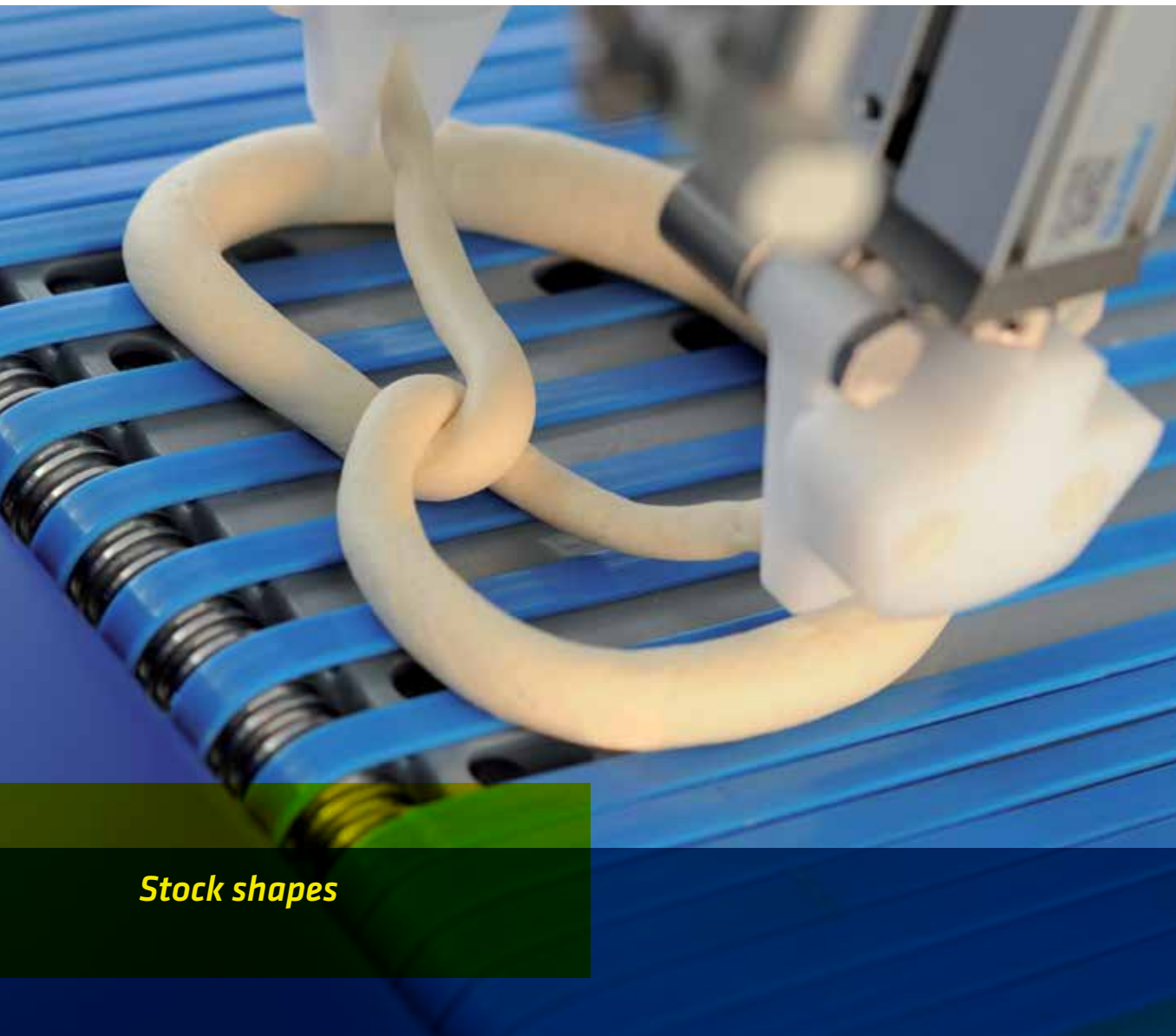


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Curbell Plastics is a proud supplier of Ensinger materials.



Stock shapes

Plastics used in food technology

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In many areas of industry, technical plastics play a vital role in improving the efficiency and competitive standing of customer applications. Lightweight, versatile plastics have a proven track record stretching back over many decades in the processing and packaging of foods. Their success is based on a combination of material benefits which are brought to bear even at raised temperature levels. These include primarily good mechanical properties and high resistance to chemicals.

There are widely varied application possibilities for technical plastics in plant and machinery for meat, fish and poultry processing. Materials from Ensinger enhance production speed and safety in the manufacture of dairy produce, baked goods and confectionery production.

They are frequently used in this type of application as gears, bearing bushes or in the form of other machine components. Plastics can also come into direct contact with foodstuffs, for example in filling, mixing and portioning systems. Stringent demands are placed on these plastics, particularly in the case of plant components which come into direct contact with food. The main objective of EU and US regulations is to exclude any damaging effects due to the migration of substances.

At Ensinger, product safety takes number one priority. The special care taken in this field is reflected by product-specific conformity certificates with FDA approval for raw material, regulation (EC) No. 1935/2004, (EU) No. 10/2011 (migration tested on semi-finished products) as well as (EC) No. 2023/2006 and seamless traceability.

Our Quality Management is in step with international standards and is firmly rooted in our corporate procedures. Above and beyond DIN EN ISO 9001, Ensinger GmbH is also certified to the Medical Products Standard DIN EN ISO 13485. Our semi-finished products are manufactured in compliance with the requirements of Regulation (EU) No. 2023/2006 on good manufacturing practice (GMP) for materials and articles intended to come into contact with food.



In many cases, plastics replace metals or ceramics. They often provide the only alternative when it comes to the implementation of unusual technical applications. Ensinger offers a wide portfolio of products for the food industry.

Plastics in application: Food industry

Dairy technology

In the manufacture of cheese and dairy products, technical plastics are used in a number of different process steps, such as separating the whey and portioning, as well as transportation and cutting (for instance in SOS systems).

Detergents put high demands on plastics in terms of chemical resistance. TECAPEEK TF10 blue fulfills these requirements and offers in addition high strength as well as excellent slide friction properties even at higher temperatures. Furthermore it is optically detectable due to its blue color which leads to an increased process safety in foreign body control.

Meat, fish and poultry processing

Before a ham or salami sausage lies finish packaged on the supermarket shelf, the product has already undergone a large number of processing steps. One such example is the manufacture of an everyday hamburger. The minced meat patties are portioned and shaped by special machines.

To guarantee cleanliness and hygiene, machines and other equipment are regularly cleaned. The material TECAFORM AH (POM-C) developed by Ensinger offers excellent chemical resistance. The mechanical material properties are brought to bear particularly at very high levels of production capacity utilization. Thanks to TECAFORM AH (POM-C), costs for maintenance and replacement are reduced to a minimum.

