## High-performace plastics used in semi-conductor production and electronics

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ENSINGER
ASK. THINK. SUCCEED.

## Utilisation of plastics in the production of semi-conductors

Many of the process stages involved in semi-conductor production call for handling components made of highly qualified materials.Their specific properties, including material purity, resistance to chemicals and good dimensional stability even at high temperatures make high-performance plastics from ENSINGER ideally suited for the manufacture and processing of wafers.

For semi-conductor production and electrical applications ENSINGER offers a broad range of high performance plastics. According to customer specifications we develop plastics with special properties and produce high quality semi-finished products and finished parts for challenging applications.

**The outstanding properties of ENSINGER high-performance plastics:**

- High thermo-mechanical strength
- Minimal thermal expansion
- Good wear resistance
- Good chemical resistance to acids, alkalis, greases and solvents, hydrogen peroxide, demineralised water, hot steam
- Good plasma resistance
- Minimal outgassing under vacuum
- Minimal extraneous ion content
- Good electrical insulating properties/ defined static conductivity

**Approvals**

Before plastics can be approved for clean room applications, they must comply with stringent requirements within the framework of exhaustive testing to ensure their suitability. To address the specific demands of semi-conductor production, ENSINGER processes special high-performance plastics capable of complying with strict clean room production standards. ENSINGER is certified according to ISO 9001.

## Plastics for every process stage.

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ENSINGER high-performance plastics demonstrate the utmost precision and maximum reliability throughout every stage involved in the complex manufacture and processing of wafers. For example during coating and etching of silicon wafers - a field in which handling components made of ENSINGER plastics have proved highly successful over many years.

### Cutting and polishing

During these processing stages, which include for instance chemical mechanical planarisation (CMP), plastics with good chemical resistance and hardness properties such as TECAPET, TECATRON and TECAPEEK are beneficial.

### Coating and etching processes

Ultra high purity silicon is used as a substrate for the semi-conductor structure, which calls for dimensional accuracy in the nanometer range. Highly caustic acids and alkalis as well as detergents and solvents are involved in generating these nanostructures. Plastics belonging to the fluoropolymer group as well as TECAPEEK, TECATRON and TECAFINE have proved highly successful for this type of application. Also in the case of new technologies such as dry etching using plasma technology, plastics such as VESPEL®, SINTIMID and TECAPEEK from ENSINGER are commonly used.

### Sheathing, encapsulating and contacting

The storage and transportation of silicon wafers during the manufacturing process entails a certain degree of physical contact. To preclude any damage to the finished chip, temperature resistant materials such as VESPEL®, SINTIMID and TECAPEEK are used. These offer a high degree of stability under thermal mechanical load.

### Gauging, testing and packaging

ENSINGER offers a whole range of benefits: VESPEL®, SINTIMID PAI, TECATRON and TECASON are characterised by outstanding dimensional stability. Materials such as TECAPEEK ESD, SINTIMID PAI ESD, TECAPEI ESD, TECANAT ESD and TECAFORM AH SD suppress the build up of static charges. And for sliding friction applications, friction modified materials from ENSINGER have proved highly successful for a wide range of performance categories.

# ENSINGER Plastics for semiconductor production

- **VESPEL®**
  Material with continuous service temperature over 300 °C. Dimensionally stable, creep resistant. Good electrical insulating properties, good plasma resistance. Vacuum resistant, minimal extraneous ion content.

- **SINTIMID HP**
  Continuous service temperature 300 °C. High deflection temperature for brief periods up to 365 °C. Dimensionally stable, creep resistant, good hardness level. Excellent plasma resistance, vacuum resistance. High degree of material purity.

- **SINTIMID PAI**
  High-strength PAI with high deflection temperature for brief periods up to 328 °C. Outstanding dimensional stability, good wear resistance. Very good electrical conductivity, solvent resistant.

- **SINTIMID PAI ESD**
  High-strength, statically conductive PAI. High deflection temperature for brief periods up to 328 °C. Dimensionally stable, good wear resistance. Solvent resistant.

- **TECATOR 5013**
  High thermal resilience for cryogenic and high temperature ranges up to 270 °C. High thermal stability long term. Electrically insulating. Very tough and rigid.

- **TECAPEEK ELS**
  Statically conductive, high strength, minimal thermal expansion. Good chemical resistance, abrasion resistance, good heat conduction properties. Low extraneous ion content, low outgassing.

- **TECAPEEK GF 30**
  High strength, good dimensional stability. Good electrical insulating properties, abrasion resistant.

- **TECAPEEK**
  Minimal extraneous ion content. Very good chemical resistance, abrasion resistant.

- **TECATRON PPS**
  Very good chemical resistance. Electrically insulating and abrasion resistant. Minimal extraneous ion content.

- **TECAPEI**
  High-grade electrically insulating material, low dielectric loss factor.

- **TECAPEI ESD 7**
  Statically conductive, high strength and rigidity, creep resistant, good dimensional stability. Heat deflection temperature up to 215 °C, abrasion resistant.

- **TECANAT ESD 7**
  Statically conductive PC with nanotubes.

