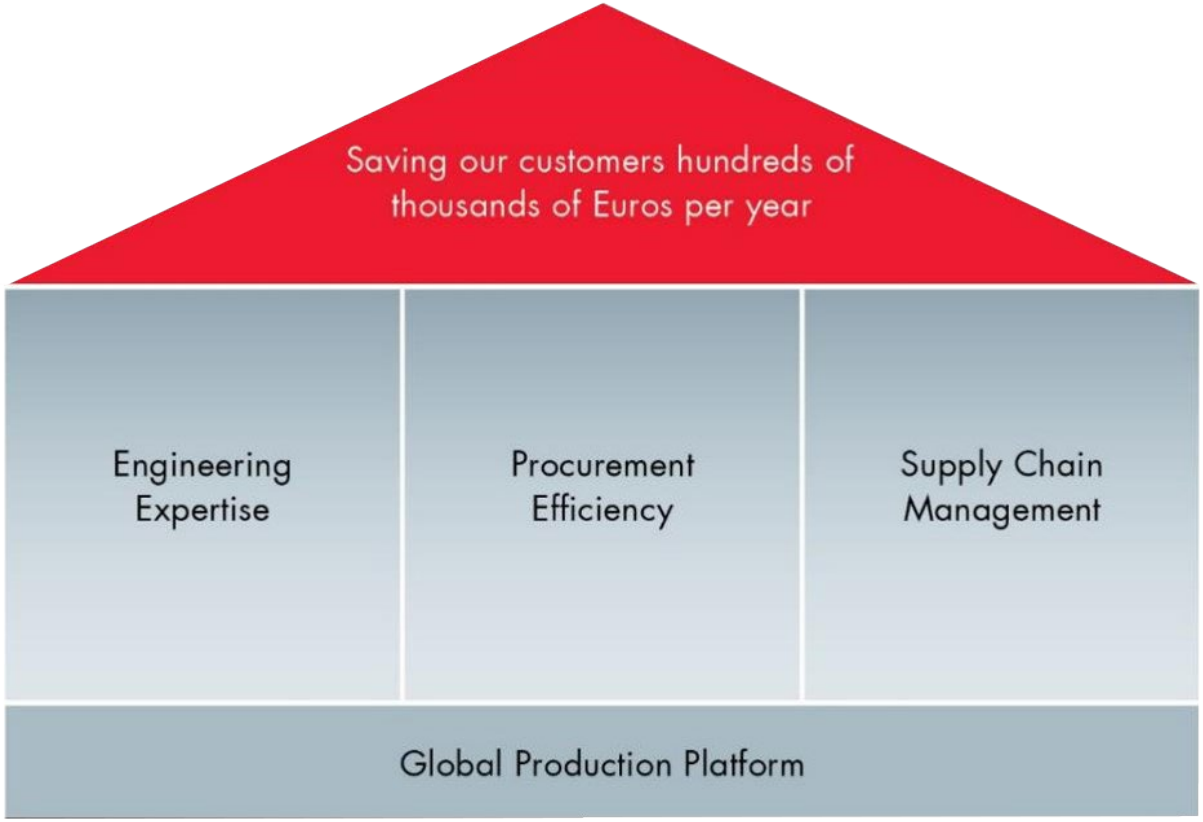
Angst+Pfister

“Valves are components for shutting off or controlling the flow of liquids or gases in the process industry. In order to prevent the environment (machine, application or even human health) from being damaged by leakage of the medium, it is essential to ensure safe operation with the appropriate reliable sealing solutions.”

Introduction to Angst+Pfister

- Since its founding in 1920, the Angst+Pfister Group has grown from a small Swiss-based company into a globally operating enterprise.
- Being an engineering-led solutions provider with deep application knowledge across a variety of industries
- Offering identical products, price and quality across the globe
- Enhancing supply chain efficiency and global sourcing
- Providing three primary sales channels: Direct sales, certified partners and APSOparts® online shop

Core Competencies



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Value Chain

Engineering Services
- Virtual design
- TCO studies
- Define norms & specifications

Fast Prototyping
- Customizations
- Pre-series tests
- Complete quality certificates

Global Production Platform
- Top producers, high flexibility
- Best price/quality countries

Supply Chain Management
- OTD reporting
- JIT/Kanban
- Frame contracts/ rolling planning

After Market Service
- Global support
- Spare parts
- Field service engineers

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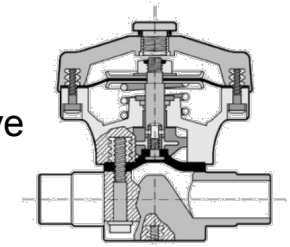
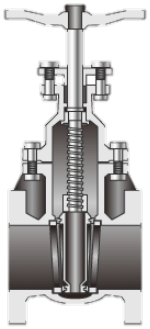
Main types of valves