Plastics from Ensinger are also busy at work inside machines for meat, fish or poultry processing. The excellent abrasion behaviour, high strength and hardness of plastics such as



TECAFORM AH (POM-C) make them ideally suited as machine components for minimal downtime and enhanced productivity. Where extremely high temperatures occur during production for process or machine-related reasons, the material TECAPEEK (PEEK) offers an ideal solution. It maintains its excellent properties even under the toughest of environmental conditions and can be exposed for brief periods to temperatures of up to 300 °C.

TECAPEEK (PEEK), TECAFORM AH (POM-C) all conform to food regulations and comply with the latest statutory requirements.



Bakery technology

Dough manufacture is one of the key process stages in the manufacture of baked goods. After mixing and stirring the ingredients, the dough is rolled out and shaped using, rolling machines and presses.

Excess strain on components can result in pieces breaking off into the dough. This is the reason why many food producers use metal detectors. To avoid additional test procedures and added costs, Ensinger has developed a product range with inductively detectable plastics. As the existing metal detectors are also suitable for tracing these new ID plastics, the safety of food processing operations can be enhanced without requiring any investment in new equipment.

TECAFORM AH ID (POM-C) is suitable for applications requiring good sliding properties (minimal adhesion). In humid atmospheres or where there is direct contact with fluid, this material with its low water absorption properties offers an ideal alternative. Ensinger also has a solution for manufacturing processes involving very high temperatures. The tried and tested high-performance plastic TECAPEEK (PEEK) also comes in an inductively detectable version: TECAPEEK ID blue (PEEK).

This material combines good chemical resistance with excellent mechanical properties which are retained at high temperature levels.

And in the unlikely event that a plastic part should ever break off, ID material splinters will be picked up by the detector.

A wide selection of material components can already be replaced by ID plastics in the manufacture of food products. The lower weight of these materials makes a decisive contribution to energy and cost savings. This represents another major step on the road to the sustainable production methods modern consumers expect.

There are areas in which testing for foreign bodies takes place by visual inspection. For this requirement, the following plastics can be supplied in a blue coloured version:

- TECAFORM AH (POM-C)
- TECAMID 6 (PA)
- TECASON P (PPSU)
- TECAPEEK (PEEK)

The coloured plastics conform with food regulations and comply with currently valid legislation.

Food conveying

Conveying systems are used to transport products from one machine to the next between the individual manufacturing steps.

Where chain systems are used, the rollers must demonstrate good sliding properties and be highly resistant to wear. TECAMID 6 (PA 6) from Ensinger complies perfectly with these requirements.

Conveying systems exist in which products are deep fried at 140 -190 °C. Where this type of temperature and grease resistance is called for, TECAPEEK (PEEK) is the material of choice.

Food packaging

At the end of the production chain, products are automatically filled and packaged. Technical plastics also have a role to play in this last process step prior to despatch.

For applications such as worm conveyors, star conveyors or sliding rails, Ensinger offers a whole range of plastics with excellent sliding properties. The material TECAGLIDE green (PA 6 C), which has been modified with a special solid lubricant, not only offers a low slide-friction coefficient, but also the necessary mechanical strength.

With a low specific weight compared to metal, TECAGLIDE green (PA 6 C) helps reduce the energy input required to operate the conveyor system.



Plastics in application: Beverage industry



Along with mineral water, a whole series of different types of beverage are manufactured industrially and filled in vessels such as bottles, cans or barrels.

After consumption, the majority of empty bottles are returned for reuse. Ensinger is an important material supplier of machine components used in bottle sorting plants. Technical plastics such as TECAFORM AH (POM-C) are available in a range of colours and are ideally suited for use as bottle holders and grippers.

After sorting, the bottles are cleaned inside and out. Cleaning plants offer a range of application possibilities for plastics: From mechanical parts at the infeed and outfeed to the bottle slide. These can be manufactured from plastics such as TECAST T natural (PA 6 C), in order to prevent unnecessary scratches on the glass.

When selecting materials for the production of cleaning plant components, the application conditions have to be taken into account (hot water, high water pressure and use of chemicals). TECAPEEK natural (PEEK) and the modified material TECAPEEK PVX black (PEEK) comply with the stringent demands involved.

In the actual filling plants, plastics are used due to their low specific weight and their good sliding properties. Whether quick-change devices, worm conveyors or slide rails, the lightweight materials help save energy and reduce maintenance costs due to low wear. Cast nylon TECAST T MO black (PA 6 C) with its molybdenum disulphide filler combines good damping properties and high strength. In addition, this material offers improved surface hardness and good slide friction properties even in dry running operations.

Plastic components from Ensinger are even used for the final process stages. Typical components include star conveyors in labelling and packaging machines.

Product portfolio

The basis for wide-ranging applications

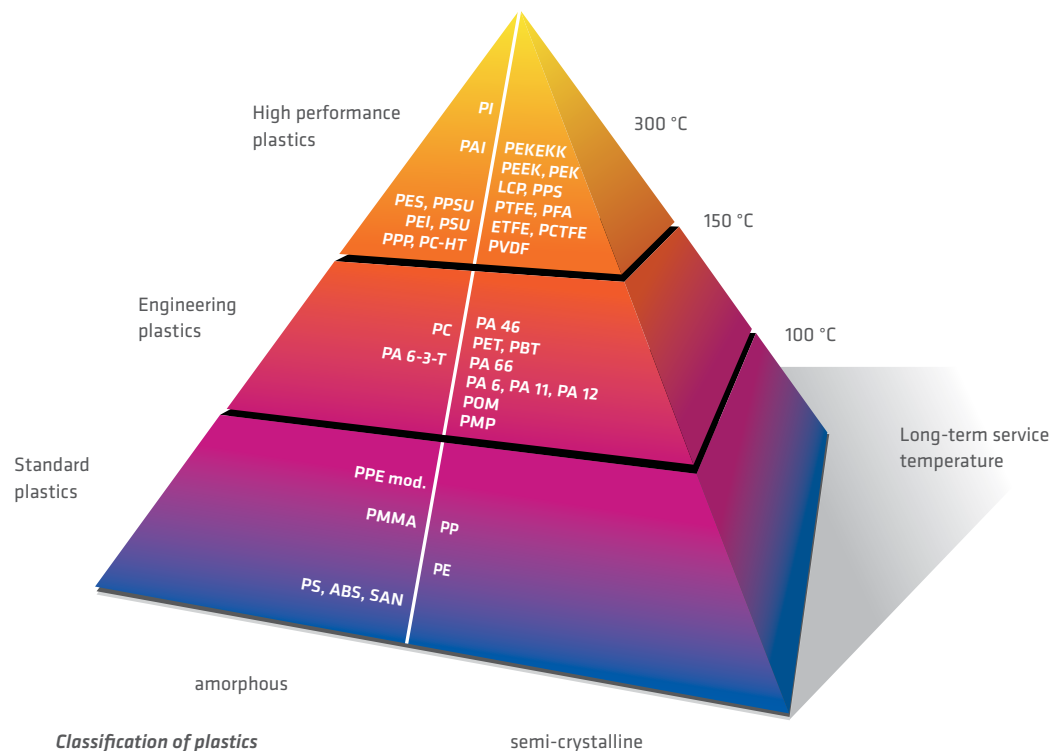
For food technology our product portfolio offers a wide range of engineering and high-performance plastics for various applications with and without food contact.

