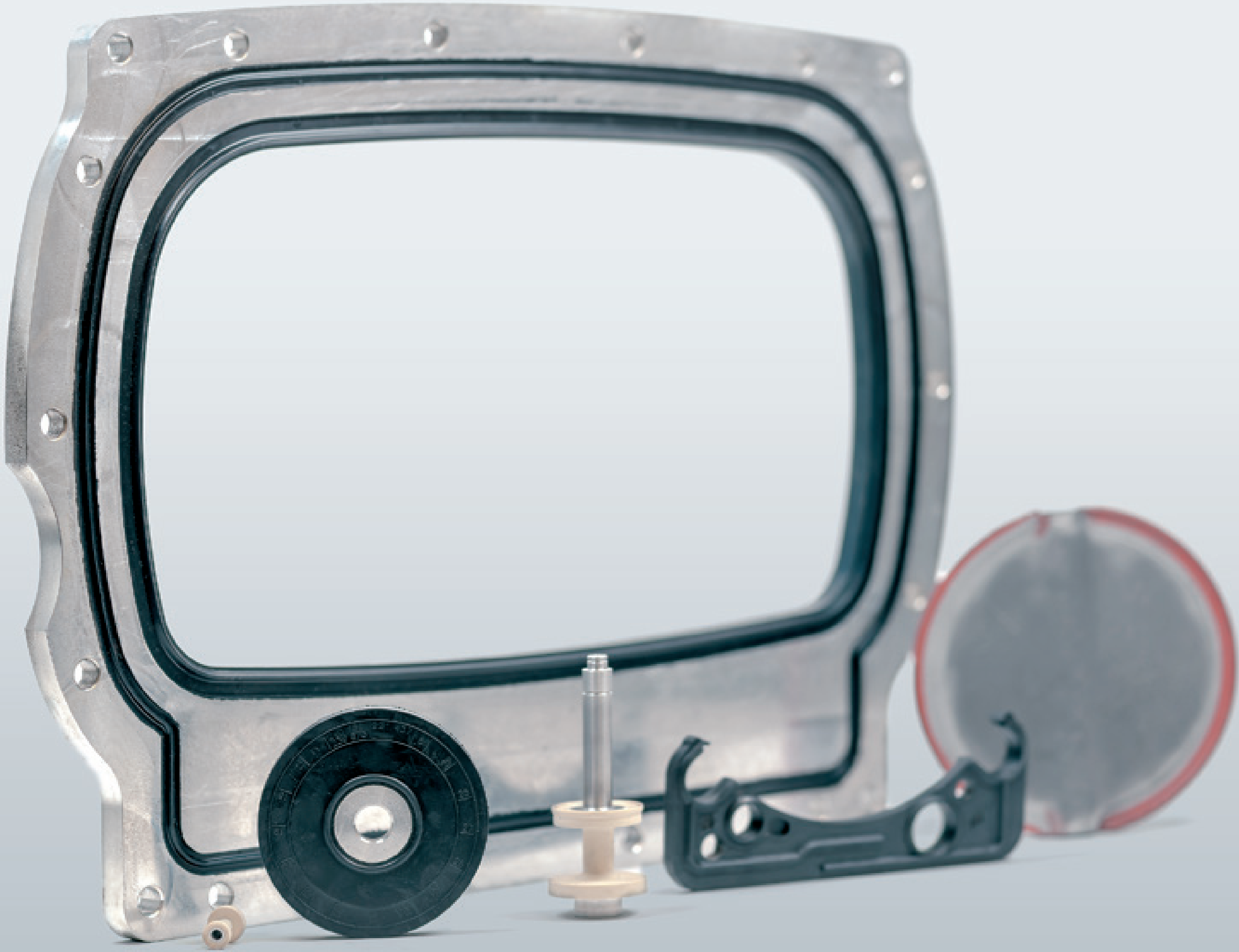
Moulded Rubber Parts, Membranes, Rubber-Metal and Rubber-Plastic Bonded Parts



- 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.

Moulded Rubber Parts, Membranes, Rubber-Metal and Rubber-Plastic Bonded Parts

In our internationally active group we manufacture all types of Rubber Moulded Parts, Membranes and Rubber-Metal and Rubber-Plastic Bonded Parts.

We develop and manufacture high-quality moulded rubber parts and diaphragms from all known rubber-elastic materials.

We manufacture rubber-metal and rubber-plastic parts in various material combinations. Metals such as steel, stainless steel, brass, aluminium and plastics such as HGW, PA, PEEK are used as carrier materials.