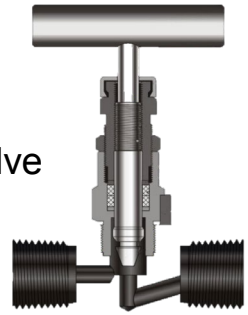
Diaphragm valve



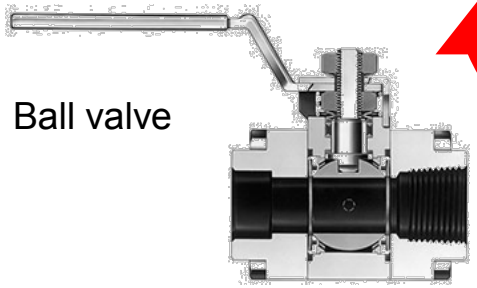


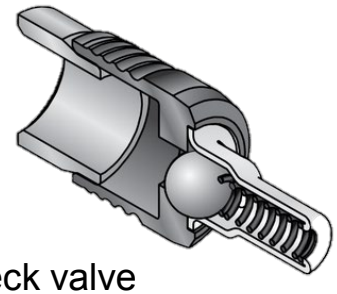
Gate valve

Needle valve



Ball valve





Check valve

Butterfly valve

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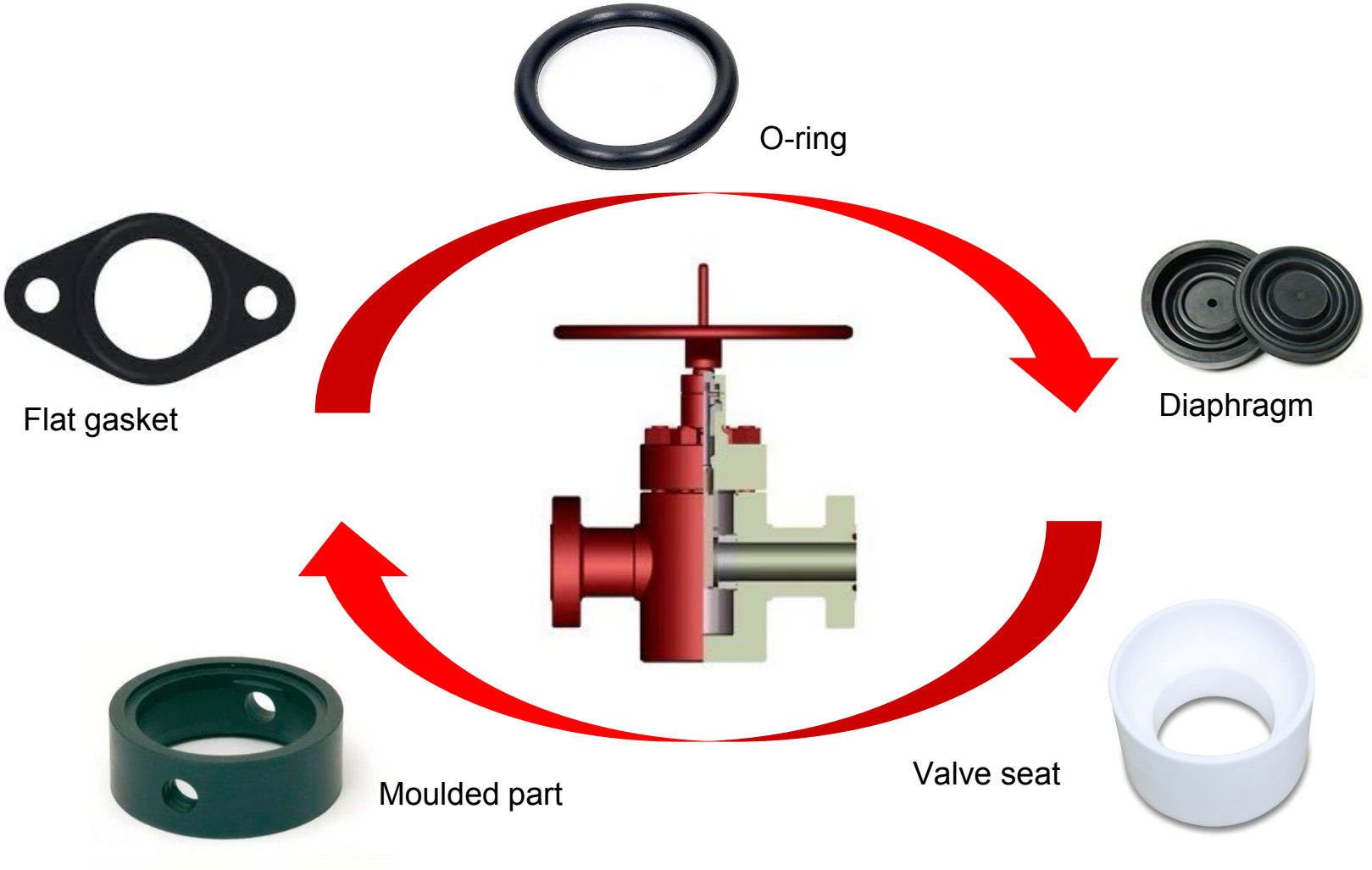
Sealing elements & bearings most often used in valves



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Examples for sealing elements most often used in valves

O-ring

Valve seat

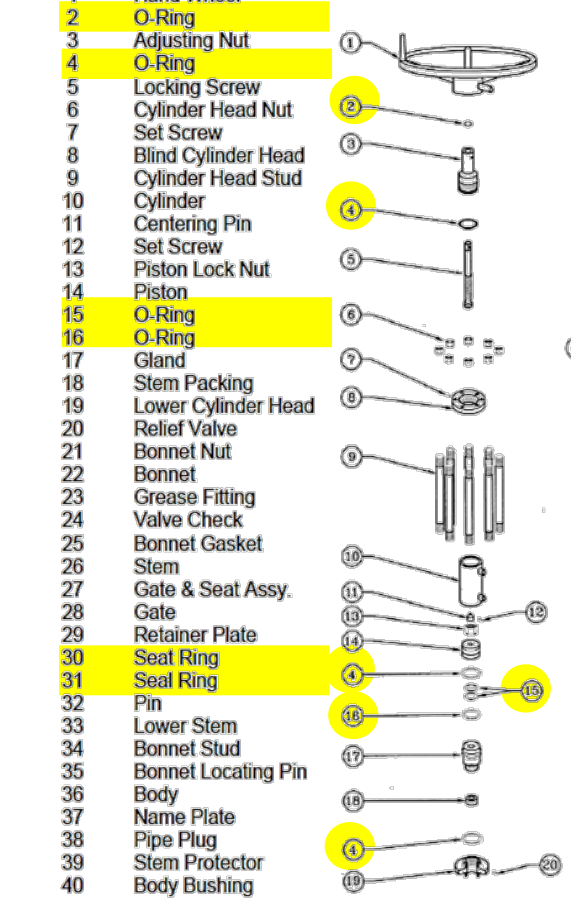
Moulded part

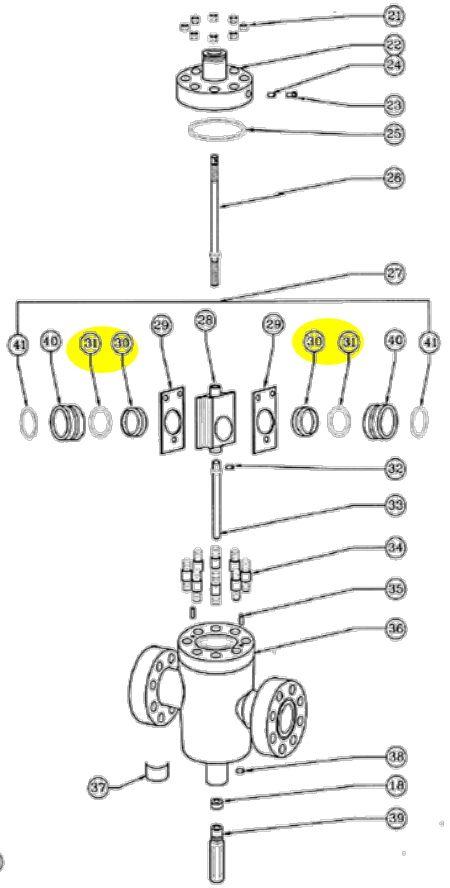
Flat gasket

Diaphragm

Parts List

1	Hand Wheel
2	O-Ring
3	Adjusting Nut
4	O-Ring
5	Locking Screw
6	Cylinder Head Nut
7	Set Screw
8	Blind Cylinder Head
9	Cylinder Head Stud
10	Cylinder
11	Centering Pin
12	Set Screw
13	Piston Lock Nut
14	Piston
15	O-Ring
16	O-Ring
17	Gland
18	Stem Packing
19	Lower Cylinder Head
20	Relief Valve
21	Bonnet Nut
22	Bonnet
23	Grease Fitting
24	Valve Check
25	Bonnet Gasket
26	Stem
27	Gate & Seat Assy.
28	Gate
29	Retainer Plate
30	Seat Ring
31	Seal Ring
32	Pin
33	Lower Stem
34	Bonnet Stud
35	Bonnet Locating Pin
36	Body
37	Name Plate
38	Pipe Plug
39	Stem Protector
40	Body Bushing
41	Body Bushing Seal
42	Guide
43	Grease Fitting





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Requirements for valves in the Process Industry

Pure Materials

Approvals

Broad Chemical resist.

High Temp. resistance

CIP & SIP

Sterilization

White colour

Low Perme -ability

Pharma

Chemical

Food

Beverage

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Requirements for sealing elements for valves

PROFITABILITY	**DURABILITY** • Long life cycle • High abrasion resistance • Good mechanical properties **= LOWER OPERATIONAL COSTS**	**PERFORMANCE** • Low gas permeability • Low friction for dynamic application • CIP / SIP **= HIGHER VALUE**
MARKET POTENTIAL	**VERSATILITY** • Broad chemical resistance • Wide temperature range (low and high temperature) • One material for different applications **= WIDER CUSTOMER BASE**	**COMPLIANCE (Approvals)** • Food • Gas • Drinking water • Pharmaceutical • Oil & gas **= ELIMINATION OF ENTRY BARRIERS**

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Angst+Pfister solution: PERTEC® family of compounds

PERTEC®
UP VMQ

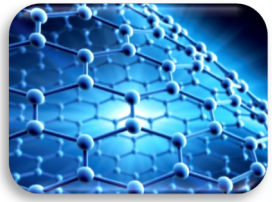
A new **„Ultra Pure“** compound whose formulation uses only **substances listed in European and US food regulations**. Especially designed for applications where the pureness of the material is absolutely essential, like in the food, pharma and medical industries.

