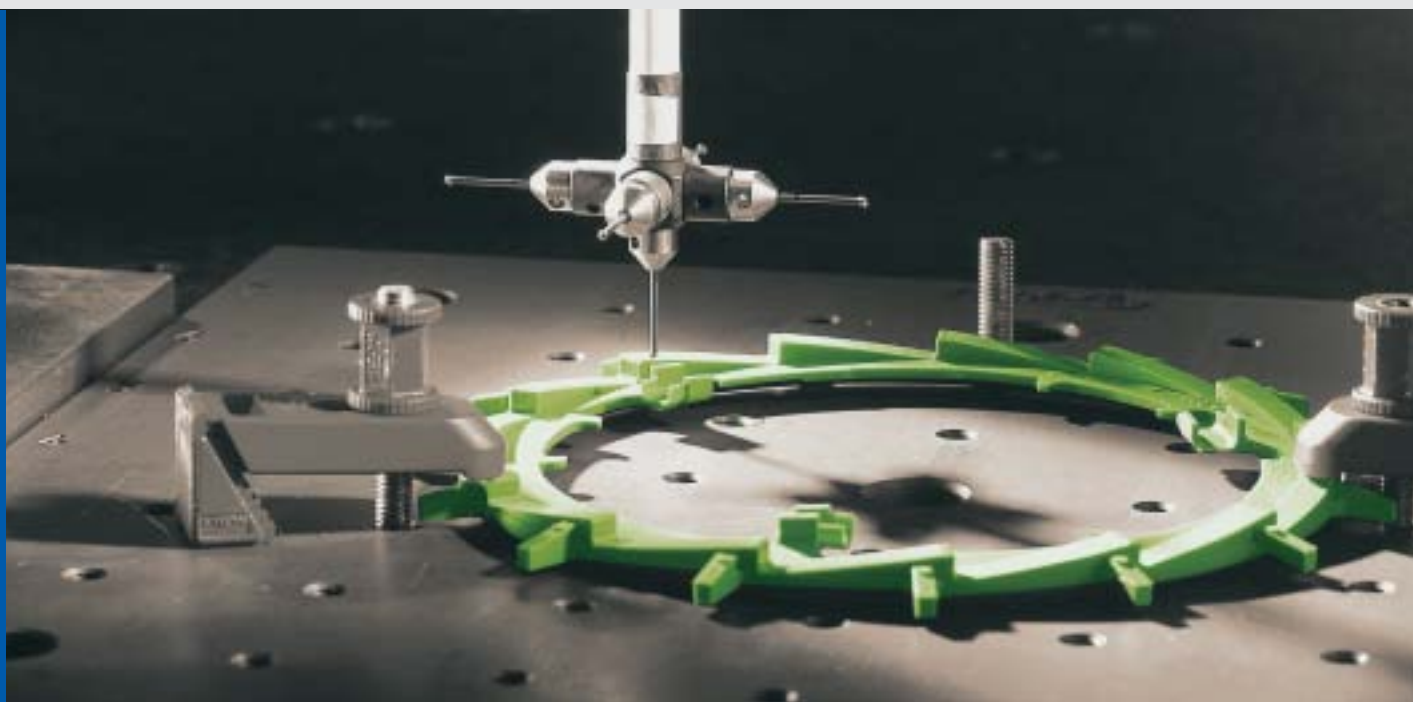


High performance in geometry and materials.



High performance for ultra-precision components.



Complex high-end applications call for high performance - in terms both of geometry and materials. ENSINGER uses state-of-the-art CAD/CAM technologies to produce high-performance precision parts - from the single component through to the finished assembly. You too can benefit from "high performance" engineering from the house of ENSINGER: The most complex geometries, tightest tolerances and highly specialized materials.

Ask. Think. Succeed.

The ENSINGER philosophy - "To ask. To think. To succeed." places the customer firmly at the focus of all our actions. In intensive dialogue with our customers, we develop and implement optimum solutions to address individual needs. Because perfect interaction only happens on the back of successful communication.

Approvals.

