trygonal
GROUP

O-rings and Static Sealing Profiles

- We are a sealing and plastic parts manufacturer
- We see ourselves as a partner to our customers
- We are independent, holistic and solution-oriented
- We are an international network company and we work world-wide
- We see our company culture like life: varied, complex and exciting
- We value greatly the individuality and the expertise of the staff
- We are committed to high professional ethics and integrity in all we do

All this creates a passionate, innovative and dynamic team to support your business.

Trygonal O-rings and Static Sealing Profiles

We are an active international group of independent seal manufacturers and plastics processors. In our group, we produce all types of gaskets and plastic parts such as O-rings, moulded rubber parts, metal rubber compounds, foam moulded parts, semi-finished products and machines for machining seals. The latest production techniques are used.

The most commonly used sealing element is the O-ring. Trygonal offers a wide range of O-rings and static seals. Each O-ring size is available in metric or inch dimensions, and custom sizes are possible. The smallest size starts at a cord thickness and internal diameters of less than 1 mm. The largest O-rings are manufactured in cross sections of 30 mm or larger and up to a diameter larger than 3 m.

Materials

We have a wide range of materials, both for standard and specialty applications. A selection of our materials are EPDM, FPM, NBR, HNBR, CR, MVQ, FVMQ, TFE, FFKM. For special applications, we also manufacture O-rings made out of UHMWPE, PTFE, PEEK, polyurethane, FEP-coated or metallic materials.

Static sealing profiles

- Dairy Fittings
- Square profiles
- Roof edge profiles
- Double roof edge profiles
- Back-up rings

Surface treatment

O-rings can be specially surface treated. For example: Labs-free, halogenated, greased with molykote, talc, PTFE-coated or cured.

Delivery standards

All O-rings are available in accordance with DIN 3771, ISO 3601, AS 568 B, BS 1806, BS 4518 and other standards.

Approvals

BAM, BfR, with DVGW W 270, FDA, MIL, KTW, NSF, UL, USP, WRAS, 3-A Sanitary Standards

Applications

Automotive, construction, mining, railways, power generation, aerospace, semiconductor, power plant, solar and wind power, food & beverage, engineering, medical, mobile hydraulics, oil & gas, paper, pharmaceutical, steel works

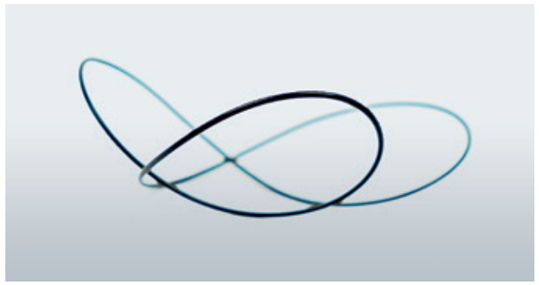
Delivery program

Standard O-rings

Our O-rings are manufactured in all common rubber materials, according to international standards, in metric and inch dimensions in hardness ranges from 40 to 95 Shore A or IRHD. In addition, a large number of special materials are available.

Advantage:

- Tools are available for currently 30 347 dimensions in 200 cord thicknesses.



Turned O-rings

For special dimensions or if the application requires a special material, O-rings can also be turned. Turned O-rings are available from batch size 1 up to several thousand pieces, in dimensions from ø10 × 1.0 mm to ø1450 × 25 mm depending on the material group.

Advantages:

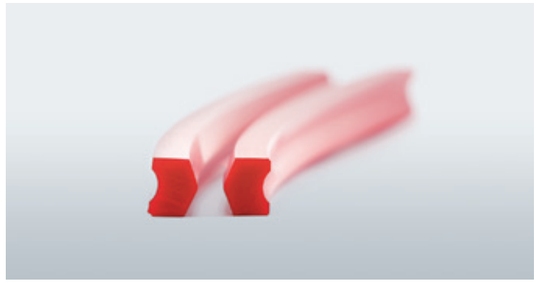
- no mould costs
- Ring can be deployed in the shortest possible time

FEP, PFA coated O-rings

Sheathed O-rings combine the positive properties of the sheath and the rubber-elastic core and are therefore ideally suited for applications in the chemical, food and pharmaceutical industries.

Advantages:

- low coefficient of friction and good sliding properties
- resistant to many organic and inorganic chemicals
- high thermal load capacity
- FDA approved
- low vapour permeability
- low compression set



Alternatives to the O-ring

Various profile geometries can be produced as an alternative to the O-ring in turned and injection moulded form.