- Ultra Pure material
- All food approvals
- PAH Cat. 1
- High elongation
- Good mechanical properties
- Translucent

PERTEC®
UP FKM

Another member of the „Ultra Pure“ family of compounds providing **broad chemical resistance & designed for applications where the pureness of the material is absolutely essential**, like in the food, pharma and medical industries.

- Ultra Pure material
- All food approvals
- PAH Cat. 1
- High elongation
- Good mechanical properties
- Black compound
- Broad chemical resistance



PERTEC®
NP FKM

Perfect choice for all applications where low friction is mandatory. Relevantly enhanced features thanks to a new class of peroxide curable compounds developed on the bases of nano PTFE. Different concentrations in terms of fluorine content (chemical resistance) available

- Very low friction
- Low permeability
- High elongation
- Pure material
- Broader chemical resistance

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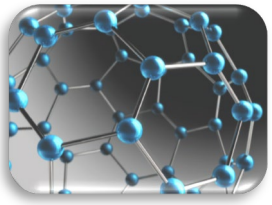
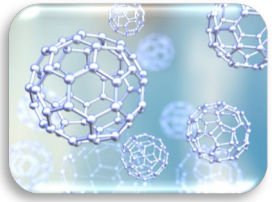
Angst+Pfister solution: PERTEC® family of compounds



PERTEC®
CIP/SIP FKM

Developed to ensure **reliable long term operation** for industries that rely heavily on CIP and SIP, such as food, pharma and medical. Components are thus exposed to aggressive cleaning chemicals, high temperatures and fat concentration. **Complies with all required regulations for the food, pharma and medical industry.**

- High temp. resistance up to +200°C
- Low friction, good abrasion resistance
- Low permeability
- Broad resistance against chemicals like concentrated acids and oxidizing substances



PERTEC®
ST FKM

The special compound mixture and a high fluorine content makes PERTEC® ST FKM **highly resistant against steam and hot water, giving it a very long life time**.
Perfectly suitable for steam and hot water applications like closed piping systems for hot water pumping.

- Broad chemical resistance over a wide range of aggressive liquids
- Low permeability
- Excellent resistance to mineral oils & greases. Very good ozone-, weather, age and oxygen-resistance

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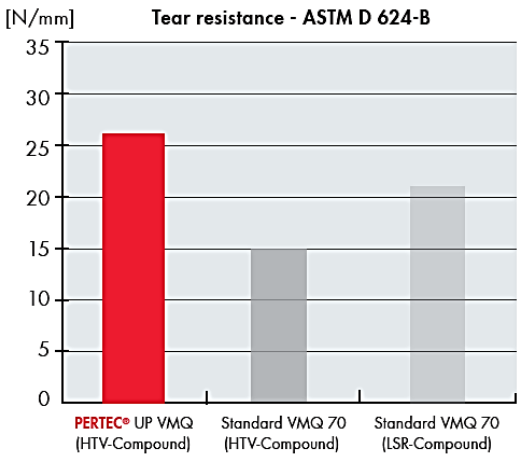
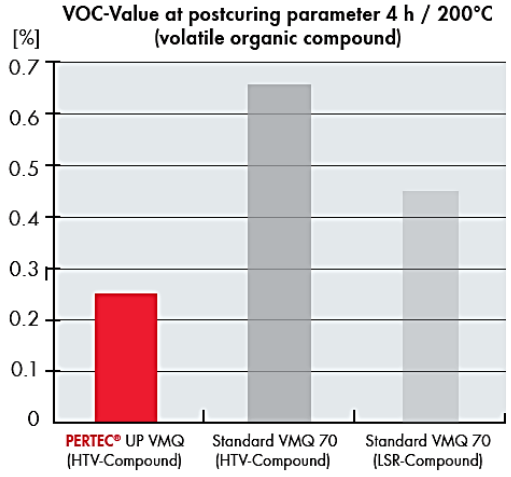
PERTEC® UP VMQ – Performance & Certificates

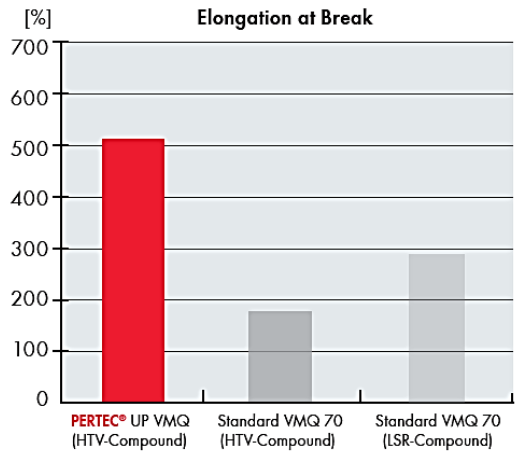
- **PERTEC® UP VMQ** complies with almost all **food contact, pharma and medical** regulations worldwide.
- Due to the high purity of the material, many **other regulations can be fulfilled – e.g. NSF 61 for drinking water or WRAS (BS 6920).**
- Typical products: O-rings, moulded parts & membranes

3-A Sanitary Standard Number 18-03 Class I	PAH Category 1 (AfPS GS 2014:01)
ADI free	PAHs requirements according Regulation (EU) No 1272/2013
BfR XV (Silicone)	Phthalate free
D.M. 21/03/1973	SR 817.023.21
DPR 777/82	USP Class VI Chapter 87 and Chapter 88, 121°C
DVGW EN 549 D2/H3	
DVGW W 270	
EC 1935/2004 article 3	
FDA - CFR 21 - 177.2600 food a) - f)	
French Arrete 17.12.92 No. 293 (migration test)	
GB 4806.1-2016	
GB 9685-2016	
GB 4806.11-2016	
GMC/RES. N° 28/99	
KIWA NSF/ANSI 51 formulation	
KTW Guideline cold water (23 °C) and hot water (85 °C)	
LFGB § 30/31	

Pharma | Chemical | Food & Beverage | Medical | Drinking water







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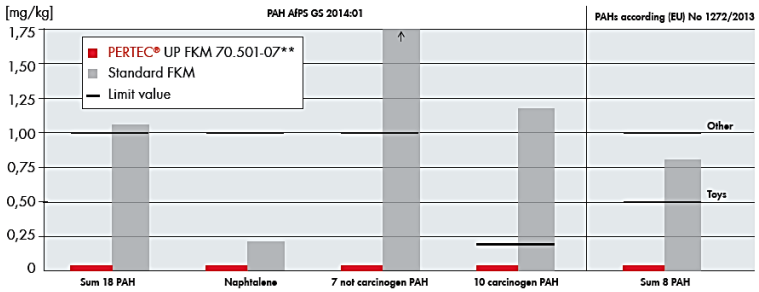
PERTEC® UP FKM – Performance & Certificates

- **PERTEC® UP FKM** complies with almost all **food contact, pharma and medical** regulations worldwide.
- Due to the high purity of the material, many **other regulations can be fulfilled – e.g. UBA Elastomer Guideline, DVGW W270, WRAS (BS6920) and NSF 61 for drinking water.**
- Typical products: O-rings, moulded parts & membranes



Comparison Technical Data

	PERTEC® UP FKM 70.501-07	Standard FKM
Density	1,92 g/cm³	2,07 g/cm³
Hardness	70 Shore A	70 Shore A
Tensile strenght	20,2 MPa	7 MPa
Elongation at rupture	316%	125%