Applications **without** direct food contact

For components which do not come into contact with food, we offer a broad spectrum of engineering and high-performance plastics from our product range:

Available product families:

- | | |
|-------------------|----------------------------|
| → TECAFORM (POM) | → TECAFLON (PVDF, PTFE) |
| → TECAMID (PA) | → TECASON (PPSU, PSU, PES) |
| → TECAST (PA 6 C) | → TECATRON (PPS) |
| → TECAPET (PET) | → TECAPEEK (PEEK) |
| → TECANAT (PC) | → TECASINT (PI) |





Applications *with direct food contact*

Especially for components which come into direct contact with food, we offer a broad spectrum of suitable materials and issue the food conformity for their stock dimensions.

This conformity complies to regulations (EC) No 1935/2004, (EU) No 10/2011 with migration results tested on semi-finished products and (EC) No 2023/2006 including FDA conformity on raw materials. We issue an order-related certificate of conformity for all in-stock dimensions of the following materials:



FDA conformity (on raw materials) tested on semi-finished products:
(EC) No 1935/2004
(EU) No 10/2011
(EC) No 2023/2006

Available materials of the standard portfolio:

- | | |
|--------------------------------|-------------------------------|
| → TECAFORM AH natural (POM-C)* | → TECAPET white (PET) |
| → TECAFORM AH black (POM-C) | → TECANAT natural (PC) |
| → TECAFORM AD natural (POM-H) | → TECAPEEK natural (PEEK) |
| → TECAMID 6 natural (PA 6) | → TECAPEEK black (PEEK) |
| → TECAMID 66 natural (PA 66)* | → TECAST T natural (PA 6 C)** |

*For distinct tube dimensions ex stock with an outside diameter ≤ 90 mm we cannot issue food conformity. Special production on demand.

**Ø 50-200 + plates

Special portfolio for food technology:

Besides our available standard stock portfolio we offer a special portfolio of materials fulfilling the specific demands of food technology in terms of safety and performance.

These materials comply of course just as well to the latest EU regulations and FDA conformity on raw materials. The most important ones of the following materials are available ex stock:

Optically detectable plastics

→ TECAFORM AH blue (POM-C)

→ TECAMID 6 blue (PA)

→ TECAPEEK blue (PEEK)

Function: The blue colour of the plastic clearly stands out from the colour of processed foods.

Benefits: Optical detection is economical and continues to prove successful in a wide range of applications.

Inductively detectable plastics (ID)

→ TECAFORM AH ID blue (POM-C)

→ TECAMID 6 ID blue (PA 6)

→ TECAPEEK ID blue (PEEK)

Function: These plastics come complete with an additive to permit detection with the aid of a metal detector.

Benefits: Broken fragments can be quickly traced as part of the standardized process control system. The costly process of destroying whole batches and even image-tainting recall campaigns can be avoided.

Plastic for slide friction applications

→ TECAPET TF grey (PET)

Function: Plastic with improved sliding properties.

Benefits: Longer maintenance intervals due to less wear and abrasion.

Optically detectable, sliding friction modified high temperature plastic:

→ TECAPEEK TF10 blue (PEEK)

Function: Excellent slide friction properties and abrasion resistance as well as high strength and chemical resistance.

Benefit: The high performance plastic with combined property profile covers a broad range of applications.



Materials with added value

Plastics with multiple uses cover a wide range of applications. In food technology this concerns mainly the combination of very good mechanical strength with good chemical resistance and good sliding properties.

TECAPEEK TF10 blue

High temperature resistant thermoplast with very good impact resistance at low temperatures.

- Good strength at high temperatures
- Very good sliding properties
- Excellent chemical resistance
- Optically detectable
- Conforms to food regulations

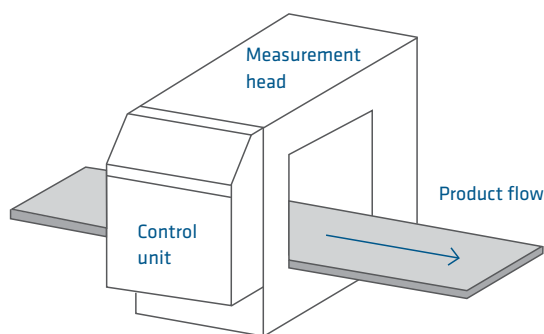


ID materials

The principle of detecting plastics in foodstuffs is currently based on visual inspection (blue coloration). However, it is only possible to detect foreign bodies in food if the fragment is positioned close to the surface. In any other event, optical detection is not possible. In this case, any possible defect in a component is only noticed when it is far too late to prevent the destruction of large quantities of food if contamination has taken place.

TECAPEEK ID blue

Suitable for permanent utilization at up to 260 °C, excellent chemical resistance, inductively detectable, conforming to food regulations.



Schematic diagram of a metal detector in operation

TECAMID 6 ID blue

Very tough and impact resistant, high strength. Inductively detectable, conforming to food regulations.

TECAFORM AH ID

Easily machined, minimal water absorption, inductively detectable, conforming to food regulations. Available in blue and grey.

Properties:

- Detectable with metal detectors within the framework of standardized process control
- Chemical resistance in analogy to the base polymer
- Essential mechanical properties unchanged compared to the base polymer
- Fragments from 3 mm in size can be detected depending on the surrounding medium

Note:

When detecting ID materials by means of a metal detector, the fragment may be located below the surface of the food and still be picked up as a foreign body. This new development permits rapid detection and so minimizes potential damage.



UD materials

UD materials represent a further development of ID materials. These meet the requirements of additional X-ray detection. Product safety is further enhanced by an additional detection method. The Ensinger UD materials are thus optically, metal and X-ray detectable and thus detectable with all methods used in food processing. The material properties and detection limits are the same as for ID materials.

