HaloPolymer

FUSE FLUOROPOLYMERS. FLUOROPRENES and LATEXES

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PROPERTIES and APPLICATION

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INTRODUCTION

OJSC “HaloPolymer” began to make fluoroplastic

in the middle of the last century. The first product, industrially developed in 1955 year, was tetrafluoroethylene homopolymer – fluoroplastic -4. Nowadays this polymer is also the leading mass product, that is well-known to Russian and foreign customers. Later one by one the production of other fluorinated polymers and copolymers began.

At the same time fluorated monomer productions were created and developed, and nowadays OJSC “HaloPolymer”, produces almost all kinds of mineable fluoromonomers in order to produce and modern existing products and to create new fluoropolymer products.

The further tasks were to develop better quality of output products, to create modified products and to increase the production scale.

Nowadays the process is developed in several directions:

1. The improvement of existing fluoropolymer production processes for better quality of the products.
2. The processing of new products production technologies or existing technologies modernization according to particular consumer tasks.
3. The expansion of fluoropolymer production and development of fluorine plastics reprocessing to the end product.

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FUSE FLUOROPOLYMERS

OJSC “HaloPolymer” produces not only polytetrafluorethylene,

it also produces series of thermoplastic fluoropolymers, which can be processed by high efficiency methods: hot-pressing and transfer molding, extrusion, die casting.

Fuse fluorineplastics are not so heat-resistant as PTFE and don’t have so good antifriction and antistick properties, but they are trust worthy in operating under heavy mechanical loading and increased radiation.

Fuse fluorineplastics vary in fusing point, density, rigidity, operating temperature range, weather resistance and resistance to different chemical environments.

Fuse fluorineplastics can be obtained in the form of grouts (concentrated suspensions). Fuse fluorine plastics can be obtained in the form of grouts (concentrated suspensions). The coatings made of such grouts are famous for elevated adhesion to metal and low permeability.

The coating can be obtained from many fuse fluorine plastics by powder spraying

Some fuse fluorine plastics (F-42, F-32L, F-2M) have selective solubility in organic solvents, that’s why, if apply methods of polymers reprocessing from the solvents, it is possible to expand the product mix: films, coatings, varnished cloths, fibers.

1.1 Fluorine plastics - 4 MB

Perfluorinated fuse polymer. Teflon FEP analog, has almost all goodness of PTFE, but it cannot be processed by extrusion and injection molding, this is due to reduced alloy viscosity.(F-4MB - 10^3 – 10^5Pa×cat plus 300°C; PTFE - 10^{16} Pa×cat plus 370°C).

As this copolymer is perfuorocopolymer, this allows to save PTFE resistance to different corrosive environments, chemicals and solvents.

Fluorine plastic - 4MB is industrially applied at the temperature from minus 190 to plus 220 C in the same spheres as **fluorine plastic-4**. Reprocessing of **F-4MB** by casting method, extrusion, hot-pressing expands the product mix made of polytetrafluorethylene. Complicated configuration products can be made of polytetrafluorethylene.

Fluorineplastics - 4MB quality number must meet the following requirements:

Indicator name	A	B	VO	V	VN	P
Visual environment	Granules of lens-shaped and cylindrical form			Granules of lens-shaped and cylindrical form		White powder
Melt flow rate, g/10 min At 300°C	Not defined	Not defined	2,0–8,0	4,0–8,0 (granules)		5,5–8,0
At 370 °C	2,0–7,0	4,5-8,0	Not defined	Not defined		Not defined
Thermal stability – weight loss, % not more than At 300°C	0,25	0,18	0,25	0,40	0,25	0,25
At 370°C	Not defined	0,5	Not defined	Not defined		
Rupture resistance, MPa (kg/sm²), not less than	24 (250)	22 (220)	22 (230)	17 (170)	23 (240)	20 (200)
Breaking elongation, %, not less than	320	320	310	285	320	300

1.2 Fluorine plastic-40 fluorine plastic-40M

Copolymer TFE with ethylene (analog Tefzel). It has a big practical value. Being partially perfluoropolymer, it conserves thermal and chemical fastness, has high dielectric indexes, is famous for high tensile, hardness, attrition resistance, radiation resistance. **F-40M** is a modified analog of **F-40** and has the same properties as **F-40**. This product is much more stable, less cracking prone, it's granules are much lighter.

Fluorineplastics-40, **40M** are proof to boiling concentrated sulphuric, nitric, salt acids, hydrofluoric acid, 45% caustic liquor and the majority of well-known solvents. Under the effect of these environments mechanical and physical properties change insignificantly.