Before plastics can be approved for special applications, they must comply with the most stringent requirements on the basis of exhaustive testing to ensure their suitability. Which is why high performance is an absolute must - in terms both of materials and process engineering. ENSINGER machining is EADS certified. For certain processes involved in the engineering of high-performance plastics, process audits are executed in accordance with VDA 6.1. ENSINGER is also certified to ISO 9001 and ISO 13485.



ENSINGER: Engineering performance for your sector of industry.

Always abreast of the latest technological developments, drawing on a sound fund of practical experience and detailed production expertise, the specialists from ENSINGER are committed to engineering solutions specifically tailored to your branch of industry and your requirements. Particularly in fields demanding stringent standards of quality and reliability, the high-performance plastics developed by the ENSINGER specialists have been successfully tried and tested the world over.

| **Automotive engineering**

For the automobile sector, ENSINGER offers low-wear plastics resistant to temperature, fuel and oil which comply with the stringent production and serial requirements of the industry as outlined by VDA standards.

| **Vacuum technology**

High-performance plastics from ENSINGER are characterized by their minimal water absorption properties and minimum outgassing.

| **Medical technology**

High-temperature plastics from ENSINGER comply with the high hygiene standards imposed in the medical technology industry. Their resistance to hydrolysis makes them ideally suited for frequent cleaning, disinfection and sterilization.

| **Electronic engineering**

Whether high precision, extremes of temperature, electrical insulation or defined conductivity: ENSINGER offers plastics for particularly demanding applications in conjunction with highly effective mass production methods such as injection moulding.

| **Semiconductor engineering**

High-performance plastics from ENSINGER are used for the production of special handling components needed for high-tech applications involving cleanroom production. Their properties include low density, chemical resistance, minimal outgassing and high material purity.

| **Aviation and aerospace engineering**

Weight saving, high efficiency and reliability are decisive criteria when it comes to products used in aviation and aerospace engineering applications. As an ideal alternative to metal and glass, high-performance plastics from ENSINGER offer impressive properties: Low density, optical transparency, corrosion resistance and self-extinguishing behaviour.

| **Nuclear technology**

ENSINGER high-performance plastics demonstrate good resistance to energy-rich gamma and X rays. They comply with the stringent safety requirements essential for applications in nuclear installations.



Selector rod from SACHSEN- RING FAHRZEUGTECHNIK. **TECAMID 66 GF 25 mod.** takes care of reduced friction values.



LightCycler from ROCHE DIAGNOSTICS. **TECAPEEK MT sw** is able to reliably withstand the extreme changes of temperature occurring with fast cycling times.



Fusion experiment TEXTOR, JÜLICH RESEARCH CENTRE: The temperature and vacuum resistant **SINTIMID PUR HT** was used to produce retaining clips for current coils used to generate magnetic fields.

ENSINGER process technologies for high-performance products.

| Machining

ENSINGER looks back on many years of experience in the machining of plastics. ENSINGER semi-finished products form the ideal basis for optimum finished parts used in widely varied sectors of industry – from automotive through to aviation and aerospace engineering and medical technology.

ENSINGER manufactures milled components to a high standard of precision using state-of-the-art CNC controlled machining centres. Depending on the customer's terms of reference, 2, 3, 4 and 5-axis milling centres are used: For small milled components, small machining centres with chip-to-chip times of less than a second are available. Large parts are processed on machines designed to allow machining lengths of up to 2000 mm. Simple parts are manufactured using conventional milling machines.

The latest automatic lathes are also used at ENSINGER for machining turned parts.

Cyclically controlled lathes and automatic CNC lathes with powered tools and two-sided machining allow efficient production across the board – from small parts through to large-volume components with diameters exceeding 1000 mm. Production volumes are of no significance here – ENSINGER is ideally equipped to deal with anything from minimal batch sizes through to large scale series production.



In order to guarantee the manufacture of stress-free finished parts, when working with complex geometries with close tolerances we carry out a heat treatment process to reduce material tension.

Three-dimensional and freely programmable coordinate measuring machines guarantee precise quality surveillance as well as comprehensive monitoring and documentation of all the relevant dimensions.

The ENSINGER production range is rounded off by finish machining (deburring), surface treatment (vibratory finishing and shot blasting), the complete assembly of modules and connecting techniques (such as heating element, friction and ultrasonic welding), the insertion of threaded inserts and inscription of plastic components by means of engraving, laser or hot stamping.