Portfolio of ultra-detectable materials

- TECAFORM AH UD blue (POM-C)
- HYDEX 4101 UD blue (PBT)

Application examples



Deflector*

TECAFORM AD natural
(POM-H)
High mechanical strength.
Easily machined.



Scraper

TECAFORM AH ID grey
(POM-C, detectable filler)
Inductively detectable.
Good toughness and strength.
Good resistance to
cleaning agents.



Object slide*

TECAFORM AD natural
(POM-H)
High strength.
Good chemical resistance.
Good machinability.

Conveyor screw

TECAGLIDE green
(PA 6 C)
Low friction coefficient.
Good abrasion behaviour.
Easy machining capability.
For applications without
food contact.

**from Schreyer Sondermaschinen GmbH*

Application examples



*Closing die**

TECAPEEK black
(PEEK)

Long-term service temperatures of up to 260 °C.
Brief exposures of up to 300 °C.
Excellent mechanical properties.

*Throughfeed filler***
TECAFORM AH natural
(POM-C)
Good chemical resistance.
High resilience.



*Throughfeed filler***
TECAMID 6 natural
(PA 6)

High degree of toughness.
Resistance to oils,
greases and fuels.
Good abrasion resistance.



Cheese basket

TECAFORM AH natural
(POM-C)

Good form stability.
Good mechanical strength.
Low moisture absorption.



Spacer disc**

TECAPET white
(PET)

Very light.
Very abrasion resistant.
Easily machined.

**from Heinrich GmbH*

***from MAJA - Maschinenfabrik Hermann Schill GmbH & Co. KG*

Quality assurance

Raw material information

Only raw materials suitable for contact with food are used for the production of stock shapes. Suitability of the granulates intended for contact with food is confirmed for us by our suppliers, in the form of declarations in accordance with (EU) No 1935/2004 and (EU) No 10/2011 (PIM). The declarations contain statements about the relevant materials and where applicable about the limiting values for migration.

Stock shape production and delivery

The raw materials are processed to stock shapes in accordance with manufacturer's instructions. The production processes and specifications used are suitably documented. An effective system of quality assurance and quality control is set out within the ISO 9001 certification.

Production in accordance with GMP

For materials and articles intended to come into contact with food, Regulation (EC) No 2023/2006 sets out rules on good manufacturing practice (GMP).

This regulation applies to all areas and stages of manufacture, processing and sale of materials and objects, with the exception of those relating to the raw materials.

The fundamental requirements of Regulation (EC) No 2023/2006 are:

- An effective system of quality assurance which ensures the conformity of materials and objects with the applicable rules.
- An effective quality control system which encompasses for instance the continuous monitoring of GMP and the execution of corrective actions.
- Documentation: Documents containing information on the specifications, manufacturing recipes, production methods and results of quality control which are significant for the conformity and safety of the finished material or finished article.
- Detailed regulations: The annex contains detailed regulations for printing inks.

Declaration of conformity

For some material categories (such as POM), for reasons of supply security, equivalent raw materials are specified from different suppliers and used depending on their availability in the market. These product specifications are clearly assigned in the declaration of conformity.

For certificates and confirmations in accordance with (EU) No 10/2011 the test rules set out by (EC) No 2002/72 and (EU) No 10/2011 apply in parallel for the transition period up to the end of 2015. In principle the limit values following (EU) No 10/2011 are to be used.

Direct assignment of documents to supplied goods effectively prevents misuse and eliminates any possibility of confusion. This is the reason why product certificates for food contact are only ever issued on an order-specific basis at Ensinger.

Recipients of stock shapes must in turn adhere to a similar specification procedure for their products and take suitable measures to ensure traceability of the materials used.

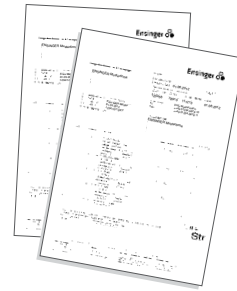


Traceability

Due to product coding and statements of conformity Ensinger has direct traceability of the delivered semifinished product.

1 Invoice / delivery note

The order and invoice number is shown on the invoice / delivery note, for semi-finished products the batch number is also shown on the delivery note. This allows goods to be traced back using these numbers. A certificate to ISO 10204 is issued on an order-specific basis.

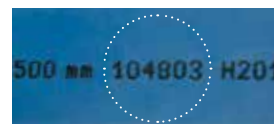


Customer · Order · Invoice
54000 11999 · 1000001 · 4000011111

Production number 104803

2 Semi-finished products

The 6-digit production and manufacturing number is located on the semi-finished product. Starting with the production or manufacturing number data from the production process can be traced (production data, production protocol, control cards).



→ Production number

3 Compounds

The lot number of the compound can be determined from the production/ manufacturing number of the semi-finished product.



4 Raw materials

The lot number of the compound is traceable back to the formulation and so to the delivered raw material batch, the relevant raw material specification and the safety data sheet.



Key facts at a glance

Ensinger secures foolproof traceability from the delivery note to the raw material.

EU regulations

In Europe, primarily the following legal regulations apply to plastic commodity products in contact with food:

- Regulation (EC) No 1935/2004 as a framework regulation.
- Regulation (EC) No 2023/2006 on Good Manufacturing Practice (GMP) for materials and objects intended to come into contact with food.
- Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food.

Regulation (EU) No 10/2011, also known as the PIM (Plastics Implementation Measure), includes a union list of authorised monomers and additives for the production of plastic materials and articles. Apart from regulations with regards to plastic production, (EU) No 10/2011 stipulates that for every processing step it must be verified that the requirements of (EU) No 10/2011 are adhered to. For each processing step, requirements with regards to compliance tasks are given, which have to be evaluated accordingly, and certified in a declaration of conformity.

For Ensinger stock shapes, an evaluation based on migration test has been performed. The results are confirmed in an order specific declaration.