The material does not age under light stimulus and atmospheric forcing. The products, exposed to heat effect (to plus 200° C) and light stimulus during thousands of hours almost don't change mechanical properties.

Fluorineplastic-40 conserves high specific insulation resistance (to 10^{17}ом×см) to the temperature plus 120—130° C. At the temperature plus 150°C it reduces 10^{10}ом×см.

Fluorineplastics-40, **40M** are used for production of products, by operation of which the combination of high dielectric qualities with thermal and chemical stability is required.

Layers, vessels, membranes, valves, pump parts and other products made of **fluorine plastic-40**, **41** and meant for operation in aggressive environments at the temperature from minus 60°C to plus 200°C are produces for chemical industry.

Fluorineplastics-40 and 40M quality number must meet the following requirements:

Indicator name	P	SH	LD-1	SH-1	SH-2	LD-2
1. Visual environment	White powder without visible foreign substances			Granules of lens-shaped and cylindrical form		
2. Moisture content, not more than %	0,05	0,05	0,05	Not defined		
3. Thermostability – weight loss, % not more than	1,2	1,2	1,9	2,7	2,7	3,0
4. Rupture resistance, MPa (kg/sm²), not less than	31 (320)	29 (300)	24 (250)	31 (320)	31 (320)	29 (300)
5. Breaking elongation, %, not less than	170	170	100	160	160	160
6. No-strength temperature, °C	295–320	Not defined				
7. Melt flow rate, g/10 min	Not defined	0,01–4,0	4–60	0,01–0,4	0,4–4,0	4–70

Fluorineplastics-40, 40M are proved for different insulators production, because their dielectric properties do not depend on temperature and frequency. Nonwettability and nonswelling in water allow to use the isolation from **fluorine plastics -40, 40** Munder the moist conditions.

All products made of **Fluorineplastics-40, 40M** due to irradiation stability can be operated under any kind of radiation in certain doses.

Recommended application domain and reprocessing methods of fluorine plastics -40, 40M:

mark P – the production of products, parts and knots by pressing and die-casting methods;
mark SH – the production of insulation, wires and cable products, special purpose mechanical gaskets by pressing and extrusion methods;
mark SH-1, SH-2 – the production of wires and cable products by extrusion;
marks LD-1, LD-2 – the production of cable products by extrusion and die-casting methods.

1.3 Fluorine plastic-2M

Fluorineplastic-2M (F-2M) – is a modified vinylidene fluoridepolymer.

F-2M is inferior to fluorineplastic-4 concerning heatproof (fusing point and operating), dielectric qualities, antifriction and antistick properties.

Fluorineplastic-2M –differs from other fluorine plastics by the biggest tenacity, hardness (to 90 MPa Brinell), not cool flowing under load, is highly elastic, resistant to abrasion, attrition, slotting, ultraviolet and ionizing radiation effect.

F-2M – is not easily combustible. Operating temperature range – from minus 40°C to plus 150°C.

F-2M is proof to acids, alkalis, heavy oxidizers, halogen and the majority of organic compounds. The exception are fuming sulphuric acid and other sulphonating agents under high temperatures, and also acetone and other polar solvents (dimethylformamide, dimethylacetamide, dimethyl sulphoxide) and primary amines (butilamines and other).

Tensile stress at film break made of **F-2M** after month soaking in concentrated acids, alkalis, hydrogen dioxides, dinitrogen, chloride and brome tetroxides, triethylamine, isooctane, trichloroethylene and other solvents almost doesn't change.

F-2M is easily welded and reprocessed from melt by any known for thermoplastic methods at relatively low temperatures (from plus 180 to plus 240°C).

The material is ideal for corrosion protection in chemical and processing industry and for application in especially green fields like pharmaceutical, food and semiconductor production, atomic energetic.

Our company produces the following F-2M marks:

Indicator name	F-2M Marks						
	A	B	V	G	D	E	ZH
Visual environment	Granules	Granules	Powder	Powder	Powder	Powder	Granules
Moisture content, % not more than	Not defined	Not defined	0,05	0,05	0,05	0,05	Not defined
Melt flow index, g/10 min, within	3,0–7,0	7,0–20,0	4,0–7,0	7,0–20,0	Not less than 20	3,0–8,0	2,5–8,0
Thermostability (weight loss), % not more than	0,3	0,4	0,3	0,4	0,5	0,3	0,3
Rupture resistance, MPa (kg/sm²)	49,0 (500)	44,1 (450)	52,9 (540)	44,1 (450)	44,1 (450)	46,5 (475)	46,5 (475)
Breaking elongation, %, not less than	400	400	410	400	400	400	400

Laminated coverings made of **F-2M**, used for lining of different, especially large chemical objects, reactors, capacities, filters etc., are highly applied in industry.