- **TECAFLON PTFE TFM**
  Very high chemical resistance, low absorption rates. Extremely low dielectric loss factor, weldable. High material purity.

- **TECAFLON PVDF**
  Good chemical resistance, thermal application up to 150 °C. More mechanically stable than TECAFLON TFM.

- **TECADUR PET**
  Very good solvent resistance, dimensionally stable, low water absorption.

- **TECAFORM AH SD**
  Statically conductive, carbon black-free, inherently active continuous non-contaminating antistatic agent.

- **TECAFORM AH ELS**
  Electrically conductive POM with special conductive carbon black for general applications.

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## Contamination

Because of the danger of metal ion contamination, when manufacturing components for the semi-conductor industry, any contact with metal materials must be excluded. ENSINGER high-performance plastics reliably comply with this requirement.

| | VESPEL® SP1 | SINTIMID HP | TECAPEEK E grade |
|---|---|---|---|
| **Aluminium** | <1 | <2 | 0,1 |
| **Calcium** | <1 | <4 | 5 |
| **Iron** | <1 | <2 | 1,3 |
| **Copper** | | <1 | 0,4 |
| **Sodium** | | | |
| **Magnesium** | <3 | <5 | <25 |
| **Potassium** | | | |
| **Zinc** | 0 | <1 | 0,3 |

**Test in accordance with ICP-MS  Concentration levels stated in ppm**

## Outgassing behaviour

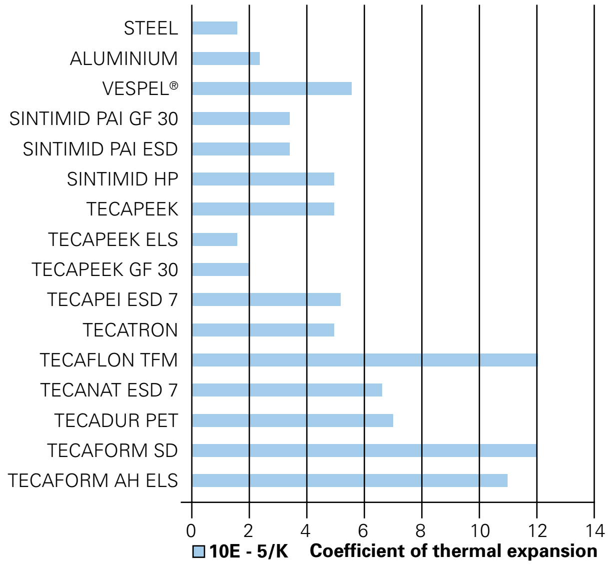
To comply with requirements in high vacuum environments, the materials used must be low-outgassing. High-performance plastics from ENSINGER fulfil these stringent requirements, offering maximum material purity and ensuring the minimal water absorption necessary for stability when working at high vacuum. Reject rates can be reduced as a result of the minimal risk of contamination.

| | Outgassing characteristic | VESPEL® SP1 (PI) | SINTIMID PUR HT (PI) | TECAPEEK ELS (PEEK) | TECAPEEK GF 30 (PEEK) | TECAPEEK (PEEK) |
|---|---|---|---|---|---|---|
| **Total weight loss** | TML % | 1,3 | 1,5 | 0,33 | 0,2 | 0,26 |
| **Collected evaporated condensable material** | CVCM % | 0 | 0 | 0 | 0 | 0 |
| **Reabsorbed water vapour** | WVR % | 0,7 | 0,8 | 0,12 | 0,08 | 0,12 |