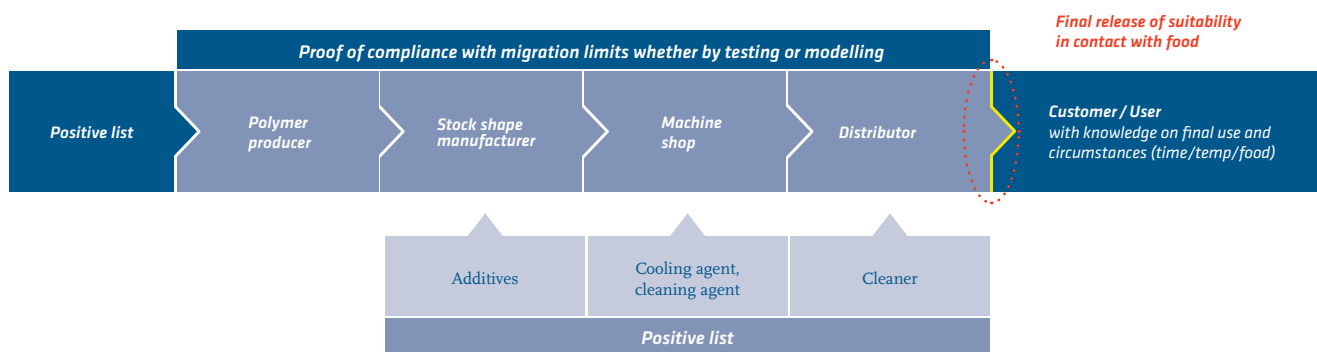
Colorants

Colorants are not specified in the union list and are subjected to a separate national consideration, for example according to rules set out by the German Federal Institute for Risk Assessment (BfR). In addition to Regulation ((EU) No 10/2011, the BfR publishes plastic recommendations for the suitability of several materials for food contact.

Why is Ensinger unable to take responsibility for final testing for suitability in contact with foods on behalf of customers?

In this context, Ensinger is a supplier of semi-finished products which have no use-specific finished part geometry. Following additional processing steps to become a finished part, final inspection must be carried out on the premises of the company which distributes the end product, taking into consideration the final component design.

Testing on the semi-finished product can do no more than provide an indication. It does not reflect the final status of the product (such as its surface quality).



Migration tests

In contact with food, reciprocal action between the plastic component and food can result in the migration of substances.

To eliminate the risk of a health hazard as far as possible, the admissible migration of substances and procedures for testing are set out in Regulation (EU) No 10/2011.

The maximum admissible migration quantity of substances is defined in the main by two limiting values:

- Overall migration limit (OML): Maximum admissible quantity of non-volatile substances which may be released by a material or article into food simulants. The limit is defined as 10 mg per dm² of the surface coming into contact with food.
- Specific migration limit (SML): Maximum admissible quantity of specific substances released from a material or article into food or food simulants. SMLs are calculated in milligrams of substance per kilogram of food (mg/kg).

In the case of substances for which no specific migration value or any other restrictions have yet been defined, a general specific migration value of 60 mg/kg applies.

Supplementary EU guideline

The ground rules for migration testing are set out in Regulation (EU) No 10/2011. As these are complex processes, these ground rules cannot encompass every foreseeable case and all the details necessary for test execution. For this reason, an EU guideline is due to be compiled explaining the detailed aspects of applying the ground rules for migration testing.

Key facts at a glance

Migration verifications play an important role in the assessment of product suitability in the EU regulations.

Calculation of migration values

When reviewing conformity, the specific migration values are given in mg per kg of food. The actual application conditions (temperature, contact time, etc.) are taken into account in the calculation.

There are cases in which the ratio between contact surface and the volume of food are not known, for instance because it cannot be determined due to the shape of the articles. This also applies to plastic stock shapes. The migration value is calculated for these products based on the assumption of a surface-to-volume ratio of 6 dm² per kg of food, and expressed in mg per kg. This is based on the assumption that 1 kg of food assumes a cube-shaped volume with an edge length of 1 dm. All-round surface contact corresponds to 1 dm² x 6 = 6 dm² surface with food contact = 6 dm² / 1 kg of food.

For finished articles produced from stock shapes for which the actual use is known, it is generally possible to determine the actual ratio of surface to volume. In this case, the specific migration values are calculated accordingly.

The materials for which no specific migration limit and no other limitations are set out, a generally specific migration limit of 60 mg/kg is applicable. Using a surface-to-volume ratio of 6 dm² per kg of food, this corresponds to a general specific migration value of max. 10 mg/dm² contact surface.

Calculation example

In an application involving a surface-to-volume ratio of 6 dm² per kg of food, for a material with a general migration value of 60 mg/kg, adherence to conformity has to be tested.

In the first case, a migration value of 120 mg/kg is determined for the material. This would mean that the migration limit is exceeded. However, the specification can be adhered to by reducing the contact surface of the article relative to the volume of food by changing the design.

$$\frac{60 \text{ mg / kg}}{120 \text{ mg / kg}} \times 6 \text{ dm}^2 / \text{kg} = 3 \text{ dm}^2 / \text{kg}$$

In the second case, a migration value of 20 mg/kg is determined. This means that the migration value is adhered to. The contact surface of the article could even be increased to a ratio of 18 dm²/kg:

$$\frac{60 \text{ mg / kg}}{20 \text{ mg / kg}} \times 6 \text{ dm}^2 / \text{kg} = 18 \text{ dm}^2 / \text{kg}$$

$$\frac{\text{Admissible limiting value}}{\text{Determined migration value}} \times \frac{\text{Surface}}{\text{Volume}} = \left(\frac{\text{Surface}}{\text{Volume}} \right)_{\text{corrected}}$$

US regulations

In the USA, the regulations of the Food and Drug Administration (FDA) and the NSF 51 and 3 A SSI are applicable.

FDA

According to FDA stipulations (in accordance with CFR Title 21 - Food and Drugs) various materials suitable for food contact are recorded on the basis of a positive list.

- Part 177 contains the list of standard polymers which are suitable for single or multiple contact with foods.
- In part 178, the relevant additives, production aids and dyes are listed.

The positive lists contain information regarding the requirements imposed on physical and chemical composition and also on approved application conditions.

According to the FDA, certificates are issued for stock shapes intended for repeated contact with foods. A suitability statement is provided here with confirmation of the material listing. The end user is also required to provide the FDA with verification of compliance with the migration values and suitability for the finished component.

NSF

NSF International (National Sanitation Foundation) is a not-for-profit organization whose function is to provide certification in the field of health and safety. These standards encompass a very wide range of applications, from water quality through food safety to pharmaceuticals.

The NSF maintains lists of products and manufacturers which comply with their require-

ments. To be listed, the material has to be tested. The producing location is also audited. The NSF/ANSI standard 51 „Food Equipment Materials“ is a generally recognized standard which requires a check of the formulation on the basis of FDA regulations, laboratory testing and an audit of the manufacturing location. This certification must be extended on a yearly basis.

3-A Dairy

3-A was founded by three dairy-related associations in order to define requirements for the dairy industry in the form of sanitary standards and practices for equipment and systems used in the dairy industry.

The 20-25 3-A Sanitary Standard refers to multiple-use plastic materials in dairies.

The standard describes the cleanability of a material. In addition, it defines that the material may not lose its functional characteristics or surface quality even under tough environmental conditions following regular treatment with bactericides. This area is not covered by the FDA regulations. Although the 20-27 3-A Sanitary Standard is not legally binding, it is generally acknowledged.

