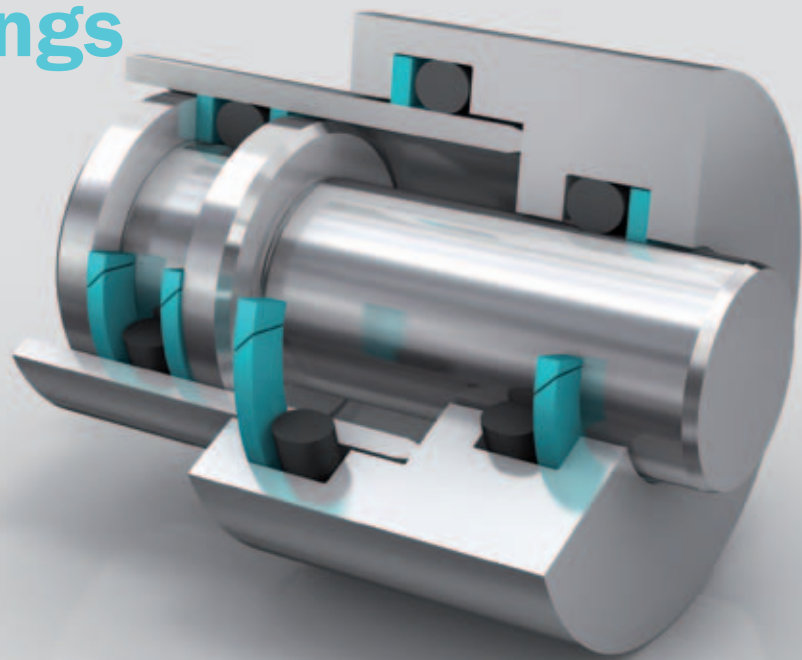


O-Rings and Back-up Rings



Your Partner for Sealing Technology



Your Partner for Sealing Technology

Trelleborg Sealing Solutions is a major international sealing force, uniquely placed to offer dedicated design and development from our market-leading product and material portfolio: a one-stop-shop providing the best in elastomer, thermoplastic, PTFE and composite technologies for applications in aerospace, industrial and automotive industries.

With 50 years of experience, Trelleborg Sealing Solutions engineers support customers with design, prototyping, production, test and installation using state-of-the-art design tools. An international network of over 70 facilities worldwide includes over 20 manufacturing sites, strategically-positioned research and development centers, including materials and development laboratories and locations specializing in design and applications.

Developing and formulating materials in-house, we utilize the resource of our material database, including over 2,000 proprietary compounds and a range of unique products.

Trelleborg Sealing Solutions fulfills challenging service requirements, supplying standard parts in volume or a single custom-manufactured component, through our integrated logistical support, which effectively delivers over 40,000 sealing products to customers worldwide.

Facilities are certified to ISO 9001:2008 and ISO/TS 16949:2009. Trelleborg Sealing Solutions is backed by the experiences and resources of one of the world's foremost experts in polymer technology: the Trelleborg Group.

ISO 9001:2008

ISO/TS 16949:2009

The information in this brochure is intended to be for general reference purposes only and is not intended to be a specific recommendation for any individual application. The application limits for pressure, temperature, speed and media given are maximum values determined in laboratory conditions. In application, due to the interaction of operating parameters, maximum values may not be achieved. It is vital therefore, that customers satisfy themselves as to the suitability of product and material for each of their individual applications. Any reliance on information is therefore at the user's own risk. In no event will Trelleborg Sealing Solutions be liable for any loss, damage, claim or expense directly or indirectly arising or resulting from the use of any information provided in this brochure. While every effort is made to ensure the accuracy of information contained herewith, Trelleborg Sealing Solutions cannot warrant the accuracy or completeness of information.

To obtain the best recommendation for a specific application, please contact your local Trelleborg Sealing Solutions marketing company.

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Introduction



The Trelleborg Group



Automotive

- Antivibration Systems
- Noise and Vibration Dampening
- Fluid Systems



Wheel Systems

- Agricultural and Forestry Tires
- Industrial Tires



Engineered Systems

- Engineering Solutions
- Marine Fenders
- Industrial Fluid Control
- Sealing Profiles for Buildings
- Water Proofing
- Offshore