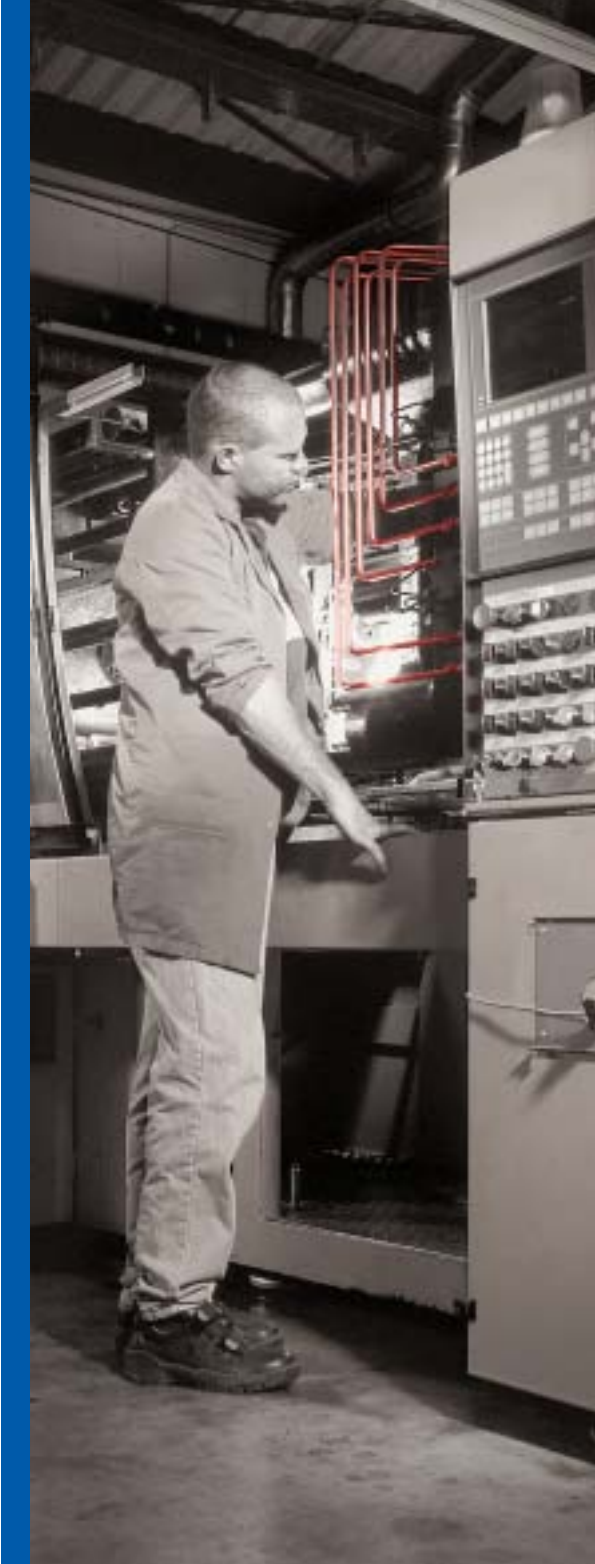
Filter segment for PALL. **TECASON E** supplies the basis for a wide temperature range, is translucent and hydrolysis resistant.



Nozzle block - machined to a high degree of precision. The material used was **TECAPEEK natural**, which is characterized by its high temperature resistance, its dimensional stability and chemical resistance.



Fibre guide used in the textile processing industry – produced from **TECAFORM**, which is suitable for applications involving stringent purity requirements.



| Injection moulding

The comprehensive material and process engineering expertise of ENSINGER specialists plays an instrumental role in ensuring the success of optimum customer solutions. ENSINGER has a whole range of benefits to offer in the field of injection moulding: Development, tool building, production, assembly, finishing and packaging.

Alongside a broad fund of specialist expertise, ENSINGER also offers special machines designed for the processing of high-performance plastics. Benefiting from an in-house toolmaking shop, our specialists are able to produce highly precise and complex geometries using the ENSINGER injection moulding technique.

To allow the low-cost manufacture of plastic components with differing properties, 2-component technology is used. This means that previously necessary work stages such as gluing, welding or screwing are now no longer required.

