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What is ECTFE EN

ECTFE

ECTFE / E-CTFE (ethylene chlorotrifluoroethylene) – semi-crystalline high-performance fluoropolymer, chemically resistant, tough and flame-retardant

ECTFE (ethylene chlorotrifluoroethylene, also E-CTFE) is a semi-crystalline fluoropolymer from the family of high-performance plastics. It combines outstanding chemical resistance – including against strong alkalis, to which many other fluoropolymers are more sensitive – with exceptionally high toughness and low-temperature impact strength, high purity and very good weathering resistance. ECTFE is also inherently flame-retardant (UL 94 V-0) with low smoke generation.

Classification and basic character

ECTFE belongs to the group of fluoropolymers and is an alternating copolymer of ethylene and chlorotrifluoroethylene. This structure gives it high chemical and thermal resistance combined with very high toughness and impact strength – even at low temperatures down to about -50 °C. Unlike more brittle-appearing fluoropolymers, ECTFE is remarkably ductile with around 250 % elongation at break. It can be machined and welded, absorbs virtually no moisture and is high-purity.

Chemical resistance, purity and fire behaviour

The outstanding feature of ECTFE is its very broad chemical resistance: it withstands strong acids, halogens such as chlorine, oxidising agents and – unlike PVDF – also strong alkalis and amines. Added to this are very high purity with low permeation and outgassing as well as excellent weathering and UV resistance. ECTFE is inherently flame-retardant (UL 94 V-0) with low smoke generation and is therefore frequently used in the semiconductor industry, cleanroom technology and chemical plant engineering as a lining and component.

How ECTFE is made and processed

ECTFE is produced by copolymerisation of ethylene and chlorotrifluoroethylene. From the raw polymer, semi-finished stock such as plates, round bars and tubes is extruded or pressed; in addition, ECTFE is used as a powder coating and lining for apparatus. From the semi-finished stock we machine precision parts – turning, milling, drilling and sawing produce clean results. ECTFE can also be welded. As it absorbs virtually no moisture, components are dimensionally stable.

Mechanical, thermal and electrical properties

ECTFE reaches a yield stress of about 30 MPa with a tensile modulus around 1,500 MPa and a density of about 1.71 g/cm³. Characteristic is the very high elongation at break of about 250 % and the excellent low-temperature impact strength – ECTFE is tough and impact-resistant rather than brittle. The service temperature ranges from about -50 °C up to a continuous +150 °C, short-term to around 180 °C – higher than PVDF. Electrically, ECTFE is a good insulator with high resistivity. The material is inherently flame-retardant (UL 94 V-0).

When ECTFE is the right choice

ECTFE is worthwhile whenever the highest chemical resistance – including against strong alkalis – must be combined with toughness, purity and fire safety – for example:

- Linings and components for aggressive media, chlorine and oxidising agents
- Components for the semiconductor industry and cleanroom technology (high-purity, low outgassing)
- Components requiring fire safety and low smoke generation
- Applications with low-temperature impact and outdoor weathering loads
- Chemical plant engineering with media that attack PVDF (strong bases, amines)

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When ECTFE is NOT the right choice

Equally important are the limits of the material:

- High mechanical load or stiffness requirements – moderate modulus and yield stress; then PVDF, PEEK or filled materials
- Very tight budget – ECTFE is an expensive high-performance fluoropolymer
- Continuous service above about 150 °C – then PTFE/PFA or PEEK
- When PVDF is sufficient at lower cost (provided no strong alkalis are involved)

What does ECTFE cost?

ECTFE is a high-performance fluoropolymer and is priced considerably above PVDF and most engineering plastics. As a rough guide, semi-finished stock prices are in the range of about 40–90 €/kg. The component price is determined mainly by the semi-finished shape and dimension, material utilisation (offcut), machining effort and lot size. We are happy to quote binding prices on request based on your drawing.

Machining at Liedtke

ECTFE machines well – turning, milling, drilling and sawing produce clean results. As ECTFE absorbs virtually no moisture, the components are dimensionally stable; we ensure sufficient cooling and adapted cutting parameters to avoid heat build-up. Because of its high toughness, we use sharp tools. This is how we reliably produce precision parts for chemical, semiconductor and cleanroom applications – from single pieces to series production.

Advantages and disadvantages at a glance

An honest assessment – and how the disadvantages can be mitigated in practice:

Advantages

- Outstanding chemical resistance – including against strong alkalis
- Very high toughness and low-temperature impact strength (down to -50 °C)
- Inherently flame-retardant (UL 94 V-0), low smoke generation
- High purity – ideal for semiconductor and cleanroom
- High continuous service temperature (up to 150 °C) and good weathering resistance

Disadvantages

- Moderate strength and stiffness (tensile modulus around 1,500 MPa)
- High price – expensive high-performance fluoropolymer
- Continuous service limited to about 150 °C
- Combustion products contain hydrogen fluoride and hydrogen chloride – observe fire safety

Practical tip: ECTFE plays to its strengths wherever aggressive media – especially strong alkalis – meet toughness, purity and fire safety, for example in semiconductor manufacturing or chemical lining construction. Where the resistance of PVDF is sufficient and no strong bases are involved, PVDF is more economical; for higher temperatures, PTFE/PFA or PEEK are options.

Typical Properties

- Outstanding chemical resistance (incl. strong alkalis)
- Very high toughness and low-temperature impact strength
- Inherently flame-retardant (UL 94 V-0)
- High purity
- High continuous service temperature (up to 150 °C)
- Good weathering and UV resistance

Product Examples

- Linings and coatings for apparatus
- Components for aggressive media, chlorine and oxidising agents
- Wet-bench and cleanroom components for semiconductors
- Pipes, fittings and sealing elements in chemical processing
- Fire-safety-critical components with low smoke generation

Typical Industries

- Chemical plant engineering
- Semiconductor industry
- Cleanroom technology
- Electronics
- Food industry
- Environmental and process engineering

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- Machinable and weldable
- Electrically insulating
- Weathering-resistant outdoor components

	Test Method	Unit	Value
General Properties			
Density	DIN EN ISO 1183-1	g / cm^3	1.71
Flammability (thickness 3 mm / 6 mm)	UL 94		V0 / V0
Mechanical Properties			
Yield stress	DIN EN ISO 527	MPa	30
Elongation at break	DIN EN ISO 527	%	250
Tensile modulus	DIN EN ISO 527	MPa	1500
Shore hardness	DIN EN ISO 868	scale D	71
Thermal Properties			
Melting temperature	ISO 11357-3	°C	230
Coefficient of linear thermal expansion	DIN 53752	10^{-6} / K	90
Service temperature, long-term	Average	°C	-50 ... 150
Service temperature, short-term (max.)	Average	°C	180
Heat deflection temperature	DIN EN ISO 75, method A, HDT	°C	70
Electrical Properties			
Volume resistivity	DIN EN 62631-3-1	Ω * cm	10^{15}
Surface resistivity	DIN EN 62631-3-2	Ω	10^{13}
Dielectric strength	IEC 60243	kV / mm	15

The values stated are typical average values for ECTFE natural; they serve as an aid to material selection and are not a legally binding warranty of specific properties. ECTFE is resistant to a very wide range of chemicals, including strong alkalis – media resistance must be verified case by case. Price information is a rough, non-binding guide and may vary depending on market situation, grade, dimension and quantity.

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