Advantages:

- Alternative profiles which do not require support rings against gap extrusion
- Rectangular rings; static, axial and radial sealing
- no twisting possible

Back-up Rings

Various support ring geometries are available in turned, moulded, endless and slotted quality.

Advantage:

- The Back-up Ring prevents the immigration of the O-rings in the sealing gap.

Determination and rough design of the O-ring

The O-rings are defined by the inner diameter and the cord thickness.

The dimension of the O-ring must be approx. 1–6% smaller in the case of an external seal. The O-ring is thus installed slightly stretched.

The dimension of the O-ring should be approx. 1–3% larger in the case of an internal seal. The O-ring is thus installed slightly compressed.

O-ring Dimensions

We stock more than 10 000 O-ring tools in our warehouse, which are constantly updated. Naturally, tools are not available for all standards and sizes. Depending on the material, different O-ring manufacturing tolerances can result for the same nominal sizes as well as for different materials.

For this reason, new tools are created for specific applications and quantities. In general, however, all O-ring sizes can be manufactured in our O-ring Speed production in the required standards from a Shore hardness of 80 Shore A up to a diameter of 2000 mm.

O-ring special sizes

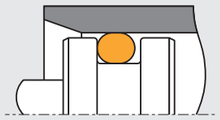
Special O-ring sizes can also be manufactured according to customer and application requirements – on request in specific materials.

International standards

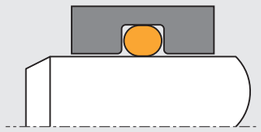
All O-rings are available according to DIN 3771, ISO 3601, AS 568 B, BS 1806, JISB 2401, LJF R, MIL.

Possible applications

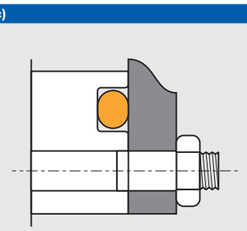
Piston seal (static/dynamic)



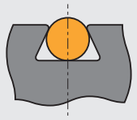
Rod seal (static/dynamic)



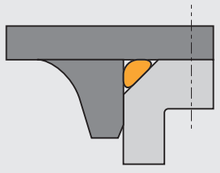
Flange gasket (static)



Trapezoidal groove (static)



Triangular groove (static)



Depending on the pressure, additional support rings are used for flange, piston and rod applications.

Shape and surface deviation

The DIN ISO 3601-3 standard defines permissible form and surface deviations of O-rings. It distinguishes between admissible mistakes according to their type characteristics.

O-rings with the grade characteristic N are intended for general applications and meet the high demands on dynamic and static seals.

O-rings with grade characteristic S are intended for applications that require a higher quality standard with regard to permissible deviations and surface qualities.

O-ring alternatives, static sealing elements

Depending on the application, functional problems can also occur with O-rings (twisting, pressure, extrusion, DVR, leakage). The solution is sealing profiles specially developed for the application:

- Rectangular rings; static, axial and radial sealing
- X-rings; radial, dynamic sealing
- Roof edge profiles; static, axial and radial sealing at higher pressures
- FEP coated O-rings; for high chemical material loads
- Metal rings; axial sealing at highest system pressures

PTFE

The PTFE O-ring is only suitable for static applications such as flange sealing in chemical plant engineering and is the first choice for aggressive media.

TS35/TK35/TR35

If an O-ring is to be used dynamically, there are better technical alternatives such as the TS35. A profile ring that cannot be twisted can be used for a longer period of time.

Metal + C-rings

Metal + C-rings are used at higher temperatures up to 980 °C and higher pressures up to 6800 bar.

Manufacturing processes

We manufacture O-rings in various ways with different crosslinkers.

Compression method

In the compression process, a blank is inserted into a mould, which consists of two mould halves and is closed. This procedure is suitable for small to medium series.

Trygonal «Speed-Service», fast O-ring production

If there is a hurry in the production or assembly, we provide O-rings (in smaller quantities) machining (from 80 Shore A) up to a diameter of 600 mm, and deliver them within 24 hours. If this is not enough, we can deliver the O-ring by special transport within a few hours directly to the customer.

Injection moulding

In the injection moulding process, the material is automatically injected into the mould. This process is suitable for medium to large series.