**Test according to ESA PSS-01-702**

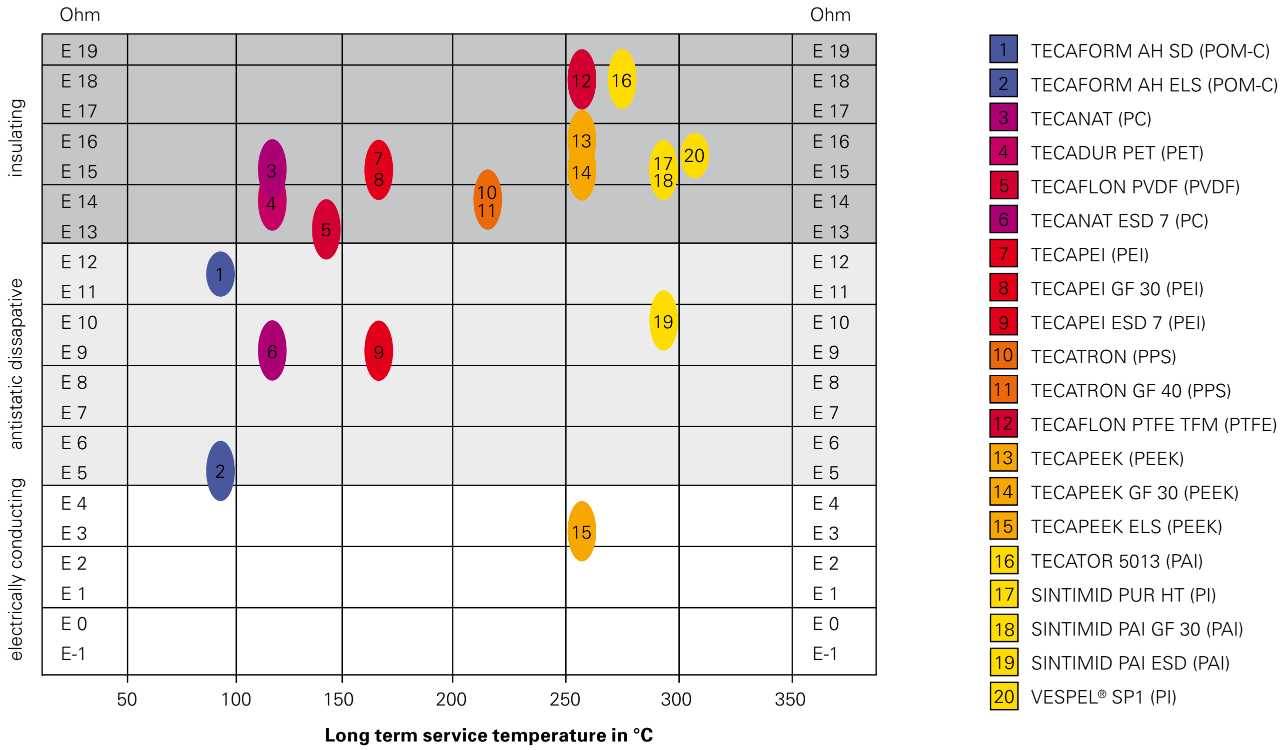
## Thermal expansion

The plastics developed by ENSINGER for use in etching and cleaning applications provide the minimal coefficent of thermal expansion essential for precise handling, fixing and contact over a wide range of temperatures. Fibre reinforced plastics are capable of achieving values comparable to steel and aluminium.




## Surface resistance

The insulating effect or static conductivity capability of ENSINGER high performance plastics is achieved by the selective addition of electrically active substances. These include special conductive carbon black, carbon fibres, conductive microfibres with nanostructure or inherently conductive materials. Due to the risk of contamination is conductive carbon black, mainly used for applications where the actual semi-conductor structures are closed and sealed. Carbon fibres, nanotubes and inherently conductive substances demonstrate higher abrasion resistance and therefore have a lower tendency to contamination. Here, electrical characteristic values can be kept within more easily definable limits.



## Comprehensive engineering expertise enables innovative production techniques.

The comprehensive engineering expertise of ENSINGER industry specialists provides technically challenging and customised solutions. The result of intense development together with our customers is special customised materials. Customer-specific compounding is possible even for minimal batch sizes.

From product development and material selection, tooling construction to shipment, our materials undergo a continuous process of quality assurance. More than 40 production sites and sales branches in 13 countries ensure that our products will reach you anywhere and on time.

### Extrusion

The very latest process technologies and highly specialised expertise are essential to the manufacture of application-specific semi-finished products. ENSINGER is equipped to extrude all commonly used thermoplastic polymers to any required customer geometry. Our many years of experience in extrusion technology guarantee the very highest quality standard of the required material characteristics.

### Compression Moulding

Alongside extrusion, ENSINGER also makes use of compression moulding as a production method for semi-finished products. This method is particularly suitable for high-temperature plastics with difficult processing properties such as PI, PEEK and PPS. High-grade semi-finished products and custom cast parts are manufactured using a special pressing technique. These are then used to produce ultra high precision parts.

