

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.

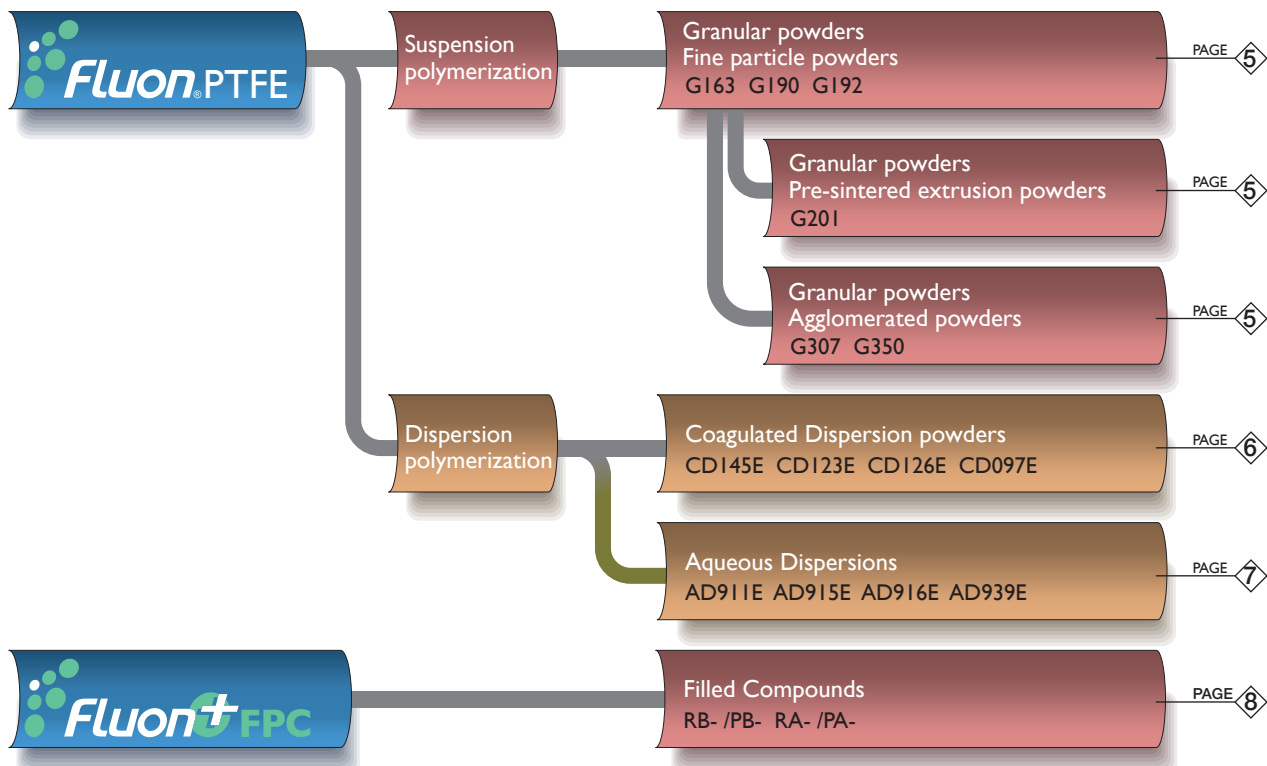
PTFE is the most basic fluoropolymer. Fluon® is refined PTFE offered by AGC. We respond to a variety of needs through advanced fluorochemical technology.



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) .





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 Related standard* | 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 | ASTM D695 | 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 | ASTM D2240 ASTM D785 | 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 |
| | Creep in compaction | defomation % permanet deformation % | ASTM D621 13.7MPa,24h,24°C | 14 8 |
| Thermal | 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 |

*AGC test methods on this document are not in full conformity with JIS and ASTM official standards.

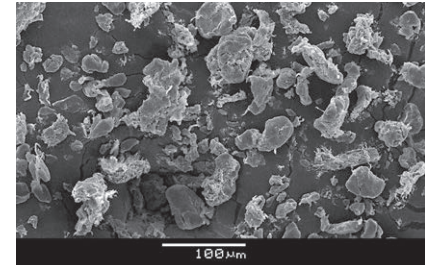


Fluon® PTFE G grades moulding for insulator (Application of electrical, heat resistance and weather resistance properties)

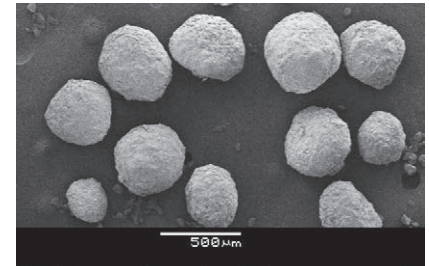
Fluon® PTFE Granular powders (Moulding powders) are used for the production of sheets, rods, billet and other general mouldings. Filled compounds have improved creep and wear resistance and are described in the page of 7.



