SOLVAY

asking more from chemistry®

Halar® ECTFE

Typical Properties

SPECIALTY POLYMERS

Halar® ECTFE

A Unique Combination of Properties

Halar® ECTFE is a melt-processable fluoropolymer offering a unique combination of properties thanks to its chemical structure which alternates copolymers of ethylene and chlorotrifluoroethylene.

- Excellent chemical resistance (pH 1 – 14)
- Excellent barrier properties
- Good electrical properties
- Broad use temperature range from cryogenic to 150 °C
- UL-94 V-0 vertical burn at 0.18 mm
- Low flame spread, low smoke generation
- Excellent impact strength
- Good mechanical properties
- Excellent abrasion resistance
- Exceptional surface smoothness
- Excellent weathering resistance

Halar® ECTFE is available in a range of viscosities for extrusion and molding applications. Halar® powders are available in different particle sizes optimized for specific coating processes.

Halar® ECTFE is a thermoplastic resin that can be processed by any technique applicable to polyethylene, including:

- Injection molding
- Extrusion
- Blow molding
- Rotomolding
- Electrostatic powder coating

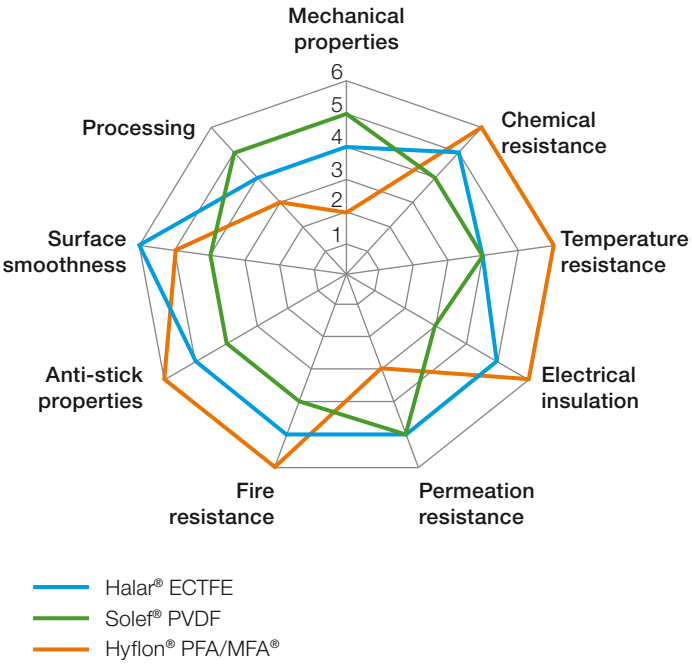
Halar® ECTFE is widely used in the Chemical Processing industry, the high purity Semiconductor market, the Wire and Cable market, the Pharmaceutical industry, Films and a variety of other demanding filtration and corrosion protection market applications.

Halar® ECTFE forms part of the Solvay Specialty Polymers' range of fluoropolymers, all of which are easily processed by injection, extrusion and all conventional processing techniques.

The fluoropolymer range also includes:

- Solef® PVDF (polyvinylidene fluoride)
- Hyflon® PFA/MFA® (copolymer of tetrafluoroethylene and perfluoroalkylvinylethers)
- Hylar® PVDF for coating applications

Relative performance of melt processable fluoropolymers



Halar® ECTFE grades

Grade	Description
Halar® 902	Pellets for sheet extrusion and compression molding
Halar® 901	Pellets for sheet/pipe extrusion and compression molding
Halar® 300DA	Pellets for film/tube extrusion, Wire & Cable and injection molding
Halar® 350LC	Pellets for film/tube extrusion, Wire & Cable and injection molding
Halar® 500LC	Pellets for Wire & Cable and injection molding
Halar® 513LC	Pellets for monofilament extrusion
Halar® 1450LC	Pellets for fiber extrusion and injection molding
Halar® 1400LC	Pellets for melt blown fibers