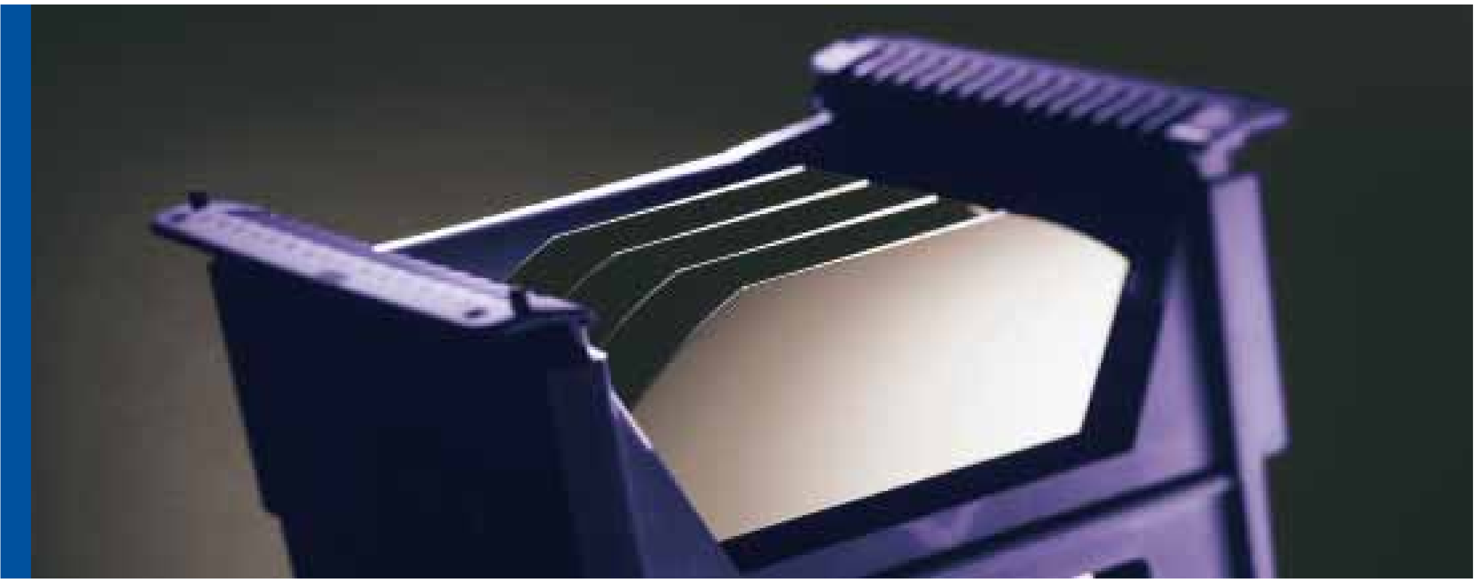
### Injection moulding

ENSINGER injection moulded components conform to the stringent quality requirements prevailing in the semi-conductor production industry. The use of injection moulding techniques produces the ultra precise, complex geometries required for retaining fixtures or conveying applications. Our customers benefit here from our own internal toolmaking shop and our range of state-of-the-art high-performance equipment.

### Machining

ENSINGER produces milled components to an outstanding standard of precision on the very latest CNC controlled machining centres. State-of-the-art machines are also available for machining turned components. In order to guarantee low-stress finished parts even when producing complex geometries involving the highest of tolerances, we carry out a heat treatment process to reduce material stress.

## Typical applications.



| | | High purity water systems | Chemical cleaning systems | Wafer-handling-systems | Retainer rings | Wafer wands | Wafer trays | Wafer carrier | Clamp rings (plasma etching) | Focus rings (plasma etching) | Wafer etching (chemical) | Wafer-etching (plasma) | Heat exchangers | Vacuum tweezers | Chip-test-equipment | Test sockets for chips | Chip carriers | Burn-in-sockets | Insert for spring contacts | Insulators | Contact sockets | Contact plugs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VESPEL® SP 1** | PI | | | | | • | | • | • | • | • | | | • | | | | • | • | • | | |
| **SINTIMID HP** | PI | | | | | • | | • | • | • | • | | | • | | | | • | • | • | | |
| **SINTIMID PAI GF** | PAI GF | | | | | | | • | | | | | | | | • | • | • | | | | |
| **SINTIMID PAI ESD** | PAI ESD | | | • | | | | | | | | | | | • | • | • | • | | | | |
| **TECATOR 5013** | PAI | | | | | | | | | | | | | • | | • | | • | | | | |
| **TECAPEEK ELS** | PEEK ELS | • | • | • | | | • | • | | | | | • | • | • | | | | | | • | • |
| **TECAPEEK** | PEEK | • | • | • | • | | • | • | | | | • | • | • | • | | • | | | | | |
| **TECAPEI GF** | PEI GF | | | • | | | | | | | | | | | • | | | | | | | |
| **TECAPEI ESD 7** | PEI ESD | | | • | | | | | | | | | | | • | | • | | | | | |
| **TECATRON** | PPS | | • | • | • | | | | | | | • | | | • | | | | | | | |
| **TECAMAX SRP** | PPP | | | | • | | | | | | | | | | | | | | | | | |
| **TECAFLON TFM** | TFM PTFE | • | • | • | | | • | | | | | • | • | | | | | | | | | |
| **TECAFLON PVDF** | PVDF | • | • | • | | | | | | | | • | • | | | | | | | | | |
| **TECANAT ESD 7** | PC ESD | | | • | | | | • | | | | | | | • | | | | | | | |
| **TECADUR PET / TECAPET** | PET | | | • | | | | | | | | | | | • | | | | | • | • | |
| **TECAFORM AH SD** | POM-C ESD | | | • | | | | | | | | | | | • | | | | | | | |

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Rollers.
**VESPEL® SP 21.**
Suitable for clean room production, low outgassing.

Insulating sleeves.
**VESPEL® SP1.**
High thermal resiliance under high temperatures, electrically insulating.

Contact plate.
**TECAPEEK**.
Very rigid and tough. Dimensionally stable.

Wafer handling wand.
**TECAPEEK ELS.**
Electrically dissipative. High dimensional stability.

Centering insert in the wafer gripper.
**VESPEL®**.
High thermal resiliance.

Support comb.
**TECAPEEK.**
High toughness, dimensionally stable, high chemical resistance.

Guide profile.
**TECATRON GF 40.**
Very good tribological properties. Low thermal expansion.

