

F1
The moulding of PTFE granular powders

F3/4/5
The Processing of PTFE coagulated dispersion powders

F6
Impregnation with PTFE aqueous dispersions

F9
Finishing processes for polytetrafluoroethylene

Fluoropolymer as Environmental-symbiotic Technology

Nowadays, environmental protection is regarded as the highest priority theme in every industrial field. Fluoropolymer and fluoroelastomer have been applied into environmental friendly products and process techniques. The properties of fluoropolymer and fluoroelastomer such as weatherability, nonflammability and chemical resistance, give longer life to various products and save resources and reduce industrial wastes. For examples, Fluon® ETFE is used for fuel hose of automobile to reduce its fuel permeation, and F-CLEAN® ETFE film is used as film for agricultural house because of its long life. AGC helps your continuous effort for environment protection, through our development, improvement, and enhanced applications of these products. Simultaneously, AGC as a manufacturer of fluorine chemicals establishes recycling process technique and anti-pollution process technique in actual production sites, to continuously effort to reduce the environmental load by the fluorine products themselves. AGC believes that the technology of fluoropolymer with advantageous possibilities contributes to solve environmental problems and plays an important role in realizing a safe and comfortable society of environment-symbiotic type.

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AGC
Your Dreams, Our Challenge

 **Fluon® PTFE**

POLYTETRAFLUOROETHYLENE



AGC - A total solution supplier of fluorine chemicals
Fluon® - The top fluoropolymer brand name

Fluon® PTFE - The most basic fluoropolymer supplied by the most reliable manufacturer

PTFE has opened up a new era of advanced material: fluoropolymers. Its long-lasting credibility and superiority have been refined by AGC's globally recognized fluorine technology.

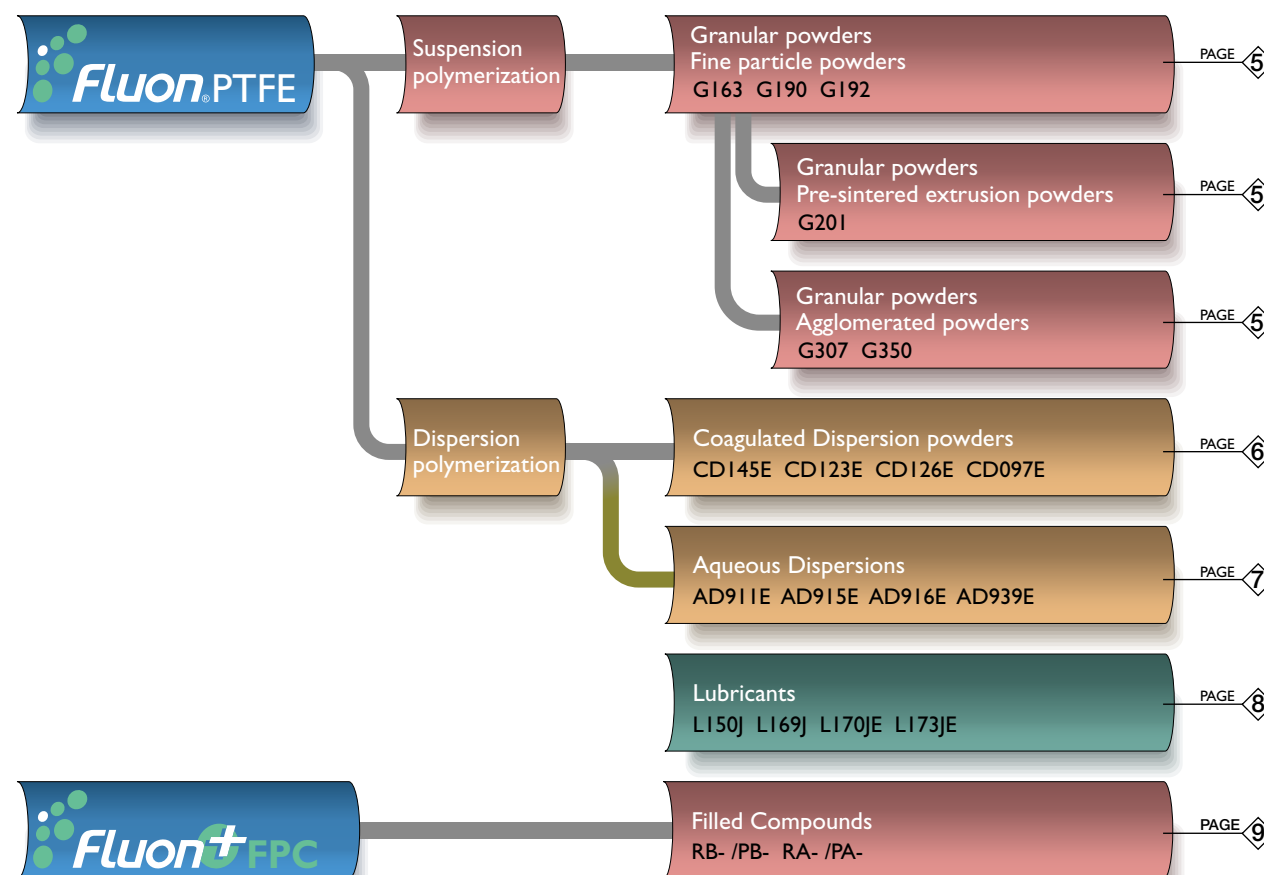
Fluon®PTFE (Polytetrafluoroethylene; CAS 9002-84-0) is the most basic type of fluoropolymer and has a 70-year history. Its unique characteristics, such as chemical resistance, heat resistance, weather resistance and electrical isolation, have been recognized in a wide range of industries, dominating over 60% of the total demand for fluoropolymers. As a total solution supplier of fluoropolymers, AGC has already realized reliability in both supply ability and quality, and aggressively seeks new opportunities in this epoch-making field and further refinement of its technical service quality.