Sealing Solutions

- Precision seals for the Industrial, Automotive and Aerospace markets

Trelleborg Sealing Solutions



Food, Pharmaceutical and Chemical Processing



Machine Tools



Oil and Gas



Semiconductor



Automotive



Aerospace



Fluid power



Life Sciences



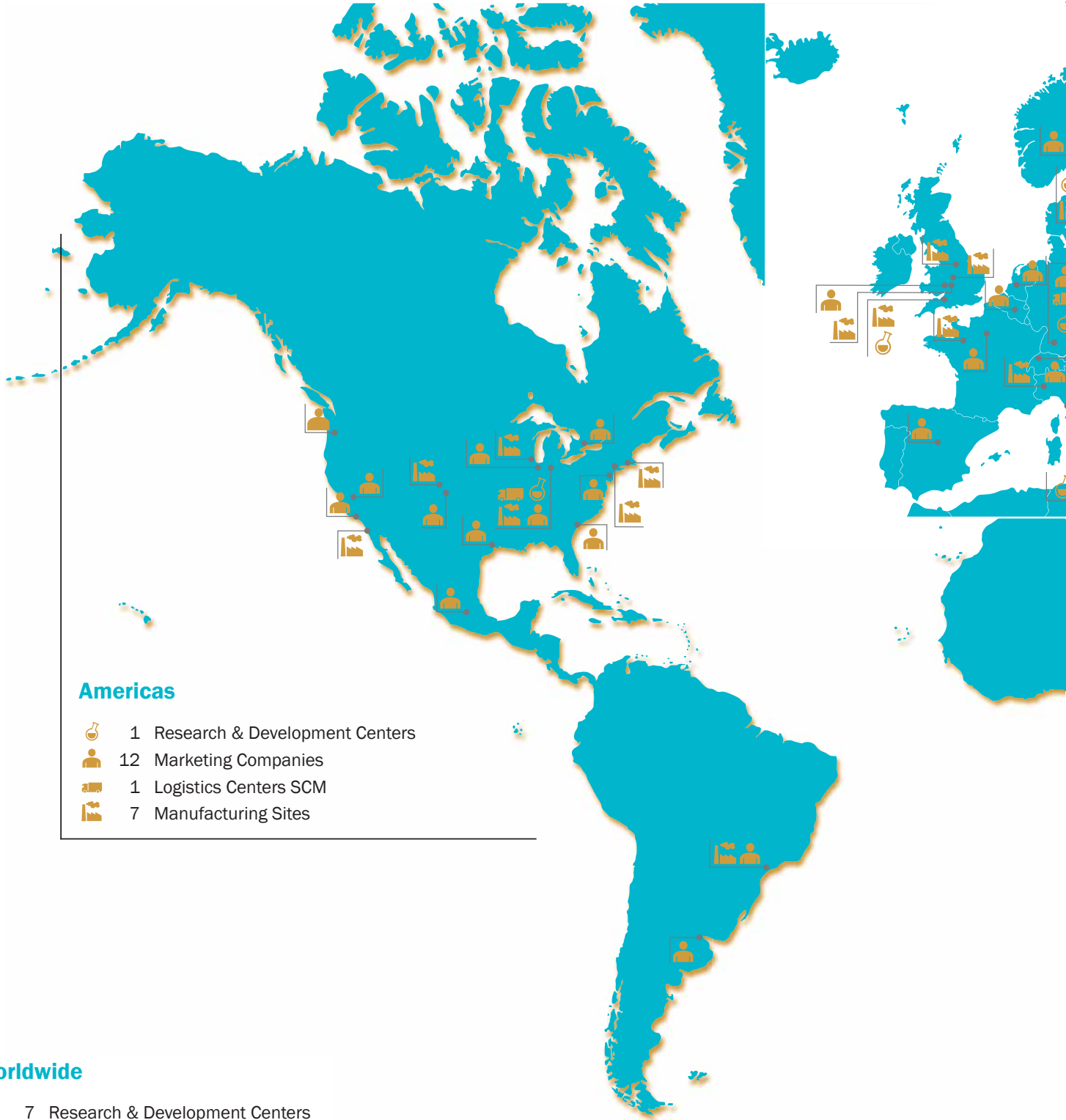
Off-Highway

We build long term partnerships with customers and suppliers by providing leading technology and excellent service



Renewable Energy



Trelleborg Sealing Solutions - Global Resources



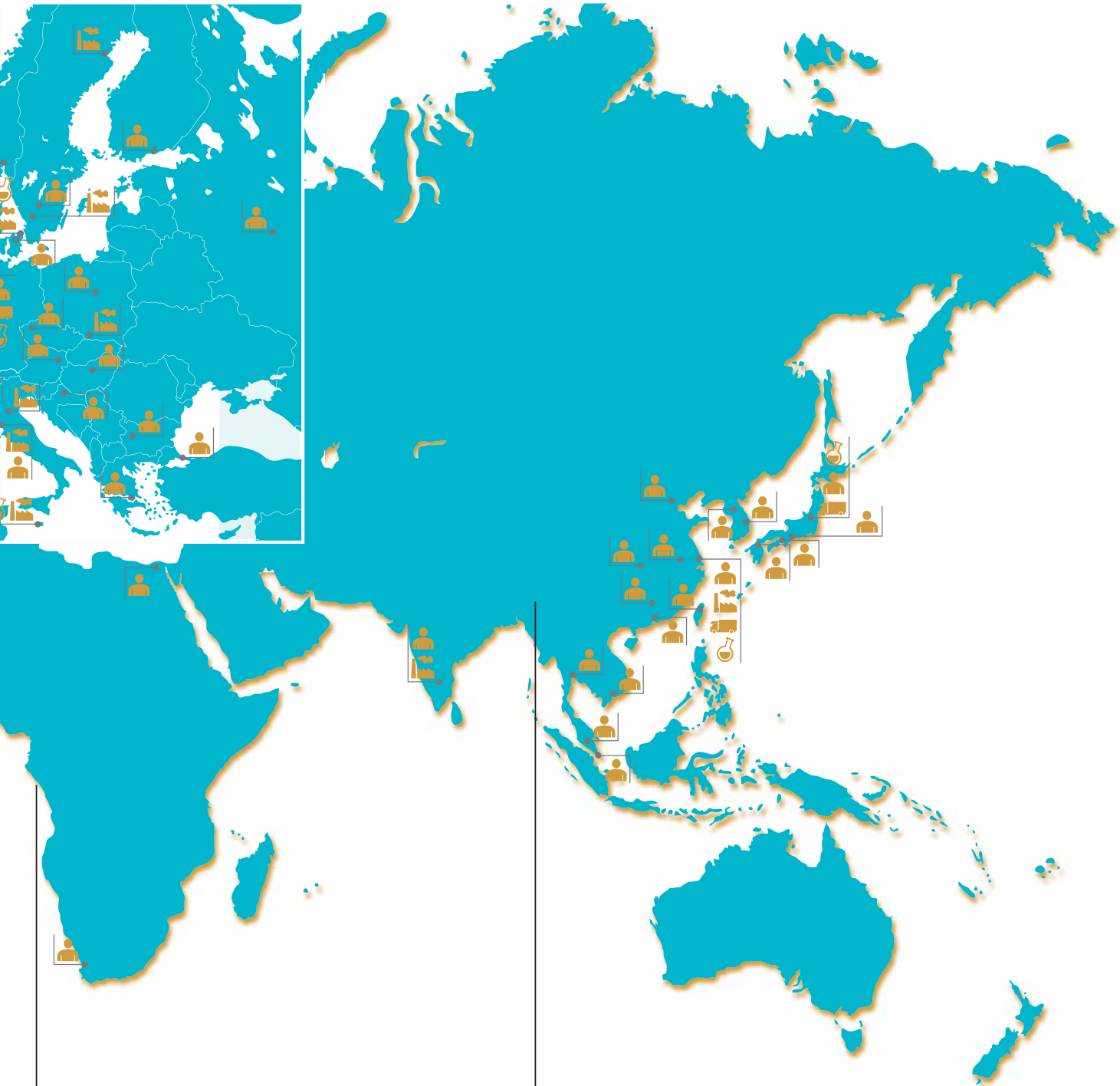
Americas

-  1 Research & Development Centers
-  12 Marketing Companies
-  1 Logistics Centers SCM
-  7 Manufacturing Sites





