

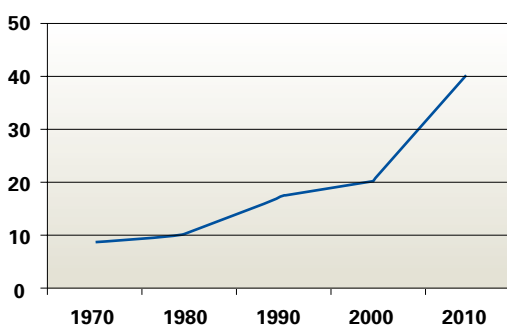


## Plastics in aviation and aerospace applications.



The dream of flying would quickly become a thing of the past without today's plastics. This is easily substantiated by a casual glance at the inside of a modern aeroplane. The use of plastics makes planes lighter, safer and more economical. This is by no means the case for just the interior, however, but also for sophisticated technical parts, structural elements and propulsion components, for example.

More recently, the significance of technical plastics and composites in aviation and aerospace applications has grown rapidly.



Development of the weight of technical plastics and composites [in %] used in commercial aeroplanes

### Areas of application for plastics in aviation and aerospace

Interior components, technical parts, structural elements as well as components for navigation, propulsion engineering and satellite technology.

### Advantages of plastics

- | Every extra kilogramme a plane weights costs energy to move it and thus money. The use of modern polymer materials and reinforcing fibres makes it possible to achieve lightweight constructions and hence fuel savings
- | Plastic components can normally be fabricated economically
- | Plastics are approx. 50% lighter than aluminium
- | Compared to metals, plastics do not corrode
- | Plastics provide a high degree of freedom in design
- | Plastics with modified sliding properties are best suited for use in dry operation under extreme conditions
- | Transparent plastics serve as lighter and more impact resistant alternatives to glass

### Properties of high-performance plastics

- | High thermal and mechanical stability
- | Inherently flame retardant
- | Low degree of thermal expansion
- | High chemical resistance even at raised temperatures
- | Low level of outgassing in vacuum
- | Good electrical insulation

### Approvals

Before plastics are approved for applications in aviation and aerospace, they normally have to undergo testing which is specific for the components.

ENSINGER processes special high-performance plastics to satisfy special needs, which meet the high standards and fulfill the requirements of QSF-B, AS 9100, OSU, ABD 0031 or FAR 25.853. TECAPEEK® products are qualified according to IPS 04-06-004-01 specifically for interior Airbus applications.

## ENSINGER Plastics for aviation and aerospace.

### | VESPEL®/SINTIMID

Materials with a continuous service temperature of 300 °C. High strength, rigidity and creep strength. Good chemical resistance and excellent sliding properties for specific grades. Excellent electrical insulation properties and inherently flame retardant. May be used in cryogenic applications. High degree of purity and low out-gassing in vacuum.

### | TORLON®

High mechanical strength and toughness. Very good creep resistance, low thermal expansion and high thermal resistance. Good mechanical values up to temperatures of 260 °C. Good frictional characteristics for special types. May be used in cryogenic applications. Good chemical resistance and inherently flame retardant.

### | TECAPEEK

Semi-crystalline plastic with high strength, rigidity and hardness. Continuous service temperature up to 260 °C. Resistant to many different types of hydraulic fluid (Skydrol) and chemicals, also at high temperatures. Excellent dimensional stability and very good sliding properties for special types. Inherently flame retardant. Extremely low smoke gas emission and density, as well as extremely low toxicity of the smoke gases.

### | TECATRON/TECATRON VF

Plastic with very high strength, rigidity and hardness. Continuous service temperature of 230 °C. Excellent chemical resistance even at high temperatures. Excellent dimensional stability and low water absorption. Inherently flame retardant. Very good creep resistance.

### | TECASON P VF

Very good creep strength and extremely impact resistant. Outstanding resistance to fluids used in the aerospace industry. Highly resistant to radiation (gamma, X-rays, etc.). Extremely low smoke gas emission and density. Inherently flame retardant.

### | TECAPEI

Amorphous plastic with high strength and continuous service temperature of 170 °C. Good chemical resistance to many substances, such as fully halogenated hydrocarbons, alcohols and aqueous solutions. Excellent dimensional stability. Inherently flame retardant. Extremely low smoke gas emission and density, as well as extremely low toxicity of the smoke gases.

### | TECAMAX SRP

Amorphous plastic with extremely high strength and hardness without the use of fillers. Continuous service temperature of 140 °C. Very good chemical resistance and outstanding cryogenic properties. Very good scratch resistance. Inherently flame retardant, extremely low smoke gas emission and density.



Sensor plate  
**TECAPEEK GF 30.**



Attenuation tube  
**TECAFORM AH**



Twin Pulley  
**TECAPEI GF 30**



Output Pulley  
**TECAPEI GF 30**



S-frequency aerial for satellites  
**TECAPEEK and VESPEL® SP1**

## Process engineering to match the highest demands.



Perfect products are the result of highly precise production processes and the most modern process technology. The comprehensive know-how of ENSINGER's industrial specialists in conjunction with engineering expertise makes technically demanding and customised solutions possible. All processes are subject to continuous quality assurance. Thanks to the global sales network, our products reach you anywhere and on time every time.

