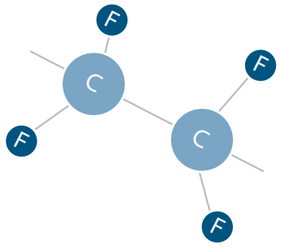
PTFE NÜNCHRITZ
become flexible

material information

···PTFE PURE, VIRGINAL – NUE 1

Polytetrafluoroethylene – PTFE – is a polymerisate of tetrafluoroethylene. It is a partially crystalline fluorinated plastic with the highest level of fluorination. The fluorine atoms "lie down" in a protective coating manner on the carbon chain.



PTFE has a special place among the plastics because of its combination of many outstanding characteristics:

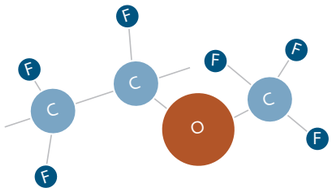
- resistant to virtually all organic and inorganic chemicals
- temperature resistance from –200°C to +260°C
- excellent electrical insulation properties
- low friction coefficient, without stick-slip-effect
- marked anti-adhesive behaviour
- physiologically harmless (FDA and BfR conformity)
- outstanding weather resistance and aging properties
- no water absorption
- low thermo-conductivity
- extremely low flammability (UL 94 [at 1.5 mm]: VO, LOI index: 95%)
- PTFE can be used in a vacuum

Points to remember with pure PTFE:

- relatively low resistance to wear and tear, on requirement the use of PTFE compounds should be testet
- higher tendency to cold flow
- low resistance to energy charged radiation, from radiation dosages of 10 kGy changes occus in the polymer characteristics
- not for processing in injection moulding

···MODIFIED PTFE – NUE M 1

Modified PTFE is a further development of PTFE with improved characteristics compared with the standard PTFE as a result of chemical modification (incorporation of a modifier in the polymer chain). Well-known examples of the modified material are the DyneonTM TFM types, the so-called second generation PTFE.



Advantages of NUE M 1 compared with NUE 1

- lower tendency to cold flow
- tighter structure with fewer voids
- improved compression stress relaxation (recovery)
- improved welding qualities
- smoother surfaces on machined parts

···PTFE COMPOUNDS

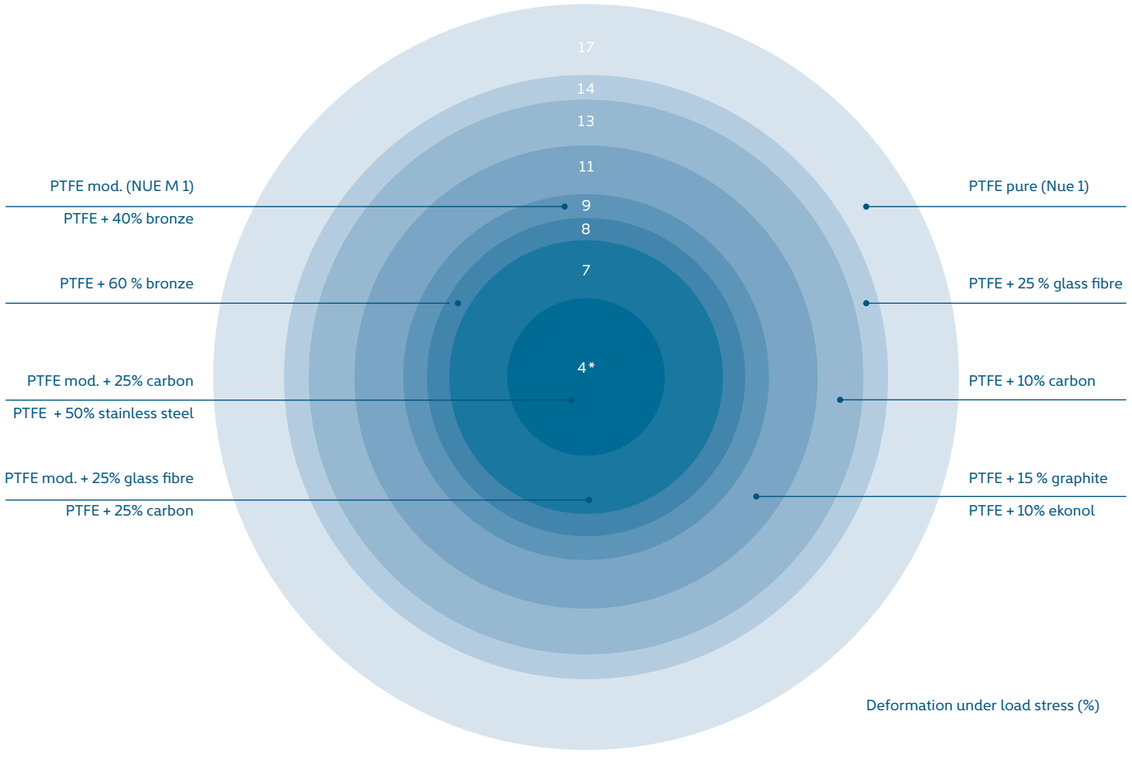
Mixing of various fillers with PTFE permits targeted characteristics improvement of the basic material to suit it for specific areas of application:

- the cold flow (deformation under load stress, see diagram) is reduced enormously
- multiple improvement in wear and tear resistence
- the electrical conductivity can be increased
- the thermo-conductivity can be increased
- thermal expansion is reduced

Deformation under load stress

It comes to cold flow under pressure. This is the result of a deformation under load stress, which is a special material characteristic. The difference between standard PTFE (NUE 1) and the modified variants (NUE M 1) together with the effects the various filler materials have can be clearly recognised.

Deformation under load stress (14 N/mm2, 24 h, 23 °C Test specimen: Ø 10 x 10 mm)



The influence of several fillers on the characteristics compared to unfilled PTFE:

CHARACTERISTICS	FILLER MATERIAL			
	glass	carbon	bronze	graphite
density	●	○	●	○
Tensile strength	○	○	○	○
break	○	○	○	○
ball impression hardness	●	●	●	●
compression strength / deformity under stress load	●	●	●	●
Resistance to wear and tear	●	●	●	●
Coefficient of friction	●	●	●	●
Thermal expansion	○	○	○	○
Temperature area of application	○	○	○	○
Thermal conductivity	○	●	●	●
electrical conductivity	○	●	●	●
Dielectric strength	○	○	○	○
Porosity	●	●	●	●
Resistance to chemicals	○	○	○	○

● increased
○ reduced
○ unchanged

···PTFE COMPOUNDS

The most commonly used filler materials include: glass, graphite, carbon and bronze. In addition aluminium oxide, lead pigments, VA-steel and polymers are used for special applications. A combination of different filler materials can be used application-specifically to achieve enormous improvements in the material characteristics. Its also possible to have coloring or a custom specific material development.

FILLER MATERIAL	CHARACTERISTICS	FILLER MATERIAL PROPORTION IN WEIGHT %	APPLICATION EXAMPLES
Glass e.g. NUE 125	• good pressure resistance • high wear and tear resistance • good electrical properties • FDA conformity • reduced thermal coefficient of expansion	up to 40 %	Sealing and guide elements, under static and dynamic stress load insulation elements
Graphite e.g. NUE 215	• good pressure resistance • improved heat conductivity • very good dry-operation characteristics	up to 15 %	sliding bearings for smooth counterfaces, static and dynamic sealing elements under load stress
Carbon e.g. NUE 325K	• very good pressure resistance • very high resistance to wear and tear • great hardness • improved electrical conductivity	up to 35 %	dynamic stress load withstanding sealing elements and bearings
Carbon fibre e.g. NUE 310F	• very low deformation under load stress • very good chemical resistance • good resistance to wear and tear • also in water	up to 25 %	sliding bearings
Bronze e.g. NUE 640	• very good pressure resistance • high wear and tear resistance • good emergency running properties	up to 60 %	sliding bearings and guide rails, sealing and guide elements
Lead pigment e.g. NUE 1002	• electrical conductivity	up to 4 %	anti-static equipment
VA-steel e.g. NUE 750	• good pressure resistance • good thermal conductivity • broad range of chemical resistance	up to 60 %	ball and valve seat rings
Polymers e.g. NUE 1004	• good pressure resistance • high wear and tear resistance	up to 20 %	sliding bearings and expendable parts for smooth counterfaces

