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جهت مشاوره

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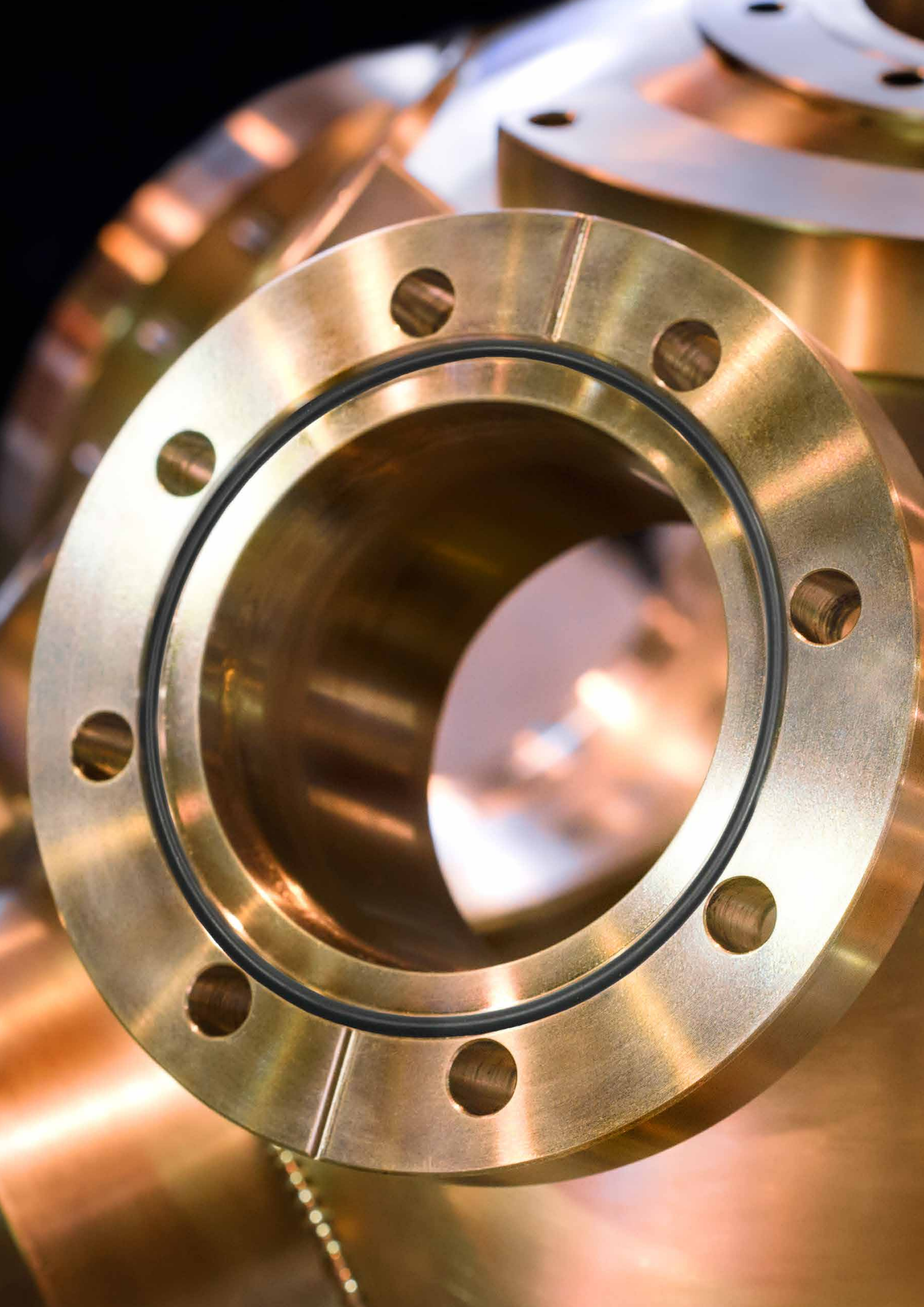
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O-Ring Catalogue

Epidor

Seals and
Rubber Technology



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WHO ARE WE?

EPI INDUSTRIES Family of Companies, a consolidated group of companies with more than sixty years of experience, creates in May 2016 EPIDOR Seals and Rubber Technology.



Epidor
Seals and
Rubber
Technology

A new company was born with the mission of continuing to develop the business of sealing and vibration insulation products of Epidor SAU and Lidering SAU, prestigious firms with several decades of experience in the market.

Epidor Seals and Rubber Technology inherits all the knowledge of the product and the market and is oriented to the development of its specialties to offer to the equipment manufacturers (OEM) solutions of contrasted quality as those that we cite next:

- Design and development of innovative technical solutions for high quality mechanical engineering components.
- Technical and logistical services associated with the product in the ranges of sealing and vibration isolation.
- A qualified team of experienced and skilled people focused on the needs of clients.
- A firm commitment to providing value-added solutions.
- A strong presence in the Iberian market and subsidiaries in 5 countries.
- An internal business culture to promote corporate values and principles to all *stakeholders*.
- Our effort to be recognized as a reliable partner that provides with guarantee and optimum quality of customer service.



ISO 9001

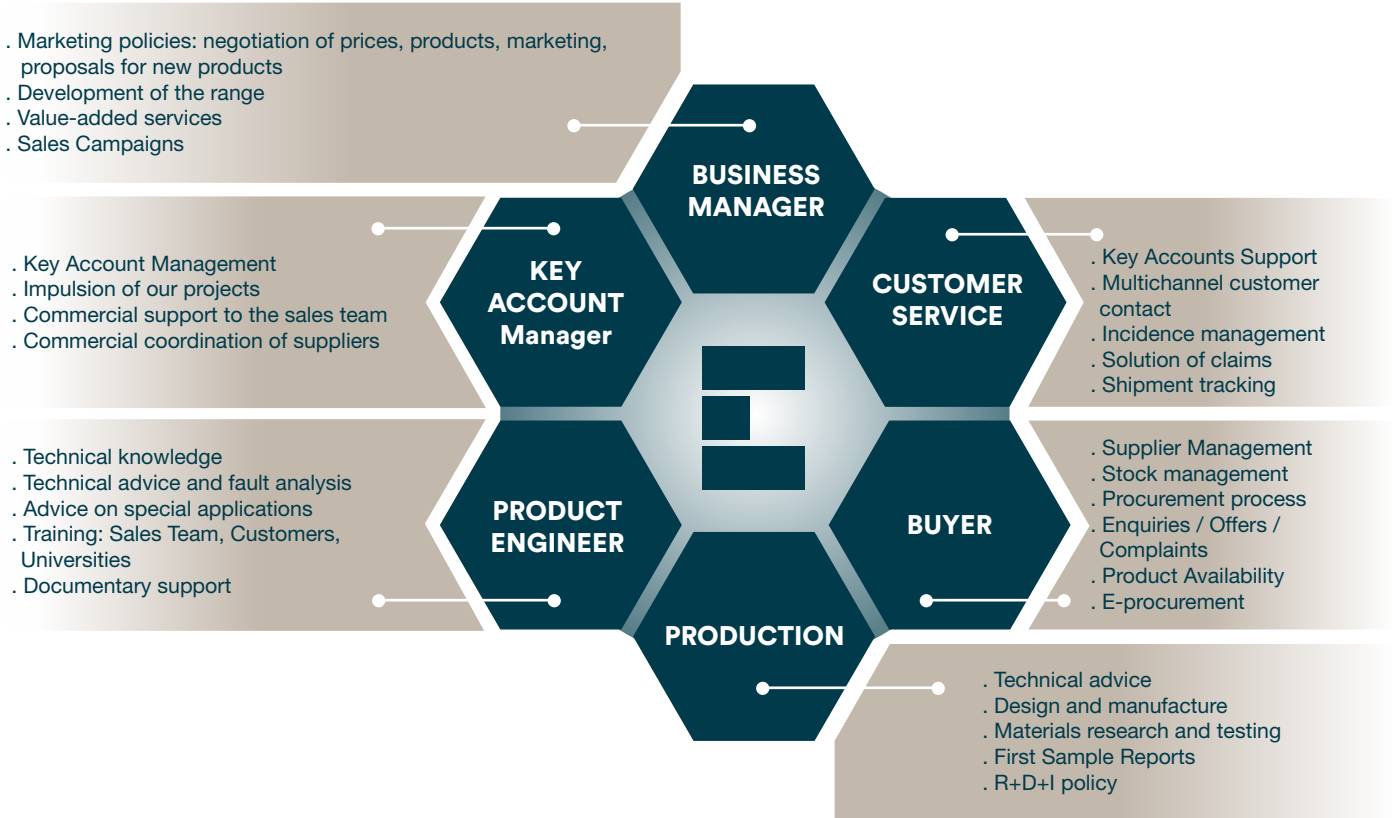
Epidor Seals and Rubber Technology offers equipment manufacturers (OEMs) a wide range of product-related services:

- Design and development of innovative technical solutions for high quality mechanical engineering components.
- Trainings adapted to each need.
- Support in the design of your equipment.
- Product failure analysis.
- Reports of first samples, quality controls.
- Vibration isolation for the protection of people, equipment and working environments.
- Personalized logistics: special labels, kits for spare parts or assembly, stock of material, packaging adapted to each product.

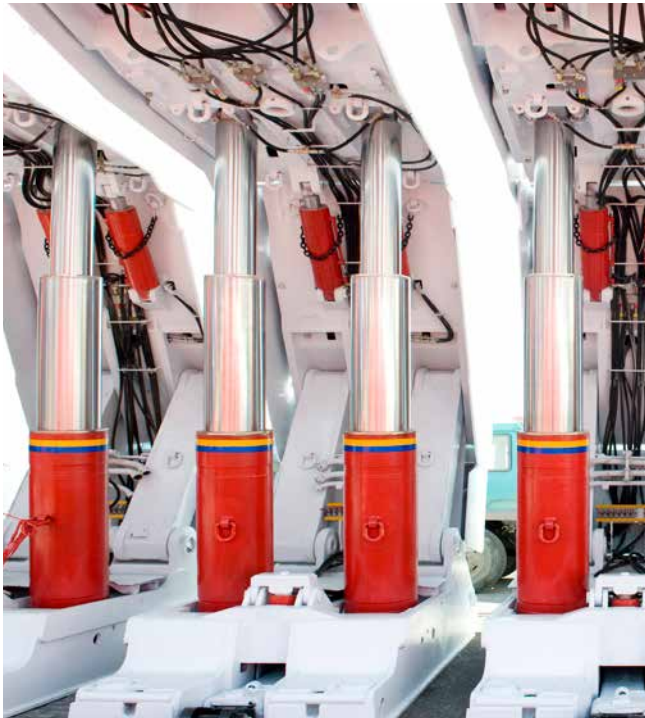
OUR TEAM AND RESSOURCES

This proven experience in all industrial sectors together with a team of skilled people allows us to provide solutions tailored to each point of application of the product. We are a specialized supplier of a wide range of mechanical engineering components that provide value-added solutions to the Customer, generating their satisfaction and trust.

At **Epidor Seals and Rubber Technology** our team of salespeople, application engineers, buyers, production and R&D&I are all focused on customer satisfaction. As members of EPI INDUSTRIES Family of Companies we have central services for product quality control and logistics adapted to any need.



OUR CUSTOMERS



EQUIPMENT MANUFACTURERS (OEM)

Our value contribution to **equipment manufacturers (OEMs)** lies in our collaboration to design the best solution for their products. This implies intense communication to understand the technical needs of the product to be manufactured, as well as its characteristics and the competitive advantages that this product must meet in its market.

We collaborate with the technical, engineering, product and prototype design, purchasing and procurement departments to define the standards of pre-shipment, service, deliveries, schedules, assembly kits or spare parts kits for the Customer's own after-sales management.

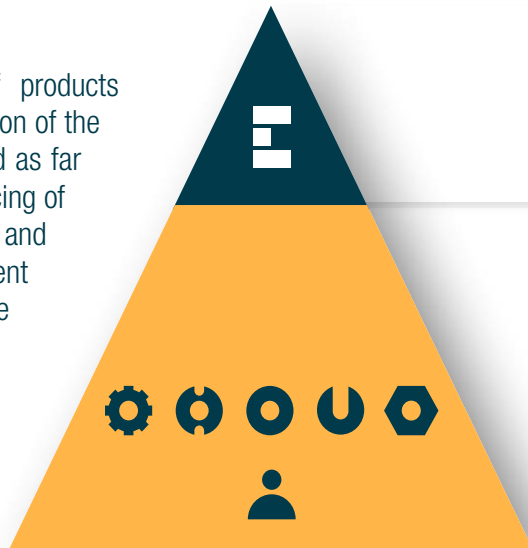
The presence of our Group's subsidiaries abroad facilitates the extension of our advisory and support services in third countries

MAINTENANCE AND REPAIR (MRO)

We serve the needs of MRO customers and companies supplying goods and services from the group company, **EPIDOR Technical Distribution**. Its strategic approach is focused on the management, from the proximity, of industrial customers with a wide variety of consumption of products and mechanical components.

Our extensive experience in all industrial sectors allows us to provide solutions adapted to each point of application of the product. We collaborate with the Departments of Manufacturing, Plant Maintenance and Materials Procurement.

The broad portfolio of products and services, the reduction of the portfolio of suppliers and as far as possible, the outsourcing of maintenance services and procurement management are real needs of the market that we can meet.



Epidor
Seals and
Rubber
Technology

[EPIDOR]
Technical
Distribution

MAIN PRODUCTS

Since the middle of the 20th century, we have established close cooperation with the world's leading manufacturers of sealing and vibration isolation products. From this collaboration is born a very wide range of products and solutions.

In the whole product range we have the ability to make tailor-made solutions.



HYDRAULICS AND PNEUMATICS SEALING

The experience accumulated over more than 50 years in the design, manufacture and marketing of sealing solutions for hydraulic and pneumatic cylinders, allows us to offer a wide range of collars, scrapers and guides for low, medium and high pressure environments of the fluid to be sealed.



ROTARY SHAFT SEALING

Dynamic sealing solutions for shafts in the process and automotive industry: shaft seals, V-rings, labyrinth seals and bushings for shaft protection or recovery of damaged shafts.



STATIC SEALING

Static Sealing Solutions, including **O-rings**, **X-Ring seals**, flanges seals of various shapes and materials, aseptic seals and energized seals, among other solutions.



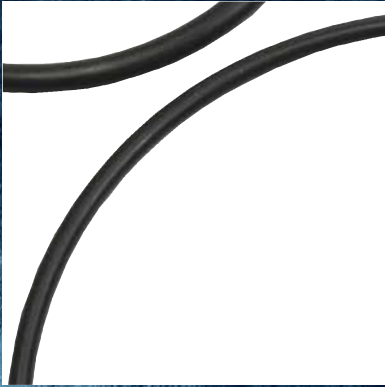
OTHER PRODUCT RANGES

We offer the Customer a wide range of products adapted to each need. The developed knowledge of the processes of moulding, extrusion or confection allows us to contribute solutions in very diverse forms and materials. Extruded profiles and molded gaskets such as membranes, bellows, suction cups and other design products.



VIBRATION ISOLATION

Elements of protection of machines, equipment and working environments by designing the best solution for the control and isolation of vibrations.



INTRODUCTION

O-rings are elastomer rings used in fluid sealing.

The range of O-rings comprises the following types:



O-rings of
Homogeneous material



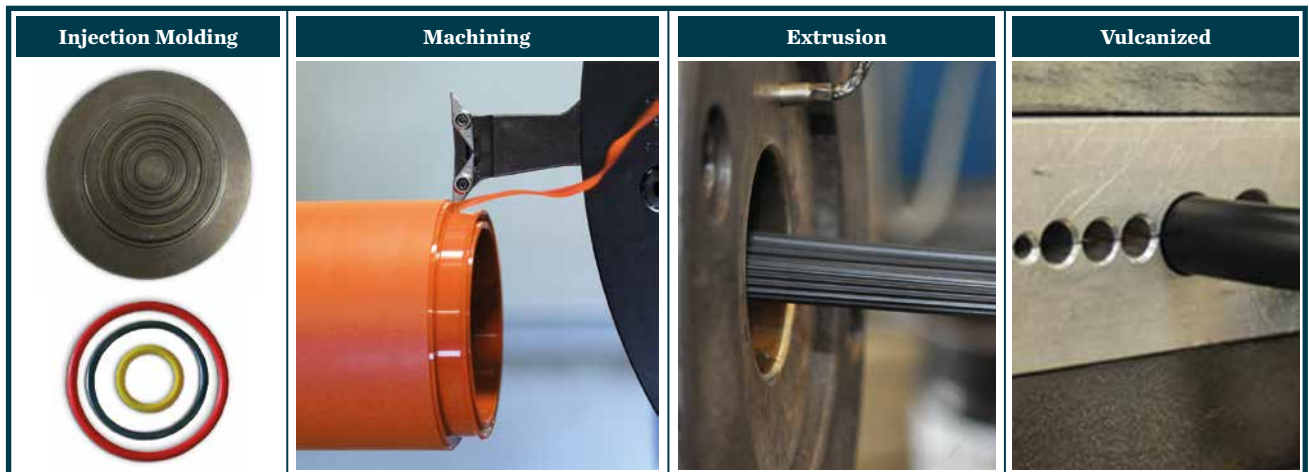
O-rings
encapsulated



There is a similar element for the same applications, in the form of a cross with rounded ends (X-Ring).

Its manufacture can be by:

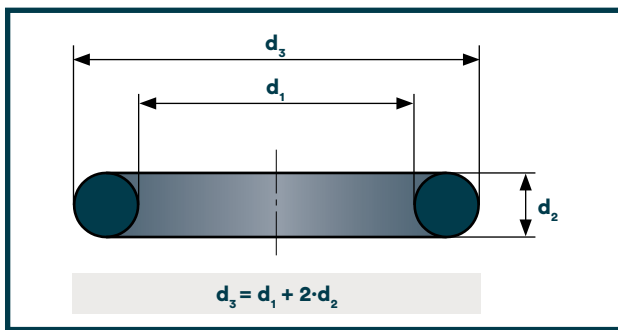
- Injection moulding (large quantities)
- Compression moulding (small series and large sizes)
- Machining
- O-ring extrusion, O-ring cutting and subsequent bonding by vulcanization or gluing
- Continuous Moulding



Manufacture of gaskets. **Figure 1**

The first patent of this seal is dated May 12, 1896 and its inventor was the Swede J. O. Lundberg.

An *O-Ring* is never defined by its outer diameter but by its **inner diameter (d_1)** and by the **cross-section of the O-Ring** of the bull (d_2) which coincides with its thickness.



Definition of O-ring by diameters. **Figure 2**

For example, the designation of the O-ring with an inner diameter of 20.2 mm, an outer diameter of 26.2 mm and a thickness of 3.0 mm is "20.2 x 3.0 mm".

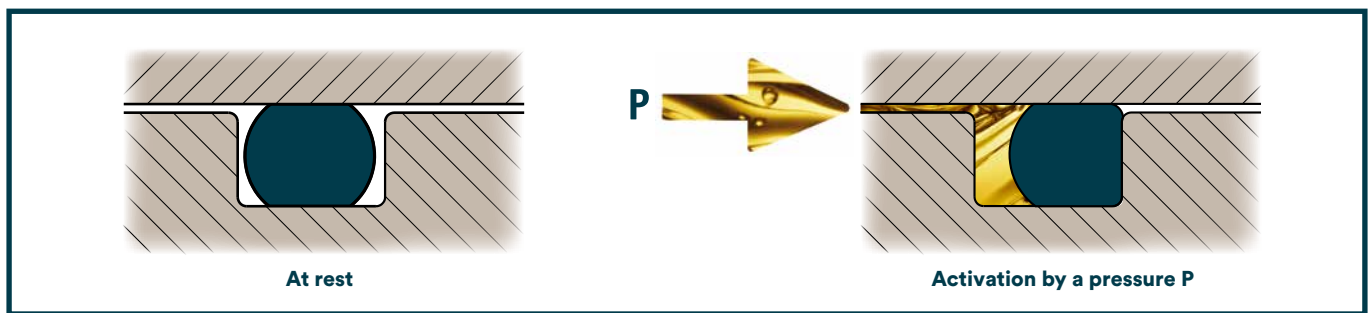
O-rings ensure the sealing of fluids in machines and conductions, both in **Static Sealing** services and in **Dynamic** applications.

The O-ring owes its sealing capacity to its elastic nature which allows axial or radial deformation of its section, depending on the design of its housing. It should be noted that an elastomer is non-compressible; i.e. under a compression load it will react by adapting to the available volume of the housing.

However, spongy or cellular elastomers are compressible because they contain gas (air CO₂, N₂) in their structure.

When the O-ring is subjected to a certain force, depending on the design of its groove or housing, the joint reacts by showing one type of deformation or another. This deformation already exerts in itself a certain sealing effect.

If, in addition to this force, the contribution of a pressurised fluid is added, the reaction of the O-ring is simultaneously tensified by the pressure exerted by the fluid to be sealed:



Gasket at rest and the same gasket activated by a pressure P. **Figure 3**

An O-ring is used both to close two components without relative movement (**Static Sealing**) and to achieve a watertight joint between two elements in relative movement (**Dynamic Sealing**).

Elastomer O-rings must meet the following requirements:

REQUIREMENTS

- Sufficient chemical inertia to the fluid to be sealed. It is permissible for this to cause a slight increase in volume or swelling in the material (*Swelling*), but should never cause a contraction in the material.
- Resistance to foreseeable temperatures during operation.
- Wear resistance.
- Adequate hardness, depending on the application pressure.
- Low remaining deformation.

The fluid to be sealed and the temperature at the point of application determine the base material. The operating pressure, the kind of movement and the extrusion groove decide the hardness of the base material.

The immediate advantages of an O-ring compared to other products are:

ADVANTAGES

- Having a small section that allows it to be easily mounted in confined spaces.
- Material science offers a wide range of elastomers.
- Because of their design, they can work axially or radially.
- Low acquisition cost.

MATERIALS

O-rings are manufactured from elastomers for two reasons:

- They are easy to install and can be deformed for convenience.
- They are mounted in housings and are adapted to them by expansion or by upsetting.

Elastomers are classified into thermostables and thermoplastics. They are differentiated by the degree of cross-linking after the curing or vulcanisation reaction and by their behaviour with temperature. The most interesting elastomers from the point of view of sealing are thermosets.

THERMICALLY STABLE POLYMERS

The main characteristic of a thermostable elastomer is that when heated it cannot be moulded due to the cross-linking of chains. When a certain temperature is exceeded, it degrades. The family of rubbers, silicones and polyurethane foams belong to this category.

In particular, the rubber family has certain properties of great industrial interest:

PROPERTIES

- They can be electrical insulators, conductors or antistatic.
- Resistant to a greater or lesser extent to weathering and solar radiation.
- Acoustic and vibration insulators.
- They offer a wide range of service temperatures: -65 °C to +320 °C.
- Resistant to fire with various behaviors such as flame coloring, smoke, burning without flame or self-extinguishing depending on the formulation of the material.
- They admit a great variety of pigmentations

Natural rubber or polysoprene (NR)

Natural rubber is the only non-synthetic rubber. It is extracted from a milky emulsion (latex) contained in the sap of the *Hevea Brasiliensis* tree.

CHARACTERISTICS OF INDUSTRIAL INTEREST:

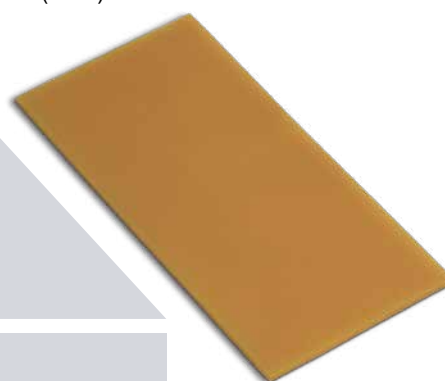
- Good resistance to water, acids, bases and lyes. Biodegradable.
- Very good electrical properties.
- Excellent breaking load, elongation, tear and abrasion resistance.
- High resilience or elasticity to rebound.



- Swelling in oils, greases and hydrocarbons. It can't withstand ozone.



- **Operating temperature:** -60 °C to +80 °C



OTHER RUBBER FORMULATIONS:

The properties of an elastomer are determined by the base polymer used. However, its final properties can be modified by including additives in its formulation such as plasticizers, stabilizers, pigments and fungicides, among other components. This makes it possible to design a custom rubber.

Due to the great variety of chemical products used in the process, the development of many rubber formulations has been favoured. The most used, among others, are those presented below:

... THERMICALLY STABLE POLYMERS

Acrylonitrile / Butadiene copolymer (NBR)

Synthetic rubber developed from a copolymer of acrylonitrile and butadiene, whose concentration in acrylonitrile varies between 18 % and 50 %.

If the acrylonitrile concentration is low, the NBR obtained has a higher resilience and its elasticity is improved at low temperature. If the acrylonitrile concentration is high then the chemical resistance to oil increases, however the elasticity and the resistance to the remaining deformation decrease.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- ✔
 - Good chemical resistance to aliphatic hydrocarbons, mineral oils (lubricant oils and hydraulic oils hardly inflammable like HFA, HFB and HFC's), greases based on mineral oil, animal and vegetable greases, water up to 100 °C, inorganic acids and bases in low centering.
 - Medium resistance to swelling in combustibles with high aromatic content.

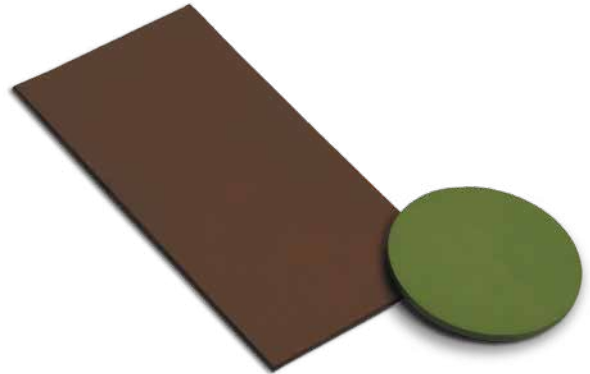
- Strong swelling in aromatic hydrocarbons, chlorinated hydrocarbons, hydraulic fluids with low flammability like HFD, esters, polar solvents (acetone), strong acids as well as ether-glycol-based brake fluids.

- ✘
 - Ozone and weather attack

- **Operating temperature:**
-30 °C to +110 °C
- **Special formulation:**
-60 °C to +135 °C

Fluorocarbon Rubber (FPM / FKM)

Fluorelastomers, Viton® being the best known of them, are the most suitable rubbers for continuous service in a temperature range between 200 °C and 250 °C and are also non-flammable.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Good resistance to hydrocarbons, mineral oils and fats with additives, fuels and hydrocarbons, both aliphatic and aromatic, inorganic acids and bases, even at high concentrations.
 - In peroxide-cured formulations, FPM improves compatibility with traditionally incompatible fluids such as alcohols, hot water, steam and alcohol-containing fuels.
 - ✔
 - Resistance to ozone and ageing.

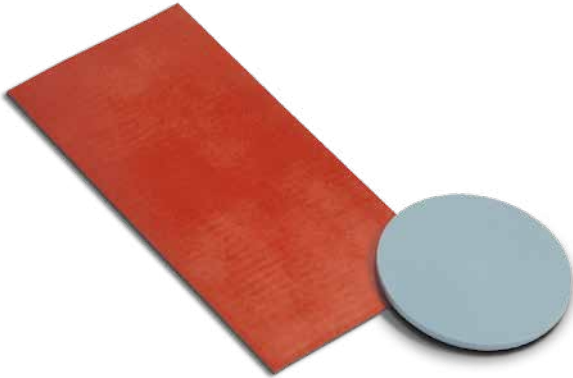
- Strong swelling in organophosphates (Pydraul 10E), ammonia, amines, saturated steam, superheated steam, polar solvers (ketones, dioxane, ethyl acetate) as well as in difficult-to-flame fluids (Skydrol) and ether-glycol-based brake fluids.
 - ✘
 - Their performance suffers greatly for temperatures below -10 °C.

- **Operating temperature:**
-20 °C to +210 °C
- **Special formulation:**
-51 °C to +225 °C
-15 °C to +250 °C

Methyl Silicone Vinyl Rubber (VMQ)

Silicone rubbers stand out for their high thermal resistance and good flexibility when cold.

They are highly recommended for high and low temperature applications.

**CHARACTERISTICS OF INDUSTRIAL INTEREST:**

- Very good resistance to oxygen and ozone.
- The electrical properties are excellent as well as its resistance to weathering.
- Good resistance to vegetable oils, high aniline index oils, motor and gear oils.



- Moderate resistance to swelling in mineral oils and greases, ether-glycol-based brake fluids and water up to 100 °C
- Strong swelling in low molecular weight esters and ethers, aromatic and aliphatic hydrocarbons, concentrated acids and bases, and superheated steam.
- The permeability to gases at room temperature is greater than that of other elastomers.



- **Operating temperature:**
-60 °C to +250 °C
- **Special formulation:**
-100 °C to +250 °C

Ethylene / propylene / diene terpolymer (EPPDM)

Elastomer with good wear resistance.

Its composition contains between 45 % and 75 % of ethylene, being in general more resistant the higher this percentage is.

**CHARACTERISTICS OF INDUSTRIAL INTEREST:**

- Good resistance to hot water, steam, lyes, oxidizing media, acids, bases, polar solvents, ketones, hardly flammable liquids of the HFC group, some types of the HFD group and ether-glycol-based brake fluids.
- Good resistance to ozone, weathering and low temperature
- The curing reaction can be with sulphur or an organic peroxide, depending on the properties to be enhanced.
- Good electrical insulator.



- Strong swelling in mineral oils and greases, aromatic and chlorinated hydrocarbons.
- **Operating temperature:**
-39 °C to +150 °C
- **Special formulation:**
-50 °C to +288 °C

... THERMICALLY STABLE POLYMERS

Perfluorocarbon Rubber (FFPM / FFKM)

They are fully fluorinated polymers with elastomer characteristics and are highly recommended for applications with aggressive chemicals at high temperatures.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Almost universal chemical inertia, similar to PTFE. High temperature thermal stability.
- Excellent resistance to steam, ozone and weathering



- When compared to other materials, its price is high.
- They have poor physical properties and limited use in low-temperature services. Fluorine refrigerant attack (R11,12, 13, 113, 114...)



- **Operating temperature:**
-15 °C to +276 °C
- **Special formulation:**
-46 °C to +250°C
-15 °C to +327°C

Hydrogenated acrylonitrile / butadiene copolymer (H-NBR)

Its properties depend on the initial concentration of acrylonitrile and the degree of hydrogenation of the copolymer butadiene.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- The chemical inertia, temperature resistance, tensile and tear strength, elongation and abrasion resistance of NBR are improved.
- Excellent resistance to oil, steam, hot water and ozone.
- The curing reaction can be with sulphur or with an organic peroxide, depending on the properties to be enhanced.



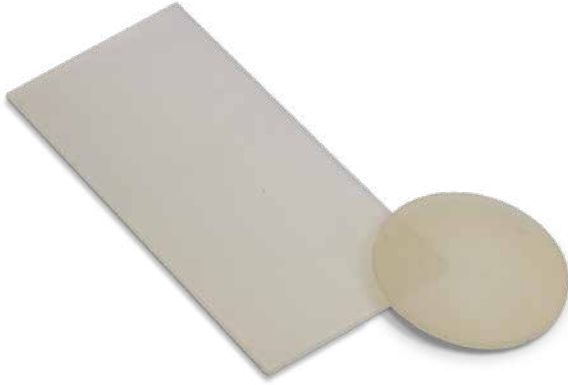
- Attack by polar organic solvents (ketones), esters, aromatic compounds and strong acids.
- Poor flame resistance and poor electrical properties



- **Operating temperature:**
-36 °C to +150 °C
- **Special formulation:**
-55 °C to +160 °C

Fluorine Vinyl Methyl Silicone Rubber (FVMQ)

Fluorinated silicone rubbers improve the chemical inertia of silicone but are more expensive.

**CHARACTERISTICS OF INDUSTRIAL INTEREST:**

- Improves the chemical resistance of silicone rubber (VMQ) to aromatic hydrocarbons, organo-chlorinated and petroleum derivatives.
- Excellent resistance to ozone, ageing and low temperatures.
- Good electrical properties.



- Poor wear resistance. Gas permeability similar to that of VMQ.
- Attack by acids and bases, silicone oils and greases, steam and organo-chlorinated derivatives with low molecular weight.



- **Operating temperature:**
-55 °C to +225 °C

Chloroprene rubber (CR)

Chloroprene rubber, also known as Neoprene®, was one of the first synthetic rubbers developed to be resistant to oil.

It is a general purpose rubber with an excellent balance of physical and chemical properties.

**CHARACTERISTICS OF INDUSTRIAL INTEREST:**

- Good ozone and weathering resistance. Offers excellent rubber-metal links.
- Its resistance to the flame is excellent, being one of the few rubbers that self-extinguish.
- Good resistance to high aniline mineral oils, silicone oils and greases, alcohols, glycols, ammonia and refrigerants.



- Strong swelling in aromatic and aliphatic hydrocarbons, ketones, concentrated acids and bases and steam. It tends to absorb water.
- Low permeability to gases and their electrical properties are poor.



- **Operating temperature:**
-40 °C to +100 °C.

... THERMICALLY STABLE POLYMERS

Copolymer of tetrafluoroethylene and propylene (FEPM)

Material with high chemical inertia in aggressive media, also known as Aflas™.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Excellent thermal resistance. Good resistance to ozone and weathering.
- Chemical resistance to oil derivatives, steam up to +170 °C, amines, organophosphates, strong acids and bases.
- Improved chemical resistance to a wide range of automotive fluids (lubricants, brake fluids), mineral oils and silicone oils.



- Incompatible with gasoline, ketones, ethers and solvents.



- **Operating temperature:**
-5 °C to +230 °C
- **Special formulation:**
-25 °C to +250 °C

Styrene / Butadiene Copolymer (SBR)

This rubber can be a substitute for natural rubber (NR). Its physical resistance, resilience and low temperature properties are generally lower than those of NR although the heat aging and abrasion resistance properties are better.

Its main application is the manufacture of tires that consumes almost a third of world production.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Good resistance to aging and temperature up to 110 °C.
- Good chemical resistance to acids, lyes, alcohols, glycols and water.



- Low chemical resistance to oxidizing media, mineral acids, greases and lubricants.
- Strong swelling in mineral oils, petroleum-based greases, fuels and aliphatic, aromatic and clo- rados hydrocarbons.



- **Operating temperature:**
-50 °C to +110 °C

Isobutene/isoprene copolymer (IIR)

Synthetic rubber of isobutene and isoprene. Highly recommended for high vacuum / high pressure services.

**CHARACTERISTICS OF INDUSTRIAL INTEREST:**

- Very good resistance to aging and weathering.
- Excellent gas impermeability. Good electrical properties.
- Good chemical resistance to acids, lyes, alcohols, glycols and water.
- Very low resilience, which gives it a high shock-absorbing capacity.



- Low chemical resistance to oxidizing acids, mineral acids, greases and lubricants.
- Strong swelling in mineral oils, lubricating greases, gasolines and aliphatic, aromatic and chlorinated hydrocarbons.



- **Operating temperature:**
-50 °C to +120 °C.

Copolymer epichlorohydrin / ethylene oxide (ECO)

Rubber with similar properties to NBR but improved thermal resistance and chemical inertia.

**CHARACTERISTICS OF INDUSTRIAL INTEREST:**

- Very good resistance to ozone, aging and weathering.
- Excellent gas impermeability. Good electrical properties.
- Good chemical resistance to acids, alcohols, oils, mineral fats, vegetable and animal oils as well as aliphatic hydrocarbons, gasoline and water.



- Its low recovery to elastic deformation limits its field of application.
- Corrosion in metals.
- Strong swelling in aromatic hydrocarbons, chlorinated hydrocarbons, ketones, esters and hydraulic fluids which are difficult to ignite like HSD.



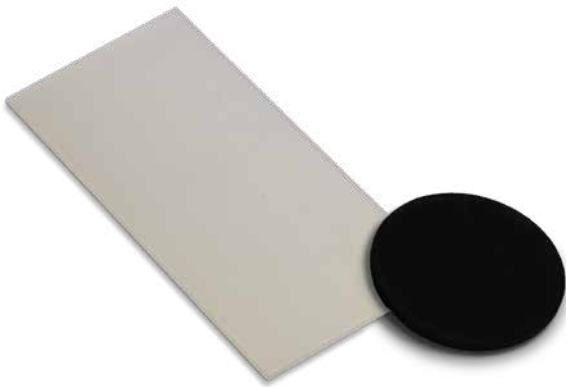
- **Operating temperature:**
-40 °C to +120 °C

... THERMICALLY STABLE POLYMERS

Chlorosulphonated polyethylene (CSM)

This polymer, also known as Hypalon®, is the result of polyethylene chlorosulphonation.

It stands out, among other aspects, for its capacity of conservation of the color.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Very good resistance to ozone, aging and weathering.
- Excellent impermeability to gases and water. Good electrical properties.
- Good flame resistance and is self-extinguishing.



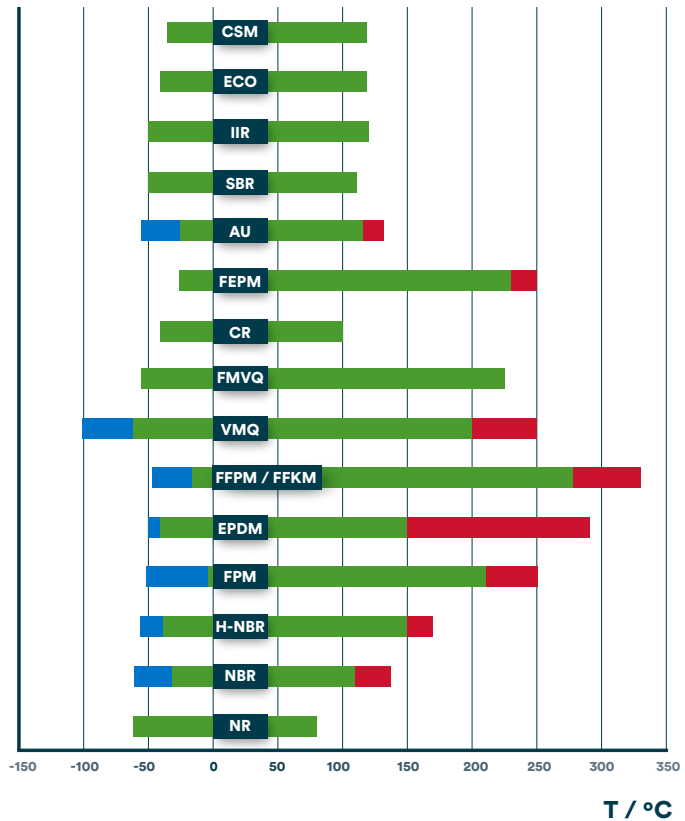
- Poor resistance to fuels, aromatic hydrocarbons, chlorides and esters.
- It is not recommended in dynamic filling applications due to its high remnant deformation (*Compression Set*).



- **Operating temperature:**
-35 °C to +120 °C

THERMAL RESISTANCE OF THE ELASTOMERS EXPOSED ABOVE:

- Usual range
- Special Formulation for Low Temperature
- Special Formulation for High Temperature



Elastomers vs T. Graph 1

DETECTABLE ELASTOMERS



This range of materials allows a quick detection in case of possible contamination in the process. Such contamination may be caused by excessive wear of the O-ring or improper installation causing it to break.

For this purpose, specific formulations of FPM, NBR, EPDM and VMQ incorporating metallic particles have been developed. Colours black, blue and dark grey.

At the most critical point of the manufacturing process, the installation of a magnetic separator or X-ray equipment can be chosen. In the event that a fragment of a process O-ring is accidentally released, the magnetic separator or X-ray equipment shall detect it and the corresponding alarm shall be activated.

Detectable elastomers minimise the risk of small pieces appearing in the finished product and consequently reduce rejection rates and product losses.

Detectable materials meet the highest demands of the pharmaceutical, food and biotechnology industries and feature **FDA; ADI-Free; EC 1935/2004** and **EC 2023/2006** certifications.

Currently, **USP Class VI** VI certification is only available for silicone (VMQ).



NOTE: In case of consultation, information on the detection method used should always be provided, among other details.

Detectable Elastomers Table

Material	Color	Shore A	Visual Detection	T Range
FPM	Black	75	-	-10 °C ... +200 °C
	Blue	70	✓	-20 °C ... +200 °C
NBR	Black	70	-	-40 °C ... +120 °C
	Blue	70	✓	-40 °C ... +120 °C
EPDM	Black	75	-	-40 °C ... +150 °C
	Blue	70	✓	-40 °C ... +150 °C
VMQ	Dark grey	75	-	-60 °C ... +200 °C

THERMOPLASTIC ELASTOMERS

A thermoplastic elastomer, in contrast to a thermostable elastomer, can be almost completely melted and remodelled. It melts when heated and hardens when cooled. This circumstance allows its manufacture by moulding and injection.

The thermoplastic elastomers of greatest industrial interest are:

MATERIALS

- PP (Polypropylene)
- PE (Polyethylene)
- PVC (polyvinyl chloride)
- PS (Poliestireno)
- PC (Policarbonato)
- PET (Polyethylene Terephthalate)
- AU (Polyester urethane)

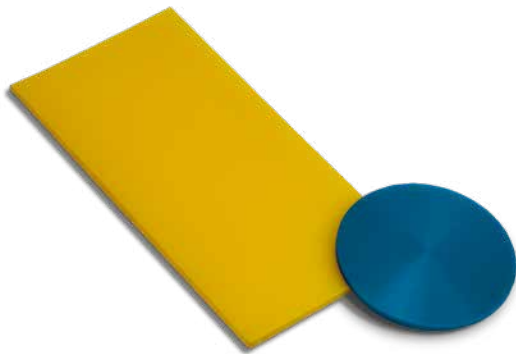
Polyester urethane (AU) is widely used as an O-ring material and therefore stands out from the other materials mentioned.

Polyurethane (AU)

A distinction must be made between polyether urethane (EU) and polyester urethane (AU).

Polyurethanes are thermoplastic elastomers that do not belong to the rubber family and yet have excellent wear resistance, excellent tensile strength and high elasticity compared to other elastomers.

Highly recommended for high pressure services.



CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Extraordinary resistance to traction; good resistance to breakage and abrasion.
- Good resistance to ozone, ageing and low temperatures.
- Good electrical properties.
- Good resistance to mineral oils and aliphatic fats and hydrocarbons.

According to compositions, they are hydrolyzed to a greater or lesser degree. Not resistant to ketones, alkalis, amines, esters, ethers, alcohols and glycols.



- **Operating temperature:**
-25 °C to +110 °C
- **Special formulation:**
-55 °C to +115 °C

FLUOROPOLYMERS

Family of high-performance plastics. These materials stand out for their non-stick properties, their high chemical inertia (almost universal), burning without flame, low friction and a high dielectric constant, among other properties.

Polytetrafluorethylene (PTFE)

Although PTFE is a stiffer material than elastomers, it is of sufficient interest to be used in low-temperature applications where elastomers are impaired in their elastic capacity.

Pure PTFE is white. It is manufactured by sintering and cannot be moulded.

Commercially, PTFE, among other names, is known as Teflon®.

CHARACTERISTICS OF INDUSTRIAL INTEREST:

- Almost universal chemical inertia.
- Temperature range from -200 °C to +260 °C.
- Very low friction coefficient.



- It has a very high residual deformation and reduced elasticity.
- Fluency and relaxation problems under compressive load.



Some properties of pure PTFE are enhanced by the addition of certain additives in its formulation:

- Graphite and carbon reduce thermal expansion.
- Bronze improves resistance against creep or remanant deformation.
- Molybdenum sulphide provides greater wear resistance.

Polytetrafluorethylene / perfluoro (alkoxy vinyl-ether) (PFA)

This material is an option to the lining of O-rings to convert them into so-called encapsulated seals for high temperature static applications.

It has similar properties to PTFE, with a low coefficient of friction and low reactivity, but PFA is more easily conformable. Transparent and translucent material.

This material is FDA compliant.

Polytetrafluoroethylene / hexafluoropropylene (FEP)

One of its applications is as side encapsulating material for O-rings. This resin has properties very similar to those of PTFE.

The main difference lies in the maximum service temperature (+205 °C) and in the colouring as FEP is colourless and translucent.

This material is FDA compliant.

Fluoropolymer Comparison Chart

		Fluoropolymers			
		FEP	PFA	PTFE	
Characteristics	Colouring		Translucent	Translucent	White
	Tensile strength	ASTM D1457	23,0 MPa	25,0 MPa	31,0 MPa
	Hardness (Shore D)	ASTM D2240	56	60	58
	Specific gravity	ASTM D792	2,15	2,15	2,15
	Friction Dynamic coefficient	ASTM D1894	< 0,3	< 0,2	< 0,1
	Water absorption	ASTM D570	< 0,01 %	< 0,03%	< 0,01 %
	Maximum working temperature		204 °C	260 °C	260 °C

METAL

Metals and their alloys are used:

- always in static applications.
- when the seal is going to work under extreme conditions: high vacuum, high pressure and/or temperature, cryogenics
- when the elastomer may suffer a radiation attack

For these services the range of materials includes among other metals:

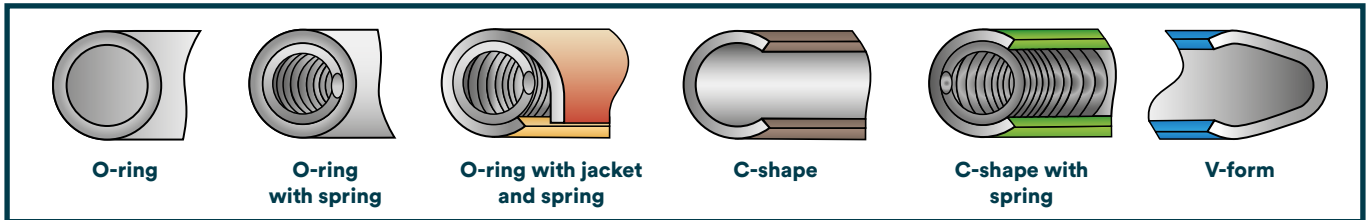
- RANGE**
- stainless steels (300 series)
 - nickel alloys
 - aluminum
 - copper
 - tantalum
 - titanium
 - silver



Photo courtesy of TECHNETHICS GROUP.

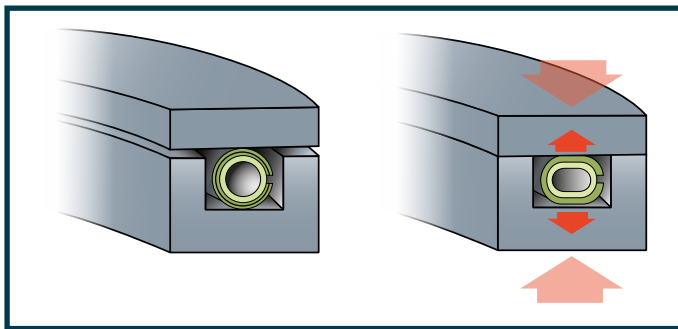
In this context, the sections of the sealing joints can be of various geometries, as shown in Figure 4.

Likewise, metal seals can be solid or hollow. The hollows may contain a pressurised (N₂), have micro-perforations on the inside or be energised by a spring.



Various geometries for metal seals. **Figure 4**

The metal-to-metal seal allows optimum compression of the seal and better control in thermal cycles.



Concept of the Metal - Metal closure. **Figure 5**

The sealing achieved with this solution is very high. There are two levels:

- **AIR” level:** leakage of an air flow rate of 10⁻⁵ m³/s pressure of 1 bar. This flow is equivalent to filling a 1.5 L bottle for a period of 6 months.
- **HELIO” level:** leakage of a flow of 10⁻¹² m³/s helium at a pressure of 1 bar. This flow is equivalent to the volume of a pinhead over a period of 50 years

Even in highly aggressive environments, where expensive alloys are used, a stainless steel spring

can be encapsulated in FEP resin or PFA resin. These coatings can be designed to withstand pressures up to 100 bar at cryogenic temperatures.

PROPERTIES OF ELASTOMERS

Elastomers do not differ from other materials simply because they are “elastic”. There are many formulations of many different synthetic rubbers. Consequently, the properties are more variable than in other materials.

However, not all combinations of properties are feasible. Due to the nature of these materials the properties are linked to each other and the changes can improve some and worsen others. For example, NBR cannot be expected to have high oil resistance along with better low temperature performance.

PHYSICALM PROPERTIES

HARDNESS

It is the most used parameter to characterize elastomers.

Hardness is an indication of:

- The ability of the gasket to seal under pressure.
- The ability to provide the required compressive strength.
- Resistance to extrusion. The criterion of “The higher the pressure, the greater the hardness” is followed.
- Resistance to wear and abrasion..

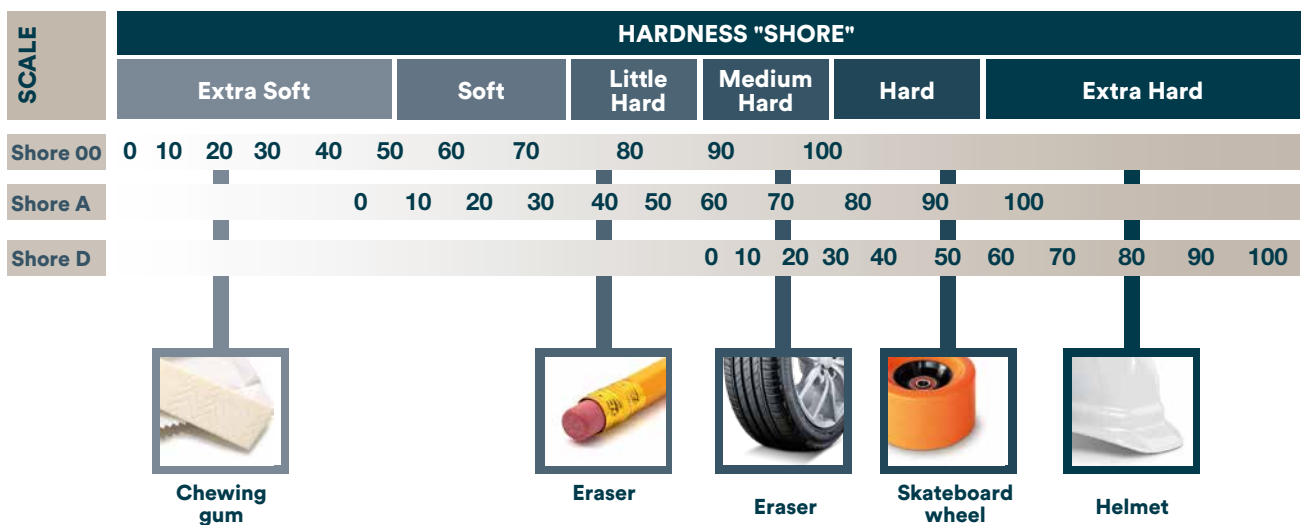
In practice, 3 hardness scales are usually used:

SCALE

- **Shore 00** (for materials with hardness < 75 °Sh A)
- **Shore A** (most used in the industrial sector)
- **Shore D** (for materials with hardness > 95 °Sh A)
- **IRDH** (*International Rubber Hardness Degree*)

To avoid errors, it should always be mentioned on what scale the hardness of interest is referred to.

