

# Tecnoflon® PFR LT

## Low Temperature Perfluoroelastomer

Tecnoflon® PFR LT represents a breakthrough in perfluoroelastomer (FFKM) technology. It offers outstanding sealing behaviour in the widest range of aggressive media along with excellent compression set values and best in class low temperature flexibility. Thanks to a new proprietary fluorinated monomer technology, Tecnoflon® PFR LT extends the low temperature sealing capability of perfluoroelastomers down to  $-40^{\circ}\text{C}$  (from approximately  $-10^{\circ}\text{C}$ ), whilst retaining typical fluid resistance.

It is suitable for most applications in temperature ranging from  $-40^{\circ}\text{C}$  to  $230^{\circ}\text{C}$ , offering outstanding resistance to aggressive media such as hot organic and inorganic acids, caustics, amines (especially hot amines, i.e. at temperature higher than  $+70^{\circ}\text{C}$ ), ketones, aldehydes, esters, ethers, alcohols, fuels, solvents, sour gases, hydrocarbons, steam, hot water, formate solutions and mixed process streams.

Tecnoflon® PFR LT can be combined with the cure system and other typical fluoroelastomer compounding ingredients; its mixing can be accomplished with two roll mills or internal mixers. Finished goods may be produced by a variety of rubber processing methods.

The primary use for Tecnoflon® PFR LT is the manufacturing of any kind of elastomeric sealing element such as Orings, gaskets, valve bodies, butterfly valves, pump housings and stators, metal bonded parts, diaphragms, profiles, etc. These sealing elements can be used in mechanical seals, pumps, compressors, valves, reactors, mixers, sprayers, dispensers, quick connect couplings, controls, instrumentation, etc. in a wide range of industrial sectors.

Tecnoflon® PFR LT is marketed in the form of raw polymer (1 kg box) in order to give the transformer the freedom and the opportunity to develop and fine tune compounds and items best suited to the final application.

### Handling and safety

Normal care and precautions should be taken to avoid skin contact, eye contact and breathing of fumes. Smoking is prohibited in working areas. Wash hands before eating or smoking. For complete health and safety information, please refer to the material safety data sheet.

### Basic characteristics of the raw polymer are as follows

Property	Typical Value	Unit	Test Method
ML (1+10') at $121^{\circ}\text{C}$	25	MU	ASTM D1646
Specific gravity	2.00	$\text{g}/\text{cm}^3$	ASTM D792
Colour	Translucent		
Packaging/Form	1 kg/Slabs		

# Tecnoflon® PFR LT

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## 75 Shore A black compound

Test Compound	Typical Value	Unit	Test Method
Tecnoflon® PFR LT	100	phr	
Luperox® 101XL-45	2.5	phr	
Drimix® TAIC (75%)	4	phr	
N-550 Carbon Black	25	phr	

Property	Typical Value	Unit	Test Method
Compound density	1.95	g/cm <sup>3</sup>	ASTM D792
<b>MDR 12 min at 160°C arc 0.5°</b>			ASTM D6601
Minimum torque	1.9	lb·in	
Maximum torque	29.0	lb·in	
t <sub>s2</sub>	30	s	
t' <sub>50</sub>	70	s	
t' <sub>90</sub>	280	s	
<b>Post cure: 4 h at 230°C</b>			
100% modulus	7.2	MPa	ASTM D412C
Tensile strength	18.4	MPa	
Elongation at break	200	%	
Hardness	77	Shore A	ASTM D2240
<b>Compression set</b> 25% deformation, O-ring #214			ASTM D395 method B
70 h at 200°C	27	%	

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## Additional black compounds

Test Compound	Unit	50 Shore A	60 Shore A	85 Shore A	Test Method
Tecnoflon® PFR LT	phr	100	100	100	
Luperox® 101XL-45	phr	2	1.5	2.5	
Drimix TAIC (75 %)	phr	3	2	4	
N-990 MT Carbon Black	phr	3	20	–	
N-550 Carbon Black	phr	–	–	35	
Ultrasil® 360	phr	–	–	–	