### Extrusion

ENSINGER extrudes semi-finished goods from more than 100 different thermoplastics as rods, sheets and tubes in the dimensions the customer requires and as stock items. Many years of experience and the most modern equipment ensure the highest quality of all products, as well as individually adaptable material properties.

### Machining

Small parts and large size components can be economically produced on the most modern CNC-controlled processing centres and cycle-controlled automatic turning lathes. Lot sizes are irrelevant. Complex geometries are possible with simultaneous four and five-axis processing.

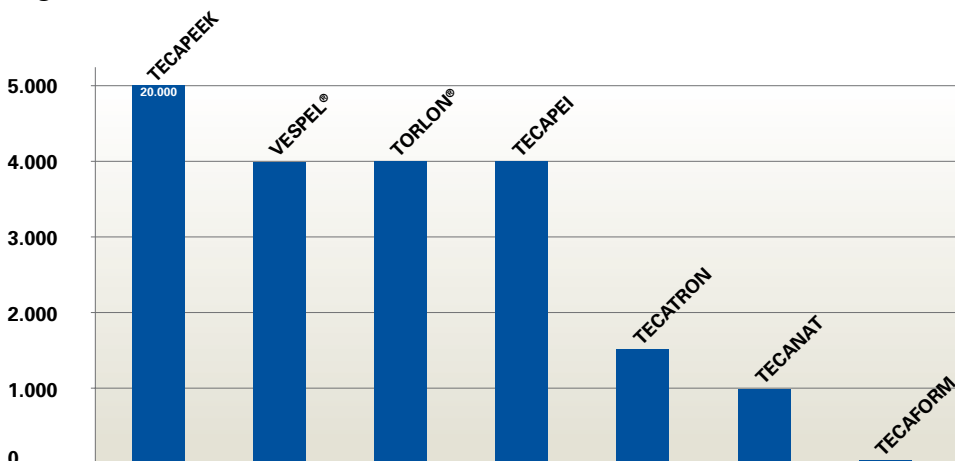
### Injection moulding

We produce high-precision and demanding geometries for large volume production using injection moulding. These are used, for example, in holding fixtures or material handling equipment.

### Industrial profiles

ENSINGER demonstrates its high level of expertise in the production of special profiles and special tubes. Solid profiles, hollow chamber profiles and particularly thin-walled profiles are manufactured for this purpose from specially adapted materials.

### Highest radiation resistance



Approximate values:  
Dosage in kGy, which reduce elongation by 25%.

## Outstanding properties and top performance for your safety.



### Outstanding resistance to chemicals

High-performance plastics have to show special properties in their resistance to chemicals, in order to be used in the aviation and aerospace industry. This depends on the state of the part, the geometry and the internal stress of the materials. Our plastics satisfy these requirements. It is recommended that a test for suitability is carried out for definite applications, taking into account the resistance at different temperatures, concentrations, residence times and mechanical loads.

		Resistance to acids	Resistance to alkalis	Resistance to solvents	Resistance to stress cracking
<b>VESPEL®</b>	PI	+	0	++	++
<b>SINTIMID</b>	PI	+	0	++	++
<b>TORLON®</b>	PAI	+	+	++	++
<b>TECAPEEK</b>	PEEK	+	++	++	++
<b>TECATRON VF</b>	PPS	+	++	++	++
<b>TECASON P VF</b>	PPSU	+	+	0	0
<b>TECAPEI</b>	PEI	0	+	+	0
<b>TECAMAX SRP</b>	PPP	++	++	+	+

Chemical resistance according to different temperatures, residence times, concentrations and the geometry of the parts (possibly internal stress)  
 ++ good resistance + resistant 0 limited resistance

### Safety through special fire protection properties

For certain plastic applications, high requirements are placed on flame retardant properties. ENSINGER plastics satisfy the current flammability ratings for aviation and aerospace purposes.

	Name of raw material		Manufacturer of raw material	UL 94	FAR 25.853	ABD 0031	ATS 1000.001	Remarks
<b>VESPEL®</b>	VESPEL®	PI	DuPont	V-0	No data	No data	No data	
<b>SINTIMID</b>	SINTIMID	PI	Degussa	V-0	No data	No data	No data	
<b>TORLON®</b>	Torlon®	PAI	Solvay	V-0	No data	No data	No data	only injection moulding
<b>TECAPEEK</b>	VICTREX® PEEK™	PEEK	Victrex	V-0	Yes	Yes	Yes	
<b>TECATRON VF</b>	Fortron®	PPS	Ticona	V-0	No data	No data	No data	
<b>TECASON P VF</b>	Radel R®	PPSU	Solvay	V-0	Yes	No data	Yes	R7700 series
<b>TECAPEI</b>	Ultem®	PEI	GE Plastic	V-0	Yes	Yes	No data	
<b>TECAMAX SRP</b>	Primospire™SRP	PPP	Solvay	V-0	No data	Yes	No data	