PTFE is the most basic fluoropolymer. Fluon® is refined PTFE offered by AGC. We respond to a variety of needs through advanced fluorochemical technology.



Product portfolio

Fluon® PTFE is available in a variety of product forms, in order to be effective in various processes and applications. The product portfolio for Fluon® includes powders (Granular powders, Filled Compounds, Coagulated Dispersion powders), dispersions (Aqueous Dispersions) and additives (Lubricants).



Chemical resistance, heat resistance, electrical isolation ...
With its numerous superior characteristics, PTFE is the mainstream in fluoropolymers.



Fluon® PTFE possesses numerous excellent properties and is widely used around the world. It is known as a highly functional fluoropolymer with superior characteristics, such as chemical resistance and heat resistance, as well as electrical insulation, low friction and non-stick properties.

- Heat resistance : Usable within a wide temperature range from -180 to +260°C.
- Chemical resistance : Durable to the most of chemical agents and solvents.
- Nonflammability : Has an oxygen index of at least 95%, meets UL specification UL94V-0, and is non - flammable.
- Electrical properties : Dielectric constant and dielectric tangent are stably low at all frequencies; exhibits excellent insulation.
- Friction : Shows the minimum coefficient of friction in solids.
- Non-stick : Excellent non-stick and release properties.
- Weather resistance : Can be used outdoors for a long period of time and is highly durable against sunlight, wind, rain and exhaust gases.