Worldwide

-  7 Research & Development Centers
-  49 Marketing Companies
-  4 Logistics Centers SCM
-  22 Manufacturing Sites





Trelleborg Sealing Solutions - Global Resources



Europe

-  4 Research & Development Centers
-  19 Marketing Companies
-  1 Logistics Centers SCM
-  13 Manufacturing Sites

Asia

-  2 Research & Development Centers
-  18 Marketing Companies
-  2 Logistics Centers SCM
-  2 Manufacturing Sites

Your partner for sealing technology

Our mission

We will be the supply partner of first choice within our chosen markets, working globally through our local teams. We will build long-term partnerships with customers and suppliers by providing leading technology and excellent service. We are determined to be different.

Sealing technology

Trelleborg Sealing Solutions offers an outstandingly comprehensive sealing portfolio – a one-stop-shop providing the best in elastomer, thermoplastic, Polytetrafluoroethylene (PTFE) and composite technologies; our solutions are featured in virtually every application conceivable within the aerospace, automotive and industrial industries.

A worldwide presence

We are uniquely placed to offer a dedicated design and development service for sealing solutions, globally servicing, supporting and supplying our customers through an unrivalled international network.

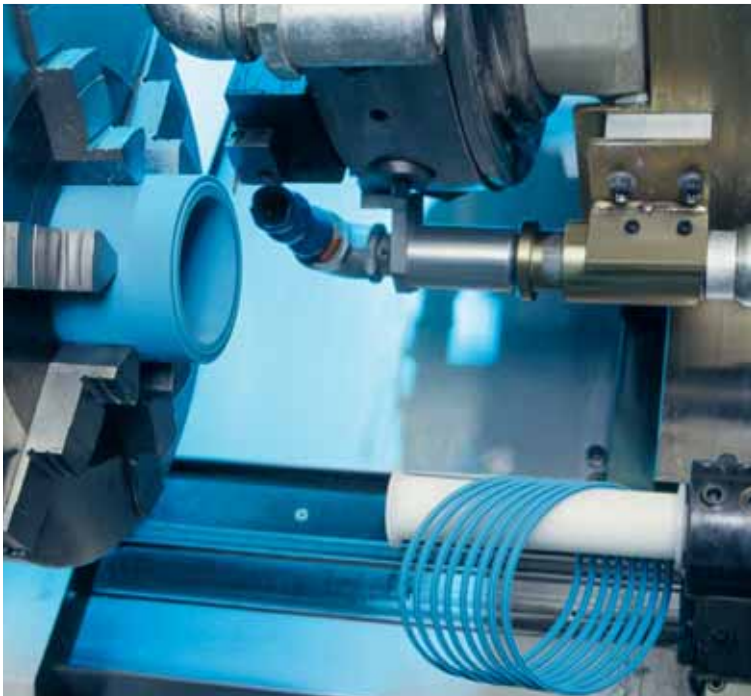
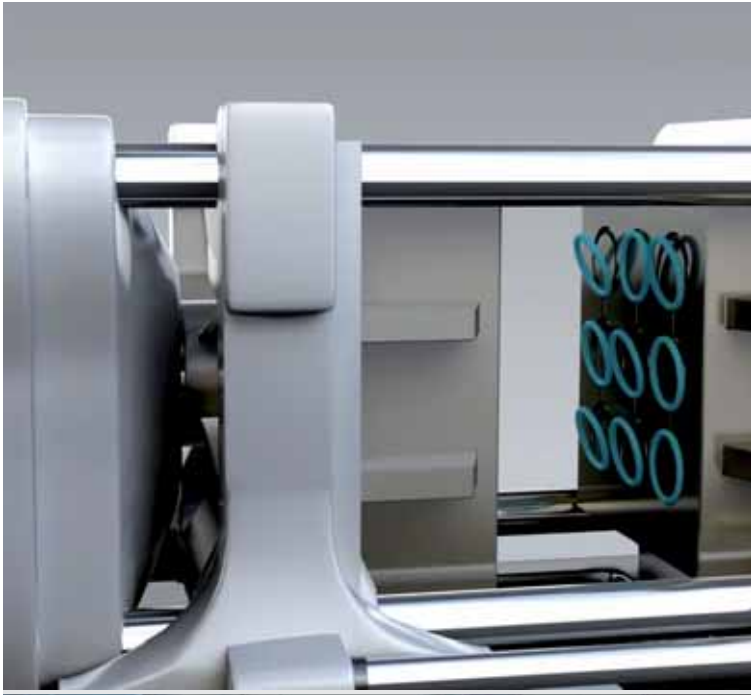
- Over 70 facilities worldwide
- More than 20 manufacturing sites
- 7 strategically positioned materials and development laboratories
- Internationally linked design and application centers

Commitment - To customers' needs long-term

The aim of Trelleborg Sealing Solutions is to facilitate customers in the achievement of cost effective, durable solutions that match their specific business requirements and needs. We are one of the world's foremost experts in polymer sealing technology. We develop and manufacture market safety-critical polymer-based precision seals and associated systems.



Your partner for sealing technology



Products, brands and materials

Our pioneering products

Trelleborg Sealing Solutions is pioneering within the sealing industry and continuously developing innovative products.

