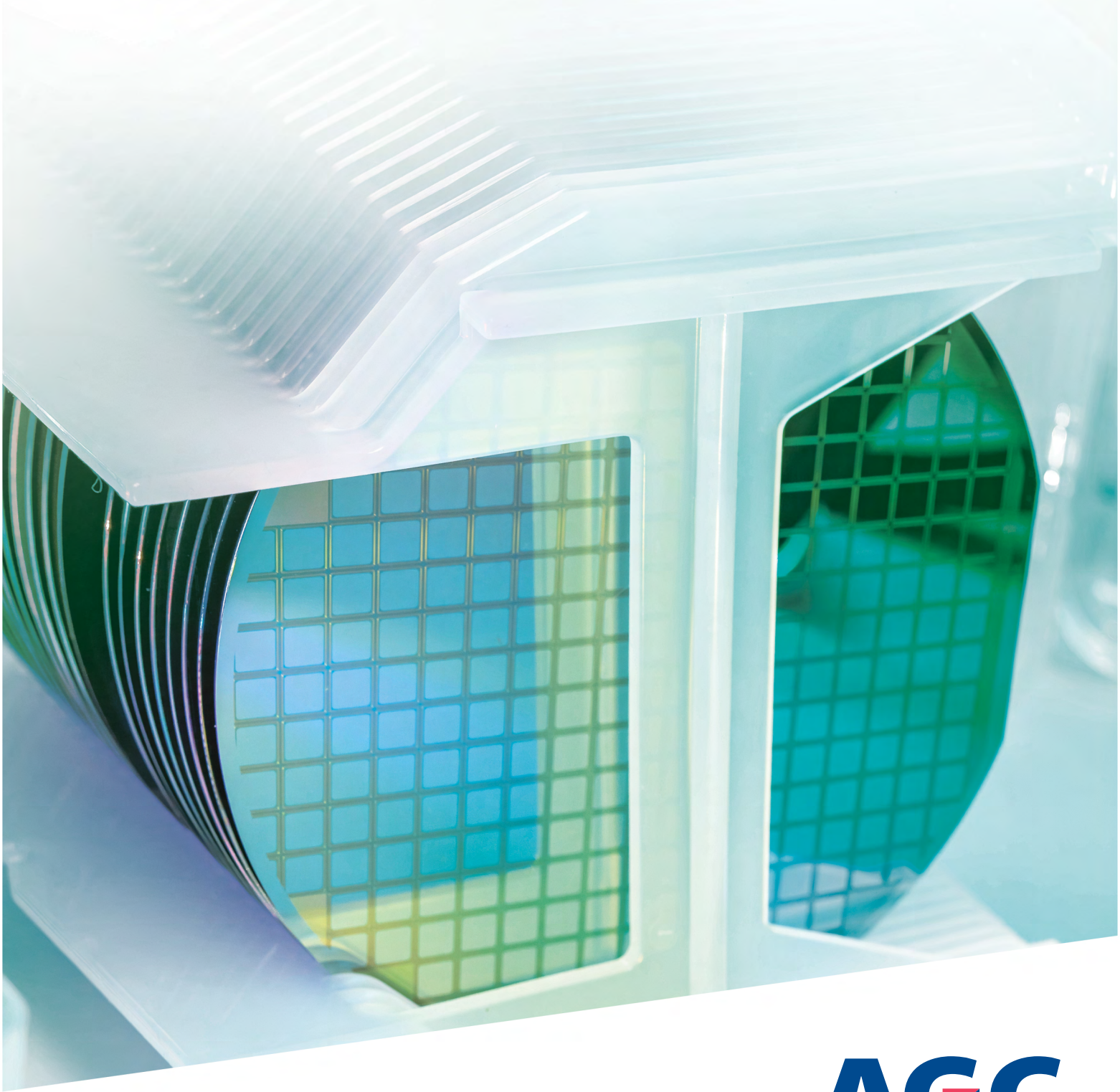
Fluon® PFA

Perfluoroalkylvinylether-Tetrafluoroethylene Copolymer



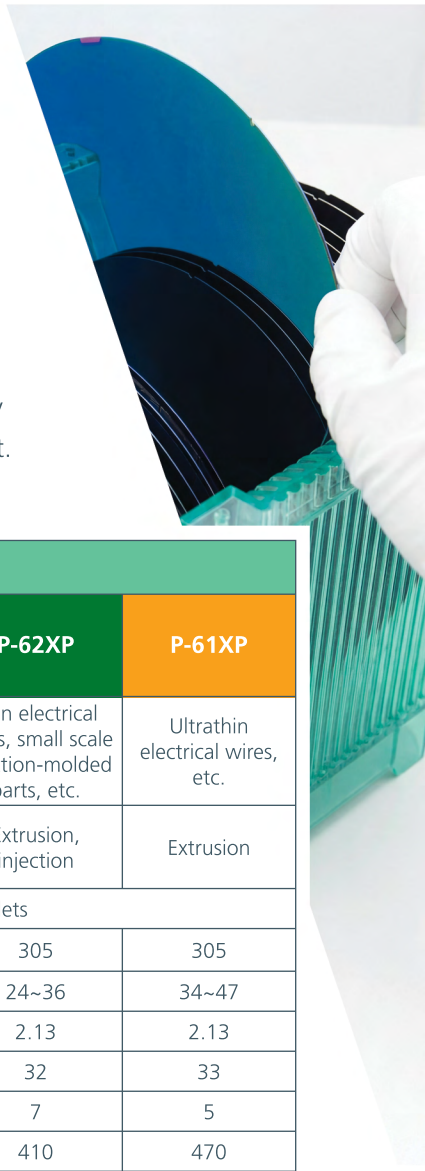
AGC

Your Dreams, Our Challenge

Fluon® PFA is a high-end fluoropolymer resin with a high degree of thermoplasticity and stability, and possesses freedom of workability.

Fluon PFA is a copolymer of tetrafluoroethylene and perfluoroalkoxyethylene. While it has similar characteristics to PTFE, it is also a thermoplastic suited to melt molding, and is compatible with a range of forming methods including injection molding, extrusion, and blow molding.

This fluoropolymer resin has excellent chemical, electrical, mechanical, and surface properties in addition to superb moldablity and workability. It can therefore be used with stability as electrical wire coating and linings, semiconductor manufacturing equipment material, in electric/electrical/ precision components, etc. even under harsh conditions such as when exposed to chemicals or heat.



Fluon PFA Grades and Specifications

	Property		Unit	ASTM Test Method	Grades P-66P	P-63P	P-62XP	P-61XP
General	Applications				Tubing, linings, etc.	Electrical wires, injection-molded parts, etc.	Thin electrical wires, small scale injection-molded parts, etc.	Ultrathin electrical wires, etc.
	Molding methods				Extrusion, transfer, blow, compression	Extrusion, injection	Extrusion, injection	Extrusion
	Form				Cylindrical pellets			