Impact vulcanised round cord rings

If the mechanical requirements allow this, toroidal sealing rings can be vulcanised to O-rings. Almost any size can be produced in the shortest possible time using this manufacturing method.

Surface treatment and coatings

O-rings are surface treated or coated to improve assembly, automatic mountability, optical, friction and cleanliness green.

Labs-free (no paint wetting interference – LA)

- Silicones and other substances that interfere with paint wetting are completely removed
- After this process, the cleaned parts are safely „labs-free“
- Suitable for all materials except MVQ and MFQ
- O-rings that are mounted in paint shops or come into contact with paint must be „labs-free“

Dynamic Application (DA)

- PTFE – black or grey
- Well structured surface
- Mating surfaces made of metal

Conditional Dynamic Application (BA)

- PTFE – transparent (two-component)
- Suitable for plastic mating surfaces
- Smooth surface structure

Mounting aid (MA)

- PTFE-FDA compliant (one-component)
- Reduction of press-in forces
- Surface adhesion moderate

Easy assembly (ME)

- PTFE-ME (one component)
- Separation is ensured
- Automatic processing

Chemical resistance (CB)

- Coating with: Silicone, PTFE
- Improvement of chemical resistance

Fluorination (FL)

- The result is a flexible, thin and hard outer layer that greatly reduces the coefficient of friction.
- Only NBR and EPDM materials can be treated.
- This treatment prevents sticking and facilitates separation.

Material overview

Abbreviated designation	Chemical name	Approvals see table Approvals	Default color	Other colours	minimal operating temperature	maximum operating temperature	Hardness	Tear resistance, unreinforced	Tear resistance, amplified	Ultimate elongation	Rebound resilience	Abrasion resistance	Tear resistance	Electrical contact resistance	Alkali resistance	Ageing stability	Petrol resistance	Hot water	Ozone resistance	Resistance to oil and grease	Acid resistance	Qualities: Standard	Qualities: Special	Qualities: Rigid, not elastic	Qualities: Colour selection	Qualities: Availible Compounds	Qualities: Code-No.
					°C	°C	Shore A																				
	Elastomer compounds																										
CR	Polychloroprene elastomer		black		–35	+100	40–90	●●	●	●	●●	●	●	●●	●	●	●	●	●	●	●●		●			9	80-04
EPM/EPDM	Ethylen-propylen-dien elastomer	●	black	green red beige blue grey	–40	+140	30–90	●●	●●	●●	●●	●●	●●	●	●	●	●●	●	●	●	●	●				●	33	80-03
FFKM	Perfluor elastomer	●	black	beige yellow ○ white ○ transparent	–55	+300	50–80	●●	●●	●●	●●	●●	●●	●●	●	●	●	●	●	●	●		●			4	80-18
FPM	Fluor elastomer	●	black	green red brown beige blue yellow ○ white	–30	+230	50–90	●●	●●	●●	●●	●●	●●	●●	●	●	●	●	●	●	●	●				●	40	80-01
HNBR	Hydrogenated acrylonitrile elastomer	●	black	green brown	–40	+150	50–90	●●	●	●	●●	●	●●	●●	●●	●●	●	●●	●●	●	●	●					9	80-09
IIR/CIIR	Butyl elastomer/Chlorbutyl elastomer		black		–50	+100	60–80	●●	●●	●	●	●●	●●	●	●	●	●	●	●	●	●			●			3	80-16
MFQ	Flour silicone elastomer		red	brown blue grey ○ transparent	–40	+210	45–80	●	●●	●●	●●	●●	●	●	●●	●	●●	●	●●	●●	●●			●		●	8	80-07
MVQ	Silicone elastomer	●	red	green beige blue yellow ○ white grey	–40	+230	30–80	●	●●	●●	●●	●●	●	●	●●	●	●●	●●	●●	●	●●	●●	●			●	51	80-06
NBR	Nitrile-butadiene elastomer	●	black	green red blue yellow ○ white grey	–40	+120	40–90	●●	●	●	●●	●	●●	●●	●●	●●	●	●●	●●	●	●●	●	●	●		●	41	80-02
NR	Natural rubber		black	blue grey	–40	+80	40–90	●	●	●	●	●	●	●	●●	●●	●	●●	●●	●	●●	●●		●			4	80-08
SBR	Styrene-butadiene elastomer	●	black		–40	+100	45–75	●	●	●	●●	●	●●	●	●●	●●	●	●●	●●	●	●●	●●		●			4	80-12
TPU (AU/EU)	Polyurethane elastomer	●		red brown blue yellow ○ transparent	–30	+110	60–95	●	●	●	●●	●	●●	●●	●●	●	●	●●	●	●●	●●		●		●	18	80-13
	Themoplastics																										
PEEK	Polyetherketone	●	beige		–50	+260	–																	●		6	80-63
PTFE	Polytetraflourethylene	●	○ white		–200	+260	–																●	●	●	12	80-60
TPE	Thermoplastic elastomers		○ white	various	–40	+140	30–80																		●	10	80-20
UHMWPE	Polyethylene	●	○ white	various	–200	+80	–																	●	●	5	80-66
	Other materials																										
Metal	Metal	–	–		–250	+500	–																			4	80–70/71/72