- Turcon® AQ Seal®
- D-A-S Compact Seal®
- Turcon® Double Delta®
- Turcon® Excluder®
- Turcon® Glyd Ring®
- Turcon® Hatseal®
- Zurcon® L-Cup®
- Turcite® Slydring®
- Turcite®-B Slydway®
- Turcon® Stepseal®
- V-Ring®
- Turcon® Varilip® PDR
- Turcon® Variseal®
- Turcon® VL Seal®
- Turcon® Wedgpak®
- Wills Rings®
- Zurcon® Wynseal

World renowned names

We own many of the longest established and leading names within the seal industry. These include:

- American Variseal
- Busak+Shamban
- Dowty Seals
- Chase Walton
- Forsheda
- GNL
- Hydro-Components
- Impervia
- Nordex
- Orkot
- Palmer Chenard
- Polypac
- SF Medical
- Shamban
- Silcofab
- Skega
- Stefa
- Wills

Proprietary materials

Ongoing development has yielded some of the most successful sealing materials available.

- HiMod®
- Isolast®
- Orkot®
- Turcite®
- Turcon®
- Turel®
- Zurcon®



Products, brands and materials



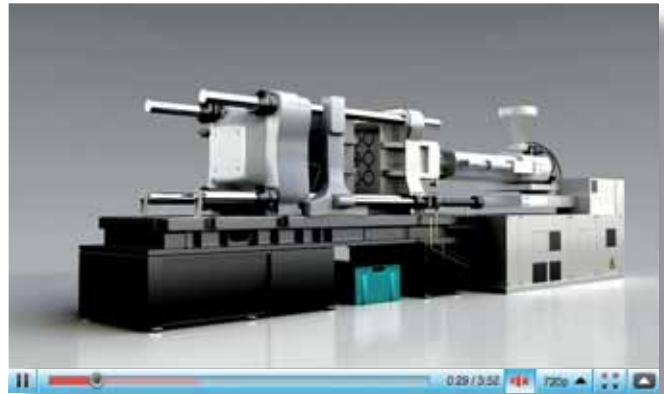


Films & 3D Animations

Seals get animated

Complex sealing configurations can feature a large number of sealing elements. Trying to illustrate these on a 2D page is difficult and can never properly show their function or characteristics. Trelleborg Sealing Solutions turned to the latest graphic technologies to produce 3D animations of applications and typical sealing solutions for them.

A range of films specific to different industries and products are available to view on the Trelleborg Sealing Solutions website or via YouTube.



You can now link to our films and animations from

www.tss.trelleborg.com/films



or view them on YouTube at

www.YouTube.com/trelleborgseals







Online tools

Online tools make life easier

Trelleborg Sealing Solutions has developed a number of online tools that make the working life of an engineer specifying seals easier.

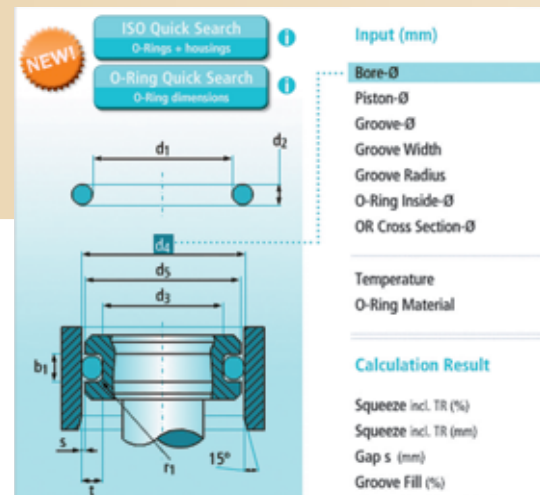
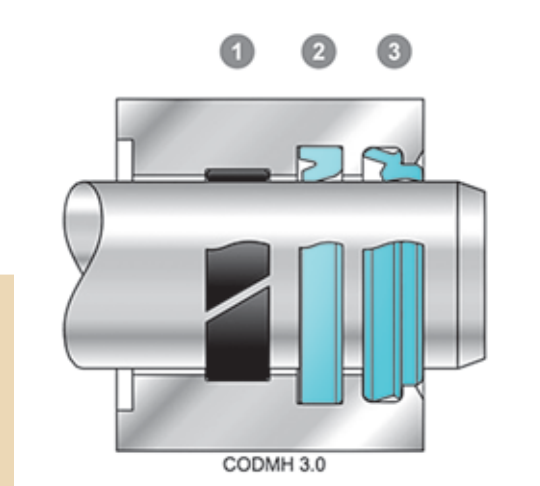
All these industry-leading online tools are available free-of-charge from the Trelleborg Sealing Solutions website at www.tss.trelleborg.com. To use these advanced services all you have to do is register in the Members Area.

www.tss.trelleborg.com



Sealing Solutions Configurator

The Sealing Solutions Configurator is the first tool of its kind offered by any seal supplier. It allows engineers to identify a proven sealing solution for their specific application in just four easy steps.



O-Ring Calculator

An industry-leading tool, the easy to use O-Ring calculator includes a sizing capability, design parameter recommendations and complete measurements. Results and comments may be printed, saved online or filed as a PDF.



Powerful Electronic Catalog






With the powerful electronic catalog you can search through over 100,000 seals by item number or by their properties. Comprehensive and detailed information can be accessed along with an interactive quote facility.



Versatile CAD Service

The CAD download facility provides thousands of drawings from a wide seal range. It gives the option of 2- or 3-dimensional files, in a range of formats to suit most commonly used CAD systems.



-  Very good suitability
-  Good suitability
-  Limited suitability
-  Unsuitable
-  Insufficient Information

Materials Search and Chemical Compatibility Check

These two programs allow you to find out the compatibility of sealing materials to hundreds of different media and help identify the most suitable material for your application.

Part I

O-Ring



Double Acting

Static and partly dynamic sealing applications

Material:
Elastomers, Zurcon[®] and others



A General information

A.1 Description

O-Rings offer the designer an efficient and economical sealing element for a wide range of static or dynamic applications.

Inexpensive production methods and its ease of use have made the O-Ring the most widely used seal.

A wide choice of elastomer materials for both standard and special applications allow the O-Ring to be used to seal practically all liquid and gaseous media.