Hard film made of **fluorineplastic -2M**, sustaining sterilization, can be applied for packaging of reagents and medical apparatus.

Recommended application domain and reprocessing methods of fluorine plastics - 2M:

mark A – for cable insulation by extrusion method;
mark B – for obtaining of films, molding products, fibers by extrusion, injection molding, die casting methods;
marks V, G, E – for reprocessing by extrusion methods;
mark D- for obtaining of coating by powder spraying method;
mark ZH – for cable insulation and production of molded parts by extrusion and pressing methods.

1.4 Fluorineplastic-32L

Fluorineplastic-32L (F-32L) is a chemical-resistant polymer, readily imbibed by ketones, esters, halocarbon-113, tetrahydrofuran.

There are two mark so **fluorineplastic-32L**: **F-32LN** – thin, **F-32LV** - thick.

F-32L has perfect moist protective properties and is proof to the aggressive environments such concentrated nitric acid, salt acid, sulphuric acid, acetic acid, strong caustics. The month soaking at room temperature in this environments leads to swelling, not exceeding 1%.

Fluorineplastic-32L is applied for production of lacquer and cocoon, based on it. Lacquers made of **fluorineplastic-32L (F-32L)** have low crystallinity and are one of the best moist protective lacquers. Moisture permeability of coatings, made of them, is $0{,}16\times10^{-15}$ кg/(s*m*Pa) {$0{,}08\times10^{-9}$ g/(ch*cm*mm of mercury.)}, it is 30 times less, than polyethylene moisture permeability, 40-60 times less than epoxide lacquer moisture permeability, and 80-120 times less than moisture permeability of oil varnish film. Lacquer coatings have good corrosion resistance, dielectric and optical properties, weather resistance. The coating is easy to clean from radio-contamination.

Lacquer coatings are recommended for protection of capacitive equipment, pipes, insert, different parts, transducers (control instruments) from aggressive environments effects under the temperature to plus 60-70°C. The coatings, connecting with corroding liquids such as nitric acid, sulphuric acid, salt acid, acetic acid, oxalic acid, caustic soda are efficient for several years. When bring pigments to lacquer, moist protective enamels are obtained, proof to hydrocarbon and aggressive environments, thermostable to plus 200°C (short time to plus 250°C).

Fluorineplastic-32L must meet Industrial Standard 6-05-432-78 requirements:

Indicator name	Fluorine plastic-32L	
	Mark «N»	Mark «V»
Visual environment	White or superfine white coarse powder.	
1% polymer solution viscosity ration in IEC and IEC	1,56–1,90	1,27–1,55
Tensile stress at break, MPa, (kg/sм²), not less than	26,0 (265)	15,7 (160)
Breaking elongation, %, not less than	220	220
Thermostability (weight loss), % not more than	0,6	0,8
Moisture content, % not more than	0,1	0,1

Maximum lacquer coating operating temperature based on **F-32L** is plus 150-170°C (short time to plus 200°C).

Transparency in infrared spectrum allows to use coatings made of fluorine **plastic-32L** in optical industry.

Coatings made of **Fluorineplastic-32L** can be applied not only to metal surfaces, but also to glass to protect it from hydrofluoric acid corrosivity.

Fluorineplastic-32L analog is produced abroad by Solvay Solexis company – trade description Solef of mark 31008 и 30003.

1.5 Fluorine plastic-42

Fluorineplastic-42 (F-42) is one of few dissolvable fluoroplastics, is famous for high tenacity, chemical stability to the most aggressive environments, irradiation stability and is proof to atmospheric forcing and low friction coefficient.

Fluorineplastic-42 melts in ketone, especially in acetone at plus 20°C, in esters and in dimethylformamide – at plus 50°C; does not melt in spirits, aromatic and chlorinated hydrocarbons.

Specification of F-42 is famous for cross linking with partial or entire is solvability loss under the temperature, exceeding crystallite fusion temperature, and under irradiation

In spite of good dissolve ability in some solvents, **F-42** is famous for chemical stability to concentrated acids, alkalis and oxidizers.

F-42 is a crystal in polymer with crystallite fusing temperature plus155-160°C.

Fluorineplastic-42 is famous for resistance to light aging. 200 hour radiation with ABM-4 lamp doesn't lead to occurrence of carbonyl groups and double linkage in polymer IR spectrum. The thin layer of **fluorineplastic-42**, applied to coating made of light-fugitive material, protects it from UV-exposure.