● very good ●● good ●● moderate ●● conditionally ● insufficient

Customer service, packaging

Customer service, comprehensive advice and technical support are our top priorities. From the development to the production process and the desired packaging, we rely on a trustful cooperation with our customers.

- Technical advice for individual problem solving
- Prototyping and product optimization
- On request application-related material mixtures, metal types, finishes (e.g. surface treatment) are available
- Depending on your requirements and drawings
- An extensive range of standard articles is always on call

Storage

The storage life of the different materials depends on various boundary conditions (reference DIN 7716/DIN 9088).

Storage conditions	
Heat	the storage temperature should not exceed at 5°–25°C; direct exposure to sunlight should be avoided.
Humidity	the humidity should be below 70%; extreme conditions should be avoided.
Light	the O-rings should be stored in dark rooms, they should be protected from daylight.
Oxygen	the O-rings should be packed in air-tight bags and protected from draughts.
Deformation	the O-rings should be stored in a relaxed state. O-rings of larger diameter can be stored twisted and folded.

Materials	Maximum lifetime
AU, CIIR, EU, NR, SBR, TPU	5 years
CR, HNBR, NBR	7 years
EPDM, FFKM, FPM, MFQ, MVQ	10 years
PEEK, PTFE, TPE, UHMWPE	10 years
Metal	>10 years

Approvals / Conformity

The materials and sealing elements we use must conform to all legal requirements. Special material compounds have been designed to meet all these standards. Ask us, we can help.

Type	Explanation	Materials: CR	EPM/EPDM	FFKM	FPM	HNBR	IIR/CIIR	MFQ	MVQ	NBR	NR	SBR	TPU (AU/EU)	PEEK	PTFE	TPE	UHMWPE
ACS	Drinking water in France		●														
BfR	Compliance for food in Germany		●						●								
DIN EN 681-1	Water supply and drainage		●														
DVGW DIN EN 549	Gas inserts in Germany									●	●						
DVGW W 270	Microorganisms in drinking water		●														
EC 2002/72	Food safety in EU																
FDA	Food and drug administration in USA		●	●	●	●			●	●		●	●	●	●		●
KTW	Drinking water in Germany		●							●							
NSF 51	National science foundation; Food in USA		●														
NSF 61	Drinking water in USA		●														
USP Class VI	U.S. Pharmacopoeia, United States		●	●													
WRAS	Drinking water in UK		●														

Brief descriptions of elastomer compounds

Chloroprene elastomer (CR)

- Polychloroprene is an excellent universal elastomer with an attractive balance of properties and few practical limitations. Universal neoprene grades are divided into two groups: sulfur-modified grades and mercaptan-modified grades. Sulfur-modified neoprenes have increased tear strength and elasticity, while mercaptan-modified neoprenes have better resistance to heat and compression set.
- Good inherent flame resistance; moderate oil and gasoline resistance; excellent adhesion to fabrics and metals; very good weather, ozone and natural ageing resistance; good abrasion and flexural fracture resistance; very good alkali and acid resistance.
- Poor to good resistance to aromatic and oxygenated solvents; limited flexibility at low temperatures.

Fluor elastomer (FPM)

- There are different types of fluorine elastomers, they are based on monomers, which form the framework of the elastomer. Three curing systems with different performance characteristics are available. These characteristics define the performance of the product. Contact your supplier to determine which product and curing system is best suited for your process.
- Excellent resistance to high temperatures; excellent resistance to oil, gasoline, hydraulic fluids and hydrocarbon solvents; very good tightness to gases and vapours; very good resistance to weathering, oxygen, ozone and sunlight; good flame retardancy.
- Medium tear and cut resistance, very low resistance to oxygenated solvents.