State-of-the-art CNC-controlled presses, vacuum presses, injection moulding machines and CAD/CAM systems are used.

The processing methods used are either compression, injection, injection compression, transfer moulding or cold runner technology. We manufacture the necessary moulds and tools in our own tool shop.

Materials

Rubber elastomers (NBR, H-NBR, EPDM, FPM, MVQ, NR, SBR, CIIR, MFQ, FFKM):
For a wide range of operating conditions, resistances and stresses

Elastomers (TPU, TPE):
Polyurethanes for highest mechanical stresses in different hardnesses and material compounds

Surface treatment

Moulded Rubber Parts can be subjected to special surface treatments:
Labs-free, halogenated, molycoated, talcumized, PTFE-coated

Approvals

DVGW, KTW D1 D2, FDA, NSF, UL, MIL, EU 1935/2004

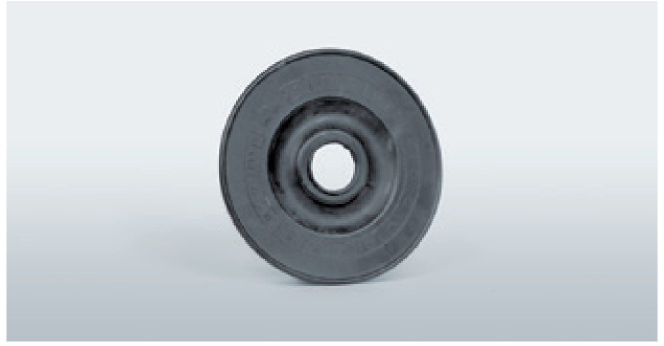
Applications

Automotive, construction, mining, railways, power generation (power plants, solar energy and wind power), aircraft construction, semiconductors, food and beverages, mechanical engineering, medical technology, mobile hydraulics, oil and gas, paper, pharmaceuticals, steelworks, valve and fitting technology, water preparation

Delivery program

Rubber moulded parts

We manufacture according to customer drawings and specifications, using either the compression, injection, injection compression or transfer moulding process or cold runner technology. The moulded rubber parts are manufactured from all common elastomers and special materials.



Membranes

Our elastomer diaphragms without fabric inserts are used in a wide variety of industries, e.g. mechanical engineering, gas industry, pneumatics, medical technology, chemicals and pharmaceuticals, automotive engineering, food industry, etc.

Rubber-metal connecting parts

Production is carried out according to customer drawings and specifications. Metals such as steel, stainless steel, brass, aluminium etc. are used as carrier material. A variety of material combinations are possible.

Rubber-plastic connecting parts

Production is carried out according to customer drawings and specifications. As carrier material we use the appropriate plastics like HGW, PA or PEEK.

Correct selection of the elastomer material

When selecting the material, a number of important selection criteria must be taken into account, such as the operating conditions to be expected, the design requirements, approvals, standards and costs.

Operating conditions

- Which medium (liquid, gaseous, solid) does the component come into contact with?
- What is the minimum and maximum operating temperature?
- Is it a static or dynamic application?

What type of load is applied to the component?

- Direction of action: tension, compression, bending, torsion
- Load distribution: point load, area load

Approvals, regulations, standard specifications, test criteria

- Selection of the material with the necessary prerequisites

Design requirements

- Component geometry with description
- Critical dimensions and tolerances
- Information on the desired service life
- Installation and assembly considerations

Cost in relation to value

- When selecting the materials for your components, the guiding principle should be „value-in-use".
- The overall evaluation should also take into account quality, service life and maintenance costs saved.

Approvals / Conformity

The materials and components manufactured must meet high legal requirements in relation to their application. Special material mixtures have been developed for this purpose, for more information please contact us.

Type	Explanation	Materials											
		CR	EPM/EPDM	FFKM	FPM	HNBR	IIR/CIIR	MFQ	MVQ	NBR	NR	SBR	TPU (AU/EU)
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		●										