Ftorlon film, coatings and varnished cloth are produced of solution **F-42** in acetone.

According to normative documents, the following marks can be produced:

Indicator name	Marks				
	F-42V	F-42LD-1	F-42LD-2	F-42L	F-42P
Visual environment	White powder		Granules of lens-shaped and cylindrical form	White powder	
Moisture content, % not more than	0,04	0,05	Not defined	0,05	0,05
Tensile stress at break, MPa, (kg/sm²), not less than	43 (439)	40 (410)	42 (430)	41 (420)	41 (420)
Breaking elongation, %, not less than	420	460	460	470	390
Solution and acetone viscosity ratio	Not defined	2,4–5,0	2,4–5,0	2,5–3,7	More 5,5
Solution inherent viscosity in acetone	0,65-0,80	Not defined			
Relative viscosity of 14% solution in acetone, with	30-100	Not defined	Not defined	Not defined	Not defined
Thermostability (weight loss), at the temperature300°C, %, not more than	0,3	0,3	0,4	0,3	0,3

FUSE FLUOROPOLYMERS

Name	Mark	Melt Flow Index, g/10min	Processing temperature, °C	Operating temperature, °C		Marketable state
				low	high	
F-4MB (FEP)	A	2–7	220–380	-180	200	granules
	B	4,5–8				granules
	VN	2–8				granules or powder
F-40 (ETFE)	P		200–380	-100	200	powder
	SH	0,01–4				granules
	LD	4–60				granules
F-2M (PVDF)	B	7–20	135–270	-55	150	granules
	V	4–7				powder
	E	3–8				powder
	ZH	2–8				granules
F-42	V	Solution viscosity		-70	150	powder
	LD-1					powder
	LD-2					granules
	L					powder
	P					powder / granules
	V	265-285 (CAM)				powder
F-32L	V	Solution viscosity		-60	200	powder
	N					powder

Application	Analogs
Electro insulating products, sealants, chemical apparatus coating, pipes, labware, elastic capacities.	Teflon® FEP Neoflon FEP
Pressed layings and sealants, wires and cables insulation.	Tefzel® Neoflon ETFE Fluon ETFE
Sealants, layings, lining, cable lapping, building constructions cocoons.	Kynar Solef
Fiber for workwear, stuffing boxes, layins, pipes, anticorrosive and low-conductivity coats.	none
For obtaining of coatings, highly resistant to aggressive environments. For producing of water protective films, produced by extrusion method. For producing of high quality concentrated lacquers.	

Fluorine polymers properties

Properties	F-4MB	F-40	F-42	F-2M	F-32L
Electrical properties					
Specific insulation resistance, Ohm/m	$>10^{15}$	$5*10^{14}–10^{15}$	$10^{9}–10^{10}$	$(0,5–9)*10^{11}$	$>10^{14}$
Surface resistivity, Ohm	$>10^{16}$	$10^{12}–10^{14}$	$10^{10}–10^{11}$	–	–
Dielectric loss factor					
At 1 khz	$(2–3)* 10^{-4}$	$(2–3)* 10^{-3}$	$(2-3)* 10^{-2}$	$(1,2–2)* 10^{-2}$	$(1–2)* 10^{-3}$
At 1 MHz	$(6–8)* 10^{-4}$	$(6–8)* 10^{-3}$	0,1–0,2	0,17	$(1,5–2)* 10^{-2}$
Permitivity					
At 1 khz	1,9–2,1	2,5–2,6	9–11,3	8–10	2,5–2,7
At 1 MHz	1,9–2,1	2,5–2,6	8,2	7	2,5–2,7
Dielectric strength (thickness of the sample 2 mm), MV/m	25–35	20–25	10,6–17	18–22	20–30
Arc resistance, with	165	72	–	>350	–
Physical properties					
Density, kg/m^3	2140–2170	1650–1700	1900–2000	1750–1800	1920–1950
Crystallites fusing temperature, °C	230–250	250–270	150–160	142–156	105
Glass transition temperature, °C	-90	-100	-45		30
Vicat softening temperature, °C	90–120	140	97–105	95–118	43–50
Specific heat, kJ/kg*K	1,17				
Conductivity factor, Vt/m*K	0,26	0,24			
Line expansion temperature coefficient*10^{-5}, 1/°C	9	6-9	9-12	8-12	
Operating temperature, °C					
minimal	-180	-100	-60	-55	-60
maximal	200	200	120	150	200