Key facts at a glance

US regulations governing plastics in contact with foods summarize suitable materials and products in positive lists.

Chinese regulations

In China, plastic consumer goods with food contact are subject to the National Food Safety Standard.

AR 9685-2016 - National Food Safety Standard: Standard for the use of additives for food contact materials and articles.

The regulations applicable in China are regulated in various standards. The standard lays down the principles for the use of additives in food contact materials. These should be assessed in a similar way to the (EU) No 10/2011 in terms of their scope, maximum content, specific migration limit value or maximum residue level and specific total migration limit value. This standard also includes monomers and other polyreaction initiators used in the processing of food contact materials and their products.

Unlike (EU) No 10/2011, no detailed assessment is required at each stage of processing. It is possible to refer to the raw material base used in the corresponding processing stage.

For certain Ensinger semi-finished products, a declaration based on raw materials according to GB 9685-2016 is available, which does not include testing on the semi-finished product.

Drinking water regulations

Drinking water does not fall within the scope of food manufacturing guidelines, but is monitored in accordance with special regulations which are not internationally standardized at present.

Drinking water is used not only for consumption but frequently used in the preparation of food, either as a manufacturing component or in cleaning processes.

Germany

Plastics in contact with drinking water (KTW)

- Testing in accordance with DVGW (German Technical and Scientific Association for Gas and Water) regulations and the 2001 Drinking Water Ordinance 2001 using a microbial growth test in accordance with work sheet W 270.
- Migration values in accordance with DIN EN 12873-1: 2004 and -2: 2005 in accordance with the updated guidelines of the German Environmental Protection Agency (dated 08/10/2008).

UK

- Testing in accordance with WRAS (Water Regulations Advisory Scheme), certifications from WRC-NSF (Cooperation Water Research Council and NSF). Certificate validity five years.

USA

- Testing in accordance with NSF 61 (National Sanitation Foundation) with approvals specific to the manufacturer, specific production locations, material types and temperature specifications.

Other country-specific tests

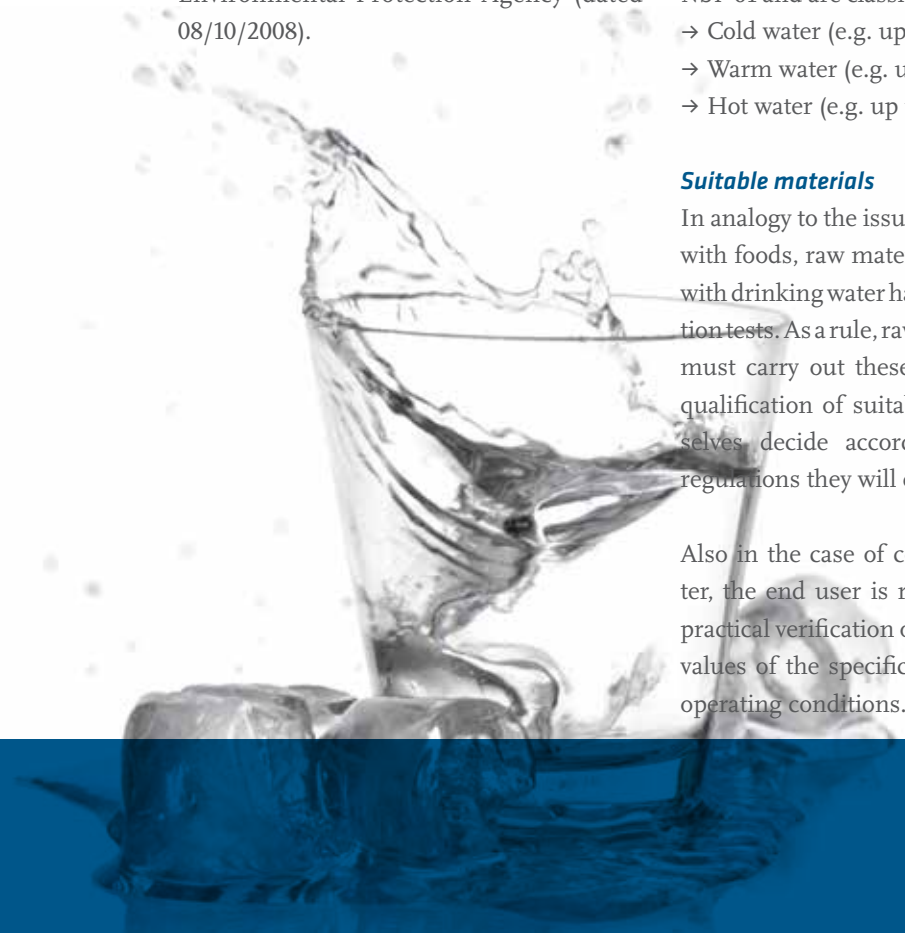
The country-specific test specifications are not transferrable and must be individually tested in each case. However, their statements are similar in respect to the suitability of specific application conditions for drinking water. These are comparable according to KTW, WRAS and NSF 61 and are classified into three categories:

- Cold water (e.g. up to 23 °C)
- Warm water (e.g. up to 60 °C)
- Hot water (e.g. up to 85 °C)

Suitable materials

In analogy to the issue of suitability for contact with foods, raw materials intended for contact with drinking water have to pass suitable migration tests. As a rule, raw material manufacturers must carry out these migration tests for the qualification of suitable materials, and themselves decide according to which regional regulations they will carry out the tests.

Also in the case of contact with drinking water, the end user is responsible for providing practical verification of adherence to migration values of the specific component itself under operating conditions.



Chemical resistance

Consequently, temperature, the concentration of agents, exposure periods and also mechanical load are all important criteria when testing for chemical resistance. The following table lists resistance to different chemicals. This information is provided to the best of our current knowledge and is designed to provide data about our products and their applications. Consequently it is not intended to provide

any legally binding assurance or guarantee of the chemical resistance of our products or their suitability for a concrete application. For a more concrete application, we recommend producing your own verification. Standard tests are performed under normal climatic conditions 23/50 in accordance with DIN EN ISO 291.