# ENSINGER High temperature plastics. Material standard values.

## Mechanical properties

| Trade name | DIN-abbreviation | Additives and/or colour | Service temperature °C long term | Density (ASTM D 792, DIN EN ISO 1183) | Tensile strength at yield (ASTM D 638, DIN EN ISO 527) | Tensile strength at break (ASTM D 638, DIN EN ISO 527, ASTM D 1708 (ai)) | Elongation at break (ASTM D 638, DIN EN ISO 527, ASTM D 1708 (ai)) | Molulus of elasticity after tensile test (ASTM D 638, DIN EN ISO 527) | Modulus of elasticity after flexural test (ASTM D 790, DIN EN ISO 178) | Hardness (ball indentation: ISO 2039/1, Shore D: ASTM D 2240, DIN 53 505 (d), Rockwell: ASTM D 785, ISO 2039/2 (r)) | Impact resistance see footnote (4) on page 19 | Creep rupture strength after 1000 h with static load | Time yield limit for 1% elongation after 1000 h | Coefficient of friction p = 0,05 N/mm², v = 0,6 m/s on steel, hardend and ground | Wear (conditions as previous) | Trade name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $\rho$ g/cm³ | $\sigma_S$ MPa | $\sigma_R$ MPa | $\varepsilon_R$ % | $E_Z$ MPa | $E_B$ MPa | $H_K$ MPa | $a_n$ kJ/m² | $\sigma_{B/1000}$ MPa | $\sigma_{1/1000}$ MPa | $\mu$ – | V $\mu$/km | |
| **VESPEL® SP1** | PI | brown | 300 | 1,43 | | 86 (a) | 7,5 (a) | 3275 | 3100 | | | | | 0,35 | | **VESPEL® SP1** |
| **SINTIMID PUR HT** | PI | black | 300 | 1,35 | | 116 | 9 | 4000 | 4000 | | 75 (c) | | 12 | 0,8 | | **SINTIMID PUR HT** |
| **SINTIMID PAI ESD** | PAI | black | 300 | 1,54 | 85 | | 4 | 4500 | | 93 (d) | 21 (ai) | | | | | **SINTIMID PAI ESD** |
| **SINTIMID PAI GF 30** | PAI GF 30 | 30% glass fibre | 300 | 1,57 | | 94 | 4 | 5800 | 6675 | | 16 | | | | | **SINTIMID PAI GF 30** |
| **TECATOR 5013** | PAI | yellow-brown | 260 | 1,42 | 147 | 137 | 21 | 3800 | 3750 | E 86 | 142 (ai) | | | | | **TECATOR 5013** |
| **TECAPEEK** | PEEK | natural, also black(1) | 260 | 1,30 | 95 | | 25 | 3000 | 4100 | M99 | o. Br. (c) | | | 0,30-0,38 | | **TECAPEEK** |
| **TECAPEEK GF 30** | PEEK GF 30 | 30% glass fibre | 260 | 1,51 | | 180 | 2,5 | 9500 | 10000 | M103 | 60 (c) | 36 | | 0,38-0,46 | | **TECAPEEK GF 30** |
| **TECAPEEK ELS** | PEEK CF | carbon fibre, black | 260 | 1,44 | | 175 | 1 | 15500 | | M105 | 30 (c) | | | | | **TECAPEEK ELS** |
| **TECAPEEK PVX** | PEEK CF CS TF | 10% carbon fibre, graphite, PTFE, black | 260 | 1,48 | | 130 | 1,5 | 9500 | 8100 | 208(2) | 30 (c) | | | 0,11 | | **TECAPEET PVX** |
| **TECATRON** | PPS | natural | 230 | 1,35 | 75 | | 4 | 3700 | 3600 | 190 | 50 (c) | | | | | **TECATRON** |
| **TECATRON GF 40** | PPS GF 40 | 40% glass fibre, natural | 230 | 1,64 | | 185 | 1,9 | 14000 | 13000 | 320 | 45 (c) | | | | | **TECATRON GF 40** |