Properties	F-4MB	F-40	F-42	F-2M	F-32L
Mechanical properties					
Rupture resistance, MPa	15,6–28	20–42	14,6–45,1	34,3–55	8,3–27,5
Breaking elongation, %	270–360	100–350	200–580	350–550	150–300
Elastic modulus, MPa					
At expansion	340–400	1200			
At compression		625–1270			
At cross-breaking					
At 20°C	540–590	770–1500	390–490	930–1370	490–690
At minus 60°C	940	1440–1730	1170–2740	3920–4420	2750–3140
Ultimate tensile stress, Mpa					
At compression	15–16	50			
At cross-breaking	20–29	29–33	29–39	54–83	
Impact resilience, kJ/m²	>125	>125	134–190	147–210	Don't break
Brennel hardness, MPa	29–49	55–66	39–49	68-88	29–39
Steel friction coefficient	0,05-0,2	0,09	0,04		0,04
Other properties					
Breaking temperature	More 380	More 350	More 360	More 350	–
Thermostability (weight loss), %	0,1–0,4 (300°C, 3 hour)	0,2–0,3 (275°C, 5 hour)	0,2–0,6 (275°C, 5 hour)	0,2–0,4 (275°C, 5 hour)	0,1–1,0 (270°C, 5 hour)
Resistance to chemical agent effect					
Concentrated acids	C	C	C	C	C
Restricted solvents	C	C	°C	°C	°C
Alkalis	C	C	C	C	C
Oxidizer (hydrogen dioxide)	C	C	C	–	C
Flammability	Don't fire	Don't fire	Don't fire	Don't burn away	Don't fire
Oxygen index flammability, %	100	30	75	100	–
Irradiation stability, Gy	10^4	$(1–3)*10^6$	10^5	–	–

HaloPolymer

FLUOROPRENES AND LATEXES

As for their properties,

fluoroprenes significantly predominate other synthetic and natural rubbers and they are meant for operating under harsh conditions. They are resistant to concentrated and dilute mineral acids, many aliphatic, aromatic and chlorinated hydrocarbon, petroleum, different oils, lubricants and gases. Fluoroprene is unique, because it combines chemical inertness and has high heat resistance, exceeding heat resistance of all known rubbers (except siloxane rubber).

LLC “Halopolymer Kirovo-Chepetsk” affiliated to holding OJSC “HaloPolymer” - is the only fluoroprene producer in Russia, It produces normal rubbers **SKF-26**, **SKF -32**, **SKF -26 NM**, **SKF -26 ONM** and new fluoroprene series under the trademark ELAFTOR, which meet strict requirements of modern market (sched.1).

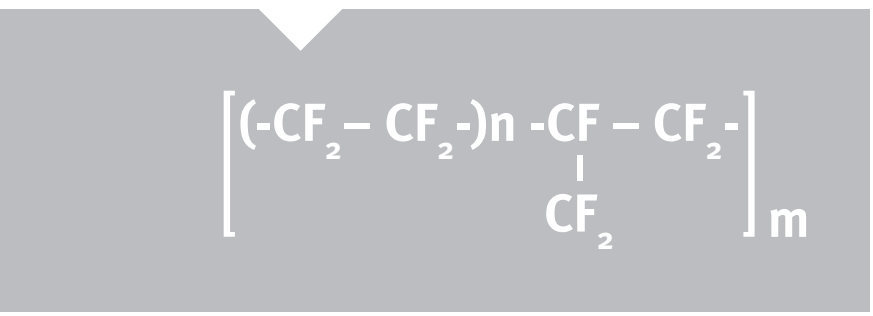
Fluoroprene: properties and application

Fluoroprene has not only high chemical resistance and heat resistance, it also has good physic-mechanical, dielectric properties, it is nonflammable, nonwettable, radiation proof and biologically inert.

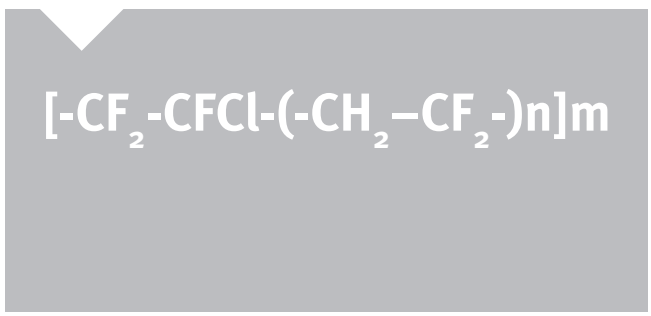
Fluoroprene has broad area of application. They can be applied to units and machinery parts, connecting with petroleum, oils, concentrated acids etc. That’s why automobile, oil extraction and chemical industries are the main consumers of these product. Products, made of fluoroprene are more and more applied in aviation, semiconductor and space industry. As long as fluoroprene dissolves in ketones, esters and some other polar solvents, they can be used in sealing components, glues and coatings production.