List of properties

	Properties (Unit)	ASTM	Fluon® PTFE
Physical	Specific gravity	— ASTM D792	2.1~2.2
	Melting point	°C ASTM D1457	327
Mechanical	Tensile Strength	MPa ASTM D638	20.6~34.3
	Elongation	% ASTM D638	200~400
	Compressive strength	1% deformation MPa 10% deformation MPa	5.1 15.1
	Modulus of compressive elasticity	GPa ASTM D695	0.412
	Bending strength	MPa ASTM D790	17.2
	Modulus of bending elasticity	GPa ASTM D790	0.578
	Impact test (IZOD)(notched)	J/m ASTM D256	157
	Hardness	Durometer Rockwell	D55 R25
	Coefficient of static friction	Bowden-Laben type steel ball, 0.2mm/s	0.05
	Coefficient of dynamic friction	Matsubara test machine 0.686MPa/3m/min	0.11
Thermal	Creep in compaction	defomation % permanet deformation %	14 8
	Thermal conductivity	W/m • °C ASTM C177	0.25
	Specific heat	J/g • °C ASTM D1457	1.05
	Coefficient of liner expansion	10 ⁻⁵ /°C ASTM D696	12.3
	Thermal deformation temperature	0.451MPa °C 1.81MPa °C ASTM D648	120 51
Electrical	Volume resistivity	Ω • cm ASTM D257	>10 ¹⁸
	Surface resistivity	Ω ASTM D257	10 ¹⁷
	Dielectric breakdown voltage (0.1mm thickness)	MV/m ASTM D149	100
	Dielectric constant	60Hz 10 ³ Hz 10 ⁶ Hz ASTM D150	2.1 2.1 2.1
	Dielectric loss tangent	60Hz 10 ³ Hz 10 ⁶ Hz ASTM D150	<0.002 <0.002 <0.002
	Arc resistance	s ASTM D495	>300
Durability & others	Chemical resistance	— ASTM D543	excellent
	Flammability	°C ASTM D635	nonflammable
	Moisture	% ASTM D570	<0.01
	Oxygen Index 24hr	— ASTM D2863	>95

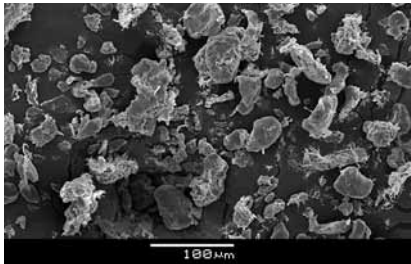


Fluon® PTFE G grades moulding for insulator (Application of electrical, heat resistance and weather resistance properties)

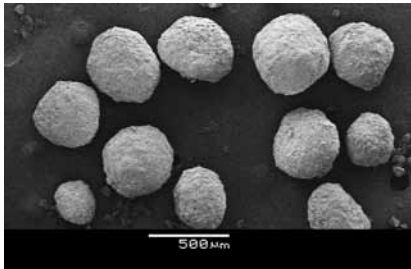
Fluon® PTFE Granular powders (Moulding powders) are used for the production of sheets, rods, billet and other general mouldings. Filled compounds have improved creep and wear resistance and are described in the page of 9.



Example parts moulded and machined by Fluon® PTFE G grades (Application of electrical, heat resistance and weather resistance properties)



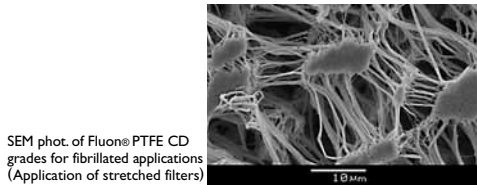
Fluon® PTFE G190 (Fine particle powders) SEM photo.



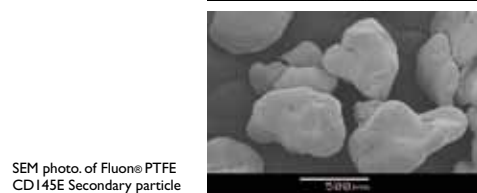
Fluon® PTFE G350 (Agglomerated powders) SEM photo.