O-Rings are vulcanized in molds and are characterised by their circular form with annular cross section. The dimensions of the O-Ring are defined by the inside diameter d_1 and the cross section d_2 (Figure 1).

Cross sections of approx. 0.35 to 40 mm and inside diameters up to 5,000 mm and more are available.

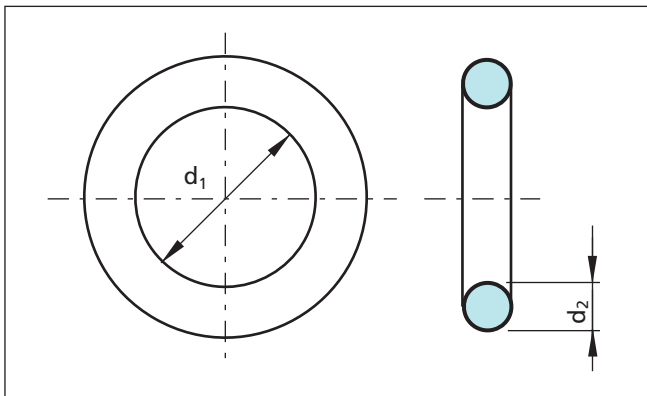


Figure 1 O-Ring dimensioning

Advantages

Compared with other sealing elements, the O-Ring has a wide range of advantages:

Simple, one piece groove design reduces hardware and design costs

- Compact design allows smaller hardware
- Easy, foolproof installation reduces risk
- Applicable to a wide range of sealing problems, static, dynamic, single or double acting
- Wide compound choice for compatibility with most fluids
- Ex stock availability of many sizes worldwide for easy maintenance and repair

A.2 Applications

O-Rings are used as sealing elements or as energizing elements for hydraulic slipper seals and wipers and thus cover a large number of fields of application. There are no fields of industry where the O-Ring is not used. From an individual seal for repairs or maintenance to a quality assured application in aerospace, automotive or general engineering. The O-Ring is used predominantly for static sealing applications:

- As a radial static seal, e.g. for bushings, covers, pipes, cylinders
- As an axial static seal, e.g. for flanges, plates, caps.

O-Rings in dynamic applications are recommended **only for moderate service conditions**. They are limited by the speed and the pressure against which they are to seal:

- For low duty sealing of reciprocating pistons, rods, plungers, etc.
- For sealing of slowly pivoting, rotating or spiral movements on shafts, spindles, rotary transmission leadthroughs, etc.



A.3 Method of operation

O-Rings are double-acting sealing elements. The initial squeeze, which acts in a radial or axial direction depending on the installation, gives the O-Ring its initial sealing capability. These forces are superimposed by the system pressure to create the total sealing force which increases as the system pressure increases (Figure 2).

Under pressure, the O-Ring behaves in a similar way to a fluid with high surface tension. The pressure is transmitted uniformly to all directions.

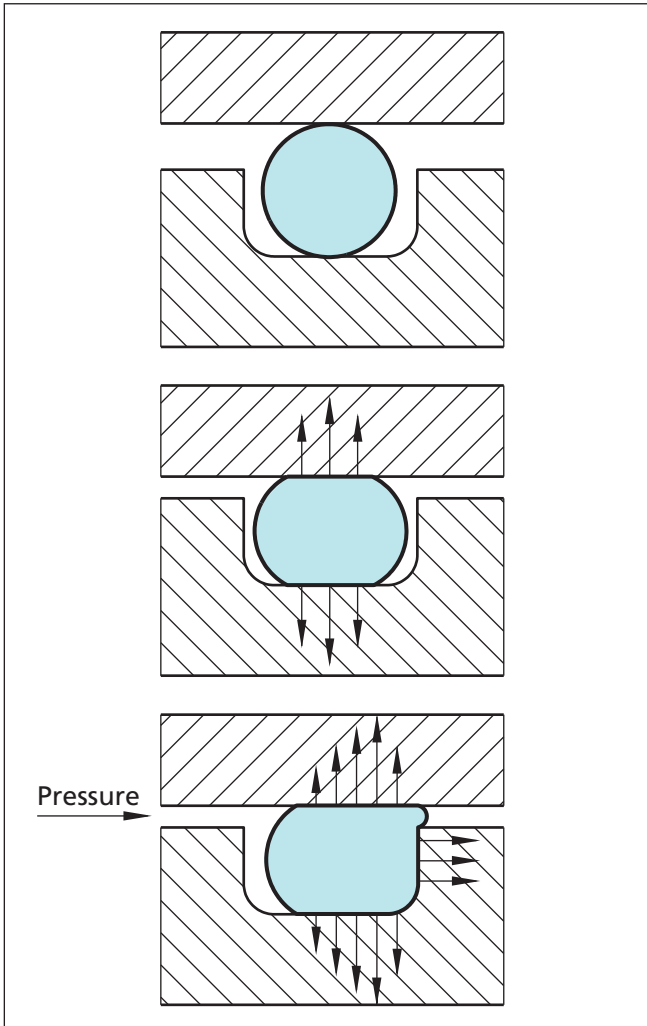


Figure 2 O-Ring sealing forces with and without system pressure



B Technical information

B.1 Materials

B.1.1 Elastomers

Equipment manufacturers and end users expect sealing systems to operate leak free and to maintain long service life. Reliability is crucial to effective low maintenance cost operations. To find the perfect sealing solution in each individual case both material performance and seal design are critically important. One of the main used material

groups for sealings are the elastomers. They show good properties like elasticity or good chemical compatibility.

The following tables provide a summary of the various elastomer material groups. Trelleborg Sealing Solutions can offer a large number of materials within each group.

If no particular specifications are given for the material, standard NBR (Nitrile Rubber) in 70 Shore A will be supplied (see chapter "B.1.5 Standard materials").