Hardness tests are governed by **ASTM D 2240**; **ASTM D 1415**; **ISO 48**; **ISO 1400** and **ISO 1818**.



Shore Hardness Scales. **Graph 2**

Most elastomers of interest have hardnesses between 50 – 90 °Sh A.

... PHYSICAL PROPERTIES

TENSILE STRENGTH

This is the load applied per unit of surface of the original cross section, applied at the moment when the specimen ruptures. It is also called "Break Load".

Tensile tests are performed before and after exposing the material to deterioration caused by oils, ozone, weathering and oxygen, among other agents.

The testing standards are ASTM D 412 and ISO 37.

ELONGATION AT BREAK

It is the extension caused by a tensile stress and is expressed as a % relative to the original length of the specimen.

The elongation at break is therefore that obtained when the sample is broken.

Tests for this property are governed by ASTM D 412 and ISO 37.

TEAR STRENGTH

It is the force necessary to achieve the wear of a sample.

Tear tension tests are in accordance with ASTM D 624 and ISO 34.

COMPRESSION SET

This property is defined as the residual deformation of a sample subjected to stress, compression or shear stress after the deforming force has ceased. Thus, for a higher value of remaining deformation, one has a worse elasticity. This is useful when comparing "similar" formulations.

If the cause of the remaining deformation is a tensile stress, the remaining tensile stress deformation is obtained. If it is a compression load then it is the *Compression Set* and if it is a shear then it is the shear deformation.

Tests for deformation by compression can be at constant load or at constant deformation,

according to ASTM D 395 and ISO 815 standards D 395 e ISO 815.

Constant load test

A sample is compressed under load, conditioned for a stipulated time and at a specified temperature (22 hours at 70°C) after which the load is removed and the recovery of the sample is measured at ambient temperature and after 30 minutes.

The remaining deformation at constant load is the deformation after the test, expressed as a percentage of the deformation at the start of the test.

Constant deformation test

In this test the sample is compressed by 25% of its original thickness. The assembly is conditioned for a stipulated time at the established test temperature.

The test result is expressed as % with respect to the deformation during the test

STRESS RELAXATION

The loss of tension when a vulcanized elastomer remains deformed constantly for a certain period of time.

It is expressed as % of remaining stress, after an arbitrary lapse of time and at a given temperature.

DELAYED DEFORMATION

All elastomers show a gradual increase in deformation under constant load over time.

It is expressed as a % of deformation relative to the total minus that obtained after 5 minutes of testing.

RESILIENCE

When the deformation force on an elastomer sample ceases, it recovers its original state and thus produces energy. Resilience is the relationship between this energy and the energy needed to produce the initial deformation. It is usually expressed in %.

Resilience tests are governed by ASTM D 1054; ASTM D 2632 and ISO R1767.

HYSTERESIS

It is the energy lost in each cycle of deformation, as a consequence of internal friction. As an example, take the bounces of a rubber ball. The height of the bounces is getting smaller and smaller, and the loss of energy is associated with the reduction in height.

WEAR RESISTANCE

It is defined as the resistance of an elastomeric formulation to contact wear against a moving abrasive surface. Material loss is measured under specific load and speed conditions.

Its result is expressed in mm³ or as a comparison in % with respect to a standard elastomer compound.

The following table presents the results of the abrasion test according to DIN 53515:

Abrasion results of different substances

Material	Loss (mm ³)
Polyurethane (AU)	17
Hydrogenated acrylonitrile / butadiene copolymer (H-NBR)	72
Acrylonitrile / Butadiene copolymer (NBR)	100
Ethylene / propylene / diene terpolymer (EPDM)	140
Fluorocarbon Rubber (FPM / FKM)	175
Methyl Silicone Vinyl Rubber (VMQ)	250

Note that the test does not reproduce real working conditions and therefore the test results and actual behaviour cannot be correlated. In other words, the information obtained should be interpreted qualitatively rather than quantitatively.

DENSITY

The relationship between the mass of a body and the volumen it occupies is its density.

In the field of elastomers, the density of a certain material varies due to the various additives contained in its formulation. For this reason, one does not think of a generic value of density but of a range of values.

Density tests are governed by ASTM D 1817; ISO 2871 and BS 903A1.

Density ranges of some elastomers

Material	Density (gr/cm ³)
Natural rubber (NR)	0,95 - 0,97
Acrylonitrile / Butadiene copolymer (NBR)	1,10 - 1,35
Chloroprene rubber (CR)	1,20 - 1,50
Styrene / Butadiene Copolymer (SBR)	1,10 - 1,35
Isobutene / isoprene copolymer (IIR)	1,10 - 1,30
Ethylene / propylene / diene terpolymer (EPDM)	0,90 - 1,15
Chlorosulphonated polyethylene (CSM)	1,45 - 1,60
Polyurethane (AU)	1,10 - 1,21
Methyl Silicone Vinyl Rubber (VMQ)	1,15 - 1,40
Fluorocarbon Rubber (FPM / FKM)	1,80 - 2,00

WHEATHING AND SOLAR DETERIORATION

Exposure of an elastomer to sunlight and weathering accelerates its degradation. If the elastomer is stretched, a generalized cracking appears.

It can also form a surface film that transforms into a hard, resinous substance that cracks over time. Another effect is the decrease in tensile strength. Tests are governed by ASTM D 518 and ASTM D 1171.

The speed and extent of these changes depend on the conditions of exposure and, above all, on the formulation of interest.

AGEING DETERIORATION

If the storage conditions specified by the manufacturer are not observed, the elastic item may crack, soften, become sticky or harden.

The oxygen pressure elastomer aging acceleration test is described in ASTM D 572.

PERMEABILITY

The permeability of an elastomer sheet is a measure of the ease with which a liquid or gas can pass through it.

ELECTRICAL PROPERTIES

The properties of industrial interest of the material of an O-ring are insulation resistance, resistivity, conductivity and dielectric resistance, among others.

INSULATION RESISTANCE

The insulation resistance between two electrodes in contact with the elastomer to be tested, is the relationship between the direct current voltage (V_{cc}) applied to them and the total current circulating between them.

RESISTIVITY

Resistivity is the specific electrical resistance of a given material. A high resistivity value indicates that the material is bad with conductor while a low value indicates that it is a good electrical conductor.

Tests are governed by ASTM D 257.

Resistivity is designated by the Greek letter rho minuscule (ρ) and measured in ohm-cm ($\Omega \cdot \text{cm}$).

DIELECTRIC RESISTANCE

The voltage required to drill a sample of known thickness.

It is expressed in volts per 0.025 mm thickness.

DIELECTRIC CONSTANT

A measure of a material's ability to store electrical energy. The higher the value of the relative dielectric constant (K'), the better the electrical conductivity of the material of interest.

POWER FACTOR

The power factor of an insulating material its tendency to generate heat when subjected to an electric current.

CONDUCTIVITY

It's the opposite property to resistivity. Electrical conductivity is the measure of a material's ability to let electrical current pass through it.

An elastomer formulation is considered to be conductive up to a resistivity of $10^6 \Omega \cdot \text{cm}$.



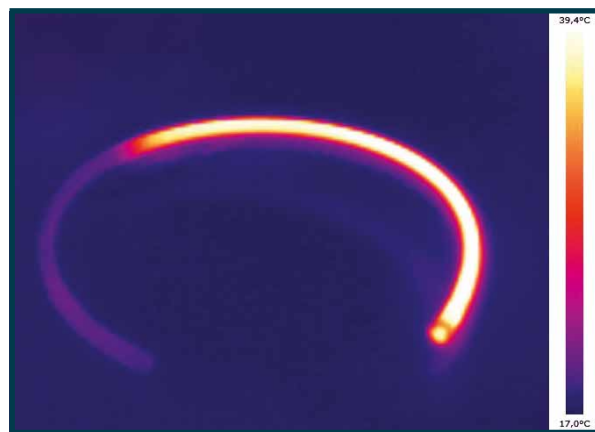
Conductivity of materials. **Figure 6**

THERMAL PROPERTIES

THERMAL EXPANSION COEFFICIENT

The coefficient of thermal expansion expresses the relative change in length or volume that occurs in a solid body or fluid when heated. The unit is $^{\circ}\text{C}^{-1}$.

The rubber has a coefficient of expansion between $100 \cdot 10^{-6}/^{\circ}\text{C}$ – $120 \cdot 10^{-6}/^{\circ}\text{C}$. However, this value can be doubled for pure rubbers or reduced by half for a hard rubber. That is to say, the coefficient of expansion is different according to which is the formulation of the elastomer and, it is observed that the addition of ingredients reduces this coefficient.



Temperature gradient. **Figure 7**

LOW TEMPERATURE BEHAVIOUR

Elastomers undergo changes when exposed at low temperatures. Some occur immediately; others after prolonged exposure. Changes are generally reversible when the elastomer is heated to room temperature, and may become permanent in extreme conditions.

When an elastomer is cooled down slowly, a gradual hardening is observed which makes it difficult to stretch it until the glass transition temperature (T_g) is reached. At this temperature, elastomers go from a more rubber-elastic-flexible state to a hard-rigid state, the fragility of which increases significantly until it breaks in the event of an impact.

Low-temperature formulations contain plasticizers such as nitrobenzene, carbon sulfide, or β -naftil salicylate that improve flexibility and reduce the fragility point of the mixture.

The test value TR10 according to ASTM D 1329 or ISO 2921 establishes the value in $^{\circ}\text{C}$ at which a sample which is stretched by 25 % or 50 % is recovered up to 10 % after freezing. This value is the most important value for low temperatures in order to evaluate the sealing characteristics of O-rings or similar, although it constitutes a low temperature conservative limit (in static applications, temperatures up to 10°C or 15°C lower than this value can be used).

HEAT RESISTANCE

The ability of an elastomer to retain its properties as a result of prolonged exposure to high temperatures.

The class and speed of change in the physical properties depend on the type of elastomer and the test conditions.

Tests are governed by ASTM D 454

CHEMICAL RESISTANCE

The chemical resistance or inertia of a certain material describes its behaviour when it interacts with the different agents in its environment. Tests are governed by ASTM D 471 and ISO 1817.

The chemical attack on a certain elastomer can manifest as a softening of it, as an appearance of cracks and as a dimensional change by absorption of the chemical agent or swelling, among other scenarios. If the attack is more severe, the elastomer may even dissolve completely in the media and disappear.

As dimensional stability is of great importance, as in the case of O-rings, swelling will disable the elastomer regardless of its other properties of interest. However, if the original resilience and abrasion resistance have weakened to the point where the elasticity is no longer satisfactory, then the change in volume may be irrelevant.

In the event of a chemical attack, the material may degrade to such an extent that the O-ring does not perform its function. There is also a possibility of contamination of the environment surrounding the material, without it being seriously affected itself.

The chemical properties of the various industrial formulations are summarized in resistance to attack by oils, ozone and water. **Annex III¹** consists of Chemical Resistance tables that provide guidance on the behaviour of elastomers in different media.

OZONE RESISTANCE

The ozone attack leads to the formation of cracks that can become deep. These are perpendicular to the direction of the applied stress and can cause the O-ring to break if the stress is large enough.

Ultraviolet radiation catalyzes the formation of ozone from atmospheric oxygen and therefore, this attack is more common than is believed since most elastomeric pieces work at tension showing the effects of the ozone attack.

Tests are governed by ASTM D 1149 and ISO 1431/1.

WATER RESISTANCE

All natural and synthetic rubber formulations absorb water. The consequences depend on the severity of the exposure and the demands of the service. However, water absorption is low compared to oil, which swells significantly more.

Polyurethane-based materials are hydrolysed, according to formulations. This aspect is important when the material is used in conditions of high environmental humidity or in contact with high temperature water.

RESISTENCIA AL ACEITE

In general, when a rubber formulation is exposed to oil, a swelling of the part and a worsening of its physical properties is observed.

ASTM D 471 describes tests to measure deterioration resulting from contact with oil and quantified by changes in physical properties before and after immersion.

Specifically, weight, volume, tensile strength, elongation at break and hardness are compared.

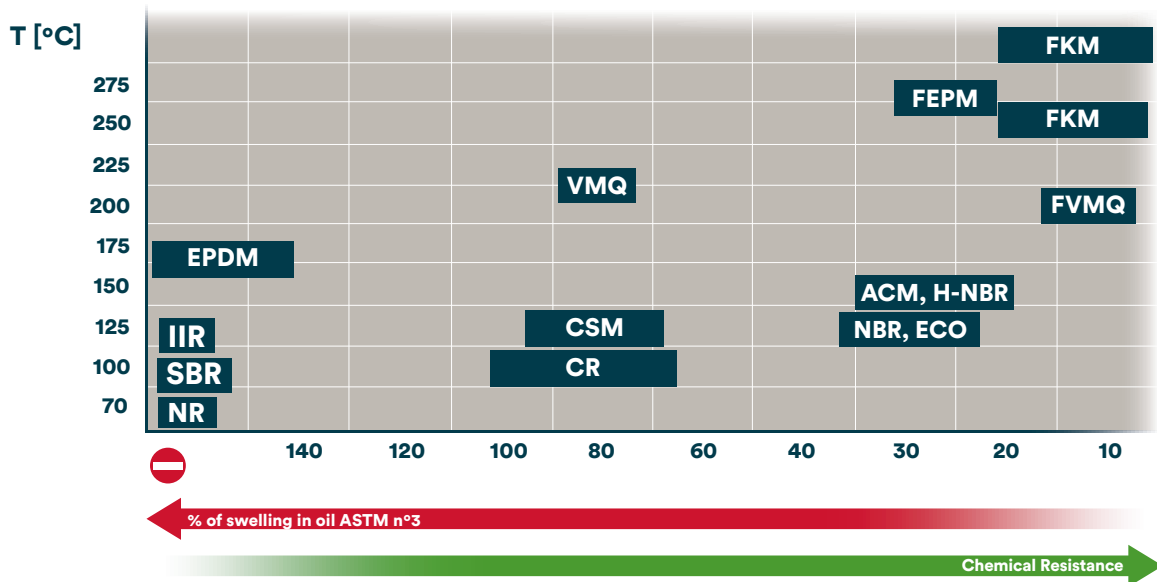
The temperature of the test is selected from a standardised list and in such a way that it is the closest to the working temperature.

The standard specifies reference oils and fuels for carrying out the test:

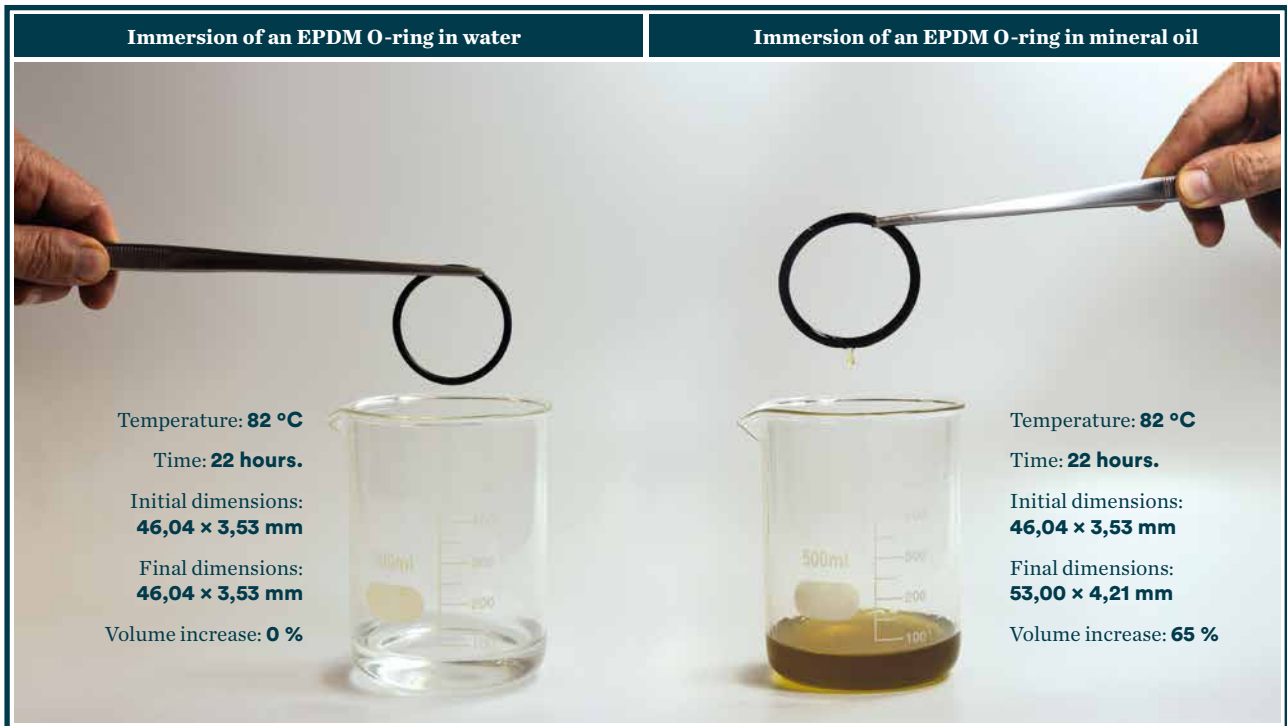
- ASTM oil no. 1 with low swelling (aniline point of 124 °C).
- Medium swelling ASTM oil no. 2 (93°C aniline point).
- Oil ASTM n° 3 of high swelling (70 °C aniline point).
- Reference fuel A (100 % isooctane) comparable to motor gasoline.
- Reference fuel B (70 % isooctane/ 30 % toluene) comparable to kerosene.

¹ Annex III. See page 83

The following graph shows the behaviour of some elastomers against ASTM n° 3 oil and temperature.



Elastomers and swelling. Graph 3



Test of EPDM swelling in mineral oil. Figure 8

FLAME BEHAVIOIR

When elastomers are exposed to a flame, they show characteristic behaviors that allow a certain identification along with their hardness and density, among other properties.



Table of elastomer behaviour in flames

Material	Color of the flame	Fumes	Combustion	Odor	Observations
Natural rubber (NR)	Dark yellow	Black	Good	Burnt rubber	Sticky residue
Acrylonitrile butadiene rubber (NBR)		Black	Good	Unpleasant	Sticky residue. The flame crackles lightly
Chloroprene rubber (CR)	Yellow with green border	Pale yellow	Bad	Irritating and suffocating	Hard to ignite. It is immediately extinguished when the flame is removed.
Styrene Butadiene Rubber (SBR)		White	Good	Burnt rubber	The burnt part dries. out
Butyl rubber (IIR)				Pleasant	The burned part gets pasty.
Ethylene propylene diene rubber (EPDM)		Black	Good	Burnt wood	The crackling flame.
Chlorosulphonated polyethylene (CSM)	Green blue	Blue	Bad	Unpleasant	It swells when it burns. It goes out when the flame is removed.
Silicone Rubber (VMQ)	Burns with difficulty	White	Bad	Sweet smell	It is immediately extinguished when the flame is removed. White ashes.
Fluorocarbon Rubber (FPM)	Does not hold flame	White	Bad	Waxy	It is immediately extinguished when the flame is removed. Carbonized waste.
Polyurethane (AU)	Yellow with blue border	Black	Good	Spicy	It is slowly extinguished out of the flame.
Polytetrafluoroethylene (PTFE)	Burns without flame			Burned hair	

What should be observed is the ease of ignition, the color of the flame, the release of any odor, the presence and color of its fumes.

It is also noteworthy to detail if the sample does not ignite at all, if it burns inside the flame, if it extinguishes when separated from the flame or if the sample continues to burn after being removed from the flame.

HIGH-PERFORMANCE SURFACE TREATMENTS

Sometimes it is convenient to modify the functionality of the O-ring and for this purpose its surface can be treated with a wide range of coatings that allow:

FUNCTION

- Facilitate the identification of the joint by means of personalized coloration.
- Decrease of the *Stick-slip* effect and improvement of the dynamic behaviour.
- Increased wear resistance.



Other times, you want to enhance a lubricating effect on the part or prevent them from sticking to each other. Lubrication treatments have been designed for this purpose.

However, before applying a certain coating or treatment, the part must be cleaned properly.

CLEANING TREATMENTS

Current cleaning processes ensure that the part is free of any contaminants. This circumstance has brought with it the development and implementation of cleaning protocols, especially in the automotive and electronics industries.

The basic procedure consists of cleaning with water and specific detergents, which removes surface impurities. The next level of cleaning is carried out in an ISO Class 7 clean room, the part is cleaned properly and delivered with double packaging.

Surface cleaning can be improved by means of an ultrasonic bath according to “**CleanSafe 787C**” in ISO Class 7 clean room and double packaging. This method is especially indicated for those parts that will come into contact with oxygen. Biomedicine and biotechnology.

The electronics and automotive industries use parts that have been previously painted. Plasma sweep cleaning removes substances that may damage the future protective paint layer. The parts treated in this way are “**PWIS free**” certified according to standards such as **VW PV 3.10.7, FN 942010-2 and QZ 24**.

Cleaning methods do not affect material properties such as hardness, working temperatures, colour or structure.

COLOURING



Photo courtesy of
TECHNÉ.

The coating also makes it possible to pigment the part of interest with a certain colour (RAL and PANTONE). It reduces friction and facilitates its identification in the field, without altering the properties of the O-ring. Colouring is resistant to dynamic and static stresses.

For example, if an O-ring is pinched and part of the material goes into the process then, if a camera system is available on the production line, the chances of foreign body detection will increase.

... HIGH-PERFORMANCE SURFACE TREATMENTS. Lubrication treatments.
... CONTINUE

LUBRICATION TREATMENTS

Improving the lubrication of the part facilitates its assembly as well as its dynamic behavior, especially with regard to the *Stick-slip* effect (irregular movement in the displacement of the piston rod, with pulls).

Among others, there are various lubricating agents such as silicone oils, molybdenum disulfide, PTFE or talc.

LUBRICANTES

- The silicone oil is transparent and USP Class VI certified.
- Molybdenum disulfide (MoS₂) performs well in a humid or high temperature environment.
- PTFE is applied as a transparent film that facilitates the assembly of the part thanks to its self-lubricating property.
- Talc fills the cavities on the surface of the part, making it slippery. Pharmaceutical quality.

The lubricating agents are absorbed on the surface of the O-ring and gradually disappear over the service life of the part. For dynamic services, a coating is recommended.

COATINGS



Coatings are used to improve some elastic properties and are mostly based on PTFE resins with additives.

They increase abrasion resistance, improve chemical resistance and may even increase hardness slightly. They are usually a few microns thick and most are permanent.

The parts treated in this way can be used for both static and dynamic applications.

Table of most common coatings

Component	Reduction of assembly effort (*)	Anti Stick-slip	Dynamic friction reduction	Increased service life	Certifications	Thickness / μm	Color
PTFE	20 %	✓	50 %	35 %	-	5 - 10	Translucent
PTFE	35 %	✓	60 %	35 %	FDA	5 - 10	Translucent
PTFE	30 %	✓	50 %	60 %	-	10 - 15	Translucent
PTFE	40 %	✓	50 %	50 %	FDA, WRAS, KTW, W270	10 - 15	White
PTFE / Graphite	5 %	✓✓	80 %	80 %	-	20 - 35	Black
PTFE / Graphite / Silicone	50 %	✓✓	50 %	50 %	-	10 - 15	Black
Silicone	70 %	✓✓	60 %	50 %	-	10 - 15	Translucent

(*) average value on test bench and with respect to identical untreated parts.

The results obtained are for specific working conditions that do not necessarily coincide with those in the field. In case of doubt, please contact our Technical Department.

Specific coatings can be designed on request.

CERTIFICATIONS

CERTIFICATION ENTITIES

In order to guarantee a minimum level of quality in the manufacture of articles for food, pharmaceutical and biotechnology services, there are bodies that regulate the tests to which the materials used in the manufacture of these consumables must be subjected.

However, it is not at all easy, since there is no international standard that regulates, for example, the use of MDPE in contact with drinking water, but different standards per country.

Each country has its own certification bodies and, at the same time, they can be admitted by other countries and thus lead, in their legislation, the corresponding certificate. The most relevant certification bodies, among others, are the following:

FDA (*Food and Drug Administration*)



This agency is the internationally recognized federal agency responsible for ensuring the safety of food and medicines.

Through the Codes of Federal Regulation (CFR), the organism establishes a list of materials and chemical products homologated for the contact with foods that are published in a list to that effect.

(www.fda.gov)

However, the FDA does not approve products made with them. This procedure is the responsibility of the manufacturer, according to the quality controls that it has in place

The most common CFR's are:

- **21 CFR 177.2600** applicable to repetitive-use rubber formulations.
- **21 CFR 177.1550** applicable to perfluorocarbon resins.
- **21 CFR 177.1680** applicable to polyurethane resins.

BFR (*Federal Institute for Risk Assessment*)



The Federal Institute for Risk Assessment of the Federal Republic of Germany has the

following as its main objectives. The aim is to protect consumers by regulating food safety standards for products and contaminants.

(www.bfr.bund.de)

CE regulation



It's the European version of the U.S. FDA approval.

“Framework” n° 1935/2004: Regulation (EC) No 1935/2004 contains definitions, restrictions and requirements for all food contact materials. Its logo certifies that the material of interest conforms to the provisions of that regulation.

EC 10/2011: EU Regulation 10/2011 is governed by Directive 2002/72/EC and the Vinyl Chloride Monomer Directive, and concerns materials to be in contact with food such as kitchen utensils and processing and packaging equipment.

(<http://eur-lex.europa.eu>)

NSF (*National Sanitary Foundation*)



This U.S. organization inspects and certifies materials that are in contact with food and drinking water, while defining acceptable levels of contaminants and impurities which may be released

from or come from components and products in drinking water devices..

NSF / ANSI 51 Standard: Applies to materials and coatings involved in the manufacture of products in contact with food.

Standard NSF / ANSI 61: certifies systems and components used in the supply of drinking water.

(www.nsf.org)

...CERTIFICATION ENTITIES

3-A (Sanitary Standards)



3-A Sanitary

Association founded by the U.S. food and milk industry that defines the specifications and best practices for the design, manufacture, installation and use of hygienic equipment.

Like the FDA, its regulations are adopted as a basis all over the world.

Regulation **18-03** “3-A Sanitary standard for rubber and similar multi-purpose materials for working in contact with products in dairy equipment” describes the requirements for food quality materials for cleaning and sterilization.

To meet regulatory requirements, elastomers must meet 21 CFR 177.2600 and also be resistant to steam sterilization, milk fats, acid and alkaline cleaning solutions, and chlorine compounds.

(www.3-a.org)

USP (United States Pharmacopeial Convention)



It is a non-government organisation that sets standards to ensure the quality of medicines, ingredients foodstuffs and dietary supplements.

These standards are published in the *United States Pharmacopeia* and the *National Formulary* (USP-NF). **USP Class VI** compliance is usually required.

(www.usp.org)

EHEDG (European Hygienic Engineering & Design Group)



European consortium made up of equipment manufacturers, food industries, suppliers of food industries, research institutes and universities, public health authorities and government agencies, whose

objective is the promotion of food safety through

improving designs and hygienic engineering in all aspects of food processing

(www.ehedg.org)

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals)



The Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (abbreviated as REACH) is a European regulation that regulates the production of chemicals, their use and their potential impacts on both human health and the ecosystem. The prohibitive substances are published in the **SVCH (Substances of Very High Concern)** list in Annex XIV.

RoHS (Restriction of Hazardous Substances)

RoHS

RoHS is a directive adopted by the European Community aimed at reducing the use of some hazardous substances in electrical and electronic equipment (lead; cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated di-phenyl ethers)..

It has recently been replaced by directive **2015/863/UE**, also known as RoHS 3, which extends to Phtalates.

(www.rohsguide.com)

WRAS (Water Regulations Advisory Scheme)



Certification of the United-Kingdom on that is based on the **BS 6920** for approved materials in contact with potable water.

Unlike FDA certification, the material must pass tests that demonstrate no spread of bacteria affecting the color, appearance, or taste characteristics of drinking water.

(www.wras.co.uk)

DVGW (German an Gas and Water Association)



Some homologations of the German Gas and Water Association.

W 270: Protocol of microbiological tests cluded in the “**Arbeitsblatt W270**” directive assessing possible microbial growth in non-metallic materials in contact with drinking water.

EN 549: Standard for rubber materials for appliances and equipment using gaseous fuel.

EN 682: Requirements for gasket materials used in pipes and fittings for the conveyance of hydrocarbon gases and fluids.

KTW: Initials of “**Kunststoffe und Trinkwasser**”, German quality standard for plastic and rubber components in contact with drinking water. The finished product is tested to rule out the influence on the smell, taste, colour of the drinking water and the non-propagation of bacteria.

(www.dvgw.de)

ADI (Animal Derived Ingredients)



There are infectious diseases of animal origin, such as bovine spongiform encephalopathy (BSE / BSE or bovine spongiform

encephalopathy). In the case of mad cow disease), which may be transmitted via materials or products the formulation of which with constituents of animal origin

Consequently, manufacturers must provide for the use of certain compounds intended for human consumption and their approval is displayed with the characteristic “**ADI Free**” label.

(www.ema.europa.eu)

KIWA



Kiwa NV is a European testing, inspection and certification institution based in Rijswijk (The Netherlands)..

(www.1kiwa.com)

AED / RGD Standards

The following standards define the requirements for non-metallic materials for gas tightness and resistance to rapid gas decompression (*AED - Anti-Explosive Decompression / RGD - Rapid Gas Decompression*).

Norsok



Standard **M-710 Rev.2 Section 7.3 Annex B.**

ISO



Standard **23936-2.**

NACE



Standard **TM0297.**

TOTAL



General Specification **GS PVW 142, Appendix 8.**

UBA (Umwelt Federal Office)



The German Federal Agency for the Environment (**Umwelt Bundesamt, UBA**) attempts to unify the criteria and requirements of the toxicological and hygienic regulations for elastomers and plastic components, in contact with drinking water, from European countries in the regulations generically called “**UBA**”.

(www.umweltbundesamt.de)

UL (Underwriters Laboratories)



U.S. security and certification consulting offering validation, testing, inspection, auditing, consulting and training services..

(www.ul.com)

CERTIFICATES ACCORDING TO EN 10204

This standard describes the different types of certificates of conformity that are delivered to the Customer.

Although this standard was developed for metallic products, its procedures apply to other products such as elastomers.

In the 2006 revision of standard EN 10204, 4 types of certification are considered, divided into two categories according to the type of tests carried out:

CERTIFICATE TYPES

- **Non-specific” tests**
The manufacturer performs a series of tests, according to its guidelines for Inspection of Quality, with the objective of examining if the manufactured one is adapted to the purchase order received. The analysis sample can include several production lots.
- **Specific” tests**
The manufacturer carries out a certain test before delivery of the product in accordance with the requirements of the purchase order in order to verify whether the manufactured products comply correctly with the specifications of the order

CERTIFICATE OF CONFORMITY 2.1. ACCORDING TO 10204

Document by which the manufacturer guarantees that the products supplied to its distributor are in conformity with the specifications of the order, without providing the results of the “non-specific” tests it may have carried out.

Material delivery notes, “FDA” certificates, “KTW” certificates, warehouse life expectancy certificates and “EN 549” certificates, among others, are examples of 2.1 documents.

The type of test and how to carry it out must be previously defined in the order. This document is signed by an authorized representative of the manufacturer who is not part of the production department.

If the Customer requires, for example, an EPDM to have a certain breaking load, then the document compiling the results of the control test carried out and its traceability is of type 3.1.

Another example of document 3.1. is the so-called “material certificate” where the manufacturer includes the results of controls on the quality of the raw material and the elements that ensure its traceability.

CERTIFICATE OF CONFORMITY 2.2. ACCORDING TO EN 10204

It is a 2.1. document where the manufacturer provides the results of the ‘non-specific’ tests set out in its Quality Inspection guidelines.

CERTIFICATE OF CONFORMITY 3.2. ACCORDING TO 10204

It is a document 3.1. which is signed by an authorized representative of the manufacturer and which does not pertain to the department of production and further, by an inspector authorized by the Customer or by an inspector designated by official regulations. Document 3.2. is not usually asked for because of the costs involved.

CERTIFICATE OF CONFORMITY 3.1. ACCORDING TO 10204

This document replaces the old certificate 3.1. B and issued by the manufacturer, where he confirms that the products delivered to his distributor meet the technical requirements of the order and provides the results of the “specific” tests indicated in the purchase order.

The products supplied by Epidor are accompanied by control or conformity documents in accordance with EN 10204.

PRODUCTION

Currently there are three technologies that make it possible to manufacture O-rings according to sizes and quantities:

MOULDING

The elastomer is placed in a mould which is heated until softened. It is then cooled and the “molded” part is removed.

Thus, for large quantities and relatively small sizes, **injection moulding** is preferably used.

For small quantities, however, large sizes, either **pressure or continuous moulding** is chosen

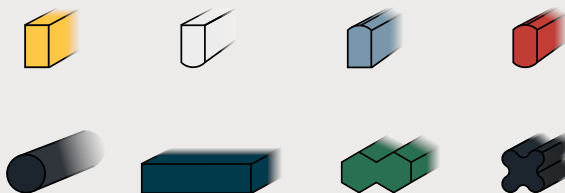


EXTRUSION

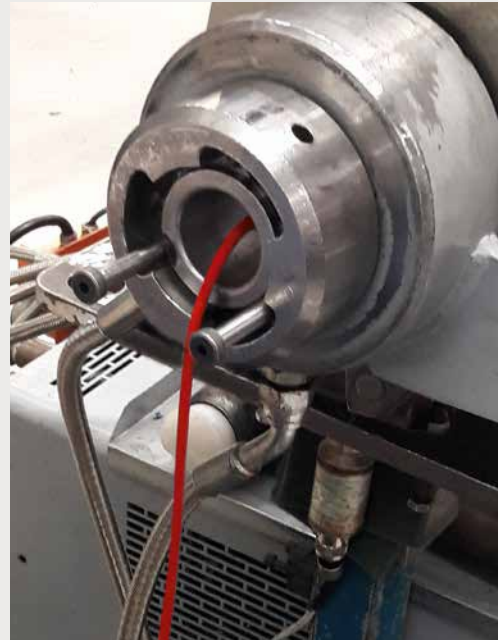
By **extrusion** of the elastomer through a nozzle in the form of the so-called “O-ring”.

Nozzles can have various diameters as well as different geometries, always having the common name “O-ring”.

Thus, “cord” of different sections can be manufactured as long as the right nozzle is available:



The thread thus obtained is cut to length and by gluing or vulcanizing the ends are joined to achieve the desired joint.



MACHINING

By **machining** a solid rod with a tooling machine. The material is attached to a plate while a tool removes material until the desired piece is obtained.

It is an interesting option when small quantities are desired. The size restriction is imposed by the machine itself according to the available tools (inner diameter machining) and according to the size of the supporting plate (outer diameter machining)



MOULDED O-RINGS



Moulded O-rings comply with DIN 3771 issued by the *Duetsches Institut für Normung (DIN)*. With this standard, the O-ring is identified by its inner diameter and cross-section.

Additionally, a letter is added according to the quality of the gasket and, optionally, a code for the elastomer and its IR hardness

- **VERSIÓN N:** N seals meet the usual quality requirements and are suitable for both static and dynamic sealing services.

O-rings N are available from stock.

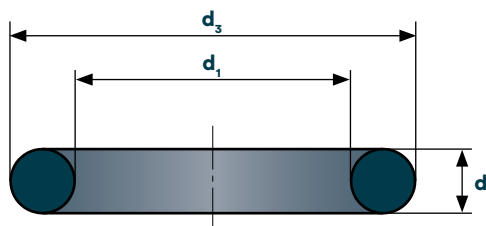
- **VERSIÓN S:** version for demanding working conditions and with stricter quality controls than N-type O-rings. These seals should be ordered as “O-rings version S” while reporting on the application.

Its manufacture is exclusive and upon request.

Both qualities have the same manufacturing tolerances.

Manufacturing Tolerances Table

Range d_1 / mm	Tolerance / mm
≤ 3	± 0,10
from 3 a 6	± 0,16
from 6 a 10	± 0,20
from 10 a 18	± 0,25
from 18 a 50	± 0,40
from 50 a 80	± 0,63
from 80 a 100	± 0,80
from 100 a 120	± 1,00
from 120 a 180	± 1,25
from 180 a 250	± 1,60
from 250 a 315	± 2,00
from 315 a 400	± 2,50
from 400 a 500	± 3,15
from 500 a 630	± 4,00
from 630 a 800	± 6,30



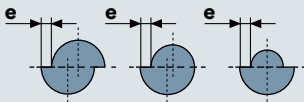
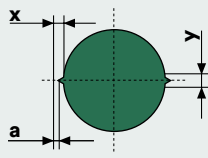
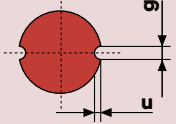
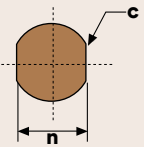
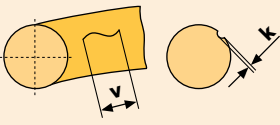
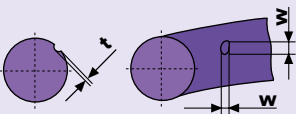
Range d_2 / mm	Tolerance / mm
≤ 1,80	± 0,08
from 1,80 a 2,65	± 0,09
from 2,65 a 3,55	± 0,10
from 3,55 a 5,30	± 0,13
from 5,30 a 7,00	± 0,15
from 7,00 a 8,00	± 0,16
from 8,00 a 10,00	± 0,18
from 10,00 a 15,00	± 0,22

The tolerances shown are valid for material NBR and 70 °Sh A.

For other elastomers and hardnesses, there may be variations from the data in the table. This, however, has no negative effect. However, they are distinguished by their maximum values in terms of defects in finish and that are detected in the visual control of manufacture of each seal.

... CONTINUE

Manufacturing defects and admissible values for seals N and S, according to thickness d_2 .

Type of defect	Dimension										
	Marks	Type N					Type S				
		1,80	2,65	3,55	5,30	7,00	1,80	2,65	3,55	5,30	7,00
Variation in shape 	e	0,08	0,10	0,13	0,15	0,15	0,08	0,08	0,10	0,12	0,13
Burr 	x y a	0,10 0,10	0,12 0,12	0,14 0,14	0,16 0,16	0,18 0,18	0,10 0,10	0,10 0,10	0,13 0,13	0,15 0,15	0,15 0,15
Notch 	g u	0,18 0,08	0,27 0,08	0,36 0,10	0,53 0,10	0,70 0,13	0,10 0,05	0,15 0,08	0,20 0,10	0,20 0,10	0,30 0,13
Lack of material due to deburring 		Deviations from the cross-section are permitted provided that the dimension n is not reduced below the minimum diameter d_2 of the O-ring.									
Extrusion (impede axial expansion) 	v k	1,50 ^a 0,08	1,50 ^a 0,08	6,50 ^a 0,08	6,50 ^a 0,08	6,50 ^a 0,08	1,50 ^a 0,05	1,50 ^a 0,05	5,00 ^a 0,05	5,00 ^a 0,05	5,00 ^a 0,05
Microperforations and surface laminations 	W T	0,60 0,08	0,80 0,08	1,00 0,10	1,30 0,10	1,70 0,13	0,15 0,08	0,25 0,08	0,40 0,10	0,63 0,10	1,00 0,13

CORD RING. EXTRUDED AND VULCANIZED O-RINGS.

The elastomer formulation is extruded as an o-ring that is cut to a length equivalent to the circumference perimeter and the ends (previously overlapped at 45°) are joined by vulcanization. The resulting joint is strong and durable.

In this way, large diameter O-rings can be manufactured for large tank flanges and covers.

- Saving of the cost of the mold.
- No diameter restriction.
- No moulding burrs.
- Suitable for standardised accommodation.
- Faster manufacturing.



- Unsuitable for dynamic sealing.
- Minimum hardness of 60 °Sh A.
- They are not competitive in small sizes and large quantities (molding).
- Lower accuracy tolerances.



Elastomer Formulations Availability Table

Materials	Shore A hardness			
	60	70	75	90
FEPM (Aflas™)			✓	
CR	✓		✓	
CR *			✓	
EPDM	✓	✓	✓	
EPDM *		✓	✓	
NBR	✓	✓	✓	✓
NBR *			✓	
VMQ *		✓	✓	
FPM	✓		✓	
FPM *			✓	

* FDA Certification

The O-ring is vulcanized in the usual thicknesses from 1.78 mm to 25.40 mm (other sizes under request).

On the other hand, vulcanised O-rings, unlike moulded O-rings, have some limitations with respect to the inside diameter (d_1) as they depend on the section of the extruded cord (d_2) and on the vulcanising tool which does not allow the handling of small diameters.

There is no unified criteria because, ultimately, it is up to the manufacturer to decide which O-ring with diameter d_1 can manufacture from the smallest O-ring section d_2 that can extrude.

... CONTINUE

The manufacturing tolerances of O-ring cors improve in some cases the normal category E1 (UNE 53-508-77).

Manufacturing tolerances of the O-ring section

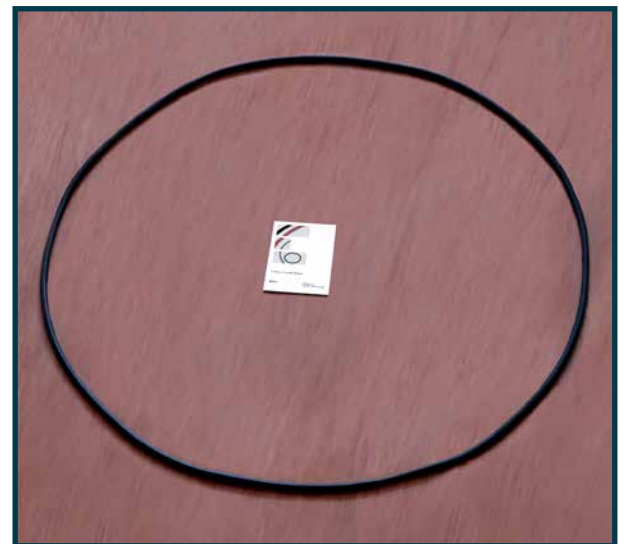
Range d_2 / mm	Tolerance / mm
1,78	± 0,10
2,00	± 0,10
2,40	± 0,12
2,62	± 0,12
3,00	± 0,12
3,18	± 0,15
3,40	± 0,15
3,53	± 0,15
4,00	± 0,15
4,50	± 0,20
4,80	± 0,20
5,00	± 0,20
5,34	± 0,20
5,50	± 0,25
5,70	± 0,25
6,00	± 0,25
6,35	± 0,25
6,50	± 0,25
6,99	± 0,25
7,50	± 0,25
8,00	± 0,25
8,40	± 0,25
9,00	± 0,25
9,52	± 0,25
10,00	± 0,33
11,10	± 0,38
12,00	± 0,45
12,50	± 0,45
12,70	± 0,45
13,00	± 0,45
14,00	± 0,50
14,30	± 0,50
15,00	± 0,50
15,90	± 0,50
18,00	± 0,70
19,05	± 0,70
20,63	± 0,70
25,40	± 0,80

As for the inside diameters (d_1), the tolerances are given in the table below:



Manufacturing tolerances d_1 for O-ring

Range d_1 / mm	Tolerance
1,78	± 0,10
de 25 a 40	± 0,35 %
de 40 a 63	± 0,40 %
de 63 a 100	± 0,40 %
de 100 a 160	± 0,40 %
> 160 mm	± 0,50 %



Large vulcanized O-ring (1.470 x 10).

Figure 9

COMPRESSION STEP-MOLDING SYSTEM

In just a few years, this manufacturing process has been developed, which consists of moulding the static seal section by section until the entire development of the o-ring is completed. At the same time that it is molded, the rubber is vulcanized. The section of the gasket shall be that of the corresponding mold.



Photo courtesy of NORTHERN ENGINEERING (SHEFFIELD) LTD.

With this manufacturing method any O-ring or profile of interest can be produced.

In the specific case of O-rings, the smaller size that can be manufactured is 200 x 2.62 mm.

For circular section moulds, the largest diameter section is 60 mm.

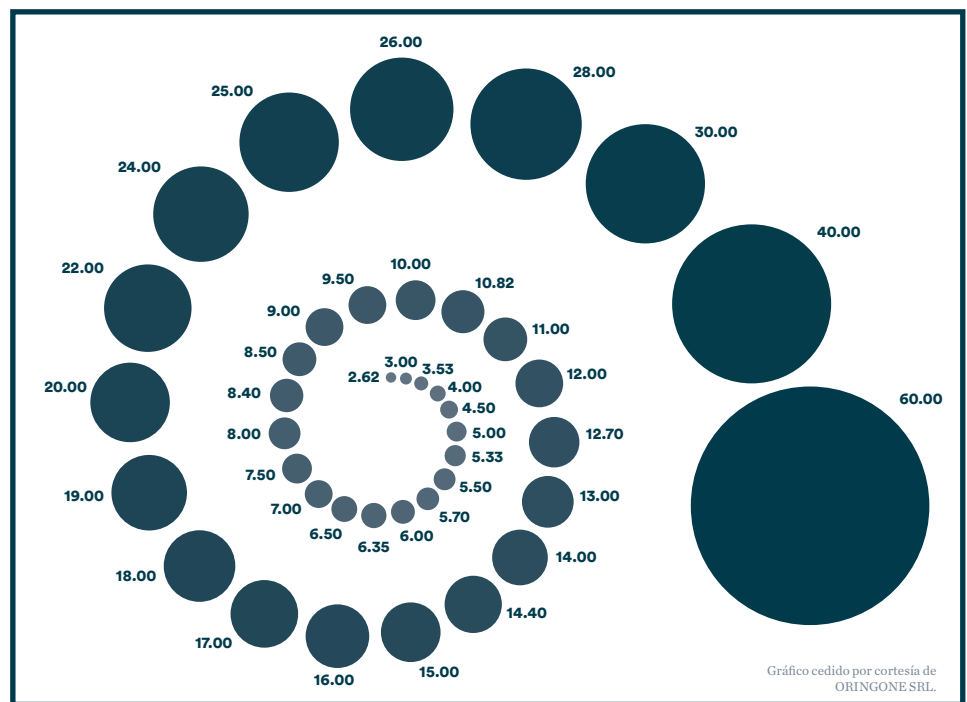


Gráfico cedido por cortesia de ORINGONE SRL.

Available manufacturing diameters, **Figure 10**

Among others, the advantages of continuous moulding are the following:

NO DISCONTINUITIES

Although the joints in the seals obtained by extrusion and joined by vulcanisation are of contrasting quality, the finish is a handmade process and, therefore, exposed to variables.

There are cases in which, due to manufacturing limitations, O-rings have more than one vulcanization point.

With the continuous moulding system, the finish is not only better, but is homogeneous throughout the entire seal perimeter, as there are no joints as such. And O-rings can be manufactured without joints and with a length as long as necessary.

... CONTINUE

MANUFACTURING TOLERANCES

They are the same as those of a moulded gasket (ISO 3601-1) and clearly less than the tolerances of extruded gaskets.

The fabrication tolerances for molded O-rings (ISO 3601-1) and the fabrication tolerances for seals manufactured by extrusion and subsequent vulcanization (ISO 3302-1 / E1) are given in the attached table.

Section (mm)	Tolerance (mm)	
	ISO 3601-1	ISO 3302-1 Cat E1
2,62	± 0,08	± 0,25
3,00	± 0,09	± 0,25
3,53	± 0,10	± 0,25
4,00	± 0,10	± 0,25
4,50	± 0,10	± 0,35
5,00	± 0,13	± 0,35
5,33	± 0,13	± 0,35
5,70	± 0,15	± 0,35
6,00	± 0,15	± 0,35
6,35	± 0,15	± 0,35
6,50	± 0,15	± 0,40
7,00	± 0,15	± 0,40
7,50	± 0,15	± 0,40
8,00	± 0,18	± 0,40
8,40	± 0,18	± 0,40
9,00	± 0,20	± 0,40
9,52	± 0,20	± 0,40
10,00	± 0,20	± 0,40
11,00	± 0,20	± 0,50
12,00	± 0,22	± 0,50
13,00	± 0,23	± 0,50
14,00	± 0,25	± 0,50
15,00	± 0,27	± 0,50
16,00	± 0,28	± 0,50
17,00	± 0,30	± 0,70
18,00	± 0,32	± 0,70
20,00	± 0,36	± 0,70

MULTIPLE GEOMETRIES

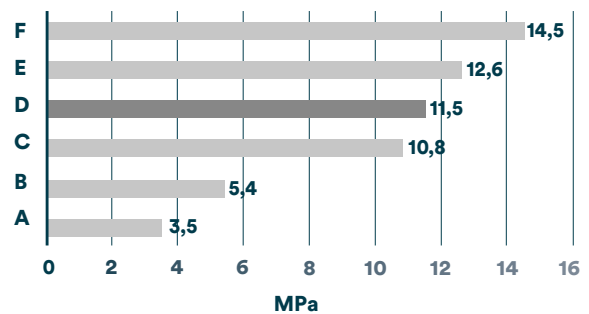
Static seals with a triangular, rectangular or square cross-section can be produced by

means of continuous moulding. There is no restriction on its geometry as, if necessary; the specific mould can always be developed.

MECHANICAL PROPERTIES

O-rings manufactured by continuous moulding exhibit a noticeable improvement in tensile strength and remanent deformation.