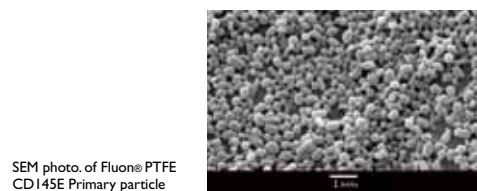
Fluon® PTFE CD097E and CD145E for tube application (Application of chemical and heat resistance properties)



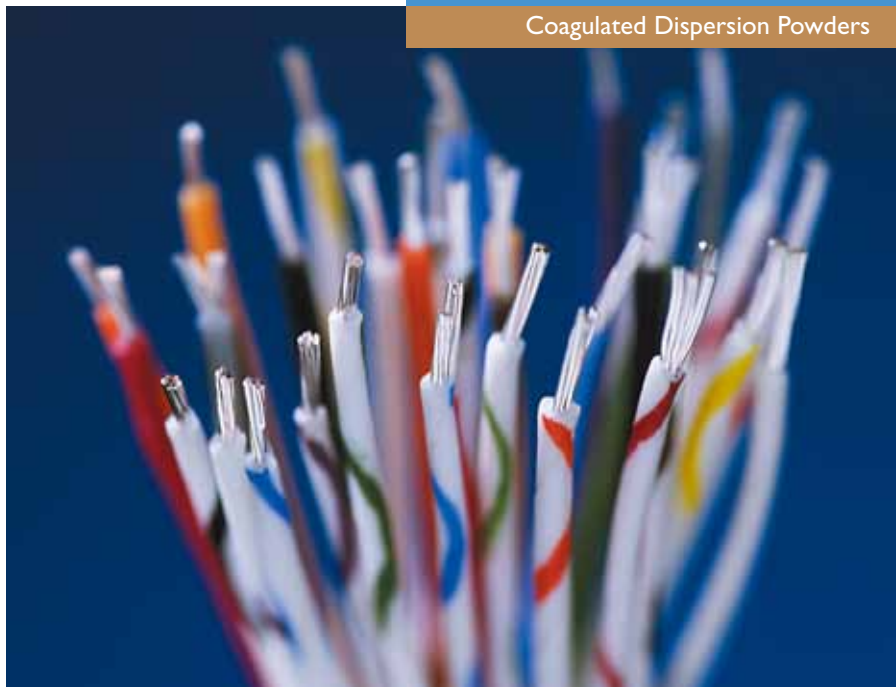
SEM photo of Fluon® PTFE CD grades for fibrillated applications (Application of stretched filters)



SEM photo of Fluon® PTFE CD145E Secondary particle



SEM photo of Fluon® PTFE CD145E Primary particle



Fluon® PTFE CD grades for wire coating (Application of electrical properties and heat resistance properties)

Fluon® PTFE CD coagulated dispersion powders (fine powders) are used for paste extrusion to make tapes, stretched films, filters, tubes, rods and wire coating.

Key properties									Applications	Characteristics
Properties	Bulk density	Median particle size	Powder flow	Recommended moulding pressure	Tensile strength	Elongation	Diametrical shrinkage	Surface finish		
Test method	Complying with JIS K6891	*1	—	MPa	ASTM D4894	ASTM D4894	*2	—		
Unit	g/l	µm	—	MPa	MPa	%	%	—		
G163	330	25	—	16	42	350	4.2	Excellent	Large billet (300 ~ 1,500mmH), Sheet moulding, Feed stock for Filled compounds	Fine particle powders, High tensile strength, Excellent surface finish, Higher bulk density, (G190 and G192)
G190	440	25	—	16	42	370	4.3	Excellent		
G192	460	25	—	16	41	360	4.7	Excellent		
G201	630	550	Excellent	—	23 (JIS-K7137)	250 (JIS-K7137)	—	Good	Ram extrusion Pipe, Rod(<φ20mm)	Presintered polymer, High powder flow, Lower crystallinity
G307	750	650	Excellent	30	36	350	2.8	Good	General moulding Automatic moulding Isostatic moulding Ram extrusion Pipe, Rod(>φ20mm)	Agglomerated (Free flowing) Powders, The best powder flow (G307) The highest bulk density (G350, G355)
G350	900	370	Very good	30	37	380	2.9	Very good		
G355	900	350	Very good	30	39	350	2.8	Very good		

