

Tecnoflon® PFR 95

Perfluoroelastomer

Tecnoflon® PFR 95 is a perfluoroelastomer (FFKM) offering wide operational range and superior compression set resistance, thanks to its unique peroxide curing system that does not need any coagent (TAIC or equivalent) for curing to be carried out.

Thanks to its curing system, 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 95 is suitable for most applications in temperature ranging from –10 °C to 280 °C.

Tecnoflon® PFR 95 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 95 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 chemical and petrochemical industry, hydrocarbon processing, petroleum exploration and extraction, food processing, pharmaceutical and bio analytical industry, aerospace and semiconductor manufacturing industries.

Tecnoflon® PFR 95 is registered in the FDA Inventory of Effective Premarket Notifications for Food Contact Substances. It can be compounded so that the finished gaskets or seals can be used in food processing equipments (see “food processing compounds” section below).

Tecnoflon® PFR 95 is marketed in the form of raw polymer (1 kg and 5 kg boxes) 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.

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 °C	35	MU	ASTM D1646
Specific gravity	2.03	g/cm ³	ASTM D792
Colour	Translucent		
Packaging/Form	1 kg and 5 kg/Slabs		

Tecnoflon® PFR 95

Perfluoroelastomer

Black compounds

Test Compound	Unit	70 Shore A	80 Shore A	90 Shore A	Test Method
Tecnoflon® PFR 95	phr	100	100	100	
Luperox® 101XL-45	phr	1.5	1.5	1.5	
ZnO	phr	5	–	–	
N-990 MT Carbon Black	phr	15	25	60	
Struktol® HT 290	phr	–	0.5	–	
PAT 777	phr	–	0.7	1.0	
Struktol® WS280	phr	–	–	0.5	

Property	Unit	70 Shore A	80 Shore A	90 Shore A	Test Method
Mooney viscosity ML (1+10') at 121 °C	MU	38	42	n/a	ASTM D1646
Compound density	g/cm ³	2.06	2.01	1.96	ASTM D792
MDR 12 min at 170 °C arc 0.5°					ASTM D6601
Minimum torque	lb·in	0.6	0.8	2.5	
Maximum torque	lb·in	14.3	18.0	36.5	
t _{s2}	s	79	64	47	
t' ₅₀	s	154	137	145	
t' ₉₀	s	369	366	370	
Post cure: (8+16) h at 250 °C					
100% modulus	MPa	5.6	8.7	18.6	ASTM D412C
Tensile strength	MPa	19.3	17.8	19.8	
Elongation at break	%	206	235	113	
Hardness	Shore A	70	80	93	ASTM D2240
Compression set 25% deformation, O-ring #214					ASTM D395 method B
70 h at 200 °C	%	30	20	21	

Tecnoflon® PFR 95

Perfluoroelastomer

Compression set resistance

Test Compound	Typical Value	Unit	Test Method
Tecnoflon® PFR 95	100	phr	
Luperox® 101XL - 45	4	phr	
ZnO	5	phr	
Austin Black 325	8	phr	
N-990 MT Carbon Black	7	phr	

Property	Typical Value	Unit	Test Method
Post cure: (8+16) h at 250°C			
100% modulus	7.0	MPa	ASTM D412C
Tensile strength	16.9	MPa	
Elongation at break	185	%	
Hardness	69	Shore A	ASTM D2240
Compression set			
25% deformation, O-ring #214			ASTM D395 method B
70 h at 23°C	23	%	
70 h at 100°C	15	%	
70 h at 200°C	18	%	
70 h at 225°C	27	%	
70 h at 250°C	40	%	
70 h at 275°C	57	%	
70 h at 300°C	76	%	
70 h at 316°C	87	%	
336 h at 200°C	30	%	

Tecnoflon® PFR 95

Perfluoroelastomer

Heat aging

Test Compound	Typical Value	Unit	Test Method
Tecnoflon® PFR 95	100	phr	
Luperox® 101XL-45	4	phr	
ZnO	5	phr	
Austin Black 325	8	phr	
N-990 MT Carbon Black	7	phr	