| **TECATRON PVX** | PPS CF CS TF | 10% carbon fibre, graphite, PTFE, black | 230 | 1,47 | | 115 | 1,5 | 10000 | | 203(2) | 20 (c) | | | 0,21 | 0,69 | **TECATRON PVX** |
| **TECASON S** | PSU | translucent | 160 | 1,24 | 80 | 6 | > 50 | 2600 | | 147 | o. Br. (c) | 42 | 22 | 0,4 | | **TECASON S** |
| **TECASON E** | PES | translucent | 180 | 1,37 | 90 | 6 | 40 | 2700 | | 148 | o. Br. (c) | | 20 | | | **TECASON E** |
| **TECASON P** | PPSU | coloured | 170 | 1,29 | 70 | | > 50 | 2350 | 2600 | | | | | | | **TECASON P** |
| **TECAPEI** | PEI | translucent | 170 | 1,27 | 105 | | > 50 | 3200 | 3300 | 140 | 4 (c) | | | | | **TECAPEI** |
| **TECAPEI ESD 7** | PEI ESD 7 | black | 170 | 1,26 | | 65 | 4 | 2760 | 2920 | 123 (r) | 7,5 (ai) | | | | | **TECAPEI ESD 7** |
| **TECAPEI GF 30** | PEI GF 30 | 30% glass fibre | 170 | 1,51 | | 165 | 2 | 9500 | 9000 | 165 | 40 (c) | | | | | **TECAPEI GF 30** |
| **TECAFLON PTFE TFM** | PTFE | | 260 | 2,18 | 25 | | > 50 | | 700 | 30 | n. b. (c) | 5 | 1,58 | 0,08-0,1 | 21 | **TECAFLON PTFE TFM** |
| **TECAFLON ETFE** | E/TFE | | 150 | 1,73 | 45 | | 40 | 800 | | 60 (d) | n. b. (c) | | | 0,4 | | **TECAFLON ETFE** |
| **TECAFLON PVDF** | PVDF | | 150 | 1,78 | 50 | | > 30 | 2000 | 2000 | 80 | n. b. (c) | 34 | 3 | 0,3 | | **TECAFLON PVDF** |
| **TECAFLON PVDF CF 8** | PVDF CF 8 | 8% carbon fibre, black(1) | 150 | 1,78 | | 93 | 1 | 6000 | 6000 | | | | | 0,23 | | **TECAFLON PVDF CF 8** |
| **TECAFLON PVDF AS** | PVDF | conductive carbon, black(1) | 150 | 1,83 | 55 | 43 | 25 | 4200 | 4500 | 82 (d) | 60 (ai) | | | 0,23 | | **TECAFLON PVDF AS** |
| **TECAFLON PCTFE** | PCTFE | natural | 150 | 2,09 | | 35 | > 50 | 1400 | | 70 | n. b. (c) | | | 0,35 | | **TECAFLON PCTFE** |
| **TECAMID 66 CF 20** | PA 66 CF 20 | 20% carbon fibre, black | 110 | 1,23 | | 190/150* | 2,5/6* | 13500/10000* | | 187/200* | 45 (c) | | | 0,16-0,2 | 0,7 | **TECAMID 66 CF 20** |
| **TECANAT** | PC | transparent | 120 | 1,20 | 60 | | | 2300 | | 100 | n. b. (c) | 48 | 18 | 0,52-0,58 | 22 | **TECANAT** |
| **TECANAT ESD 7** | PC | | 120 | 1,22 | | 62 | 8 | 2290 | 2340 | | 6,4 (ai) | | | | | **TECANAT ESD 7** |
| **TECAPET** | PET | natural, also in black (1) | 110 | 1,37 | 88 | | | 3200 | | 95 | 40 (c) | | 13 | 0,25 | 0,35 | **TECAPET** |
| **TECAFORM AH** | POM-C | natural | 100 | 1,41 | 62 | | 30 | 2700 | | 145 | n. b. (c) | 40 | 13 | 0,32 | 8,9 | **TECAFORM AH** |
| **TECAFORM AH ELS** | POM-C | conductive carbon, black(1) | 100 | 1,45 | 50 | | 15 | 2000 | | M97(r) | >1000 (di) | | | | | **TECAFORM AH ELS** |
| **TECAFORM AH SD** | POM-C | beige | 100 | 1,33 | 45 | | > 25 | 1400 | 1450 | | 100 (ai) | | | 0,18 | | **TECAFORM AH SD** |
| **TECAFINE PP ELS** | PP | conductive carbon, black | 100 | 0,98 | 26 | 18 | 27 | 1200 | | 71 | 30 (c) | | | | | **TECAFINE PP ELS** |