Physical	Melting point		°C		305	305	305	305
	MFR		g/10 min	D3307	1~3	7~18	24~36	34~47
	Specific gravity			D792	2.12	2.13	2.13	2.13
Mechanical	Tensile strength	23 °C	MPa	D638	40	32	32	33
		250 °C	MPa	D638	15	9	7	5
	Elongation	23 °C	%	D638	340	410	410	470
		250 °C	%	D638	830	690	600	530
	Impact strength	Izod, notched	J/m	D256A	No breakage	No breakage	No breakage	No breakage
	Hardness	Durometer		D1706	60	59	60	59
	Bending modulus		MPa	D790	600	600	600	600
	MIT		Cycles	D2176	$5.0x10^5$	$2.5x10^4$	$1.8x10^4$	$1.4x10^4$
Thermal	Thermal conductivity		W/m·°C	C177	0.25			
	Specific heat		kJ/kg·°C	-	1.05			
	Coef. of linear expansion	-15 - 150 °C	10^{-5}/°C	D696	15			
	Max. usable temperature (in combination)		°C	-	260			
Electrical	Volume resistivity		Ω·cm	D257	$>10^{17}$			
	Surface resistivity		Ω/sq	D257	$>10^{17}$			
	Dielectric constant	1 kHz		D150	<2.1			
		1 MHz		D150	<2.1			
	Dielectric tangent	1 kHz		D150	<0.0003			
		1 MHz		D150	<0.0003			
	Arc resistance		S	D495	>300			
Other	Moisture		%	D570	<0.03			
	Flammability			UL-94	V-0			
	Oxygen index			D2863	>95			

CASE 1 Injection Molding

A lineup of upgrades is available suited to injection molding. Injection molding is possible into a wide range of shapes, large or small. Resistance to acidic, alkaline, and other chemicals allows it to be used in fittings and filter bodies for semiconductor manufacturing equipment. It also has a high degree of purity and is compliant with SEMI F57 and C90 standards.