Property	Unit	50 Shore A	60 Shore A	85 Shore A	Test Method
<b>Post cure: 4 h at 230°C</b>					
100 % modulus	MPa	1.0	2.4	6.9	ASTM D412C
Tensile strength	MPa	6.5	11.3	14.0	
Elongation at break	%	287	270	169	
Hardness	Shore A	50	60	84	ASTM D2240
<b>Compression set</b>					
25 % deformation, O-ring #214					ASTM D395 method B
70 h at 200°C	%	37	23	26	

# Tecnoflon® PFR LT

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## Oil & gas compound

Test Compound	Typical Value	Unit	Test Method
<b>Tecnoflon® PFR LT</b>	100	phr	
Luperox® 101XL-45	2.5	phr	
Drimix® TAIC (75%)	5	phr	
N-550 Carbon Black	35	phr	
SiO <sub>2</sub> (Ultrasil® 360)	10	phr	
PAT 777	1	phr	
Struktol® WS 280	0.5	phr	
Armeen® 18D	0.3	phr	

Property	Typical Value	Unit	Test Method
<b>MDR 12 min at 170 °C arc 0.5°</b>			ASTM D6601
Minimum torque	4.1	lb·in	
Maximum torque	52.0	lb·in	
t <sub>s2</sub>	25	s	
t' <sub>50</sub>	65	s	
t' <sub>90</sub>	190	s	
<b>Post cure: (1+4) h at 230 °C</b>			
50 % modulus	5.0	MPa	ASTM D412C
100 % modulus	9.2	MPa	
Tensile strength	11.5	MPa	
Elongation at break	115	%	
Hardness	91	Shore A	ASTM D2240
<b>Compression set</b> 25 % deformation, O-ring #214			ASTM D395 method B
70 h at 200 °C	32	%	

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### Rapid gas decompression tests

The Tecnoflon® PFR LT oil & gas compound on page 4 was successfully tested in the following conditions referring to Norsok standard M-710, "Qualification of non-metallic sealing materials and manufacturers", Rev 2, October 2001 and successfully passed the Rapid Decompression Test.

Property	Typical Value	Unit	Test Method
Gas	90/10 CH <sub>4</sub> /CO <sub>2</sub>	mol %	
O-ring replication	6		
Groove fill	65	%	
Temperature	100	°C	
Pressure	150	bar	
Number of cycles	10		
First cycle duration	72	h	
Cycles 2 – 10 duration	23–24	h	
Hold period between cycles	1	h	
De-pressurization rate	20	bar/minute	
Sampling after cycles	10		

O-rings #312 (13.64 mm internal diameter – 5.33 mm cross-section) were submitted to testing.

All O-rings met the Norsok M-710 acceptance criterion after the 10 cycle RGD test, since the ratings were as below:

**Norsok rating: 0000, 0000**

whereby the Norsok rating numbers are as follows:

0: no cracks, holes or blisters of any size.

# Tecnoflon® PFR LT

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## 75 Shore A white compound

Test Compound	Typical Value	Unit	Test Method
Tecnoflon® PFR LT	100	phr	
Luperox® 101XL-45	2.5	phr	
Drimix TAIC (75 %)	4	phr	
SiO <sub>2</sub> (Ultrasil® 360)	20	phr	
TiO <sub>2</sub> (Ti-Pure® R-960)	5	phr	

Property	Typical Value	Unit	Test Method
Compound density	1.97	g/cm <sup>3</sup>	ASTM D792
<b>MDR 12 min at 160°C arc 0.5°</b>			ASTM D6601
Minimum torque	3.2	lb·in	
Maximum torque	35.2	lb·in	
t <sub>s2</sub>	22	s	
t' <sub>50</sub>	34	s	
t' <sub>90</sub>	65	s	
<b>MDR 12 min at 150°C arc 0.5°</b>			ASTM D6601
Minimum torque	3.2	lb·in	
Maximum torque	35.7	lb·in	
t <sub>s2</sub>	29	s	
t' <sub>50</sub>	53	s	
t' <sub>90</sub>	130	s	
<b>Post cure: (1+4) h at 230°C</b>			
100% modulus	4.4	MPa	ASTM D412C
Tensile strength	10.0	MPa	
Elongation at break	160	%	
Hardness	75	Shore A	ASTM D2240
<b>Compression set</b> 25% deformation, O-ring #214			ASTM D395 method B
70 h at 200°C	25	%	