Table 1 Elastomer

Designation	Trade Name*	Abbreviation		
		ISO 1629	ASTM D 1418	TSS
Acrylonitrile-Butadiene Rubber (Nitrile Rubber)	Europrene® Krynac® Nipol N® Perbunan NT Breon®	NBR	NBR	N
Hydrogenated Acrylonitrile-Butadiene Rubber	Therban® Zetpol®	HNBR	HNBR	H
Polyacrylate Rubber Polyacrylate Rubber ACM	Noxtite® Hytemp® Nipol AR®	ACM	ACM	A
Chloroprene Rubber	Baypren® Neoprene®	CR	CR	WC
Ethylene Propylene Diene Rubber	Dutral® Keltan® Vistalon® Buna EP®	EPDM	EPDM	E
Silicone Rubber	Elastoseal® Rhodorsil® Silastic® Silopren®	VMQ	VMQ	S
Fluorosilicone Rubber	Silastic®	FVMQ	FVMQ	F
Tetrafluoroethylene-Propylene Copolymer Elastomer	Aflas®	FEPM	TFE/P**	WT
Butyl Rubber	Esso Butyl®	IIR	IIR	WI
Styrene-Butadiene Rubber	Buna S® Europrene® Polysar S®	SBR	SBR	WB
Natural Rubber		NR	WR	WR
Fluorocarbon Rubber	Dai-EI® Fluorel® Tecnoflon® Viton®	FKM	FKM	V
Perfluoro Rubber	Isolast® Kalrez®	FFKM	FFKM	J
Polyester Urethane Polyether Urethane	Zurcon® Adiprene® Pellethan® Vulcollan® Desmopan®	AU EU	AU EU	WU WU

* Selection of registered trade names

** Abbreviation not yet standardised.

ASTM = American Society for Testing and Materials
ISO = International Organisation for Standardisation



O-Ring

Designation	Trade Name*	Abbreviation		
		ISO 1629	ASTM D 1418	TSS
Chlorosulphonated Polyethylene Rubber	Hypalon®	CSM	CSM	WM
Polysulphide Elastomer	Thiokol®	-	TWT	WY
Epichlorohydrin Elastomer	Hydrin®	-	-	WO

* Selection of registered trade names

** Abbreviation not yet standardised.

ASTM = American Society for Testing and Materials

ISO = International Organisation for Standardisation

Table 2 The most important types of synthetic rubber, their grouping and abbreviations

Chemical name	Abbreviation	
	ISO 1629	ASTM D 1418
M - Group (saturated carbon molecules in main macro-molecule-chain) - Polyacrylate Rubber - Ethylene Acrylate Rubber - Chlorosulfonated Polyethylene Rubber - Ethylene Propylene Diene Rubber - Ethylene Propylene Rubber - Fluorocarbon Rubber - Perfluoro Rubber	ACM AEM CSM EPDM EPM FKM FFKM	ACM CSM EPDM EPM FKM FFKM
O - Group (with oxygen molecules in the main macro-molecule chain) - Epichlorohydrin Rubber - Epichlorohydrin Copolymer Rubber	CO ECO	CO ECO
R - Group (unsaturated hydrogene carbon chain) - Chloroprene Rubber - Butyl Rubber - Nitrile Butadiene Rubber - Natural Rubber - Styrene Butadiene Rubber - Hydrogenated Nitrile Butadiene Rubber	CR IIR NBR NR SBR HNBR	CR IIR NBR NR SBR HNBR
Q - Group (with Silicone in the main chain) - Fluorosilicone Rubber - Methyl Vinyl Silicone Rubber	FVMQ VMQ	FVMQ VMQ
U - Group (with carbon, oxygen and nitrogen in the main chain) - Polyester Urethane - Polyether Urethane	AU EU	AU EU



B.1.2 Application parameters of elastomers

Elastomers as all other organic chemicals have limited use. External influences such as various media, oxygen or ozone as well as pressure and temperature will affect the material properties and therefore their sealing capability.

Elastomers will amongst others swell, shrink or harden and develop cracks or even tears. The following information illustrates the different application parameters.

