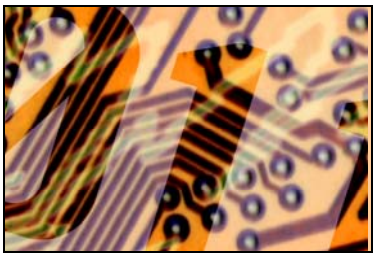

Tecnoflon® **PFR 95HT**

Perfluoroelastomer

Solvay
Solexis

SOLVAY

TECNOFLON® PFR 95HT

TECNOFLON® PFR 95HT is a perfluoroelastomer (FFKM) offering a significantly wider operational range and superior compression set resistance than any other perfluoroelastomer, thanks to its unique peroxide curing system that does not need any coagent (TAIC or equivalent) for curing to be carried out.
It can offer a very broad chemical resistance in a wide variety of media including acids, caustics, ketones, aldehydes, esters, ethers, methanol, solvents, sour gases, hydrocarbons, steam, hot water and mixed process streams along with excellent thermal resistance.

Tecnoflon® PFR 95HT is suitable for most applications in temperature ranging from –10°C to 300°C.

Tecnoflon® PFR 95HT can be combined with 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 95HT is the manufacturing of any kind of elastomeric sealing element such as O-rings, 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 chemical and petrochemical industry, hydrocarbon processing, petroleum exploration and extraction, food processing, pharmaceutical and bio-analytical industry, aerospace and semiconductor manufacturing industries.

Tecnoflon® PFR 95HT 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 produce high performance rubber articles such as O-rings, seals, diaphragms and other parts used in process industries.

Basic characteristics of the raw polymer are as follows:

PROPERTIES	TYPICAL VALUES
ML (1+10') @ 121°C (MU)	75
Specific gravity (g/cm^3)	2.05
Colour	Translucent
Packaging / Form	1 kg / Slabs

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.

TYPICAL BLACK COMPOUNDS

FORMULATION		70 Shore A	70 Shore A	80 Shore A	90 Shore A
Tecnoflon® PFR 95HT		100	100	100	100
Luperox 101XL-45	phr	1.5	1.5	1.5	1.5
ZnO	phr	5	-	5	-
Austin Black 325	phr	10	12	15	-
MT N-990 Carbon Black	phr	10	12	15	-
N-550 Carbon Black	phr	-	-	-	35
MADI LI01S	phr	-	-	0.3	-
Armeen 18D	phr	-	-	0.3	-
COMPOUND MOONEY VISCOSITY					
ML (1+10') @ 121°C	MU	108	115	120	n.d.
COMPOUND DENSITY					
Density	g/cm^3	1.99	1.94	1.98	1.98
MDR 12 min @ 170°C arc 0.5°					
Minimum Torque	lb.in	2.7	2.9	3.3	-
Maximum Torque	lb.in	21.1	19.7	29.7	-
t_{s2}	s	55	62	49	-
t'_{50}	s	123	138	124	-
t'_{90}	s	364	348	276	-
MDR 24 min @ 170°C arc 0.5°					
Minimum Torque	lb.in	-	-	-	3.9
Maximum Torque	lb.in	-	-	-	27.2
t_{s2}	s	-	-	-	57
t'_{50}	s	-	-	-	205
t'_{90}	s	-	-	-	572
TYPICAL PHYSICAL PROPERTIES					
Post Cure: (8+16) h @ 290°C					
100 % Modulus	MPa	6.9	7.7	13.6	17.5
Tensile Strength	MPa	18.3	17.0	16.5	19.3
Elongation at Break	%	224	202	130	110
Hardness	Shore A	72	73	80	88
COMPRESSION SET (25 % Deformation, ASTM D395 Method B, #214 O-Ring)					
70 h @ 200°C	%	21	23	23	31

COMPRESSION SET RESISTANCE

FORMULATION		
Tecnoflon® PFR 95HT		100
Luperox 101XL-45	phr	1.5
ZnO	phr	5
Austin Black 325	Phr	8
MT N-990 Carbon Black	phr	7

TYPICAL PHYSICAL PROPERTIES		
Post Cure: (8+16) h @ 290°C		
100 % Modulus	MPa	6.3
Tensile Strength	MPa	18.0
Elongation at Break	%	207
Hardness	Shore A	68
COMPRESSION SET (25 % Deformation, ASTM D395 Method B, #214 O-Ring)		
70 h @ 23°C	%	25
70 h @ 100°C	%	18
70 h @ 200°C	%	18
70 h @ 225°C	%	30
70 h @ 250°C	%	39
70 h @ 275°C	%	50
70 h @ 300°C	%	58
70 h @ 316°C	%	67
336 h @ 200°C	%	30