The following results refer to the ASTM D 412 C tensile strength test of 7 O-rings of 200 x 7 mm at 70 FPM manufactured by various processes.



- Test F: specimen according to ISO 37 Type 1
- Test E: O-ring by moulding (compression)
- Test D: O-ring by continuous moulding
- Test C: O-ring by moulding (injection)
- Test B: Hot Vulcanization of O-ring
- Test A: O-ring bonding with adhesive

Tensile strength test. **Graph 4**

The great difference in results between the gasket produced by the continuous moulding (D) and those manufactured from the O-ring cord (A, B) stands out.

Another parameter of interest is the value of remaining deformation. O-rings manufactured by continuous moulding and from the O-ring cord are tested.

The results show that continuous moulding reduces the remaining deformation values by more than 10 points per cent-cents.

ENCAPSULATED O-RINGS

It sometimes happens that a conventional elastomer O-ring does not offer sufficient chemical resistance to the process fluid. What is done then is to replace the elastomer with PTFE, which has always been considered an ideal sealing material because of its chemical resistance.

And a new problem arises: PTFE lacks sufficient elasticity and the new O-ring does not guarantee a safe sealing of the fluid in the long term.

ELASTOMER	Circular section	 <p>The solution to this situation is to coat the conventional elastomer with a completely closed, seamless thermoplastic material, such as FEP or PFA resin, to become an encapsulated O-ring.</p> <p>The new gasket combines the chemical inertia of FEP or PFA, with the elasticity of elastomers such as silicone (VMQ) or fluorelastomer (FPM/Viton®) and even EPDM.</p> <p>The elastomer (VMQ, FPM or EPDM) in the encapsulated seal core provides elastic memory along with appropriate resistance to the <i>Compression Set</i> effect, even at high temperatures.</p>
	S. rectangular	 <p>For Camlock couplings, an encapsulated gasket with a straight cross-section has been developed.</p>
STAINLESS STEEL	Circular section	 <p>At extremely low temperatures, such as cryogenic services, elastomers become excessively rigid and lose their elasticity significantly without being able to be used as nuclei.</p> <p>In order to solve this problem, a stainless steel spring is chosen to replace the elastomer.</p> <p><small>Photography seal NES Astra Seal® ceded by courtesy of NORTHERN ENGINEERING (Sheffield).</small></p>

Preferably, an encapsulated O-ring should be used for static sealing services. However, it can be used in dynamic applications as long as the peripheral speed is very low and the movement is rotary.

The advantages of an encapsulated joint are as follows:

- Excellent chemical inertia.
- Low friction and therefore reduced sliding - jamming effect (*Stick-slip*).
- Energized seal with much greater elasticity than its equivalent in PTFE.



... CONTINUE

DESIGNS

Different combinations of materials are available and it is the application itself that determines the choice of material.

If FDA certification is required, both the liner and the core of the encapsulated seal must meet the requirements for use in contact with food products.

The fact that the encapsulation is FDA but not its core does not mean that the encapsulated gasket is totally FDA. In case of coating breakage, if the elastomer is not suitable for food use, then the food certification of the article would be compromised.

The FEP and PFA resins meet the requirements demanded by:

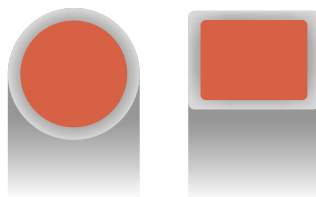


Silicone Core (VMQ)

SILICONE
(VMQ)

- Conventional silicone: red and white.
- Silicone option with food certification: red color.
- Temperature range: -50 °C to +260 °C.

SOLID core



Translucent encapsulation of FEP

Although technically inferior to FPM as a sealing material, silicone has the ability to work at lower temperatures. The maximum temperature is limited by the FEP coating.

Temperature range: -50 °C to +204 °C

Translucent PFA / solid core encapsulation.

The PFA resin coating improves the resistance of the encapsulated O-ring to abrasion while increasing the thermal roof.

Temperature range: -50 °C to +260 °C.

HOLLOW core



Translucent encapsulation of FEP / hollow core

Recommended design for applications where a low load is required as the gasket compresses more easily than the solid core gasket.

Temperature range: -50 °C to +204 °C.

Translucent PFA encapsulation / hollow core

Recommended design for applications where a low load with a good remaining deformation is required.

Temperature range: -50 °C to +260 °C.

... ENCAPSULATED O-RINGS. Designs.
... CONTINUE

Fluorelastomer Core (FPM)

FPM

- Conventional fluorelastomer: black.
- Food-certified fluorelastomer: black.
- Temperature range: -40 °C to +204 °C

SOLID core



Translucent encapsulation of FEP

This option offers the best sealing characteristics from the low *Compression Set* value of the FPM elastomer.

Temperature range: -40 °C to +210 °C

Translucent PFA / solid core encapsulation.

The PFA resin coating improves the abrasion resistance of the encapsulated O-ring.

Temperature range: -40 °C to +210 °C.

HOLLOW core



Translucent encapsulation of FEP / hollow core

Recommended design for applications where a low load is required as the gasket compresses more easily than the solid core gasket.

Temperature range: -40 °C to +210 °C.

Translucent PFA encapsulation / hollow core

Recommended design for applications where a low load with a good remaining deformation is required.

Temperature range: -40 °C to +210 °C..

Ethylene / propylene / diene Terpolymer (EPDM) core

EPDM

- Conventional elastomer: black.
- Option with food certification: black color.
- Temperature range: -35 °C to +125 °C.

SOLID core



Translucent encapsulation of FEP

This option is recommended when low gas permeability and good water resistance are desired. The encapsulation limits the lower temperature and the elastomer limits the upper temperature.

Temperature range: -35 °C to +125 °C..

... CONTINUE

ENCAPSULATED O-RINGS ...

Stainless Steel Core

AISI 302

- Cryogenic temperatures. For temperatures below -100 °C consult our technical department..



Translucent encapsulation of FEP

This option is recommended when low gas permeability and good water resistance are desired. The encapsulation limits the lower temperature and the elastomer limits the upper temperature.

Temperature range: -250 °C to +204 °C.

Encapsulado translúcido de PFA

Recommended design for applications where a low load with a good remaining deformation is required.

Temperature range: -250 °C to +260 °C.

WALL THICKNESS

The encapsulated O-ring liner has a minimum wall thickness of 0.2 mm which is far greater than that of a liner. The table below relates the wall thickness to section d_2 of the encapsulated O-ring.

Manufacturing tolerances of the O-ring section

Section d_2	Thickness of encapsulation
1,60	0,22
1,78	0,24
2,00	0,26
2,40	0,32
2,50	0,32
2,62	0,34
3,00	0,34
3,40	0,35
3,53	0,35
3,60	0,39
4,00	0,39
4,25	0,40
4,50	0,40
5,00	0,48
5,34	0,50
5,50	0,50
5,70	0,50
6,00	0,50
6,35	0,50

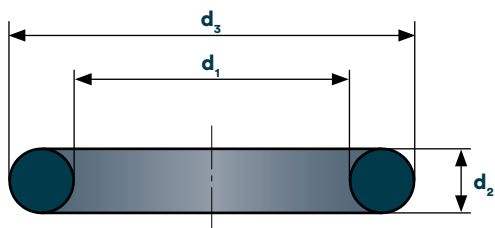
Section d_2	Thickness of encapsulation
6,50	0,52
6,99	0,55
8,00	0,58
8,40	0,58
9,00	0,63
9,52	0,70
10,00	0,74
10,50	0,77
11,10	0,77
12,00	0,78
12,70	0,80
14,00	0,80
14,30	0,80
15,00	0,84
15,90	0,86
18,00	0,90
19,05	0,90
20,63	0,93
25,40	1,05

MANUFACTURING TOLERANCES

... CONTINUE

The tolerances for both the inside diameter (d_1) and the cross-section (d_2) are given below.

Manufacturing tolerances d_1 for elastomer encapsulated O-rings.



Range d_1 / mm	Tolerance of d_1 / mm
from 10,60 a 16,09	$\pm 0,20$
from 16,10 a 25,09	$\pm 0,25$
from 25,10 a 40,09	$\pm 0,35$
from 40,10 a 63,09	$\pm 0,40$
from 63,10 a 100,09	$\pm 0,50$
from 100,10 a 160,00	$\pm 0,70$
> 160	$\pm 0,5 \%$

For each section (d_2), there is a diameter interval (d_1) where the section tolerance is somewhat greater than the conventional one.

From that range of diameters, the cross-section tolerances are reduced. It is not possible to manufacture gaskets with a diameter smaller than the minimum specified in the table.

For construction reasons, with reference to the tolerance of the section (d_2), there is a limitation on the minimum inside diameter of the gasket (d_1).

Manufacturing tolerances d_2 for elastomer encapsulated O-rings.

Section d_2 / mm	Tolerance Section \pm / mm	d_1 minimum / mm	d_3 maximum / mm
1,57	0,13	7,62	63,50
1,78	0,13	7,62	139,70
1,96	0,13	12,19	139,70

Section d_2 / mm	Tolerance Section \pm / mm	d_1 minimum / mm	d_3 maximum / mm
2,03	0,13	12,19	139,70
2,36	0,13	12,19	254,00
2,49	0,13	12,19	254,00
2,54	0,13	12,19	254,00
2,62	0,13	12,19	254,00
2,72	0,13	12,70	254,00
2,79	0,13	12,70	254,00
2,92	0,13	12,70	254,00
3,00	0,13	12,70	254,00
3,10	0,13	12,70	254,00
3,18	0,13	12,70	508,00
3,43	0,15	12,70	508,00
3,53	0,15	12,70	508,00
3,76	0,15	19,05	508,00
3,99	0,15	19,05	635,00
4,19	0,15	25,40	635,00
4,32	0,15	25,40	635,00
4,50	0,15	25,40	635,00
4,70	0,20	25,40	635,00
4,93	0,20	27,94	635,00
5,33	0,20	27,94	> 38,60
5,59	0,25	31,75	> 42,93
5,72	0,25	38,10	> 49,54
5,99	0,25	38,10	> 50,08
6,35	0,25	44,45	> 57,15
6,99	0,25	57,15	> 71,13
7,52	0,25	76,20	> 91,24
8,00	0,25	82,55	> 98,55
8,51	0,38	88,90	> 105,92
9,02	0,38	95,25	> 113,29
9,53	0,38	101,60	> 120,66
10,03	0,38	101,60	> 121,66
11,00	0,38	184,15	> 206,15
12,07	0,38	203,20	> 227,34
12,70	0,38	304,80	> 330,20
13,97	0,64	304,80	> 332,74
14,99	0,64	381,00	> 410,98
15,88	0,64	381,00	> 412,76
19,05	0,89	457,20	> 495,30
19,99	0,89	635,00	> 674,98
25,4	1,27	939,80	> 990,60

CONTINUE ...

In relation to stainless steel encapsulated O-rings, the following table presents the available sections, their tolerances, as well as the minimum and maximum diameters of fabrication.

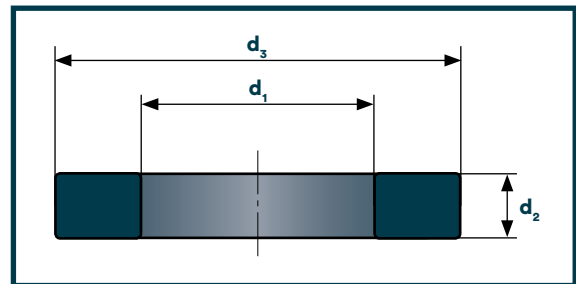


Manufacturing tolerances d_2 for stainless steel encapsulated O-rings.

Section d_2 / mm	Tolerance Section \pm / mm	d_1 minimum / mm	d_3 maximum / mm
1,78	0,12	10,60	76,20
1,91	0,15	12,70	76,20
2,00	0,15	19,05	76,20
2,40	0,15	19,05	76,20
2,62	0,15	19,05	88,90
2,72	0,15	19,08	88,90
2,92	0,15	31,75	127,00
2,95	0,15	31,75	127,00
2,97	0,15	31,75	127,00
3,00	0,15	31,75	127,00
3,10	0,15	31,75	127,00
3,18	0,15	31,75	127,00
3,53 / 3,56	0,15	31,75	190,50
3,80	0,20	38,10	190,50
4,00	0,20	38,10	190,50
4,32	0,20	38,10	304,50
4,80 / 4,88	0,20	44,45	914,40
5,00	0,25	50,80	> 60,80
5,34	0,25	50,80	> 61,48
6,35	0,43	76,20	> 88,90
6,99	0,43	88,90	> 102,88
8,00	0,43	101,60	> 117,60

NOMINAL DIMENSIONS

The following table lists Camlock type couplings, with nominal dimensions up to a size of 6 inches, and the dimensions of the corresponding straight section encapsulated seals.



Rectangular section static seal parameters.

Figure 11

Encapsulated rectangular seals.

Nominal coupling size / mm	d_1 / mm	Section d_2 / mm	d_3 / mm
12,70	17,00	4,00	26,00
19,00	22,20	5,54	35,00
25,40	27,00	6,35	39,70
31,70	34,50	6,35	49,20
38,00	41,30	6,35	55,60
50,80	50,80	6,35	66,70
63,50	60,30	6,35	79,40
76,20	76,20	6,35	94,50
101,60	101,60	6,35	123,60
152,40	152,40	6,35	179,40



NES gasket Ncap™ installed in a coupling Camlock type. Figure 12

INSTALLATION AND ASSEMBLY

The housing must be free of dirt and metal particles. It is recommended to lubricate the surface with oil or grease before installation.

Due to the low elasticity of the FEP it is necessary to heat the O-ring briefly between 120 °C and 150 °C (oil), achieving sufficient elasticity for assembly. Installation cones should be used and, once in their housing, it may be necessary to reheat to regain initial seal measurements if parts are to be assembled at the time.

Proper installation is essential for long life of the encapsulated O-ring. The causes of 90 % of detected faults are problems with mounting or housing design.

Internal Slot Installation

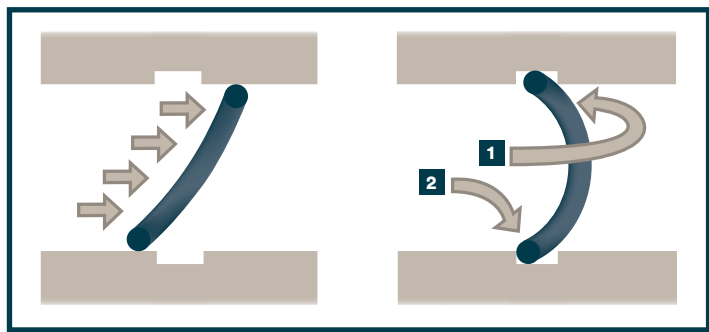
Mounting an encapsulated in an internal groove can be difficult as the gasket must be compressed.

To increase the flexibility of the seal, it can be heated by submerging it in hot water or oil (60 °C - 70 °C) for 10 minutes, discarding the use of hot air.

It must then be inserted into the housing and the seal shaft must be carefully positioned beyond the housing.

Then, after firmly placing the opposite shaft into the groove, pull back on the forward shaft and the gasket will be in place.

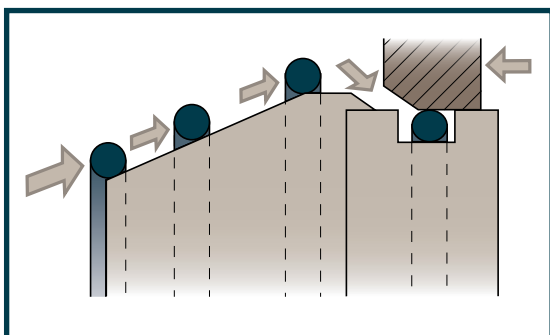
It is highly recommended to insert the shaft while the seal is still warm and flexible.



Installation in accommodation. **Figure 13**

Piston installation

It is possible to install encapsulated gaskets in some solid piston grooves using a “monoblock cone”. Again, the gasket must be submerged in hot water and quickly pushed over the cone until it falls into the housing.



Piston installation. **Figure 14**

It should be emphasised that the encapsulations can only be stretched or compressed to a very small degree and assembly difficulties can be avoided if the encapsulations are demountable.

By applying an external pressure with a matrix, the seal will regain its correct diameter.

The matrix is manufactured, like the cone, in brass or plastic and with great care to smooth any edge. Both these devices and the groove itself can cause damage to the gasket if they are not completely free of burrs or sharp edges.

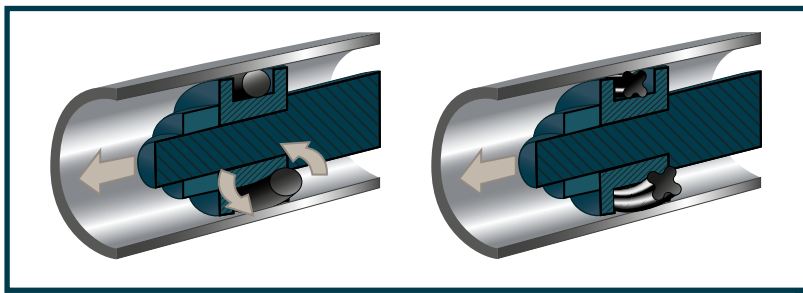
“X-RING” O-RINGS

Visually, the “X-Ring” seals stands out for its profile, from which it takes its name.

This kind of gasket was developed to solve the problem of a conventional O-ring in high pressure hydraulic services.

The reciprocating motion causes the seal to rotate on its axial axis, resulting in wear.

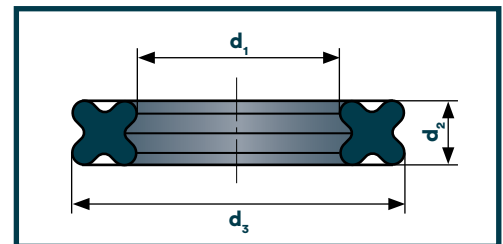
The housing of an O-ring of circular cross-section must be wide enough to allow a certain inter-verage of the seal. However, in a long stroke or high speed alternative motion, the beams may stretch and eventually tear the O-ring compromising its tightness.



Beam problem and its solution with X-Ring joint. **Figure 15**

Like an O-ring with a circular cross-section, the **X-Ring** is defined by its inner diameter (d_1) and its cross-section (d_2).

The “X-Ring” seal acts by deformation of the double edge.



Inner diameter and cross-section of an X-ring joint. **Figure 16**



The four-lobe configuration and flexibility of the **X-Ring** allows it to resist the distortion and extrusion that pressure pulsations or high pressures of hydraulic cylinders frequently cause. And since the contact area is smaller, friction and therefore wear is also reduced.

ADVANTAGES

The “**X-Ring**” seal has advantages over an O-ring with a circular cross-section and the same dimensions:

- In alternative movements it does not twist because it does not tend to turn on itself.
- Lower friction as it requires less assembly preload.
- More effective closing.
- The lobes have no manufacturing burrs. If the seal has burrs, these are located in the two-lobed valley with no risk of leakage due to surface irregularities.

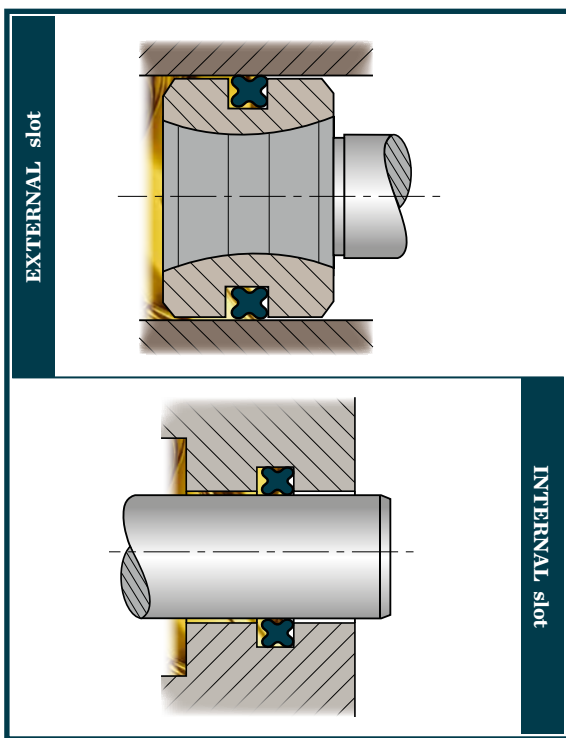


APPLICATION FIELDS

The “X-Ring” joint is usually used in **Dynamic Sealing** services, both for axial movement (alternative) and for rotary movement. It also admits services of **Static Sealing**, although it is not so usual.

Dynamic tightness in the sealing of:

- Hydraulic cylinders (piston and rod seals).
- Combination of axial and rotational movements (piston that moves and rotates at the same time).



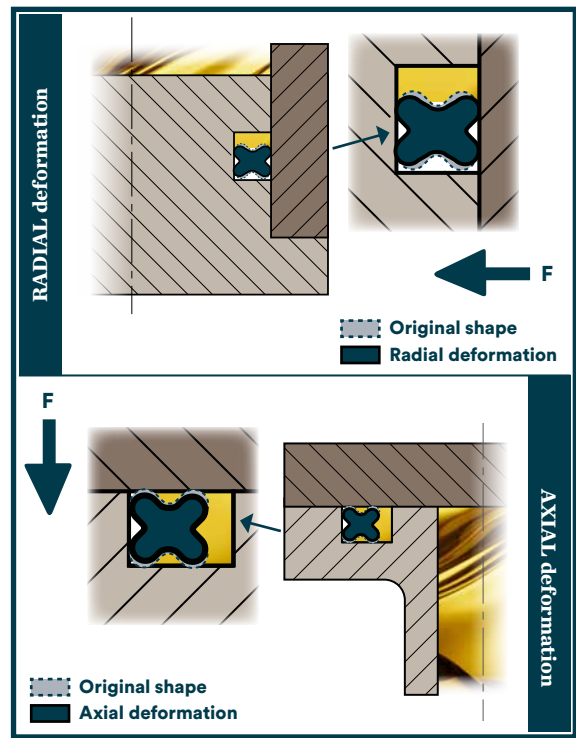
Dynamic watertightness. **Figure 17**

Axial forward and reverse motion or also called, alternative:

- Up to 5 MPa (50 bar) without support ring.
- Up to 30 MPa (300 bar) with support ring.
- Maximum speed up to 0.5 m/s.

Rotating movement:

- Up to 3 MPa (30 bar) without support ring.
- Up to 15 MPa (150 bar) with support ring.
- Maximum speed up to 2.0 m/s



Static tightness. **Figure 18**

Operational limits are imposed by working conditions.

Static tightness in:

- Up to 5 MPa (50 bar) without support ring.
- Up to 40 MPa (400 bar) with support ring..

Available elastomers limit service time.

Elastomeric materials available

Material	Shore A	T Range
FPM	90	-10 °C to +200 °C
NBR	85	-40 °C to +120 °C
EPDM	80	-40 °C to +150 °C

GENERAL ASPECTS OF ASSEMBLY

In this section some general considerations are presented in relation to the environment surrounding the O-ring and on the groove of its housing.

O-RING HOUSING

An O-ring performs its function in a designated space for carrying out the operation of the tank: the housing.

Accommodation is defined by three aspects:

ASPECTS

- Geometry (rectangular / triangular / trapezoidal).
- Its dimensions.
- Its surface finish.

Whatever the kind of O-ring, its housing should preferably be rectangular although it can also be triangular and trapezoidal.

For a rectangular geometry, the sides can have a maximum inclination of 5°. The inner surface of the housing must always be larger than the transverse surface of the O-ring.

This ensures that the pressure of the fluid affects a relatively large area of the O-ring, as well as sufficient space in the housing, in case there is an increase in the volume of the O-ring due to chemical attack.

In the sections *Static Sealing*² and *Dynamic Sealing*³ the recommended dimensions for housings and surface finishes are detailed depending on the application of the O-ring of interest.

In the design tables for O-ring housings, both factors have been taken into account.

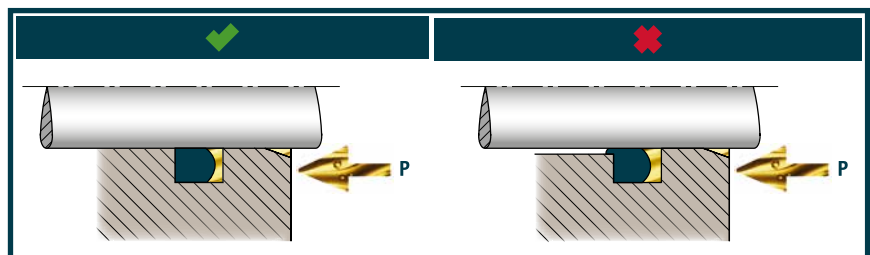
The rounding R2 at the bottom of the housing groove can be replaced by a chamfer at the bottom with an inclination of 45°.

Metal parts that come into contact with the O-ring must be carefully machined. Before assembly they must be cleaned in order to remove any foreign bodies.

Carbon steel is generally used for rods and cylinders. Well-polished, pore-free cast iron can also be used. Aluminium, bronze or brass as well as stainless steel are subject to greater wear in dynamic applications due to their low hardness. However, they are also used on specific occasions.

EXTRUSION GAP

The extrusion groove is the groove between the O-ring and the surface against which it closes or antagonist. If this clearance is excessive, the O-ring (which is under pressure) can penetrate into this space and suffer an extrusion phenomenon and subsequent rupture.



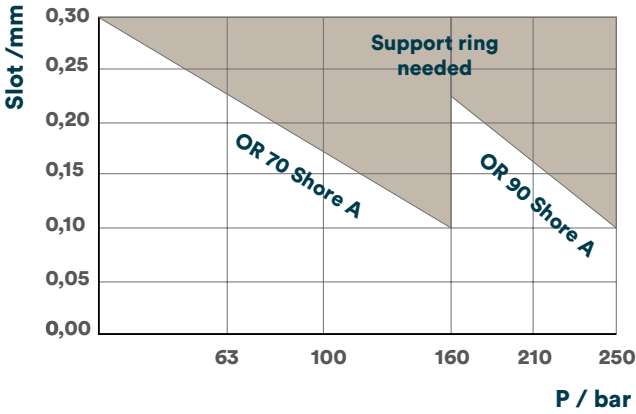
Installation in accommodation. **Figure 19**

² Chapter *STATIC WATERPROOFING*. See page 56

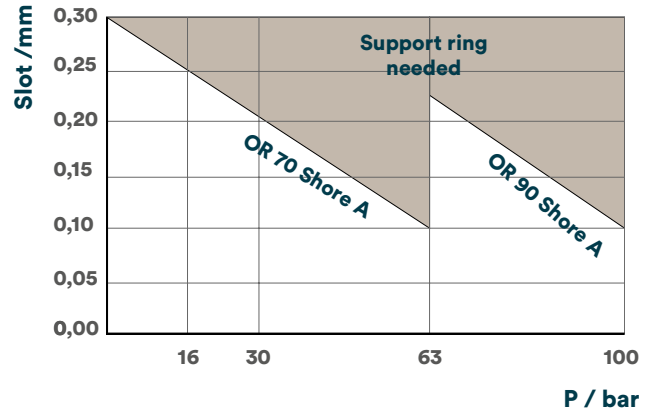
³ Chapter *DYNAMIC STAINLESSING*. See page 63

... EXTRUSION GAP

The permissible clearances between groove and antagonist surface are shown in the following graphs:



Static tightness. **Graph 5**

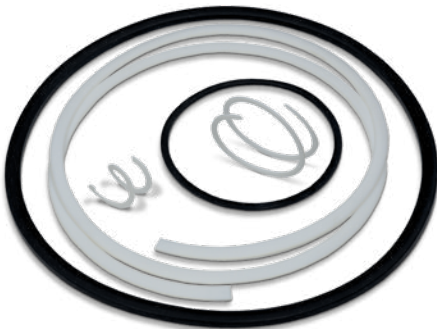


Dynamic tightness (axial). **Graph 6**

With support rings made of PTFE resin, the working clearance can be up to a maximum of 0.3 mm.

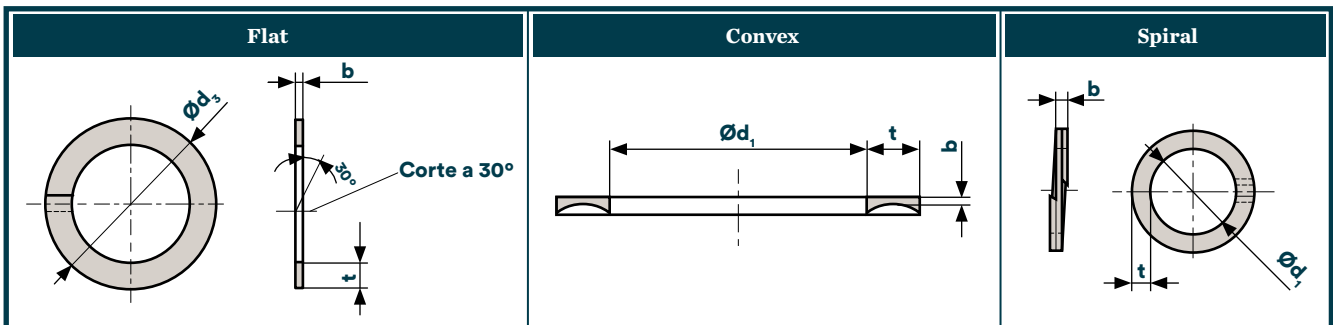
The dimensions indicated in the assembly tables must be respected, avoiding as far as possible any modification that leads to a greater clearance with the antagonist surface..

BACK-UP RINGS



They are flat, concave section elements with a cross section and are used as auxiliary elements of the O-rings to prevent them from being introduced through the extrusion groove when sealing pistons and rods.

On request, spiral rings can be supplied for very specific working conditions, such as sudden temperature fluctuations. Even if the ring shrinks, there is always a spiral protecting the O-ring from extrusion.



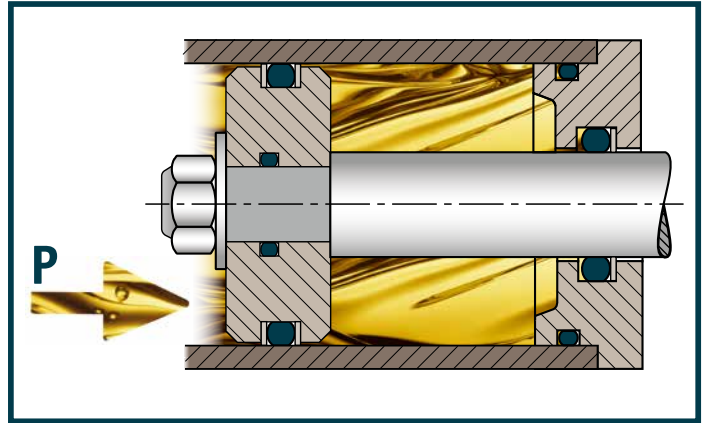
Support rings. **Figure 20**

The support rings must be installed on the side opposite to the pressure and, in the case of an alternating movement, it is then recommended to place rings on both sides of the O-ring.

The support rings in stock are made of PTFE and NBR 90. For large series, other thermoplastics can be manufactured on request.

In the case of different deformations of the O-rings or dimensions not listed in the stock lists, then the dimension of the groove will be stated in the purchase order.

Depending on the extrusion groove between the two sliding parts, the O-rings with support ring can work under dynamic loads up to 250 bar and statically up to 400 bar.



Installation of support rings. **Figure 21**

CHAMFERING

For assembly reasons, the edges must be chamfered and rounded carefully.

The dimensions shown in the attached table correspond to minimum values.

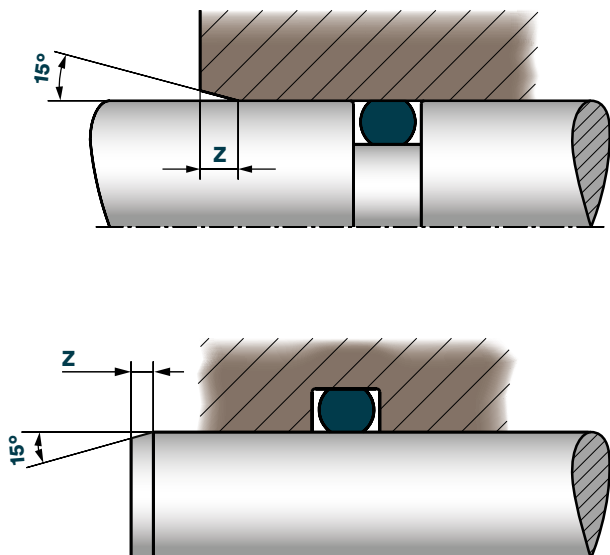
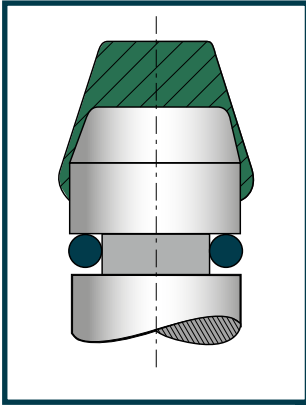


Table of recommended chamfers

d_2 / mm	Z / mm
1,50	1,0
1,78	1,1
2,00	1,2
2,40	1,4
2,50	1,4
2,62	1,5
3,00	1,6
3,50	1,8
3,53	1,8
4,00	2,0
4,50	2,3
5,00	2,5
5,33	2,7
5,50	2,8
5,70	3,0
6,00	3,1
6,50	3,3
6,99	3,6
7,00	3,6
7,50	3,8
8,00	4,0
8,50	4,2
9,00	4,3
9,50	4,4
10,00	4,5

INSTALLATION



Installation . Figure 22

Before assembling the O-ring, the working area must be cleaned of dirt particles and machining residues. The O-ring must not be twisted when placed in its housing. The use of a mandrel or mounting sleeve is recommended.

When placing the seal in its housing, avoid passing through sharp edges, stepped shafts, threads and grooves, and it is advisable to cover all those parts of the machine that may damage the seal.

A slight expansion of the O-ring can be accepted for assembly, provided that sufficient time is allowed for the seal to regain its original shape

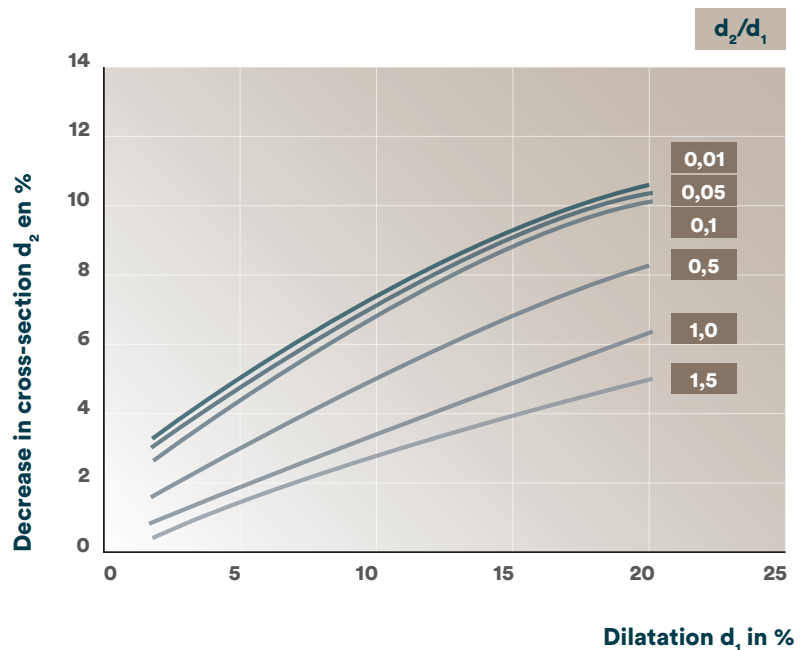
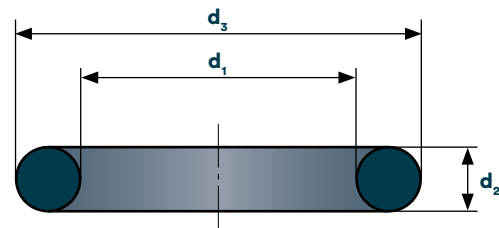
DILATATION AND UPSETTING

To improve the holding of an O-ring in its housing during installation, additional design criteria such as contraction and expansion are used. They exclude encapsulated O-rings and metal O-rings.

The **contraction** shrinks the O-ring in its housing. It is recommended that with respect to the outside diameter (d_3) the contraction should not exceed 3 %, because of otherwise there is a danger that the O-ring undergoes such a deformation that your outer perimeter doesn't fit at 100 % over the bottom diameter of the housing.

The other option is to **stretch or dilate** the O-ring at the time of installation. To this end, when choosing an O-ring, you must consider an inside diameter (d_1) up to 6 % smaller than the internal diameter of the housing to be able to stretch it properly in the phase of assembly.

As the seal expands, the cross-section decreases. If it is reduced excessively, then its behavior will worsen under compression. According to Guldin's rule, an increase of the inside diameter (d_1) by 1 % is equivalent to approximately a decrease of section (d_2) of 0,5 %.



Changes in d_2 when dilating an o-ring of d_1 . Graph 7

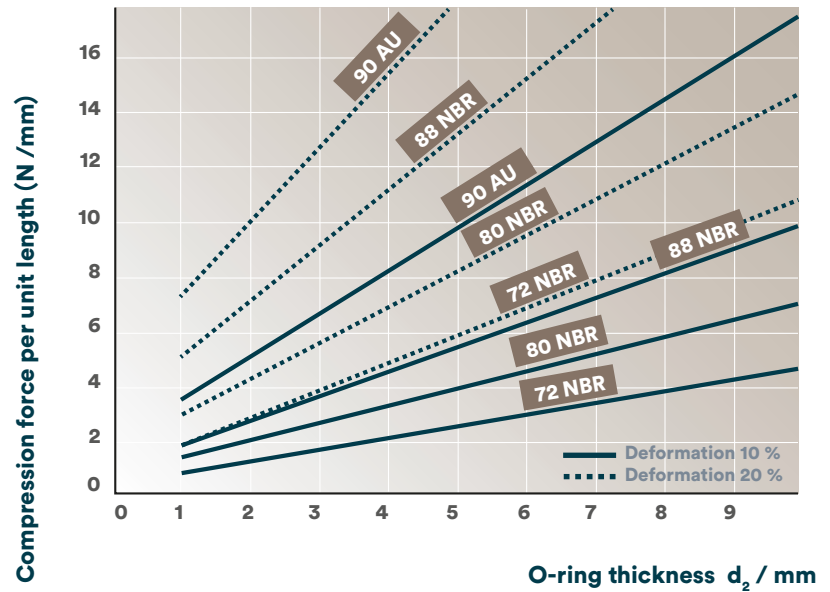
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FORCE NECESSARY TO DEFORM SECTION (d_2) OF AN O-RING

This graph shows the compressive force required to obtain a 10 and 20% deformation of the section (d_2) of an O-ring, depending on the section of the gasket and the elastomer.

These values have been determined on the basis of standard materials. However, this graph can serve as a guideline for determining the compression force per unit length in other elastomers, depending on their Shore hardness, since the necessary deformation force depends on it.

For the same material, the deformation increases linearly with the thickness of the joint.



Compression of an O-ring vs. thickness. **Graph 8**

STATIC SEALING



O-rings are preferably used as a solution to static sealing problems in covers, fittings and bolts.

With proper selection of the O-ring material and correct design of the O-ring, it can be guaranteed that the O-ring will withstand working pressures up to 1.000 bars.

The hardness of the elastomer shall be chosen according to the operating pressure as well as the tolerances of the extrusion groove.

HARDNESS

- For applications with $P < 160$ bar, 70 °Sh A materials are recommended
- For applications with $P > 160$ bar, 90 °Sh A materials are recommended.
- In case of pulsating pressures, the hardness must always be higher than 80 °Sh A.

When considering the housings, the clearances indicated in **Gráfico 7**⁴ must be taken into account.

The following table summarizes the recommended housing for Static **Static sealing** services.

Table O-rings, housings and deformations in Static sealing

Static Tightness	Rectangular housing	Triangular housing	Trapezoidal housing
Moulded O-rings	✓	✓	✓
Extruded O-rings	✓	✓	✓
Encapsulated O-rings	✓	✗	✓
X-ring gaskets	✓	✗	✗

A rectangular housing admits radial and axial deformations.

A triangular housing has a mixed deformation.

Only radial deformation can occur in a trapezoidal housing.

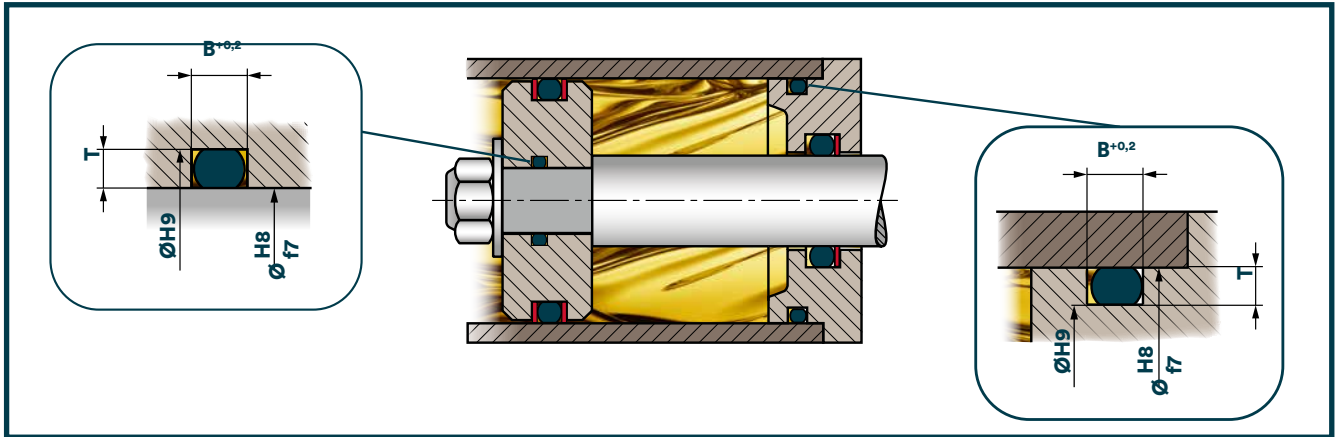
NOTE: In the following tables, the dimension “B” is understood as the width of the housing and the dimension “T” as the difference between the housing diameters and the bottom of the housing, divided by two. That is, the dimension “T” is the section of the housing and includes the extrusion slot.

⁴ See page 54

RECTANGULAR HOUSING FOR RADIAL SEALING

When installing the O-ring in its housing and proceeding with its closure, the O-ring section deforms quickly. The criterion for choosing where to machine the housing (outside - inside) depends on the machining and assembly possibilities.

A housing must never have a square geometry. Its width must always be greater than its height.



Rectangular pockets. **Figure 23**

RECOMMENDED HOUSINGS FOR EXTRUDED AND MOULDED O-RINGS

■ Dimensions of rectangular housings. Radial deformation.

d_2 / mm	T / mm	$B^{+0,2}$ / mm
1,50	1,10 ± 0,06	2,18
1,60	1,20 ± 0,06	2,31
1,78	1,40 ± 0,07	2,54
2,00	1,50 ± 0,08	2,86
2,40	1,80 ± 0,10	3,38
2,50	1,90 ± 0,10	3,51
2,62	2,00 ± 0,10	3,57
3,00	2,30 ± 0,15	4,08
3,50	2,70 ± 0,14	4,58
3,53	2,70 ± 0,14	4,72
4,00	3,10 ± 0,16	5,23
4,50	3,50 ± 0,18	5,85
5,00	3,90 ± 0,20	6,46
5,30	4,10 ± 0,21	7,10
5,33	4,10 ± 0,21	7,14
5,50	4,30 ± 0,22	7,20
5,70	4,40 ± 0,23	7,66
6,00	4,70 ± 0,24	8,05
6,50	5,10 ± 0,26	8,37

d_2 / mm	T / mm	$B^{+0,2}$ / mm
6,99	5,50 ± 0,26	8,97
7,00	5,50 ± 0,28	8,98
7,50	5,90 ± 0,30	9,63
8,00	6,30 ± 0,32	10,27
8,40	6,40 ± 0,34	10,78
8,50	6,70 ± 0,34	10,91
9,00	7,10 ± 0,36	11,55
9,50	7,50 ± 0,38	12,19
10,00	7,90 ± 0,40	12,75
10,50	8,20 ± 0,42	13,48
11,00	8,60 ± 0,43	14,08
11,50	9,00 ± 0,46	14,69
12,00	9,40 ± 0,48	15,31
12,50	9,80 ± 0,50	15,92
13,00	10,20 ± 0,52	16,54
13,50	10,60 ± 0,54	17,15
14,00	11,00 ± 0,56	17,77
14,50	11,40 ± 0,58	18,38
15,00	11,80 ± 0,60	19,00

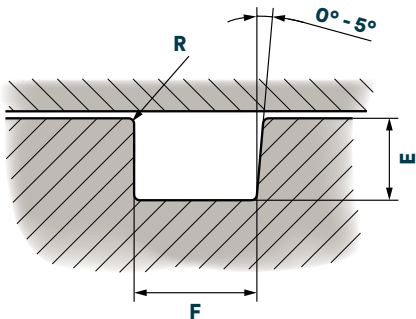
...RECTANGULAR HOUSING FOR RADIAL SEALING

RECOMMENDED HOUSINGS FOR ENCAPSULATED O-RINGS

The housings are sensibly the same as those recommended for standard O-rings, so encapsulated O-rings can generally replace them without modifying their housings.

The table below shows the recommended dimensions.

Enclosures for encapsulated seals



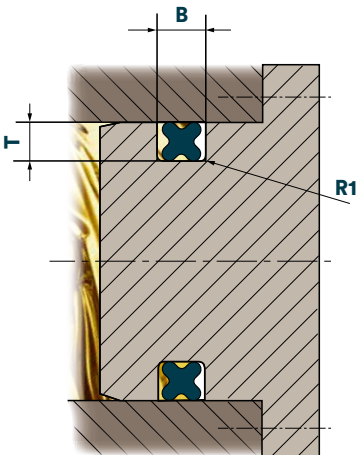
Section d_2 / mm	Depth of groove (E) / mm	Box width (F) / mm	Radius (R) / mm
1,78	1,30	2,30	0,50
2,00	1,50	2,65	0,50
2,60	2,05	3,50	0,50
3,00	2,40	4,00	0,50
3,53	2,90	4,50	0,50
4,00	3,30	5,00	1,00
5,00	4,10	6,50	1,00
5,34	4,50	7,00	1,00
5,70	4,85	7,50	1,00
7,00	6,00	9,50	1,00
8,40	7,25	11,00	1,50

RECOMMENDED HOUSINGS FOR "X-RING" SEALS

To accommodate its working environment, the "X-Ring" seal housing is narrower than that of its circular cross-section counterpart. As a general rule, the "X-Ring" seal is installed in a groove or rectangular section housing with groove bottom angles and rounded edges.

"X-Ring" gasket housings

Section n / mm	T $\pm 0,05$ / mm	B $+0,2$ / mm	R1 / mm
1,78	1,40	2,10	0,25
2,62	2,15	3,15	0,25
3,53	2,90	4,10	0,50
5,33	4,45	6,40	0,50
6,99	5,85	8,40	0,50



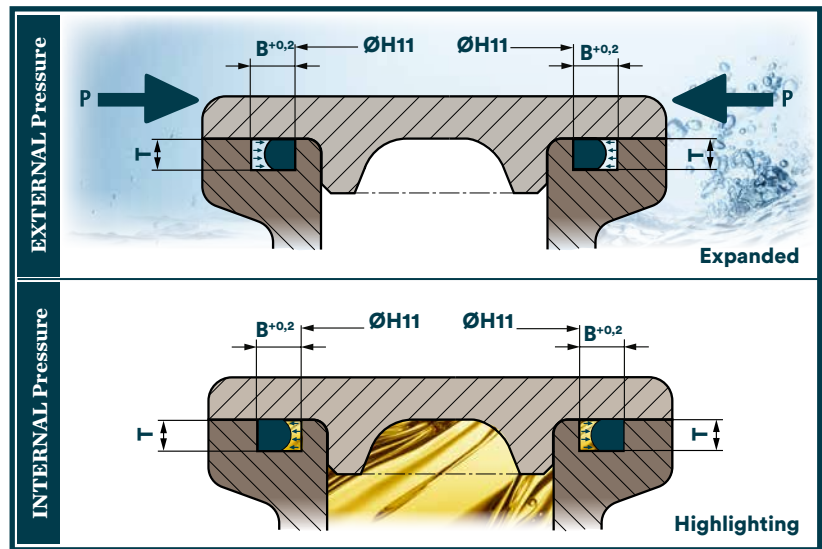
RECTANGULAR HOUSING FOR AXIAL SEALING

In flanges and covers, the O-ring is deformed axially. When designing the junction and its housing, the direction of the fluid pressure must be taken into account.

For a pressure exerted from the outside, the inside diameter of the seal (d_1) must be equal or smaller than the inside diameter of the groove (**dilated**).

If the pressure is exerted from the inside, the outer diameter (d_3) of the gasket must be equal to or greater than the diameter (d_3) of the outer edge of the groove (**upsetting**).

This avoids that, if there are pressure variations, they can move the gasket in its housing preventing its wear.