2.1 Fluoroprene SKF-26 and SKF-32

FluoropreneSKF-26 – copolymer of vinylidene fluoride and hexafluoropropylene.



FluoropreneSKF-32 – copolymer of vinylidene fluoride and chlorotrifluoroethylene.



GOST 18376-79
TS 2294-048-13693708-2010

As for resistance to aggressive environments including acids, petroleum and other fuels, different oils, fluoroprenes significantly predominate all other elastometers. By 7 days immersion to fuming nitric acid at 20°C, it swells, but remains elastic. Elasticity also remains by several days fluoroprene boiling in fuming nitric acid, while usual rubbers, that contain no fluoro, break under this conditions for several minutes.

Fluoroprene SKF-26 and SKF-32 quality number:

Indicator name	Rubber mark	
	SKF-26	SKF-32
Moony viscosity		
ML(4+4)150°C	80–105	
ML(4+4)160°C		70–95
Moisture content, % not more than	0,15	0,15
Thermostability (weight loss) % , not more than	0,20 (300°C*3h)	0,15 (270°C*5h)
Shrinkage,%	16–25	16–25

Fluoroprenes SKF-32 and **SKF-26** have very high thermal stability. **SKF-26** hundreds hours longstanding heating at 200°C doesn't lead to rubbers destruction. In addition, it's tenacity and elasticity is preserved. Fluoroprene breaking temperature is more than 300°C. As for fluoroprene heatproof, it is consistent with siloxane rubber, but significantly predominate them in tenacity, abrasive resistance, resistance to different oils, gasoline, and other organic solvents.

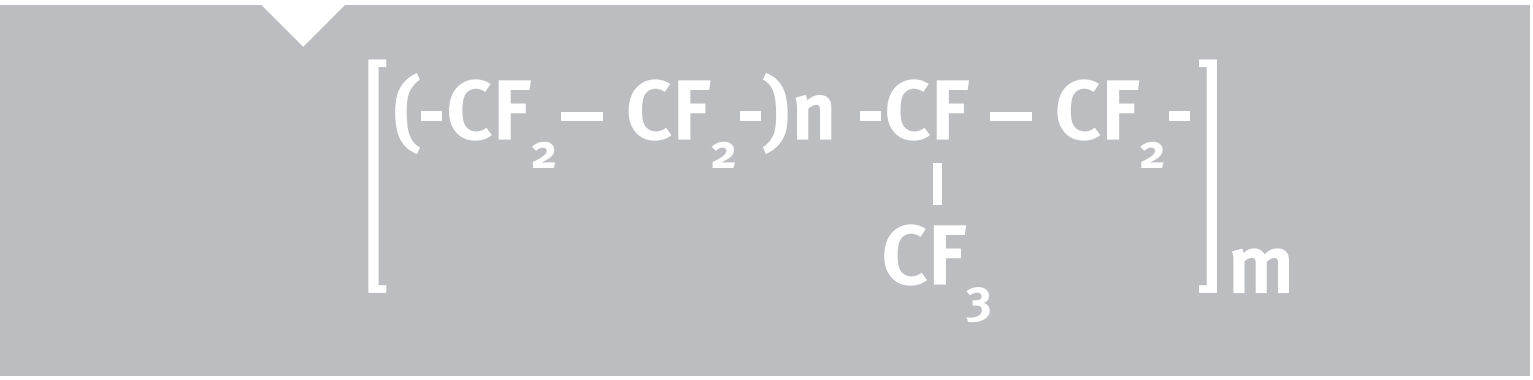
Fluoroprenes SKF-32 and **SKF-26** dissolve in esters, ketones, some other polarsolvents, and they swell in aromatic hydrocarbons, alkalis and bases.

Rubber based on **fluoroprene SKF-32** and **SKF-26** don't flame, has perfect ozone and weather resistance. Heatproof, anticorrosion, electro insulating, oil-, petroleum-, and acid-proof products (hoses, pipes, diaphragms, seals, layers etc.) can be made of rubber based on fluoroprene.

The products, made of **fluoroprene SKF-32** and **SKF-26** are essential in chemical, aviation, automobile, tractor, shipbuilding and other industries.