Property	Unit	70 h	168 h	336 h	1,000 h	Test Method
Heat aging at 250 °C						ASTM D573
Δ Tensile strength	%	-1	10	-6	-31	
Δ Elongation at break	%	3	13	9	28	
Δ Hardness	Shore A	1	1	-1	0	
Δ Weight	%	-1.2	-2.3	-2.9	-2.9	
Heat aging at 275 °C						ASTM D573
Δ Tensile strength	%	2	-18	-40	-	
Δ Elongation at break	%	26	39	73	-	
Δ Hardness	Shore A	1	0	-1	-	
Δ Weight	%	-2.0	-2.2	-4.1	-	

Tecnoflon® PFR 95

Perfluoroelastomer

Effect of zinc oxide

Test Compound	Unit	With ZnO	Without ZnO	Test Method
Tecnoflon® PFR 95	phr	100	100	
Luperox® 101XL-45	phr	1.5	1.5	
ZnO	phr	5	–	
Austin Black 325	phr	10	10	
N-990 MT Carbon Black	phr	10	10	

Property	Unit	With ZnO	Without ZnO	Test Method
Mooney viscosity ML (1+10') at 121 °C	MU	1.99	1.95	ASTM D1646
Compound density	g/cm ³	61	56	ASTM D792
MDR 12 min at 170 °C arc 0.5°				ASTM D6601
Minimum torque	lb·in	0.8	0.8	
Maximum torque	lb·in	17.3	16.3	
t _{s2}	s	74	72	
t' ₅₀	s	171	144	
t' ₉₀	s	536	380	
Post cure: 4 h at 230 °C				
100% modulus	MPa	6.4	6.1	ASTM D412C
Tensile strength	MPa	16.5	16.6	
Elongation at break	phr	213	208	
Hardness	Shore A	70	68	ASTM D2240
Compression set 25% deformation, O-ring #214	MU			ASTM D395 method B
70 h at 200 °C	25	21	23	

Tecnoflon® PFR 95

Perfluoroelastomer

Food processing compounds

Tecnoflon® PFR 95 is registered in the FDA Inventory of Effective Food Contact Substances (FCS) Notifications, being the subject of Food Contact Notification (FCN #126), with an effective date July 21, 2001.

(see the list of effective notifications for FCN available on the Agency's web site at:

<http://www.accessdata.fda.gov/scripts/fdcc/?set=FCN>

The finished compounds are intended for repeated use as components of gaskets or seals used in food processing equipment intended to contact food Types I through VII as described in Table 1 of 21 CFR 176.170(c) as follows:

Table 1: Types of Raw and Processed Foods

- I. Nonacid, aqueous products; may contain salt or sugar or both (pH above 5.0)
- II. Acid, aqueous products; may contain salt or sugar or both, and including oil-in-water emulsions of low- or high-fat content
- III. Aqueous, acid or nonacid products containing free oil or fat; may contain salt, and including water-in-oil emulsions of low- or high-fat content
- IV. Dairy products and modifications:
 - A Water-in-oil emulsions, high- or low-fat
 - B Oil-in-water emulsions, high- or low-fat
- V. Low-moisture fats and oil
- VI. Beverages:
 - A Containing up to 8 percent of alcohol
 - B Non-alcoholic
 - C Containing more than 8 percent alcohol
- VII. Bakery products other than those included under Types VIII or IX of this table:
 - A Moist bakery products with surface containing free fat or oil
 - B Moist bakery products with surface containing no free fat or oil
- VIII. Dry solids with the surface containing no free fat or oil (no end test required)
- IX. Dry solids with the surface containing free fat or oil

Data for establishing compliance with the FDA standards for PFR 95 based compounds were obtained from cured items having the formulation shown below:

Tecnoflon® PFR 95	100	phr
Luperox® 101XL-45	1.5	phr

Extraction tests were performed on slabs that were presscured for 10 min at 170 °C, followed by an oven post-cure of 24 h at 200 °C.

Compounding guidelines for food processing

To design FDA compliant compounds, some restrictions have to be taken into account as far as the curatives, the fillers and the process aids are concerned.