Ethylene-propylene diem elastomer (EPM/EPDM)

- EPM and EPDM are both co- and terpolymers of ethylene, propylene and a monomer containing diene (ter-employer) to facilitate vulcanization. The monomer ratios are varied to obtain specific properties and properties. Due to their unique combination of properties they can be used in a variety of products.
- EPM elastomers have excellent resistance to ozone, water and steam, alkalis and acids, salt solutions and oxygenated solvents.
- EPM and EPDM have very low temperature resistance and excellent electrical properties. Poor resistance to oil, petrol and hydrogenated solvents.

Hydrogenated acrylonitrile-elastomer (HNBR)

- Hydrogenated nitrile (HNBR) is a family of products designed to eliminate some of the defects of nitriles. HNBR shows improved chemical resistance, a higher service temperature and a lower brittle temperature than normal nitrile. HNBR polymers are reacted with hydrogen to hydrogenate part of the unsaturation of NBR to improve chemical compatibility with certain media such as sour gas, ozone and some additive packages.
- Very good resistance to oil and gasoline: excellent resistance to petroleum-based hydraulic fluids, wide operating temperature range, good resistance to hydrocarbon solvents, very good resistance to alkalis and solvents.
- Low resistance to ozone, sunlight and natural ageing, poor resistance to oxygenated solvents.

Perfluor elastomer (FFKM)

- Perfluoroelastomers are products with a high utility value.
- The best combination of chemical and high temperature resistance of all elastomers. Thermal stability depends on polymer and curing chemistry. Peroxide crosslinking perfluoroelastomers have similar thermal stability to FKM, while proprietary curing systems (such as Kalrez®) offer temperature resistance up to 327 °C (620 °F) with specific polymers.
- The performance of perfluoroelastomers is limited at lower temperatures.

Butyl elastomer (IIR) / Chlorbutyl elastomer (CIIR)

- Butyl is unlike other synthetic elastomers or natural rubber resistant to ozone and corrosive chemicals. Butyl and chlorobutyl behave like plastic by creeping, flowing cold and having a poor compression set. CIIR differs from IIR essentially only in its better compression set.
- Excellent gas and vapour tightness, very good resistance to heat, Oxygen, ozone and sunlight; high energy absorption (attenuation); excellent resistance to alkalis and oxygenated solvents; good hot tear strength; excellent resistance to water and steam.
- High compression set; poor resistance to oil, petrol and hydrocarbon solvents; low rebound resilience; poor elasticity.

Fluor silicone elastomer (MFQ)

- In addition to the typical properties of normal silicone rubber (MVQ), fluorosilicone rubber (MFQ) also exhibits significantly improved heat resistance and very good low-temperature flexibility.
- Excellent weather resistance and excellent resistance to ozone and UV rays, good electrical properties.
- Fluorosilicones show a considerably better resistance compared to standard silicones. chemical resistance in hydrocarbons, aromatic mineral oils, fuels and low-molecular aromatic hydrocarbons such as benzene or toluene.

Silicone elastomer (MVQ)

- The most outstanding property of silicone is its ability to maintain rubber-like properties through extreme temperatures. The operating temperatures range from −55 °C to +200 °C. Silicones are normally used in applications that require high resistance.
- Excellent heat resistance; excellent flexibility at low temperatures; low compression set; very good electrical insulation; excellent resistance to weathering, ozone, sunlight and oxidation; excellent color stability.
- Poor abrasion resistance, tear and cut growth resistance; low tensile strength; inferior resistance to oil, gasoline and solvents; poor resistance to alkalis and acids.

Nitrile-butadiene elastomer (NBR)

- NBR are copolymers of butadiene (BD) and acrylonitrile (ACN). The monomer ratio can be varied over a wide range. NBR with higher ACN offers improved oil resistance, fuel resistance and tear strength.
- Very good oil and petrol resistance: excellent resistance to Hydraulic fluids based on crude oil, large operating temperature range, good resistance to hydrocarbon solvents, very good resistance to Alkalis and solvents.
- Low resistance to ozone, sunlight and natural aging, poor Resistance to oxygenated solvents.