	Limit value category 1	**Limit value category 2**		**Limit value category 3**	
PAH AfPS GS 2014:01	Materials indented to be put in the mouth, or materials of toys with intended longterm skin contact (longer than 30s)	Materials not covered by category 1, with foreseeable skin contact for longer than 30 seconds (long-term skin contact) or repeated short-term skin contact		Materials not covered by category 1 or 2 with foreseeable skin contact up to 30 seconds (short term skin contact)	
		Toys	Other products	Toys	Other products
10 carcinogen PAH	< 0,2 mg/kg	< 0,2 mg/kg	< 0,5 mg/kg	< 0,5 mg/kg	< 1 mg/kg
	Limit value for each one of the 10 carcinogen PAH-Single substance				
7 not carcinogen PAH	< 1 mg/kg	< 5 mg/kg	< 10 mg/kg	< 20 mg/kg	< 50 mg/kg
	Sum limit value of the 7 not carcinogen PAH				
Naphtalene	< 1 mg/kg	< 2 mg/kg		< 10 mg/kg	
18 PAH	< 1 mg/kg	< 5 mg/kg	< 10 mg/kg	< 20 mg/kg	< 50 mg/kg
	Sum limit value of all 18 PAH's				

BfR XXI (Natural and synthetic rubber) Category 4

ADI free

EC 1935/2004 article 3

FDA - CFR 21 - 177.2600 food a) - f)

French Arrete 17.12.92 No. 293 (migration test)

GB 4806.11-2016

KIWA NSF/ANSI 51 formulation

LFGB § 30/31

PAH Category 1 (AfPS GS 2014:01)

PAHs requirements according Regulation (EU) No 1272/2013

SR 817.023.21

Phthalate free

Pharma | Chemical | Food & Beverage | Medical | Drinking water

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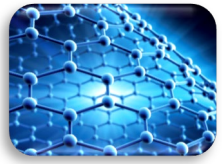
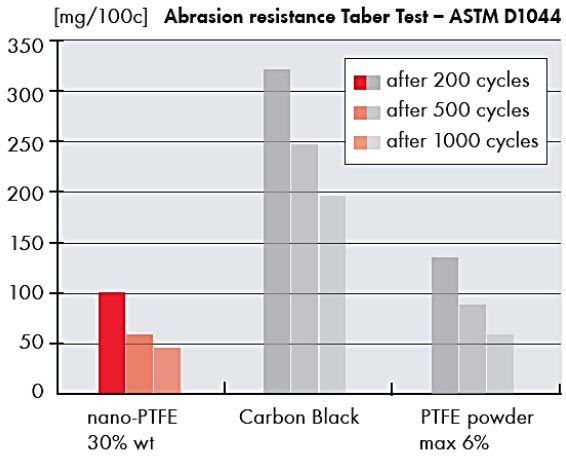
PERTEC® NP FKM – Performance

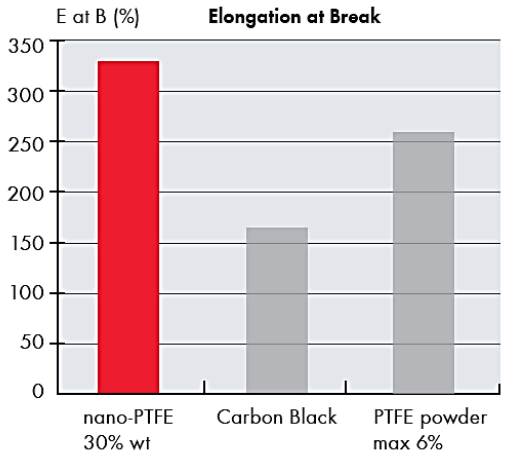


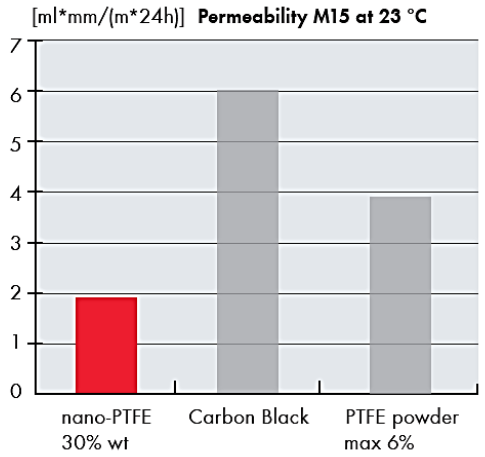
- Typical products: O-rings, moulded parts, membranes & dynamic seals
- Depending on the application, the concentration of the nano-PTFE may vary from 0% up to 40% wt.
  - Right: the effects of nano-PTFE content on mechanical properties
  - Below: The outstanding effect of nano-PTFE filler in terms of abrasion resistance, elongation at break and permeability, compared to other fillers

nano-PTFE	% wt	40	30	15	5	0
Mold press 10 min at 160 °C	-	Post Cure (1+4) h at 230 °C				
Tensile Strength	MPa	18,0	20,3	21,9	22,9	22,4
M100	MPa	6,5	5,2	2,2	1,5	1,4
Elongation at Break	%	300	332	340	356	350
Hardness	Shore A	85	78	64	56	54
C. Set 70 h at 200 °C o-rings #214	%	36	27	24	22	22

Pharma Chemical Food & Beverage Valves Pumps Couplings







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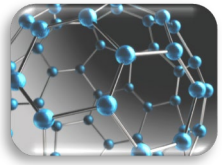
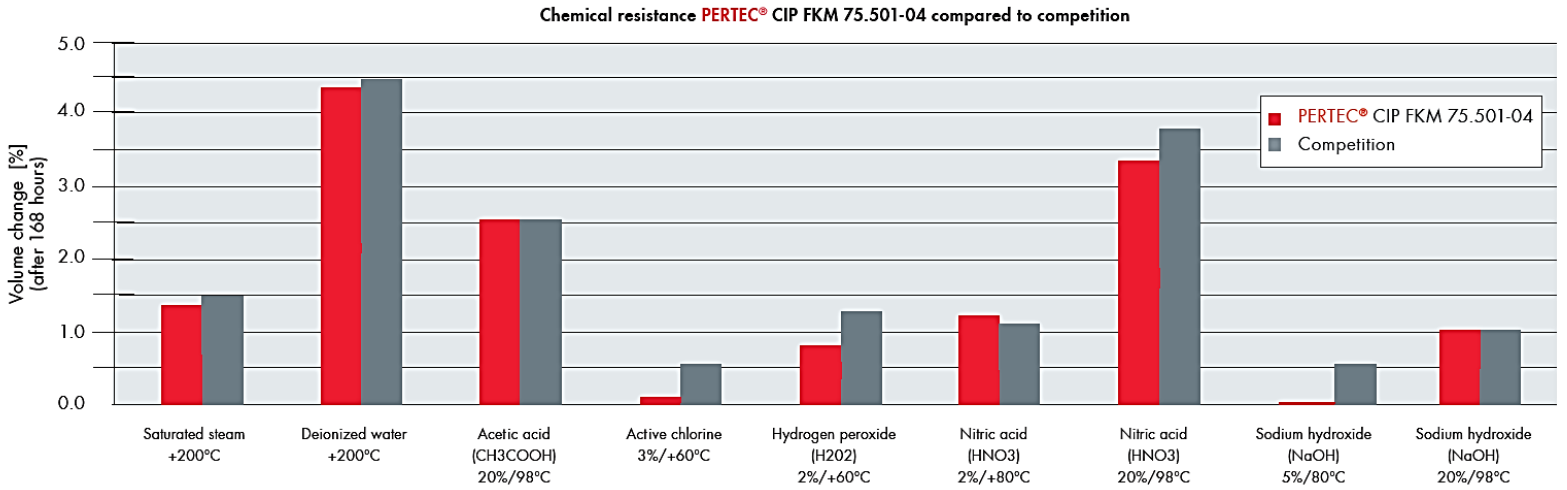
PERTEC® CIP FKM – Performance & Certificates



- **PERTEC® CIP FKM** typical products: O-rings, moulded parts, membranes & dynamic seals