G100 grades series; Fine particle powders

G200 grades series; Pre-sintered extrusion powders

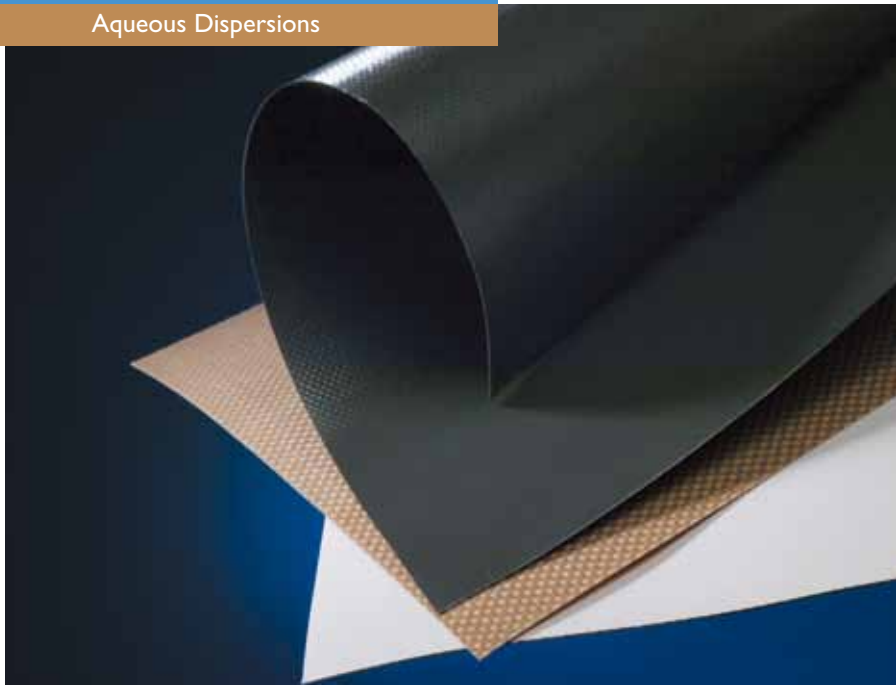
G300 grades series; Agglomerated (free flowing) powders

*1: at recommended preforming pressure

*2 AGC Method

Key properties									Applications
Properties	Buld density	Median particle size	Specific gravity	Relative extrusion pressure	Tensile strength	Elongation	Reduction ratio	Transparency	
Test method	Complying with JIS K6892	Complying with ASTM D4895	Complying with JIS K6892	*1	ASTM D4895	ASTM D4895	—	—	
unit	g/l	µm	—	—	MPa	%	—	—	
CD145E	510	550	2.17	2.1	39	430	50 ~ 500	—	Low density tape, Hose, Tube
CD123E	550	500	2.16	2.5	41	420	25 ~ 300	—	Electrical tape, Stretched film, Pipe, Hose, Wire coating
CD126E	460	500	2.18	2.5	33	440	25 ~ 300	—	Flat cable, Stretched Film
CD129E	580	500	2.16	2.3	38	420	25 ~ 300	—	Stretched Film
CD097E	500	500	2.18	1.0	35	500	250 ~ 4000	Very good	Fine tube, Wire coating

*1 Based on standard AGC extrusion test (20° included die angle, 16% Isopar H, RR=1000)

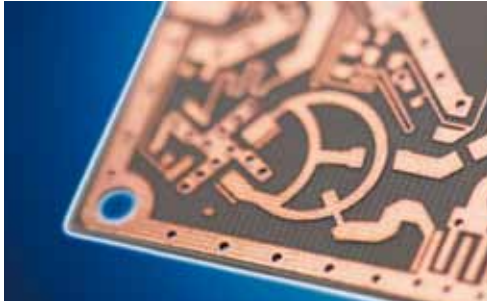


Fluon®PTFE ADs for glass cloth coating (Application of non-stick and friction properties)