	TECAPEEK (PEEK)	TECAPEEK TF10 blue (PEEK)	TECATRON (PPS)	TECASON P (PPSU)	TECASON S natural (PSU)	TECAFLON PTFE natural (PTFE)	TECAFLON PVDF natural (PVDF)	TECAMID 6 (PA 6)	TECAST T (PA 6 C)	TECAMID 66 (PA 66)	TECANAT (PC)	TECAPET (PET)	TECAFORM AH (POM-C)	TECAFORM AD natural (POM-H)	TECAPRO (PP)	TECARAN ABS (ABS)
Acids - weak	+	+	+	+	+	+	+	-	-	-	(+)	+	(+)	-	+	+
Acids - strong	(+)	(+)	+	(+)	(+)	+	(+)	-	-	-	-	-	-	-	(+)	-
Alkalis - weak	+	+	+	+	+	(+)	(+)	(+)	(+)	(+)	-	-	+	(+)	+	+
Alkalis - strong	+	+	+	+	+	+	+	+	+	+	-	(+)	-	-	+	n.i.
Solvents - alcohol	+	+	+	+	+	+	+	+	+	+	(+)	+	+	+	+	+
Solvents - ether	+	+	+	+	+	+	+	+	+	+	-	+	(+)	+	(+)	n.i.
Ketone	+	+	+	-	-	+	(+)	+	+	+	-	(+)	(+)	(+)	(+)	-
Water - cold	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Water - hot	+	+	+	+	+	+	+	(+)	(+)	(+)	(+)	-	+	-	+	+

+ = resistant

(+) = conditionally resistant

- = not resistant

n.i. = no information

Frequently asked questions

What does traceability mean?

The logging and documentation of all product and process data by all involved producers - from the raw material through to the used finished part - provide the assurance of traceability back to the product's origin. In case of any claim for damages, the possible fault can then quickly be localized and identified.

How can products be unambiguously identified?

To ensure that products cannot be confused or mistaken, a product code is imprinted on them which contains the product name, article number and production batch.

Does the coding ink have a negative impact on its use in contact with foods?

The coding ink and coloured printing inks are tested and are verified as physiologically harmless.

Do external changes of colour due to storage or climatic influences have a negative impact on the semi-finished product?

Semi-finished products or cut blanks are produced with plus tolerances in accordance with DIN so that the outer shell and consequently any discolouration or scuffing can be removed without fail during finished part production.

Why do end customers bear final responsibility for the declaration of conformity?

Plastic stock shapes are not finished products with a finally defined purpose and geometry as defined by the regulations. Final testing for the specific application requires knowledge of all application conditions. Influencing factors include the contact medium, contact time and temperature and cleaning conditions.

Consequently no definitive and final assessment of migration values can be carried out on the component by the stock shapes supplier. This task remains the responsibility of the plant manufacturer or operator on the basis of the migration limit information provided.

How are simulants assigned to foods in accordance with EU Regulation no. 10/2011?

Food simulants conforming to a certain food category are selected in accordance with table 2 in Annex III of the Regulation.

Testing the migration value in food simulants A, B and D2 (or were applicable using substitute simulants) includes all kinds of foods. This also encompasses foods for which the simulants (C, D1, E) are assigned where applicable in table 2.

How is consumer protection safeguarded for plastics in contact with food?

The main objective is to exclude negative reciprocal impact between the plastic component and the contacted foods in the form of organoleptic, colour-related and primarily toxic effects.

Seamlessly applied declarations of conformity at every manufacturing level are key tools in the assurance of food safety. Added to this are traceability data using the methods of good manufacturing practice (GMP) implemented in quality assurance systems with verifiable documentation of product and process data.

Key facts at a glance

***Please do not hesitate to contact our technical service:
techservice.shapes@de.ensinger-online.com or by telephone on +49 7032 819 101***

Material standard values

Material		TECAPEEK natural	TECAPEEK PXX black	TECAPEEK ID blue	TECAPEEK TF10 blue	TECAFLON PVDF natural	TECANAT natural	TECAPET white	TECAPET TF grey	TECAMID 6 natural	TECAMID 6 ID blue
Chemical Designation		PEEK	PEEK	PEEK	PEEK	PVDF	PC	PET	PET	PA 6	PA 6
Fillers			carbon fibres, PTFE, graphite	detectable filler	PTFE				solid lubricant		detectable filler
Density (DIN EN ISO 1183)	[g / cm ³]	1.31	1.44	1.49	1.38	1.78	1.19	1.36	1.43	1.14	1.24
Mechanical properties											
Modulus of elasticity (tensile test) (DIN EN ISO 527-2)	[MPa]	4,200	5,500	4,600	3,400	2,200	2,200	3,100	3,200	3,300	3,600
Tensile strength (DIN EN ISO 527-2)	[MPa]	116	84	111	95	62	69	79	78	79	80
Tensile strength at yield (DIN EN ISO 527-2)	[MPa]	116	84	111	95	62	69	79	78	78	80
Elongation at yield (DIN EN ISO 527-2)	[%]	5	3	4	5	8	6	5	4	4	4
Elongation at break (DIN EN ISO 527-2)	[%]	15	3	6	8	17	90	10	6	130	21
Modulus of elasticity (flexural test) (DIN EN ISO 178)	[MPa]	4,200	6,000	3,700	3,900	2,100	2,300	3,200	3,300	2,900	
Flexural strength (DIN EN ISO 178)	[MPa]	175	142	166	149	77	97	121	119	100	
Compression modulus (EN ISO 604)	[MPa]	3,400	4,000	4,800	3,000	1,900	2,000	2,700	2,700	2,700	
Compressive strength (1% / 2%) (EN ISO 604)	[MPa]	23 / 43	23 / 44	25 / 46	22 / 39	16 / 28	16 / 29	19 / 35	21 / 38	24 / 41	/
Impact strength (Charpy) (DIN EN ISO 179-1eU)	[kJ / m ²]	n. b.	28	72	48	150	n. b.	81	42	n. b.	n. b.
Notched impact strength (Charpy) (DIN EN ISO 179-1eA)	[kJ / m ²]	4					14	4		7	4
Ball indentation hardness (ISO 2039-1)	[MPa]	253	250	260	220	129	128	175	183	155	
Thermal properties											
Glass transition temperature (DIN EN ISO 11357)	[°C]	150	146	150	157	-40	149	81	82	45	45
Melting temperature (DIN EN ISO 11357)	[°C]	341	341	341	340	171	n.a.	244	249	221	220
Service temperature, short term	[°C]	300	300	300	300	150	140	170	170	160	160
Service temperature, long term	[°C]	260	260	260	260	150	120	110	110	100	100
Thermal expansion (CLTE), 23 - 60 °C (DIN EN ISO 11359-1;2)	[10 ⁻⁵ K ⁻¹]	5	3	5	6	16	8	8	8	12	
Thermal expansion (CLTE), 23 - 100 °C (DIN EN ISO 11359-1;2)	[10 ⁻⁵ K ⁻¹]	5	3	5	6	18	8	10	10	13	
Specific heat (ISO 22007-4:2008)	[J / (g*K)]	1.1	1.1	1.1		1.3	1.3			1.6	
Thermal conductivity (ISO 22007-4:2008)	[W / (m*K)]	0.27	0.82	0.27		0.25	0.25			0.37	
Electrical properties											
Specific surface resistance (DIN IEC 60093)	[Ω]	10 ¹⁵	10 ⁴ - 10 ^{11 a}	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	>10 ¹³
Surface volume resistance (DIN IEC 60093)	[Ω*cm]	10 ¹⁵	10 ¹²	10 ¹⁴	10 ¹⁴		10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	
Miscellaneous data											
Water absorption 24 h / 96 h (23 °C) (DIN EN ISO 62)	[%]	0.02 / 0.03	0.02 / 0.03	0.02 / 0.03	0.02 / 0.03	< 0.01 / < 0.01	0.03 / 0.06	0.02 / 0.03	0.02 / 0.03	0.3 / 0.6	0.3 / 0.6
Resistance to hot water / bases		+	+	+	+	+	-	-	-	(+)	(+)
Resistance to weathering		-	-	-	-	+	(+)	-	-	-	-
Flammability (UL94) (DIN IEC 60695-11-10;)		VO	VO ^b	VO ^b	VO ^b	VO ^b	HB ^b	HB ^b	HB ^b	HB ^b	HB ^b