3-A Sanitary Standard Number 18-03 Class I	LFGB § 30/31
ADI free	SR 817.023.21
BfR XXI (Natural and synthetic rubber) Category 4	PAH Category 1 (AfPS GS 2014:01)
EC 1935/2004 article 3	PAHs requirements according Regulation (EU) No 1272/2013
FDA - CFR 21 - 177.2600 food Chapter a) - f)	Phthalate free
GB 4806.11-2016	USP Class VI chapter 87 and 88, 121°C
KIWA NSF/ANSI 51 formulation	

Pharma Chemical Food & Beverage Medical



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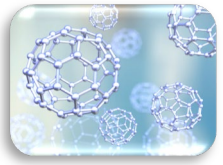
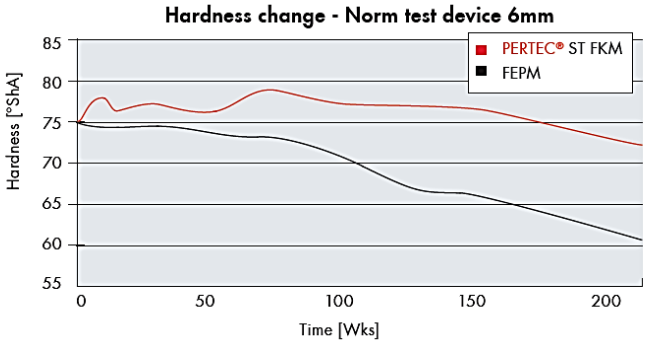
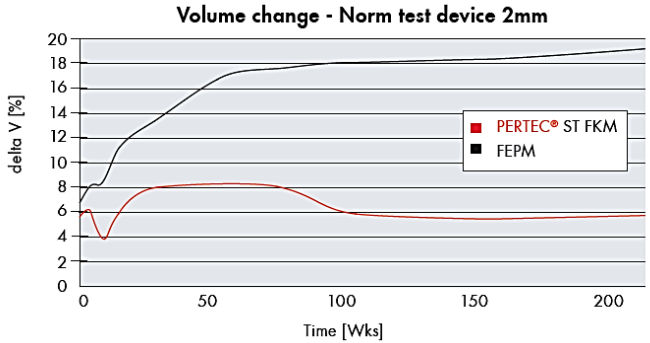
PERTEC® ST FKM – Performance



- **PERTEC® ST FKM** typical products: O-rings, moulded parts & membranes

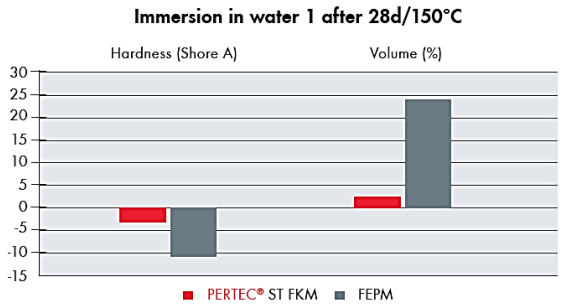
Test in the autoclave at 150°C steam for 208 weeks*



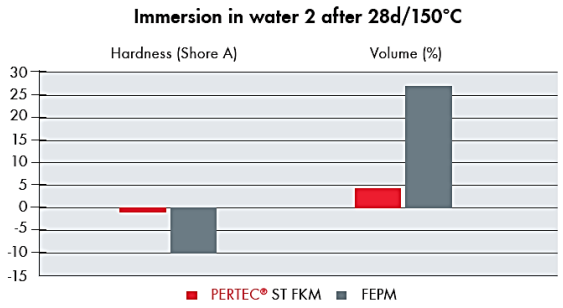


Resistance to corrosion inhibitors*

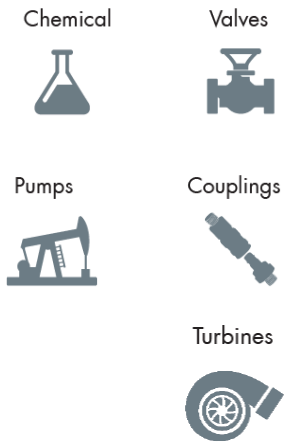
A corrosion inhibitor is a chemical substance that, when added to a liquid or gas, decreases the corrosion rate of a material, typically a metal or an alloy.



Water 1 with 150g/m3 of ST-DOS H-200 and 200g/m3 of ST-DOS H-413



Water 2 with 400g/m3 of ST-DOS H-200 and 350g/m3 of ST-DOS H-413



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Overview approvals PERTEC®

Approvals	PERTEC® UP VMQ 70.501-01	PERTEC® UP FKM 70.501-07	PERTEC® NP FKM 70.501-04	PERTEC® NP FKM 80.501-01	PERTEC® CIP FKM 75.501-04	PERTEC® ST FKM 75.501-02
Food	FDA 21 BfR XV French Arreté EC 1935/20014 article 3 LFGB § 30/31 SR 817.023.21 3A Sanitary standard no 18-03 Class 1 GB 4806.11-2016 (Extraction values) GB 9685-2016 (Positiv list) GB 4806.1-2016 (equal to EC 1935/2004) Mercosur GMC 28/99 (Positiv list) NSF 51 for food	FDA French Arreté (Migration test) LFGB § 30/31 EC 1935/2004 article 3 BfR XXI Class 4 SR 817.023.21 GB 4806.11-2016 NSF 51 for food	FDA	FDA	FDA 21 LFGB § 30/31 EC 1935/2004 article 3 BfR XXI Class 4 SR 817.023.21 GB 4806.11-2016 3A Sanitary Class I NSF 51	
Drinking Water	KTW (85°C) DVGW W 270					
Pharma-ceutical	USP Class VI, 121°C				USP Class VI, 121°C	
Gas	EN 549 D2 H3					
Others	PHA Class 1 PAHs No 1272/2013	PAH Class 1 PAHs No 1272/2013			PAH Class 1 PAHs No 1272/2013 Storage tests over 168h in different chemicals, water and steam relevant for CIP cleaning are done.	
In Progress		UBA Elastomer Guideline DVGW W 270				

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Standard elastomers compound table (HITEC®)

Material Type		A+P code	Color	Hardness [Shore A]	TR 10 [°C]	Temperatur range in air [°C]	Approvals		
							Food/Pharmaceutical	Drinking Water	Others
Standard Compounds (HITEC®)	EPDM	EPDM 70.10-02	black	70±5	-36	-55 to +150	3-A Sanitary, BfR, D.M. 174, D.M. 1973, EC 1935/2004, FDA, French Arrete, GB 4806.11, NSF 51, USP Class VI	ACS, AS/NZS, EN 681, W270, W534, KIWA, NSF 61, ÖNORM, UBA WRAS	ADI free
	FKM	FKM 75.16-04	black	70±5	-17	-25 to +200	D.M. 1973, EC 1935/2004, FDA, GB 4806.11, USP Class VI		ADI free, BAM, EN 549
	NBR	NBR 70.10-02	black	70±5	-20	-25 to +125	D.M. 1973, EC 1935/2004, FDA, GB 4806.11	ACS, CLP, W270, NSF 61, ÖNORM, UBA, WRAS	ADI free, EN 549, DVGW 406
	VMQ	VMQ 70.10-01	red-brown	70±5	-42	-60 to +230	3-A Sanitary, D.M. 1973, EC 1935/2004, FDA, GB 4806.11, USP Class VI		ADI free, EN 549, DVGQ 406

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Perfluor-elastomers compound table