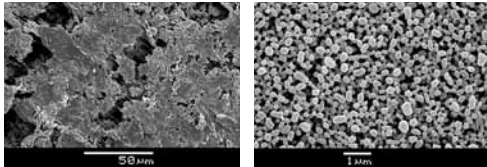
Fluon®PTFE dispersions are aqueous dispersion stabilized by surfactants. Fluon®PTFE dispersions are used for glass clot coating, metal coating, binder, additives, etc. APFO isn't used in production process of Fluon®PTFE dispersions, and stabilizer is green surfactant which is desirable of the environment.



Fluon® PTFE ADs for glass cloth roofing structure (Application of weather resistance properties)



Fluon® PTFE ADs for print circuit board (Application of electrical properties)

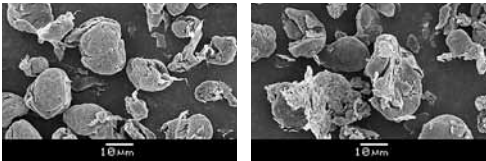


SEM photo of Fluon® PTFE binder example (Application of PTFE fibril) SEM photo of Fluon® PTFE fine particle in dispersion

Key properties							Applications	Characteristics
Properties	PTFE content	Surfactant content	Median particle size	Specific gravity (23℃)	pH(23℃)	Viscosity(23℃)		
Test method	Complying with JIS K 6893	Complying with JIS K 6893	Light scattering method	Complying with JIS K 6893	Complying with JIS K 6893	B-type viscometer		
unit	%	% / PTFE	μm	—	—	mPa・s		
AD911E	61	5	0.25	1.52	10	26	General purpose	—
AD915E	61	3	0.25	1.52	10	19	Metal coating, additives	Fit for oversea use
AD916E	58	8	0.25	1.49	10	19	Glass cloth coating (over coating)	Better wetting
AD939E	61	3	0.30	1.52	10	19	Additives	High molecular weight PTFE, fir for oversea use

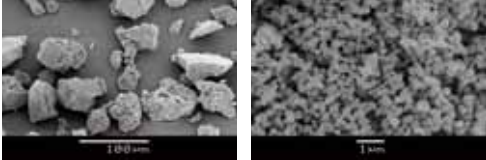


Fluon® PTFE Lubricant additives to Nylon in automotive gear shift housing (Application of friction properties)



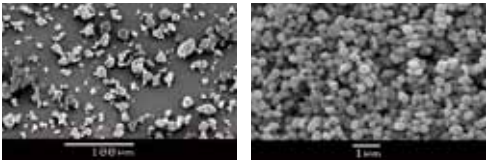
Fluon® PTFE L150J

Fluon® PTFE L169J



Fluon® PTFE L170JE(Low magnify)

Fluon® PTFE L170JE(High magnify)



Fluon® PTFE L173JE(Low magnify)

Fluon® PTFE L173JE(High magnify)