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.

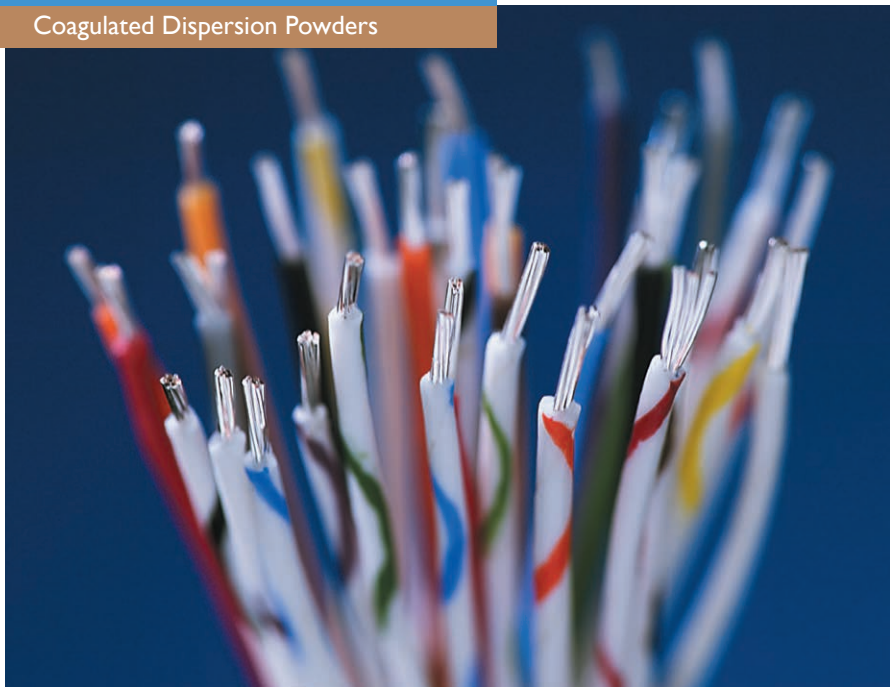
| Properties <small>test method/related standard*1</small> | Bulk density <small>Complying with JIS K6891</small> | Median particle size <small>*2</small> | Key properties | | | | | | Applications | Characteristics |
|---|---|---|----------------|-------------------------------|----------------------------------|-----------------------------------|-----------------------|----------------|---|---|
| | | | Powder flow | Recommended moulding pressure | Tensile strength | Elongation | Diametrical shrinkage | Surface finish | | |
| | | | | | ASTM D4894 | ASTM D4894 | *3 | — | | |
| 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 <small>(JIS-K7137)</small> | 250 <small>(JIS-K7137)</small> | — | 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: AGC test methods on this document are not in full conformity with JIS and ASTM official standards.

*2: at recommended preforming pressure

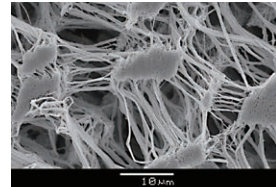
*3 AGC Method



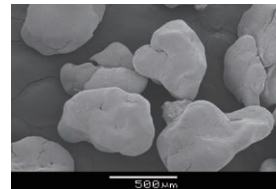
Fluon® PTFE CD grades for wire coating (Application of electrical properties and heat resistance properties)



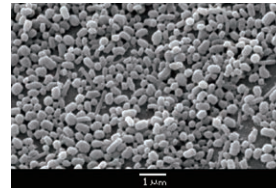
Fluon® PTFE CD097E and CD145E for tube application (Application of chemical and heat resistance properties)