Rectangular pockets. **Figure 24**

RECOMMENDED HOUSINGS FOR EXTRUDED AND MOULDED O-RINGS

■ Dimensions of rectangular housing. Axial deformation.

d_2 / mm	T / mm	$B^{+0,2}$ / mm
1,50	1,13 ± 0,05	2,18
1,60	1,20 ± 0,05	2,31
1,78	1,34 ± 0,05	2,54
2,00	1,50 ± 0,05	2,86
2,40	1,80 ± 0,05	3,38
2,50	1,88 ± 0,05	3,51
2,62	2,02 ± 0,05	3,57
3,00	2,31 ± 0,05	4,08
3,50	2,70 ± 0,05	4,72
3,53	2,82 ± 0,05	4,58
4,00	3,20 ± 0,05	5,23
4,50	3,60 ± 0,05	5,85
5,00	4,00 ± 0,05	6,46
5,33	4,26 ± 0,05	7,14
5,50	4,40 ± 0,05	7,41
5,70	4,56 ± 0,05	7,66
6,00	4,80 ± 0,05	8,05
6,50	5,40 ± 0,05	8,37
6,99	5,80 ± 0,05	8,97

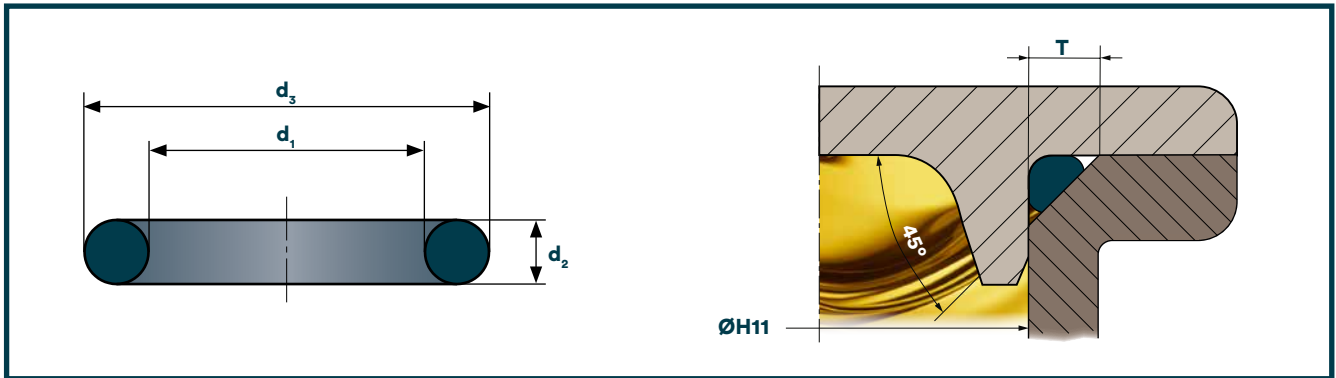
d_2 / mm	T / mm	$B^{+0,2}$ / mm
7,00	5,81 ± 0,05	8,98
7,50	6,23 ± 0,10	9,63
8,00	6,64 ± 0,10	10,27
8,40	6,97 ± 0,10	10,78
8,50	7,06 ± 0,10	10,91
9,00	7,47 ± 0,10	11,55
9,50	7,89 ± 0,10	12,13
10,00	8,30 ± 0,10	12,75
10,50	8,72 ± 0,10	13,48
11,00	9,13 ± 0,10	14,08
11,50	9,55 ± 0,10	14,69
12,00	9,96 ± 0,10	15,31
12,50	10,38 ± 0,10	15,92
13,00	10,79 ± 0,10	16,54
13,50	11,21 ± 0,10	17,15
14,00	11,62 ± 0,10	17,77
14,50	12,04 ± 0,10	18,38
15,00	12,45 ± 0,10	19,00

RECOMMENDED HOUSINGS FOR EXTRUDED AND MOULDED O-RINGS FOR ENCAPSULATED ORING AND "X-RING"

No distinction is made between rectangular housings for axial and radial deformations, so both dimensions are equal.

TRIANGULAR HOUSING FOR RADIAL / AXIAL SEALING

Triangular cross-section housings are sometimes used for threaded flanges and lids. However, it is difficult to practice such grooves with proper accuracy.



Triangular pocket. Figure 25

The tightness of an O-ring in a triangular housing assembly implies the accuracy of the dimension of the groove, so the measurements indicated in the table must be observed with the utmost care. However, if possible, it is more advisable to mount in a rectangular housing.

It is recommended that the O-ring be expanded by no more than 6 % with respect to its inner diameter (d_1) in order to ensure a better fit during the assembly phase.

Recommended housing dimensions are the same for molded O-rings manufactured by extrusion / vulcanization. Encapsulated O-rings and “X-Ring” cannot be mounted in this type of housing.

■ Dimensions of triangular housings

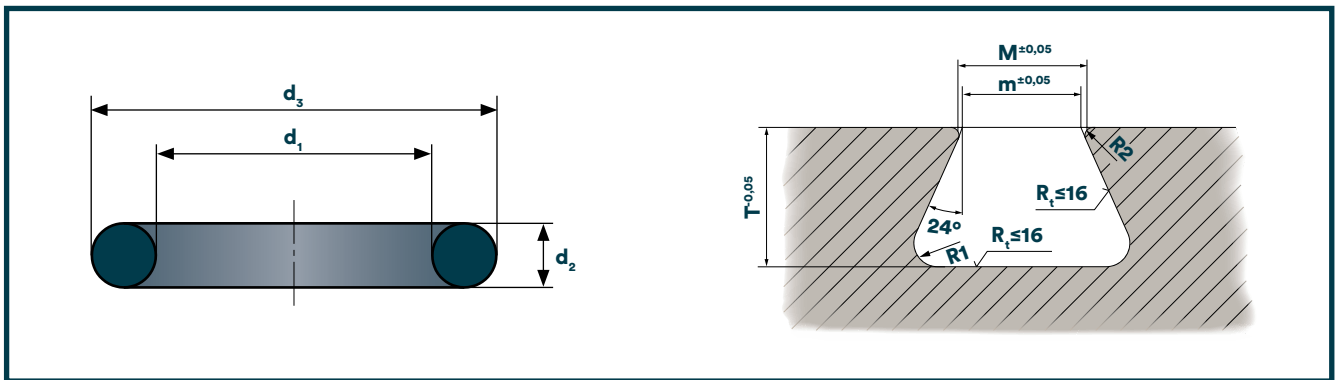
d_2 / mm	T / mm
1,00	1,45 ± 0,08
1,50	2,11 ± 0,08
1,60	2,13 ± 0,08
1,78	2,38 ± 0,08
2,00	2,70 ± 0,08
2,40	3,25 ± 0,12
2,50	3,40 ± 0,12
2,62	3,55 ± 0,12
3,00	4,10 ± 0,20
3,50	4,80 ± 0,20
3,53	4,85 ± 0,20
4,00	5,50 ± 0,20
4,50	6,15 ± 0,20
5,00	6,85 ± 0,20
5,33	7,35 ± 0,20
5,50	7,55 ± 0,20
5,70	7,85 ± 0,20
6,00	8,25 ± 0,20
6,50	8,95 ± 0,26

d_2 / mm	T / mm
6,99	9,60 ± 0,30
7,00	9,60 ± 0,30
7,50	10,30 ± 0,30
8,00	11,00 ± 0,30
8,40	11,55 ± 0,30
8,50	11,70 ± 0,30
9,00	12,40 ± 0,40
9,50	13,05 ± 0,40
10,00	13,70 ± 0,40
10,50	14,40 ± 0,40
11,00	15,10 ± 0,40
11,50	15,80 ± 0,40
12,00	16,50 ± 0,50
12,50	17,15 ± 0,50
13,00	17,85 ± 0,50
13,50	18,50 ± 0,50
14,00	19,20 ± 0,50
14,50	19,90 ± 0,50
15,00	20,60 ± 0,50

TRAPEZOIDAL HOUSING FOR RADIAL SEALING

This option is rarely used, except when it is necessary to firmly confine the O-ring in its mounting groove.

Due to the difficulty of machining this housing, this design is recommended for O-rings from a thickness (d_2) of 3.5 mm. The inside diameter of the O-ring shall be calculated by subtracting the thickness of the seal d_2 from the mean diameter of the housing.



Triangular pocket. **Figure 26**

The O-ring is radially deformed.

■ Dimensions of trapezoidal or “on fly wings” housings

d_2 / mm	T / mm	m / mm	M / mm	R1 / mm	R2 / mm
3,53	2,90 ± 0,07	2,9	3,1	0,6	0,2
3,55	2,90 ± 0,07	2,9	3,1	0,6	0,2
4,00	3,30 ± 0,08	3,3	3,5	0,7	0,2
4,50	3,70 ± 0,09	3,7	4,0	0,7	0,3
5,00	4,10 ± 0,10	4,1	4,4	0,8	0,3
5,30	4,40 ± 0,11	4,4	4,7	0,9	0,3
5,33	4,40 ± 0,11	4,4	4,7	0,9	0,3
5,50	4,50 ± 0,11	4,5	4,8	0,9	0,3
5,70	4,70 ± 0,11	4,7	5,0	0,9	0,3
6,00	5,00 ± 0,12	5,0	5,5	1,0	0,4
6,50	5,40 ± 0,13	5,4	5,9	1,1	0,4
7,00	5,80 ± 0,14	5,8	6,3	1,2	0,4
7,50	6,20 ± 0,15	6,2	6,7	1,2	0,4
8,00	6,70 ± 0,16	6,7	7,3	1,3	0,5
8,40	7,10 ± 0,17	7,1	7,7	1,4	0,5
8,50	7,30 ± 0,17	7,3	7,9	1,5	0,5
9,00	7,50 ± 0,18	7,5	8,1	1,5	0,5
9,50	7,90 ± 0,19	7,9	8,6	1,6	0,6
10,00	8,30 ± 0,20	8,3	9,0	1,7	0,6

Recommended housing dimensions are the same for molded O-rings, extruded / vulcanized and encapsulated. The “X-Ring” gaskets cannot be mounted in this type of housing.

SURFACE FINISHES

The surface finishes, irrespective of the method of manufacture of the O-ring, for both the housing and the antagonist surface are as follows:

Antagonist Surface (cover / bearing / cover)

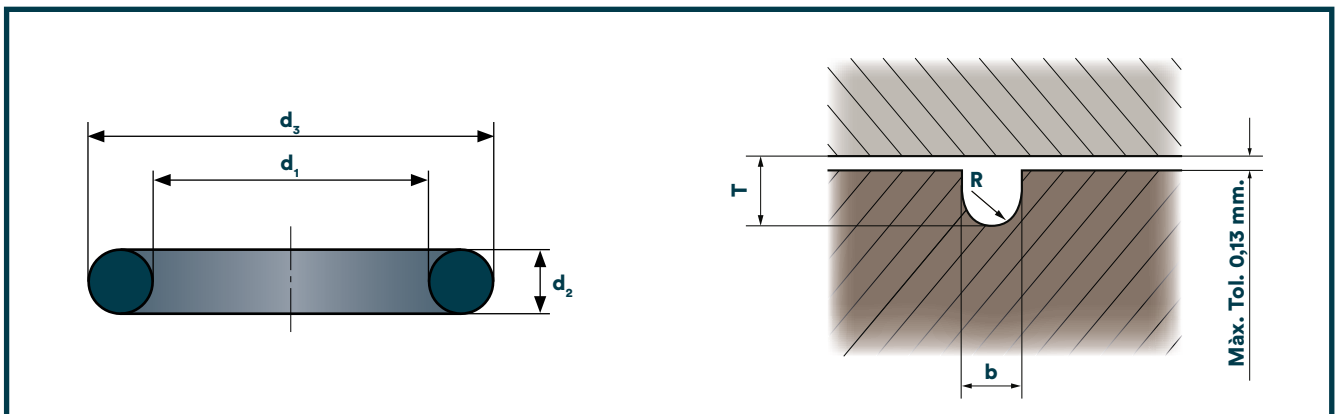
$$R_a = 0,2 - 0,6 \mu\text{m} \quad (R_{\text{m}\acute{\text{a}}\text{x}} = 0,8 - 3,2 \mu\text{m})$$

Housing (back and walls)

$$R_a = 1,0 - 4,0 \mu\text{m} \quad (R_{\text{m}\acute{\text{a}}\text{x}} = 6,0 - 16,0 \mu\text{m})$$

POCKET FOR PTFE O-RINGS AND AXIAL SEALING

There is still some machinery with semi-circular housings, also called half-round housings, for PTFE O-rings.



Pocket for PTFE O-rings. **Figure 27**

In these cases, the dimensions of the working slots are calculated according to the following formulas.

Housing section (T). For O-rings with $1,78 \text{ mm} \leq d_2 \leq 5,33 \text{ mm}$

$$T = d_2 \cdot (1 - \alpha) \quad 0,1 \leq \alpha \leq 0,2$$

Housing section (T). For O-rings with $5,33 \text{ mm} \leq d_2 \leq 7,00 \text{ mm}$

$$T = d_2 \cdot (1 - \alpha) \quad 0,1 \leq \alpha \leq 0,15$$

Housing width (b)

$$b = 1,1 \cdot d_2$$

Housing bottom radius(R)

$$R = b / 2$$

However, it is recommended to design rectangular housings whenever possible and to use Rubber O-Rings or encapsulated O-rings.

DYNAMIC SEALING

In a dynamic sealing environment, a distinction must be made between applications for hydraulics and for pneumatics. In any case, due to friction, the deformation of the cross-section must be minimised with respect to a static seal..

The wear of a seal and the friction it causes are significantly reduced by an adequate lubrication by the fluid to be sealed (in the case of a hydraulic system) or by an effective oil spray (in the case of a pneumatic system).

The hardness of the elastomer is selected according to the operating pressure and the tolerances of the extrusion groove.

DUREZA

- For applications with $P < 63$ bar, 70 °Sh A materials are recommended.
- For applications with $P < 63$ bar, 90 °Sh A materials are recommended.

When considering the housings, the clearances indicated in **chart 7**⁵ must be taken into account. Unlike **Static Sealing**, the geometry of the O-ring housings is rectangular.

The attached table summarizes the **Dynamic Sealing** services:

■ **Table O-rings in Dynamic Sealing**

Dynamic Sealing	Rotative movement	Axial movement Hydraulics	Axial movement Pneumatic
Moulded O-rings	✓	✓	✓
Extruded O-rings	✗	✗	✗
Encapsulated O-rings	✗	✓	✓
X-ring gaskets	✓	✓	✓

The working conditions (fluid; pressure; sliding speed; temperature), the finish of the sliding surfaces of the mounting space as well as the material and quality of the O-ring must be analysed in anticipation of possible leaks.

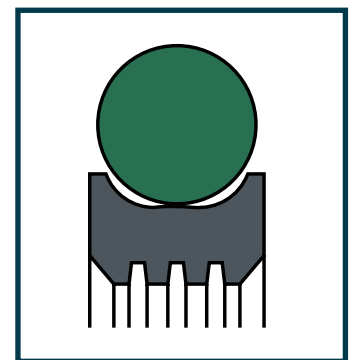
HYDRAULICS. RECTANGULAR HOUSING FOR ROTATIVE MOVEMENT

It is currently considered that the O-ring is not the best choice for a rotary motion (either cyclic or continuous) due to the wear suffered from friction.

Seals have been developed that absorb the stress caused by rotary motion without any difficulty, such as the **DR 115** model, which combines a PTFE support and the O-ring itself in the same piece.

For further information, please refer to the “**Customized Sealing**” catalogue for hydraulics and pneumatics applications.

However, if the installation of a more efficient seal is not possible and if the operating conditions are not very demanding, then O-rings can be used as a solution to the sealing of a shaft.



Gasket model DR 115. **Figure 28**

⁵ See page 54

...HYDRAULICS, RECTANGULAR HOUSING FOR ROTATIVE MOVEMENT

In such cases, peripheral velocities of up to approximately 4 m/s may be permitted provided that neither a very long service life nor perfect tightness is required.

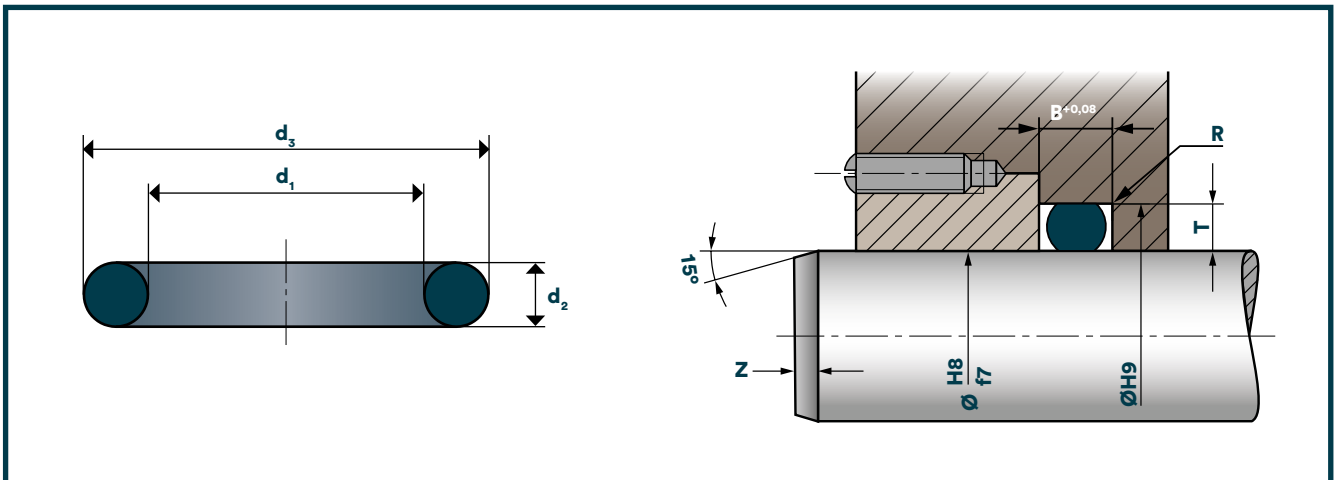
The O-ring must always be mounted on the outside of the housing, i.e. on the static part. The inner diameter of the seal (d_1) should be approximately 5 % larger than the diameter of the shaft to be sealed and therefore be stressed at the time of assembly.

To prevent the O-ring from moving in its housing, its width should, if possible, be equal to or slightly greater than the thickness of the O-ring (d_2).

Adequate lubrication must be ensured and good heat dissipation is essential. The hardness of the material must be equal to or greater than 80 °Sh A.

The shaft to be sealed must be hardened on its surface to a minimum of 60 HRC. The point of contact of the O-ring with the shaft must be machined without traces of orientation and with a roughness $R_{\text{max}} \leq 2 \mu\text{m}$.

RECOMMENDED HOUSINGS FOR MOLDED O-RINGS



Rectangular pocket for rotary movement. Figure 29

■ Dimensions of rectangular housing for rotary movement

d_2 / mm	T / mm	$B^{+0,08}$ / mm	z / mm	R / mm
1,78	1,69	2,01	1,10	0,50
2,40	2,28	2,67	1,50	0,50
2,62	2,49	2,90	1,60	0,50
3,00	2,85	3,31	1,80	0,50
3,53	3,35	3,86	2,00	1,00
5,33	5,06	6,01	2,70	1,00
5,70	5,42	6,45	2,90	1,00
6,99	6,64	7,84	3,50	1,50

■ Relationship d_1 and d_2 an O-ring for rotary motion

	d_1 / mm	d_2 / mm
To	9	1,78
of	8 - 19	2,40 - 2,62
of	18 - 40	3,00 - 3,53
of	37 - 130	5,33 - 5,70
of	110 - 150	6,99

RECOMMENDED HOUSINGS FOR O-RINGS BY EXTRUSION AND VULCANIZATION

The use of an extruded o-ring is not recommended because movement can weaken the junction of the ends and break at the vulcanization point.

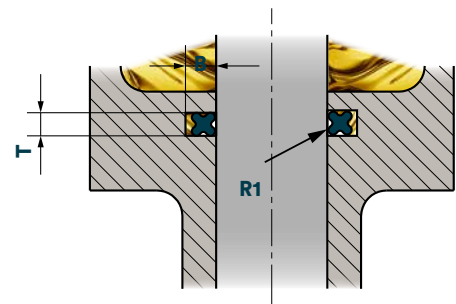
RECOMMENDED HOUSINGS FOR ENCAPSULATED O-RINGS

The use of encapsulated O-rings as a radial dynamic sealing solution is not recommended as there is a risk of breakage of the O-ring casing.

RECOMMENDED HOUSINGS FOR “X-RING” JOINTS

■ “X-Ring” gasket housings

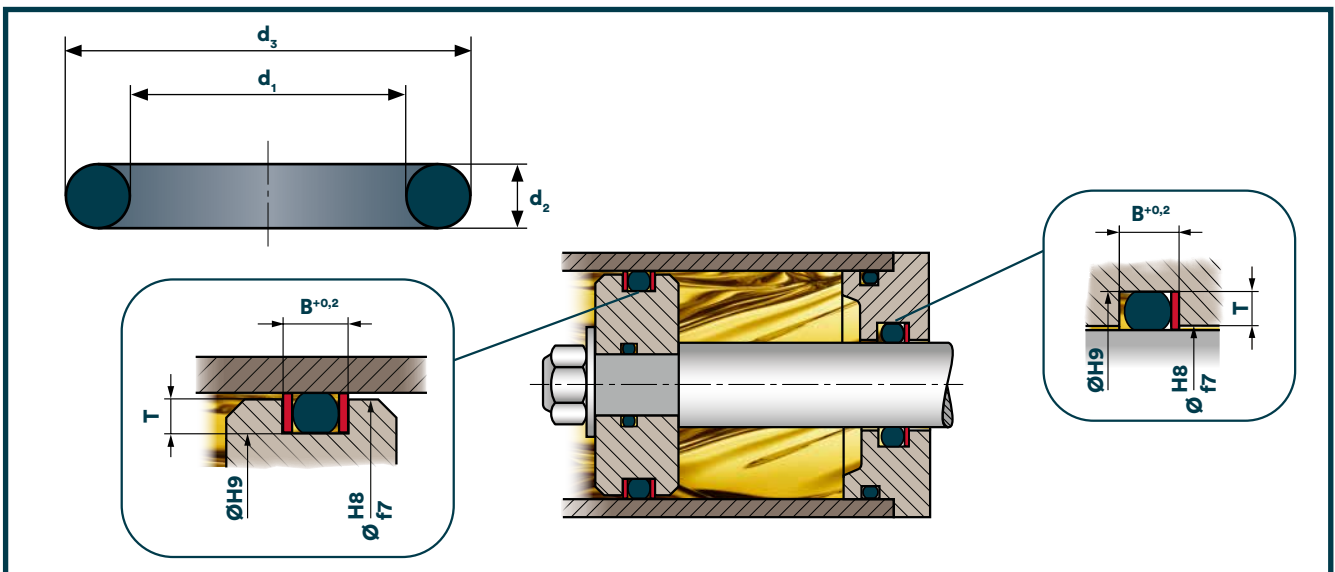
Section / mm	T ±0,05 / mm	B +0,1 / mm	R1 / mm
1,78	1,60	2,00	0,25
2,62	2,40	2,80	0,25
3,53	3,35	3,80	0,50
5,33	4,95	6,00	0,50
6,99	6,65	7,70	0,50



HYDRAULICS. RECTANGULAR HOUSING FOR AXIAL MOVEMENT

In a hydraulic system, O-rings are used only in cases where there is little space for mounting a collar (rod or piston); when there are short strokes of low frequency and as long as total tightness is not required.

Depending on the thickness of the seal, the dimensions of the housing are equivalent to an average deformation of the section of 10 to 15 % and must never be less than 6 %..



Rectangular housing for axial movement. **Figure 30**

Note that, if necessary, the assembly includes 2 support rings for the double acting piston seal, and a support ring for the stem seal.

...HYDRAULICS, RECTANGULAR HOUSING FOR AXIAL MOVEMENT

RECOMMENDED HOUSINGS FOR MOLDED O-RINGS

■ Dimensions of rectangular pocket for axial movement

d_2 / mm	T / mm	$B^{+0,2}$ / mm
1,50	1,32 ± 0,03	1,86
1,78	1,57 ± 0,04	2,17
2,00	1,76 ± 0,04	2,44
2,40	2,11 ± 0,05	2,88
2,50	2,20 ± 0,05	2,99
2,62	2,31 ± 0,05	3,13
3,00	2,64 ± 0,06	3,57
3,50	3,08 ± 0,07	4,13
3,53	3,11 ± 0,07	4,16
4,00	3,52 ± 0,08	4,76
4,50	3,96 ± 0,09	5,31
5,00	4,40 ± 0,10	5,87
5,33	4,74 ± 0,11	6,42

d_2 / mm	T / mm	$B^{+0,2}$ / mm
5,50	4,90 ± 0,11	6,66
5,70	5,07 ± 0,11	6,89
6,00	5,34 ± 0,12	7,23
6,50	5,79 ± 0,13	7,81
6,99	6,22 ± 0,14	8,37
7,00	6,23 ± 0,14	8,38
7,50	6,68 ± 0,15	8,98
8,00	7,12 ± 0,16	9,58
8,50	7,57 ± 0,17	10,17
9,00	8,01 ± 0,18	10,77
9,50	8,46 ± 0,19	11,37
10,00	8,90 ± 0,20	11,97

RECOMMENDED HOUSINGS FOR O-RINGS BY EXTRUSION AND VULCANIZATION

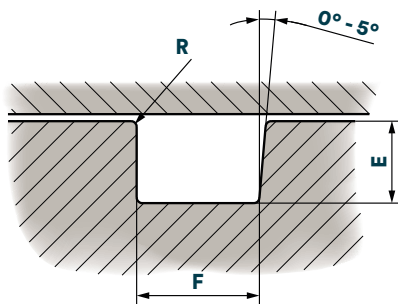
The use of an extruded o-ring is not recommended because movement can weaken the union of the ends and break at the vulcanization point.

RECOMMENDED HOUSINGS FOR ENCAPSULATED O-RINGS

There are two reasons for choosing an encapsulated seal: extreme temperature and/or aggressiveness of the medium. If no other option is possible, an encapsulated gasket can be used as a dynamic sealing solution as long as the speed is very low.

The reason for this limitation is due to the risk of rupture of the O-ring liner (only 0.2 mm thick) when subjected to the alternative movement of the cylinder.

■ Enclosures for encapsulated joints

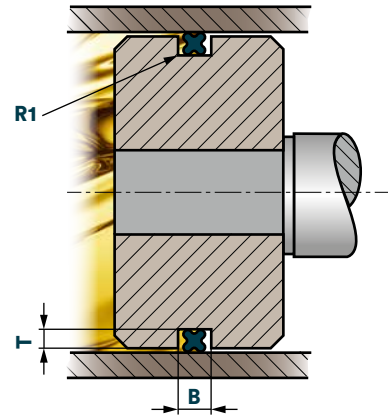


Section d_2 / mm	Depth of groove (E) / mm	Box width (F)	Radius (R) / mm
1,78	1,55	2,30	0,50
2,00	1,80	2,65	0,50
2,60	2,35	3,50	0,50
3,00	2,60	4,00	0,50
3,53	3,05	4,50	0,50
4,00	3,50	5,00	1,00
5,00	4,40	6,50	1,00
5,34	4,70	7,00	1,00
5,70	5,00	7,50	1,00
7,00	6,20	9,50	1,00
8,40	7,50	11,00	1,50

RECOMMENDED HOUSINGS FOR "X-RING" SEALS

"X-Ring" housings

Section / mm	T ±0,05 / mm	B +0,1 / mm	R1 / mm
1,78	1,50	2,00	0,25
2,62	2,35	3,00	0,25
3,53	3,25	4,00	0,50
5,33	4,90	6,00	0,50
6,99	6,50	8,00	0,50



PNEUMATICS. RECTANGULAR HOUSING FOR AXIAL MOVEMENT WITH RADIAL SEALING

To ensure minimum friction and prolong the service life of the O-ring, section deformation must be kept low. The deformation will be between 2 - 6 %, depending on the thickness of the seal.

For pneumatic applications (low pressure) the support rings are not necessary.

RECOMMENDED HOUSINGS FOR O-RINGS BY EXTRUSION AND VULCANIZATION

The use of an extruded o-ring is not recommended because movement can weaken the junction of the ends and break at the vulcanization point.

RECOMMENDED HOUSINGS FOR ENCAPSULATED O-RINGS

There are two reasons for choosing an encapsulated seal: extreme temperature and/or aggressive media. Almost always, the medium will be a pressurized inert gas and this discards the encapsulated gasket in favor of the molded gasket.

RECOMMENDED GASKET HOUSINGS "X-RING"

NOTA: Identical housings to those listed in the table Housings for "X-Ring" ⁶ seals in hydraulic applications

Recommended housings for molded O-rings.

d ₂ / mm	T / mm	B ^{+0,2} / mm
1,50	1,35	1,86
1,78	1,60	2,17
2,00	1,80	2,44
2,40	2,16	2,88
2,50	2,25	2,99
2,62	2,36	3,13
3,00	2,70	3,57
3,50	3,15	4,13
3,53	3,18	4,16
4,00	3,60	4,76
4,50	4,19	5,31
5,00	4,65	5,87
5,33	4,96	6,42
5,50	5,12	6,66
5,70	5,30	6,89
6,00	5,58	7,23
6,50	6,05	7,81
6,99	6,50	8,37
7,00	6,51	8,38
7,50	7,13	8,98
8,00	7,60	9,58
8,50	8,08	10,17
9,00	8,55	10,77
9,50	9,03	11,37
10,00	9,50	11,97

⁶ See page 65

PNEUMATICS. FLOATING DESIGN FOR AXIAL MOVEMENT WITHOUT AXIAL DEFORMATION

Floating mounting is suitable for sealing pistons or plungers so that the seal cross-section is not deformed. The advantage of this design is that the piston can be easily moved with little friction and consequently very little wear.

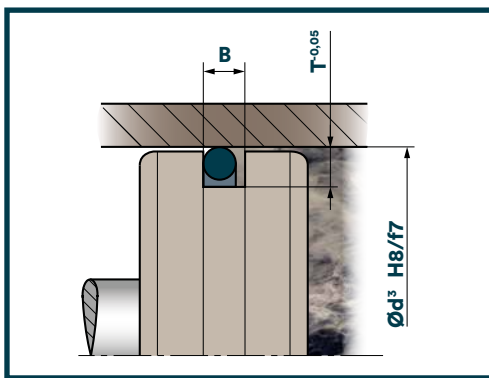
However, at each compression cycle as the pressure in the working cylinder increases, the process gas leaks slightly until the O-ring seals the clearance between the piston and the cylinder wall. For this reason this design is almost obsolete. The evolution of the materials allows us to use a design like the one in the previous section

Pneumatics. Rectangular pocket for axial movement with radial deformation ⁷.

When determining the size of the O-ring, the outer diameter of the O-ring shall be 2 - 5 % larger than the diameter of the cylinder (d_3). In addition, the O-ring must not touch the bottom of its housing.

RECOMMENDED HOUSINGS FOR MOLDED O-RINGS

For housing dimensions, the values given in the Table **Recommended Housings for Molded O-rings ⁸** are recommended.



Rectangular pocket for pneumatics. **Figure 31**

Rectangular housing dimensions

d_2 / mm	$T^{-0,05}$ / mm	B / mm
1,78	1,90	2,00 ± 0,05
2,40	2,55	2,70 ± 0,05
2,62	2,75	2,90 ± 0,05
3,00	3,15	3,40 ± 0,05
3,53	3,70	4,00 ± 0,10
5,33	5,50	6,00 ± 0,10
5,70	5,90	6,40 ± 0,10
6,99	7,20	7,90 ± 0,10

RECOMMENDED HOUSINGS FOR O-RINGS BY EXTRUSION AND VULCANIZATION

The use of an extruded o-ring is not recommended because movement can weaken the union of the ends and break at the vulcanization point.

RECOMMENDED HOUSINGS FOR "X-RING" JOINTS

NOTE: : Identical housings as defined in hydraulic applications ⁹.

⁷ See page 67

⁸ See page 64

⁹ See table "X-Ring" gasket housings on page 67

SURFACE FINISHES

The surface finishes, irrespective of the method of manufacture of the O-ring, for both the housing and the antagonist surface are as follows:

■ Antagonist surface (wall of cylinder or cylinder liner, piston rod or axle)

SURFACE

$$R_a = 0,2 - 0,6 \mu\text{m} \quad (R_{\text{max}} = 0,8 - 3,2 \mu\text{m})$$

■ Housing (back and walls)

HOUSING

$$R_a = 1,0 - 2,5 \mu\text{m} \quad (R_{\text{max}} = 6,0 - 10,0 \mu\text{m})$$

O-RINGS FAILURES

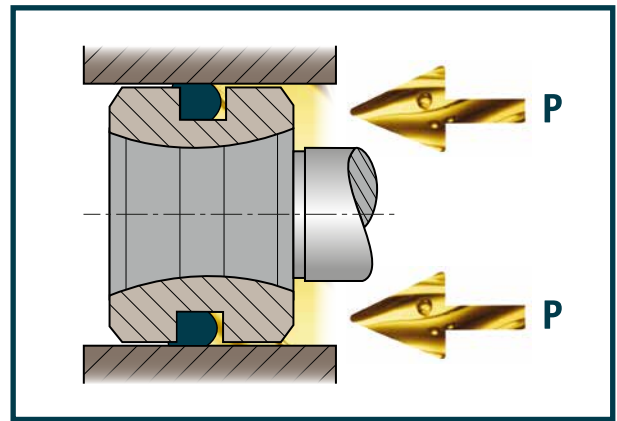
The causes for the leakage of an O-ring can be diverse and may be one of them or a combination of them. The most common problems with O-rings are detailed in this section.

However, in order for an O-ring to have a reasonable service life, it is important to design an adequate housing, correctly choose the elastomer of the O-ring, perform tests to validate it and the necessary User training.

EXTRUSION



Photo courtesy of PPE Precision Polymer Engineering



Extrusion failure of an O-ring with external seal. **Figure 32**

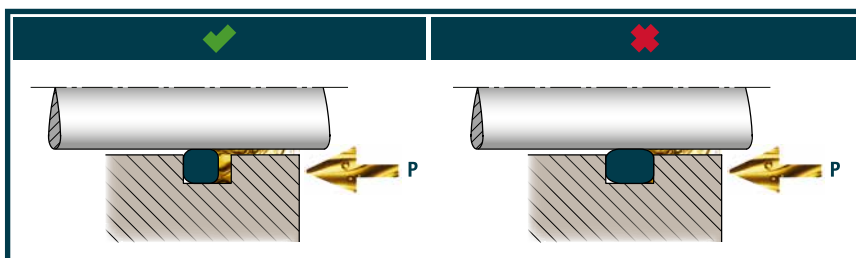
O-ring extrusion is one of the most common reasons for failure in pressurized applications, such as a hydraulic cylinder. And also a swelling of the material can cause similar effects.

In these cases, the gasket is forced to penetrate through the extrusion groove with consequent deterioration.

To avoid this problem, solutions will have to be applied according to the causes detected. Using the support rings presented in the section **Support Rings**¹⁰, reducing the extrusion groove or using elastomers of greater hardness are, among others, solutions to be applied.

RESIDUAL DEFORMATION

While residual deformation is normal and acceptable in very long term applications, failure due to this cause in a short period of time may indicate incorrect housing sizing or excess temperature.



Housing. **Figure 33**

In order for the O-ring to seal properly, it must not deform excessively and must have sufficient space in the housing to be able to adapt to the compressive force.

CONTINUE ...

¹⁰ See page 52

... CONTINUE

If the seal is compressed excessively, the remaining deformation of the elastomer causes a crushing of the O-ring altering its elasticity, as explained in section **Physical Properties**¹¹.

A high temperature (not necessarily excessive) accelerates this type of process, so a higher thermal range compound will better resist this phenomenon.



Photo courtesy of
PPE Precision Polymer Engineering

ABRASION



Photo courtesy of
PPE Precision Polymer Engineering

The O-ring shows a surface that has suffered friction, weight loss and even lacerations and tears. In the case of a hydraulic cylinder, abrasion is the result of repeated rubbing between the O-ring and the antagonist surface.

The reasons are many and can be excessive working pressure, inadequate surface finish, insufficient lubrication, excessive temperature, etc...

Abrasion can be avoided with proper lubrication and a material suitable for the working conditions.

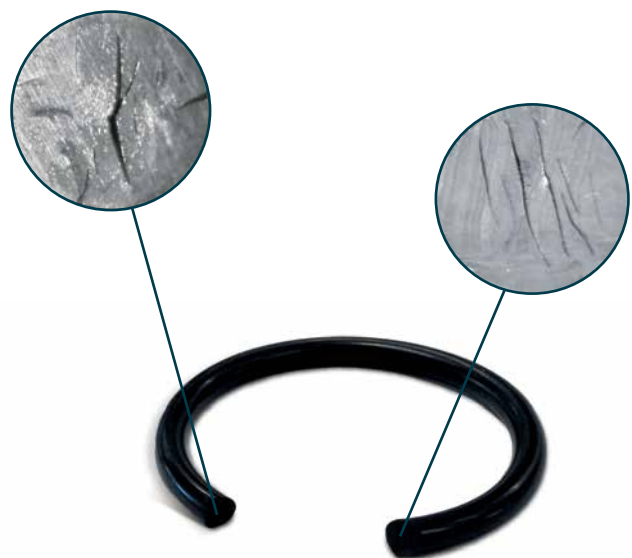
EXPLOSIVE DECOMPRESSION

When an elastomer is exposed to a gas at high pressure and temperature for an extended period of time, the gas diffuses into the polymer.

As the pressure suddenly decreases, the micro gas bubbles increase in volume and the gas expands. If the elastomer cannot contain the gas bubbles, then internal fissures form which damage the O-ring.

To reduce the risk of explosive decompression damage, increase the compression time and reduce the temperature, while choosing a material resistant to explosive decompression according to international standards **NACE TM0187, TOTAL GS EP PVV 142 Appen- says 8, Norsok M710 Annex B and ISO 23936-2. Annex B.**

Reduced O-ring sections suffer less from this effect.



¹¹ See page 21

SPIRAL CUTS

The seal shows repeated and spiral cuts, the result of a torsion that generates high stress and is visible in the cuts.

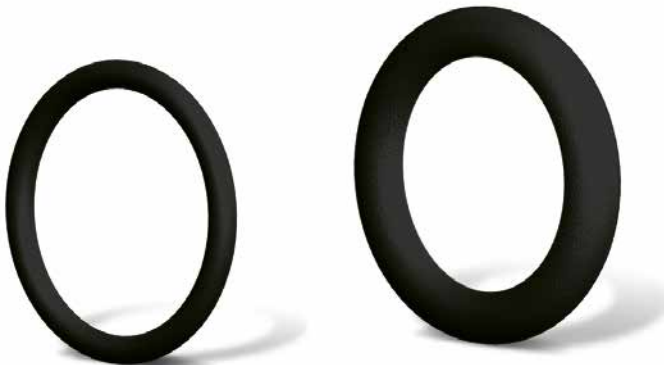
The cuts are generally produced by the alternative movement of the piston-stem assembly, with a certain eccentricity, which creates a different stress in various areas of the joint. Influential factors are surface finishes, improper lubrication and installation errors.

The solution may be to increase the hardness of the elastomer even though the replacement of the O-ring with an **X-Ring**, can also be considered, as described in section **Encapsulated Seals**¹².



Photo courtesy of PPE Precision Polymer Engineering

SWELLING



BEFORE the exhibition

AFTER the exhibition

This problem arises when a liquid diffuses into the elastomer and is sipped into it.

Liquid molecules occupy spaces between elastomer chains, increasing their separation, and with this, the material suffers a visible increase in volume, its appearance becomes porous and loses hardness being softer and deformable, among other consequences.

NOTA: For more information see section **Chemical Compatibility Chart**¹³.

CHEMICAL ATTACK

Chemical attack occurs when the elastomer or some of its components (e.g., the plasticizer used) react chemically with the fluid in contact.

In this case, unlike simple swelling, the O-Ring is unrecoverable and may even disappear from its housing.



Photo courtesy of PPE Precision Polymer Engineering

¹² See page 42

¹³ See page 26

USE OF CHEMICAL RESISTANCE CHARTS

Annex III ¹⁴ is a table of chemical resistance of the most common elastomers according to the temperature of the test and the chemical agent.

Depending on how the elastomer of interest behaves in contact with a given fluid, the resistance of the elastomer can be classified as:

RESISTENCE

- 1 Excellent
- 2 Good result
- 3 Moderate Attack
- 4 Not
- “ - ” No data

The information provided by the tables is strictly qualitative and for guidance only. Limitations of chemical resistance tables:

LIMITATIONS

- in most cases, the tables do not reproduce the actual working conditions.
- the tests refer to chemically pure fluids, not mixtures.
- no extrapolation should be made from the results of the tests submitted

In case of doubt, it is recommended to test specimens with the working fluid and to assess the degradation of the elastomer if it occurs.

When in doubt, it is recommended to test specimens with the working fluid and to assess the degradation of the elastomer if it occurs.

¹⁴ See page 83

COMPLEMENTS

O-RING BOXES



Various kinds of boxes containing the O-rings are marketed in the most common sizes and in different materials.

Two of them (H and G) are the most popular.

TYPE H O-RING BOX

It contains 28 different measures in sections of 2 / 2.5 / 3 and 4 mm with a total of 404 units. The available materials are 70 NBR; 80 FPM and 70 VMQ.

Units	$d_1 \times d_2$
18	3 x 2
18	4 x 2
18	5 x 2
18	6 x 2
17	7 x 2
17	8 x 2
17	10 x 2
14	10 x 2,5
14	11 x 2,5
14	12 x 2,5
14	16 x 2,5
14	17 x 2,5
14	19 x 2,5
12	19 x 3
12	38 x 3
9	38 x 4
9	42 x 4
9	45 x 4
12	36 x 3
12	33 x 3
12	32 x 3
12	30 x 3
12	20 x 3
12	22 x 3
12	24 x 3
12	25 x 3
12	27 x 3
12	28 x 3

TYPE G O-RING BOX

Contains 30 different sizes in sections of 1.78 / 2.62 / 3.53 and 5.33 mm, with a total of 382 units. Available materials are 70 NBR; 90 NBR; 80 FPM and 70 VMQ.

Units	$d_1 \times d_2$
20	2,90 x 1,78
20	3,68 x 1,78
20	4,48 x 1,78
20	5,28 x 1,78
20	6,07 x 1,78
20	7,66 x 1,78
20	9,25 x 1,78
13	13,95 x 2,62
13	12,37 x 2,62
13	10,78 x 2,62
13	9,19 x 2,62
13	15,54 x 2,62
13	17,13 x 2,62
13	18,72 x 2,62
10	18,64 x 3,53
10	37,69 x 3,53
7	37,47 x 5,33
7	40,65 x 5,33
7	43,82 x 5,33
10	36,10 x 3,53
10	34,52 x 3,53
10	32,92 x 3,53
10	31,34 x 3,53
10	29,75 x 3,53
10	20,22 x 3,53
10	21,82 x 3,53
10	23,40 x 3,53
10	24,99 x 3,53
10	26,58 x 3,53
10	28,17 x 3,53

MEASUREMENT OF AN O-RING

In many occasions the size and section of the O-ring of interest must be verified before proceeding with its assembly. Such a simple task is immediately complicated by the elasticity of the O-ring.

MEASURING TAPE



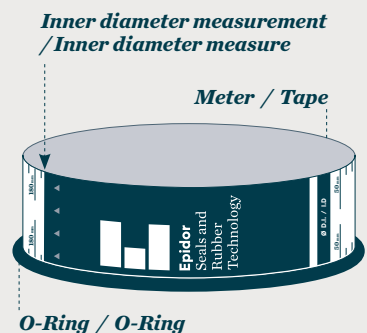
There is an economic option, although not very precise, which is the tape measure for O-rings that establishes thicknesses or sections up to 10 mm (d_2) and inside diameters of up to 365 mm (d_1).

The section is obtained by comparison with the disks indicated on the back of the tape.

To measure the inside diameter, the O-ring must be arranged on a flat surface and follow the steps below:

STEPS TO FOLLOW

- 1 Choose the side of the tape with the metric scale.
- 2 Insert the meter into the inside perimeter of the O-ring.
- 3 Wrap the meter around itself in such a way that the arrows indicate the inside diameter.



The O-ring Tape provides an approximate reading of the actual measurement, but sufficiently valid for guidance.

For more precise measurements are available:

CALIBRATED CONES

The calibrated metal cones enables O-ring seals from 1 to 125 mm inside diameter (d_1) to be measured with great precision.

The O-ring is inserted into the measuring cone and read on the graduated scale of a cone generator. There are measuring cones with differences in diameters (d_1) of only 0.1 mm.

The ease and speed of measurement, even of used/worn seals, make this support an extremely useful instrument.

To measure the thickness (d_2) of the O-ring more accurately, it is recommended to use the Constant Compression Gauge.



LOW FORCE CALIPER

The joint thickness measurement (d_2) can be obtained with a calibre or caliper specific for rubbers.

Its peculiarity lies in the fact that the device adjusts the compression force (0.5 - 1.0 N) when the pointer marks 12:00 h, thus guaranteeing the repeatability of the measurement.



O-RING GAUGE



ORservice

The o-ring meter, together with its APP developed for Android devices, allows to measure o-rings of any diameter offering a fork of superior and inferior measurements for the o-ring of interest.



EXTRACTION TOOLS FOR O-RINGS



It is sometimes difficult to remove the seal, especially if it has suffered from chemical attack and has adhered to its housing. In order to facilitate its replacement, extraction tools such as those shown in the following image can be used.

The most common are extractors with angled tips and different orientations:



RECEPTION AND STORAGE



BASICS

Some of the aspects listed below may seem trivial, but their effects may be due to real component failures. Minimal damage to the O-ring can cause premature equipment failure.

BASICS

- Keep an eye on the packaging.
- Keep the gaskets in their original packaging until they are assembled.
- Protect gaskets from dust and dirt.
- Do not allow gaskets to come into contact with sharp-edged objects such as metal shavings, sharp edges on mounting tools, chamfers and housings.

O-RING STORAGE AND SERVICE LIFE

Regulations on the conditions and storage time of elastomers:

DIN 9088 ARP 5316 DIN 7716 UNE 53 607/82

■ Environmental factors

AMBIENT

- Ambient humidity (< 65 %)
- Sunlight
- Avoid sudden temperature changes
- UVA Radiation

■ Storage

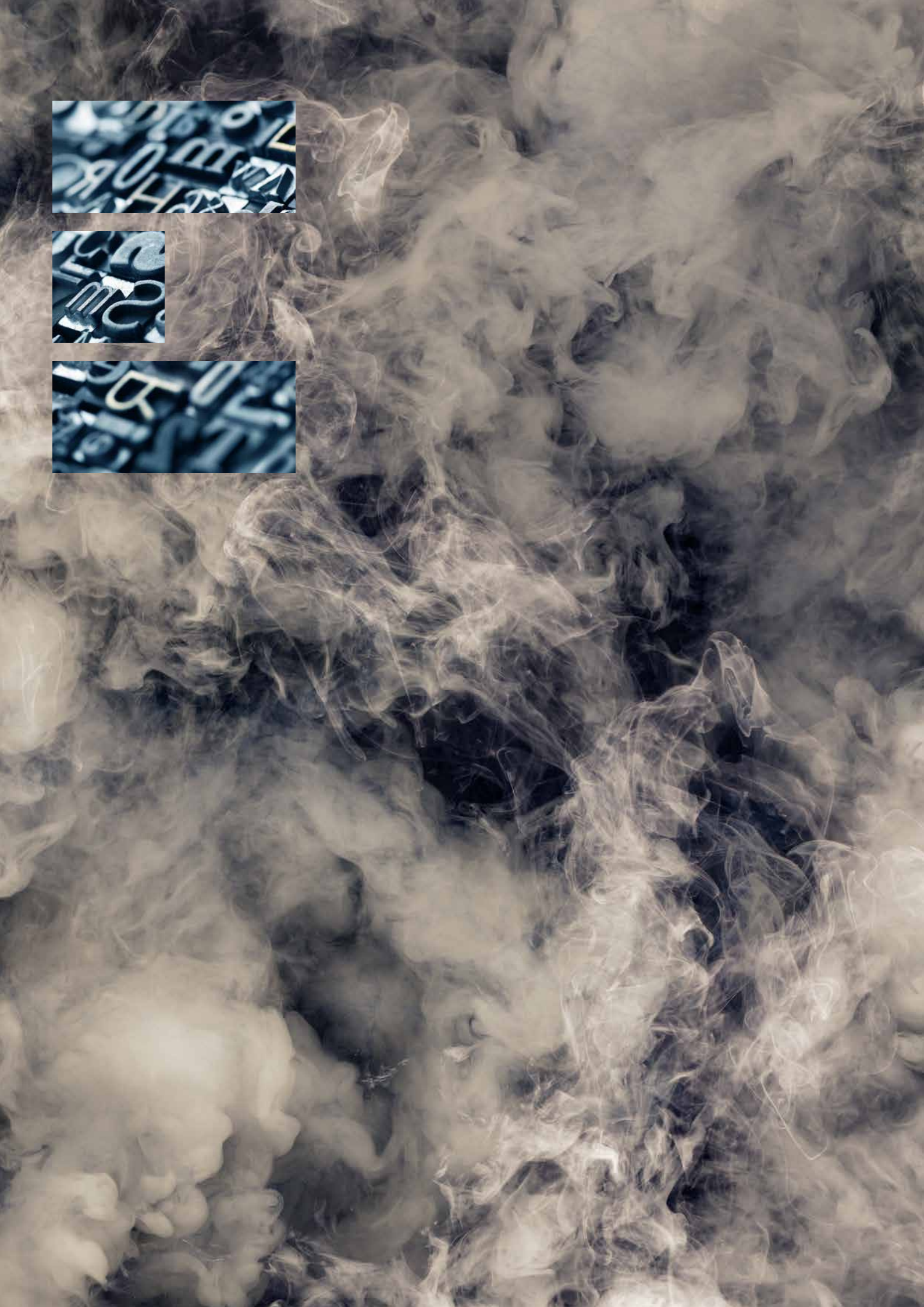
STORAGE

- Protected material (packaging)
- Avoid deformations (overweight)

The service life of an O-ring is linked to **DIN 9088**. Generically speaking, the maximum storage time of elastomer gaskets are:

- a) NBR, H-NBR and EPDM **10 years**.
- b) FPM, VMQ and FVMQ **15 years**.
- c) PFA y FEP **unlimited**.

NOTE: Regardless of storage conditions and product expiration dates, it is essential that the material has good elasticity and is not cracked.