Metal Elution

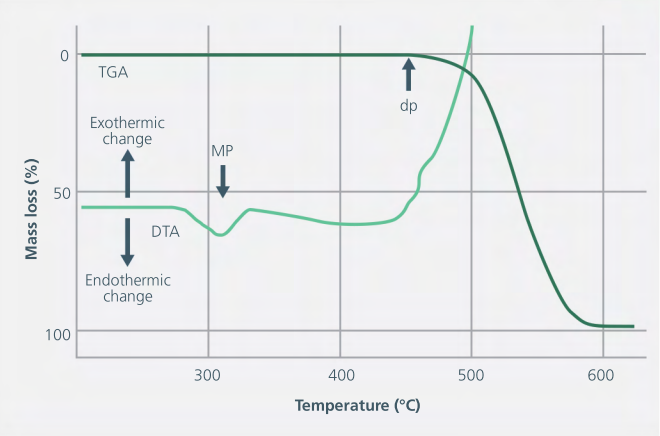
Fluon PFA is compliant with SEMI F57 standards. This polymer resin has a small level of metal elution, and has a high degree of purity.

Metal	Fluon PFA	Ref. Value	Metal	Fluon PFA	Ref. Value
Al	0.2	≤ 5	Li	< 0.1	≤ 2
As	< 0.1	≤ 2	Mg	< 0.1	≤ 2
Sb	< 0.1	≤ 2	Mn	< 0.1	≤ 5
Ba	< 0.1	≤ 15	Ni	0.1	≤ 1
B	0.1	≤ 30	K	0.3	≤ 10
Cd	< 0.1	≤ 2	Na	0.6	≤ 10
Ca	0.5	≤ 10	Sr	< 0.05	≤ 0.5
Cr	0.1	≤ 1	Ti	< 0.1	≤ 2
Cu	0.2	≤ 10	Sn	< 0.1	≤ 2
Fe	0.3	≤ 5	V	< 0.1	≤ 2
Pb	≤ 0.1	≤ 1	Zn	0.4	≤ 5

*1 Units (μg/m²)
*2 Data presented here are measured values and not guaranteed values.
This data is calculated based on the average value of n=6.

Thermal Properties

Thermal analysis behavior
Temperature rise speed: 10°C/min, in air
Melting point: 302 ~ 310°C
Starting point for loss of mass under heating: around 450°C with no residuum after decomposition at 700°C.

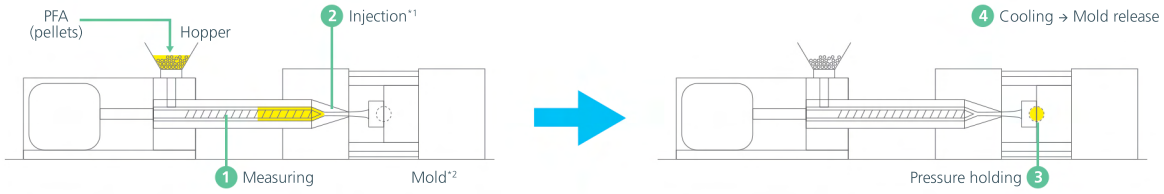


Recommended Forming Conditions

Forming conditions: P-62XP/P-63P

	Injection Machine						Mold
	C1	C2	C3	NH	Injection Speed	Pressure Holding	Temp.
P-62XP	310 °C	350 °C	385 °C	385 °C	20 mm/s	50 MPa	190 °C

Usage / Workflow



*1 Injection: Pressing of the screw outwards causes melted polymer held in the end of the cylinder to be injected into the mold
*2 Mold: For PFA polymer, the temperature of the mold can be increased to as much as 250 °C

CASE 2 Extrusion

A lineup of upgrades is available suited to extrusion molding. Extrusion is possible into a plethora of electrical wire coating shapes and a variety of tube diameters, thick or thin. Fluon PFA has excellent electrical properties, heat resistance, and mechanical strength, and can be formed into thin wire. This allows it to be used in wiring in smartphones, tablets, etc.

Electrical Properties

Dielectric constant and dielectric tangent (ASTM D150)
Figures 1 and 2 show the dependence on frequency of the dielectric constant and the dielectric tangent.