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



SEM photo. of Fluon® PTFE CD145E Secondary particle



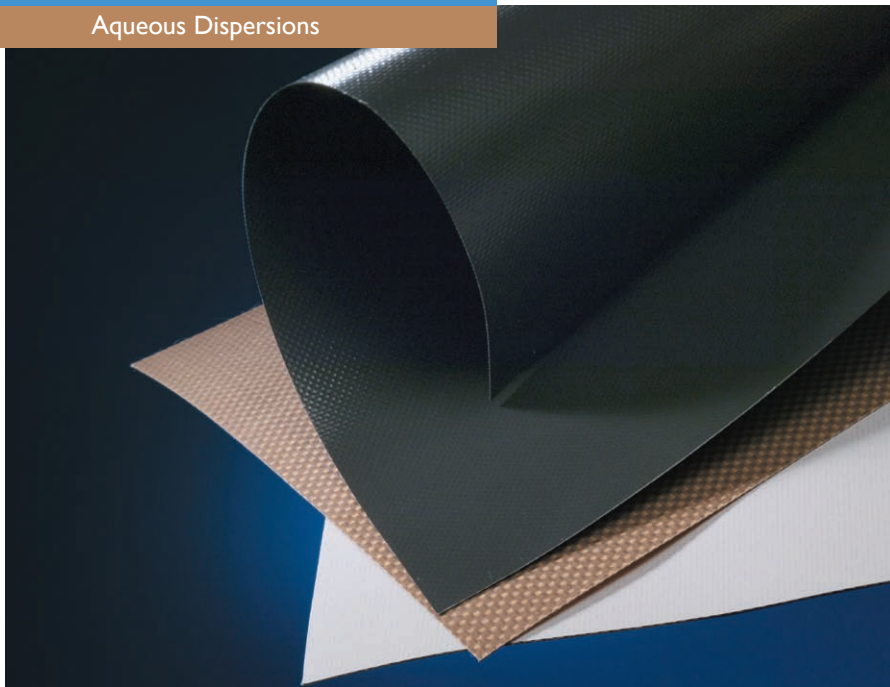
SEM photo. of Fluon® PTFE CD145E Primary particle

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

| Properties | Key properties | | | | | | | | Applications |
|------------|----------------|----------------------|------------------|-----------------------------|------------------|------------|-----------------|--------------|---|
| | Buld density | Median particle size | Specific gravity | Relative extrusion pressure | Tensile strength | Elongation | Reduction ratio | Transparency | |
| | unit | 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 AGC test methods on this document are not in full conformity with JIS and ASTM official standards.

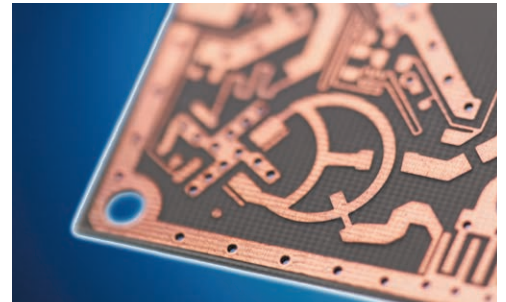
*2 Based on standard AGC extrusion test (20° included die angle, 16% Isopar H, RR=1000)



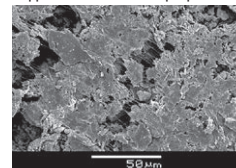
Fluon® PTFE ADs for glass cloth coating (Application of non-stick and friction properties)



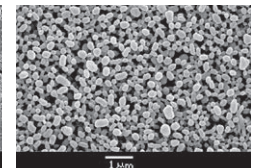
Fluon® PTFE ADs for glass cloth roofing structure (Application of weather resistance properties)



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



SEM photo of Fluon® PTFE binder example (Application of PTFE fibril)