The information corresponds with current knowledge, and indicates our products and possible applications. We cannot give you a legally binding guarantee of the physical properties or the suitability for a specific application. Existing commercial patents are to be taken into account. A definite quality guarantee is given in our general conditions of sale.

Tests are carried out in a standard atmosphere of 23° C 50 RH according to DIN 50 014.
We reserve the right to make technical alterations.
These values represents the average of a number of individual measurements. Unless otherwise stated the test results apply to injection moulded samples.

**Thermal properties** | **Electrical properties** | **Miscellaneous data**

| Trade name | Melting point (DIN 53 765) $T_m$ °C | Glass transition temperature (DIN 53 765) $T_g$ °C | Heat distortion temperature DIN EN ISO 75 method A HDT/A °C | Heat distortion temperature DIN EN ISO 75 method B HDT/B °C | Service temperature short term °C | Thermal conductivity (23°C) λ W/(K·m) | Specific heat (23°C) c J/(g·K) | Coefficient of linear thermal expansion (23°C, ASTM D 696, DIN ISO 7991, ASTM E 831) α $10^{-5}$ 1/K | Dielectric constant (106 Hz, ASTM D 150, DIN 53 483, IE-250) $\varepsilon_r$ – | Dielectric loss factor (106 Hz, ASTM D 150, DIN 53 483, IE-250) tan δ – | Specific volume resistance (ASTM D 257, EC 93, DIN IEC 60093) $\rho_D$ Ω·cm | Surface resistance (ASTM D 257, EC 93, DIN IEC 60093) $R_O$ Ω | Dielectric strength (ASTM D 149, DIN EN 60093) $E_d$ kV/mm | Resistance to tracking (DIN EN 60112, VDE 0303 part 1) Stufe | Moisture absorption to equilibrium 23 °C/50% rel. humidity (DIN EN ISO 62) $W(H_2O)$ % | Water absorption at saturation (DIN EN ISO 62) $W_S$ % | Resistance to hot water washing soda – | Flammability acc. to UL-Standard 94 – | Resistance to weathering(5) – | Trade name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VESPEL® SP1** | | | 360 | 360 | 360 | 0,35 | 1,13 | 5,4 | 3,55 | 0,0034 | $10^{14}$ - $10^{15}$ | $10^{15}$ - $10^{16}$ | 22 | | 1,3 | | | V0 | | **VESPEL® SP1** |
| **SINTIMID PUR HT** | | 360-375 | 368 | | 350 | 0,22 | 1,04 | 4,9 | 3,1 | 0,003 | $10^{17}$ | $10^{16}$ | 20 | | 2,6 | 3,6 | (+) | V0 | (+) | **SINTIMID PUR HT** |
| **SINTIMID PAI ESD** | | 340 | | | 320 | | | 3,3 | | | $10^{9}$-$10^{11}$ | $10^{9}$-$10^{11}$ | | | | 2,1 | (+) | V0 | (+) | **SINTIMID PAI ESD** |
| **SINTIMID PAI GF 30** | | 330 | 320 | | 320 | | | 3,3 | | | | $10^{9}$-$10^{11}$ | | | | | (+) | V0 | (+) | **SINTIMID PAI GF 30** |
| **TECATOR 5013** | | 275 | 278 | | 270 | 0,26 | 0,24 | 3,1 | 3,9 | 0,031 | > $10^{15}$ | > $10^{18}$ | 23,6 | | 2,5 | 4,5 | + | V0 | - | **TECATOR 5013** |
| **TECAPEEK** | 343 | 143 | 140 | 182 | 300 | 0,25 | 0,32 | 5 | 3,2-3,3 | 0,001-0,004 | $10^{16}$ | $10^{15}$ | 20 | | 0,1 | 0,5 | + | V0 | - | **TECAPEEK** |
| **TECAPEEK GF 30** | 343 | 143 | 315 | | 300 | 0,43 | | 2 | | 0,004 | $10^{15}$ | $10^{15}$ | 24,5 | | 0,1 | 0,1 | + | V0 | - | **TECAPEEK GF 30** |
| **TECAPEEK ELS** | 343 | 143 | | | 300 | 0,9 | | 1,5 | | | $10^{2}$-$10^{4}$ | $10^{1}$-$10^{3}$ | | | 0,1 | 0,2 | + | V0 | + | **TECAPEEK ELS** |
| **TECAPEEK PVX** | 343 | 143 | 277 | | 300 | 0,24 | | 2,2 | | | $3 \times 10^{5}$ | $5 \times 10^{6}$ | | | 0,1 | 0,1 | + | V0 | + | **TECAPEEK PVX** |
| **TECATRON** | 280 | 90 | 110 | | 260 | 0,25 | | 5 | | | $10^{13}$ | $10^{15}$ | | | 0,01 | | + | V0 | - | **TECATRON** |
| **TECATRON GF 40** | 280 | 90 | 260 | | 260 | 0,25 | 1,18 | ca. 3 | 4 | 0,004 | $10^{13}$ | $10^{15}$ | 20 | KC 175 | 0,02 | 1 | + | V0 | - | **TECATRON GF 40** |
| **TECATRON PVX** | 280 | 90 | | | 260 | | | 3-4(2) | | | $4 \times 10^{5}$(2) | $1 \times 10^{6}$(2) | | | 0,02 | | + | V0 | + | **TECATRON PVX** |
| **TECASON S** | | 180 | 169 | 181 | 180 | 0,25 | 1 | 5,5 | 3,1 | 0,005 | $10^{16}$ | $10^{14}$ | 42 | KA 1 KB 175 | 0,2 | 0,8 | + | V0 | - | **TECASON S** |