Elastomer heat resistance / swelling in oil

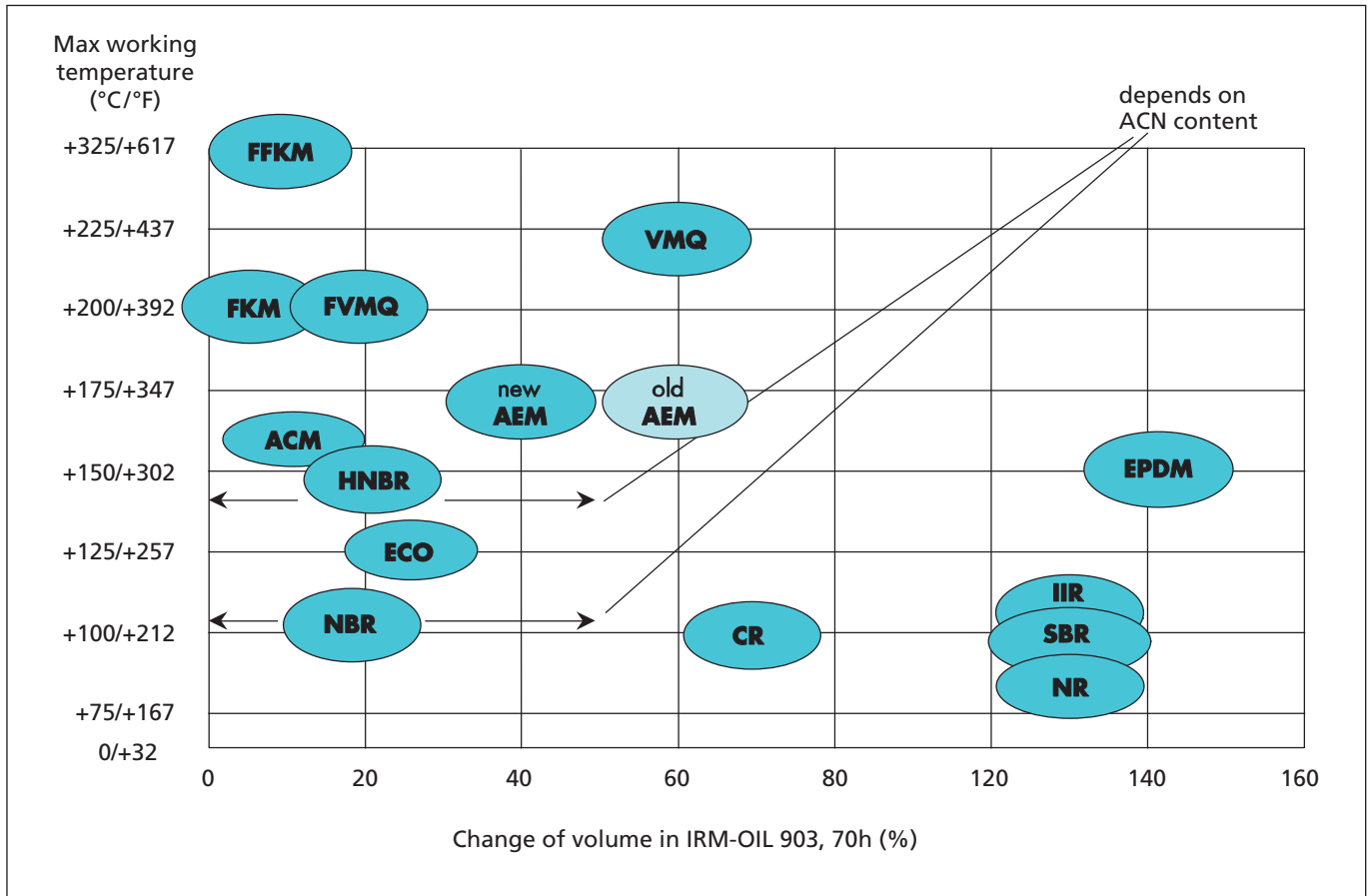


Figure 3 Change of volume in IRM-Oil 903 (old ASTM-Oil No 3)



O-Ring

Temperature range

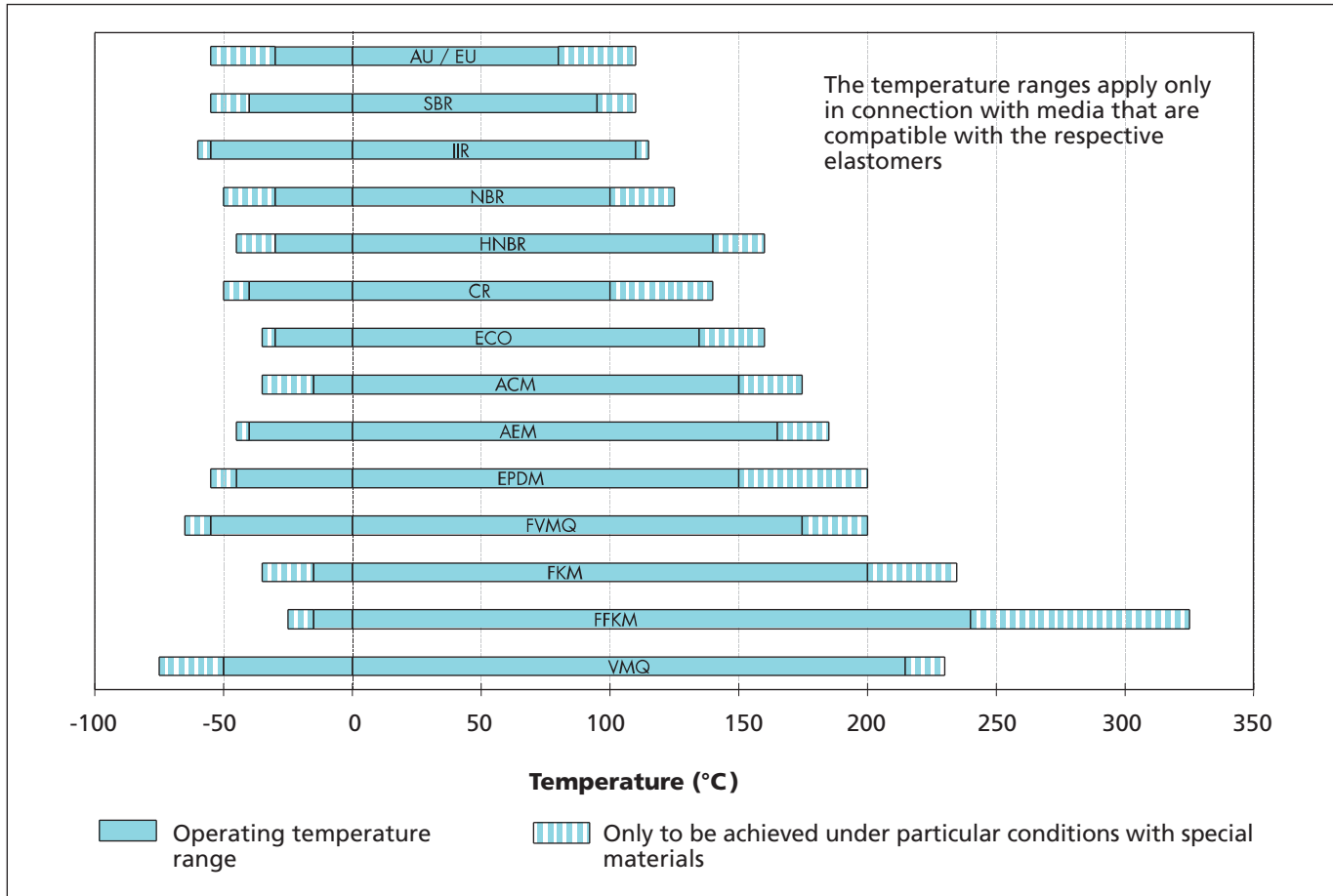


Figure 4 Temperature range of various elastomers

General field of application

Elastomer materials are used to cover a large number of fields of application. The various elastomers can be characterised as follows:

ACM (Polyacrylate Rubber)

ACM shows excellent resistance to ozone, weathering and hot air, although it shows only a medium physical strength, low elasticity and a relatively limited low temperature capability. The operating temperatures range from -20 °C and +150 °C (for a short period of time up to +175 °C). Special types can be used down to -35 °C. ACM-materials are mainly used in automotive applications which require special resistance to lubricants containing many additives (incl. sulphur) at high temperatures.