ANNEX I

NOMENCLATOR OF MATERIALS FOR THE MOST FREQUENT O-RINGS

Description	Abbreviation	Trade names
Chloroprene Rubber	CR	Neoprene
Ethylene / propylene rubber	EPM	Epcar B / Vistalon
Fluor Vinyl Rubber Methyl Silicone	FVMQ	Snow White
Fluorocarbon Rubber	FPM	Viton
Perfluorocarbon Rubber	FFPM	Kalrez / Perlast / Chemraz / Simriz
Polysulphide Rubber	T	Thiokol
Methyl Silicone Vinyl Rubber	VMQ	Siloprene
Natural Rubber or Natural Polysoprene	NR	-
Polyvinyl chloride	PVC	-
Copolymer acrylate / chlorovinyl ether	ACM	Hycar / Nipolar
Acrylonitrile / butadiene copolymer	NBR	Buna-N / Perbunan
Copolymer of epichlorohydrin / ethylene oxide	ECO	Hydrin / Herclor
Styrene / butadiene copolymer	SBR	Solprene / Europrene
Ethylene / acrylate copolymer	AEM	Vamac
Isobutylene / isoprene copolymer	IIR	Exxon Butyl / Esso Butyl
Copolymer of tetrafluoroethylene and propylene	FEPM	Aflas
Hydrogenated acrylonitrile / butadiene copolymer	H-NBR	Therban / Tornac / Zetpol
Polyaryl etherketone	PEEK	Victrex / KetaSpire
Polycarbonate	PC	-
Polychlorethylene	CM	-
Polyurethane	AU	Simritan / Novathan / Hytane
Polystyrene	PS	-
Polyether urethane	EU	Elastothane / Vulkollan
Polyethylene	PE	-
Chlorosulphonated polyethylene	CSM	Hypalon
Ultra high molecular weight polyethylene	UHMW-PE	-
Synthetic polyisoprene	IR	Natfyn
Polyethylene oxide	POM	Delrin / Celcon
Polypropylene	PP	-
Polysiloxane (silicone)	SI	-
Polyamide resin	PA	Nylon
Polyimide resin	PI	Meldin / Vespel
Polytetrafluoroethylene resin	PTFE	Teflon / Rulon
Polytetrafluoroethylene / hexafluoropropylene resin	FEP	Teflon-FEP / Neoflon-FEP
Polytetrafluoroethylene / perfluoro resin (alcoxiviny-ether)	PFA	Teflon-PFA / Neoflon-PFA
Polyethylene Terephthalate	PET	-
Ethylene / propylene / diene terpolymer	EPDM	Nordel / Epcar

ANNEX II

ISO80 TOLERANCE TABLE

For nominal dimensions up to 500 mm

Nominal dimensions (mm)	OUTSIDE dimensions (Shafts)														
	z6	u6	u8	s6	r6	p6	n6	k6	j6	h6	h8	h9	h11	g6	f7
> 1,6 - 3	+35	+25	+36	+22	+19	+16	+13	+6	+4	0	0	0	0	-2	-6
	+28	+18	+22	+15	+12	+9	+6	0	-2	-7	-14	-25	-60	-8	-16
> 3 - 6	+43	+31	+46	+27	+23	+20	+16	+9	+6	0	0	0	0	-4	-10
	+35	+23	+28	+19	+15	+12	+8	+1	-2	-8	-18	-30	-75	-12	-22
> 6 - 10	+51	+37	+56	+32	+28	+24	+19	+10	+7	+0	0	0	0	-5	-13
	+42	+28	+34	+23	+19	+15	+10	+1	-2	-9	-22	-36	-90	-14	-28
> 10 - 14	+61		+67												
	+50	+44	+40	+39	+34	+29	+23	+12	+8	0	0	0	0	-6	-16
> 14 - 18	+71	+33	+72	+28	+23	+18	+12	+1	-3	-11	-27	-43	-110	-17	-34
	+60		+45												
> 18 - 24	+86	+54	+87												
	+73	+41	+54	+48	+41	+35	+28	+15	+9	0	0	0	0	-7	-20
> 24 - 30	+101	+61	+81	+35	+28	+22	+15	+2	-4	-13	-33	-52	-130	-20	-41
	+88	+48	+48												
> 30 - 40	+128	+76	+99												
	+112	+60	+60	+59	+50	+42	+33	+18	+11	0	0	0	0	-9	-25
> 40 - 50		+86	+109	+43	+34	+26	+17	+2	-5	-16	-39	-62	-160	-25	-50
		+70	+70												
> 50 - 65		+106	+133	+72	+60										
		+87	+87	+53	+41	+51	+39	+21	+12	0	0	0	0	-10	-30
> 65 - 80		+121	+148	+78	+62	+32	+20	+2	-7	-19	-46	-74	-190	-29	-60
		+102	+102	+59	+43										
> 80 - 100		+146	+178	+93	+73										
		+124	+124	+71	+51	+59	+45	+25	+13	0	0	0	0	-12	-36
> 100 - 120		+166	+198	+101	+76	+37	+23	+3	-9	-22	-54	-87	-220	-34	-71
		+144	+144	+79	+54										
> 120 - 140		+195	+233	+117	+88										
		+170	+170	+92	+63										
> 140 - 160		+215	+253	+125	+90	+68	+52	+28	+14	0	0	0	0	-14	-43
		+190	+190	+100	+65	+43	+27	+3	-11	-25	-63	-100	-250	-39	-83
> 160 - 180		+235	+273	+133	+93										
		+210	+210	+108	+68										
> 180 - 200		+265	+308	+151	+106										
		+236	+236	+122	+77										
> 200 - 225		+287	+330	+159	+109	+79	+60	+33	+16	0	0	0	0	-15	-50
		+258	+258	+130	+80	+50	+31	+4	-13	-29	-72	-115	-290	-44	-96
> 225 - 250		+313	+356	+169	+113										
		+284	+284	+140	+84										
> 250 - 280		+347	+396	+190	+126										
		+315	+315	+158	+94	+88	+66	+36	+16	0	0	0	0	-17	-56
> 280 - 315		+382	+431	+202	+130	+56	+34	+4	-16	-32	-81	-130	-320	-49	-108
		+350	+350	+170	+98										
> 315 - 355		+426	+479	+226	+144										
		+390	+390	+190	+108	+98	+73	+40	+18	0	0	0	0	-18	-62
> 355 - 400		+471	+524	+244	+150	+62	+37	+4	-18	-36	-89	-140	-360	-54	-119
		+435	+435	+208	+114										
> 400 - 450		+530	+587	+272	+166										
		+490	+490	+232	+126	+108	+80	+45	+20	0	0	0	0	-20	-68
> 450 - 500		+580	+637	+292	+172	+68	+40	+5	-20	-40	-97	-155	-400	-60	-131
		+540	+540	+252	+132										

Tolerances in $\mu\text{m} = (1 / 1000 \text{ mm})$

OUTSIDE dimensions					INTERNAL dimensions (Holes)										Nominal dimensions (mm)
f8	e8	e9	d9	d10	H7	H8	H9	H10	H11	F8	E9	D10	D11	C11	
-6	-14	-14	-20	-20	+9	+14	+25	+40	+60	+20	+39	+60	+80	+120	> 1,6 - 3
-20	-28	-39	-45	-60	0	0	0	0	0	+6	+14	+20	+20	+60	
-10	-20	-20	-30	-30	+12	+18	+30	+48	+75	+28	+50	+78	+105	+145	> 3 - 6
-28	-38	-50	-60	-78	0	0	0	0	0	+10	+20	+30	+30	+70	
-13	-25	-25	-40	-40	+15	+22	+36	+58	+90	+35	+61	+98	+130	+170	> 6 - 10
-35	-47	-61	-76	-98	0	0	0	0	0	+13	+25	+40	+40	+80	
-16	-32	-32	-50	-50	+18	+27	+43	+70	+110	+43	+75	+120	+160	+205	> 10 - 14
-43	-59	-75	-93	-120	0	0	0	0	0	+16	+32	+50	+50	+95	> 14 - 18
-20	-40	-40	-65	-65	+21	+33	+52	+84	+130	+53	+92	+149	+195	+240	> 18 - 24
-53	-73	-92	-117	-149	0	0	0	0	0	+20	+40	+65	+65	+100	> 24 - 30
-25	-50	-50	-80	-80	+25	+39	+62	+100	+160	+64	+112	+180	+240	+280	> 30 - 40
-64	-89	-112	-142	-180	0	0	0	0	0	+25	+50	+80	+80	+120	> 40 - 50
-30	-60	-60	-100	-100	+30	+46	+74	+120	+190	+76	+134	+220	+290	+330	> 50 - 65
-76	-106	-134	-174	-220	0	0	0	0	0	+30	+60	+100	+100	+140	> 65 - 80
-36	-72	-72	-120	-120	+35	+54	+87	+140	+220	+90	+159	+260	+340	+390	> 80 - 100
-90	-126	-159	-207	-260	0	0	0	0	0	+36	+72	+120	+120	+170	> 100 - 120
-43	-85	-85	-145	-145	+40	+63	+100	+160	+250	+106	+185	+305	+395	+460	> 120 - 140
-106	-148	-185	-245	-305	0	0	0	0	0	+43	+85	+145	+145	+210	> 140 - 160
-50	-100	-100	-170	-170	+46	+72	+115	+185	+290	+122	+215	+335	+460	+550	> 160 - 180
-122	-172	-215	-285	-355	0	0	0	0	0	+50	+100	+170	+170	+260	> 180 - 200
-56	-110	-110	-190	-190	+52	+81	+130	+210	+320	+137	+240	+400	+510	+620	> 200 - 225
-137	-191	-240	-320	-400	0	0	0	0	0	+56	+110	+190	+190	+280	> 225 - 250
-62	-125	-125	-210	-210	+57	+89	+140	+230	+360	+151	+265	+440	+570	+650	> 250 - 280
-151	-214	-265	-350	-440	0	0	0	0	0	+62	+125	+210	+210	+300	> 280 - 315
-68	-135	-135	-230	-230	+63	+97	+155	+250	+400	+165	+290	+480	+630	+720	> 315 - 355
-165	-232	-290	-385	-480	0	0	0	0	0	+68	+135	+230	+230	+360	> 355 - 400
														+760	> 400 - 450
														+840	> 450 - 500
														+880	
														+480	

... ISO80 TOLERANCE TABLE

For nominal dimensions from 500 mm to 3,150 mm

Nominal dimensions (mm)	OUTSIDE dimensions (Axles)																	
	d10	e8	e9	f8	f9	g6	g7	h6	h7	h8	h9	h10	h11	h12	h13	h14	h15	h16
>500 - 630	-260	-145	-145	-76	-76	-22	-22	0	0	0	0	0	0	0	0	0	0	0
	-540	-255	-320	-186	-251	-66	-92	-44	-70	-110	-175	-280	-440	-700	-1100	-1750	-2800	-4400
>630 - 800	-290	-160	-160	-80	-80	-24	-24	0	0	0	0	0	0	0	0	0	0	0
	-610	-285	-360	-205	-280	-74	-104	-50	-80	-125	-200	-320	-500	-800	-1250	-2000	-3200	-5000
>800 - 1000	-320	-170	-170	-86	-86	-26	-26	0	0	0	0	0	0	0	0	0	0	0
	-680	-310	-400	-226	-316	-82	-116	-56	-90	-140	-230	-360	-560	-900	-1400	-2300	-3600	-5600
>1000 - 1250	-350	-195	-195	-98	-98	-28	-28	0	0	0	0	0	0	0	0	0	0	0
	-770	-360	-455	-263	-358	-94	-133	-66	-105	-165	-260	-420	-660	-1050	-1650	-2600	-4200	-6600
>1250 - 1600	-390	-220	-220	-110	-11	-30	-30	0	0	0	0	0	0	0	0	0	0	0
	-890	-415	-530	-305	-420	-108	-155	-78	-125	-195	-310	-500	-780	-1250	-1950	-3100	-5000	-7800
>1600 - 2000	-430	-240	-240	-120	-120	-32	-32	0	0	0	0	0	0	0	0	0	0	0
	-1030	-470	-610	-350	-490	-124	-182	-92	-150	-230	-370	-600	-920	-1500	-2300	-3700	-6000	-9200
>2000 - 2500	-480	-260	-260	-130	-130	-34	-34	0	0	0	0	0	0	0	0	0	0	0
	-1180	-540	-700	-410	-570	-144	-209	-110	-175	-280	-440	-700	-1100	-1750	-2800	-4400	-7000	-11000
>2500 - 3150	-520	-290	-290	-145	-145	-38	-38	0	0	0	0	0	0	0	0	0	0	0
	-1380	-620	-830	-475	-685	-173	-248	-135	-210	-330	-540	-860	-1350	-2100	-3300	-5400	-8600	-13500

Nominal dimensions (mm)	INTERNAL dimensions (Holes)																	
	D10	E8	E9	F8	F9	G6	G7	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16
>500 - 630	+540	+255	+320	+186	+251	+66	+92	+44	+70	+110	+175	+280	+440	+700	+1100	+1750	+2800	+4400
	+260	+145	+145	+76	+76	+22	+22	0	0	0	0	0	0	0	0	0	0	0
>630 - 800	+610	+285	+360	+205	+280	+74	+104	+50	+80	+125	+200	+320	+500	+800	+1250	+2000	+3200	+5000
	+290	+160	+160	+80	+80	+24	+24	0	0	0	0	0	0	0	0	0	0	0
>800 - 1000	+680	+310	+400	+226	+316	+82	+116	+56	+90	+140	+230	+360	+560	+900	+1400	+2300	+3600	+5600
	+320	+170	+170	+86	+86	+26	+26	0	0	0	0	0	0	0	0	0	0	0
>1000 - 1250	+770	+360	+455	+263	+358	+94	+133	+66	+105	+165	+260	+420	+660	+1050	+1650	+2600	+4200	+6600
	+350	+195	+195	+98	+98	+28	+28	0	0	0	0	0	0	0	0	0	0	0
>1250 - 1600	+890	+415	+530	+305	+420	+108	+155	+78	+125	+195	+310	+500	+780	+1250	+1950	+3100	+5000	+7800
	+390	+220	+220	+110	+110	+30	+30	0	0	0	0	0	0	0	0	0	0	0
>1600 - 2000	+1030	+470	+610	+350	+490	+124	+182	+92	+150	+230	+370	+600	+920	+1500	+2300	+3700	+6000	+9200
	+430	+240	+240	+120	+120	+32	+32	0	0	0	0	0	0	0	0	0	0	0
>2000 - 2500	+1180	+540	+700	+410	+570	+144	+209	+110	+175	+280	+440	+700	+1100	+1750	+2800	+4400	+7000	+11000
	+480	+260	+260	+130	+130	+34	+34	0	0	0	0	0	0	0	0	0	0	0
>2500 - 3150	+1380	+620	+830	+475	+685	+173	+248	+135	+210	+330	+540	+860	+1350	+2100	+3300	+5400	+8600	+13500
	+520	+290	+290	+145	+145	+38	+38	0	0	0	0	0	0	0	0	0	0	0

Tolerances in µm = (1 / 1000 mm)

ANNEX III

CHEMICAL RESISTANCE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
2-Ethylacrylic acid		1	-	-	-	4	2	4	4	2	4
2-Ethylbutyl acetate		1	-	4	-	-	-	4	-	-	4
2-Ethylhexyl acetate		1	-	4	-	-	-	4	-	-	4
2-methylamyl alcohol		1	-	4	-	-	-	1	-	-	1
2-methyl amyl acetate	20	1	-	4	-	-	-	1	-	-	-
Acetaldehyde	20	1	-	4	3	4	2	3	2	3	3
Acetamide	60	1	-	3	2	1	1	1	1	2	4
Acetic acid (hot @ high pressure)	100	1	3	2	3	4	3	4	3	4	4
Acetic anhydride	80	1	2	4	4	4	2	4	2	2	4
Acetone cyanohydrin	80	1	-	4	-	-	4	4	-	2	3
Acetonitrile (methyl cyanide)	80	1	1	1	2	1	1	2	-	1	-
Acetophenone	80	1	4	4	4	4	1	4	4	4	4
Acetyl acetone	80	1	4	4	4	4	1	4	4	4	4
Acetyl chloride	40	1	1	1	4	2	4	4	3	4	4
Acetylene	80	1	1	1	1	1	1	1	2	2	2
Acetylsalicylic acid (aspirin)	80	1	-	-	-	-	4	2	-	1	-
Acrylic aldehyde (acrolein)	40	1	1	1	-	4	1	2	4	2	3
Adipic acid	80	1	2	1	1	1	2	1	1	1	1
Aerocina 50		-	-	4	-	4	1	3	4	4	-
AEROSHELL 750 Oil		-	-	1	-	1	4	3	4	4	-
Aketone	40	1	4	4	4	4	1	4	4	3	3
Allyl alcohol	80	1	1	2	-	1	2	1	1	2	1
Allyl bromide	60	1	-	2	-	-	-	4	-	4	4
Allyl chloride	40	1	-	2	1	-	2	2	-	2	4
Alumbre	100	1	1	1	1	1	1	1	1	1	1
Aluminium acetate	80	1	1	3	2	4	1	2	4	2	3
Aluminium and potassium sulphate	60	1	1	1	-	4	1	1	1	1	1
Aluminium bromide	80	1	1	1	1	1	1	1	1	1	1
Aluminium chloride	80	1	1	1	1	1	1	1	2	1	1
Aluminium fluoride	60	1	1	1	1	1	1	1	2	1	1
Aluminium hydroxide	20	1	1	2	-	-	2	2	-	1	2
Aluminium nitrate	60	1	1	1	1	1	1	1	2	1	1
Aluminium phosphate	60	1	1	1	1	1	1	1	1	1	1
Aluminium sulphate	100	1	1	1	1	1	1	1	1	1	2
Amines	80	1	2	4	3	4	2	4	2	2	2
Ammonia gas, cold	20	1	1	4	1	4	1	1	1	1	1
Ammonia gas, hot	80	1	2	4	4	4	2	4	1	2	4
Ammonia salt		1	1	1	1	2	1	1	3	1	1
Ammonium acetate	80	1	1	1	-	-	1	1	-	2	1
Ammonium chloride	60	1	1	1	1	2	1	1	3	1	1
Ammonium fluoride	20	1	1	1	-	-	1	1	-	2	1
Ammonium nitrate		1	1	2	1	3	1	1	3	1	1
Ammonium nitrite		1	1	3	1	3	1	1	2	1	1
Ammonium persulphate		1	1	3	4	4	1	4	1	1	4
Ammonium phosphate		1	-	4	1	4	1	1	1	1	1
Ammonium sulphate		1	1	4	1	4	1	1	1	1	2
Ammonium sulphide		1	1	4	3	4	1	3	1	1	2
Ammonium thiocyanate		1	1	1	-	-	1	1	-	1	1
Ammonium thiosulphate		1	1	1	-	-	1	1	-	1	-
Amyl (pentyl) alcohol	80	1	1	2	2	1	1	2	4	2	2
Amyl acetate	20	1	3	4	4	4	1	4	4	4	4
Amyl borate	80	1	1	1	1	-	4	1	-	2	2
Amyl chloride (chloropentane)	80	1	1	1	2	2	4	3	4	4	4
Amyl chloronaphthalene	80	1	2	1	4	2	4	4	4	4	4
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Amyl naphthalene	80	1	2	1	4	2	4	4	4	4	4
Amylamine (Pentylamine)	80	1	-	-	-	-	-	2	-	-	2
Amylamine (Pentylamine)	60	1	-	-	-	-	-	2	-	-	2
Anderol, L-774 (on a di-ester basis)		-	-	1	-	3	4	3	4	4	-
Anderol, L-826 (on a di-ester basis)		-	-	1	-	3	4	3	4	4	-
Anderol, L-829 (on a di-ester basis)		-	-	1	-	3	4	3	4	4	-
Anhydrous ammonia	40	1	2	4	2	4	1	2	2	1	4
Aniline	100	1	1	3	4	3	2	4	4	4	4
Aniline dyes		1	1	2	4	2	2	4	3	2	2
Aniline hydrochloride		1	1	2	2	2	3	3	3	4	4
Aniline oil		1	2	3	4	3	2	4	4	4	4
Anisole (methyl phenyl ether)	80	1	-	3	-	-	-	4	-	4	4
Anthraquinone		1	-	-	-	-	1	2	-	-	1
Antifreeze	60	1	1	1	2	1	1	2	1	1	1
Antifreeze PRESTONE		-	-	1	-	1	1	1	1	1	-
Aqua regia (HNO ₃ (c): HCl(c) / 1:3)	80	1	3	2	4	3	3	4	4	4	4
Argon		1	1	1	2	2	1	3	2	4	4
Arsenic Acid	80	1	1	1	1	1	1	2	1	1	1
Arsenium trichloride	80	1	-	4	2	-	3	2	-	1	4
Asphalt	80	1	-	1	-	2	4	2	4	2	4
Askarel	80	1	1	1	2	2	4	2	4	4	4
ASTM fuel A (without aromatics)	80	1	3	1	1	1	4	1	4	2	4
ASTM fuel B (30 % aromatic)	80	1	4	1	1	1	4	1	4	4	4
ASTM fuel C (50 % aromatic)	80	1	4	1	2	2	4	2	4	4	4
ASTM fuel D	80	1	4	1	2	1	4	1	4	4	4
ASTM Oil No. 1	80	1	1	1	1	1	4	1	1	1	4
ASTM Oil No. 2	80	1	2	1	1	1	4	1	4	3	4
ASTM Oil No. 3	80	1	3	1	1	1	4	1	3	4	4
ASTM Oil No. 4	80	1	2	1	2	2	4	2	4	4	4
Asymmetric dimethylhydrazine (UDMH)	20	2	3	4	2	4	1	2	4	2	2
ATL-857		-	-	1	-	3	4	3	4	4	-
AUREX 903 R (MOBILE)		-	-	1	-	4	4	1	4	3	-
BARDOL B		-	-	1	-	3	4	4	4	4	-
Barium carbonate	20	1	1	1	1	-	1	1	-	1	1
Barium chloride	60	1	1	1	1	1	1	1	1	1	1
Barium hydroxide	60	1	1	1	1	1	1	1	1	1	1
Barium sulphate	20	1	1	1	1	1	1	1	1	1	1
Barium sulphide		1	1	1	1	1	1	1	1	1	1
BAYOL D		-	-	1	-	1	4	1	4	3	-
Beaver oil		1	1	1	1	1	2	1	1	1	2
Beer	20	-	-	1	-	-	1	1	1	1	-
Benzaldehyde	60	2	2	4	4	4	1	4	4	4	4
Benzene	60	1	3	1	4	1	4	4	4	4	4
Benzenesulfonic acid (10 %)	60	2	-	1	4	2	4	4	4	2	4
Benzoic acid		1	1	1	4	2	4	4	4	4	4
Benzol	80	1	3	1	4	1	4	4	4	4	4
Benzophenone	80	1	1	1	4	1	2	4	2	4	4
Benzoyl chloride	80	1	1	1	4	2	4	4	4	4	4
Benzyl alcohol	40	1	1	1	4	2	2	4	1	2	4
Benzyl benzoate	60	1	2	1	4	1	2	4	4	4	4
Benzyl chloride (chlorotoluene)	20	1	1	1	4	2	4	4	4	4	4
Benzyl chloride	40	1	1	1	4	2	4	4	4	4	4
Benzylidene chloride	60	1	1	1	-	2	4	4	4	4	4
Biphenyl (phenylbenzene)	40	1	2	1	4	2	4	4	4	4	4
Black liquor (Kraft paste)	40	1	1	1	-	2	2	2	2	2	2
Blast furnace gas		1	1	1	4	2	4	4	1	4	4
Bleach Licor	60	1	1	1	2	2	1	3	2	3	4
Bleach solution	80	1	2	2	2	2	1	2	2	2	2
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

NOTE: The information shown in the tables should only be used as a reference guide. The tests have been carried out in the laboratory and do not have to reproduce real field conditions. It is the responsibility of the User to check the chemical compatibility of the process fluid with the elastomer of interest. For further information, please contact our Technical Dept

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Borax (sodium borate)	60	1	1	1	1	2	1	2	2	4	2
Bordeaux mixture (copper sulphate / lime slurry)		1	1	1	-	2	1	2	1	2	2
Boric acid	60	1	1	1	1	1	1	1	1	1	1
Brake fluid (glycol based)	80	1	1	4	3	4	1	3	3	2	1
Brake fluid (mineral oil based)		1	1	1	1	1	4	1	3	2	4
Brake fluid (silicone oil based)		1	1	4	3	4	1	3	3	2	1
Brake fluid (w/o petroleum)		-	-	4	-	4	1	3	3	3	-
Brake fluid ATE	100	-	-	4	4	1	1	4	1	3	-
Brake fluid ATE BLAU	80	-	-	-	-	1	1	4	1	3	-
Brake fluid DELCO		-	-	4	-	4	1	3	3	3	-
Brake fluid GIRLING		-	-	4	-	4	1	-	-	3	-
Brake fluid MOPAR		-	-	4	-	1	1	3	3	3	-
Brake fluid WAGNER 21B		-	-	4	-	4	1	3	3	3	-
BRAY GG-130		-	-	1	-	3	4	3	4	4	-
BRAYCO 719-R (W-H-910)		-	-	1	-	3	1	3	3	3	-
BRAYCO 910		-	-	4	-	4	1	3	4	3	-
BRET 710		-	-	4	-	4	1	3	4	3	-
Brine		1	1	1	1	1	2	1	1	2	1
Brine	80	1	1	1	1	1	1	1	1	2	1
Bromhydric acid	80	1	1	1	4	3	1	4	4	3	4
Bromine (vapors from)	20	1	1	1	4	2	4	4	4	4	4
Brominebenzene	20	1	4	1	4	2	4	4	4	4	4
Bromochlor trifluoroethane (halothane)	20	1	1	1	4	2	4	4	4	4	4
Bromochloromethane	20	1	1	2	4	-	2	4	-	4	4
Bromotoluene	40	1	-	2	-	-	-	4	-	-	4
Bromotrifluormethane (Halon 13)		2	1	1	1	2	1	1	4	1	1
Butadiene		1	-	1	4	1	4	4	4	4	4
Butane		1	3	1	1	1	4	1	4	2	3
Butanediol	60	1	-	1	-	-	1	4	-	2	1
Buthyl benzoate	20	1	-	1	4	1	1	4	4	4	4
Butylphenol	80	1	-	1	-	-	4	4	4	4	4
Butirona	20	1	-	4	-	-	-	4	-	-	4
Butoxyethanol		1	3	4	4	4	2	3	4	3	4
Butter	80	1	1	1	1	1	2	1	2	2	4
Butyl acetate	80	1	4	4	4	4	2	4	4	4	4
Butyl acetyl ricinoleate		1	1	1	2	2	1	2	-	2	4
Butyl acrylate	80	1	4	4	4	4	4	4	1	4	4
Butyl alcohol	60	1	1	1	1	1	2	2	3	1	1
Butyl bromide		1	-	2	-	-	-	4	-	-	4
Butyl butyrate	20	1	-	1	-	1	1	4	-	4	4
Butyl carbitol (Butidigol)	80	1	2	2	4	4	1	4	4	3	4
Butyl chloride	20	1	-	2	-	-	-	4	-	-	4
Butyl oleate		1	1	1	4	2	2	4	3	4	4
Butyl stearate	20	1	1	1	2	2	4	2	3	4	4
Butylamine	40	1	2	4	4	4	3	3	3	4	3
Butylene	60	1	-	1	2	2	4	2	4	3	4
Butyric acid	40	1	2	2	4	4	2	4	4	4	4
Butyric aldehyde	40	2	3	4	4	4	2	4	4	4	4
Butyric anhydride	20	1	-	-	-	-	-	3	-	-	4
Calcium acetate	40	1	1	4	2	4	2	3	4	2	3
Calcium bisulfite		1	1	1	1	2	4	1	3	1	4
Calcium bisulphate		1	-	1	-	-	2	1	-	2	-
Calcium carbonate		1	1	1	1	1	1	1	1	1	1
Calcium chlorate		1	1	1	1	-	1	1	-	1	-
Calcium chloride	60	1	1	1	1	1	1	1	1	1	1
Calcium cyanide		1	1	1	1	1	1	1	1	1	1
Calcium disulphide		1	-	1	-	-	-	1	-	-	-
Calcium hydroxide (lime slurry)	40	1	1	1	1	1	1	1	3	1	1

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Calcium hypochlorite	20	1	1	1	2	2	1	3	2	3	3
Calcium nitrate	20	1	1	1	1	1	1	1	2	1	1
Calcium oxide		1	-	-	-	-	-	-	-	-	-
Calcium oxychloride		1	1	1	-	2	2	2	2	3	4
Calcium permanganate		1	-	1	-	-	-	1	-	-	-
Calcium phosphate		1	1	1	1	1	1	1	1	2	1
Calcium polysulphide		1	1	1	-	1	1	4	1	1	4
Calcium silicate		1	1	1	1	-	1	1	-	1	1
Calcium sulphate (gypsum)		1	1	1	1	-	1	1	-	1	1
Calcium sulphide		1	1	1	1	1	1	2	2	1	2
Calcium sulphite		1	1	1	1	1	1	1	1	1	1
Calcium thiosulphate		1	1	1	2	1	1	2	1	1	2
Camphor		1	-	2	-	-	4	1	-	2	4
Capric acid	20	1	2	-	-	-	-	-	-	-	-
Caproic aldehyde		1	-	4	-	4	2	4	2	1	4
Caprylic alcohol		1	1	1	2	2	1	2	2	2	2
Carbamate		1	-	1	-	1	2	3	-	2	4
Carbinol (methanol)	20	1	1	1	1	2	1	2	2	1	1
Carbitol	40	1	2	2	-	2	2	2	2	2	2
Carbolic acid (phenol)		1	1	1	4	1	2	4	4	4	4
Carbon dioxide (dry)	80	1	1	2	1	2	2	1	2	2	2
Carbon dioxide (wet)	80	1	1	2	1	2	2	1	2	2	2
Carbon disulfide	40	1	1	1	3	1	4	4	3	4	4
Carbon monoxide	60	1	1	1	1	2	2	1	1	3	3
Carbon tetrachloride	60	2	4	1	2	2	4	2	4	4	4
Carbonic Acid	20	1	1	1	2	1	1	2	1	1	2
Caustic Potash		1	2	2	-	2	1	2	3	2	2
Caustic soda (sodium hydroxide)	80	1	1	4*	-	2	1	2	3	2	2
Cellosolve (2-etoxytanol)	80	1	1	4	4	4	2	4	4	4	4
Cellosolve, acetate (2-butxyethyl acetate)	80	1	3	4	4	4	2	4	4	4	4
Cellosolve, butilo (2-butoxytanol)	80	1	2	4	4	4	2	4	4	3	4
Cellosolve, methyl (2-methoxyethanol)	80	1	2	4	4	4	2	4	4	3	4
CELLUTHERM 2505A		-	-	1	-	3	3	3	3	3	-
Cemenum (isopropyl toluene)	20	1	-	1	4	2	4	4	4	4	4
Cetane (hexadecane)	80	1	1	1	1	3	4	1	4	2	4
Cetyl / palmitic alcohol		1	-	-	-	-	-	-	-	-	-
Chloral hydrate	60	2	-	3	-	-	3	4	-	3	3
Chlorextol		1	1	1	2	2	4	2	4	2	4
Chloric acid	20	1	-	1	-	-	1	4	-	4	4
Chlorinated brine		1	1	1	4	1	4	4	4	4	4
Chlorinated lime (calcium hypochlorite)	20	1	1	1	-	2	2	2	2	3	4
Chlorinated solvents		1	4	1	4	1	4	4	4	4	4
Chlorine (dry gas)		1	3	1	3	1	4	4	4	4	4
Chlorine (wet gas)		1	3	1	3	2	4	4	3	3	4
Chlorine dioxide	40	1	3	2	4	2	3	4	3	4	4
Chlorine trifluoride		2	4	4	4	4	4	4	4	4	4
Chloroacetic acid	20	1	2	4	4	4	2	4	3	4	4
Chloroacetone	20	1	4	4	4	4	1	4	4	4	4
Chlorobromomethane	40	1	3	1	4	2	2	4	4	4	4
Chlorobutadiene (chloroprene)	20	1	2	1	4	2	4	4	4	4	4
Chlorobutane		1	-	2	-	-	-	4	-	-	4
Chlorodifluormethane		1	1	4	-	4	1	4	4	1	2
Chlorodiphenyl		-	-	1	-	-	4	4	-	4	-
Chlorododecane		1	2	1	4	1	4	4	4	4	4
Chloroform	40	1	4	1	4	2	4	4	4	4	4
Chloronaphthalene (Halowax oil)	20	1	4	1	-	2	4	4	4	4	4
Chloronitroethane		-	-	3	-	-	-	4	-	-	4
Chloropentafluoroethane		1	-	2	1	3	1	1	3	1	1
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

NOTE: The information shown in the tables should only be used as a reference guide. The tests have been carried out in the laboratory and do not have to reproduce real field conditions. It is the responsibility of the User to check the chemical compatibility of the process fluid with the elastomer of interest. For further information, please contact our Technical Dept

CONTINUE ...

* Specialty Compounds Only. Please, check with our Technical Dpt.

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Chlorosulphonic acid	40	1	1	4	4	4	4	4	4	4	4
Chlorotrifluoroethylene		2	-	-	-	-	-	4	-	-	-
Chlorotrifluoromethane		2	1	3	1	3	1	1	4	1	2
Chromic acid, 50 %		1	1	1	4	3	2	4	3	4	4
Chromic oxide, aqueous solution	20	1	1	1	4	2	2	4	2	4	4
Chromium (III) sulphate	20	1	2	1	2	-	2	2	-	-	-
Chromium plating, solutions for		1	1	1	4	2	2	4	2	4	4
Citric acid	60	1	1	1	1	1	1	1	1	1	1
CITY SERVICE 140 coolant		-	-	1	-	1	4	1	4	3	-
CLOFENO T64	100	1	-	1	-	-	-	4	3	4	-
Clordane	60	1	1	1	2	2	4	2	4	3	4
Clorobenzene	20	1	1	1	-	1	1	4	-	4	4
Clorox		1	1	1	2	1	2	2	2	2	4
Cobalt chloride	40	1	1	1	1	1	1	1	2	1	1
Coconut oil	60	1	1	1	1	1	3	1	1	3	4
Cod liver oil	20	1	1	1	1	1	1	1	2	2	4
Coffee shop	40	1	1	1	2	1	1	2	1	1	1
Coke gas	80	1	1	1	1	2	4	1	2	2	4
Coke oven gas	80	1	1	1	4	2	4	4	2	4	4
Coliche licor	80	1	-	-	-	-	2	2	-	1	2
Colophony	20	1	-	-	-	-	-	1	-	3	-
Concentrated ammonium hydroxide	20	1	1	2	4	3	1	4	1	2	3
COOLANOL 45 coolant	40	1	1	1	1	2	4	1	4	1	4
COOLANOL coolant	40	1	1	1	1	2	4	1	4	1	4
Coolant	80	1	1	1	1	1	4	1	4	2	4
Copper acetate	80	1	4	4	2	4	1	2	4	2	4
Copper and potassium cyanide	20	1	1	1	1	1	1	1	1	1	1
Copper carbonate		1	-	1	1	-	-	1	-	-	1
Copper chloride	80	1	1	1	1	1	1	1	1	1	2
Copper cyanide		1	2	1	1	1	1	1	1	1	1
Copper sulphate, 10 %	80	1	1	1	1	1	1	1	1	1	2
Copper sulphate, 50 %	80	1	1	1	1	1	1	1	1	1	2
Copper sulphide		1	-	1	-	-	-	1	-	-	1
Corn oil	80	1	1	1	1	1	3	1	1	3	4
Cotton seed oil	80	1	1	1	1	1	3	1	1	3	4
Creosote	80	1	1	1	2	1	4	1	4	2	4
Cresol (hidoxitoluene)	80	1	1	1	2	2	4	4	4	4	4
Crotonaldehyde	40	1	-	2	-	-	2	2	-	1	4
Crotonic acid	80	1	-	3	-	4	2	4	4	2	4
Cyclohexane	40	1	2	1	1	1	4	1	4	3	4
Cyclohexanol (Hexalin)	60	1	1	1	2	1	4	2	4	2	4
Cyclohexanone	80	1	3	4	4	4	2	4	4	4	4
Cyclopentane	20	1	-	1	-	-	4	4	-	1	4
Decalin (decahydronaphthalene)	60	1	-	1	4	2	4	4	4	4	4
Decanal	60	1	-	4	-	-	4	4	-	-	4
Decane	80	1	1	1	1	1	4	1	2	3	4
Decanol	80	1	-	2	-	-	-	1	-	4	1
Denatured alcohol	40	1	1	1	2	1	1	2	1	1	1
DESMODUR T	20	3	-	-	4	-	4	4	-	4	-
DESMOPHEN 2000	80	-	-	-	1	-	-	1	-	-	-
Detergent, solution	80	1	1	1	1	1	1	1	1	2	2
Dextron	80	1	1	1	1	2	4	1	4	2	4
Dextrose	80	1	1	1	1	1	1	1	1	1	1
Diacetone alcohol	40	1	4	4	4	4	1	4	4	4	4
Diazinon		1	-	2	-	2	4	3	4	3	4
Dibenzyl ether	80	1	3	4	4	2	2	4	2	4	4
Dibenzyl sebacate	80	1	2	2	4	3	2	4	3	4	4
Dibromodifluoromethane		1	-	-	-	4	2	4	4	4	4
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Dibromoethylbenzene	60	1	3	2	4	2	4	4	4	4	4
Dibutyl etern	40	1	-	4	-	3	3	3	4	4	4
Dibutyl f-talate (DBP)	40	1	2	3	4	3	2	4	2	4	4
Dibutyl sebacate (DBS)		1	2	2	4	2	2	4	2	4	4
Dibutylamine	80	1	2	4	4	4	4	4	3	3	4
Dichloro fluormethane	20	2	-	4	4	4	4	4	4	2	4
Dichloro isopropyl ether		1	3	3	4	3	3	4	4	4	4
Dichloro tetrafluoroethane	60	2	-	2	1	2	1	1	4	1	1
Dichloroacetic acid	80	1	-	4	-	-	1	4	-	4	4
Dichlorobenzene	40	1	-	1	4	2	4	4	4	4	4
Dichlorobutane	20	1	1	1	2	2	4	2	4	4	4
Dichlorodifluoromethane (Halon 122)		1	2	2	1	2	2	1	4	1	1
Dichloroethyl ether	20	1	-	-	-	-	-	4	4	-	4
Dichloroethylene	20	1	-	2	-	3	4	4	4	4	4
Dicyclohexylamine	60	1	3	4	3	4	4	3	4	4	4
Diesel Fuel	60	-	-	1	1	1	4	1	3	3	-
Diesel Fuel	80	1	1	1	1	1	4	1	4	3	4
Diesel Oil		-	-	1	-	1	4	1	4	3	-
Diethanol amine (DEA)	80	1	-	-	-	-	-	2	-	1	2
Diethyl carbonate	60	1	-	-	-	-	-	4	-	4	-
Diethyl phthalate (DEP)		1	-	3	-	-	-	4	-	4	4
Diethyl sebacate	20	1	2	2	3	2	3	3	2	4	4
Diethylamine	20	1	-	-	-	-	-	2	-	-	-
Diethylamine	20	1	-	4	3	4	3	3	3	3	3
Diethylbenzene (DEB)	20	1	-	1	-	2	4	4	4	4	4
Diethylene glycol (Digol)	20	1	1	1	1	1	1	1	2	1	3
Diethylene oxide	20	1	4	4	3	4	2	4	4	4	4
Diethyl ether	20	1	4	3	3	3	3	3	4	3	4
Diisobutylene		1	-	1	3	3	4	2	4	4	4
Diisobutyl ketone	60	1	-	4	4	4	2	4	4	4	4
Diisodecyl adipate (DIDA)		1	-	3	-	-	-	4	-	-	4
Diisodecyl phthalate (DIDP)	80	1	-	3	-	-	1	4	-	4	4
Diisooctyl adipate (DIOA)		1	-	3	-	-	-	4	-	-	4
Diisooctyl phthalate (DIOP)		1	-	3	-	-	-	4	-	-	4
Diisooctyl sebacate (DIOS)		1	-	2	-	3	3	3	3	4	4
Diisopropyl benzene		1	-	1	4	2	4	4	3	4	4
Diisopropyl amine		-	-	-	-	-	-	2	-	-	2
Diisopropyl ketone		1	-	4	4	4	2	4	4	4	4
Diluted acetic acid	60	1	2	1	2	2	1	2	1	1	2
Diluted ammonium hydroxide		1	1	2	2	2	1	2	1	2	2
Dimethyl amine (DMA)	20	1	-	4	4	4	4	4	4	4	4
Dimethyl aniline		1	-	4	4	4	3	3	4	4	4
Dimethyl ether (Methyl ether)	20	1	4	2	-	1	3	2	1	3	4
Dimethyl ketone (Acetone)	40	1	4	4	4	4	1	4	4	3	3
Dimethyl phthalate		1	2	2	4	2	2	4	1	4	4
Dimethyl sulfide (DMS)	20	-	-	-	-	-	-	4	-	-	4
Dimethyl sulphate	80	-	-	2	-	-	-	4	-	-	4
Dimethylformamide (DMF)	60	1	1	4	2	4	3	2	2	4	4
Dinitrotoluene (DNT)	80	1	4	3	4	4	4	4	4	4	4
Diocetyl Phthalate (DOP)	80	1	2	2	3	2	2	3	3	4	4
Diocetyl sebacate	80	1	1	2	4	3	2	4	3	4	4
Dioxolane	40	1	4	4	4	4	2	4	4	4	4
Dipentene (Limonene)	40	1	3	1	2	3	4	2	4	4	4
Dipropyl amine	80	1	-	-	-	-	-	2	-	-	2
Dipropylene Glycol	80	1	-	1	1	-	-	1	-	-	1
Disinfectant SAGROTAN	20	1	-	1	3	1	1	3	1	3	-
Disodium phosphate (DSP)	80	1	1	1	1	1	1	1	4	2	1
Disulfide dichloride	40	1	1	1	4	2	4	4	3	4	4

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Divinyl benzene (DVB)	40	1	3	2	-	3	4	4	4	4	4
Dodecylbenzene	40	1	-	1	-	-	-	4	-	-	4
Dodecylbenzene	80	1	-	1	-	-	-	4	-	-	4
DOW CHEMICAL 50-4		-	-	4	-	4	1	-	-	3	-
DOW CHEMICAL ET378		-	-	-	-	-	-	4	4	4	-
DOW CHEMICAL ET588		-	-	4	-	4	1	3	-	3	-
DOW CORNING 3 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 11 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 33 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 44 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 55 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 220 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 510 silicone		-	-	1	-	1	1	1	3	1	-
DOW CORNING 1208 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 4050 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING 6620 Emulsion		-	-	1	-	1	1	1	3	1	-
DOW CORNING F60 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING F61 Additive		-	-	1	-	1	1	1	3	1	-
DOW CORNING XF60 Additive		-	-	1	-	1	1	1	3	1	-
DOW GUARD		-	-	1	-	1	1	1	1	1	-
DOWTHERM 209		-	-	-	-	1	-	1	1	3	-
DOWTHERM A		-	-	1	-	3	4	4	4	4	-
Drinking water		1	1	1	1	1	1	1	1	1	1
Drinking water	80	-	-	1	-	-	1	1	1	3	-
Dry calcination gas	80	-	-	1	-	1	1	4	1	1	-
Dry cleaning fluids	80	2	3	1	3	2	4	3	4	2	4
Duco Paint Thinner	60	1	2	2	4	3	4	4	4	4	4
Engine oil	100	1	-	1	1	1	4	1	3	3	-
Epichlorohydrin (ECH)	80	2	4	4	4	4	2	4	4	4	4
Epoxy resin		1	2	4	-	-	1	3	3	1	1
Essence of lavender	20	1	1	1	3	2	4	2	4	4	4
ESSO 208 fuel		-	-	1	-	1	4	1	4	3	-
ESSO engine oil		-	-	1	-	1	4	1	-	3	-
ESSO type A fluid for automatic transmissions		-	-	1	-	1	4	1	4	3	-
ESSTIC 42, 43		-	-	1	-	1	4	1	4	3	-
Estyrene (vinylbenzene)	20	1	2	2	4	3	4	4	4	4	4
Ethane	80	1	-	1	1	2	4	1	4	2	4
Ethanol	80	1	1	1	2	1	1	2	1	1	1
Ethanol amina	80	1	1	4	2	4	2	2	2	2	2
Ethanolamine (MEA)	40	1	1	4	4	4	2	4	2	4	2
Ethyl acetate	40	1	4	4	4	4	2	4	2	4	4
Ethyl acetate	80	1	-	4	4	4	2	4	2	4	3
Ethyl acrylate	40	1	3	4	4	4	3	4	2	3	4
Ethyl benzoate	80	1	3	1	4	1	4	4	4	4	3
Ethyl bromide	20	1	1	1	2	1	4	2	4	4	3
Ethyl butyrate	80	1	-	3	-	-	4	4	-	4	-
Ethyl cellulose		1	-	4	-	4	2	2	2	2	2
Ethyl chloride	80	1	2	1	1	1	2	1	4	2	3
Ethyl chloroformate (chlorocarbonate)	60	1	2	1	4	2	4	4	4	4	4
Ethyl cyanide (propionitrile)	60	1	1	1	1	3	3	2	4	2	4
Ethyl formate	2	2	2	1	4	1	2	4	4	2	4
Ethyl hexanol	80	1	1	1	-	1	1	1	2	1	2
Ethyl iodide	20	-	-	2	-	-	-	4	-	1	4
Ethyl mercaptan		1	1	1	4	3	3	4	3	3	4
Ethyl oxalate		1	1	1	4	2	1	4	4	3	1
Ethyl silicate		1	1	1	1	1	1	1	1	1	2
Ethyl sulphate		1	1	2	-	-	1	4	-	-	4
Ethylaluminium dichloride		1	-	2	-	-	-	4	-	-	4
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Ethylamine		1	-	4	-	-	1	3	-	3	3
Ethylbenzene	20	1	2	1	4	1	1	4	4	4	4
Ethylbutyl alcohol	80	1	-	1	-	1	3	1	2	2	1
Ethylbutyric aldehyde		1	-	4	-	-	-	4	-	-	4
Ethylcyclopentane		1	2	1	1	1	4	1	4	3	4
Ethylene	20	1	2	1	1	1	2	1	4	3	3
Ethylene dibromide (EDB)	60	1	-	1	-	3	4	4	4	4	4
Ethylene dichloride (EDC)	60	1	2	1	4	3	4	4	4	4	4
Ethylene glycol	80	1	1	1	2	1	1	2	1	1	1
Ethylene hydrochloride	80	1	1	1	4	2	2	4	3	2	2
Ethylene oxide (ETO)	80	1	3	4	4	4	3	4	4	4	4
Ethylenediamine	60	2	2	4	1	4	1	1	1	1	2
Etil butil cetona	80	1	-	4	-	-	-	4	-	-	4
Exhaust gas with carbon dioxide	60	1	1	1	1	1	1	1	1	1	-
Exhaust gas with carbon monoxide	60	1	1	1	1	1	1	1	1	1	-
Exhaust gas with hydrochloric acid	60	-	-	1	-	-	1	1	-	1	-
Exhaust gas with hydrofluoric acid (traces)	60	1	-	1	1	-	1	1	-	1	-
Exhaust gas with hydrogen chloride	60	1	-	1	3	-	1	3	-	1	-
Exhaust gas with nitrous oxide	80	1	-	1	-	3	1	-	4	1	-
Exhaust gas with sulphur dioxide	80	-	-	1	-	-	1	3	-	1	-
Exhaust gas with sulphuric acid	80	1	-	1	4	-	1	4	-	3	-
Fatty acids	20	1	1	1	2	-	3	2	3	2	4
Fenil and ettil etern (fenetol)	80	1	4	4	4	4	4	4	4	4	4
Fish oil	80	1	1	1	1	1	4	1	1	3	4
Flaxseed oil	80	1	1	1	1	1	3	1	1	3	4
Fluid FAM A according to DIN 51604	20	1	-	1	3	1	4	3	4	4	-
Fluid FAM C according to DIN 51604	20	1	-	-	4	3	4	4	4	4	-
Fluid type A for automatic transmissions	80	1	1	1	1	1	4	1	2	2	4
Fluorine (dry)	80	2	-	2	4	2	3	4	4	3	4
FLUORINERT FC-43 coolant		-	-	1	-	1	1	1	1	1	-
FLUORINERT FC-75 coolant		-	-	3	-	3	1	1	1	1	-
Fluorobenceno	20	1	-	3	4	2	4	4	4	4	4
Fluoroboric acid	80	1	-	2	-	1	1	1	-	1	2
Fluorolube (fluorocarbon lubricant)	20	2	2	2	1	2	1	1	1	1	4
Fluorosilicic acid	80	1	1	2	2	4	2	2	4	2	3
Formaldehyde	60	1	1	4	3	4	2	3	2	3	3
Formamida	80	1	-	3	-	-	2	3	-	3	-
Formic acid	80	2	3	3	3	4	2	3	4	2	2
Forona	20	1	4	4	4	4	2	4	4	4	4
Freon 11 / MF / CFC 11 / R 11 (trichlorofluormethane)	20	2	4	2	2	2	4	2	4	4	4
Freon 12 / R 12 (dichlorodifluoromethane)	20	2	4	2	1	3	2	1	4	1	1
Freon 13 / R 13 (chlorotrifluoromethane)	20	1	1	1	1	3	1	1	4	1	1
Freon 13 B1 / R 13 B1 (bromotrifluoromethane)	20	2	2	2	1	2	1	1	4	1	1
Freon 14 / R 14 Halon 14 (tetrafluoroethane)	20	1	1	1	1	3	1	1	4	1	1
Freon 21 / R 21 (dichlorofluoromethane)	20	2	-	4	-	4	4	4	4	2	4
Freon 22 / R 22 (dichlorofluoromethane)	20	2	-	4	4	4	1	4	4	1	2
Freon 31 / R 31 (chlorofluoromethane)	20	2	-	4	4	-	1	4	-	1	2
Freon 32 / R 32 (difluoromethane)	20	2	4	4	1	3	1	1	-	1	1
Freon 112 BF / R 112 (tetrachlorodifluoroethane)	20	2	4	1	2	3	4	2	4	2	4
Freon 113 / TF / R 113 (trichlorotrifluoroethane)	20	3	4	2	-	4	3	1	4	1	2
Freon 114 / R 114 (dichlorotetrafluoroethane)	20	3	4	2	1	2	1	1	4	1	1
Freon 114 B2 / R 114 B2 (dibromotetrafluoroethane)	20	3	4	2	2	2	4	2	4	1	3
Freon 115 / R 115 (chloropentafluoroethane)	20	3	4	2	1	4	1	1	4	1	1
Freon 134 A / R 134 A (tetrafluoromethane)	20	2	4	4	1	3	1	1	2	2	3
Freon 143 A / R 143 A (trifluoroethane)	80	1	2	1	4	2	4	4	4	4	4
Freon 502 / R 502 (mixture of R 22 and R 115)	20	3	-	2	1	-	1	2	-	1	1
Freon BF		-	-	1	-	-	4	3	4	3	-
Freon C316 / R C316 (dichlorohexafluorocyclobutane)	20	2	-	-	1	-	1	1	-	1	1