HEAT AGING

FORMULATION					
Tecnoflon® PFR 95HT					100
Luperox 101XL-45				phr	1.5
ZnO				phr	5
Austin Black 325				phr	8
MT N-990 Carbon Black				phr	7
HEAT AGING @ 250°C		**70 h**	**168 h**	**336 h**	**1000 h**
Δ Tensile Strength	%	-1	-2	-13	-24
Δ Elongation at break	%	+7	+12	+19	+30
Δ Hardness	Shore A	-1	-2	-2	-2
Δ Weight	%	-0.7	-1.3	-1.7	-2.2
HEAT AGING @ 275°C		**70 h**	**168 h**	**336 h**	**1000 h**
Δ Tensile Strength	%	-1	-18	-30	-40
Δ Elongation at break	%	+20	+35	+45	+65
Δ Hardness	Shore A	-1	-2	-3	-4
Δ Weight	%	-1.1	-2.0	-3.1	-3.6
HEAT AGING @ 300°C		**70 h**	**168 h**	**336 h**	**1000 h**
Δ Tensile Strength	%	-20	-39	-50	-
Δ Elongation at break	%	+40	+62	+85	-
Δ Hardness	Shore A	-2	-3	-4	-
Δ Weight	%	-2.1	-3.1	-4.0	-

TYPICAL WHITE COMPOUNDS

FORMULATION		70 Shore A	70 Shore A
Tecnoflon® PFR 95HT		100	100
Luperox 101XL-45	phr	1.5	1.5
$BaSO_4$ (Blanc Fixe HD 80)	phr	40	-
SiO_2 (Ultrasil® 360)	phr	-	10
TiO_2 (Ti-Pure® R-960)	phr	5	5
COMPOUND MOONEY VISCOSITY			
ML (1+10') @ 121°C	MU	93	96
COMPOUND DENSITY			
Density	g/cm^3	2.44	2.08
MDR 12 min @ 170°C arc 0.5°			
Minimum Torque	lb*in	2.7	2.8
Maximum Torque	lb*in	18.2	17.3
t_{s2}	s	42	45
t'_{50}	s	83	82
t'_{90}	s	214	197
TYPICAL PHYSICAL PROPERTIES			
Post Cure: (8+16) h @ 250°C			
100 % Modulus	MPa	5.6	5.3
Tensile Strength	MPa	15.6	19.9
Elongation at Break	%	280	218
Hardness	Shore A	70	69
COMPRESSION SET (25 % DEFORMATION, ASTM D395 METHOD B, #214 O-Ring)			
70 h @ 200°C	%	20	25

LOW HARDNESS – TRANSLUCENT COMPOUND

FORMULATION		
Tecnoflon® PFR 95HT		100
Luperox 101 (92%)	phr	1
COMPOUND DENSITY		
Density	g/cm^3	2.05
MDR 12 min @ 170°C arc 0.5°		
Minimum Torque	lb*in	1.2
Maximum Torque	lb*in	11.5
t_{s2}	s	70
t'_{50}	s	101
t'_{90}	s	192
TYPICAL PHYSICAL PROPERTIES		
Post Cure: (8+16) h @ 250°C		
100 % Modulus	MPa	1.5
Tensile Strength	MPa	11.4
Elongation at Break	%	283
Hardness	Shore A	56
COMPRESSION SET (25 % DEFORMATION, ASTM D395 METHOD B, #214 O-Ring)		
70 h @ 200°C	%	35

COLD FLEXIBILITY

DSC		
T_g onset	°C	-7
T_g midpoint	°C	-1
Retraction curve (ASTM D1329)		
TR_{10}	°C	-1
TR_{30}	°C	3
TR_{50}	°C	6
TR_{70}	°C	9

FORMULATION		
Tecnoflon® PFR 95HT		100
Luperox 101XL-45	phr	1.5
ZnO	phr	5
Austin Black 325	phr	8
MT N-990 Carbon Black	phr	7
Brittleness temperature (ASTM D2137)		
100% pass	°C	-11
50% pass	°C	-17

FLUID RESISTANCE OVERVIEW

Inorganic acids	A
Organic acids	A
Alkalis	A
Amines (RT)	A
Hot amines (> 70°C)	C
Water / Steam	A
Ketones	A
Esters	A
Ethers	A
Aldehydes	A
Alcohols	A
Hydrocarbons	A
Sour gas	A
Lubricants	A
Fluorinated fluids	C

Symbol	Volume Swelling (%)
A	< 10%
B	10 - 30%
C	30 - 50%
D	> 50 %

FLUID RESISTANCE

ACID FLUIDS

For optimal acid resistance, zinc oxide and Wollastonite fillers are not recommended; white inert mineral fillers and carbon blacks should be selected in acidic and basic environments.