Through the use of modern automatic injection moulding machines with handling devices, downstream work processes can be fully automated.

Depending on customer requirements, additional finish processing methods such as insert moulding or coating, hot embedding or ultrasonic welding as well as machining are all possible. Complex assemblies are created using a combination of different process technologies and individual components.

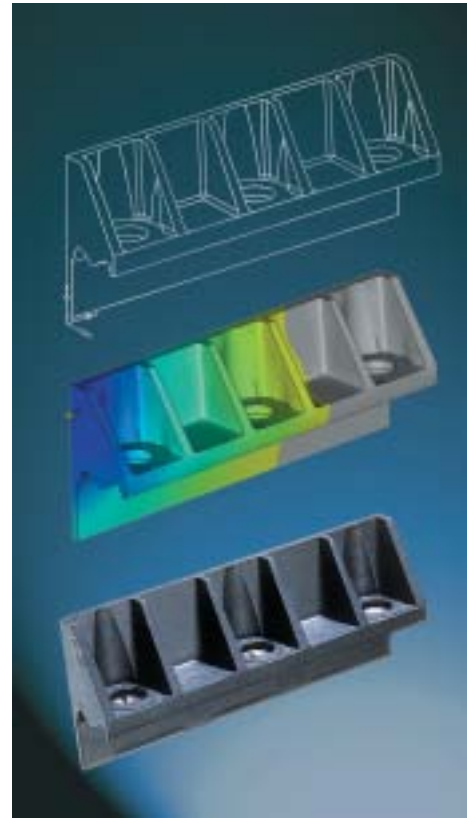
ENSINGER injection moulded parts comply with the high standards of quality demanded in many fields of industry – such as automotive engineering and medical technology. On-going production controls based on computer-aided measurement systems using specially developed testing devices are your guarantee of quality and perfection.



Handwheel for KSB ARMATUREN made of **TECAMID 6 GF 35**: high mechanical strength and minimal heat conductivity.



Actuating mechanism for seat belt tensioner from TAKATA. **TECAFORM AD** offers impressive sliding properties and high strength.



On the basis of your product brief, we develop and implement optimum solutions, making use of the very latest technological developments. From data transfer using CAD through computerised simulated filling studies in the computer to plastic components engineered ready for volume production. High performance by ENSINGER.

Industrial profiles and special tubes - precision made to measure

ENSINGER demonstrates a high degree of excellence in engineering profiles and special tubes for industrial applications, with geometries and materials precisely tuned to the specific application.

| Profiles

ENSINGER produces profiles using the extrusion and co-extrusion method. For example full profiles, hollow chamber profiles and particularly thin-walled profiles with wall thicknesses of 0.4 to 0.5 mm made of materials specially adapted to the application in question. Thermoplastic polymers are used as a basis which can be reinforced with carbon or aramid fibre, or dry lubricated. Using the co-extrusion method, reinforcing agents such as metals can be integrated, plastics with varying characteristics can be connected by means of sheathing, or hard-soft connections produced, for example for sealing lips. Piece length variations, special packaging requirements and general tolerances in line with DIN 19941 are all possible in agreement with the customer.

| Tubes

Due to many years of experience and enormous production know-how, ENSINGER is capable of producing tubes with minimal diameters of 2 and 3 mm up to maximum diameter of 90 mm. Any graduation of wall thickness is possible from 0.3 up to 7 mm. Here, too, extremely narrow tolerances can be implemented in agreement with the customer. Benefits such as low tooling costs, batch sizes from as low as 80 kg and varying lengths offer even greater flexibility and lower-cost solutions.

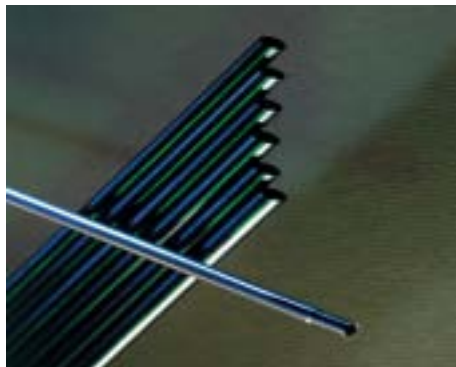




Luminaire covers used in a BOEING 777. The transparent material **TECANAT PC** is self-extinguishing and offers good welding capability.