Working processes for PTFE

PTFE does not allow itself to be shaped like other thermoplastic plastics by injection moulding processes, traditional extrusion or film blowing. For PTFE, the process of sintering is used. After shaping through the compression of powder, the so-called green parts are sintered at high temperature, and the material properties are set-adjusted in this case. The resulting semi-finished products, which indicate simple shapes, are then processed by machining.

The production processes for PTFE semi-finished products includes:

- hydraulic moulded
- isostatic moulded
- RAM extrusion

PTFE semi-finished products can be worked with the following processes:

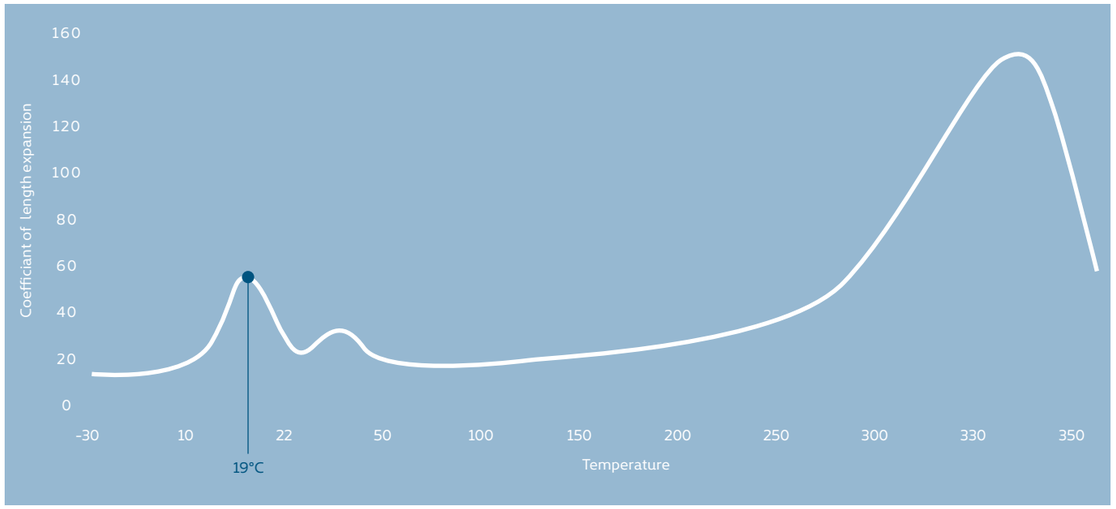
- turning
- milling
- centerless grinding

···NOTES FOR APPLICATION SYSTEMS AND CONSTRUCTION

PTFE temperature behaviour

Two temperature ranges lead to a specific behaviour pattern in the thermal expansion of PTFE and PTFE compounds (see diagram).

Coefficient of expansion and temperature dependence graph



- A crystalline grain conversion from triclinic to hexagonal takes place at 19° C. Particular attention must be paid to this in the measurement of components in a narrow tolerance range (retain standard temperature to DIN 50014) as also in parts laying and in assembly work.
- The crystallite melting point is at approx. 342° C.

The continuous use temperature of PTFE is at 260° C, and short term at 300° C*. The relatively high thermal coefficient of expansion can also be used in a targeted manner, as for example in the shrinking of bushes (cooling) and for the easier assembly of components (heating).