HCl 37%	80°C	70 h
Δ Tensile Strength	%	-4
Δ Elongation at Break	%	-15
Δ Hardness	Shore A	-1
Δ Volume	%	+1.6
HF 49%	**23°C**	**720 h**
Δ Tensile Strength	%	+5
Δ Elongation at Break	%	-23
Δ Hardness	Shore A	0
Δ Volume	%	+0.3
Nitric acid 65%	**80°C**	**168 h**
Δ Tensile Strength	%	-30
Δ Elongation at Break	%	+5
Δ Hardness	Shore A	-10
Δ Volume	%	+10
Glacial acetic acid	**100°C**	**336 h**
Δ Tensile Strength	%	-35
Δ Elongation at Break	%	-3
Δ Hardness	Shore A	-10
Δ Volume	%	+7

FLUID RESISTANCE

ALKALINE FLUIDS AND AMINES

KOH 50%	125°C	168 h
Δ Tensile Strength	%	-10
Δ Elongation at Break	%	-15
Δ Hardness	Shore A	-2
Δ Volume	%	+0.4
Ethylene diamine	23°C	504 h
Δ Volume	%	+1.8
Ethylene diamine	60°C	336 h
Δ Tensile Strength	%	-10
Δ Elongation at Break	%	-13
Δ Hardness	Shore A	-8
Δ Volume	%	+20
NH_3 28%	100°C	168 h
Δ Tensile Strength	%	-15
Δ Elongation at Break	%	-18
Δ Hardness	Shore A	-7
Δ Volume	%	+15
2-(2-aminoethoxy) ethanol (diglycolamine)	100°C	168 h
Δ Tensile Strength	%	+1
Δ Elongation at Break	%	-4
Δ Hardness	Shore A	-1
Δ Volume	%	+7
N-methyl-diethanolamine (MDEA)	100°C	168 h
Δ Tensile Strength	%	+2
Δ Elongation at Break	%	0
Δ Hardness	Shore A	-2
Δ Volume	%	+4.6

FLUID RESISTANCE

WATER AND STEAM

Water	220°C	168 h
Δ Tensile Strength	%	-12
Δ Elongation at Break	%	+1
Δ Hardness	Shore A	-1
Δ Volume	%	+2.0
Steam	**220°C**	**168 h**
Δ Tensile Strength	%	-9
Δ Elongation at Break	%	+5
Δ Hardness	Shore A	-2
Δ Volume	%	+2.2

FLUID RESISTANCE

AEROSPACE FLUIDS

Fuel B	23°C	70 h
Δ Tensile Strength	%	+4
Δ Elongation at Break	%	-2
Δ Hardness	Shore A	+1
Δ Volume	%	+0.2
Skydrol LD4	125°C	70 h
Δ Tensile Strength	%	-19
Δ Elongation at Break	%	+14
Δ Hardness	Shore A	-4
Δ Volume	%	+4.6
Reference Oil 300	175°C	720 h
Δ Tensile Strength	%	-9
Δ Elongation at Break	%	+6
Δ Hardness	Shore A	-2
Δ Volume	%	+0.6

MISCELLANEOUS PFR PROPERTIES

In general, the following properties can be considered as typical or average values for perfluoroelastomers.

THERMAL EXPANSION

Following the definition of linear coefficient of thermal expansion: $L = L_0 \cdot (1+\alpha \cdot \Delta T)$, the average value between 80 and 250°C is as follows:

$\alpha = 3.5 \cdot 10^{-4}$ 1/K

SPECIFIC HEAT

	Specific heat (J/g)	
	Black compounds	White compounds
50°C	0.98	0.83
100°C	1.05	0.86
150°C	1.12	0.91

GAS PERMEATION RATE

	Permeability (T = 30°C)
	$(cm^3(STP)\cdot mm/m^2\cdot atm\cdot d)$
Nitrogen	250
Oxygen	450
Helium	5400

ELECTRICAL PROPERTIES

Dielectric constant and loss factor at 50 Hz frequency.
Volume and surface resistivity were measured applying 100 V direct tension.

Dielectric constant	ε'	3.50
Loss Factor	$\tan(\delta)$	0.030
Surface resistivity	R_s (Ω)	$5.0\cdot10^{16}$
Volume resistivity	R_v ($\Omega\cdot$cm)	$6.1\cdot10^{16}$

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