2.2 Fluoroprenes SKF-26 NM and SKF-26 ONM

Fluorineprenes SKF-26 NM and **SKF-26 ONM** are copolymers of vinylidene fluoride and hexafluoropropylene



TS 6-05-1652-88

Fluoroprenes quality numbers SKF-26 NM and SKF-26 ONM:

Indicators	Rubber mark	
	SKF-26 NM	SKF-26 ONM
Moony viscosity		
ML(4+4)100°C	40–95	
40%solutiondynamicviscosityin acetone, MPa*s		40–79
Moisture content, % not more than	0,5	0,5
Thermostability (weight loss 300°C,3h) % mas, not more than	1,5	2,0

Fluoroprenes SKF-26 NM and **SKF-26** are low-molecule fluoroprenes and are not a base for rubber. Applied as heat- and oil-and-petrol resistant sealant, glues and plasticizers to rubber compounds based on high-molecule rubber.

2.3 Fluoroprenes Elaftor series 2000

Elaftor 2031(SKF-26/3)
Elaftor 2041(SKF-26/4)
Elaftor 2051 (SKF-26/5)
Elaftor2061 (SKF-26/6)
Elaftor 2071(SKF-26/7)
Elaftor 2081 (SKF-26/8)

Plant standard 044-363-95

$$[(-CH_2 - CF_2-)n - \underset{\displaystyle CF_3}{\underset{|}{CF}} - CF_2 -]m$$

Indicators	SKF-26/3	SKF-26/4	SKF-26/5	SKF-26/6	SKF-26/7	SKF-26/8
	Elaftor 2031	Elaftor 2041	Elaftor 2051	Elaftor 2061	Elaftor 2071	Elaftor 2081
Chemistry	Copolymer of vinylidene fluoride and hexafluoropropylene					
Visual environment	Granules					
Fluorine content, % mass	66					
Moony viscosity ML (1+10)120°C	30–35	36–45	46–55	56–65	66–75	76–85
Density, g/cm³	1,83					
T glass transition, °C	-17					
Vulcanization: bisfenol, amine						

These fluoroprene marks are copolymers of vinylidene fluoride and hexafluoropropylene. **Fluoroprenes Elaftor series 2000 (SKF-26/3-8)** are produced over a wide range of Moony viscosity (from 30 to89). Rubbers based on fluoroprenes **SKF-26/3-8** have high chemical resistance, heat resistance and resistance in different oils and fuels.

This series fluoroprenes are reprocessed by pressing, tubing and extrusion methods. Injection molding method can be used by low-viscosity marks reprocessing. **Rubbers SKF-26/3-8** are applied by production of seals, gaskets, valves, hoses and other rubber products.

2.4 Fluoroprenes Elaftorseries 3000

Elaftor 3031 (SKF-264/3)
Elaftor 3041 (SKF-264/4)
Elaftor 3051 (SKF-264/5)
Elaftor 3061 (SKF-264/6)
Elaftor 3071 (SKF-264/7)
Elaftor 3081 (SKF-264/8)

TS 2294-018-13693708-2004

$$(\text{-}CF_2 - CF_2\text{-})n - (\text{-}CF(CF_3) - CF_2\text{-})m - (\text{-}CF_2 - CH_2\text{-})p$$

Indicators	SKF-264/3	SKF-264/4	SKF-264/5	SKF-264/6	SKF-264/7	SKF-264/8
	Elaftor3031	Elaftor 3041	Elaftor 3051	Elaftor3061	Elaftor3071	Elaftor3081
Chemistry	Terpolymer of vinylidene fluoride, hexafluoropropylene and tetrafluorethylene.					
Visual environment	Granules					
Fluorine content, % mass.	68					
Moony viscosity ML(1+10)120°C	30–39	40–49	50–59	60–69	70–79	80–89
Density, g/cm³	1,87					
T glass transition, °C	-13					
Vulcanization: bisfenol, amine						

FluoropreneSKF-264 marks are produced over a wide range of Moony viscosity (from 30 to 89). Fluoroprene is a terpolymer of vinylidene fluoride, hexafluoropropylene and tetrafluorethylene.

FluoropreneSKF-264 containes more fluorine in comparison with **SKF-26**, and this makes it hyper chemical and petrol resistant. Depending on viscosity **SKF-264** can be reprocessed by tubing, injection molding and extrusion methods.