Typical Properties of Halar® ECTFE Grades

	Unit	Halar® 902	Halar® 901	Halar® 300DA[1]	Halar® 350LC	Test Method
Physical properties						
Density at 23 °C/73 °F	g/cm³ (lb/ft³)	1.68 (105)	1.68 (105)	1.68 (105)	1.68 (105)	ASTM D792
Water absorption (24 h at 23 °C/73 °F)	%	< 0.1	< 0.1	< 0.1	< 0.1	ASTM D570
Melt flow index (275 °C/527 °F)	g/10 min					ASTM D1238
2.16 kg		–	1	2	4	
5 kg		1	–	–	–	
Mechanical properties						
Tensile at 23 °C/73 °F						
Stress at yield	MPa (psi)	30 (4,300)	30 (4,300)	30 (4,300)	30 (4,300)	ASTM D3275
Stress at break	MPa (psi)	47 (6,800)	54 (7,800)	54 (7,800)	54 (7,800)	ASTM D3275
Elongation at yield	%	5	5	5	5	ASTM D3275
Elongation at break	%	250	250	250	250	ASTM D3275
Modulus (1 mm/min)	MPa (kpsi)	1,655 (240)	1,655 (240)	1,655 (240)	1,655 (240)	ASTM D638
Flexural at 23 °C/73 °F						ASTM D790
Strength (2.5 mm/min)	MPa (psi)	47 (6,800)	47 (6,800)	47 (6,800)	47 (6,800)	
Modulus (2.5 mm/min)	MPa (kpsi)	1,690 (245)	1,690 (245)	1,690 (245)	1,690 (245)	
IZOD impact (notched V 10 mm, 23 °C/73 °F, 3.2 mm thick)	J/m (ft·lbf/in)	no break	no break	no break	no break	ASTM D256
IZOD impact (notched V 10 mm, –40 °C/–40 °F, 3.2 mm thick)	J/m (ft·lbf/in)	65 (1.22)	110 (2.06)	105 (1.96)	95 (1.78)	ASTM D256
Shore D hardness (2 mm thick)		75	75	75	75	ASTM D2240
Rockwell R hardness		90	90	90	90	ASTM D785
Abrasion resistance	mg/1,000 rev	25–35	25–35	25–35	25–35	TABER CS 17, 1 kg
Friction coefficient	static dynamic	0.2 0.2	0.2 0.2	0.2 0.2	0.2 0.2	ASTM D1894

[1] *Halar® "DA" grades comply with the FDA's Register of Food Additive Regulations, Sec. 21 CFR 177.1380 (suitable for repeated use applications at temperatures up to 100 °C (212 °F) in contact with non-fatty foods)*

	Unit	Halar® 902	Halar® 901	Halar® 300DA	Halar® 350LC	Test Method
Thermal properties						
Crystallinity by DSC						ASTM D3418
Melting point	°C (°F)	225 (436)	242 (468)	242 (468)	242 (468)	
Heat of fusion (80 °C/176 °F to end of melting)	J/g (BTU/lb)	28 (12)	42 (18)	42 (18)	42 (18)	
Crystallization point	°C (°F)	205 (400)	222 (432)	222 (432)	222 (432)	
Crystallization heat	J/g (BTU/lb)	28 (12)	40 (17)	40 (17)	40 (17)	
Deflection temperature (4 mm thick, load 1 kg)						ASTM D648
Load 0.46 MPa	°C (°F)	90 (195)	90 (195)	90 (195)	90 (195)	
Load 1.82 MPa	°C (°F)	65 (150)	65 (150)	65 (150)	65 (150)	
Glass transition (Tg)	°C (°F)	85 (185)	85 (185)	85 (185)	85 (185)	DMTA
Brittleness temperature (on 2 mm pressed sheet)	°C (°F)	< –76 (< –105)	< –76 (< –105)	< –76 (< –105)	< –76 (< –105)	ASTM D746A
Molding shrinkage (linear)	%	2.5	2.5	2.5	2.5	
Thermal stability	°C (°F)	405 (760)	405 (760)	405 (760)	405 (760)	TGA, 1 % Mass loss, N_2
Linear thermal expansion coefficient	10^{-6}/K (10^{-6}/°F)	100 (56)	100 (56)	100 (56)	100 (56)	ASTM D696
Thermal conductivity at 40 °C/104 °F	W/m·K (BTU·in/h·ft²·°F)	0.15 (1.05)	0.15 (1.05)	0.15 (1.05)	0.15 (1.05)	ASTM C177
Specific heat at 23 °C/73 °F	J/g·K (BTU/ lb·°F)	0.95 (0.23)	0.95 (0.23)	0.95 (0.23)	0.95 (0.23)	
Electrical properties						
Volume resistivity (intensity at 23 °C/73 °F, 50 % RH)	Ω·cm (Ω·inch)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	ASTM D257
Dielectric strength at 23 °C/73 °F, 3.2 mm thick	kV/mm (V/mil)	14 (350)	14 (350)	14 (350)	14 (350)	ASTM D149
Dielectric constant at 23 °C/73 °F, 10^6 HZ		2.57	2.57	2.57	2.57	DIN 53483
Fire resistance						
UL-94 flammability test	Class	V–0	V–0	–	V–0	UL-94
Limiting oxygen index (sheet 3 mm thick)	%	52	52	52	52	ASTM D2863