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Freon C318 / RC 318 (octafluorocyclobutane)	20	3	4	2	1	-	1	1	-	1	1
Freon K-142b	20	3	4	2	2	4	4	2	-	1	1
Freon K-152a	20	3	-	4	1	-	1	1	-	1	1
Freon PCA	20	3	4	2	1	-	4	1	4	1	2
Freon T-P3	20	2	1	1	1	1	1	1	1	1	1
Freon T-WD602	20	2	-	1	2	-	2	2	4	2	2
Freon TA	20	3	3	3	1	-	1	1	1	1	1
Freon TC	20	2	-	1	1	-	2	1	4	1	2
Freon TMC	20	2	-	1	2	-	2	2	3	2	3
Fuel MIL-G-5572		-	-	1	-	1	4	1	4	3	-
Fuel MIL-J-5161		-	-	1	-	1	4	3	4	4	-
Fuel MIL-P-27402 (Hydrazine / UDMH)		-	-	-	-	-	1	3	4	3	-
Fuel oil # 6		-	-	1	-	1	4	3	1	4	-
Fuel oil	80	1	1	1	1	1	4	1	4	3	4
Fuel reference ASTM A		-	-	1	-	1	4	1	4	3	-
Fuel reference ASTM B		-	-	1	-	1	4	1	4	4	-
Fuel reference ASTM C		-	-	1	-	3	4	3	4	4	-
Fuel SR-10		-	-	1	-	1	4	1	4	4	-
Fuel SR-6		-	-	1	-	1	4	3	4	4	-
Fuel type I (MIL-S-3136)		-	-	1	-	1	4	1	4	3	-
Fuel type II (MIL-S-3136)		-	-	1	-	3	4	3	4	4	-
Fuel type III (MIL-S-3136)		-	-	1	-	3	4	1	4	4	-
Fuels with aromatic hydrocarbons		1	2	1	2	2	4	2	4	4	4
Fumaric acid	20	1	1	1	1	1	2	1	2	2	2
Fuming sulfuric acid (oleum)	80	1	2	2	4	4	4	4	4	4	4
Furan (Furfuran)	20	1	-	4	4	4	3	4	4	4	4
Furfural (Furfuraldehyde)	20	2	3	4	3	4	2	4	4	4	4
Furfuryl alcohol	60	1	2	4	4	4	2	4	4	4	4
Gallic acid	20	1	1	1	2	1	2	2	3	3	2
Gasohol	20	1	-	1	4	2	4	3	4	4	4
Gasoline	40	1	3	1	3	1	4	2	4	4	4
Gelatine	40	1	1	1	1	1	1	1	1	1	1
Glacial acetic acid	60	1	3	2	2	4	2	2	2	4	3
Glauber's salt (decahydrated sodium sulfate)	80	1	1	1	4	1	2	4	-	2	4
Gluconic Acid	60	1	-	1	-	-	-	3	-	-	4
Glucose	80	1	1	1	1	1	1	1	1	1	1
Glycerin (Glycerol)	80	1	1	1	1	1	2	1	1	1	1
Glycine	40	1	-	1	-	-	1	2	-	1	2
Glycol	80	1	1	1	2	1	1	2	1	1	1
Glycol monoethyl ether	20	1	-	-	2	-	4	2	4	2	3
Glycolic acid (hydroxyacetic acid)	80	1	-	1	-	1	2	1	1	2	1
Grease (animal origin)	80	-	-	1	-	1	4	1	1	1	-
Grease (light)	20	1	2	1	1	1	4	1	4	4	4
Grease (Lithium type) ATLANTIC EP		-	-	1	-	1	4	1	4	3	-
Grease (Lithium type) LUBRIPLATE Aero		-	-	1	-	1	4	1	3	1	-
Grease (mineral origin)	80	-	-	1	-	1	4	1	1	3	-
Grease (petroleum-based)		1	1	1	1	1	4	1	4	2	4
Grease (petroleum-based) MIL-G3278		-	-	1	-	3	4	3	4	4	-
Grease (petroleum-based) MIL-G3545		-	-	1	-	1	4	1	4	3	-
Grease (petroleum-based) MIL-G15793		-	-	1	-	3	4	1	4	3	-
Grease AEROSHELL 7		-	-	1	-	1	4	1	3	3	-
Grease AEROSHELL 17		-	-	1	-	1	4	1	3	3	-
Grease DOW CORNING 5		-	-	1	-	1	1	1	3	1	-
Grease for general use SUNOCO		-	-	1	-	1	4	1	4	3	-
Grease GULF GS-7050		-	-	1	-	1	4	1	4	4	-
Grease KEYSTONE 87HX		-	-	1	-	1	4	1	4	4	-
Grease MIL-G-7118		-	-	1	-	1	4	3	4	3	-
Grease MIL-G-7187		-	-	1	-	1	4	1	4	4	-
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Grease MIL-G-7421		-	-	1	-	3	4	3	4	3	-
Grease MIL-G-7711		-	-	1	-	1	4	1	3	4	-
Grease MIL-G-10924		-	-	1	-	1	4	1	4	4	-
Grease MIL-G-25013		-	-	1	-	1	4	1	4	3	-
Grease MIL-G-25537		-	-	1	-	1	4	1	4	3	-
Grease MIL-G-25760		-	-	1	-	3	4	3	4	3	-
Grease MIL-L-4343		-	-	1	-	1	1	1	3	1	-
Grease MOBILUX		-	-	1	-	1	4	1	4	3	-
Grease SHELL ALVANIA # 2		-	-	1	-	1	4	1	3	3	-
Grease SOCONY VACUUM AMV AC781		-	-	1	-	3	4	1	4	3	-
Grease TEXACO UNI-TEMP		-	-	1	-	1	-	1	3	3	-
Green liqueur (Kraft paste)	60	2	1	1	2	2	1	2	4	2	2
GULF 372		-	-	1	-	1	4	1	4	3	-
GULF engine oil		-	-	1	-	1	4	1	4	4	-
GULF N150		-	-	1	-	3	4	1	4	4	-
GULF PARAGON		-	-	1	-	3	4	1	4	4	-
GULF PARAMOUNT 37		-	-	1	-	3	4	1	4	4	-
H and H-L Oils	80	-	-	1	-	1	4	1	3	3	-
Heavy water	80	1	1	1	-	1	1	1	1	2	1
HEF-2 ((High Energy Fuel)		1	1	1	-	2	4	2	4	4	4
Helium		1	1	1	1	1	1	1	1	1	1
HENKEL P3 Solution	100	1	-	-	1	-	1	1	-	3	-
Heptanal	80	1	-	2	-	-	-	4	-	-	4
Heptane	60	1	3	1	1	1	4	1	4	2	4
Hexachlorobutadiene	80	1	-	1	-	-	4	1	4	4	4
Hexamine		1	-	-	-	-	1	-	-	-	-
Hexanol	40	1	-	1	2	1	3	2	3	2	2
Hexone (methyl isobutyl ketone MIBK)	40	1	4	4	4	4	3	4	4	4	4
Hexylene (n-Hexene)	20	1	2	1	2	1	4	1	4	2	4
Hydraulic fluid according to DIN 51524	80	1	-	1	1	1	4	1	3	3	-
Hydraulic fluid AN-W-0-366B		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid AROCLOR 1248		-	-	1	-	3	3	3	3	4	-
Hydraulic fluid AROCLOR 1254		-	-	1	-	3	3	3	3	4	-
Hydraulic fluid AROCLOR 1260		-	-	1	-	3	-	4	3	4	-
Hydraulic fluid CELLULUBE 90, 100, 150, 220, 300, 500		-	-	1	-	3	1	4	1	4	-
Hydraulic fluid CITY SERVICE 65, 120, 150		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid CITY SERVICE PACEMAKER # 2		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid FYRQUEL 90, 100, 150, 220, 300		-	-	1	-	3	1	4	1	4	-
Hydraulic fluid FYRQUEL A60		-	-	4	-	4	3	4	3	4	-
Hydraulic fluid GULF HARMONY		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid HFA (water/oil emulsion)	60	1	-	-	1	-	4	1	-	3	-
Hydraulic fluid HFB (water/oil emulsion)	60	1	-	-	-	-	4	-	-	3	-
Hydraulic fluid HFC (glycol / water)	60	1	-	1	1	1	1	1	1	3	-
Hydraulic fluid HFD	80	1	-	-	-	-	-	4	4	-	-
Hydraulic fluid HOUGHTO-SAFE 272		-	-	3	-	3	1	1	3	3	-
Hydraulic fluid HOUGHTO-SAFE 620		-	-	3	-	3	1	1	3	3	-
Hydraulic fluid HOUGHTO-SAFE 5040		-	-	1	-	3	4	1	3	3	-
Hydraulic fluid HSA	70	-	-	1	-	-	4	1	-	3	-
Hydraulic fluid HSB	70	-	-	1	-	-	4	1	-	3	-
Hydraulic fluid HSC	70	-	-	1	-	-	1	1	1	1	-
Hydraulic fluid HSD	80	-	-	4	-	1	1	4	1	4	-
Hydraulic fluid HYDRO-DRIVE MH 50		-	-	1	-	1	4	1	3	3	-
Hydraulic fluid HYDROLUBE J-4 UCON		-	-	1	-	3	1	1	1	3	-
Hydraulic fluid HYJET III		-	-	4	-	-	1	4	-	4	-
Hydraulic fluid HYJET S		-	-	4	-	-	1	4	-	4	-
Hydraulic fluid HYJET W		-	-	4	-	-	1	4	-	4	-
Hydraulic fluid LINDOL		-	-	3	-	3	1	4	3	3	-
Hydraulic fluid LINDOL		1	1	2	4	3	1	4	3	4	4
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

NOTE: The information shown in the tables should only be used as a reference guide. The tests have been carried out in the laboratory and do not have to reproduce real field conditions. It is the responsibility of the User to check the chemical compatibility of the process fluid with the elastomer of interest. For further information, please contact our Technical Dept

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Hydraulic fluid MIL-G-21568		-	-	1	-	1	1	1	3	1	-
Hydraulic fluid MIL-H-7083		-	-	3	-	1	1	1	1	3	-
Hydraulic fluid MIL-H-13910		-	-	1	-	1	1	1	1	1	-
Hydraulic fluid MIL-H-19457		-	-	3	-	4	1	4	3	4	-
Hydraulic fluid MIL-H-27601		-	-	1	-	3	4	1	3	3	-
Hydraulic fluid MIL-L-17111		-	-	1	-	3	4	1	4	3	-
Hydraulic fluid MLO-7277		-	-	1	-	3	4	3	4	4	-
Hydraulic fluid MLO-7557		-	-	1	-	3	4	3	4	4	-
Hydraulic fluid MLO-8200		-	-	1	-	1	4	3	4	1	-
Hydraulic fluid MLO-8515		-	-	1	-	1	4	3	4	1	-
Hydraulic fluid MOBIL 24 DTE		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid MOBIL HF		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid MOBIL NYVAC 20 and 30		-	-	1	-	1	1	1	1	1	-
Hydraulic fluid MOBIL PYROGARD 42, 43, 53, 55		-	-	1	-	4	1	4	4	4	-
Hydraulic fluid MOBIL PYROGARD C, D		-	-	1	-	3	4	1	3	3	-
Hydraulic fluid MOBIL PYROLUBE		-	-	1	-	3	3	4	3	4	-
Hydraulic fluid OS 45 type III		-	-	1	-	3	4	3	4	1	-
Hydraulic fluid OS 45 type IV		-	-	1	-	3	4	3	4	1	-
Hydraulic fluid OS 70		-	-	1	-	3	4	3	4	1	-
Hydraulic fluid PYDRAUL 10E, 24ELT		-	-	1	-	4	1	4	4	4	-
Hydraulic fluid PYDRAUL 30E, 50E, 65E, 90E		-	-	1	-	1	1	4	1	4	-
Hydraulic fluid PYDRAUL 115E		-	-	1	-	3	1	4	4	4	-
Hydraulic fluid PYDRAUL 230E, 312C, 540C		-	-	1	-	4	4	4	4	4	-
Hydraulic fluid SHELL 3XF		-	-	1	-	1	4	1	-	3	-
Hydraulic fluid SHELL LO HYDRAX 27, 29		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid SHELL TELLUS 27		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid SHELL TELLUS 33		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid SKYDROL 500	80	1	1	4	4	3	1	4	3	4	4
Hydraulic fluid SKYDROL 7000	80	1	1	2	4	3	1	4	3	4	4
Hydraulic fluid STAUFFER 7700	80	1	2	1	2	2	4	2	4	4	4
Hydraulic fluid SUNOCO 3661		-	-	1	-	1	4	1	4	3	-
Hydraulic fluid SUNOCO 3XF		-	-	1	-	1	4	1	-	3	-
Hydraulic fluid SUNSAFE		-	-	1	-	1	4	1	-	3	-
Hydraulic fluid UNIVIS 40		-	-	1	-	1	4	1	4	3	-
Hydrazine (diamine)	60	2	2	4	-	4	1	2	2	2	2
Hydrazine, anhydrous	60	2	2	4	1	4	2	4	-	2	1
Hydrochloric acid, 3 M	80	1	1	1	-	2	1	3	4	3	3
Hydrochloric acid, 37 % (cold)	20	1	1	1	3	2	2	3	4	3	3
Hydrochloric acid, 37 % (hot)	80	1	1	1	3	3	3	4	4	4	4
Hydrocyanic acid		1	1	1	2	2	1	2	3	2	2
Hydrofluoric acid		1	2	2	4	4	3	4	4	3	3
Hydrogen (gas)	80	1	1	1	1	3	1	1	3	1	2
Hydrogen bromide (gas)	20	1	2	2	-	3	2	4	4	3	4
Hydrogen chloride (gas)	20	1	1	1	-	-	1	4	-	4	2
Hydrogen fluoride (gas)	20	1	2	2	4	4	4	4	4	4	4
Hydrogen peroxide, 30 %	20	1	1	1	2	1	1	2	1	1	2
Hydrogen peroxide, 90 %	20	1	1	1	3	2	3	3	2	4	4
Hydrogen sulphide	60	1	1	3	3	3	1	4	3	2	3
Hydrolube (water / ethylene glycol)	80	1	1	1	-	2	1	1	2	2	1
HYDROLUBE Hydraulic Fluid		-	-	1	-	3	1	1	3	3	-
Hydroquinone	20	2	-	3	4	2	4	3	3	4	4
HYJET Hydraulic Fluid		-	-	4	-	-	1	4	-	4	-
Hypochlorous acid	20	1	-	3	-	-	2	4	-	4	4
INDUSTRON FF44		-	-	1	-	1	4	1	4	3	-
INDUSTRON FF48		-	-	1	-	1	4	1	4	3	-
INDUSTRON FF53		-	-	1	-	1	4	1	4	3	-
INDUSTRON FF80		-	-	1	-	1	4	1	4	3	-
Ink	20	-	-	3	3	1	1	1	1	1	-
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Iodine	20	1	2	1	1	1	2	2	3	4	2
Iodine pentafluoride	20	2	4	4	4	4	4	4	4	4	4
Iodoform	20	-	-	2	-	-	-	-	-	4	4
Iron (II) chloride	20	1	1	1	1	1	1	1	2	2	1
Iron (II) sulphate	20	1	1	1	1	1	1	1	2	2	2
Iron (III) chloride	80	1	1	1	1	1	1	1	2	2	1
Iron (III) hydroxide	20	1	-	4	-	-	-	2	-	-	2
Iron (III) nitrate	20	1	1	1	1	1	1	1	2	2	2
Iron (III) sulphate	20	1	1	1	1	1	1	1	1	2	2
Isoamyl acetate	20	1	4	4	-	-	2	4	-	4	4
Isoamyl alcohol		1	1	1	-	-	1	1	-	1	1
Isoamyl butyrate		1	-	4	-	-	-	4	-	-	4
Isoamyl chloride	20	1	-	2	-	-	4	4	-	4	4
Isobutane		1	-	1	-	-	-	1	-	-	4
Isobutanol	40	1	1	1	2	2	1	2	1	1	2
Isobutilamina	20	1	-	4	-	-	-	2	-	-	2
Isobutyl chloride	20	1	2	1	4	2	2	3	1	4	4
Isobutyric acid	20	1	3	4	2	-	1	3	-	3	-
Isododecano		1	1	1	1	1	4	1	4	2	4
Isoforone	40	1	2	4	4	4	1	4	4	4	4
Isooctane	60	1	2	1	1	1	4	1	4	3	4
Isopentane	20	1	-	1	-	-	-	1	-	-	4
Isopropil eternal		1	4	4	3	3	4	3	4	3	4
Isopropyl acetate		1	4	4	4	4	2	4	4	4	4
Isopropyl alcohol (IPA)	40	1	1	1	2	2	1	2	1	2	2
Isopropyl amine (MIPA)		1	-	4	-	-	-	2	-	-	2
Isopropyl chloride		1	4	1	4	2	4	4	4	4	4
JP3 Aviation Fuel (MIL-J-5624)	20	1	-	1	3	3	4	1	4	4	-
JP3 Aviation Fuel (MIL-T-5624)		-	-	1	-	3	4	1	4	4	-
JP4 Aviation Fuel (MIL-J-5624)	20	1	-	1	3	3	4	1	4	4	-
JP5 Aviation Fuel (MIL-J-5624)	20	1	-	1	3	3	4	1	4	4	-
JP6 Aviation Fuel (MIL-J-25656)	20	1	-	1	3	3	4	1	4	4	-
JPX Aviation Fuel (MIL-J-25604)		-	-	4	-	4	4	1	4	3	-
JP4 (MIL-T-5624) fuel		-	-	1	-	3	4	1	4	4	-
JP5 (MIL-T-5624) fuel		-	-	1	-	3	4	1	4	4	-
KEL F		2	3	2	-	2	1	1	1	-	1
Kerosene	80	1	2	1	2	1	4	1	4	3	4
Lacquer		1	4	4	4	4	4	4	4	4	4
Lactam	80	1	3	4	4	4	2	4	-	2	4
Lactic acid (cold)	20	1	1	1	1	1	1	1	2	1	1
Lactic acid (hot)	80	1	1	1	4	2	4	4	2	4	4
Lanolin	60	1	-	1	1	1	4	1	1	3	-
Lard (animal fat)		1	1	1	1	1	2	1	2	2	4
Laughing gas (nitrous oxide)	20	1	1	1	1	1	1	1	1	1	-
Lauryl alcohol (n-Dodecano)	20	1	-	2	-	-	2	1	-	1	1
Lead (II) chloride	20	1	-	-	-	-	-	-	-	2	-
Lead (II) nitrate	80	1	2	1	1	1	1	1	4	1	1
Lead (II) sulphate	20	1	-	1	-	1	1	2	2	1	2
Lead acetate (II)	80	1	4	4	2	4	1	3	4	2	4
Lead chromate (II)	20	1	-	-	-	-	-	-	-	-	-
Leech	60	-	-	1	-	-	1	1	1	1	-
LEHIGH X1169		-	-	1	-	1	4	1	4	3	-
LEHIGH X1170		-	-	1	-	1	4	1	4	3	-
Light oil DTE	80	1	1	1	1	1	4	1	4	2	4
Ligroin (benzine or petroleum ether)	20	1	2	1	1	1	4	1	4	2	4
Lime based bleach		1	1	1	1	1	1	1	2	2	2
Linoleic acid	20	1	1	2	2	2	4	2	2	3	4
Liquefied petroleum gas (LPG)	80	1	-	1	2	3	4	1	3	2	4

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Lithium bromide	20	1	1	1	-	1	1	1	1	2	1
Lithium chloride	20	1	1	1	-	1	1	1	1	2	1
Lithium hydroxide	20	1	-	-	-	-	-	-	-	-	-
Lubricant (synthetic diester based)		1	1	1	2	2	4	2	4	4	4
Lubricant ANO n° 6 (GAF corporation)		-	-	1	-	1	4	1	4	3	-
Lubricant ANO n° 366 (GAF corporation)		-	-	1	-	1	4	1	4	3	-
Lubricant CIRCOLIGHT		-	-	1	-	1	4	1	4	3	-
Lubricant DOW CORNING 4		-	-	1	-	1	1	1	3	1	-
Lubricant DOW CORNING 200		-	-	1	-	1	1	1	3	1	-
Lubricant DOW CORNING 550		-	-	1	-	1	1	1	3	1	-
Lubricant DOW CORNING 704		-	-	1	-	1	1	1	3	1	-
Lubricant DOW CORNING 705		-	-	1	-	1	1	1	-	1	-
Lubricant DOW CORNING 710		-	-	1	-	1	1	1	-	1	-
Lubricant ELCO 28-EP		-	-	1	-	1	4	1	3	3	-
Lubricant ESSO XP90-EP		-	-	1	-	1	4	1	4	3	-
Lubricant GULF 90-W		-	-	1	-	1	4	1	4	4	-
Lubricant H2 (high viscosity)		-	-	1	-	3	1	1	1	3	-
Lubricant HOUGHTO-SAFE 1010		-	-	1	-	3	1	4	3	4	-
Lubricant HOUGHTO-SAFE 1055		-	-	1	-	3	1	4	3	4	-
Lubricant HOUGHTO-SAFE 1120		-	-	1	-	3	1	4	3	4	-
Lubricant LIQUIMOLY		1	1	1	1	1	4	1	4	2	4
Lubricant MCS 312		-	-	1	-	1	4	4	1	4	-
Lubricant MCS 352		-	-	4	-	3	1	4	3	4	-
Lubricant MCS 463		-	-	4	-	3	1	4	3	3	-
Lubricant U4 (high viscosity)		-	-	1	-	3	1	1	1	3	-
Lubricant UCON 50-HB-55		-	-	1	-	1	1	1	1	1	-
Lubricant UCON 50-HB-100		-	-	1	-	1	1	1	1	1	-
Lubricant UCON 50-HB-260		-	-	1	-	1	1	1	1	1	-
Lubricant UCON 50-HB-660		-	-	1	-	1	1	1	1	1	-
Lubricant UCON 50-HB-5100		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-65		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-135		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-285		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-300X		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-385		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-400 X		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-625		-	-	1	-	1	1	1	1	1	-
Lubricant UCON LB-1145		-	-	1	-	1	1	1	1	1	-
Lubricating oil (on a di-ester basis)		-	-	1	-	3	4	3	4	3	-
Lubricating oil (petroleum based)		1	1	1	1	1	4	1	2	2	4
Lubricating oils SAE 10, 20, 30, 40, 50		-	-	1	-	1	4	1	4	3	-
Magnesium acetate	20	1	-	4	-	-	-	4	-	-	4
Magnesium chloride	20	1	1	1	1	1	1	1	1	2	1
Magnesium hydroxide	20	1	1	1	2	2	1	2	3	2	2
Magnesium sulphate (Epsom salts)	80	1	1	1	1	1	1	1	1	2	2
Malathion	20	1	-	1	-	2	4	2	4	3	4
Maleic acid	80	1	1	1	4	-	4	4	3	4	4
Maleic Anhydride		1	1	1	4	-	4	4	-	4	4
Malic acid	80	1	1	1	1	1	4	1	2	2	2
Manganese (II) chloride		1	-	-	-	-	-	1	-	-	-
Manganese sulphate		1	-	1	-	-	-	1	-	-	1
Margarine	80	1	1	1	1	1	3	1	2	2	4
Mercury	20	1	1	1	1	1	1	1	2	1	1
Mercury (II) chloride	40	1	1	1	1	1	1	1	3	2	1
Mercury cyanide (II)	40	1	1	1	-	-	1	2	-	2	-
Mercury nitrate (I)		1	1	1	-	-	1	2	-	2	-
Mesityl oxide	40	1	4	4	4	4	2	4	4	4	4
Methacrylic acid	40	1	2	3	4	4	2	4	4	2	-
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Methane	40	1	2	1	1	2	4	1	4	2	4
Methanol (alcohol de madera)	40	1	1	1	1	2	1	2	2	1	1
Methyl acetate		1	4	4	4	4	2	4	4	3	4
Methyl acetoacetate		1	4	4	4	4	2	4	3	4	4
Methyl acrylate		1	4	4	4	4	2	4	4	2	4
Methyl benzoate	80	1	1	1	4	1	4	4	4	4	4
Methyl bromide	80	1	2	1	2	1	4	2	3	4	4
Methyl butyl ketone (MBK)	40	1	4	4	4	4	2	4	3	4	4
Methyl butyrate	20	1	-	-	-	4	4	-	4	-	-
Methyl carbonate	20	1	1	1	4	2	4	4	4	4	4
Methyl cellulose		1	1	4	2	4	2	2	2	2	2
Methyl chloride	80	1	4	2	4	2	3	4	4	4	4
Methyl chloroformate (chlorocarbonate)	40	1	1	1	4	2	4	4	4	4	4
Methyl ethyl ketone (MEK)	40	1	4	4	4	4	2	4	4	4	4
Methyl ethyl ketone (MEK)	40	1	4	4	4	4	3	4	2	4	4
Methyl formate	20	1	4	3	4	4	2	4	3	2	4
Methyl glycol acetate	20	1	-	4	-	-	1	4	2	3	2
Methyl iodide	20	1	-	-	-	-	1	4	-	4	-
Methyl isopropyl ketone (MIPK)	20	1	4	4	4	4	2	4	4	4	4
Methyl mercaptan	80	1	-	-	-	-	1	-	-	-	-
Methyl methacrylate (MMA)		1	-	4	-	-	2	4	4	4	4
Methyl oleate	60	1	2	1	4	2	2	4	3	4	4
Methyl propyl ketone (MPK)	40	1	-	4	-	-	2	4	-	4	4
Methylamine	20	1	-	2	-	-	2	4	-	2	2
Methylaniline		1	2	2	4	2	2	4	2	4	4
Methylcyclopentane	80	1	4	1	4	2	4	4	4	4	4
Methylene bromide (DBM)	20	1	-	2	-	-	-	4	-	4	4
Methylene Chloride (DCM)	20	1	-	1	-	2	3	4	4	4	4
Methylhydrazine		1	1	-	2	-	1	2	4	2	1
MIL-O-3503 Oil (petroleum-based)		-	-	1	-	1	4	1	4	3	-
MIL-S-81087 liquid silicone		-	-	1	-	1	1	1	3	1	-
Mineral oil	60	1	1	1	1	1	3	1	2	2	4
MOBILGAS WA200 type A fluid for automatic transmissions		-	-	1	-	1	4	1	4	3	-
Monosodium phosphate (MSP)	80	1	1	1	1	1	1	1	4	2	1
Morpholine	60	1	-	1	4	4	2	4	4	2	4
Mustard gas		1	-	1	-	1	3	-	1	3	3
n-butyl amina	60	1	2	4	4	4	3	3	3	4	3
n-Heptane	60	1	3	1	2	1	4	1	4	2	4
n-Hexaldehyde	80	1	-	4	4	4	1	4	2	1	4
n-Hexane	40	1	2	1	2	1	4	1	4	2	4
n-Octane	60	1	-	1	2	2	4	2	4	4	4
n-Pentane	20	1	-	1	1	3	4	1	4	2	3
n-Propyl Nitrate	60	1	-	4	4	4	2	4	4	4	4
Nafta	80	1	2	1	2	2	4	2	4	4	4
Naphthalene	80	1	2	1	4	1	4	4	4	4	4
Naphthenic acid	80	1	1	1	3	1	4	2	4	4	4
Natural gas / hydrogen sulfide	80	1	1	4	2	4	4	-	4	-	4
Natural gas	80	1	1	1	1	2	4	1	4	2	3
Neatsfoot oil	20	1	1	1	1	1	2	1	2	4	4
Neohexane	20	1	-	1	-	1	4	1	4	2	4
Neon	40	1	1	1	1	1	1	1	1	1	1
Neville's acid (1-naphthol-4-sulphonic acid)	20	1	1	1	4	2	2	4	4	4	4
Nickel (II) acetate	80	1	4	4	2	4	1	3	4	2	4
Nickel (II) chloride	80	1	1	1	1	1	1	1	1	2	2
Nickel (II) nitrate	80	1	1	1	-	-	1	1	-	1	1
Nickel (II) sulphate	80	1	1	1	1	1	1	1	1	2	2
Nitric acid, 3 M	40	1	2	1	3	3	2	4	4	4	4
Nitric acid, 69 %	40	1	2	1	4	3	4	4	4	4	4

NOTE: The information shown in the tables should only be used as a reference guide. The tests have been carried out in the laboratory and do not have to reproduce real field conditions. It is the responsibility of the User to check the chemical compatibility of the process fluid with the elastomer of interest. For further information, please contact our Technical Dept

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Nitrobenzene	80	1	2	1	1	1	4	1	4	2	4
Nitroethane	20	1	2	4	4	4	2	4	4	2	2
Nitrogen tetroxide		1	3	4	4	4	4	4	4	4	4
Nitromethane	80	1	3	4	4	4	2	4	4	3	3
Nitropropane	20	1	2	4	4	4	2	4	4	4	4
Nitrous acid	20	1	-	-	-	-	-	-	-	-	-
Nitrous gases (mixture of nitrogen oxides)	20	1	-	1	4	4	1	4	4	1	-
o-chloroethylbenzene		1	4	1	4	2	4	4	4	4	4
o-chloronaphthalene	40	1	-	1	4	2	4	4	4	4	4
o-cresol (cresylic acid)	40	1	1	1	2	2	4	4	4	4	4
o-dichlorobenzene (ODCB / DOWTHERM E)	60	1	-	1	4	2	4	4	4	4	4
Octachlorotoluene	40	1	-	1	-	2	4	4	4	4	4
Octadecane		1	1	1	-	1	4	1	4	2	4
Octanol		1	1	1	2	2	1	2	2	2	2
Octyl acetate	20	1	-	4	-	-	-	4	-	-	4
Oil	80	1	1	1	1	2	4	2	4	4	4
Oil Bunker	60	1	1	1	1	1	4	1	2	4	4
Oil ESSO WS812		-	-	1	-	3	4	3	4	4	-
Oil MIL-C-4339		-	-	1	-	1	4	1	-	4	-
Oil MIL-C-7024		-	-	1	-	1	4	1	4	4	-
Oil MIL-C-8188 (based on di-ester)		-	-	3	-	3	4	3	4	4	-
Oil MIL-F-16884 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-H-5606 (petroleum based)	80	-	2	1	1	1	4	1	4	2	4
Oil MIL-H-6083 (petroleum based)		-	-	1	-	1	4	1	4	1	-
Oil MIL-H-6506		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-2104 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-3150 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-6081 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-6082 (petroleum based)		-	-	1	-	1	4	1	1	3	-
Oil MIL-L-6085 (based on di-ester)		-	-	1	-	3	4	3	4	4	-
Oil MIL-L-6085A (BRAYCO 885)		-	-	1	-	3	4	3	4	4	-
Oil MIL-L-6387 (based on di-ester)		-	-	1	-	3	4	3	4	4	-
Oil MIL-L-7808 (based on di-ester)		-	-	1	-	3	4	3	4	4	-
Oil MIL-L-7870 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-9000 (petroleum based)		-	-	1	-	3	4	1	4	3	-
Oil MIL-L-9236 (based on di-ester)		-	-	1	-	3	4	3	4	4	-
Oil MIL-L-15017 (petroleum based)		-	-	1	-	3	4	1	4	3	-
Oil MIL-L-17331 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-21260 (petroleum based)		-	-	1	-	1	4	1	4	3	-
Oil MIL-L-23699		-	-	1	-	3	4	3	4	3	-
Oil MIL-L-25681		-	-	1	-	3	1	3	4	3	-
Oil mineral UNIVOLT # 35		-	-	1	-	1	4	1	4	3	-
Oil MOBIL DELVAC 1100, 1110, 1120, 1130		-	-	1	-	1	4	1	4	3	-
Oil MOBIL SAE 20		-	-	1	-	1	4	1	4	3	-
Oil MOBIL VELOCITE C		-	-	1	-	1	4	1	4	3	-
Oil MOBILUBE GX90-EP LUBE		-	-	1	-	1	4	1	4	3	-
Oil MULTIGEAR 140 EP		-	-	1	-	1	4	1	4	3	-
Oil of animal origin	60	1	1	1	1	1	2	1	2	2	4
Oil of Gaultheria (methyl salicylate)	20	1	3	4	4	4	2	4	3	4	3
Oil SUNOCO SAE 10		-	-	1	-	1	4	1	4	3	-
Oil TEXACO 1581		-	-	1	-	3	4	1	4	3	-
Oil TEXACO 3401		-	-	1	-	3	4	1	4	3	-
Oil TEXACO 3450		-	-	1	-	1	4	1	4	4	-
Oil TEXACO 3525		-	-	1	-	3	4	1	4	3	-
Oil TEXACO 3528		-	-	1	-	3	4	1	4	3	-
Oil TEXACO CAPELLA		-	-	1	-	1	4	1	4	3	-
Oil TEXACO MEROPA # 3		-	-	1	-	1	4	1	4	3	-
Oil TEXACO REGAL B		-	-	1	-	1	4	1	4	4	-
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Oil TEXAS 1500		-	-	1	-	1	4	1	3	3	-
Oil type I MIL-S-3136		1	3	1	1	1	4	1	4	2	4
Oil type II MIL-S-3136		1	-	1	-	2	4	2	4	4	4
Oil type III MIL-S-3136		1	4	1	1	1	4	1	4	4	4
Oil type IV MIL-S-3136		-	-	1	-	1	4	1	1	1	-
Oil type V MIL-S-3136		-	-	1	-	1	4	1	3	3	-
Oil type VI MIL-S-3136		-	-	1	-	1	4	1	3	4	-
Oil VEEDOL		-	-	1	-	1	4	1	3	3	-
Oils H-P	80	-	-	1	-	1	4	1	3	3	-
Oleic acid	60	1	1	1	4	2	4	3	4	4	4
Oleum (fuming sulphuric acid)	80	1	1	1	3	4	4	4	4	4	4
Olive oil	80	1	1	1	1	1	2	1	1	2	4
Organophosphate	80	1	2	1	-	3	1	4	4	4	4
Oxalic acid	60	1	1	1	2	1	1	2	2	2	2
Oxygen (100 °C < T < 200 °C)		1	2	2	3	4	4	4	2	4	4
Oxygen (T < 100 °C)		1	1	1	1	1	1	2	1	1	4
Ozone (50 ppm)		1	1	1	1	1	1	2	1	2	4
p-dichlorobenzene (PDCB)	60	1	3	1	4	2	4	4	4	4	4
Palmitic acid	60	1	1	1	1	1	2	2	4	2	3
Par-al-ketone		1	4	4	-	4	4	4	4	4	4
Paraffin	60	1	-	1	1	1	4	1	1	1	4
Paraldehyde	40	1	-	4	-	-	1	4	-	2	-
Peanut oil		1	1	1	1	1	3	1	1	3	4
Pentachlorophenol (PCP)	80	1	-	1	-	-	4	4	-	4	-
Pentachlorobenceno tool		1	-	1	-	2	4	4	4	4	4
Pentalin (pentachloroethane)	80	1	-	1	-	-	-	4	-	4	4
Pentane	80	1	-	1	-	3	4	1	4	2	4
Pentanol	80	1	1	2	2	1	1	2	4	2	2
Perchlorethylene	80	1	4	1	3	2	4	3	4	4	4
Perchloric acid	80	1	2	1	4	1	2	4	4	2	4
Petrolatum	80	1	1	1	1	1	4	1	4	2	4
Petroleum oil (crude)	20	1	1	1	1	1	4	1	4	2	4
Petroleum oil (T < 150 °C)		1	1	1	1	2	4	1	2	2	4
Petroleum oil (T > 150 °C)		1	1	1	2	4	4	4	4	4	4
Phenolsulfonic acid	20	1	-	2	-	-	-	4	-	-	4
Phenyl acetate	40	1	-	4	-	-	2	4	-	4	4
Phenyl ether (diphenyl oxide)	60	1	2	1	4	2	4	4	3	4	4
Phenyl hydrazine	80	1	1	1	4	2	4	4	3	4	2
Phenyl methyl ketone	80	1	-	4	4	4	1	4	4	4	4
Phenylbenzene (Diphenyl)	60	1	2	1	4	2	4	4	4	4	4
Phosgene	80	1	-	2	-	-	1	2	-	1	-
Phosphoric acid, 3 M	80	1	1	1	2	2	1	4	2	3	2
Phosphoric acid, 85 %	80	1	2	1	3	2	2	4	3	4	3
Phosphoryl chloride	20	1	-	-	-	-	-	4	-	4	-
Photo Developer	80	1	1	1	1	1	2	1	1	1	2
Phthalic acid	60	1	2	2	-	-	2	3	-	2	-
Phthalic anhydride	60	1	-	2	-	-	1	-	-	4	-
Pine oil	80	1	1	1	2	1	4	2	4	3	4
Pinene	80	1	1	1	2	1	4	2	4	3	4
Piperidine	20	1	-	4	4	4	4	4	4	4	4
Pirrol	80	1	-	4	4	4	3	4	3	4	3
Potassium acetate	80	1	1	4	4	4	1	2	4	2	4
Potassium bicarbonate	80	1	-	1	1	-	-	1	-	1	-
Potassium bisulfite	80	1	1	1	1	-	1	1	-	1	1
Potassium bisulphate	80	1	1	1	1	-	1	1	-	2	1
Potassium bromide	80	1	1	1	1	-	1	1	-	2	1
Potassium carbonate	80	1	1	1	1	1	1	1	1	1	1
Potassium chlorate	80	1	1	1	-	-	1	4	-	2	2
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

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Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Potassium chloride	80	1	1	1	1	1	1	1	1	1	1
Potassium chromate	80	1	1	1	-	1	1	1	1	1	2
Potassium cyanide	20	1	1	1	1	1	1	1	1	1	1
Potassium dichromate	80	1	1	1	1	1	1	1	1	1	2
Potassium ferricianide (Prussian Red)	80	1	-	-	-	-	-	4	-	-	-
Potassium ferrocyanide	80	1	-	-	-	-	-	-	-	-	-
Potassium fluoride	80	1	-	-	-	-	-	-	-	-	-
Potassium hydroxide, 50 %	80	1	1	4	2	3	1	3	3	2	2
Potassium hypochlorite	80	1	-	-	-	-	-	-	-	-	-
Potassium iodate	80	1	-	-	-	-	-	-	-	-	-
Potassium iodide	80	1	1	1	1	1	1	1	1	1	1
Potassium nitrate	80	1	1	1	1	1	1	1	1	2	1
Potassium nitrite	80	1	1	1	1	1	1	1	1	2	1
Potassium oxalate	80	1	-	-	-	-	-	-	-	-	-
Potassium perchlorate	80	1	1	1	1	1	1	2	1	2	3
Potassium permanganate	80	1	-	1	1	1	1	3	1	2	4
Potassium persulphate (KPS)	80	1	-	1	2	1	1	4	1	2	4
Potassium phosphate	80	1	1	1	-	-	1	1	-	1	-
Potassium silicate (liquid crystal)	80	1	1	1	1	-	1	1	-	1	1
Potassium sulphate	80	1	1	1	1	1	1	1	1	2	2
Potassium sulphide	20	1	1	1	1	-	1	1	-	1	1
Potassium sulphite	80	1	1	1	1	1	1	2	1	2	2
Propanal (propioaldehyde)	20	1	-	4	-	-	-	4	-	-	-
Propane (LPG)	80	1	1	1	1	2	4	1	4	2	4
Propionic acid	80	1	1	1	-	-	1	3	-	3	-
Propionitrile (ethyl cyanide)	80	1	1	1	1	3	3	2	4	2	4
Propyl acetate	60	1	4	4	4	4	2	4	4	4	4
Propyl alcohol (propanol)	80	1	1	1	1	1	1	2	2	1	1
Propyl nitrate	40	1	-	4	4	4	2	4	4	4	4
Propylamine	20	1	-	4	4	4	4	4	4	4	4
Propylenchlorhydrine	80	1	-	3	-	-	-	-	-	-	-
Propylene	80	1	1	1	4	2	4	4	4	4	4
Propylene dichloride	80	1	-	1	-	-	4	4	-	4	4
Propylene glycol	80	1	1	1	-	-	1	1	-	2	1
Propylene oxide	20	1	3	3	4	4	2	4	4	4	4
Pyric acid (TNP)	80	1	2	1	2	2	1	2	4	2	2
Pyridine	80	1	2	3	4	4	2	4	4	4	4
Pyrogalic acid (pyrogalol)	80	1	-	1	-	-	-	-	-	-	-
Quinine (sulfate)	20	1	-	1	-	-	-	-	-	-	-
Rapeseed oil	80	1	1	1	1	1	2	1	3	3	4
Red fuming nitric acid (RFNA)	40	2	3	3	4	4	4	4	4	4	4
RED LINE 100 Oil	-	-	-	1	-	1	4	1	4	3	-
Refrigerant R-130 coolant	80	1	4	1	4	2	4	4	4	4	4
RJ-1 (MIL-F-12558) fuel	-	-	-	1	-	1	4	1	4	3	-
RJ-1 (MIL-R-25576) fuel	-	-	-	1	-	1	4	1	4	3	-
RJ-1 (MIL-R-25576) fuel	80	1	1	1	1	1	4	1	4	2	4
Romanian (isopropyl benceno)	80	1	3	1	4	2	4	4	4	4	4
Rotenone	20	1	1	1	-	-	1	1	-	1	-
RP-1 (MIL-R-25576) fuel	-	-	-	1	-	1	4	1	4	3	-
RP-1 (MIL-R-25576) fuel	-	-	-	1	-	1	4	1	4	3	-
RP-1 (MIL-R-25576) fuel	80	1	1	1	1	1	4	1	4	2	4
Salicylic acid	80	1	1	1	1	1	1	1	1	1	2
Sea water	20	1	1	1	1	1	1	1	1	2	1
SHELL CARNEA Oil 19, 29	-	-	-	1	-	1	4	1	-	4	-
SHELL MACOMA Oil 72	-	-	-	1	-	1	4	1	4	3	-
SHELL UMF fuel	-	-	-	1	-	1	4	1	4	3	-
Silicon tetrachloride	40	2	-	1	-	-	-	-	-	-	-
Silicone grease	80	1	1	1	1	2	1	1	3	2	1
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Silicone oil VERSILUBE F-50		-	-	1	-	1	1	1	3	1	-
Silver bromide	20	1	-	-	-	-	-	-	-	-	-
Silver chloride	20	1	-	-	-	-	-	-	-	-	-
Silver cyanide	20	1	-	-	-	-	-	-	-	1	-
Silver nitrate	80	1	1	1	1	1	1	1	1	1	1
SINCLAIR OPALINE engine oil		-	-	1	-	1	4	1	4	3	-
Soap solutions	80	1	1	1	1	1	1	1	1	2	2
Sodium acetate	80	1	2	4	4	4	1	2	4	2	4
Sodium aluminate	80	1	-	1	-	-	-	1	-	1	1
Sodium arsenite	80	1	-	-	-	-	-	-	-	4	-
Sodium benzoate	80	1	1	1	1	1	1	1	1	1	1
Sodium bicarbonate	80	1	1	1	1	1	1	1	1	1	1
Sodium bisulfite	80	1	1	1	1	1	1	3	1	1	4
Sodium bisulphate (niter cake)	20	1	1	1	1	1	1	1	1	1	1
Sodium bromate	80	1	1	1	-	-	1	-	-	-	-
Sodium bromide	80	1	1	1	-	-	1	-	-	-	-
Sodium carbonate	80	1	1	1	1	1	1	1	1	1	1
Sodium chlorate	80	1	1	1	1	1	1	2	1	1	3
Sodium chloride	80	1	1	1	1	1	1	1	1	1	1
Sodium chlorite	80	1	2	1	-	-	1	4	-	-	-
Sodium chromate	80	1	1	1	1	1	1	1	1	1	1
Sodium citrate	80	1	-	-	-	-	-	-	-	-	-
Sodium cyanide	80	1	1	1	1	1	1	1	1	1	1
Sodium dichromate	80	1	1	1	1	1	1	1	1	1	1
Sodium ethoxide	20	1	-	-	-	-	-	-	-	-	-
Sodium ferricyanide	80	1	-	-	-	-	-	-	-	-	-
Sodium ferrocyanide	80	1	-	1	-	-	-	-	-	-	-
Sodium fluoride (Fluorol)	20	1	1	1	-	-	1	1	-	1	-
Sodium hypochlorite, 20 %	80	1	1	1	1	2	2	2	2	3	3
Sodium hyposulfite	80	1	1	1	-	1	1	2	1	1	2
Sodium iodide	80	1	1	1	-	-	1	-	-	-	-
Sodium lactate	80	1	-	-	-	-	-	1	-	-	-
Sodium metaphosphate	80	1	1	1	1	1	1	1	-	2	1
Sodium metasilicate (liquid crystal)	80	1	-	1	1	-	-	1	-	1	-
Sodium nitrate	80	1	1	1	1	1	1	2	4	2	2
Sodium nitrite	80	1	1	1	1	1	1	2	4	2	2
Sodium oleate	40	1	-	-	-	-	-	-	-	-	-
Sodium oxalate	80	1	1	1	-	-	1	1	-	-	-
Sodium perborate (PBS)	80	1	1	1	1	1	1	2	2	2	3
Sodium perchlorate	80	1	-	-	-	-	-	-	-	-	-
Sodium peroxide		1	1	1	2	1	1	2	4	2	2
Sodium persulphate	80	1	1	1	-	-	1	-	-	-	-
Sodium silicate	80	1	1	1	1	1	1	1	1	1	1
Sodium sulphide	20	1	1	2	1	2	1	2	2	1	2
Sodium sulphite	20	1	1	1	1	1	1	1	1	1	2
Sodium tartrate	80	1	-	-	-	-	-	-	-	-	-
Sodium thiosulphate	80	1	1	1	1	1	1	2	1	1	2
Solution for tanning		-	-	3	-	4	3	4	4	4	-
Solvent BAYOL 35		-	-	1	-	1	4	1	4	3	-
Solvent for lacquer		1	4	4	4	4	4	4	4	4	4
Solvent SKELLY B, C, E		-	-	1	-	1	4	1	-	4	-
Solvent SOVASOL 1, 2, 3		-	-	1	-	1	4	1	4	3	-
Solvent SOVASOL 73, 74		-	-	1	-	1	4	3	4	3	-
Solvent Stoddard	20	1	2	1	1	1	4	1	4	2	4
Soybean oil	60	1	1	1	1	1	3	1	1	3	4
Spindle oil	60	-	-	1	-	1	4	1	1	3	-
Starch		1	1	1	1	1	1	1	1	1	1
Steam	150	1	1	1*	1	4	1	4	3	3	4
Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR

NOTE: The information shown in the tables should only be used as a reference guide. The tests have been carried out in the laboratory and do not have to reproduce real field conditions. It is the responsibility of the User to check the chemical compatibility of the process fluid with the elastomer of interest. For further information, please contact our Technical Dept

CONTINUE ...

... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Steam	175	1	1	1*	3	4	1	4	4	4	4
Steam	200	1	1	1*	4	4	4	4	4	4	4
Steam	260	2	3	1*	4	4	4	4	4	4	4
Stearic acid	60	1	1	2	2	2	3	3	3	3	3
Succinic acid	80	1	1	1	-	1	1	1	1	2	1
Sucrose solution	80	1	1	1	1	1	1	1	1	2	1
Sugar cane licor	40	1	1	1	2	1	1	2	1	1	1
Sulphamic acid	60	1	-	-	-	-	1	2	-	2	2
Sulphur		1	1	1	4	1	1	4	1	1	4
Sulphur (molten)	115	1	1	1	-	3	3	4	3	3	4
Sulphur dioxide (dry)	80	1	2	4	3	2	1	4	2	4	2
Sulphur dioxide (wet)	80	1	2	4	3	2	1	4	2	3	3
Sulphur hexafluoride	80	2	2	2	2	2	1	2	2	1	4
Sulphur trioxide (dry)	80	1	2	1	4	2	3	4	3	4	4
Sulphuric acid	80	1	1	1	2	3	2	2	4	2	2
Sulphuric acid, 3 M	80	1	1	1	3	3	2	4	4	3	3
Sulphuric acid, 98 %	80	1	1	1	4	4	4	4	4	4	4
Sulphurised crude oil	80	2	2	4	2	4	4	-	4	-	-
Sulphuryl chloride	40	1	-	1	-	-	2	4	-	2	2
SWAN FINCH hydraulic fluid		-	-	1	-	1	4	1	4	4	-
SWAN FINCH Oil 90		-	-	1	-	1	4	1	4	3	-
T-chloramine	80	1	-	-	1	-	1	1	-	1	1
Tannic acid	80	1	1	1	1	1	1	2	2	2	3
Tar	20	1	1	1	2	1	4	2	2	3	4
Tartaric acid	80	1	1	1	1	1	2	1	1	2	2
Terbutyl catecol (TBC)	60	1	2	1	-	1	2	4	3	2	3
Terpineol	80	1	-	1	3	1	3	2	4	4	4
Tertiary butyl alcohol (TBA, tert-butanol)	40	1	1	1	2	2	2	2	2	2	2
Tertiary butyl mercaptan (TBM)	20	1	1	1	4	-	4	4	4	4	4
Tetrabromoethane	20	1	1	1	4	2	1	4	4	2	4
Tetrabromomethane	40	1	-	1	4	2	4	4	4	4	4
Tetrachlorodifluoroethane		1	-	1	-	4	4	2	4	2	3
Tetrachloroethylene (PERC)	80	1	4	1	4	2	4	4	4	4	4
Tetraethyl lead (TEL)	20	1	3	1	2	2	4	2	4	3	3
Tetraethyl orthosilicate	80	1	1	1	2	1	4	2	4	1	4
Tetraethylene glycol (TEG)	40	1	-	1	1	-	-	1	-	-	1
Tetrahydrofuran (THF, Oxolan)	20	1	4	4	4	4	3	4	4	4	4
Tetraline (THN)	20	1	4	1	4	1	4	4	4	4	4
Thermal oil (mineral based)	60	1	-	1	1	1	4	1	3	3	-
Thermal oil MOBILTHERM 600		-	-	1	-	1	4	1	4	3	-
Thioglycolic acid (TGA, mercaptoacetic acid)	20	1	-	-	-	-	-	-	-	-	-
THIOKOL Plasticizer TP-90B		-	-	1	-	3	1	4	-	3	-
THIOKOL Plasticizer TP-95		-	-	1	-	3	1	4	-	3	-
Thionyl chloride	40	1	-	1	4	4	4	4	4	4	4
Thiophene	60	1	-	3	-	-	4	4	-	4	4
Tin chloride (II), 15 %	20	1	1	1	1	1	1	1	2	2	1
Tin chloride (IV), 50 %	60	1	2	1	1	1	1	1	2	3	1
Titanium (IV) butoxide (TBT)	80	1	1	1	2	1	1	2	2	2	2
Titanium (IV) chloride	80	2	2	1	2	2	4	3	4	4	4
Toluene (Toluol)	80	1	4	1	3	2	4	4	4	4	4
Toluene diisocyanate (TDI)	80	1	4	4	4	4	2	4	4	4	4
Toluidine	80	1	-	2	-	-	-	4	-	-	-
Transformer oil	80	1	1	1	1	1	4	1	2	2	4
Transformer oil SHELL DIALA		-	-	1	-	1	4	1	4	3	-
Transmission fluid AEROSAFE 2300		-	-	4	-	3	1	4	3	4	-
Transmission fluid AEROSAFE 2300W		-	-	4	-	3	1	4	3	4	-
Triacetin (glycerine triacetate)	80	1	4	4	2	4	1	2	1	2	3
Trialkyl phosphate	20	1	1	4	4	4	2	4	4	4	4

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

CONTINUE ...