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## Cold flexibility

Test Compound	Typical Value	Unit	Test Method
Tecnoflon® PFR LT	100	phr	
Luperox® 101XL-45	2.5	phr	
Drimix® TAIC (75%)	4	phr	
N-550 Carbon Black	25	phr	

Property	Typical Value	Unit	Test Method
<b>DSC</b>			
T <sub>g</sub> onset	-38	°C	
T <sub>g</sub> midpoint	-32	°C	
<b>Retraction curve</b>			ASTM D1329
TR <sub>10</sub>	-30	°C	
TR <sub>30</sub>	-25	°C	
TR <sub>50</sub>	-20	°C	
TR <sub>70</sub>	-16	°C	

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## Fluid resistance overview

Fluid	Volume Swelling
Inorganic acids	< 10%
Organic acids	< 10%
Alkalis	< 10%
Amines (RT)	< 10%
Hot amines (> 70 °C)	10 – 30%
Water / Steam	< 10%
Ketones	< 10%
Esters	< 10%
Ethers	< 10%
Aldehydes	< 10%
Alcohols	< 10%
Hydrocarbons	< 10%
Sour gas	< 10%
Lubricants	< 10%
Fluorinated fluids	30 – 50%



# Tecnoflon® PFR LT

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### Fluid resistance

Property	Typical Value	Unit	Test Method
<b>Ethylene diamine, 72 h at 100°C</b>			
Δ Tensile strength	-39	%	
Δ Elongation at break	57	%	
Δ Hardness	-9	Shore A	
Δ Volume	11	%	
<b>Hexamethylene diamine, 168 h at 150°C</b>			
Δ Tensile strength	-20	%	
Δ Elongation at break	-3	%	
Δ Hardness	-1	Shore A	
Δ Volume	17	%	
<b>NH<sub>3</sub>, 28%, 336 h at 100°C</b>			
Δ Tensile strength	-13	%	
Δ Elongation at break	6	%	
Δ Hardness	-3	Shore A	
Δ Volume	6.7	%	
<b>Fuel B, 72 h at 23°C</b>			
Δ Tensile strength	-22	%	
Δ Elongation at break	-2	%	
Δ Hardness	7	Shore A	
Δ Volume	5.5	%	
<b>Steam, 168 h at 220°C</b>			
Δ Tensile strength	-26	%	
Δ Elongation at break	39	%	
Δ Hardness	-2	Shore A	
Δ Volume	0.8	%	
<b>K Formate 3 M + KOH 0.5 M, 336 h at 150°C</b>			
Δ Tensile strength	-5	%	
Δ Elongation at break	6	%	
Δ Hardness	-2	Shore A	
Δ Volume	0.6	%	
<b>Methanol, 168 h at 23°C</b>			
Δ Tensile strength	-8	%	
Δ Elongation at break	6	%	
Δ Hardness	-1	Shore A	
Δ Volume	0.8	%	

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Property	Typical Value	Unit	Test Method
<b>Ethyl acetate, 168 h at 23 °C</b>			
Δ Tensile strength	-8	%	
Δ Elongation at break	8	%	
Δ Hardness	-11	Shore A	
Δ Volume	4.2	%	

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# Tecnoflon® PFR LT

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## Acid fluid resistance

Test Compound	Unit	Masterbatches	Pure Curatives	Test Method
Tecnoflon® PFR LT	phr	100	100	
Luperox® 101XL-45	phr	2.5	–	
Luperox® 101 (92 %)	phr	–	1.7	
Drimix® TAIC (75%)	phr	4	–	
TAIC (100%)	phr	–	3	
N-550 Carbon Black	phr	25	25	

Property	Unit	Masterbatches	Pure Curatives	Test Method
<b>H<sub>2</sub>SO<sub>4</sub>, 98 %, 168 h at 65 °C</b>				
Δ Tensile strength	°C	–3	–3	
Δ Elongation at break	°C	26	23	
Δ Hardness	°C	–9	–5	
Δ Volume	°C	9.9	4.3	
<b>HNO<sub>3</sub>, 65 %, 72 h at 80 °C</b>				
Δ Tensile strength	°C	–56	–53	
Δ Elongation at break	°C	63	84	
Δ Hardness	°C	–9	–6	
Δ Volume	°C	7.4	5.4	

For optimal acid resistance, pure curatives (peroxide and cross-linking agent) are to be preferred to curative masterbatches.

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