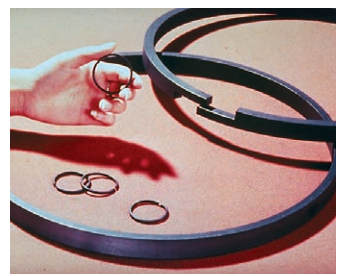
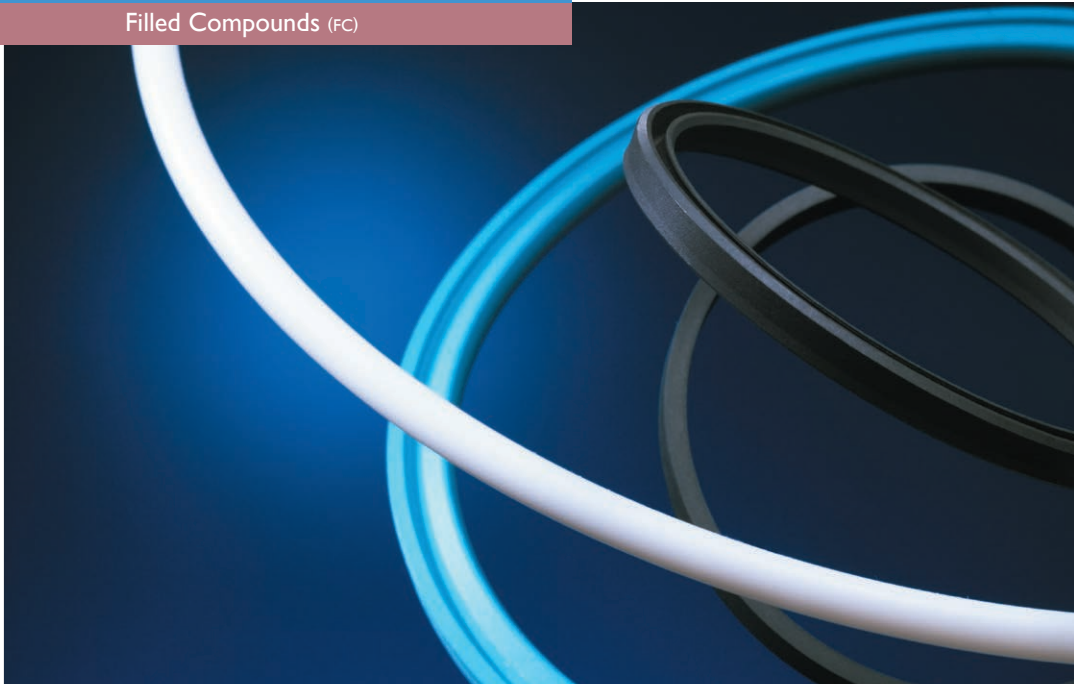
SEM photo of Fluon® PTFE fine particle in dispersion

Fluon® PTFE dispersions are aqueous dispersion stabilized by surfactants. Fluon® PTFE dispersions are used for glass cloth 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.

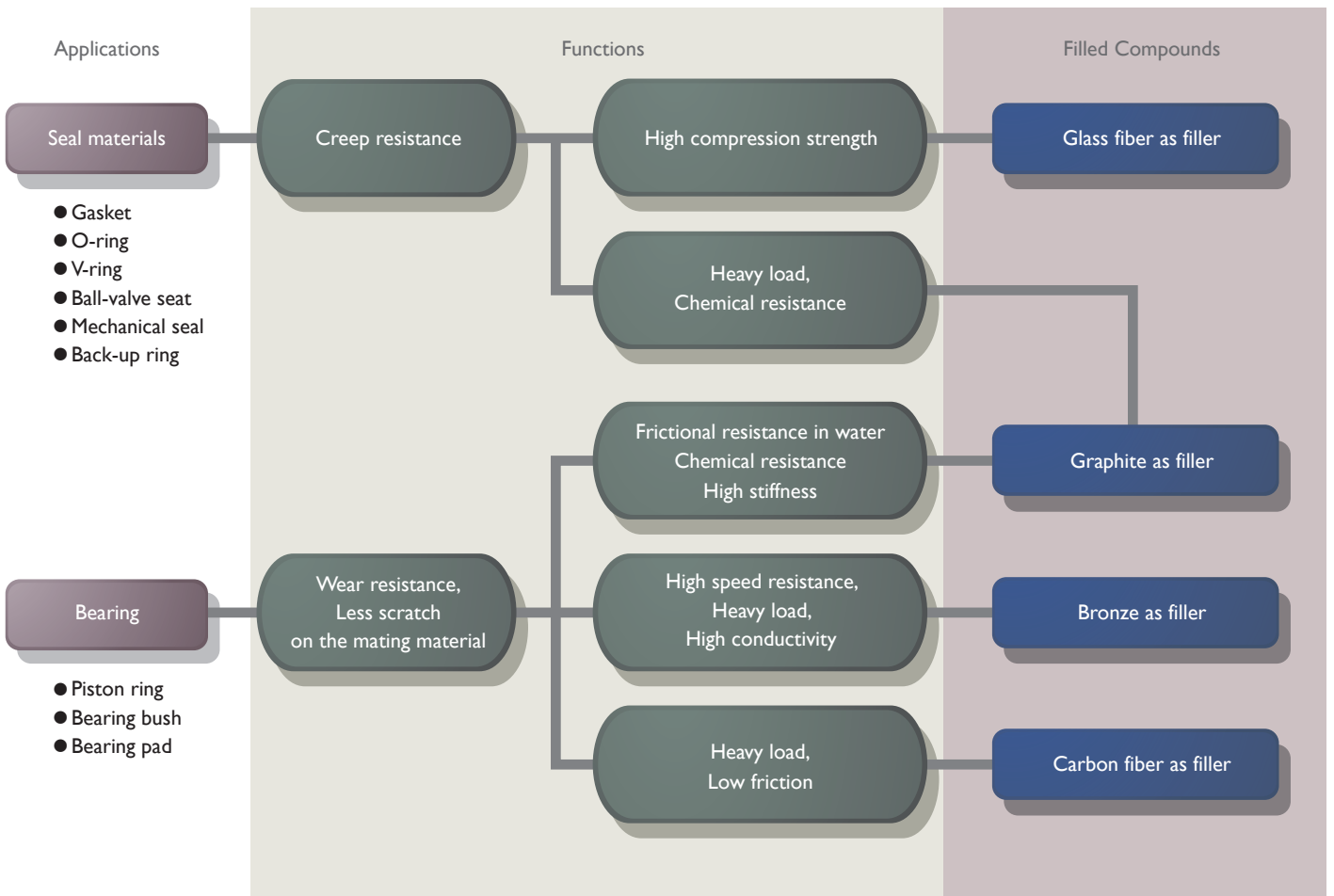
| Key properties | | | | | | | Applications | Characteristics |
|--------------------------------|---------------------------|---------------------------|-------------------------|---------------------------|---------------------------|-------------------|------------------------------------|--|
| Properties | PTFE content | Surfactant content | Median particle size | Specific gravity (23°C) | pH (23°C) | Viscosity (23°C) | | |
| test method/related standard*1 | 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*2 | 61 | 5 | 0.25 | 1.52 | 10 | 26 | General purpose | commodity |
| AD915E*2 | 61 | 3 | 0.25 | 1.52 | 10 | 19 | Metal coating, additives | Low amounts of stabilisers |
| AD916E*2 | 58 | 8 | 0.25 | 1.49 | 10 | 19 | Glass cloth coating (over coating) | Better wetting |
| AD939E*2 | 61 | 3 | 0.30 | 1.52 | 10 | 19 | Additives | High molecular weight PTFE, Low amounts of stabilisers |