	Unit	Halar® 500LC[2]	Halar® 513LC	Halar® 1450LC	Halar® 1400LC	Test Method
Physical properties						
Density at 23 °C/73 °F	g/cm³ (lb/ft³)	1.68 (105)	1.68 (105)	1.68 (105)	1.68 (105)	ASTM D792
Water absorption (24 h at 23 °C/73 °F)	%	< 0.1	< 0.1	< 0.1	< 0.1	ASTM D570
Melt flow index (275 °C/527 °F)	g/10 min					ASTM D1238
2.16 kg		18	19	50	500	
5 kg		–	–	–	–	
Mechanical properties						
Tensile at 23 °C/73 °F						
Stress at yield	MPa (psi)	30 (4,300)	30 (4,300)	30 (4,300)	30 (4,300)	ASTM D3275
Stress at break	MPa (psi)	47 (6,800)	54 (7,800)	54 (7,800)	29 (4,206)	ASTM D3275
Elongation at yield	%	5	5	5	10	ASTM D3275
Elongation at break	%	250	250	250	10	ASTM D3275
Modulus (1 mm/min)	MPa (kpsi)	1,655 (240)	1,655 (240)	1,655 (240)	1,780 (258)[3]	ASTM D638
Flexural at 23 °C/73 °F						ASTM D790
Strength (2.5 mm/min)	MPa (psi)	47 (6,800)	47 (6,800)	47 (6,800)	47 (6,800)	
Modulus (2.5 mm/min)	MPa (kpsi)	1,690 (245)	1,690 (245)	1,690 (245)	1,690 (245)	
IZOD impact (notched V 10 mm, 23 °C/73 °F, 3.2 mm thick)	J/m (ft·lbf/in)	no break	no break	no break	25 (0.47)	ASTM D256
IZOD impact (notched V 10 mm, –40 °C/–40 °F, 3.2 mm thick)	J/m (ft·lbf/in)	50 (0.93)	50 (0.93)	35 (0.65)	19 (0.36)	ASTM D256
Shore D hardness (2 mm thick)		75	75	75	69	ASTM D2240
Rockwell R hardness		90	90	90	73	ASTM D785
Abrasion resistance	mg/1,000 rev	25–35	25–35	25–35	25–35	TABER CS 17, 1 kg
Friction coefficient	static dynamic	0.2 0.2	0.2 0.2	0.2 0.2	0.2 0.2	ASTM D1894

[2] *Based on the same resin, two special grades were developed:*
1. *Halar® 558 is a foamable grade for wire coating*
2. *Halar® 5001LC is a powder grade for masterbatches/compound formulation*

[3] *50 mm/min*

	Unit	Halar® 500LC	Halar® 513LC	Halar® 1450LC	Halar® 1400LC	Test Method
Thermal properties						
Crystallinity by DSC						ASTM D3418
Melting point	°C (°F)	242 (468)	242 (468)	242 (468)	242 (468)	
Heat of fusion (80 °C/176 °F to end of melting)	J/g (BTU/lb)	42 (18)	42 (18)	42 (18)	42 (18)	
Crystallization point	°C (°F)	222 (432)	222 (432)	222 (432)	222 (432)	
Crystallization heat	J/g (BTU/lb)	40 (17)	40 (17)	40 (17)	40 (17)	
Deflection temperature (4 mm thick, load 1 kg)						ASTM D648
Load 0.46 MPa	°C (°F)	90 (195)	90 (195)	90 (195)	109 (228)	
Load 1.82 MPa	°C (°F)	65 (150)	65 (150)	65 (150)	68 (154)	
Glass transition (Tg)	°C (°F)	85 (185)	85 (185)	85 (185)	85 (185)	DMTA
Brittleness temperature (on 2 mm pressed sheet)	°C (°F)	< –76 (< –105)	< –76 (< –105)	< –76 (< –105)	20 (68)	ASTM D746A
Molding shrinkage (linear)	%	2.5	2.5	2.5	2.5	
Thermal stability	°C (°F)	405 (760)	405 (760)	405 (760)	300 (572)	TGA, 1 % Mass loss, N_2
Linear thermal expansion coefficient	10^{-6}/K (10^{-6}/°F)	100 (56)	100 (56)	100 (56)	100 (56)	ASTM D696
Thermal conductivity at 40 °C/104 °F	W/m·K (BTU·in/h·ft²·°F)	0.15 (1.05)	0.15 (1.05)	0.15 (1.05)	0.15 (1.05)	ASTM C177
Specific heat at 23 °C/73 °F	J/g·K (BTU/lb·°F)	0.95 (0.23)	0.95 (0.23)	0.95 (0.23)	0.95 (0.23)	
Electrical properties						
Volume resistivity (intensity at 23 °C/73 °F, 50 % RH)	Ω·cm (Ω·inch)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	$5.5 \cdot 10^{16}$ ($2.16 \cdot 10^{16}$)	ASTM D257
Dielectric strength at 23 °C/73 °F, 3.2 mm thick	kV/mm (V/mil)	14 (350)	14 (350)	14 (350)	14 (350)	ASTM D149
Dielectric constant at 23 °C/73 °F, 10^6 HZ		2.57	2.57	2.57	2.57	DIN 53483
Fire resistance						
UL-94 flammability test	Class	V–0	V–0	–	V–0	UL-94
Limiting oxygen index (sheet 3 mm thick)	%	52	52	52	52	ASTM D2863

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Specialty Polymers

Worldwide Headquarters
SpecialtyPolymers.EMEA@solvay.com
Viale Lombardia, 20
20021 Bollate (MI), Italy

Americas Headquarters
SpecialtyPolymers.Americas@solvay.com
4500 McGinnis Ferry Road
Alpharetta, GA 30005, USA

Asia Headquarters
SpecialtyPolymers.Asia@solvay.com
No.3966 Jindu Road
Shanghai, China 201108

www.solvay.com

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