Material overview elastomer compounds

Abbreviated designation	Chemical name	Approvals (see table Approvals)	Default color	Other colours	minimal operating temperature °C	maximum operating temperature °C	Hardness Shore A
CR	Polychloroprene elastomer		black		–35	+100	40–90
EPM/EPDM	Ethylen-propylen-dien elastomer	●	black	green, red, beige, blue, grey	–40	+140	30–90
FFKM	Perfluor elastomer	●	black	beige, yellow, white, transparent	–55	+300	50–80
FPM	Fluor elastomer	●	black	green, red, brown, beige, blue, yellow, white	–30	+230	50–90
HNBR	Hydrogenated acrylonitrile elastomer	●	black	green, brown	–40	+150	50–90
IIR/CIIR	Butyl elastomer/Chlorbutyl elastomer		black		–50	+100	60–80
MFQ	Flour silicone elastomer		red	brown, blue, grey, transparent	–40	+210	45–80
MVQ	Silicone elastomer	●	red	green, beige, blue, yellow, white, grey	–40	+230	30–80
NBR	Nitrile-butadiene elastomer	●	black	green, red, blue, yellow, white, grey	–40	+120	40–90
NR	Natural rubber		black	blue, grey	–40	+80	40–90
SBR	Styrene-butadiene elastomer	●	black		–40	+100	45–75
TPU (AU/EU)	Polyurethane elastomer	●		red, brown, blue, yellow, transparent	–30	+110	60–95

Abbreviated designation	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	Special	Rigid, not elastic	Colour selection	Availible Compounds	Code-No.
CR	good	very good	very good	good	very good	very good	good	very good	very good	very good	very good	very good	very good	good		●			9	80-04
EPM/EPDM	conditionally	good	good	good	good	good	very good	very good	very good	conditionally	very good	very good	moderate	very good	●			●	33	80-03
FFKM	conditionally	good	good	conditionally	moderate	good	moderate	very good	very good	very good	very good	very good	very good	very good		●			4	80-18
FPM	conditionally	good	good	conditionally	moderate	good	moderate	very good	very good	very good	very good	very good	moderate	very good	●			●	40	80-01
HNBR	conditionally	very good	very good	good	very good	good	moderate	good	good	very good	good	good	very good	moderate	●				9	80-09
IIR/CIIR	moderate	good	very good	insufficient	good	good	very good	very good	very good	insufficient	very good	very good	insufficient	very good		●			3	80-16
MFQ	insufficient	moderate	moderate	good	conditionally	insufficient	very good	moderate	very good	very good	moderate	very good	moderate	moderate		●		●	8	80-07
MVQ	insufficient	moderate	moderate	good	conditionally	insufficient	very good	conditionally	very good	conditionally	conditionally	very good	moderate	conditionally	●			●	51	80-06
NBR	conditionally	very good	very good	good	very good	good	moderate	good	good	very good	good	good	very good	moderate	●	●		●	41	80-02
NR	very good	very good	very good	very good	very good	very good	very good	good	good	insufficient	good	moderate	insufficient	good		●			4	80-08
SBR	very good	very good	very good	good	very good	good	very good	good	good	moderate	very good	moderate	conditionally	good		●			4	80-12
TPU (AU/EU)	very good	very good	very good	good	very good	good	good	conditionally	very good	very good	conditionally	very good	moderate	conditionally		●		●	18	80-13

very good · good · moderate · conditionally · insufficient

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)

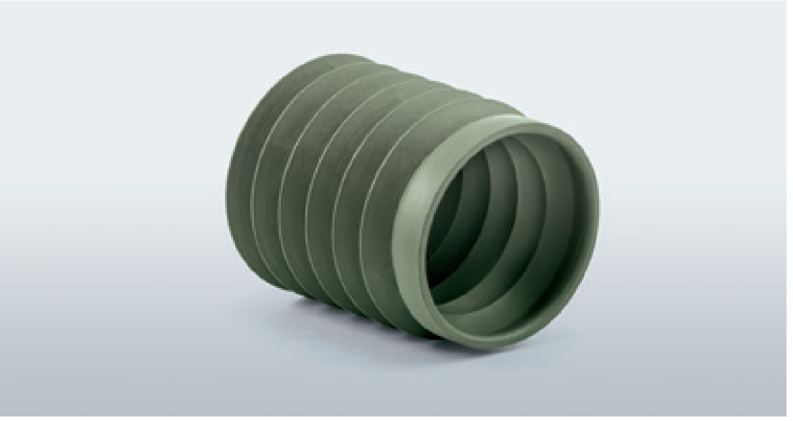
- Hydrogenated nitrile (HNBR) is a family of products designed to eliminate some of the defects of nitriles. HNBR shows improved chemical resistance, a higher service temperature and a lower brittle temperature than normal nitrile. HNBR polymers are reacted with hydrogen to hydrogenate part of the unsaturation 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.

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 hardly achieved by synthetic elastomers.
- Without the appropriate addition of protective agents, however, the resistance to ageing and ozone is only 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.