... CHEMICAL RESISTANCE
... CONTINUE

Fluid	T / °C	FFPM	FEPM	FPM	H-NBR	FVMQ	EPDM	NBR	VMQ	CR	SBR
Triaryl phosphate	20	1	1	1	4	2	1	4	3	4	4
Tributoxyethyl phosphate (TBEP)	20	1	1	1	4	2	1	4	-	4	2
Tributyl phosphate (TBP)	60	1	2	4	4	4	1	4	3	4	4
Trichloroacetic acid (TCA)	80	1	3	3	2	3	2	2	3	4	4
Trichlorobenzene (TCB)		1	-	2	-	-	-	4	-	4	4
Trichloroethane	20	1	2	1	4	2	4	4	4	4	4
Trichloroethylene (TCE)	60	1	4	1	4	2	4	4	4	4	4
Trichloropropane (TCP)		1	-	2	-	-	-	4	-	1	4
Trichoethylene (TEC)	20	1	4	1	4	3	3	4	4	4	4
Tricresyl phosphate (TCP)		1	1	2	4	2	2	4	3	4	4
Tridecanol	20	1	-	1	-	-	-	1	-	-	1
Triethanol amine (TEA)	80	2	1	3	3	3	2	3	3	2	2
Triethyl aluminium (ATE)	80	1	-	2	-	-	3	4	-	3	4
Triethyl amine (TEA)	40	1	-	2	3	3	4	3	4	3	3
Triethyl boron (TEB)	60	1	-	1	-	-	3	4	-	4	4
Triethyl phosphate (TEP)		1	-	4	-	-	-	-	-	-	-
Triethylene glycol (TEG)	80	1	1	1	1	-	1	1	-	1	1
Trinitrotoluene (TNT)	40	1	2	2	4	2	4	4	3	2	4
Trioctyl phosphate		1	1	2	4	2	1	4	3	4	4
Triphenyl phosphite	40	1	1	-	-	-	-	-	-	-	-
Trisodium phosphate (TSP)	80	1	1	1	1	1	1	1	3	2	1
Turbine Oil # 15 (MIL-L-7808A)		-	-	1	-	3	4	3	4	4	-
Turbine oil		1	1	1	1	2	4	2	4	4	4
Turbo Oil # 35		-	-	1	-	1	4	1	4	3	-
Turpentine		1	2	1	1	2	4	1	4	4	4
Turpentine	60	1	-	1	3	-	4	3	4	3	-
Urea (carbamide)	80	1	1	1	-	-	1	2	-	1	1
Uric acid		1	-	-	-	-	-	1	-	-	-
Valeric acid	80	1	-	-	-	-	1	4	-	4	-
Varnish	40	1	2	1	2	2	4	2	4	4	4
Vaseline	60	1	-	1	1	1	4	1	3	1	-
Vegetable fats		1	1	1	1	1	3	1	2	3	4
Vegetable oils		1	1	1	1	1	3	1	2	3	4
Vinegar	80	1	2	1	2	2	1	2	1	1	2
Vinyl acetate (acrylonitrile)	60	1	4	4	4	-	2	4	-	2	4
Vinyl chloride	20	1	2	1	4	2	3	4	4	4	4
Vinylacetylene	20	1	2	1	1	-	1	1	2	2	2
Waste water	80	1	1	1	1	1	1	1	1	2	1
Water (cold)	20	1	1	1	1	1	1	1	1	2	1
Water (hot)	80	1	1	1	1	1	1	2	1	-	-
Whisky	20	1	1	1	1	1	1	1	1	1	-
White oil	20	1	1	1	1	1	4	1	4	2	4
White pine oil	80	1	1	1	2	1	4	2	4	4	4
Wine	20	1	1	1	1	1	1	1	1	1	-
Wood oil from China (tung)	80	1	1	1	1	2	4	1	4	2	4
Xenon		1	1	1	1	1	1	1	1	1	1
Xylamon	20	1	-	3	4	-	4	4	4	-	-
Xylene (xylo)	80	1	3	1	4	1	4	4	4	4	4
Xylidine	80	1	1	4	3	4	4	3	4	4	4
Zeolit		1	1	1	1	1	1	1	1	1	1
Zinc acetate	80	1	3	4	2	4	1	3	4	2	3
Zinc ammonium chloride		1	-	-	1	-	-	1	-	-	-
Zinc carbonate		1	-	1	1	-	-	1	-	-	1
Zinc chloride	80	1	1	1	1	1	1	1	1	1	1
Zinc cyanide		1	-	-	1	-	-	1	-	-	-
Zinc dithionite		1	-	1	1	-	-	1	-	1	-
Zinc nitrate	80	1	-	-	1	-	-	1	-	-	-
Zinc phosphate		1	-	-	1	-	-	1	-	-	-
Zinc sulphate	80	1	1	1	1	1	1	1	1	1	2

NOTE: The information shown in the tables should only be used as a reference guide. The tests have been carried out in the laboratory and do not have to reproduce real field conditions. It is the responsibility of the User to check the chemical compatibility of the process fluid with the elastomer of interest. For further information, please contact our Technical Dept

1 Excellent 2 Good result 3 Moderate Attack 4 Not recommended "-" No data

* FPM peroxide cured

ANNEX IV

CLASSIFICATION ACCORDING TO ASTM D 2000 / UNE 53-535-94

The vast majority of specifications for rubber compounds are based on **ASTM D 2000** nomenclature. This classification system assumes that all rubber items can be sorted by designating the characteristics of the material.

These designations are determined by **TYPES**, based on resistance to heat aging, and by **CLASSES**, based on resistance to oils. This establishes basic levels which, together with values describing other complementary requirements, make it possible to complete a description of the quality of all elastomeric materials.

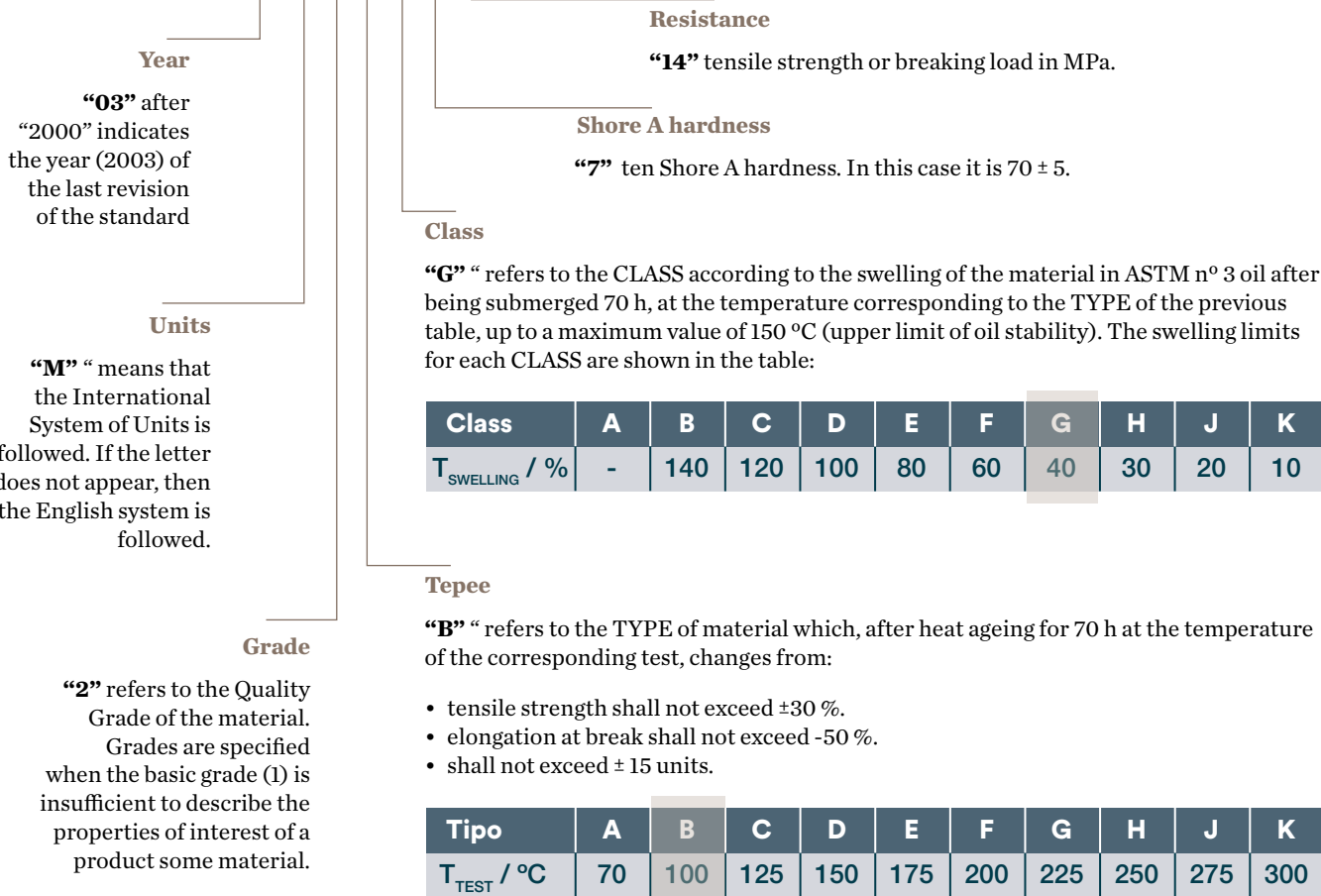
This classification allows the most relevant properties of the elastomer to be synthesized in an alphanumeric designation.

Example alphanumeric designation

ASTM D 2000 – 03 M 2 B G 714 B14 EA14 EF11 EF31 EO14 EO34 F17

MAIN CODING

ASTM D 2000 – 03 M 2 B G 714 B14 EA14 EF11 EF31 EO14 EO34 F17



CONTINUE ...

... CLASSIFICATION ACCORDING TO ASTM D 2000 / UNE 53-535-94. Main coding.
... CONTINUE

On the other hand, if the Type and Class of materials are crossed, a code is obtained for the most commonly used elastomers. Note that this table reflects the different formulations for the same elastomer. For example, the NBR belongs to several groups: BF, BG, BJ, and CH.

Type and Class	Materials
AA	NR / SBR / IR / IIR / EPM / EPDM
AK	T
BA	SBR / IIR / EPM / EPDM
BC	CR / CM
BE	CR / CM
BF	NBR
BG	NBR / AU / EU
BK	T / NBR
BJ	NBR
CA	EPM / EPDM
CE	CR / CSM / CM
CF	ACM
CH	NBR / ECO

Type and Class	Materials
DA	EPM / EPDM
DE	CSM / CM
DF	ACM
DH	ACM / HNBR
EE	AEM
H	ACM
FC	VMQ
FE	VMQ
FK	FMVQ
GE	VMQ
HK	FPM
KK	FFPM

With the exception of FC, FE, FK and GE materials, the values in the tables are for black rubbers and there may be no comparable values for rubbers of another colour.

SECONDARY CODING OR SUFFIXES

ASTM D 2000 – 03 M 2 B G 714 B14 EA14 EF11 EF31 EO14 EO34 F17

In order to provide information on properties additional to hardness, tensile strength, *Compression Set* and *Swelling* resistance, suffixes are added which make up the secondary code.

Each suffix consists of a combination of letters and numbers and indicates a test method that is the same for all materials. The admissible results for each test vary according to the Type, Class and Grade of the material.

A suffix, accompanied by the Type, Class and Grade of the material of interest, is a result. Otherwise, it's just a test sample.

Codification letters

ASTM D 2000 – 03 M 2 B G 714 B14 EA14 EF11 EF31 EO14 EO34 F17

Code	Test
A	Resistance to heat aging
B	Remaining compression deformation
C	Resistance to ozone or weathering
D	Resistance to compression-deformation
EA	Resistance to fluids (aqueous)
EF	Resistance to fluids (fuels)
EO	Resistance to fluids (oils and lubricants)
F	Low temperature resistance
G	Resistance to tearing

Code	Test
H	Bending resistance
J	Abrasion resistance
K	Adherence
M	Fire behaviour
N	Impact resistance
P	Resistance to staining
R	Resilience
Z	Any other special requirements to be detailed

... CONTINUE

Coding numbers

ASTM D 2000 – 03 M 2 B G 714 B 1 4 EA 1 4 EF 1 1 EF 3 1 EO 1 4 EO 3 4 F 1 7

First digit

The **first digit** defines a specific test and a duration, depending on the letter of the suffix and the grade of material designated. For example, for heat resistance you have to:

1st digit	1	2	3	4	5	6
Suffix "A". Resistance to heat	D 573	D 865	D 865	D 573	D 573	D 865
Time	70 h	70 h	168 h	168 h	1.000 h	1.000 h

Second digit

The **second digit** specifies the temperature of the test, depending on the letter of the designated suffix:

Temperatures for designations A, B, C, EA, EF, EO, G, K												
2nd digit	0	1	2	3	4	5	6	7	8	9	10	11
T _{TEST} / °C	*	23	38	70	100	125	150	175	200	225	250	275

* ambient temperature, in case it is an outdoor test.

Temperatures for the designation F												
2nd digit	1	2	3	4	5	6	7	8	9	10	11	12
T _{TEST} / °C	23	0	-10	-18	-25	-35	-40	-50	-55	-65	-75	-80

The letter Z has been reserved for singular specifications. For example, for hardness. If it is specified to be 75 °Sh A, then a specific hardness test must be performed. The number that accompanies the letter informs of the number of special tests to be performed.

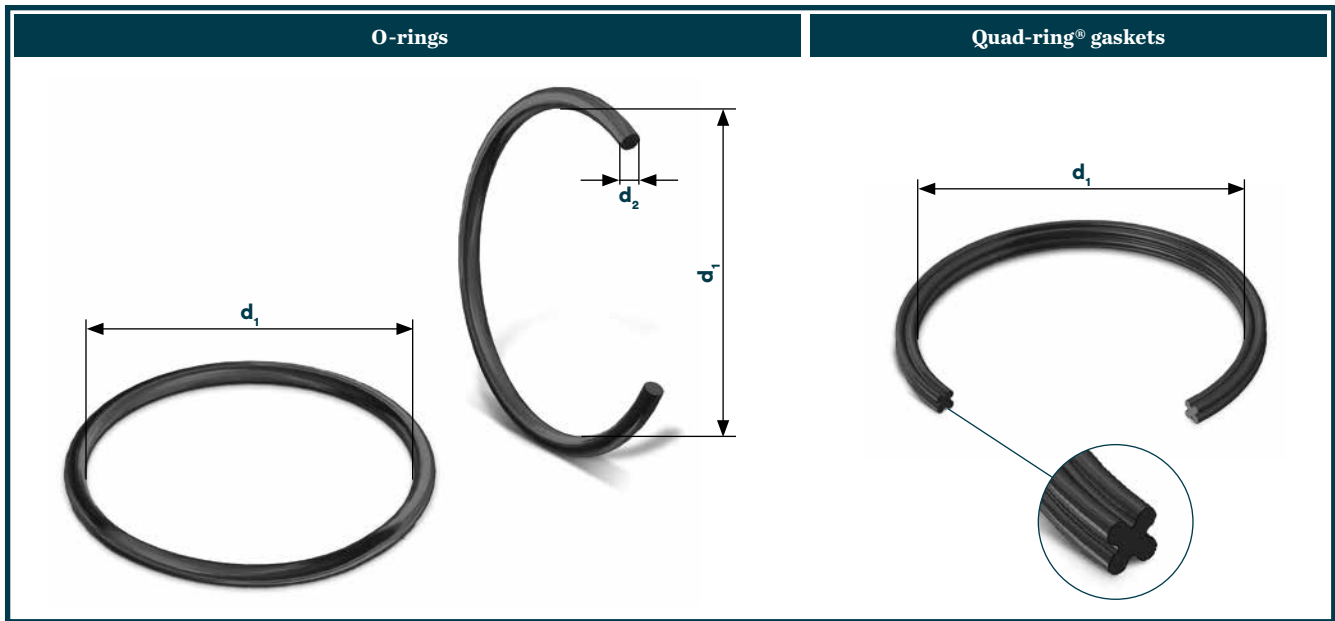
Detailed information can be found at www.astm.org

Detailed information can be found at www.aenor.es

ANNEX V

STANDARD O-RINGS

This section presents the standard dimensions for O-rings and **Quad-ring®** gaskets manufactured by moulding and according to the dimensional standards of several countries. The inside diameters (d_1) are listed according to the cross-section diameters (d_2).



Standard dimensions. **Figure 34**

The following standards are commonly used:

ISO



Regulations published by the **International Organization of Standardization (ISO)**.

ISO 3601

Refers to two groups of O-rings:

- Class A corresponds to the American standard AS 568B in its current format (900 series O-rings are not included).
- Class B alludes to O-rings in metric sizes..

ISO 6149

For **Metric Tube Fittings**.

Thirteen different sizes are included, specifying the metric thread for each of them

SMS 1586

Swedish standard for O-rings (**Sveriges Mekanstandardisering**) similar to DIN 3771 ($d_1 \times d_2$).

O-rings SMS 1586 are classified in:

- Dynamic and static services (D)
- Static services exclusively (S).

DIN 3771

The **Duetsches Institut für Normung** identifies an o-ring by:

- “ d_1 (inner \varnothing) x d_2 (cross section \varnothing)”
- can be added:
N: normal quality
S: special quality
- the acronym for elastomer
- and its IRHD hardness

BS



Regulations published by the **British Standards Institution**

BS 4518

Identifies standard metric sizes.

The size is a four-digit number indicating the inner diameter in tenths of millimetres, followed by a dash and two digits indicating the cross-section of the O-ring, also in tenths of a millimetre.

BS 4518

Identifies normalized imperial sizes.

This standard has been replaced by BS ISO 3601, however it is still used.

NFT 47-501



Regulations of the **French Standards Institute**.

Sizes are designated:

- a letter corresponding to each of the 5 section groups (A - E)
- 4 digits indicating the inside diameter
- a 2nd letter referring to accuracy A: for aerospace applications G: for general use
- a 3rd letter for the Visual class (inspection).

JIS B 2401



Japanese standards developed by **Japanese Industrial Standards (JIS)** for O-rings sizes, also known as “Japanese Measures”.

It has four series, depending on the service and identified by the letters:

- P (dynamic)
- G (static)
- S (special sizes)
- V (vacuum services). Size codes are ascending numbers.

AS 568



Nomr published by the **Society of Automotive Engineers (S.A.E.)**.

The table specifies internal diameters, cross sections, tolerances, and size identification codes (dash numbers) for O-rings used in sealing applications and for straight threaded pipe mounting bushing joints.

OUTSIDE OF NORM: If the joint of interest is not standardized and has a special size, then it can be manufactured by another of the procedures described in section Production ¹⁵:

- Machining
- Vulcanization of O-ring
- Continuous Moulding
- Conventional Moulding

¹⁵ See page 35

... NORMALIZED OR

Table of O-rings according to international standards

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT T 47-501	DIN 3771	ISO 6149	JIS B 2401	
3,00	1,00										✓
4,00	1,00										✓
5,00	1,00										✓
6,00	1,00										✓
7,00	1,00										✓
8,00	1,00										✓
9,00	1,00										✓
10,00	1,00										✓
11,00	1,00										✓
12,00	1,00										✓
13,00	1,00										✓
0,74	1,02	-001	-001								
1,78	1,02		-606								
2,54	1,02		-607								
1,07	1,27	-002	-002								
4,70	1,42	-901									
2,50	1,50									S-3	
3,00	1,50										✓
3,50	1,50									S-4	
4,00	1,50										✓
4,50	1,50									S-5	
5,00	1,50										✓
5,50	1,50									S-6	
6,00	1,50										✓
6,50	1,50									S-7	
7,00	1,50										✓
7,50	1,50									S-8	
8,00	1,50										✓
8,50	1,50									S-9	
9,00	1,50										✓
9,50	1,50									S-10	
10,00	1,50										✓
10,70	1,50									S-11.2	
11,00	1,50										✓
11,50	1,50									S-12	
12,00	1,50										✓
12,00	1,50									S-12.5	
13,00	1,50										✓
13,50	1,50									S-14	
14,00	1,50										✓
14,50	1,50									S-15	
15,50	1,50									S-16	
16,00	1,50										✓
17,00	1,50										✓
17,50	1,50									S-18	
19,00	1,50										✓
19,50	1,50									S-20	
20,00	1,50										✓
21,50	1,50									S-22	
1,42	1,52	-003	-003								
3,10	1,60				0031-16						
4,10	1,60				0041-16						
5,10	1,60				0051-16						
6,10	1,60				0061-16				M8 X 1		
7,10	1,60				0071-16						
8,10	1,60				0081-16				M10 X 1		
9,10	1,60				0091-16						
10,10	1,60				0101-16						
11,10	1,60				0111-16						
12,10	1,60				0121-16						
13,10	1,60				0131-16						

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT T 47-501	DIN 3771	ISO 6149	JIS B 2401	
14,10	1,60				0141-16						
15,10	1,60				0151-16						
16,10	1,60				0161-16						
17,10	1,60				0171-16						
18,10	1,60				0181-16						
19,10	1,60				0191-16						
20,10	1,60				0201-16						
21,10	1,60				0211-16						
22,10	1,60				0221-16						
25,10	1,60				0251-16						
27,10	1,60				0271-16						
29,10	1,60				0291-16						
32,10	1,60				0321-16						
35,10	1,60				0351-16						
37,10	1,60				0371-16						
6,07	1,63	-902									
7,65	1,63	-903									
1,78	1,78	-004	-004								
2,57	1,78	-005	-005								
2,90	1,78	-006	-006								
3,18	1,78		-801								
3,68	1,78	-007	-007								
4,47	1,78	-008	-008								
4,75	1,78		-802								
5,28	1,78	-009	-009								
6,07	1,78	-010	-010								
6,35	1,78		-803								
6,76	1,78		-610								
7,65	1,78	-011	-011								
7,94	1,78		-804								
8,74	1,78		-611								
9,25	1,78	-012	-012								
10,82	1,78	-013	-013								
11,10	1,78		-806								
12,42	1,78	-014	-014								
14,00	1,78	-015	-015								
15,60	1,78	-016	-016								
17,17	1,78	-017	-017								
18,77	1,78	-018	-018								
20,35	1,78	-019	-019								
21,95	1,78	-020	-020								
23,52	1,78	-021	-021								
25,12	1,78	-022	-022								
26,70	1,78	-023	-023								
28,30	1,78	-024	-024								
29,87	1,78	-025	-025								
31,47	1,78	-026	-026								
33,05	1,78	-027	-027								
34,65	1,78	-028	-028								
36,27	1,78		-517								
37,82	1,78	-029	-029								
39,45	1,78		-519								
41,00	1,78	-030	-030								
44,17	1,78	-031	-031								
47,35	1,78	-032	-032								
50,52	1,78	-033	-033								
53,70	1,78	-034	-034								
56,87	1,78	-035	-035								
60,05	1,78	-036	-036								
63,22	1,78	-037	-037								
66,40	1,78	-038	-038								
69,57	1,78	-039	-039								
72,75	1,78	-040	-040								
75,92	1,78	-041	-041								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
78,99	1,78		-532								
82,27	1,78	-042	-042								
85,34	1,78		-534								
88,62	1,78	-043	-043								
91,69	1,78		-536								
94,97	1,78	-044	-044								
98,04	1,78		-538								
101,32	1,78	-045	-045								
104,39	1,78		-540								
107,67	1,78	-046	-046								
110,74	1,78		-542								
114,02	1,78	-047	-047								
117,09	1,78		-544								
120,37	1,78	-048	-048								
123,44	1,78		-546								
126,72	1,78	-049	-049								
129,41	1,78		-548								
133,07	1,78	-050	-050								
135,76	1,78		-550								
138,94	1,78		-551								
142,11	1,78		-552								
145,29	1,78		-553								
148,46	1,78		-554								
151,64	1,78		-555								
154,81	1,78		-556								
157,99	1,78		-557								
161,16	1,78		-558								
164,34	1,78		-559								
170,05	1,78		-560								
170,69	1,78		-561								
173,86	1,78		-562								
1,80	1,80			A0018			A0018	1.8 X 1.8			
2,00	1,80			A0020			A0020	2 X 1.8			
2,24	1,80			A0022			A0022	2.24 X 1.8			
2,50	1,80			A0025			A0025	2.5 X 1.8			
2,80	1,80			A0028			A0028	2.8 X 1.8			
3,15	1,80			A0032			A0032	3.15 X 1.8			
3,55	1,80			A0036			A0036	3.55 X 1.8			
3,75	1,80			A0038			A0038	3.75 X 1.8			
4,00	1,80			A0040			A0040	4 X 1.8			
4,50	1,80			A0045			A0045	4.5 X 1.8			
4,75	1,80						A0048				
4,87	1,80			A0049			A0049	4.87 X 1.8			
5,00	1,80			A0050			A0050	5 X 1.8			
5,15	1,80			A0052			A0052	5.15 X 1.8			
5,30	1,80			A0053			A0053	5.3 X 1.8			
5,60	1,80			A0056			A0056	5.6 X 1.8			
6,00	1,80			A0060			A0060	6 X 1.8			
6,30	1,80			A0063			A0063	6.3 X 1.8			
6,70	1,80			A0067			A0067	6.7 X 1.8			
6,90	1,80			A0069			A0069	6.9 X 1.8			
7,10	1,80			A0071			A0071	7.1 X 1.8			
7,50	1,80			A0075			A0075	7.5 X 1.8			
8,00	1,80			A0080			A0080	8 X 1.8			
8,50	1,80			A0085			A0085	8.5 X 1.8			
8,75	1,80			A0088			A0088	8.75 X 1.8			
9,00	1,80			A0090			A0090	9 X 1.8			
9,50	1,80			A0095			A0095	9.5 X 1.8			
10,00	1,80			A0100			A0100	10 X 1.8			
10,60	1,80			A0106			A0106	10.6 X 1.8			
11,20	1,80			A0112			A0112	11.2 X 1.8			
11,60	1,80						A0116				
11,80	1,80			A0118			A0118	11.8 X 1.8			
12,10	1,80						A0121				

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
12,50	1,80			A0125			A0125	12.5 X 1.8			
12,80	1,80						A0128				
13,20	1,80			A0132			A0132	13.2 X 1.8			
14,00	1,80			A0140			A0140	14 X 1.8			
14,50	1,80						A0145				
15,00	1,80			A0150			A0150	15 X 1.8			
15,50	1,80						A0155				
16,00	1,80			A0160			A0160	16 X 1.8			
17,00	1,80			A0170			A0170	17 X 1.8			
18,00	1,80			A0180			A0180				
19,00	1,80			A0190			A0190				
20,00	1,80			A0200			A0200				
20,60	1,80						A0206				
21,20	1,80			A0212			A0212				
22,40	1,80			A0224			A0224				
23,60	1,80			A0236			A0236				
24,30	1,80						A0243				
25,00	1,80			A0250			A0250				
25,80	1,80			A0258			A0258				
26,50	1,80			A0265			A0265				
27,30	1,80						A0273				
28,00	1,80			A0280			A0280				
30,00	1,80			A0300			A0300				
31,50	1,80			A0315			A0315				
32,50	1,80			A0325			A0325				
33,50	1,80			A0335			A0335				
34,50	1,80			A0345			A0345				
35,50	1,80			A0355			A0355				
36,50	1,80			A0365			A0365				
37,50	1,80			A0375			A0375				
38,70	1,80			A0387			A0387				
40,00	1,80			A0400			A0400				
41,20	1,80			A0412			A0412				
42,50	1,80			A0425			A0425				
43,70	1,80			A0437			A0437				
45,00	1,80			A0450			A0450				
46,20	1,80						A0462				
47,50	1,80			A0475			A0475				
48,70	1,80						A0487				
50,00	1,80			A0500			A0500				
53,00	1,80			A0530							
56,00	1,80			A0560							
60,00	1,80			A0600							
63,00	1,80			A0630							
67,00	1,80			A0670							
71,00	1,80			A0710							
75,00	1,80			A0750							
80,00	1,80			A0800							
85,00	1,80			A0850							
90,00	1,80			A0900							
95,00	1,80			A0950							
100,00	1,80			A1000							
106,00	1,80			A1060							
112,00	1,80			A1120							
118,00	1,80			A1180							
125,00	1,80			A1250							
8,92	1,83	-904									
10,52	1,83	-905									
2,80	1,90										P3
3,80	1,90										P4
4,80	1,90										P5
5,80	1,90										P6
6,80	1,90										P7
7,80	1,90										P8

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
8,80	1,90									P9	
9,80	1,90									P10	
11,89	1,98	-906									
4,00	2,00										✓
5,00	2,00										✓
5,00	2,00										✓
6,00	2,00										✓
7,00	2,00										✓
8,00	2,00										✓
9,00	2,00										✓
10,00	2,00										✓
11,00	2,00										✓
12,00	2,00										✓
13,00	2,00										✓
14,00	2,00										✓
15,00	2,00										✓
16,00	2,00										✓
17,00	2,00										✓
18,00	2,00										✓
19,00	2,00										✓
20,00	2,00										✓
21,90	2,00									S-22.4	
23,00	2,00										✓
23,50	2,00									S-24	
24,00	2,00										✓
24,50	2,00									S-25	
25,00	2,00										✓
25,50	2,00									S-26	
26,00	2,00										✓
27,00	2,00										✓
27,50	2,00									S-28	
28,00	2,00										✓
28,50	2,00									S-29	
29,00	2,00										✓
29,50	2,00									S-30	
30,00	2,00										✓
31,00	2,00									S-31.5	
31,50	2,00									S-32	
32,00	2,00										✓
33,50	2,00									S-34	
34,00	2,00										✓
34,50	2,00									S-35	
35,00	2,00									S-35.5	
35,50	2,00									S-36	
36,00	2,00										✓
37,00	2,00										✓
37,50	2,00									S-38	
38,50	2,00									S-39	
39,50	2,00									S-40	
40,00	2,00										✓
41,50	2,00									S-42	
42,00	2,00										✓
43,00	2,00										✓
43,50	2,00									S-44	
44,50	2,00									S-45	
45,00	2,00										✓
45,50	2,00									S-46	
46,00	2,00										✓
47,00	2,00										✓
47,50	2,00									S-48	
48,00	2,00										✓
49,50	2,00									S-50	
50,00	2,00										✓
52,00	2,00										✓

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT T 47-501	DIN 3771	ISO 6149	JIS B 2401	
52,50	2,00									S-53	
54,50	2,00									S-55	
55,00	2,00										✓
55,50	2,00									S-56	
59,50	2,00									S-60	
60,00	2,00										✓
62,00	2,00										✓
62,50	2,00									S-63	
64,50	2,00									S-65	
65,00	2,00										✓
66,50	2,00									S-67	
69,50	2,00									S-70	
70,00	2,00										✓
70,50	2,00									S-71	
74,50	2,00									S-75	
79,50	2,00									S-80	
80,00	2,00										✓
84,50	2,00									S-85	
89,50	2,00									S-90	
94,50	2,00									S-95	
99,50	2,00									S-100	
100,00	2,00										✓
104,50	2,00									S-105	
109,50	2,00									S-110	
111,50	2,00									S-112	
114,50	2,00									S-115	
119,50	2,00									S-120	
124,50	2,00									S-125	
129,50	2,00									S-130	
131,50	2,00									S-132	
134,50	2,00									S-135	
139,50	2,00									S-140	
144,50	2,00									S-145	
149,50	2,00									S-150	
13,46	2,08	-907									
9,30	2,20								M12 X 1.5		
11,30	2,20								M14 X 1.5		
13,30	2,20								M16 X 1.5		
15,30	2,20								M18 X 1.5		
17,30	2,20								M20 X 1.5		
19,30	2,20								M22 X 1.5		
16,36	2,21	-908									
3,30	2,40					D 3.3 x 2.4					
3,60	2,40				0036-24						
4,30	2,40					D 4.3 x 2.4					
4,60	2,40				0046-24						
5,30	2,40					D 5.3 x 2.4					
5,60	2,40				0056-24						
6,30	2,40					D 6.3 x 2.4					
6,60	2,40				0066-24						
7,30	2,40					D 7.3 x 2.4					
7,60	2,40				0076-24						
8,30	2,40					D 8.3 x 2.4					
8,60	2,40				0086-24						
9,30	2,40					D 9.3 x 2.4					
9,60	2,40				0096-24						
9,80	2,40									P10A	
10,30	2,40					D 10.3 x 2.4					
10,60	2,40				0106-24						
10,80	2,40									P11	
11,00	2,40									P11.2	
11,30	2,40					D 11.3 x 2.4					
11,60	2,40				0116-24						
11,80	2,40									P12	

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NF T 47-501	DIN 3771	ISO 6149	JIS B 2401	
12,30	2,40					D 12.3 x 2.4				P12.5	
12,60	2,40				0126-24					P13	
12,80	2,40										
13,30	2,40					D 13.3 x 2.4				P14	
13,60	2,40				0136-24						
13,80	2,40										
14,30	2,40					D 14.3 x 2.4				P15	
14,60	2,40				0146-24						
14,80	2,40										
15,30	2,40					D 15.3 x 2.4				P16	
15,60	2,40				0156-24						
15,80	2,40										
16,30	2,40					D 16.3 x 2.4				P17	
16,60	2,40				0166-24						
16,80	2,40										
17,30	2,40					D 17.3 x 2.4				P18	
17,60	2,40				0176-24						
17,80	2,40										
18,60	2,40				0186-24					P19	
18,80	2,40										
19,60	2,40				0196-24					P20	
19,80	2,40										
20,60	2,40				0206-24					P21	
20,80	2,40										
21,60	2,40				0216-24					P22	
21,80	2,40										
24,60	2,40				0246-24						
27,60	2,40				0276-24						
29,60	2,40				0296-24						
31,60	2,40				0316-24						
34,60	2,40				0346-24						
35,60	2,40				0356-24						
37,60	2,40				0376-24						
39,60	2,40				0396-24						
41,60	2,40				0416-24						
44,60	2,40				0446-24						
45,60	2,40				0456-24						
47,60	2,40				0476-24						
49,60	2,40				0496-24						
51,60	2,40				0516-24						
54,60	2,40				0546-24						
55,60	2,40				0556-24						
57,60	2,40				0576-24						
58,60	2,40				0586-24						
59,60	2,40				0596-24						
61,60	2,40				0616-24						
62,60	2,40				0626-24						
64,60	2,40				0646-24						
67,60	2,40				0676-24						
69,60	2,40				0696-24						
17,93	2,46	-909									
19,18	2,46	-910									
5,00	2,50										✓
6,00	2,50										✓
7,00	2,50										✓
8,00	2,50										✓
9,00	2,50										✓
10,00	2,50										✓
11,00	2,50										✓
12,00	2,50										✓
13,00	2,50										✓
14,00	2,50										✓
15,00	2,50										✓
17,00	2,50										✓

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT T 47-501	DIN 3771	ISO 6149	JIS B 2401	
18,00	2,50										✓
19,00	2,50										✓
20,00	2,50										✓
22,00	2,50										✓
23,00	2,50										✓
24,00	2,50										✓
25,00	2,50										✓
26,00	2,50										✓
27,00	2,50										✓
30,00	2,50										✓
31,00	2,50										✓
32,00	2,50										✓
33,00	2,50										✓
35,00	2,50										✓
38,00	2,50										✓
40,00	2,50										✓
42,00	2,50										✓
45,00	2,50										✓
48,00	2,50										✓
50,00	2,50										✓
51,00	2,50										✓
54,00	2,50										✓
55,00	2,50										✓
57,00	2,50										✓
60,00	2,50										✓
1,24	2,62	-102	-102								
2,06	2,62	-103	-103								
2,84	2,62	-104	-104								
3,63	2,62	-105	-105								
4,42	2,62	-106	-106								
4,45	2,62										
5,23	2,62	-107	-107								
6,02	2,62	-108	-108								
7,59	2,62	-109	-109								
9,19	2,62	-110	-110								
9,93	2,62		-613								
10,77	2,62	-111	-111								
11,91	2,62		-614								
12,37	2,62	-112	-112								
12,70	2,62										✓
13,11	2,62										
13,94	2,62	-113	-113								
15,09	2,62		-616								
15,54	2,62	-114	-114								
15,88	2,62		-019								
17,12	2,62	-115	-115								
17,45	2,62		-810								
17,86	2,62		-617								
18,72	2,62	-116	-116								
20,29	2,62	-117	-117								
20,62	2,62		-812								
21,89	2,62	-118	-118								
22,23	2,62		-813								
23,47	2,62	-119	-119								
23,80	2,62		-814								
25,07	2,62	-120	-120								
26,64	2,62	-121	-121								
28,24	2,62	-122	-122								
29,82	2,62	-123	-123								
31,42	2,62	-124	-124								
32,99	2,62	-125	-125								
34,59	2,62	-126	-126								
36,17	2,62	-127	-127								
37,77	2,62	-128	-128								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
39,34	2,62	-129	-129								
40,94	2,62	-130	-130								
42,52	2,62	-131	-131								
44,12	2,62	-132	-132								
45,69	2,62	-133	-133								
47,29	2,62	-134	-134								
48,90	2,62	-135	-135								
50,47	2,62	-136	-136								
52,07	2,62	-137	-137								
53,64	2,62	-138	-138								
55,25	2,62	-139	-139								
56,82	2,62	-140	-140								
58,42	2,62	-141	-141								
59,99	2,62	-142	-142								
61,60	2,62	-143	-143								
63,17	2,62	-144	-144								
64,77	2,62	-145	-145								
66,34	2,62	-146	-146								
67,95	2,62	-147	-147								
69,52	2,62	-148	-148								
71,12	2,62	-149	-149								
72,69	2,62	-150	-150								
74,27	2,62		-640								
75,87	2,62	-151	-151								
77,44	2,62		-641								
80,62	2,62		-642								
82,22	2,62	-152	-152								
83,79	2,62		-643								
88,57	2,62	-153	-153								
94,92	2,62	-154	-154								
101,27	2,62	-155	-155								
107,62	2,62	-156	-156								
113,97	2,62	-157	-157								
120,32	2,62	-158	-158								
126,67	2,62	-159	-159								
133,02	2,62	-160	-160								
139,37	2,62	-161	-161								
145,72	2,62	-162	-162								
152,07	2,62	-163	-163								
158,42	2,62	-164	-164								
164,77	2,62	-165	-165								
171,12	2,62	-166	-166								
177,47	2,62	-167	-167								
183,82	2,62	-168	-168								
190,17	2,62	-169	-169								
196,52	2,62	-170	-170								
202,87	2,62	-171	-171								
209,22	2,62	-172	-172								
215,57	2,62	-173	-173								
221,92	2,62	-174	-174								
228,27	2,62	-175	-175								
234,62	2,62	-176	-176								
240,97	2,62	-177	-177								
247,32	2,62	-178	-178								
4,50	2,65			B0045							
5,30	2,65			B0053							
6,00	2,65			B0060							
6,90	2,65			B0069							
8,00	2,65			B0080							
9,00	2,65			B0090			B0090				
9,50	2,65			B0095			B0095				
10,00	2,65			B0100			B0100				
10,60	2,65			B0106			B0106				
11,20	2,65			B0112			B0112				

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
11,60	2,65						B0116				
11,80	2,65			B0118			B0118				
12,10	2,65						B0121				
12,50	2,65			B0125			B0125				
12,80	2,65						B0128				
13,20	2,65			B0132			B0132				
14,00	2,65			B0140			B0140	14 X 2.65			
14,50	2,65						B0145				
15,00	2,65			B0150			B0150	15 X 2.65			
16,00	2,65			B0160			B0160	16 X 2.65			
17,00	2,65			B0170			B0170	17 X 2.65			
18,00	2,65			B0180			B0180	18 X 2.65			
19,00	2,65			B0190			B0190	19 X 2.65			
20,00	2,65			B0200			B0200	20 X 2.65			
20,60	2,65						B0206				
21,20	2,65			B0212			B0212	21.2 X 2.65			
22,40	2,65			B0224			B0224	22.4 X 2.65			
23,60	2,65			B0236			B0236	23.6 X 2.65			
24,30	2,65						B0243				
25,00	2,65			B0250			B0250	25 X 2.65			
25,80	2,65			B0258			B0258	25.8 X 2.65			
26,50	2,65			B0265			B0265	26.5 X 2.65			
27,30	2,65						B0273				
28,00	2,65			B0280			B0280	28 X 2.65			
30,00	2,65			B0300			B0300	30 X 2.65			
31,50	2,65			B0315			B0315	31.5 X 2.65			
32,50	2,65			B0325			B0325	32.5 X 2.65			
33,50	2,65			B0335			B0335	33.5 X 2.65			
34,50	2,65			B0345			B0345	34.5 X 2.65			
35,50	2,65			B0355			B0355	35.5 X 2.65			
36,50	2,65			B0365			B0365	36.5 X 2.65			
37,50	2,65			B0375			B0375	37.5 X 2.65			
38,70	2,65			B0387			B0387	38.7 X 2.65			
40,00	2,65			B0400			B0400				
41,20	2,65			B0412			B0412				
42,50	2,65			B0425			B0425				
43,70	2,65			B0437			B0437				
45,00	2,65			B0450			B0450				
46,20	2,65			B0462			B0462				
47,50	2,65			B0475			B0475				
48,70	2,65			B0487			B0487				
50,00	2,65			B0500			B0500				
51,50	2,65			B0515			B0515				
53,00	2,65			B0530			B0530				
54,50	2,65			B0545			B0545				
56,00	2,65			B0560			B0560				
58,00	2,65			B0580			B0580				
60,00	2,65			B0600			B0600				
61,50	2,65			B0615			B0615				
63,00	2,65			B0630			B0630				
65,00	2,65			B0650			B0650				
67,00	2,65			B0670			B0670				
69,00	2,65			B0690			B0690				
71,00	2,65			B0710			B0710				
73,00	2,65			B0730			B0730				
75,00	2,65			B0750			B0750				
77,50	2,65						B0775				
80,00	2,65			B0800			B0800				
82,50	2,65						B0825				
85,00	2,65			B0850			B0850				
87,50	2,65						B0875				
90,00	2,65			B0900			B0900				
92,50	2,65						B0925				
95,00	2,65			B0950			B0950				

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
97,50	2,65						B0975				
100,00	2,65			B1000			B1000				
106,00	2,65			B1060							
112,00	2,65			B1120							
118,00	2,65			B1180							
125,00	2,65			B1250							
132,00	2,65			B1320							
140,00	2,65			B1400							
150,00	2,65			B1500							
160,00	2,65			B1600							
170,00	2,65			B1700							
180,00	2,65			B1800							
190,00	2,65			B1900							
200,00	2,65			B2000							
212,00	2,65			B2120							
224,00	2,65			B2240							
230,00	2,65			B2300							
236,00	2,65			B2360							
243,00	2,65			B2430							
250,00	2,65			B2500							
23,60	2,90								M27 X 2		
29,60	2,90								M33 X 2		
38,60	2,90								M42 X 2		
44,60	2,90								M48 X 2		
56,60	2,90								M60 X 2		
21,92	2,95	-911									
23,47	2,95	-912									
25,04	2,95	-913									
26,59	2,95	-914									
29,74	2,95	-916									
34,42	2,95	-918									
8,00	3,00										✓
9,00	3,00										✓
10,00	3,00										✓
11,00	3,00										✓
12,00	3,00										✓
13,00	3,00										✓
14,00	3,00										✓
15,00	3,00										✓
16,00	3,00										✓
17,00	3,00										✓
18,00	3,00										✓
19,00	3,00										✓
19,20	3,00						D 19.2 x 3				
19,50	3,00				0195-30						
20,00	3,00										✓
21,00	3,00										✓
21,50	3,00				0215-30						
22,00	3,00										✓
22,20	3,00						D 22.2 x 3				
22,50	3,00				0225-30						
23,00	3,00										✓
24,00	3,00										✓
24,20	3,00						D 24.2 x 3				
24,50	3,00				0245-30						
25,00	3,00										✓
25,50	3,00				0255-30						
26,00	3,00										✓
26,20	3,00						D 26.2 x 3				
26,50	3,00				0265-30						
27,00	3,00										✓
27,50	3,00				0275-30						
28,00	3,00										✓
29,20	3,00						D 29.2 x 3				

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
29,50	3,00				0295-30						
30,00	3,00										✓
31,00	3,00										✓
31,50	3,00				0315-30						
32,00	3,00										✓
32,20	3,00					D 32.2 x 3					
32,50	3,00				0325-30						
33,00	3,00										✓
34,00	3,00										✓
34,20	3,00					D 34.2 x 3					
34,50	3,00				0345-30						
35,00	3,00										✓
35,50	3,00				0355-30						
36,00	3,00										✓
36,20	3,00					D 36.2 x 3					
36,50	3,00				0365-30						
37,00	3,00										✓
37,47	3,00	-920									
37,50	3,00				0375-30						
38,00	3,00										✓
39,00	3,00										✓
39,20	3,00					D 39.2 x 3					
39,50	3,00				0395-30						
40,00	3,00										✓
41,00	3,00										✓
41,50	3,00				0415-30						
42,20	3,00					D 42.2 x 3					
42,50	3,00				0425-30						
43,00	3,00										✓
43,69	3,00	-924									
44,00	3,00										✓
44,20	3,00					D 44.2 x 3					
44,50	3,00				0445-30						
45,00	3,00										✓
46,00	3,00										✓
47,00	3,00										✓
49,00	3,00										✓
49,50	3,00				0495-30	S 49.5 x 3					
50,00	3,00										✓
52,00	3,00										✓
53,09	3,00	-928									
54,00	3,00										✓
54,50	3,00				0545-30	S 54.5 x 3					
55,00	3,00										✓
55,50	3,00				0555-30						
56,00	3,00										✓
57,00	3,00										✓
57,50	3,00				0575-30						
58,00	3,00										✓
59,00	3,00										✓
59,36	3,00	-932									
59,50	3,00				0595-30	S 59.5 x 3					
60,00	3,00										✓
62,00	3,00										✓
62,50	3,00				0625-30						
63,00	3,00										✓
64,00	3,00										✓
64,50	3,00				0645-30	S 64.5 x 3					
65,00	3,00										✓
67,00	3,00										✓
68,00	3,00										✓
69,00	3,00										✓
69,50	3,00				0695-30	S 69.5 x 3					
70,00	3,00										✓

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
71,00	3,00										✓
72,00	3,00										✓
73,00	3,00										✓
74,00	3,00										✓
74,50	3,00				0745-30	S 74.5 x 3					
75,00	3,00										✓
79,50	3,00				0795-30	S 79.5 x 3					
80,00	3,00										✓
84,50	3,00				0845-30	S 84.5 x 3					
85,00	3,00										✓
89,50	3,00				0895-30	S 89.5 x 3					
90,00	3,00										✓
94,50	3,00				0945-30	S 94.5 x 3					
95,00	3,00										✓
99,50	3,00				0995-30	S 99.5 x 3					
100,00	3,00										✓
104,50	3,00				1045-30	S 104.5 x 3					
105,00	3,00										✓
109,50	3,00				1095-30	S 109.5 x 3					
110,00	3,00										✓
114,50	3,00				1145-30	S 114.5 x 3					
115,00	3,00										✓
119,50	3,00				1195-30	S 119.5 x 3					
120,00	3,00										✓
124,50	3,00				1245-30	S 124.5 x 3					
125,00	3,00										✓
129,50	3,00				1295-30	S 129.5 x 3					
130,00	3,00										✓
134,50	3,00				1345-30	S 134.5 x 3					
139,50	3,00				1395-30	S 139.5 x 3					
144,50	3,00				1445-30	S 144.5 x 3					
149,50	3,00				1495-30						
150,00	3,00										✓
154,50	3,00				1545-30						
155,00	3,00										✓
159,50	3,00				1595-30						
164,50	3,00				1645-30						
169,50	3,00				1695-30						
170,00	3,00										✓
174,50	3,00				1745-30						
175,00	3,00										✓
179,50	3,00				1795-30						
180,00	3,00										✓
184,50	3,00				1845-30						
189,50	3,00				1895-30						
194,50	3,00				1945-30						
199,50	3,00				1995-30						
209,50	3,00				2095-30						
219,50	3,00				2195-30						
229,50	3,00				2295-30						
239,50	3,00				2395-30						
244,50	3,00				2445-30						
249,50	3,00				2495-30						
24,40	3,10									G25	
29,40	3,10									G30	
34,40	3,10									G35	
39,40	3,10									G40	
44,40	3,10									G45	
49,40	3,10									G50	
54,40	3,10									G55	
59,40	3,10									G60	
64,40	3,10									G65	
69,40	3,10									G70	
74,40	3,10									G75	