| **TECASON E** | | 225 | 204 | 214 | 220 | 0,18 | 1,12 | 5,5 | 3,5 | 0,005 | $10^{16}$ | $10^{14}$ | 40 | | 0,7 | 2,1 | + | V0 | - | **TECASON E** |
| **TECASON P** | | 220 | 207 | 214 | 190 | 0,35 | | 5,6 | 3,45 | | $10^{15}$ | $10^{13}$ | 15 | | 0,37 | 1,1 | + | V0 | + | **TECASON P** |
| **TECAPEI** | | 217 | 180 | 200 | 200 | 0,22 | | 5 | 3,15 | 0,001 | $10^{15}$ | $10^{15}$ | 33 | | 0,7 | 1,25 | + | V0 | - | **TECAPEI** |
| **TECAPEI ESD 7** | | 215 | 190 | | 200 | 0,25 | | 5,2 | | | $10^{6}$-$10^{8}$ | $10^{8}$-$10^{10}$ | | | | 0,25 | | V0 | + | **TECAPEI ESD 7** |
| **TECAPEI GF 30** | | 217 | 210 | 215 | 200 | 0,23 | | 2 | 3,7 | 0,007 | $10^{15}$ | $10^{15}$ | 30 | | 0,5 | 0,9 | + | V0 | - | **TECAPEI GF 30** |
| **TECAFLON PTFE TFM** | 327 | -20 | 55 | 121 | 260 | 0,25 | | 12 | 2,1 | 0,0002 | $10^{18}$ | | 48 | | | | + | V0 | + | **TECAFLON PTFE TFM** |
| **TECAFLON ETFE** | 267 | -100 | 71 | 105 | 150 | 0,24 | 0,9 | 13 | 2,6 | 0,001 | >$10^{16}$ | > $10^{16}$ | 40 | | <0,05 | 0,03 | + | V0 | + | **TECAFLON ETFE** |
| **TECAFLON PVDF** | 172 | -18 | 95 | 140 | 150 | 0,11 | 1,2 | 13 | 8 | 0,06 | $10^{14}$ | $10^{13}$ | | KA 1 | <0,05 | <0,05 | + | V0 | + | **TECAFLON PVDF** |
| **TECAFLON PVDF CF 8** | 172 | -18 | | | 150 | | | 3,6 | | | $10^{3}$-$10^{5}$ | $10^{5}$-$10^{7}$ | | | 0,04 | | + | V0 | + | **TECAFLON PVDF CF 8** |
| **TECAFLON PVDF AS** | 174 | -30 | | | 150 | | | 1,2-1,4 | | | $10^{2}$-$10^{4}$ | $10^{2}$-$10^{4}$ | | | 0,07 | | + | V0 | + | **TECAFLON PVDF AS** |
| **TECAFLON PCTFE** | 216 | 52 | | 126 | 180 | 0,24 | 0,9 | 6,5 | 2,5 | 0,02 | $10^{16}$ | $10^{16}$ | 55-81 | KA 3c KB>600 | <0,05 | | + | V0 | + | **TECAFLON PCTFE** |
| **TECAMID 66 CF 20** | 260 | 72/5* | 245 | 250 | 170 | 0,43 | 1,8 | 5,5(2) | | | $10^{2}$-$10^{4}$(2) | $10^{2}$-$10^{4}$(2) | | | 2,2 | 6,5 | (+) | HB | + | **TECAMID 66 CF 20** |
| **TECANAT** | | 148 | 135 | 140 | 140 | 0,19 | 1,2 | 7 | 3 | 0,006 | $10^{13}$ | $10^{15}$ | 27 | KA 1 | 0,15 | 0,36 | - | HB | - | **TECANAT** |
| **TECANAT ESD 7** | | | | | | | | 6,7 | | | $10^{7}$-$10^{9}$ | $10^{8}$-$10^{10}$ | | | 0,1 | 0,3 | - | V2 | + | **TECANAT ESD 7** |
| **TECAPET** | 255 | 70 | 95 | 170 | 170 | 0,24 | 1,1 | 7 | 3,2 | 0,0021 | $10^{13}$ | $10^{15}$ | 60 | KC 350 | 0,25 | 0,5 | | HB | | **TECAPET** |
| **TECAFORM AH** | 165 | -60 | 110 | 160 | 140 | 0,31 | 1,5 | 10 | 3,5 | 0,003 | $10^{14}$ | $10^{14}$ | >50 | KA 3c | <0,3 | 0,5 | (+) | HB | - | **TECAFORM AH** |
| **TECAFORM AH ELS** | 165 | -60 | 89 | | 140 | | | 11 | | | $10^{2}$-$10^{4}$ | $10^{2}$-$10^{4}$ | | | <0,3 | 0,5 | (+) | HB | + | **TECAFORM AH ELS** |
| **TECAFORM AH SD** | 165 | -60 | 88 | | 140 | 0,3 | | 6,5 | | | $10^{9}$-$10^{11}$ | $10^{9}$-$10^{11}$ | | | 0,25 | ~0,8 | (+) | HB | - | **TECAFORM AH SD** |
| **TECAFINE PP ELS** | 165 | -18 | 150 | 90 | 120 | 0,2 | | | | | <$10^{3}$ | <$10^{4}$ | | | <0,1 | <0,1 | (+) | HB | - | **TECAFINE PP ELS** |

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NB: For polyamides the values strongly depend on the humidity contents.
* humid, after storage in standard atmosphere 23°C 50 RH (DIN 50 014) until saturation.
+ = Resistant
(+) = Limited resistance
– = Not resistant
(depending on concentration, time and temperature)

(1) When plastics are listed under „additives and colour“ as available „also in black“, the electrical properties are not valid for the black variant.
(2) Testing on semi-finished products.
(3) Expected values.
(4) Impact resistance is measured with different methods.
The values in the following tables are marked with the following letters:
(c) Charpy: DIN EN ISO 179: $a_n$ kJ/m²
(ai) Izod: ASTM D 256: $a_n$ J/m
(di) Izod: DIN EN ISO 180, $a_n$ kJ/m²
(k) Notch impact strength: DIN EN ISO 179: $a_n$ kJ/m²

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