*4 kinds (L150J, L169J, L170J, L173J)SEM phot. of Fluon® PTFE Lubricant grades



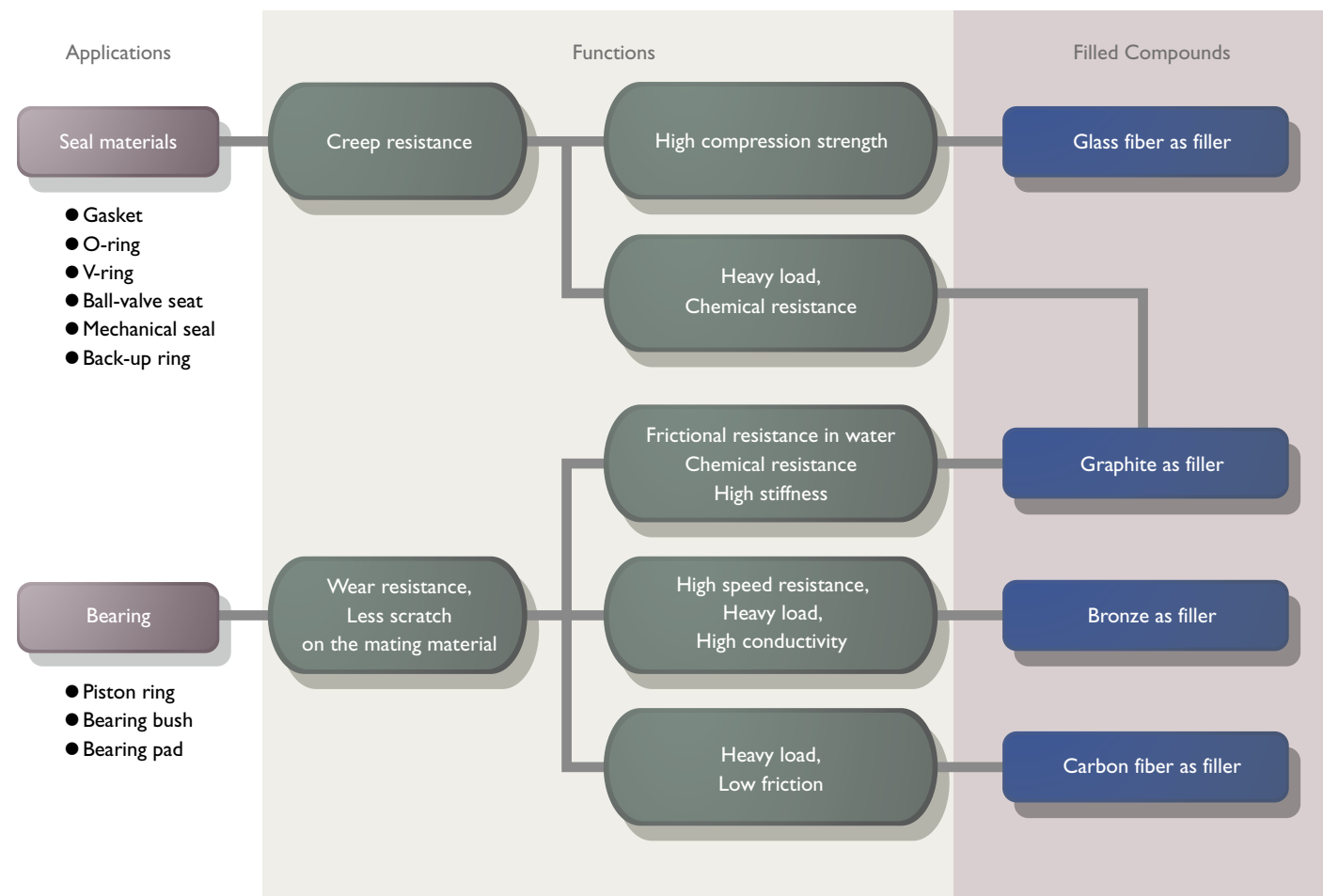
Fluon® PTFE Lubricant additives to PPS for gear and bearing (Application of friction properties)

Fluon® PTFE Lubricants are white powder of low molecular weight PTFE. Fluon® PTFE Lubricants is easily dispersible because of less sticking than usual PTFE powder, and useful as additives to plastics, rubbers, paints, greases, and so on. Addition of Fluon® PTFE Lubricants brings benefits of low friction resistance and non-stick property on the applied surface.