Figure 1. Dependence on frequency of dielectric constant

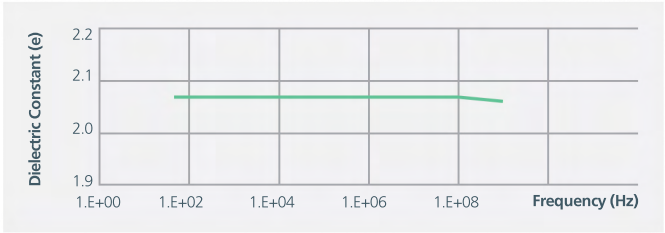
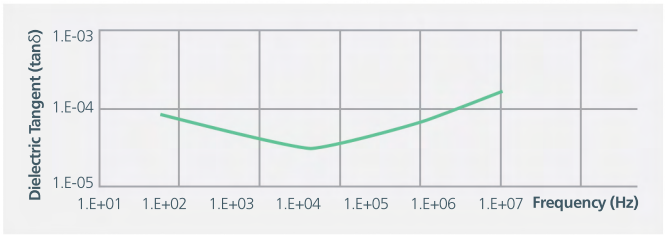


Figure 2. Dependence on frequency of dielectric tangent



Mechanical Properties

Figure 1. Dependence on temperature of tensile fracture strength

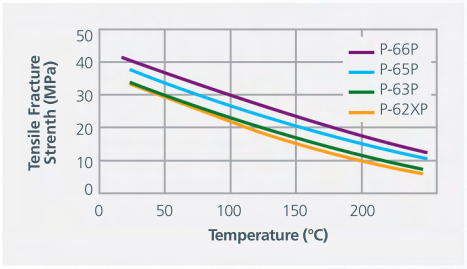
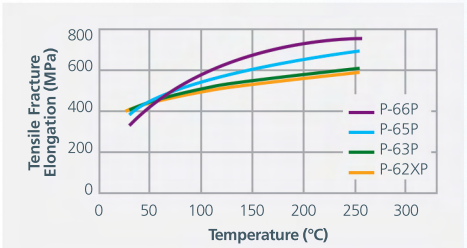


Figure 2. Dependence on temperature of tensile fracture elongation

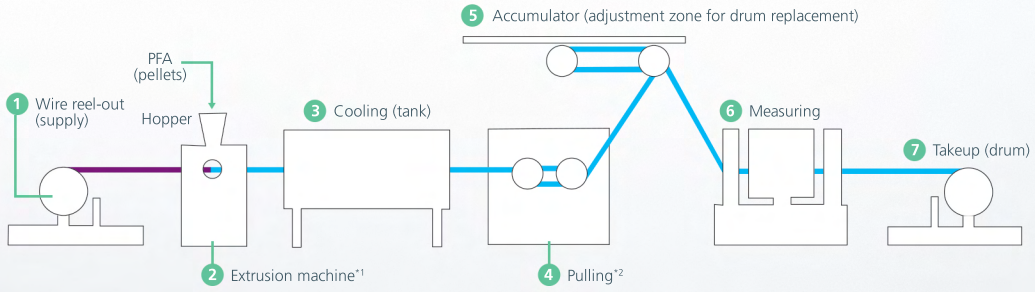


Recommended Forming Conditions

Forming conditions:
P-66P

	Extrusion Machine			Forming Temperature				
	Cylinder Diameter	Screw L/D	Screw Compression Ratio	Cylinder Rear	Cylinder Middle	Cylinder Front	Die Head	Die
P-66P	30 mm	24	3	360 °C	380 °C	380 °C	385 °C	380 °C

Usage / Workflow



*1 Extrusion machine
Mold: wire die

*2 Pulling
Controller for line speed

CASE 3 Blow molding

Resistance to acidic, alkaline and other chemical exposures are essential to blow-molded parts such as chemical bottles, fluid handling components and specialized labware.

Chemical Resistance

Fluon PFA is not affected by most chemicals, and can be used for extended periods under harsh conditions. This has allowed it to be used in semiconductor manufacturing processes and chemical industries where chemical resistance is required.

* Data presented here are measured values and not guaranteed values.

Chemical	Temperature (°C)	Time (days)	Tensile elongation retention (%)
Sulfuric acid/hydrogen peroxide	150	28	103
Fuming nitric acid	25	28	91
Concentrated hydrochloric acid	100	28	105
Ethanol	78	7	124
Acetone	56	7	119
Carbon tetrachloride	78	7	116
Chloroform	61	7	109
Toluene	110	7	111
Xylene	138	7	104
Benzene	80	7	108
n-hexane	64	7	100
Methyl ethyl ketone	80	7	94
Ethyl acetate	77	7	100
Aniline	185	7	97
Phenol	182	7	94

Formability

Figure 1.
Dependence on shear rate of melt viscosity (for P-63P)