Data generated directly after machining (standard climate Germany). For polyamides the values strongly depend on the humidity content.



Test specimen to DIN EN ISO 527-2

- + good resistance
- (+) limited resistance
- poor resistance (depending on concentration, time and temperature)
- n.b. not broken
- n.a. not applicable

- (a) Specific surface resistance testing according to DIN EN ISO 11357
- (b) No listing at UL (yellow card). The information might be taken from resin, stock shape or estimation. Individual testing regarding application conditions is mandatory.

Material		TECAMID 66 natural	TECAST T natural	TECAGLIDE green	TECAFORM AH natural	TECAFORM AH blue	TECAFORM AH ID blue	TECAFORM AD natural	TECARAN ABS grey		
Chemical Designation		PA 66	PA 6 C	PA 6 C	POM-C	POM-C	POM-C	POM-H	ABS		
Fillers				solid lubricant			detectable filler				
Density (DIN EN ISO 1183)	[g / cm ³]	1.15	1.15	1.13	1.41	1.41	1.49	1.43	1.04		
Mechanical properties											
Modulus of elasticity (tensile test) (DIN EN ISO 527-2)	[MPa]	3,500	3,500	3,200	2,800	2,800	3,200	3,400	1,700		
Tensile strength (DIN EN ISO 527-2)	[MPa]	85	83	76	67	67	68	79	32		
Tensile strength at yield (DIN EN ISO 527-2)	[MPa]	84	80	76	67	67	68	79	32		
Elongation at yield (DIN EN ISO 527-2)	[%]	7	4	14	9	9	8	37	3		
Elongation at break (DIN EN ISO 527-2)	[%]	70	55	18	32	32	10	45	49		
Modulus of elasticity (flexural test) (DIN EN ISO 178)	[MPa]	3,100	3,200	3,100	2,600	2,600	3,100	3,600	1,600		
Flexural strength (DIN EN ISO 178)	[MPa]	110	109	103	91	91	100	106	49		
Compression modulus (EN ISO 604)	[MPa]	2,700	2,900	2,500	2,300	2,300	2,400	2,700	1,400		
Compressive strength (1% / 2%) (EN ISO 604)	[MPa]	20 / 35	19 / 36	18 / 34	20 / 35	20 / 35	17 / 31	19 / 33	15 / 26		
Impact strength (Charpy) (DIN EN ISO 179-1eU)	[kJ / m ²]	n. b.	n. b.	n. b.	n. b.	n. b.	59	n. b.	n. b.		
Notched impact strength (Charpy) (DIN EN ISO 179-1eA)	[kJ / m ²]	5	4	4	8	9	11	15	34		
Ball indentation hardness (ISO 2039-1)	[MPa]	175	170	159	165	158	174	185	74		
Thermal properties											
Glass transition temperature (DIN EN ISO 11357)	[°C]	47	40	45	-60	-60	-60	-60	104		
Melting temperature (DIN EN ISO 11357)	[°C]	258	215	218	166	166	169	182			
Service temperature, short term	[°C]	170	170	130	140	140	140	150	100		
Service temperature, long term	[°C]	100	100	100	100	100	100	110	75		
Thermal expansion (CLTE), 23 - 60 °C (DIN EN ISO 11359-1;2)	[10 ⁻⁵ K ⁻¹]	11	12	11	13	13	13	12			
Thermal expansion (CLTE), 23 - 100 °C (DIN EN ISO 11359-1;2)	[10 ⁻⁵ K ⁻¹]	12	12	12	14	14	14	13			
Specific heat (ISO 22007-4:2008)	[J / (g*K)]	1.5	1.7	1.7	1.4		1.3	1.3			
Thermal conductivity (ISO 22007-4:2008)	[W / (m*K)]	0.36	0.38	0.38	0.39		0.39	0.43			
Electrical properties											
Specific surface resistance (DIN IEC 60093)	[Ω]	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴	> 10 ¹³	10 ¹⁴	10 ¹⁴		
Surface volume resistance (DIN IEC 60093)	[Ω*cm]	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹³	10 ¹⁴			10 ¹⁴		
Miscellaneous data											
Water absorption 24 h / 96 h (23 °C) (DIN EN ISO 62)	[%]	0.2 / 0.4	0.2 / 0.4	0.2 / 0.3	0.05 / 0.1	0.05 / 0.1	0.05 / 0.1	0.05 / 0.1	0.07 / 0.2		
Resistance to hot water / bases		(+)	(+)	(+)	(+)	(+)	(+)	-	-		
Resistance to weathering		-	-	-	-	-	-	-	-		
Flammability (UL94) (DIN IEC 60695-11-10;)		HB ^b	HB ^b	HB ^b	HB ^b	HB ^b	HB ^b	HB ^b	HB ^b		

The corresponding values and information are no minimum or maximum values, but guideline values that can be used primarily for comparison purposes for material selection. These values are within the normal tolerance range of product properties and do not represent guaranteed property values. Therefore they shall not be used for specification purposes. Unless otherwise noted, these values were

determined by tests at reference dimensions (typically rods with diameter 40-60 mm according to DIN EN 15860) on extruded, cast, compression moulded and machined specimens. As the properties depend on the dimensions of the semi-finished products and the orientation in the component (esp. in reinforced grades), the material may not be used without separate testing under individual circumstances.

Data sheet values are subject to periodic review, the most recent update can be found at www.ensinger-online.com

Technical changes reserved.



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Thermoplastic engineering and high-performance plastics from Ensinger are used in every important sector of industry today. Their economy and performance benefits have seen them frequently replace classically used materials.