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT T 47-501	DIN 3771	ISO 6149	JIS B 2401	
79,40	3,10									G80	
84,40	3,10									G85	
89,40	3,10									G90	
94,40	3,10									G95	
99,40	3,10									G100	
104,40	3,10									G105	
109,40	3,10									G110	
114,40	3,10									G115	
119,40	3,10									G120	
124,40	3,10									G125	
129,40	3,10									G130	
134,40	3,10									G135	
139,40	3,10									G140	
144,40	3,10									G145	
18,00	3,50										✓
20,00	3,50										✓
21,70	3,50									P22A	
22,00	3,50										✓
22,10	3,50									P22.4	
23,70	3,50									P24	
24,00	3,50										✓
24,70	3,50									P25	
25,00	3,50										✓
25,20	3,50									P25.5	
25,70	3,50									P26	
27,00	3,50										✓
27,70	3,50									P28	
28,70	3,50									P29	
29,20	3,50									P29.5	
29,70	3,50									P30	
30,00	3,50										✓
30,70	3,50									P31	
31,20	3,50									P31.5	
31,70	3,50									P32	
32,70	3,50									P33	
33,00	3,50										✓
33,70	3,50									P34	
34,70	3,50									P35	
35,00	3,50										✓
35,20	3,50									P35.5	
35,70	3,50									P36	
37,70	3,50									P38	
38,00	3,50										✓
38,70	3,50									P39	
39,70	3,50									P40	
40,00	3,50										✓
40,70	3,50									P41	
41,70	3,50									P42	
42,00	3,50										✓
43,00	3,50										✓
43,70	3,50									P44	
44,00	3,50										✓
44,70	3,50									P45	
45,00	3,50										✓
45,70	3,50									P46	
47,70	3,50									P48	
48,70	3,50									P49	
49,70	3,50									P50	
50,00	3,50										✓
55,00	3,50										✓
56,00	3,50										✓
60,00	3,50										✓
4,34	3,53	-201	-201								
5,94	3,53	-202	-202								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
7,52	3,53	-203	-203								
9,12	3,53	-204	-204								
10,69	3,53	-205	-205								
12,29	3,53	-206	-206								
13,87	3,53	-207	-207								
13,94	3,53										
15,47	3,53	-208	-208								
17,04	3,53	-209	-209								
17,07	3,53										
18,64	3,53	-210	-210								
20,22	3,53	-211	-211								
21,82	3,53	-212	-212								
23,39	3,53	-213	-213								
24,99	3,53	-214	-214								
25,81	3,53		-618								
26,57	3,53	-215	-215								
28,17	3,53	-216	-216								
29,74	3,53	-217	-217								
31,34	3,53	-218	-218								
32,92	3,53	-219	-219								
34,52	3,53	-220	-220								
36,09	3,53	-221	-221								
37,69	3,53	-222	-222								
39,70	3,53		-824								
40,87	3,53	-223	-223								
41,28	3,53		-825								
42,85	3,53		-826								
44,04	3,53	-224	-224								
44,45	3,53		-827								
46,04	3,53		-828								
47,22	3,53	-225	-225								
47,63	3,53		-829								
49,20	3,53		-830								
50,39	3,53	-226	-226								
50,80	3,53		-831								
52,39	3,53		-832								
53,57	3,53	-227	-227								
53,98	3,53		-833								
55,55	3,53		-834								
56,74	3,53	-228	-228								
57,15	3,53		-835								
58,74	3,53		-836								
59,92	3,53	-229	-229								
60,33	3,53		-837								
61,90	3,53		-838								
63,09	3,53	-230	-230								
63,50	3,53		-839								
65,10	3,53		-840								
66,27	3,53	-231	-231								
66,68	3,53		-841								
68,25	3,53		-842								
69,44	3,53	-232	-232								
69,85	3,53		-843								
71,44	3,53		-844								
72,62	3,53	-233	-233								
73,03	3,53		-845								
74,60	3,53		-846								
75,79	3,53	-234	-234								
78,97	3,53	-235	-235								
82,14	3,53	-236	-236								
85,32	3,53	-237	-237								
88,49	3,53	-238	-238								
91,67	3,53	-239	-239								
94,84	3,53	-240	-240								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
98,02	3,53	-241	-241								
101,19	3,53	-242	-242								
104,37	3,53	-243	-243								
107,54	3,53	-244	-244								
110,72	3,53	-245	-245								
113,89	3,53	-246	-246								
117,07	3,53	-247	-247								
120,24	3,53	-248	-248								
123,42	3,53	-249	-249								
126,59	3,53	-250	-250								
129,77	3,53	-251	-251								
132,94	3,53	-252	-252								
136,12	3,53	-253	-253								
139,29	3,53	-254	-254								
142,47	3,53	-255	-255								
145,64	3,53	-256	-256								
148,82	3,53	-257	-257								
151,99	3,53	-258	-258								
158,34	3,53	-259	-259								
164,69	3,53	-260	-260								
171,04	3,53	-261	-261								
177,39	3,53	-262	-262								
183,74	3,53	-263	-263								
190,09	3,53	-264	-264								
196,44	3,53	-265	-265								
202,79	3,53	-266	-266								
209,14	3,53	-267	-267								
215,49	3,53	-268	-268								
221,84	3,53	-269	-269								
228,19	3,53	-270	-270								
234,54	3,53	-271	-271								
240,89	3,53	-272	-272								
247,24	3,53	-273	-273								
253,59	3,53	-274	-274								
266,29	3,53	-275	-275								
278,99	3,53	-276	-276								
291,69	3,53	-277	-277								
304,39	3,53	-278	-278								
329,79	3,53	-279	-279								
355,19	3,53	-280	-280								
380,59	3,53	-281	-281								
405,26	3,53	-282									
430,66	3,53	-283									
456,06	3,53	-284									
14,00	3,55			C0140			C0140				
14,50	3,55						C0145				
15,00	3,55			C0150			C0150				
15,50	3,55						C0155				
16,00	3,55			C0160			C0160				
17,00	3,55			C0170			C0170				
18,00	3,55			C0180			C0180	18 X 3.55			
19,00	3,55			C0190			C0190	19 X 3.55			
20,00	3,55			CO200			CO200	20 X 3.55			
20,60	3,55						CO206				
21,20	3,55			CO212			CO212	21.2 X 3.55			
22,40	3,55			CO224			CO224	22.4 X 3.55			
23,60	3,55			CO236			CO236	23.6 X 3.55			
24,30	3,55						CO243				
25,00	3,55			CO250			CO250	25 X 3.55			
25,80	3,55			CO258			CO258	25.8 X 3.55			
26,50	3,55			CO265			CO265	26.5 X 3.55			
27,30	3,55						CO273				
28,00	3,55			CO280			CO280	28 X 3.55			
30,00	3,55			CO300			CO300	30 X 3.55			

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
31,50	3,55			CO315			CO315	31.5 X 3.55			
32,50	3,55			CO325			CO325	32.5 X 3.55			
33,50	3,55			CO335			CO335	33.5 X 3.55			
34,50	3,55			CO345			CO345	34.5 X 3.55			
35,50	3,55			CO355			CO355	35.5 X 3.55			
36,50	3,55			CO365			CO365	36.5 X 3.55			
37,50	3,55			CO375			CO375	37.5 X 3.55			
38,70	3,55			CO387			CO387	38.7 X 3.55			
40,00	3,55			C0400			C0400	40 X 3.55			
41,20	3,55			C0412			C0412	41.2 X 3.55			
42,50	3,55			C0425			C0425	42.5 X 3.55			
43,70	3,55			C0437			C0437	43.7 X 3.55			
45,00	3,55			C0450			C0450	45 X 3.55			
46,20	3,55			C0462			C0462	46.2 X 3.55			
47,50	3,55			C0475			C0475	47.5 X 3.55			
48,70	3,55			C0487			C0487	48.7 X 3.55			
50,00	3,55			CO500			CO500	50 X 3.55			
51,50	3,55			CO515			CO515	51.5 X 3.55			
53,00	3,55			CO530			CO530	53 X 3.55			
54,50	3,55			CO545			CO545	54.5 X 3.55			
56,00	3,55			CO560			CO560	56 X 3.55			
58,00	3,55			CO580			CO580	58 X 3.55			
60,00	3,55			C0600			C0600	60 X 3.55			
61,50	3,55			C0615			C0615	61.5 X 3.55			
63,00	3,55			C0630			C0630	63 X 3.55			
65,00	3,55			C0650			C0650	65 X 3.55			
67,00	3,55			C0670			C0670	67 X 3.55			
69,00	3,55			C0690			C0690	69 X 3.55			
71,00	3,55			C0710			C0710	71 X 3.55			
73,00	3,55			C0730			C0730	73 X 3.55			
75,00	3,55			C0750			C0750	75 X 3.55			
77,50	3,55			C0775			C0775	77.5 X 3.55			
80,00	3,55			C0800			C0800	80 X 3.55			
82,50	3,55			C0825			C0825	82.5 X 3.55			
85,00	3,55			C0850			C0850	85 X 3.55			
87,50	3,55			C0875			C0875	87.5 X 3.55			
90,00	3,55			C0900			C0900	90 X 3.55			
92,50	3,55			C0925			C0925	92.5 X 3.55			
95,00	3,55			C0950			C0950	95 X 3.55			
97,50	3,55			C0975			C0975	97.5 X 3.55			
100,00	3,55			C1000			C1000	100 X 3.55			
103,00	3,55			C1030			C1030	103 X 3.55			
106,00	3,55			C1060			C1060	106 X 3.55			
109,00	3,55			C1090			C1090	109 X 3.55			
112,00	3,55			C1120			C1120	112 X 3.55			
115,00	3,55			C1150			C1150	115 X 3.55			
118,00	3,55			C1180			C1180	118 X 3.55			
122,00	3,55			C1220			C1220	122 X 3.55			
125,00	3,55			C1250			C1250	125 X 3.55			
128,00	3,55			C1280			C1280	128 X 3.55			
132,00	3,55			C1320			C1320	132 X 3.55			
136,00	3,55			C1360			C1360	136 X 3.55			
140,00	3,55			C1400			C1400	140 X 3.55			
145,00	3,55			C1450			C1450	145 X 3.55			
150,00	3,55			C1500			C1500	150 X 3.55			
155,00	3,55			C1550			C1550	155 X 3.55			
160,00	3,55			C1600			C1600	160 X 3.55			
165,00	3,55			C1650			C1650	165 X 3.55			
170,00	3,55			C1700			C1700	170 X 3.55			
175,00	3,55			C1750			C1750	175 X 3.55			
180,00	3,55			C1800			C1800	180 X 3.55			
185,00	3,55			C1850			C1850	185 X 3.55			
190,00	3,55			C1900			C1900	190 X 3.55			
195,00	3,55			C1950			C1950	195 X 3.55			

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
200,00	3,55			C2000			C2000	200 X 3.55			
212,00	3,55			C2120							
218,00	3,55			C2180							
224,00	3,55			C2240							
230,00	3,55			C2300							
236,00	3,55			C2360							
250,00	3,55			C2500							
258,00	3,55			C2580							
265,00	3,55			C2650							
280,00	3,55			C2800							
290,00	3,55			C2900							
300,00	3,55			C3000							
307,00	3,55			C3070							
315,00	3,55			C3150							
335,00	3,55			C3350							
355,00	3,55			C3550							
12,00	4,00										✓
14,50	4,00									V-15	
16,00	4,00										✓
18,00	4,00										✓
20,00	4,00										✓
21,00	4,00										✓
23,50	4,00									V-24	
25,00	4,00										✓
27,00	4,00										✓
28,00	4,00										✓
30,00	4,00										✓
32,00	4,00										✓
33,50	4,00									V-34	
34,00	4,00										✓
35,00	4,00										✓
36,00	4,00										✓
38,00	4,00										✓
39,50	4,00									V-40	
40,00	4,00										✓
42,00	4,00										✓
43,00	4,00										✓
44,00	4,00										✓
45,00	4,00										✓
47,00	4,00										✓
48,00	4,00										✓
49,00	4,00										✓
52,00	4,00										✓
53,00	4,00										✓
54,00	4,00										✓
54,50	4,00									V-55	
55,00	4,00										✓
57,00	4,00										✓
58,00	4,00										✓
59,00	4,00										✓
60,00	4,00										✓
64,00	4,00										✓
65,00	4,00										✓
67,00	4,00										✓
68,00	4,00										✓
69,00	4,00									V-70	
70,00	4,00										✓
72,00	4,00										✓
74,00	4,00										✓
84,00	4,00									V-85	
85,00	4,00										✓
90,00	4,00										✓
99,00	4,00									V-100	
105,00	4,00										✓

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
110,00	4,00										✓
119,00	4,00									V-120	
120,00	4,00										✓
130,00	4,00										✓
140,00	4,00										✓
148,50	4,00									V-150	
150,00	4,00										✓
160,00	4,00										✓
170,00	4,00										✓
173,00	4,00									V-175	
180,00	4,00										✓
190,00	4,00										✓
200,00	4,00										✓
210,00	4,00										✓
220,00	4,00										✓
30,00	5,00										✓
35,00	5,00										✓
40,00	5,00										✓
45,00	5,00										✓
50,00	5,00										✓
55,00	5,00										✓
60,00	5,00										✓
65,00	5,00										✓
70,00	5,00										✓
75,00	5,00										✓
80,00	5,00										✓
85,00	5,00										✓
90,00	5,00										✓
95,00	5,00										✓
100,00	5,00										✓
105,00	5,00										✓
110,00	5,00										✓
115,00	5,00										✓
120,00	5,00										✓
125,00	5,00										✓
130,00	5,00										✓
140,00	5,00										✓
150,00	5,00										✓
160,00	5,00										✓
170,00	5,00										✓
180,00	5,00										✓
190,00	5,00										✓
200,00	5,00										✓
210,00	5,00										✓
220,00	5,00										✓
37,50	5,30			D0375			D0375				
38,70	5,30			D0387			D0387				
40,00	5,30			D0400			D0400	40 X 5.3			
41,20	5,30			D0412			D0412	41.2 X 5.3			
42,50	5,30			D0425			D0425	42.5 X 5.3			
43,70	5,30			D0437			D0437	43.7 X 5.3			
45,00	5,30			D0450			D0450	45 X 5.3			
46,20	5,30			D0462			D0462	46.2 X 5.3			
47,50	5,30			D0475			D0475	47.5 X 5.3			
48,70	5,30			D0487			D0487	48.7 X 5.3			
50,00	5,30			D0500			D0500	50 X 5.3			
51,50	5,30			D0515			D0515	51.5 X 5.3			
53,00	5,30			D0530			D0530	53 X 5.3			
54,50	5,30			D0545			D0545	54.5 X 5.3			
56,00	5,30			D0560			D0560	56 X 5.3			
58,00	5,30			D0580			D0580	58 X 5.3			
60,00	5,30			D0600			D0600	60 X 5.3			
61,50	5,30			D0615			D0615	61.5 X 5.3			
63,00	5,30			D0630			D0630	63 X 5.3			

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
65,00	5,30			D0650			D0650	65 X 5.3			
67,00	5,30			D0670			D0670	67 X 5.3			
69,00	5,30			D0690			D0690	69 X 5.3			
71,00	5,30			D0710			D0710	71 X 5.3			
73,00	5,30			D0730			D0730	73 X 5.3			
75,00	5,30			D0750			D0750	75 X 5.3			
77,50	5,30			D0775			D0775	77.5 X 5.3			
80,00	5,30			D0800			D0800	80 X 5.3			
82,50	5,30			D0825			D0825	82.5 X 5.3			
85,00	5,30			D0850			D0850	85 X 5.3			
87,50	5,30			D0875			D0875	87.5 X 5.3			
90,00	5,30			D0900			D0900	90 X 5.3			
92,50	5,30			D0925			D0925	92.5 X 5.3			
95,00	5,30			D0950			D0950	95 X 5.3			
97,50	5,30			D0975			D0975	97.5 X 5.3			
100,00	5,30			D1000			D1000	100 X 5.3			
103,00	5,30			D1030			D1030	103 X 5.3			
106,00	5,30			D1060			D1060	106 X 5.3			
109,00	5,30			D1090			D1090	109 X 5.3			
112,00	5,30			D1120			D1120	112 X 5.3			
115,00	5,30			D1150			D1150	115 X 5.3			
118,00	5,30			D1180			D1180	118 X 5.3			
122,00	5,30			D1220			D1220	122 X 5.3			
125,00	5,30			D1250			D1250	125 X 5.3			
128,00	5,30			D1280			D1280	128 X 5.3			
132,00	5,30			D1320			D1320	132 X 5.3			
136,00	5,30			D1360			D1360	136 X 5.3			
140,00	5,30			D1400			D1400	140 X 5.3			
145,00	5,30			D1450			D1450	145 X 5.3			
150,00	5,30			D1500			D1500	150 X 5.3			
155,00	5,30			D1550			D1550	155 X 5.3			
160,00	5,30			D1600			D1600	160 X 5.3			
165,00	5,30			D1650			D1650	165 X 5.3			
170,00	5,30			D1700			D1700	170 X 5.3			
172,50	5,30						D1725				
175,00	5,30			D1750			D1750	175 X 5.3			
177,50	5,30						D1775				
180,00	5,30			D1800			D1800	180 X 5.3			
182,50	5,30						D1825				
185,00	5,30			D1850			D1850	185 X 5.3			
187,50	5,30						D1875				
190,00	5,30			D1900			D1900	190 X 5.3			
195,00	5,30			D1950			D1950	195 X 5.3			
200,00	5,30			D2000			D2000	200 X 5.3			
203,00	5,30						D2030				
206,00	5,30						D2060	206 X 5.3			
212,00	5,30						D2120	212 X 5.3			
218,00	5,30						D2180	218 X 5.3			
224,00	5,30						D2240	224 X 5.3			
230,00	5,30						D2300	230 X 5.3			
236,00	5,30						D2360	236 X 5.3			
239,00	5,30						D2390				
243,00	5,30						D2430	243 X 5.3			
250,00	5,30						D2500	250 X 5.3			
254,00	5,30						D2540				
258,00	5,30						D2580	258 X 5.3			
261,00	5,30						D2610				
265,00	5,30						D2650	265 X 5.3			
268,00	5,30						D2680				
272,00	5,30						D2720	272 X 5.3			
276,00	5,30						D2760				
280,00	5,30						D2800	280 X 5.3			
283,00	5,30						D2830				
286,00	5,30						D2860				

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT T 47-501	DIN 3771	ISO 6149	JIS B 2401	
290,00	5,30						D2900	290 X 5.3			
295,00	5,30						D2950				
300,00	5,30						D3000	300 X 5.3			
303,00	5,30						D3030				
307,00	5,30						D3070	307 X 5.3			
311,00	5,30						D3110				
315,00	5,30						D3150	315 X 5.3			
320,00	5,30						D3200				
325,00	5,30						D3250	325 X 5.3			
330,00	5,30						D3300				
335,00	5,30						D3350	335 X 5.3			
340,00	5,30						D3400				
345,00	5,30						D3450	345 X 5.3			
350,00	5,30						D3500				
355,00	5,30						D3550	355 X 5.3			
360,00	5,30						D3600				
365,00	5,30						D3650	365 X 5.3			
370,00	5,30						D3700				
375,00	5,30						D3750	375 X 5.3			
379,00	5,30						D3790				
383,00	5,30						D3830				
387,00	5,30						D3870	387 X 5.3			
391,00	5,30						D3910				
395,00	5,30						D3950				
400,00	5,30						D4000	400 X 5.3			
10,46	5,33	-309	-309								
12,07	5,33	-310	-310								
13,64	5,33	-311	-311								
15,24	5,33	-312	-312								
16,81	5,33	-313	-313								
18,42	5,33	-314	-314								
19,99	5,33	-315	-315								
21,59	5,33	-316	-316								
23,16	5,33	-317	-317								
24,77	5,33	-318	-318								
26,34	5,33	-319	-319								
27,94	5,33	-320	-320								
29,51	5,33	-321	-321								
31,12	5,33	-322	-322								
32,69	5,33	-323	-323								
34,29	5,33	-324	-324								
37,47	5,33	-325	-325								
40,64	5,33	-326	-326								
43,82	5,33	-327	-327								
46,99	5,33	-328	-328								
50,17	5,33	-329	-329								
53,34	5,33	-330	-330								
56,52	5,33	-331	-331								
59,69	5,33	-332	-332								
62,87	5,33	-333	-333								
66,04	5,33	-334	-334								
69,22	5,33	-335	-335								
72,39	5,33	-336	-336								
74,61	5,33		-619								
75,57	5,33	-337	-337								
78,74	5,33	-338	-338								
79,78	5,33		-620								
81,92	5,33	-339	-339								
85,09	5,33	-340	-340								
88,27	5,33	-341	-341								
89,69	5,33		-621								
91,44	5,33	-342	-342								
94,62	5,33	-343	-343								
97,79	5,33	-344	-344								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NF T 47-501	DIN 3771	ISO 6149	JIS B 2401	
100,00	5,33		-622								
100,97	5,33	-345	-345								
104,14	5,33	-346	-346								
107,32	5,33	-347	-347								
109,54	5,33		-623								
110,49	5,33	-348	-348								
113,67	5,33	-349	-349								
116,84	5,33	-350	-350								
117,48	5,33		-860								
120,02	5,33	-351	-351								
120,65	5,33		-861								
123,19	5,33	-352	-352								
123,83	5,33		-862								
126,37	5,33	-353	-353								
127,00	5,33		-863								
129,54	5,33	-354	-354								
130,18	5,33		-864								
132,72	5,33	-355	-355								
133,35	5,33		-865								
135,89	5,33	-356	-356								
136,53	5,33		-866								
139,07	5,33	-357	-357								
139,70	5,33		-867								
142,24	5,33	-358	-358								
142,88	5,33		-868								
145,42	5,33	-359	-359								
146,05	5,33		-869								
148,59	5,33	-360	-360								
149,23	5,33		-870								
151,77	5,33	-361	-361								
154,94	5,33		-644								
158,12	5,33	-362	-362								
161,29	5,33		-645								
164,47	5,33	-363	-363								
167,64	5,33		-646								
170,82	5,33	-364	-364								
173,99	5,33		-647								
177,17	5,33	-365	-365								
183,52	5,33	-366	-366								
189,87	5,33	-367	-367								
196,22	5,33	-368	-368								
202,57	5,33	-369	-369								
208,92	5,33	-370	-370								
215,27	5,33	-371	-371								
221,62	5,33	-372	-372								
227,97	5,33	-373	-373								
234,32	5,33	-374	-374								
240,67	5,33	-375	-375								
247,02	5,33	-376	-376								
253,37	5,33	-377	-377								
266,07	5,33	-378	-378								
278,77	5,33	-379	-379								
291,47	5,33	-380	-380								
304,17	5,33	-381	-381								
329,57	5,33	-382	-382								
354,97	5,33	-383	-383								
380,37	5,33	-384	-384								
405,26	5,33	-385	-385								
430,66	5,33	-386	-386								
456,06	5,33	-387	-387								
481,46	5,33	-388	-388								
506,86	5,33	-389	-389								
532,26	5,33	-390	-390								
557,66	5,33	-391	-391								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
582,68	5,33	-392	-392								
608,08	5,33	-393	-393								
633,48	5,33	-394	-394								
658,88	5,33	-395	-395								
44,20	5,70					D 44.2 x 5.7					
44,30	5,70				0443-57						
45,30	5,70				0453-57						
47,60	5,70									P48A	
49,20	5,70					D 49.2 x 5.7					
49,30	5,70				0493-57	D 49.3 x 5.7					
49,60	5,70									P50A	
51,60	5,70									P52	
52,30	5,70				0523-57						
52,60	5,70									P53	
54,20	5,70					D 54.2 x 5.7					
54,30	5,70				0543-57						
54,60	5,70									P55	
55,30	5,70				0553-57						
55,60	5,70									P56	
57,60	5,70									P58	
59,20	5,70					D 59.2 x 5.7					
59,30	5,70				0593-57						
59,60	5,70									P60	
61,60	5,70									P62	
62,30	5,70				0623-57						
62,60	5,70									P63	
64,20	5,70					D 64.2 x 5.7					
64,30	5,70				0643-57						
64,60	5,70									P65	
66,60	5,70									P67	
69,20	5,70					D 69.2 x 5.7					
69,30	5,70				0693-57						
69,60	5,70									P70	
70,60	5,70									P71	
74,20	5,70					D 74.2 x 5.7					
74,30	5,70				0743-57						
74,60	5,70									P75	
79,20	5,70					D 79.2 x 5.7					
79,30	5,70				0793-57						
79,60	5,70									P80	
84,10	5,70					D 84.1 x 5.7					
84,30	5,70				0843-57						
84,60	5,70									P85	
89,10	5,70					D 89.1 x 5.7					
89,30	5,70				0893-57						
89,60	5,70									P90	
94,10	5,70					D 94.1 x 5.7					
94,30	5,70				0943-57						
94,60	5,70									P95	
99,10	5,70					D 99.1 x 5.7					
99,30	5,70				0993-57						
99,60	5,70									P100	
101,60	5,70									P102	
104,10	5,70					D 104.1 x 5.7					
104,30	5,70				1043-57						
104,60	5,70									P105	
109,10	5,70					D 109.1 x 5.7					
109,30	5,70				1093-57						
109,60	5,70									P110	
111,60	5,70									P112	
114,30	5,70				1143-57	D 114.3 x 5.7					
114,60	5,70									P115	
119,30	5,70				1193-57	D 119.3 x 5.7					
119,60	5,70									P120	

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

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Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NF T 47-501	DIN 3771	ISO 6149	JIS B 2401	
124,30	5,70				1243-57	D 124.3 x 5.7					
124,60	5,70									P125	
129,30	5,70				1293-57	D 129.3 x 5.7					
129,60	5,70									P130	
131,60	5,70									P132	
134,30	5,70				1343-57	D 134.3 x 5.7					
134,60	5,70									P135	
139,30	5,70				1393-57	D 139.3 x 5.7					
139,60	5,70									P140	
144,30	5,70				1443-57	D 144.3 x 5.7					
144,60	5,70									P145	
149,30	5,70				1493-57	S 149.3 x 5.7				G150	
149,60	5,70									P150	
154,30	5,70				1543-57	S 154.3 x 5.7				G155	
159,30	5,70				1593-57	S 159.3 x 5.7				G160	
164,30	5,70				1643-57	S 164.3 x 5.7				G165	
169,30	5,70				1693-57	S 169.3 x 5.7				G170	
174,30	5,70				1743-57	S 174.3 x 5.7				G175	
179,30	5,70				1793-57	S 179.3 x 5.7				G180	
184,30	5,70				1843-57	S 184.3 x 5.7				G185	
189,30	5,70				1893-57	S 189.3 x 5.7				G190	
194,30	5,70				1943-57	S 194.3 x 5.7				G195	
199,30	5,70				1993-57	S 199.3 x 5.7				G200	
204,30	5,70									G205	
209,30	5,70				2093-57	S 209.3 x 5.7				G210	
214,30	5,70									G215	
219,30	5,70				2193-57	S 219.3 x 5.7				G220	
224,30	5,70									G225	
229,30	5,70				2293-57	S 229.3 x 5.7				G230	
234,30	5,70									G235	
239,30	5,70				2393-57	S 239.3 x 5.7				G240	
244,30	5,70									G245	
249,30	5,70				2493-57	S 249.3 x 5.7				G250	
254,30	5,70									G255	
259,30	5,70				2593-57	S 259.3 x 5.7				G260	
264,30	5,70									G265	
269,30	5,70				2693-57	S 269.3 x 5.7				G270	
279,30	5,70				2793-57	S 279.3 x 5.7				G280	
284,30	5,70									G285	
289,30	5,70				2893-57	S 289.3 x 5.7				G290	
299,30	5,70				2993-57	S 299.3 x 5.7				G300	
304,30	5,70									G305	
309,30	5,70				3093-57					G310	
314,30	5,70									G315	
319,30	5,70				3193-57	S 319.3 x 5.7				G320	
324,30	5,70									G325	
329,30	5,70									G330	
334,30	5,70									G335	
339,30	5,70				3393-57	S 339.3 x 5.7				G340	
344,30	5,70									G345	
349,30	5,70									G350	
354,30	5,70									G355	
359,30	5,70				3593-57	S 359.3 x 5.7				G360	
364,30	5,70									G365	
369,30	5,70									G370	
374,30	5,70									G375	
379,30	5,70				3793-57	S 379.3 x 5.7				G380	
384,30	5,70									G385	
389,30	5,70				3893-57					G390	
394,30	5,70									G395	
399,30	5,70				3993-57	S 399.3 x 5.7				G400	
404,30	5,70									G405	
409,30	5,70									G410	
414,30	5,70									G415	

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NF T 47-501	DIN 3771	ISO 6149	JIS B 2401	
419,30	5,70				4193-57	S 419.3 x 5.7				G420	
424,30	5,70									G425	
429,30	5,70									G430	
435,30	5,70									G435	
439,30	5,70				4393-57	S 439.3 x 5.7				G440	
444,30	5,70									G445	
449,30	5,70									G450	
454,30	5,70									G455	
459,30	5,70				4593-57	S 459.3 x 5.7				G460	
464,30	5,70									G465	
469,30	5,70									G470	
474,30	5,70									G475	
479,30	5,70				4793-57	S 479.3 x 5.7				G480	
484,30	5,70									G485	
489,30	5,70				4893-57					G490	
494,30	5,70									G495	
499,30	5,70				4993-57	S 499.3 x 5.7				G500	
509,30	5,70									G510	
519,30	5,70									G520	
222,50	6,00									V-225	
272,00	6,00									V-275	
321,50	6,00									V-325	
376,00	6,00									V-380	
425,50	6,00									V-430	
34,29	6,99	-400									
37,46	6,99	-401									
40,64	6,99	-402									
43,81	6,99	-403									
46,99	6,99	-404									
50,16	6,99	-405									
53,34	6,99	-406									
56,51	6,99	-407									
59,69	6,99	-408									
62,86	6,99	-409									
66,04	6,99	-410									
69,21	6,99	-411									
72,39	6,99	-412									
75,56	6,99	-413									
78,74	6,99	-414									
81,91	6,99	-415									
85,09	6,99	-416									
88,26	6,99	-417									
91,44	6,99	-418									
94,61	6,99	-419									
97,79	6,99	-420									
100,96	6,99	-421									
104,14	6,99	-422									
107,31	6,99	-423									
110,49	6,99	-424									
113,67	6,99	-425	-425								
114,71	6,99		-624								
116,84	6,99	-426	-426								
120,02	6,99	-427	-427								
123,19	6,99	-428	-428								
124,61	6,99		-625								
126,37	6,99	-429	-429								
129,54	6,99	-430	-430								
132,72	6,99	-431	-431								
134,54	6,99		-626								
135,89	6,99	-432	-432								
139,07	6,99	-433	-433								
142,24	6,99	-434	-434								
145,42	6,99	-435	-435								
148,59	6,99	-436	-436								

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
151,77	6,99	-437	-437								
155,58	6,99		-872								
158,12	6,99	-438	-438								
159,54	6,99		-627								
161,93	6,99		-874								
164,47	6,99	-439	-439								
166,70	6,99		-628								
168,28	6,99		-876								
170,82	6,99	-440	-440								
174,63	6,99		-878								
177,17	6,99	-441	-441								
180,98	6,99		-880								
183,52	6,99	-442	-442								
187,33	6,99		-882								
189,87	6,99	-443	-443								
193,68	6,99		-884								
196,22	6,99	-444	-444								
200,03	6,99		-886								
202,57	6,99	-445	-445								
208,92	6,99		-445A								
215,27	6,99	-446	-446								
221,62	6,99		-446A								
227,97	6,99	-447	-447								
234,32	6,99		-447A								
240,67	6,99	-448	-448								
247,02	6,99		-448A								
253,37	6,99	-449	-449								
259,72	6,99		-449A								
266,07	6,99	-450	-450								
272,42	6,99		-450A								
278,77	6,99	-451	-451								
285,12	6,99		-451A								
291,47	6,99	-452	-452								
297,82	6,99		-452A								
304,17	6,99	-453	-453								
310,52	6,99		-648								
316,87	6,99	-454	-454								
323,22	6,99		-649								
329,57	6,99	-455	-455								
335,92	6,99		-650								
342,27	6,99	-456	-456								
354,97	6,99	-457	-457								
367,67	6,99	-458	-458								
380,37	6,99	-459	-459								
393,07	6,99	-460	-460								
405,26	6,99	-461	-461								
417,96	6,99	-462	-462								
430,66	6,99	-463	-463								
443,36	6,99	-464	-464								
456,06	6,99	-465	-465								
468,76	6,99	-466	-466								
481,46	6,99	-467	-467								
494,16	6,99	-468	-468								
506,86	6,99	-469	-469								
532,26	6,99	-470	-470								
557,66	6,99	-471	-471								
582,68	6,99	-472	-472								
608,08	6,99	-473	-473								
633,48	6,99	-474	-474								
658,88	6,99	-475	-475								
109,00	7,00			E1090			E1090				
112,00	7,00			E1120			E1120				
115,00	7,00			E1150			E1150				
118,00	7,00			E1180			E1180				

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
122,00	7,00			E1 220			E1220				
125,00	7,00			E1250			E1250				
128,00	7,00			E1280			E1280				
132,00	7,00			E1320			E1320				
136,00	7,00			E1360			E1360				
140,00	7,00			E1400			E1400				
145,00	7,00			E1450			E1450				
150,00	7,00			E1500			E1500				
155,00	7,00			E1550			E1550				
160,00	7,00			E1600			E1600				
165,00	7,00			E1650			E1650				
170,00	7,00			E1700			E1700				
172,50	7,00						E1725				
175,00	7,00			E1750			E1750				
177,50	7,00						E1775				
180,00	7,00			E1800			E1800				
182,50	7,00						E1825				
185,00	7,00			E1850			E1850				
185,70	7,00						E1875				
190,00	7,00			E1900			E1900				
195,00	7,00			E1950			E1950				
200,00	7,00			E2000			E2000				
203,00	7,00						E2030				
206,00	7,00			E2060			E2060	206 X 7			
212,00	7,00			E2120			E2120	212 X 7			
218,00	7,00			E2180			E2180	218 X 7			
224,00	7,00			E2240			E2240	224 X 7			
230,00	7,00			E2300			E2300	230 X 7			
236,00	7,00			E2360			E2360	236 X 7			
239,00	7,00						E2390				
243,00	7,00			E2430			E2430	243 X 7			
250,00	7,00			E2500			E2500	250 X 7			
254,00	7,00						E2540				
258,00	7,00			E2580			E2580	258 X 7			
261,00	7,00						E2610				
265,00	7,00			E2650			E2650	265 X 7			
268,00	7,00						E2680				
272,00	7,00			E2720			E2720	272 X 7			
276,00	7,00						E2760				
280,00	7,00			E2800			E2800	280 X 7			
283,00	7,00						E2830				
286,00	7,00						E2860				
290,00	7,00			E2900			E2900	290 X 7			
295,00	7,00						E2950				
300,00	7,00			E3000			E3000	300 X 7			
303,00	7,00						E3030				
307,00	7,00			E3070			E3070	307 X 7			
311,00	7,00						E3110				
315,00	7,00			E3150			E3150	315 X 7			
320,00	7,00						E3200				
325,00	7,00			E3250			E3250	325 X 7			
330,00	7,00						E3300				
335,00	7,00			E3350			E3350	335 X 7			
340,00	7,00						E3400				
345,00	7,00			E3450			E3450	345 X 7			
350,00	7,00						E3500				
355,00	7,00			E3550			E3550	355 X 7			
360,00	7,00						E3600				
365,00	7,00			E3650			E3650	365 X 7			
370,00	7,00						E3700				
375,00	7,00			E3750			E3750	375 X 7			
379,00	7,00						E3790				
383,00	7,00						E3830				
387,00	7,00			E3870			E3870	387 X 7			

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
391,00	7,00						E3910				
395,00	7,00						E3950				
400,00	7,00			E4000			E4000	400 X 7			
406,00	7,00						E4060				
412,00	7,00			E4120			E4120	412 X 7			
418,00	7,00						E4180				
425,00	7,00			E4250			E4250	425 X 7			
429,00	7,00						E4290				
433,00	7,00						E4330				
437,00	7,00			E4370			E4370	437 X 7			
443,00	7,00						E4430				
450,00	7,00			E4500			E4500	450 X 7			
456,00	7,00						E4560				
462,00	7,00			E4620			E4620	462 X 7			
466,00	7,00						E4660				
470,00	7,00						E4700				
475,00	7,00			E4750			E4750	475 X 7			
479,00	7,00						E4790				
483,00	7,00						E4830				
487,00	7,00			E4870			E4870	487 X 7			
493,00	7,00						E4930				
500,00	7,00			E5000			E5000	500 X 7			
508,00	7,00						E5080				
515,00	7,00			E5150			E5150	515 X 7			
523,00	7,00						E5230				
530,00	7,00			E5300			E5300	530 X 7			
538,00	7,00						E5380				
545,00	7,00			E5450			E5450	545 X 7			
553,00	7,00						E5530				
560,00	7,00			E5600			E5600	560 X 7			
570,00	7,00						E5700				
580,00	7,00			E5800			E5800	580 X 7			
590,00	7,00						E5900				
600,00	7,00			E6000			E6000	600 X 7			
608,00	7,00						E6080				
615,00	7,00			E6150			E6150	615 X 7			
623,00	7,00						E6230				
630,00	7,00			E6300			E6300	630 X 7			
640,00	7,00						E6400				
650,00	7,00			E6500			E6500	650 X 7			
660,00	7,00						E6600				
670,00	7,00			E6700			E6700	670 X 7			
144,10	8,40				1441-84	D 144.1 x 8.4					
149,10	8,40				1491-84	D 149.1 x 8.4					
149,50	8,40									P150A	
154,10	8,40				1541-84	D 154.1 x 8.4					
154,50	8,40									P155	
159,10	8,40				1591-84	D 159.1 x 8.4					
159,50	8,40									P160	
164,10	8,40				1641-84	D 164.1 x 8.4					
164,50	8,40									P165	
169,10	8,40				1691-84	D 169.1 x 8.4					
169,50	8,40									P170	
174,10	8,40				1741-84	D 174.1 x 8.4					
174,50	8,40									P175	
179,10	8,40				1791-84	D 179.1 x 8.4					
179,50	8,40									P180	
184,10	8,40				1841-84	D 184.1 x 8.4					
184,50	8,40									P185	
189,10	8,40				1891-84	D 189.1 x 8.4					
189,50	8,40									P190	
194,10	8,40				1941-84	D 194.1 x 8.4					
194,50	8,40									P195	
199,10	8,40				1991-84	D 199.1 x 8.4					

NOTE: If you do not find the measures of interest, consult us.

CONTINUE ...

... NORMALIZED OR. Table of O-rings according to international standards.
 ... CONTINUE

Ø (mm)		International standards									Non-standard
d ₁	d ₂	AS 568	BS 1806	ISO 3601	BS 4518	SMS 1588	NFT 47-501	DIN 3771	ISO 6149	JIS B 2401	
199,50	8,40									P200	
204,10	8,40				2041-84						
204,50	8,40									P205	
208,50	8,40									P209	
209,10	8,40				2091-84	D 209.1 x 8.4					
209,50	8,40									P210	
214,50	8,40									P215	
219,10	8,40				2191-84	D 219.1 x 8.4					
219,50	8,40									P220	
224,50	8,40									P225	
229,10	8,40				2291-84	D 229.1 x 8.4					
229,50	8,40									P230	
234,10	8,40				2341-84						
234,50	8,40									P235	
239,10	8,40				2391-84	D 239.1 x 8.4					
239,50	8,40									P240	
244,50	8,40									P245	
249,10	8,40				2491-84	D 249.1 x 8.4					
249,50	8,40									P250	
254,50	8,40									P255	
259,50	8,40									P260	
269,50	8,40									P270	
274,50	8,40									P275	
279,50	8,40									P280	
284,50	8,40									P285	
289,50	8,40									P290	
294,50	8,40									P295	
299,50	8,40									P300	
304,50	8,40									P305	
309,50	8,40									P310	
314,50	8,40									P315	
319,50	8,40									P320	
334,50	8,40									P335	
339,50	8,40									P340	
349,50	8,40									P350	
354,50	8,40									P355	
359,50	8,40									P360	
374,50	8,40									P375	
379,50	8,40									P380	
384,50	8,40									P385	
389,50	8,40									P390	
399,50	8,40									P400	
409,50	8,40									P410	
419,50	8,40									P420	
439,50	8,40									P440	
449,50	8,40									P450	
469,50	8,40									P470	
479,50	8,40									P480	
475,00	10,00									V-480	
524,50	10,00									V-530	
579,00	10,00									V-585	
633,50	10,00									V-640	
683,00	10,00									V-690	
732,50	10,00									V-740	
782,00	10,00									V-790	
836,50	10,00									V-845	
940,50	10,00									V-950	
1.044,00	10,00									V-1055	

NOTE: If you do not find the measures of interest, consult us.

■ Quad-ring® chart according to AS 568

Diameters (mm)		Diameters (mm)		Diameters (mm)		Diameters (mm)		Diameters (mm)	
d ₁	d ₂	d ₁	d ₂	d ₁	d ₂	d ₁	d ₂	d ₁	d ₂
4,70	1,42	47,29	2,62	12,29	3,53	202,79	3,53	116,84	5,33
6,07	1,63	48,90	2,62	13,87	3,53	209,14	3,53	120,02	5,33
7,65	1,63	50,47	2,62	15,47	3,53	215,49	3,53	123,19	5,33
50,52	1,78	52,07	2,62	17,04	3,53	221,84	3,53	126,37	5,33
53,70	1,78	53,64	2,62	18,64	3,53	228,19	3,53	129,54	5,33
56,87	1,78	55,25	2,62	20,22	3,53	234,54	3,53	132,72	5,33
60,05	1,78	56,82	2,62	21,82	3,53	240,89	3,53	135,89	5,33
63,22	1,78	58,42	2,62	23,39	3,53	247,24	3,53	139,07	5,33
66,40	1,78	59,99	2,62	24,99	3,53	253,59	3,53	142,24	5,33
69,57	1,78	61,60	2,62	26,57	3,53	266,29	3,53	145,42	5,33
72,75	1,78	63,17	2,62	28,17	3,53	278,99	3,53	148,59	5,33
75,92	1,78	64,77	2,62	29,74	3,53	291,69	3,53	151,77	5,33
82,27	1,78	66,34	2,62	31,34	3,53	304,39	3,53	158,12	5,33
88,62	1,78	67,95	2,62	32,92	3,53	329,79	3,53	164,47	5,33
94,97	1,78	69,52	2,62	34,52	3,53	355,19	3,53	170,82	5,33
101,32	1,78	71,12	2,62	36,09	3,53	380,59	3,53	177,17	5,33
107,67	1,78	72,69	2,62	37,69	3,53	405,26	3,53	183,52	5,33
114,02	1,78	75,87	2,62	40,87	3,53	430,66	3,53	189,87	5,33
120,37	1,78	82,22	2,62	44,04	3,53	456,06	3,53	196,22	5,33
126,72	1,78	88,57	2,62	47,22	3,53	10,46	5,33	202,57	5,33
133,07	1,78	94,92	2,62	50,39	3,53	12,07	5,33	208,92	5,33
8,92	1,83	101,27	2,62	53,57	3,53	13,64	5,33	215,27	5,33
10,52	1,83	107,62	2,62	56,74	3,53	15,24	5,33	221,62	5,33
11,89	1,98	113,97	2,62	59,92	3,53	16,81	5,33	227,97	5,33
13,46	2,08	120,32	2,62	63,09	3,53	18,42	5,33	234,32	5,33
16,36	2,21	126,67	2,62	66,27	3,53	19,99	5,33	240,67	5,33
17,93	2,46	133,02	2,62	69,44	3,53	21,59	5,33	247,02	5,33
19,18	2,46	139,37	2,62	72,62	3,53	23,16	5,33	253,37	5,33
1,24	2,62	145,72	2,62	75,79	3,53	24,77	5,33	266,07	5,33
2,06	2,62	152,07	2,62	78,97	3,53	26,34	5,33	278,77	5,33
2,84	2,62	158,42	2,62	82,14	3,53	27,94	5,33	291,47	5,33
3,63	2,62	164,77	2,62	85,32	3,53	29,51	5,33	304,17	5,33
4,42	2,62	171,12	2,62	88,49	3,53	31,12	5,33	329,57	5,33
5,23	2,62	177,47	2,62	91,67	3,53	32,69	5,33	354,97	5,33
6,02	2,62	183,82	2,62	94,84	3,53	34,29	5,33	380,37	5,33
7,59	2,62	190,17	2,62	98,02	3,53	37,47	5,33	405,26	5,33
9,19	2,62	196,52	2,62	101,19	3,53	40,64	5,33	430,66	5,33
10,77	2,62	202,87	2,62	104,37	3,53	43,82	5,33	456,06	5,33
12,37	2,62	209,22	2,62	107,54	3,53	46,99	5,33	481,46	5,33
13,94	2,62	215,57	2,62	110,72	3,53	50,17	5,33	506,86	5,33
15,54	2,62	221,92	2,62	113,89	3,53	53,34	5,33	532,26	5,33
17,12	2,62	228,27	2,62	117,07	3,53	56,52	5,33	557,66	5,33
18,72	2,62	234,62	2,62	120,24	3,53	59,69	5,33	582,68	5,33
20,29	2,62	240,97	2,62	123,42	3,53	62,87	5,33	608,08	5,33
21,89	2,62	247,32	2,62	126,59	3,53	66,04	5,33	633,48	5,33
23,47	2,62	21,92	2,95	129,77	3,53	69,22	5,33	658,88	5,33
25,07	2,62	23,47	2,95	132,94	3,53	72,39	5,33	34,29	6,99
26,64	2,62	25,04	2,95	136,12	3,53	75,57	5,33	37,47	6,99
28,24	2,62	26,59	2,95	139,29	3,53	78,74	5,33	40,64	6,99
29,82	2,62	29,74	2,95	142,47	3,53	81,92	5,33	43,82	6,99
31,42	2,62	34,42	2,95	145,64	3,53	85,09	5,33	46,99	6,99
32,99	2,62	37,47	3,00	148,82	3,53	88,27	5,33	50,17	6,99
34,59	2,62	43,69	3,00	151,99	3,53	91,44	5,33	53,34	6,99
36,17	2,62	53,09	3,00	158,34	3,53	94,62	5,33	56,52	6,99
37,77	2,62	59,36	3,00	164,69	3,53	97,79	5,33	59,69	6,99
39,34	2,62	4,34	3,53	171,04	3,53	100,97	5,33	62,87	6,99
40,94	2,62	5,94	3,53	177,39	3,53	104,14	5,33	66,04	6,99
42,52	2,62	7,52	3,53	183,74	3,53	107,32	5,33	69,22	6,99
44,12	2,62	9,12	3,53	190,09	3,53	110,49	5,33	72,39	6,99
45,69	2,62	10,69	3,53	196,44	3,53	113,67	5,33	75,57	6,99

CONTINUE ...

CONTINUE ...

CONTINUE ...

CONTINUE ...

CONTINUE ...

... QUAD-RING® CHART - AS 568 NORM.
... CONTINUE

Diameters (mm)		Diameters (mm)		Diameters (mm)		Diameters (mm)		Diameters (mm)	
d ₁	d ₂	d ₁	d ₂	d ₁	d ₂	d ₁	d ₂	d ₁	d ₂
78,74	6,99	120,02	6,99	170,82	6,99	304,17	6,99	468,76	6,99
81,92	6,99	123,19	6,99	177,17	6,99	316,87	6,99	481,46	6,99
85,09	6,99	126,37	6,99	183,52	6,99	329,57	6,99	494,16	6,99
88,27	6,99	129,54	6,99	189,87	6,99	342,27	6,99	506,86	6,99
91,44	6,99	132,72	6,99	196,22	6,99	354,97	6,99	532,26	6,99
94,62	6,99	135,89	6,99	202,57	6,99	367,67	6,99	557,66	6,99
97,79	6,99	139,07	6,99	215,27	6,99	380,37	6,99	582,68	6,99
100,97	6,99	142,24	6,99	227,97	6,99	393,07	6,99	608,08	6,99
104,14	6,99	145,42	6,99	240,67	6,99	405,26	6,99	633,48	6,99
107,32	6,99	148,59	6,99	253,37	6,99	417,96	6,99	658,88	6,99
110,49	6,99	151,77	6,99	266,07	6,99	430,66	6,99		
113,67	6,99	158,12	6,99	278,77	6,99	443,36	6,99		
116,84	6,99	164,47	6,99	291,47	6,99	456,06	6,99		

CONTINUE ... CONTINUE ... CONTINUE ... CONTINUE ...

OUTSIDE OF NORM: the seal of interest is not standardized and has a special size, then it can be manufactured by another of the procedures described in section Production ¹⁵:

- Machining
- Vulcanization of O-ring
- Continuous Moulding
- Conventional Moulding

¹⁵ See page 35

TRAINING SERVICES



Training and knowledge of our products is an essential element in our organisation: we train our own teams by means of an expert group of engineers. At the same time, we collaborate with universities and professional schools in the dissemination of knowledge of sealing systems and the correct use of products. And we also offer this service to our customers.

Below are some examples of available training courses, although in general, the training content is developed in collaboration with the Client to adapt the training to real needs

Course	Description	Duration
UP1-CG	General Sealing Concepts	2H
UP1-EE	Static Sealing Full Course	8H
UP1-JT	Static Sealing O-rings, x-ring seals, O-ring thread, support rings	4H
UP1-JB	Static Sealing Gaskets for flanges	4H
UP1-ER	Dynamic Sealing Full Course	6H
UP1-RT	Dynamic radial Sealing Seals	4H
UP1-VR	Dynamic radial Sealing Other elements for rotary axes (v-rings, labyrinths, shaft sleeves)	2H
UP1-EA	Dynamic axial Sealing Full Course	6H
UP1-JH	Dynamic axial Sealing Seals for hydraulic cylinders	4H
UP1-JN	Dynamic axial Sealing Seals for pneumatic cylinders	2H
UP1-AV	Vibration isolation Full Course	4H



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