1. Curatives

the following restrictions apply in terms of curatives amount:

Tecnoflon® PFR 95	100	phr
Luperox® 101XL-45	≤ 1.5	phr

2. Fillers

The following fillers are approved for use in items intended for repeated food contact use, under 21 CFR 177.2600, section v., and provide at the same time excellent processing behaviour and physical properties:

- Barium sulfate
- Silica
- Titanium dioxide
- Carbon black
(channel process or furnace combustion process; total carbon black not to exceed 50 % by weight of rubber product; furnace combustion black content not to exceed 10 % by weight of rubber products intended for use in contact with milk or edible oils).

3. Process aids

- Carnauba wax
- Struktol® HT 290
(concentration must not exceed 5 % by weight of the rubber compound).

Tecnoflon® PFR 95

Perfluoroelastomer

Food processing compounds

Test Compound	Unit	White, 70 Shore A	White, 80 Shore A	Black, 75 Shore A	Test Method
Tecnoflon® PFR 95	phr	100	100	100	
Luperox® 101XL - 45	phr	1.5	1.5	1.5	
BaSO ₄ (Blanc Fixe HD 80)	phr	50	50	50	
SiO ₂ (Ultrasil® 360)	phr	–	5	–	
TiO ₂ (Ti-Pure® R-960)	phr	5	5	–	
N-772 Carbon Black	phr	–	–	5	

Property	Unit	White, 70 Shore A	White, 80 Shore A	Black, 75 Shore A	Test Method
Mooney viscosity ML (1+10') at 121 °C	MU	50	80	51	ASTM D1646
Compound density	g/cm ³	2.52	2.51	2.46	ASTM D792
MDR 12 min at 170 °C arc 0.5°					ASTM D6601
Minimum torque	lb · in	0.8	1.5	0.9	
Maximum torque	lb · in	15.1	18.0	20.3	
t _{s2}	s	60	49	73	
t' ₅₀	s	120	117	157	
t' ₉₀	s	325	380	378	
Post cure: (8+16) h at 250 °C					
100 % modulus	MPa	5.1	9.1	10.0	ASTM D412C
Tensile strength	MPa	15.0	15.9	16.0	
Elongation at break	%	230	218	198	
Hardness	Shore A	69	79	76	ASTM D2240
Compression set 25 % deformation, O-ring #214					ASTM D395 method B
70 h at 200 °C	%	25	24	25	

Tecnoflon® PFR 95

Perfluoroelastomer

Cold flexibility

Property	Typical Value	Unit	Test Method
DSC			
T _g onset	-8	°C	
T _g midpoint	-1	°C	
Retraction curve			ASTM D1329
TR ₁₀	-1	°C	
TR ₃₀	3	°C	
TR ₅₀	5	°C	
TR ₇₀	8	°C	

Test Compound	Typical Value	Unit	Test Method
Tecnoflon® PFR 95	100	phr	
Luperox® 101XL - 45	1.5	phr	
ZnO	5	phr	
N-990 MT Carbon Black	15	phr	

Property	Typical Value	Unit	Test Method
Brittleness temperature			ASTM D2137
100% pass	-6	°C	
50% pass	-10	°C	

Tecnoflon® PFR 95

Perfluoroelastomer

Fluid resistance overview

Fluid	Volume Swelling
Inorganic acids	< 10%
Organic acids	< 10%
Alkalies	< 10%
Amines (RT)	< 10%
Hot amines (> 70 °C)	30 – 50%
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 95

Perfluoroelastomer

Fluid resistance

Acid fluids

Property	Typical Value	Unit	Test Method
H₃PO₄, 45 %, 168 h at 60 °C			
Δ Hardness	2	Shore A	
Δ Volume	0.1	%	
H₂SO₄, 98 %, 70 h at 60 °C			
Δ Hardness	-8	Shore A	
Δ Volume	0.5	%	
HCl, 37 %, 70 h at 80 °C			
Δ Hardness	-1	Shore A	
Δ Volume	4	%	
HF, 50 %, 168 h at 80 °C			
Δ Hardness	-2	Shore A	
Δ Volume	3	%	

Tecnoflon® PFR 95

Perfluoroelastomer

Amines

Property	Typical Value	Unit	Test Method
Ammonia, anhydrous, 70 h at 30°C			
Δ Tensile strength	-41	%	
Δ Elongation at break	9	%	
Δ Hardness	-1	Shore A	
Δ Volume	3.3	%	
Ammonia, 30% solution, 168 h at 150°C			
Δ Volume	18	%	
Ethylene diamine, 72 h at 100°C			
Δ Tensile strength	-16	%	
Δ Elongation at break	32	%	
Δ Hardness	-4	Shore A	
Δ Volume	34	%	