Surface qualities

The surface qualities that can be achieved with the standard manufacturing processes and with no additional effort required are Ra 1.6 / Rz 16 (NUE 1) to Ra 0.8 / Rz 6.3 (NUE M 1). In the case of PTFE compounds values between the following ranges can be achieved in dependence on the filler material type Ra 3.2 / Rz 25 and Ra 1.6 / Rz 16. Higher demands can be made from the surface quality in specific cases, but these are rarely necessary due to the compressibility and the low coefficient of friction of the material.

Plastic material tolerances

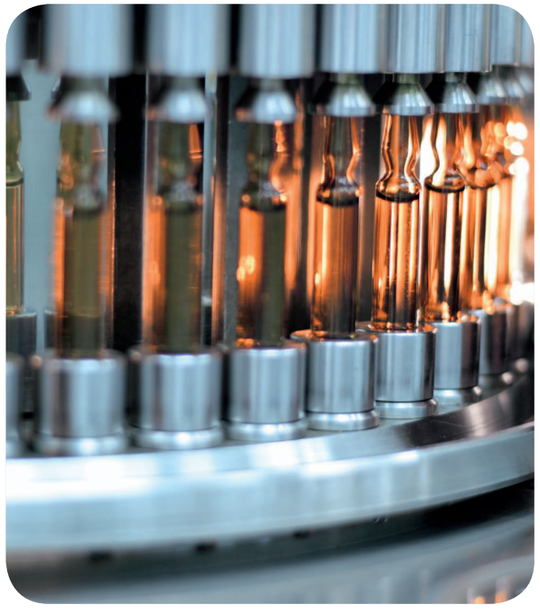
The special qualities the plastic material possesses largely rule out the need to select a very narrow range of manufacturing tolerances. As a result of the viscous-elastic properties of the material, plastic parts may shift out of a too closely selected tolerance range. Additional reasons for this may be the excessive thermal expansion the form and dimension changes due to the release of remnant stresses in the material resulting from manufacturing processes. DIN ISO 2768 T1, tolerance category m, should be referred to for general tolerances. In close tolerance work the tolerance series ≤ IT 9 is to be applied. The tolerance series IT 10 – IT 13 should be used depending on the process and the plastic used.

* short term: a few hours of temperature stress load only at either no or low mechanical stress load

···INDUSTRIES

PTFE – has a firm place in virtually every industry

The outstanding characteristics of PTFE combined with the sheer endless range of its applications make this plastic material totally indispensable in every sector of industry.



Chemicals and plant construction
- Sealing elements
- Compensators / Bellows
- Lining applications
- Components

Mechanical engineering
- Hydraulic elements
- Bearings
- Seals and gaskets
- Construction parts

Gas compressors
- Sealing and guide elements

Pharmaceuticals and foodstuffs industries
- Sealing and bearing elements

Medical systems, analytical systems
- Seals and gaskets
- Functional elements

Fitting and pump construction
- Sealing elements
- Linings and construction elements

Construction industry
- Sliding elements

Automotive industry
- Sliding and sealing elements
- Bearings

electrical systems
- Insulation parts

Semi-conductor systems
- Components
- Seals and gaskets

...THE COMPANY

Over 45 years experience in PTFE processing – ours is a record few can even approach! Our enormous production depth that starts with the compounding of the raw material through semi-finished products (hydraulic pressing and RAM extrusion) through to cutting on state-of-the-art CNC controlled turning and milling centres guarantees that you get totally reliable products from a single source. Series production or single items – we put our enormous capabilities to the test every single day. Own research and development in cooperation with raw materials producers and customers, leading universities and research institutes, plus the unrivalled experience our staff provide you with a base for getting optimum solutions to all your problems and toughest tasks that is unequalled anywhere. Whether you provide us with drawings, samples or application requirements – we will develop and manufacture it for you. Our materials testing laboratory and the regular stringent manufacturing tests we carry out in all production areas are your guarantee of an even and continuous high standard of quality. We have got what it takes for products of the highest standard, whether in our team of highly experienced and qualified staff on the one hand or our cutting edge machinery and the clear designer logic of our production processes on the other.

We are certified to DIN EN ISO 9001 : 2008 (TÜV Management Service).
You profit from our total flexibility and delivery reliability.

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