Material Type		A+P code	Color	Hardness [Shore A]	Manufacturing method	Temperatur range in air [°C]	Approvals		Notes
							Food/Pharmaceutical	Others	
Standard Comounds	FFKM	KALREZ 6375	black	75±5	moulded part	-3 to +275			Broadest chemical resistance
		KALREZ 4079	black	75±5	moulded part	-2 to +316			Broad chemical resistance at high temperature
		KALREZ 6221	white	70±5	moulded part	-0 to +260	FDA 21 CFR 177.2600 a) - f) USP Class VI Ch. 87 and Ch. 88, 121°C 3A Sanitary standard no 18-03		White compound with good steam resistance and approvals for food and pharmaceutical applications
		KALREZ 6230	black	75±5	moulded part	-0 to +260	FDA 21 CFR 177.2600 a) - f) USP Class VI Ch. 87 and Ch. 88, 121°C 3A Sanitary standard no 18-03		
Special Compounds	FFKM	KALREZ 7075	black	75±5	moulded part	-4 to +327			For very high temperature application and low compression set
		KALREZ 0090	black	95±5	moulded part	-7 to +250		NORSOK-M-710	Rapid gas decompression, hot water, amines and bases
		KALREZ 0040	black	70±5	moulded part	-17 to +220			Good for low temperature applications

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Special elastomers compound table

Material Type		A+P code	Color	Hardness [Shore A]	TR 10 [°C]	Temperatur range in air [°C]	Approvals		Notes
							Food/Pharmaceutical	Others	
Special Compounds	FKM	FKM 70.15-14	black	70±5	-30	-46 to +200		DBL 6038.42 - DBL 6038.46 (2011-11) BMW GS93010-3 5644 - (According to VW 2.8.1 C70)	Low temperature applications
		FKM 70.15-17	black	70±5	-40	-51 to +230			low temperature applications
		FKM 70.15-22	black	70±5	-45	-61 to +230			Ultra low temperature applications
		FKM 75.16-18	black	75±5	-17	-25 to +270			High Temperature applications
		FKM 90.15-03	black	90±5	-35	-41 to +250		NORSOK M710 (Rating "0000"), NACE TM0297 (Rating 1) NACE TM0187 and TOTALFINA SP-TCS-142	Rapid gas decomression and low temperature
		FKM 90.15-09	black	90±5	-45	-60 to +250		NORSOK-M-710	Rapid gas decompression and ultra low temperature applications
	HNBR	HNBR 70.15-06	green	70±5	-30	-45 to +150			
		HNBR 90.15-02	black	90±5	-38	-55 to +160		NACE TM0187-2011	Rapid gas decompression and sour gas envirements

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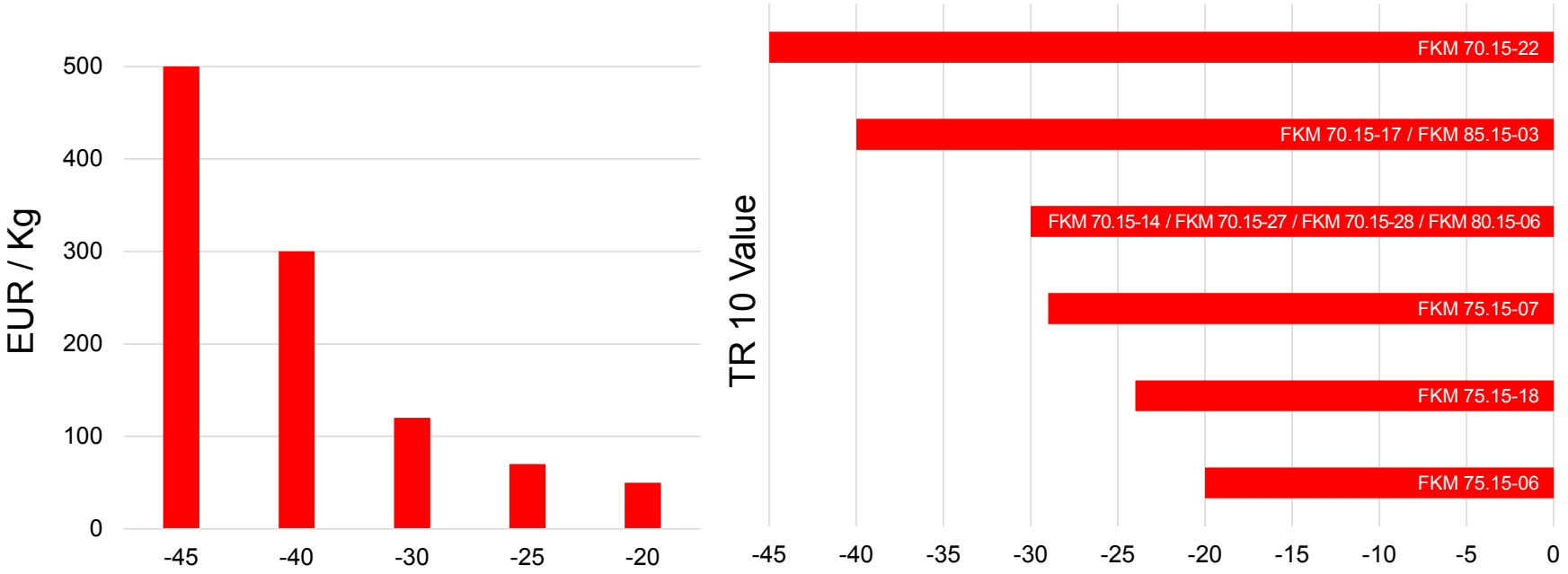
Cost ratio depending on temperature behavior