Power brushcutter from DOLMAR. A specially developed profile geometry made of **TECAMID 6** was used as a bearing for flexible drive shaft.



Thin-walled tubes made of **TECAPEEK MT** are in successful applications as sheaths or outer pipes used in endoscopy. They are equally suitable for guiding sleeves and tubes for surgical instruments.



WAGO PRO slide from ERHARD ARMATUREN. **TECADUR PET** combines outstanding sliding properties with low moisture absorption and high dimensional stability.



Compression Moulding.

Compression moulding offers a whole series of benefits, particularly when it comes to the production of top-quality semi-finished products in low volumes. The technique is particularly suitable for high-temperature plastics with difficult processing properties such as PI, PEEK, PPS and fluoropolymers. A special compression technique, which works largely without material shearing, produces extremely low-tension, stress-free semi-finished products as the basis for high-precision mouldings. In the vast majority of cases, it is generally possible to dispense with an additional intermediate annealing stage made necessary by the machining process. Customer-specific compounding is possible even when minimal batches are required.

If required by the customer, the geometry of the moulded semi-finished products can be made very close to the dimensions of the finished product. Standard shapes include panels, rods and tubes as well as rings with outside diameters of between 38 and 1520 mm.



High-grade semi-finished products are the basis for ultra-precise parts.

Further processing steps under one roof

The wide ENSINGER production spectrum is rounded off by a comprehensive range of different finish processing operations. By closely linking the selection of materials with a broad-based range of production and further processing techniques, we are able to offer flexible and low-cost complete solutions.

The benefits of ENSINGER further processing under one roof:

- | Finish machining processes: Milling, turning, drilling
- | Ultrasonic welding
- | Surface finishing: e.g. sliding block grinding, shot blasting
- | Complete assembly of modules and connection techniques
- | Integration of metal components such as threaded inserts
- | Inscription of plastic components by engraving, hot stamping, laser inscription or printing



This state-of-the-art unit connects plastic parts by means of ultrasonic welding.



If required, we can take on the job of complete component assembly.



Low-cost complete solutions: Alongside production and assembly, we also offer the best possible further processing method for your specific application.

ENSINGER engineering excellence.



New and creative engineering solutions can only be conceived and implemented on the back of comprehensive sector-specific know-how. The sector specialists at ENSINGER have the knowledge and the reliability it takes to develop specially tailored concepts for complex geometries and demanding materials. Individual solutions which will stand up to scrutiny – both technically and economically.

| **Consultancy**

Our advisors can be relied upon to provide an expert opinion no matter what the question. At ENSINGER, the focus is on customer benefit throughout every phase of a product's development.

| **Material selection**

The subsequent use of a component is the decisive factor when it comes to selecting a material. Using additives, ENSINGER creates plastics tailored to your specific application need.

| **Development**

Processing methods, further processing and product design are precisely coordinated down to the last detail. A comprehensive flow of data is created between the customer and the design and toolmaking engineers at ENSINGER. This accelerates processes and generates flexibility – from the planning stage through to production.

For ENSINGER, the search for new and convincing answers represents a challenge and our driving motivation for the future.

| **Prototypes**

To test the load capability of a product, ENSINGER makes use of the final material developed for the specific customer requirement when manufacturing prototypes.

| Tools and operating equipment

With its own tooling and operating equipment workshop, ENSINGER has all the facilities it needs to ensure product optimization right from the start. In close cooperation with designers, process and performance-oriented tools and operating equipment for high-performance products are manufactured on site. The multi-faceted machine shop permits practically any type of process to be implemented. From cylindrical and profile grinding through countersink erosion, wire cutting to NC milling and turning – practically anything is possible. We also have facilities for hardening small-scale parts. Production from one and the same source helps save unnecessary diversions and wasted time – and the know-how gained through cooperation with the customer is not spread any further. Tool repair and maintenance are possible within the shortest possible time, thus also enhancing process reliability.



State-of-the-art equipment permits ultra-precise production and processing of high-performance plastics.

| Production

ENSINGER produces anything from precision mouldings through to complete modules. Each individual production step is carefully planned and documented. Use of a manufacturing process ideally adjusted to specific production needs and applications helps to guarantee high-end quality.