*1 AGC test methods on this document are not in full conformity with JIS and ASTM official standards.

*2 For use outside Japan, please contact us.

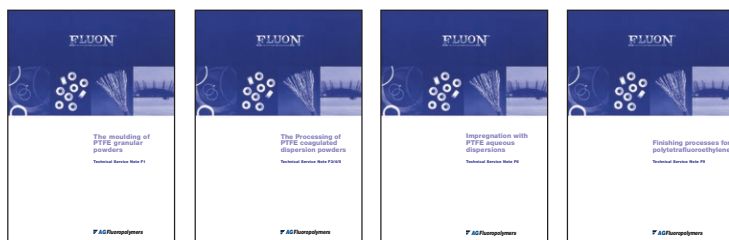


Fluon[®] PTFE Filled Compounds (FPC) have improved creep and wear resistance. A wide range of fillers such as Glass Fiber, Graphite, Bronze, Carbon fiber are available.



| 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, Improved compression resistance, Filler can be damaged by strong base and hydrogen fluoride, Improved powder flow for Z-type of PA |
| RB1015S | | 510 | — | 27.9 | 310 | 2.21 | | |
| PA1020Z | Glass fiber (20%) | 890 | 660 | 21.7 | 350 | 2.24 | | |
| PA1025Z | Glass fiber (25%) | 860 | 730 | 18.5 | 340 | 2.23 | | |
| 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, Chemical resistance, Small initial friction coefficient, Improved heavy load |
| RB2015 | | 410 | — | 21.9 | 275 | 2.14 | | |
| 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, High conductivity because of metal filler, Anti-oxidizing for PB3360 |
| PB3360T | | 1330 | 700 | 18.0 | 300 | 3.94 | | |
| 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, Improved heavy load, Improved bending strength |
| RB2510 | | 440 | — | 30.0 | 330 | 2.08 | | |
| PB2515 | Carbon fiber (15%) | 650 | 620 | 20.5 | 270 | 2.02 | | |
| PB1205 | Glass fiber (25%) + Graphite (5%) | 760 | 700 | 16.0 | 250 | 2.21 | Bearing pad, Piston ring, Mechanical seal, Ball-valve seat | Improved wear resistance, Improved creep resistance, Improved stiffness and hardness |
| PB1211 | Glass fiber (15%) + MoS ₂ (5%) | 790 | 700 | 21.5 | 305 | 2.27 | | |
| RB1211 | | 470 | — | 25.2 | 320 | 2.28 | | |
| 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, Improved wear resistance, Improved stiffness and hardness |
| RA3540G | | 620 | — | 17.1 | 365 | 2.64 | | |
| 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 wear 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



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.

Notice

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