2.5 Fluoroprene Elaftorseries 7000

Elaftor 7031 (SKF-264B/3)
Elaftor 7041 (SKF-264B/4)
Elaftor 7051 (SKF-264B/5)
Elaftor 7061 (SKF-264B/6)

TS 2294-01813693708-2004

$$[(-CF_2 - CF_2-)n -(-CF(CF_3) - CF_2-]k - (-CF_2 - CH_2-)p]m$$

Indicators	SKF-264V/3	SKF-264V/4	SKF-264V/5	SKF-264V/6
	Elaftor 7031	Elaftor7041	Elaftor 7051	Elaftor7061
Chemistry	Terpolymer of vinylidene fluoride,hexafluoropropylene, tetrafluorethylene and functional monomer			
Visual environment	Granules			
Fluorine content,% mass	70			
Moonyviscosity ML(1+10)120°C	30–39	40–49	50–59	60–69
Density, g/cm³	1,91			
T glass transition, °C	-5			
Vulcanisation: peroxide				

These fluoroprene marks are terpolymer of vinylidene fluoride, hexafluoropropylene and tetrafluorethylene, including functional monomer (cure site monomer). **Fluoroprene SKF-264V** comprises 70% of fluorine, that' why rubber products have so strong resistance in oxygen-containing fuels and a bit more chemical resistance in other aggressive environments. There is functionality in polymer chain, that's why these rubbers can cure with peroxides. Rubbers made of **SKF-264V** have high tenacity, are resistant to vapor, acids, oils, aromatic hydrocarbons and diluted alkalis.

Fluoroprenes SKF-264V/5-6 can be reprocessed by pressing, tubing and extrusion methods. **Fluoroprenes SKF-264V/3-4** are reprocessed by all methods, including injection molding.

2.6 Latex Elaftor 7000 (Latex SKF-264V)

Latex SKF-264V is high a concentrated water emulsion based on fluoroprene**SKF-264V**.

Latex is meant for obtaining of cocoons for different foundations, including rubbers, metals, concrete, plastic and also for dipping of fabrics and other materials. The coverings, obtained by **latex SKF-264V** composition application with the following vulcanization, have high chemical resistance, including resistance to fuels and oils. These latexes are alternative to solutions based on fluoroprene. However, water latexes are more environmentally friendly and safe to work with. Operating temperature range is from minus 35°C to 200°C.

TS 2294-047-13693708-2010

Indicator name	Latex Elaftor 7000
Polymer base	Terpolymer of vinylidene fluoride, hexafluoropropylene, tetrafluorethylene and functional monomer
Nonvolatile mass content %, not more than	60
pH	7–10
Fluorine content in polymer base, % mass	70

Fluoroprene types

Indicators	Conventional fluoroprenes				New fluoroprenes		
	SKF-32	SKF-26	SKF-26 NM	SKF-26 ONM	Elaftor 2000	Elaftor 3000	Elaftor7000
Visual environment	Coalescent flake				granules		
Composition	VDF+CTFE	VDF+HFP	VDF+HFP	VDF+HFP	VDF+HFP	VDF+HFP+TFP	VDF+HFP+TFP+ function monomer
Fluorine content, % mass	54 (Cl=14%)	66	66	66	66	68	70
Moony viscosity							
MB (4+4) 150°C		80–105					
MB (4+4) 160°C	70–95						
MB (1+10)120°C					30–85	30–89	30–69
MB (4+10)100°C			40–65 66–95				
40% solution dynamic viscosity in acetone, MPa*c				40–79 80–160			
Shrinkage, %	16–25	16–25					
T glass transition, °C	-17	-17	-17	-17	-17	-13	-5
Max.operating temperature, °C	200	250			250	250	250

Indicators	Conventional fluoroprenes				New fluoroprenes		
	SKF-32	SKF-26	SKF-26 NM	SKF-26 ONM	Elaftor 2000	Elaftor 3000	Elaftor7000
Specific density, g/cm³	1,83	1,83			1,83	1,87	1,91
Cure system	Med-compl. Bisphenol amines	Bisphenol amines	–	–	–	Bisphenol amines	Peroxides
Reprocessing method	Pressing	Pressing	Sealant	Sealant	Pressing Extrusion LD	Pressing Extrusion LD	Pressing Extrusion LD
Compression set (25%, 200°C, 24 hours) O-ring	22 (150°C)	10	–		11	20	22
Tshatter point, °C	-20	-20	–	–	-20	-27	-36
swelling, 168h*23°C, % mas							
In fuelC (toluol/ isooctan =50/50)	4					3	2
In fuel I (fuelC/ methanol=85/15)		30				14	4
Potassium hydroxide(20%)	sensitive						1

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