Key properties						Applications	Characteristics
Properties	Bulk Density	Median particle size		Melting point	Specific surface area		
Test method	JIS K 6891	Primary particle	Secondary particle	DSC	N ₂ —BET		
Unit	g/l	μm	μm	℃	m ² /g		
L150J	500	10	—	325	1	Plastics, Rubber	Useful for blending to resins or relatively high viscosity liquid
L169J	400	18	—	333	2	Plastics, Rubber	Useful for blending to resins or relatively high viscosity liquid
L169E	420	17	—	334	2	Plastics, Rubber	Useful for blending to resins or relatively high viscosity liquid
L170JE	500	0.3	—	333	6	Paints, Ink, Grease	Agglomerated powder of sub-micron size PTFE particle. Useful for blending to relatively low viscosity liquid after dispersing
L173JE	300	0.3	<10	332	6	Paints, Ink, Grease	Agglomerated powder of sub-micron size PTFE particle. Easy to disperse than L170JE, and useful for blending usage



Fluon® PTFE Filled Coumpounds (FPC) have improved creep and wear resistance.
A wide range of fillers such as Glass Fiber, Graphite, Bronze, Carbon fiber are available.



Properties	Fillers and contents (%)	Bulk density	Median particle size	Tensile strength	Elongation	Specific gravity	Applications	Characteristics
Grades		g/l	μ m	Mpa	%	—		
PA1015SZ	Glass fiber (15%)	880	730	26.2	360	2.22	Bearing, Gasket, Valvedisk, V-ring, O-ring, Plug-valve seat, Pump impellor, Mechanical seal	Improved wear resistance,
RB1015S		510	—	27.9	310	2.21		Improved compression resistance,
PA1020Z	Glass fiber (20%)	890	660	21.7	350	2.24		Filler can be damaged by strong base and hydorgen fluoride,
PA1025Z	Glass fiber (25%)	860	730	18.5	340	2.23		Improved powder flow for Z-type of PA
RB1025S		480	—	25.0	320	2.22		
PB2015	Graphite (15%)	670	730	15.2	200	2.14	Piston ring, Bearing, Gasket, Shock-absorber	Enhanced creep resistance,
RB2015		410	—	21.9	275	2.14		Chemical resistance, Small initial friction coefficient, Improved heavy load
PB2215H	Glass fiber (14%) + Carbon fiber (1%)	0.64	610	16.5	230	2.13		
PB3060	Bronze (60%)	1340	760	20.0	290	3.85	Bearing pad	Improved wear and creep resistance,
PB3360T		1330	700	18.0	300	3.94		High conductivity because of metal filler, Anti-oxidizing for PB3360
PB2510	Carbon fiber (10%)	670	620	25.0	300	2.07	Bearing, Piston ring, Ball-valve seat, Bearing pad, Oil seal	Improved wear resistance in water,
RB2510		440	—	30.0	330	2.08		Improved heavy load,
PB2515	Carbon fiber (15%)	650	620	20.5	270	2.02		Improved bending strength
PB1205	Glass fiber (25%) + Graphite (5%)	760	700	16.0	250	2.21	Baring pad, Piston ring, Mechanical seal, Ball-valve seat	Improved wear resistance,
PB1211	Glass fiber (15%) + MoS ₂ (5%)	790	700	21.5	305	2.27		Improved creep resistance,
RB1211		470	—	25.2	320	2.28		Improved stiffness and hardness
PB1202	Glass fiber (16%) + Graphite (2%) + Special filler (2%)	750	650	19.0	300	2.24		
PA3540LT	Carbon fiber (10%) + Bronze (30%)	940	710	13.5	285	2.66	Bearing, Packing	Improved heavy load,
RA3540G		620	—	17.1	365	2.64		Improved wear resistance, Improved stiffness and hardness
RA7003	Special filler (3%)	420	—	33.8	360	2.15	Anti-static	Semi-conductive
PA7115	Polyimide (15%)	700	650	17.6	360	1.95	Packing, Oil seal	Improved ear resistance, Less scratch on the mating material

PA, PB : Good powder flow
RA, RB : Regular powder
S : Dark center free
Z : High bulk density, High powder flow
T : Discoloration resistance

Measurement properties are based on JIS K 6891.