Comprehensive monitoring and quality testing by means of computer-aided measurements.

| Quality management

ENSINGER is able to count on a precise testing organisation and an efficient quality management system. Before any material enters volume production, its load capability is determined. The end product is subjected to part-specific testing: Computer-aided measurements guarantee comprehensive monitoring and quality testing of ENSINGER plastics.

| Logistics

Customer-oriented logistic concepts, careful warehousing and an international distribution network help cut down delivery periods to a minimum. When order picking and packaging plastic components for highly sensitive fields such as medical or semi-conductor technology, ENSINGER makes use of special packaging materials.



Just-in-time delivery: Our products will reach you punctually, no matter where and when they are needed.

ENSINGER for plastic components you can trust.



Pneumatic suspension pipe for DAIMLER CHRYSLER.

TECAMID 66 mod.: Pressure-resistant, stabilized against heat ageing, chemically resistant to fluids occurring in automotive environments.

What is impressive about ENSINGER plastics is their reliability and absolute quality. These outstanding properties have made them highly successful over a wide-ranging variety of different industrial sectors. ENSINGER offers a comprehensive range of high-performance plastics

Characteristics of ENSINGER high-performance plastics:

- | Heat-resistant, high utilizable strength even with continuous service temperatures of over 150 °C
- | High strength and rigidity coupled with low weight
- | Good sliding properties (even when dry running), wear-proof due to carbon or aramid fibres, graphite and PTFE additives
- | High pressure and creep resistance
- | Good vibration damping properties
- | Good chemical resistance to acids, alkali, grease and solvents
- | Corrosion resistant
- | Low water absorption, hydrolysis and sterilization resistant to hot water and steam
- | Excellent electrical insulating properties or adjustable conductivity
- | Flame-retardant, self-extinguishing behaviour

ENSINGER materials for top performance.

| VESPEL®

Extremely good heat and abrasion resistance, good mechanical strength and excellent dimensional stability. VESPEL® does not melt and is suitable for continuous application at cryogenic temperatures of as low as -270 °C. Due to its outstanding heat resistance, VESPEL® parts remain consistently efficient at continuous temperatures of up to 300 °C demonstrating high degrees of purity, minimal outgassing, good sliding properties and very good wear resistance.

| SINTIMID

High strength over a wide temperature range (from -270 to +300 °C), very good continuous temperature resistance, high creep resistance, excellent wear resistance when dry running or lubricated, high surface compression resistance and sliding speed. High degree of purity, minimal outgassing.

| TECAPEEK

Excellent chemical and hydrolysis resistance up to 250 °C. Electrically insulating even at high voltages. Good resistance to high-energy radiation, outstanding sliding properties. High thermal and mechanical strength, creep resistant.

| TECAFLON

Very good chemical resistance, tough, outstanding UV resistance, good electrical insulation, universal chemical resistance and excellent sliding properties (PTFE).

| TECATRON

Service temperature range up to 230 °C, good chemical resistance, oxidation and hydrolysis stability, very resistant to solvents, rigid, firm, dimensional stability and creep resistance.

| TECASON

Service temperature range 160 °C to 180 °C, translucent, creep-resistant, tough hydrolysis stability, very resistant to solvents, rigid, firm, dimensional stability and creep resistance.

| TECAFORM

Versatile engineering plastic – good sliding and abrasion properties, rigid, high-strength, tough even at temperatures below zero, highly resistant to fuels, oil, grease, solvents, good machining properties.

| TECAMID

Versatile engineering plastic – good sliding properties, high wear resistance, impact and vibration damping, good electrical insulation, extremely resistant to oil, grease, fuel, solvents. Complex dimensions can be manufactured as injection moulded PA.



TECAPEEK is ideally suited for applications involving strict hygiene standards. Metering die from GEBRÜDER HEYL.



Control cylinder made of **TECAPEEK mod.** for HOFFMANN PROPELLER. Heat-resistant and machined to the closest tolerances.



Dual-mass flywheel from LuK. Friction-optimized **TECADUR PET CF mod.** ensures dimensional stability and temperature resistance.

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