Tecnoflon® PFR 95

Perfluoroelastomer

Water and steam

Property	Typical Value	Unit	Test Method
Water, 168 h at 220°C			
Δ Tensile strength	-1	%	
Δ Elongation at break	22	%	
Δ Hardness	-2	Shore A	
Δ Volume	3.5	%	
Steam, 168 h at 220°C			
Δ Tensile strength	-4	%	
Δ Elongation at break	21	%	
Δ Hardness	-1	Shore A	
Δ Volume	1.8	%	

Tecnoflon® PFR 95

Perfluoroelastomer

Hydrocarbons and polar fluids

Property	Typical Value	Unit	Test Method
Fuel C, 504 h at 40 °C			
Δ Volume	8	%	
85% Fuel C, 15% Methyl tert-butyl ether (MTBE), 504 h at 40 °C			
Δ Volume	7	%	
M15 (85% Fuel C, 15% Methanol), 504 h at 40 °C			
Δ Volume	7	%	
Toluene, 168 h at 150 °C			
Δ Tensile strength	24	%	
Δ Elongation at break	4	%	
Δ Hardness	-1	Shore A	
Δ Volume	7	%	
Dimethyl ether, 336 h at 23 °C			
Δ Tensile strength	-35	%	
Δ Elongation at break	-7	%	
Δ Hardness	-2	Shore A	
Δ Volume	4	%	
Methyl ethyl ketone (MEK), 720 h at 45 °C			
Δ Hardness	-3	Shore A	
Δ Volume	5	%	

Tecnoflon® PFR 95

Perfluoroelastomer

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:

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

Specific heat

Property	Unit	Black Compounds	White Compounds	Test Method
50 °C	J/g	0.98	0.83	
100 °C	J/g	1.05	0.86	
150 °C	J/g	1.12	0.91	

Gas permeation

Test Compound	Permeability (T = 30 °C)	Unit	Test Method
Nitrogen	250	(cm ³ (STP)·mm/m ² ·atm·d)	
Oxygen	450	(cm ³ (STP)·mm/m ² ·atm·d)	
Helium	5,400	(cm ³ (STP)·mm/m ² ·atm·d)	

Electrical properties

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

Property	Typical Value	Unit	Test Method
Dielectric constant ϵ'	3.50		
Loss factor $\tan(\delta)$	0.030		
Surface resistivity R_s	$5.0 \cdot 10^{16}$	Ω	
Volume resistivity R_v	$6.1 \cdot 10^{16}$	$\Omega \cdot \text{cm}$	

www.solvay.com

SpecialtyPolymers.EMEA@solvay.com | Europe, Middle East and Africa

SpecialtyPolymers.Americas@solvay.com | Americas

SpecialtyPolymers.Asia@solvay.com | Asia Pacific

Material Safety Data Sheets (MSDS) are available by emailing us or contacting your sales representative. Always consult the appropriate MSDS before using any of our products. Neither Solvay Specialty Polymers nor any of its affiliates makes any warranty, express or implied, including merchantability or fitness for use, or accepts any liability in connection with this product, related information or its use. Some applications of which Solvay's products may be proposed to be used are regulated or restricted by applicable laws and regulations or by national or international standards and in some cases by Solvay's recommendation, including applications of food/feed, water treatment, medical, pharmaceuticals, and personal care. Only products designated as part of the Solviva® family of biomaterials may be considered as candidates for use in implantable medical devices. The user alone must finally determine suitability of any information or products for any contemplated use in compliance with applicable law, the manner of use and whether any patents are infringed. The information and the products are for use by technically skilled persons at their own discretion and risk and does not relate to the use of this product in combination with any other substance or any other process. This is not a license under any patent or other proprietary right. All trademarks and registered trademarks are property of the companies that comprise Solvay Group or their respective owners.

© 2014 Solvay Specialty Polymers. All rights reserved. R 02/04/2014 | Version 2.0 Design by ahlersheinel.com