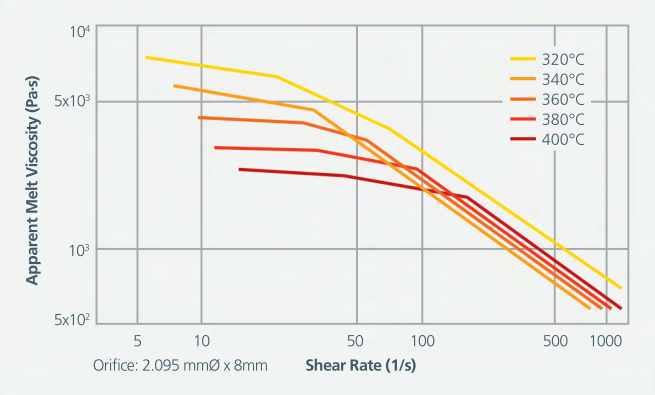
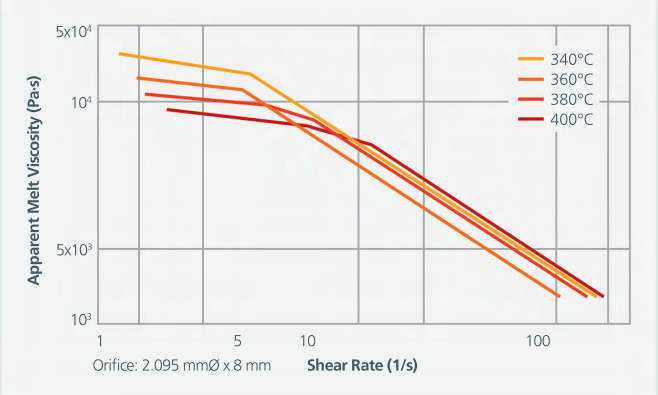
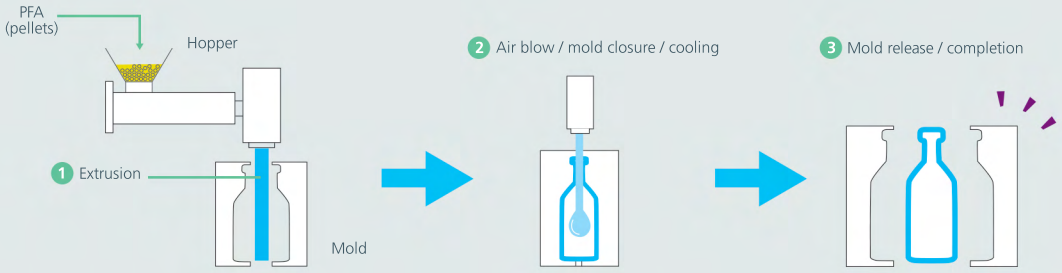


Figure 2.
Dependence on shear rate of melt viscosity (for P-66P)



Usage / Workflow



AGC Chemicals Company
AGC Inc.
Shin-Marunouchi Bldg.
1-5-1 Marunouchi
Chiyoda-ku, Tokyo
100-8405 Japan
Tel: +81-3-3218-5438
www.agc-chemicals.com

AGC Chemicals Europe, Ltd.
Hillhouse International
Fleetwood Road North
Thornton-Cleveleys
FY5 4QD
United Kingdom
Tel: +44 (0) 1253 209560
www.agcce.com

AGC Vidros do Brasil Ltda.
Estrada Municipal Doutor Jaime
Eduardo Ribeiro Pereira, 500
Jardim Vista Alegre
Guaratinguetá, SP, Brasil
CEP 12523-671
Tel: +55 12 3127-7100
www.agcchem.com/pt-br/

AGC Asia Pacific Pte., Ltd.
460 Alexandra Road
#32-01 mTower
Singapore 119963
Tel: +65 6273 5656
www.agc-asiapacific.com

AGC Chemicals Europe, Ltd.
Commercial Centre
World Trade Center, Zuidplein 80
1077 XV Amsterdam, Netherlands
Tel: +31-(0)-20-880-41-70
www.agcce.com

AGC Chemicals Trading
(Shanghai) Co., Ltd.
Room 4008/09, F40, T1
Raffles City Changning
No.1133 Changning Road
Shanghai, China 200051
Tel: +86-21-6386-2211
www.agcsh.com

AGC Chemicals
(Thailand) Co., Ltd.
944 Mitrtown Office Tower, 14th Floor
Rama 4 Road, Wangmai Sub-District
Pathumwan District, Bangkok 10330
Thailand
Tel: +66-2-092-6499
www.acth.co.th

Chemistry
for a Blue Planet
AGC Chemicals

AGC

AGC Chemicals Americas, Inc.
55 E. Uwchlan Avenue, Suite 201
Exton, PA 19341
United States of America

Telephone: +1 610-423-4300
Toll Free (US only): 800-424-7833
Fax: +1 610-423-4305

www.agcchem.com
Visit our website for compliance information and industry certifications.