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Performance compound table

Material Type		Angst+Pfister Code	Color	Hardness	Cross-linking	Manufacturing method	Operating temperature range [in °C]	Approvals		Notes
								Food/ Pharmaceutical/ Drinking Water	Others	
PERTEC®	FKM	PERTEC® CIP FKM 75.501-04	blue	75 Shore A	peroxid	moulded parts	-15 to +200	• 3-A Sanitary Standard Number 18-03 Class I • BfR XXI (Natural and synthetic rubber) Category 4 • EC 1935/2004 article 3 • FDA - CFR 21 - 177.2600 food a) - f) • GB 4806.11-2016 • KIWA NSF/ANSI 51formulation • LFGB § 30/31 • SR 817.023.21 • USP Class VI chapter 87 and 88, 121°C	• PAH Category 1 (AfPS GS 2014:01) • PAHs requirements acc. Regulation (EU) No 1272/2013	FKM nano PTFE for CIP/SIP cleanig processes and for Food and Beverage
		PERTEC® NP FKM 70.501-04	black	70 Shore A	peroxid	moulded parts	-30 to +220	• FDA - CFR 21 - 177.2600 food a) - f)		FKM nano PTFE, good permeability, low friction, for dynamic applications
		PERTEC® NP FKM 80.501-01	black	80 Shore A	peroxid	moulded parts	-30 to +220	• FDA - CFR 21 - 177.2600 food a) - f)		FKM nano PTFE, good permeability, low friction, for dynamic applications
		PERTEC® ST FKM 75.501-02	black	75 Shore A	peroxid	moulded parts	-15 to +200			For steam with high fluorine content and good chemical resitance
		PERTEC® UP FKM 70.501-07	black	70 Shore A	peroxid	moulded parts	-20 to +200	• BfR XXI (Natural and synthetic rubber) Category 4 • EC 1935/2004 article 3 • FDA - CFR 21 - 177.2600 food a) - f) • French Arrete 17.12.92 No 293 (migration test) • GB 4806.11-2016 • KIWA NSF/ANSI 51formulation • LFGB § 30/31 • SR 817.023.21	• PAH Category 1 (AfPS GS 2014:01) • PAHs requirements acc. Regulation (EU) No 1272/2013	Ultra pure FKM with good mechanical and chemical properties for food and drinking water applications
	VMQ	PERTEC® UP VMQ 70.501-01	translucent	70 Shore A	peroxid	moulded parts	-60 to +200	• 3-A Sanitary Standard Number 18-03 Class I • BfR XV (Silicone) • D.M. 21/03/1973 • DIN 777/82 • DVGW W 270 • EC 1935/2004 article 3 • FDA - CFR 21 - 177.2600 food a) - f) • French Arrete 25.11.92 No 293 • GB 4806.1-2016 • GB 4806.11-2016 • GB 9685-2016 • GMC/RES. No. 28/99 • KIWA NSF/ANSI 51formulation • KTW Guideline cold water (23 °C) and hot water (85 °C) • LFGB § 30/31 • SR 817.023.21 • USP Class VI chapter 87 and 88, 121°C	• DVGW EN 549 D2/H3 • PAH Category 1 (AfPS GS 2014:01) • PAHs requirements acc. Regulation (EU) No 1272/2013	Ultra pure VMQ with very good mechanical properties for food, drinking water and medical applications
FKM		FKM 60.501-02	black	60 Shore A	peroxid	moulded parts	-30 to +200			Low temperature compound, based on DuPont-Polymer Type "GLT" (TR10 Value -30°C)
		FKM 70.501-02	black	70 Shore A	peroxid	moulded parts	-15 to +200	• FDA - CFR 21 - 177.2600 food a) - d)		FKM with broad chemical resistants
		FKM 70.501-05	black	70 Shore A	peroxid	moulded parts	-30 to +200			Low temperature compound, based on DuPont-Polymer Type "GLT" (TR10 Value -30°C)
		FKM 75.501-03	black	75 Shore A	peroxid	moulded parts	-30 to +200			Low temperature FKM (TR 10 Value -30°C)
		FKM 75.501-05	black	75 Shore A	peroxid	moulded parts	-20 to +200			Compound for Solarthermie application
		FKM 85.501-01	black	85 Shore A	peroxid	moulded parts	-40 to +200			High pressure applications in low temperature (TR 10 Value -41°C)
VMQ		VMQ 35.501-02	red-brown	35 Shore A	peroxid	moulded parts	-50 to +200			Silicone with a very good long term high temperature behaviour and an outstanding elongation at rupture value of > 550%
		VMQ 80.501-01	transparent	80 Shore A	platinum	moulded parts	-50 to +200			VMQ with extended chemical resistance
EPDM		EPDM 50.502-01	black	50 Shore A	sulfur	moulded parts	-40 to +150			Soft EPDM for automotive industry
		EPDM 60.503-01	black	60 Shore A	sulfur	moulded parts / extrusion	-40 to +150		• DIN EN 45545-2:(2013-08) R1: HL2	Moulding compound for railway industry
		EPDM 60.504-01	black	60 Shore A	sulfur	extrusion	-40 to +100		• DIN EN 45545-2:(2013-08) R22/R23: HL3	Extrusions compound for railway industry
		EPDM 70.502-01	black	70 Shore A	peroxid	moulded parts	-55 to +150	• 3-A Sanitary Standard Number 18-03 Class II • FDA - CFR 21 - 177.2600 food e), f) • UBA Guideline, cold (23 °C) and hot water (85 °C)		Drinking water and food compound with good mechanical properties
HNBR		HNBR 60.502-01	black	60 Shore A	peroxid	moulded parts	-30 to +150			Compound for ADD Blue applications
		HNBR 60.502-02	black	60 Shore A	peroxid	moulded parts	-20 to +125		• DVGW EN 549 D2/H2	Gas application with high elongation value
		HNBR 70.502-01	black	70 Shore A	peroxid	moulded parts	-30 to +150			Low temperature compound (TR 10 Value -27°C)
NBR		NBR 70.502-02	black	70 Shore A	sulfur	moulded parts	-50 to +100			Low temperature NBR, DSC -61°C

- Download current table

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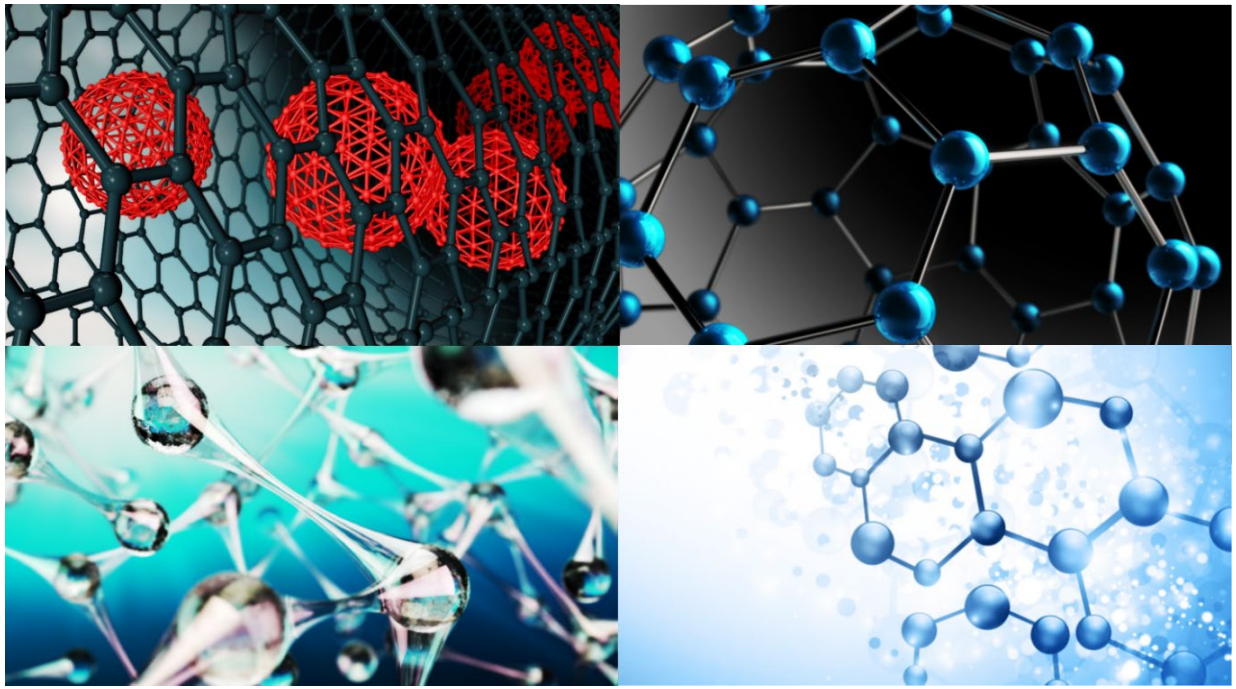
Success Stories of High-Performance Sealing and Engineering Plastics Solutions for Valve Applications



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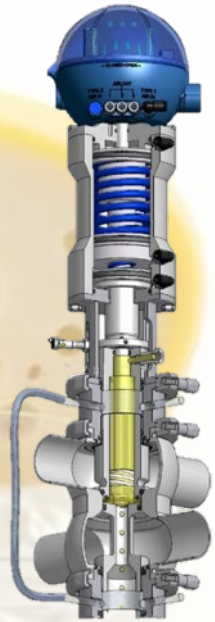
Double seal valve for food

Customer requirements

PROFITABILITY	**DURABILITY** • Current EPDM sealing elements **could not reach the requested life cycle of 1 year** as temperature increased from 140°C up to 160°C.	**PERFORMANCE** • CIP: steam at 160° & aggressive chemicals. • Lower friction on the dynamic application
MARKET POTENTIAL	**VERSATILITY** • Different types of valves mainly for the food an beverage industry.	**COMPLIANCE (Approvals)** • FDA • 3 A Sanitary for dairy food



- While the current solution fulfilled 3 of the 4 criteria the durability aspect leads to **much higher maintenance costs and machine stops.**

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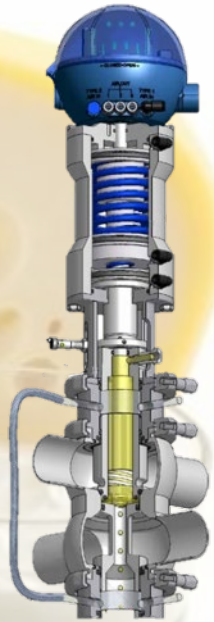
Angst+Pfister solution: PERTEC® CIP FKM 75.501-04

PROFITABILITY	• 25% higher operating temperature than requirement & 50% lower friction **= LONGER LIFECYCLE**	**PERFORMANCE** ✓ • At 200°C, operating temperature exceeds client's requirement of 160°C • 50% lower friction due to nano PTFE filled compound
MARKET POTENTIAL	**VERSATILITY** ✓ • One compound that with a wide scope of usage	**COMPLIANCE (Approvals)** ✓ • Meets and exceeds customer's requirements



- Longer lifecycle achieved thanks to 50% lower friction due to nano PTFE filled compound and temperature resistance of FKM.