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.

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.

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.

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.

Manufacturing processes

We manufacture moulded rubber parts in different ways and with different types of cross-linking.

Compression Moulding

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

Injection Moulding

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

Injection Compression Moulding

In principle, this procedure is based on the fact that a residual gap is left open when the tool is closed. The required preplasticized mixture is injected into this gap and the press is then closed. This process can be used to produce flat, high-precision molded parts that can be removed from the mold largely without burrs.

Transfer Moulding

In this process, a recess is made in the upper half of the tool, into which the unvulcanised mixture is inserted in the form of simple blanks.

The upper half of the tool is connected to the tool nest by fine channels in the area of the recess. The most important difference to the compression method is that the tool nest is already closed at the start of pressing.

Cold runner technology

In cold runner technology, the injection channels are thermally separated from the actual mould by a cooling plate.

A correctly tempered channel system prevents material loss due to vulcanised sprues. This means enormous material savings, especially with high-quality compounds.

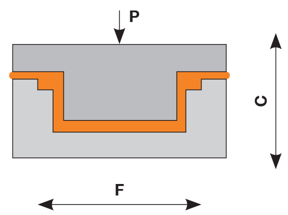
Quality and tolerances

Unless explicitly stated otherwise, all rubber-metal elements NR (natural rubber) with a hardness of 55 ±5 Shore A (medium hardness) are used as a metal element for the spring core or ST 37 (galvanized, chromated or bare). The elastomer properties are tested according to the following relevant standards.

The following standards are given as examples:

- DIN 53504 Tensile strength (N/mm²) and breaking elongation (%)
- DIN 53505 Hardness measurement (Shore A)
- DIN 53512 Density (g/cm³) and the rebound resilience (%)
- ISO 3302-1 class M3 for rubber-metal buffers
- ISO 3302-1 class M4 for rubber-metal rails

Nominal Size Allowed				Tolerance class M3		Tolerance class M4	
mm				Measure F ±mm	Measure C ±mm	Measure F ±mm	Measure C ±mm
		Up to	6,3	0,25	0,40	0,50	0,50
from	6,3	to	10	0,30	0,50	0,70	0,70
from	10	to	16	0,40	0,60	0,80	0,80
from	16	to	25	0,50	0,80	1,00	1,00
from	25	to	40	0,60	1,00	1,30	1,30
from	40	to	63	0,80	1,30	1,60	1,60
from	63	to	100	1,00	1,60	2,00	2,00
from	100	tp	160	1,30	2,00	2,50	2,50
from	160			±0,8%	±1,3%	±1,5%	± 1,5%



F refers to each dimension in horizontal direction.

C refers to each dimension in press direction **(P)**

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 and moulded part design
- Construction and material-specific design of the component
- 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

Trygonal Group

Moulded Rubber Parts, Membranes, Rubber-Metal and Rubber-Plastic Bonded Parts

- Seals
- O-rings and Static Sealing Profiles
- Customised and Large Sealing Solutions
- Materials and Semi-Finished Products
- Machines, Software & Tools
- Vibration Technology and Gripper Rails
- Plastic Turned and Milled Parts, 3D Printer Parts
- Form and Foam Parts

Germany

Trygonal Group GmbH

Neue Heimat 22
D-74343 Sachsenheim-Ochsenbach

Phone: +49 (0) 7046-9610-0
Fax: +49 (0) 7046-9610-33
info@trygonal.com

Switzerland

Trygonal Schweiz AG

Joweid Zentrum 2
CH-8630 Rüti ZH

Phone: +41 (0) 55 212 45 00
rueti@trygonal.com

Spain

Trygonal Iberia SL

Polígono Borda Berri, nº 13 Módulo C4
E-20140 Andoain (Gipuzkoa)

Phone: +34 (0) 943 303 900
iberia@trygonal.com

France

Technical consulting & sales

Phone: +33 (0) 6 44 39 61 80
france@trygonal.com

Austria

Trygonal GmbH

Industriering 5
A-9020 Klagenfurt

Phone: +43 (0) 463/310095
klagenfurt@trygonal.com

Trygonal Kunststoffinnovationen GmbH

Tragösser Straße 53
A-8600 Bruck an der Mur

Phone: +43 (0) 3862 27722-0
office@trygonal.com

Trygonal ATYP SERVICE

Beethoven Straße 1
A-2231 Strasshof

Phone: +43 (0) 2287/22235
atyp@atyp.com

Your Contact

www.trygonal.com