Natural rubber (NR)

- Natural rubber (NK) is a highly polymeric isoprene with very good physical properties, very high tensile strength, very good elasticity, very good low temperature properties, good abrasion resistance and excellent dynamic properties. This combination is Depending on achieved by synthetic elastomers.
- Without the appropriate addition of protective agents, however, the resistance to ageing and ozone is low. There is no resistance to mineral oils and greases.
- Despite more modern synthetic rubbers, natural rubber is still used for engine suspensions, machine bearings, rubber-metal compounds, clutches, damping elements and similar components.

Styrene-butadiene elastomer (SBR)

- SBR is similar to natural rubber in most respects and is the most cost-effective and highest-volume elastomer on the market. Although its physical properties are slightly worse than those of natural rubber, SBR is tougher and more resistant to heat and cracking and can easily be replaced by natural rubber in many applications. With the exception of silicone, butadiene has the lowest glass transition temperature of any commercially available elastomer and offers unusually good performance at temperatures as low as −60 °C.
- Very good elasticity, tensile strength, abrasion resistance and flexibility at low temperatures.
- Poor resistance to ozone and sunlight; very low resistance to oils, petrol and hydrocarbon solvents.

Polyurethane elastomer (TPU, AU/EU)

- Polyurethane is characterised by the combination of hardness with elasticity, excellent abrasion resistance and high tear resistance. It can be either ether or ester based. The ester-based polymer is superior in resistance to abrasion and heat; the ether-based polymer has better flexibility at low temperatures. Polyurethanes are available in both liquid and solid form. Polyurethanes are mainly used in applications that require a combination of their excellent properties: Toughness, tensile strength and abrasion resistance.
- Excellent abrasion and tear resistance; very high tensile strength with good elongation; excellent weather, ozone and sun resistance; good oil and gasoline resistance; excellent adhesion to textiles and metals.
- Poor resistance to alkalis, acids and oxygenated solvents; poorer resistance to hot water.

Brief descriptions thermoplastics

Polyetherketone (PEEK)

- The variable proportions of ether (E) and ketone/carbonyl groups (K) in the polyaryletherketones essentially determine the properties of these polymers. For example, the differences between polyether ketone, PEK and polyether ether ketone, PEEK. All polyaryletherketones are quite polar and of medium crystallinity.
- Polyether ether ketone has high mechanical strength, stiffness and hardness. It is wear resistant and has excellent friction properties. In addition, the material is characterized by high chemical resistance and energetic radiation.
- The materials show a high resistance to stress cracking, except against acetone; they are only conditionally resistant to „hard“ UV light. Oxidizing agents also attack and there is solubility in sulphuric acid.

Polytetraflourethylen (PTFE)

- Polytetrafluoroethylene is an unbranched, linear, semi-crystalline polymer consisting of fluorine and carbon. PTFE belongs to the class of polyhalogen olefins, which also includes PCTFE (polychlorotrifluoroethylene). It belongs to the group of thermoplastics, although it also has properties that make it more suitable for processing thermosetting plastics.
- Fluoropolymers have very good electrical as well as excellent chemical properties. Other physical properties such as mechanical strength and stiffness depend on the fluorine content and other additives.
- The wear resistance of PTFE is moderate, but can be improved by filler additives such as graphite or bronze powder. It also has a tendency to creep.

Thermoplastic elastomers (TPE)

- Thermoplastic elastomers are plastics that behave at room temperature in a similar way to classic elastomers, but can be plastically deformed when heat is applied and thus exhibit thermoplastic behavior.
- The two main material properties are compression set and stress relaxation.
- Compared to EPDM, they have worse material properties in the short-term behavior, but in the long-term behavior the picture is reversed compared to EPDM. TPE are less thermally and dynamically resistant than standard elastomers.

Polyethylene (UHMWPE)

- Polyethylene belongs to the group of polyolefins and is semi-crystalline and non-polar. It is by far the most frequently used plastic.
- Polyethylenes are characterized by good wear and abrasion resistance, high impact strength, high chemical resistance, low coefficient of friction and almost no water absorption. Very good electrical insulators with high dielectric strength and physiologically harmless. In addition, they are well resistant to high-energy radiation.
- The mechanical properties are only moderate compared to other plastics.

Trygonal Group

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O-rings and Static Sealing Profiles

Seals

Customised and Large Sealing Solutions

Materials and Semi-Finished Products

Machines, Software & Tools

Rubber Parts and Membranes

Rubber-Metal and Rubber-Plastic Components

Vibration Technology and Gripper Rails

Plastic Turned and Milled Parts, 3D Printer Parts

Form and Foam Parts

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