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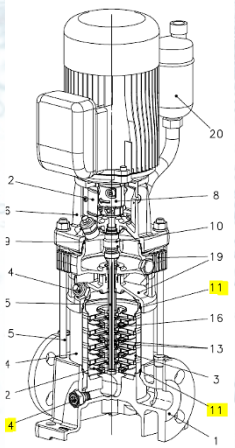
Hot Water Valves

Customer requirements

PROFITABILITY	**DURABILITY** • As current / not-specified	**PERFORMANCE** • Current operating temperature = 160°C • Desired operating temperature = 200°C
MARKET POTENTIAL	**VERSATILITY** • Increase in operating temperature and approvals needed to **address more markets & increase share**	**COMPLIANCE (Approvals)** • Must: Drinking Water for Germany (UBA.W270) • Desired: Drinking Water for other countries – e.g. USA (NSF 61) and UK (WRAS)

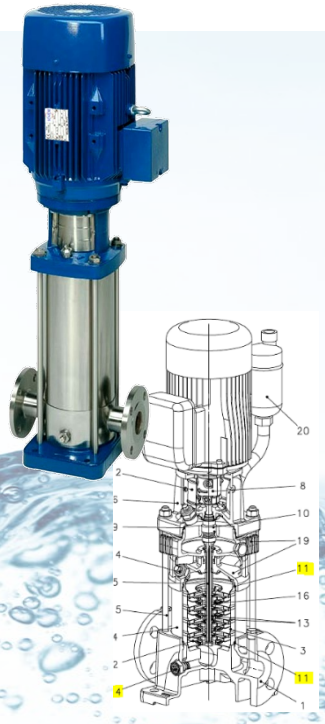


- While the current solution provides basic performance, it limits the market potential of the valve

Angst+Pfister

Angst+Pfister solution: PERTEC® UP FKM 70.501-07

PROFITABILITY	**DURABILITY** ✓ • At requested level	**PERFORMANCE** • At 200°C, operating temperature meets client's extended requirement
MARKET POTENTIAL	**VERSATILITY** • Increased operating temperature & additional approvals **= MORE MARKETS CAN BE ADDRESSED**	**COMPLIANCE (Approvals)** ✓ • All food approvals • UBA & W270 German Drinking Water • NSF 61 & WRAS available shortly



- **New markets can be addressed by higher temperature** with this detail

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Vacuum Valves

Customer requirements

PROFITABILITY	**DURABILITY** • Not specified	**PERFORMANCE** • Dynamic application with low friction • Surface treatment not possible due to bad gas permeability
MARKET POTENTIAL	**VERSATILITY** • Vacuum valves are used in a variety of industries: chemical, metal, electrical, oil & gas, semi-conductors…	**COMPLIANCE (Approvals)** • Not specified

- Performance is the key element to consider: if the sealing fails, vacuum can not be attained

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Angst+Pfister solution: PERTEC® NP FKM 70.501-04

PROFITABILITY	**DURABILITY** • Not specified	**PERFORMANCE** • More than 50% lower friction coefficient than normal FKM thanks to nano PTFE content • Very low gas permeability **=OUTSTANDING SOLUTION**
MARKET POTENTIAL	**VERSATILITY** • Use in various industries possible: e.g. chemical, metal, electrical, oil & gas, semi-conductors…	**COMPLIANCE (Approvals)** • Not Specified FDA

- **Performance achieved and better results on low gas permeability**

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Gas Valves

Customer requirements

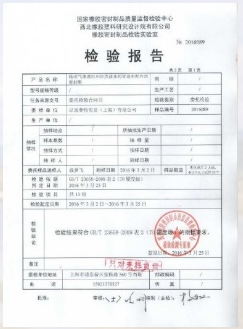
PROFITABILITY	**DURABILITY** • More than 10 years	**PERFORMANCE** • No leakage in order to avoid the accident risk when using inadequate sealing elements
MARKET POTENTIAL	**VERSATILITY** • Specific valve for gas	**COMPLIANCE (Approvals)** • GB / T23658:2009. New Chinese regulation for gas devices, approved as consequence of high accident rate

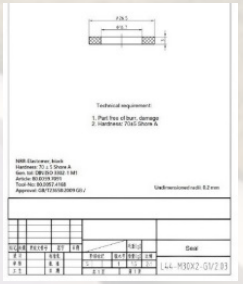
- Customer which is producing valves for the household gas application was looking for new materials tested and approved according to the new norm in NBR, HNBR and FKM

Angst+Pfister

Angst+Pfister solution:
Compound portfolio with approvals

PROFITABILITY	**DURABILITY** • Minimum 10 years	**PERFORMANCE** • NBR, HNBR & VMQ compounds • High elongation, high temperature resistance & low friction according to compound
MARKET POTENTIAL	**VERSATILITY** • Angst+Pfister's portfolio offers a solution according to requirements & budget	**COMPLIANCE (Approvals)** • Wide portfolio of approved materials for gas applications according to GB 23658, EN 549 and EN 682.





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Angst+Pfister solution:
Compound portfolio with approvals for gas

Compound	Homologations	Remarks
NBR 60.10-09	EN 682 GBL	Good ozone resistance
NBR 60.320-01	GB 23658	Standard material for economical applications
NBR 70.10-02	EN 549 B1/H3	Standard material also for drinking water applications with many O-Ring sizes available from stock
NBR 70.10-08	EN 549 B2/H3	Standard material for economical applications
NBR 70.10-13	EN 549 B2/H3	Compound with fillers for low friction
NBR 70.10-14	EN 549 B2/H3 EN 682 GBL	Both gas homologations from EU
NBR 70.10-17	EN 549 B1/H3 EN 682 GBL	Both gas homologations from EU
NBR 70.320-01	GB 23658	Standard material for economical applications
NBR 80.320-01	GB 23658	Standard material for economical applications
HNBR 60.502-02	EN 549 B2/H2	Compound with high elongation at break
HNBR 70.10-09	EN 549 C2/H3 EN 682 GBL	Both gas homologations from EU
VMQ 60.10-03	EN 549 E2/H2	Compound for high temperature applications
VMQ 70.501-01	EN 549 D2/H3	**PERTEC® UP VMQ** compound for low temperatures

- Angst+Pfister has a wide portfolio an approved materials for gas applications in accordance with GB 23658, EN 549 and EN 682.

Angst+Pfister

Existing Angst+Pfister customers in the Process Industry

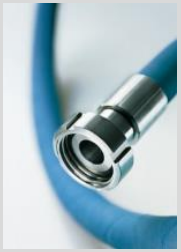
Angst+Pfister also supplies other components for the Process Industry

APSOseal®
Sealing Technology

APSOdrive®
Drive Technology

APSOvib®
Antivibration Technology

APSOplast®
Engineering Plastics Technology



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Fluid Handling Technology

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