CR (Chloroprene Rubber)

In general the CR materials show relatively good resistances to ozone, weathering, chemicals and aging. Also they show good non-flammability, good mechanical properties and cold flexibility. The operating temperatures range between -35 °C and +90 °C (for a short period of time up to +120 °C). Special types can be used down to

-55 °C. CR materials are found in sealing applications such as refrigerants, for outdoor applications and in the glue industry.

EPDM (Ethylene Propylene Diene Rubber)

EPDM shows good heat, ozone and aging resistance. In addition they also exhibit high levels of elasticity, good low temperature behaviour as well as good insulating properties. The operating temperatures of applications for EPDM range between -45 °C and +150 °C (for a short period of time up to +175 °C). With sulphur cured types the range is reduced to -45 °C and +130 °C (for short period of time up to +150 °C). EPDM can often be found in applications with brake fluids (based on glycol) and hot water.

FFKM (Perfluoro Rubber)

Perfluoroelastomers show broad chemical resistance similar to PTFE as well as good heat resistance. They show low swelling with almost all media. Depending on the material the operating temperatures range between -25 °C and +240 °C. Special types can be used up to +325 °C. Applications for FFKM can be mostly found in the chemical and process industries and in all applications with either aggressive environments or high temperatures.



FKM (Fluorocarbon Rubber)

Depending on structure and fluorine content FKM materials can differ with regards to their chemical resistance and cold-flexibility. FKM is known especially for its non-flammability, low gas permeability and excellent resistance to ozone, weathering and aging. The operating temperatures of the Fluorocarbon Rubber range between -20 °C and +200 °C (for a short period of time up to +230 °C). Suitable formulated FKM can be used down to -35 °C. FKM is also often used with mineral based oils and greases at high temperatures.

FVMQ (Fluorosilicone Rubber)

FVMQ has a good heat resistance, very good low temperature flexibility, good electrical properties and excellent resistance to weather, ozone and UV rays. FVMQ shows a significant better chemical resistance than standard Silicone especially in hydrocarbons, aromatic mineral oils, fuel and low molecular aromatic hydrocarbons e.g. Benzene and Toluene. The temperature range is between -50 °C and +175 °C (temporary up to +200 °C).

HNBR (Hydrogenated Nitrile Butadiene Rubber)

HNBR is made via selective hydrogenation of the NBR butadiene groups. The properties of the HNBR rubber depend on the ACN content which ranges between 18 % and 50 % as well as on the degree of saturation. HNBR shows good mechanical properties. The operating temperature of HNBR ranges between -30 °C and +140 °C (for a short period of time up to +160 °C) in contact with mineral oils and greases. Special types can be used down to -40 °C.

IIR (Butyl Rubber)

Butyl Rubber shows a very low gas and moisture permeability. In addition IIR also exhibits a good resistance to a large number of organic and inorganic chemicals, ozone, weathering and aging. The electrical insulating properties of IIR are excellent. Its temperature range is between -40 °C and +110 °C and for a short period of time up to +120 °C.

NBR (Nitrile Butadiene Rubber)

The properties of the Nitrile Rubber depend mainly on the ACN content which ranges between 18 % and 50 %. In general they show good mechanical properties. The operating temperatures range between -30 °C and +100 °C (for a short period of time up to +120 °C). Suitable formulated NBR can be used down to -60 °C. NBR is mostly used with mineral based oils and greases.

Polyurethane (Zurcon® Polyurethane)

Polyurethanes are an exceptionally complex material group. They are individually designed and fit various applications' needs. Therefore it is not possible to unify the materials' properties.

Zurcon® polyurethane materials from Trelleborg Sealing Solutions are customized to appropriate applications and stand out due to their excellent elastic properties and optimum abrasion resistance. Outstanding tensile strength, low compression set and good resistance to O₂ and O₃ are further significant characteristics. Depending on the individual Zurcon® polyurethane type the application temperature range from below -50 °C up to +110 °C, temporary even higher, is feasible.

VMQ (Silicone Rubber)

VMQ shows excellent heat resistance, cold flexibility, dielectric properties and especially good resistance to weather, ozone and UV rays. Specific VMQ formulations are resistant to aliphatic engine and gear oils, water up to +100 °C and high-molecular chlorinated hydrocarbons. The temperature range is between -50 °C and +175 °C (temporary up to +230 °C).

Chemical compatibility

For the pre-selection of a suitable material group a comprehensive chemical compatibility guide is available. This can be downloaded from our website www.tss.trelleborg.com or you can contact your local Trelleborg Sealing Solutions company for further details.

It is important to recognise that when using this guide, the ratings shown are based on published data and immersion tests. These tests are conducted under laboratory conditions predominantly at room temperature and may not represent adequately the conditions in the field. Relative short term laboratory tests may not pick up all the additives and impurities which may exist in long term service applications.

Care must be taken to ensure that all aspects of the application are considered carefully before a material is selected. For example at elevated temperatures some aggressive fluids can cause a much more marked effect on an elastomer than at room temperature.

Physical properties as well as fluid compatibility need to be considered. Compression set, hardness, abrasion resistance and thermal expansion can influence the suitability of a material for a particular application.

It is recommended that users conduct their own tests to confirm the suitability of the selected material for each application.

Our experienced technical staff can be consulted for further information on specific applications.



B.1.3 Characteristics and inspection of elastomers

Hardness

One of the most often named properties regarding Polymer materials is hardness. Even so the values can be quite misleading.

Hardness is the resistance of a body against penetration of an even harder body - of a standard shape defined pressure.

There are two procedures for hardness tests regarding test samples and finished parts made out of elastomer material:

1. Shore A / D according to ISO 868 / ISO 7619 / DIN 53505 / ASTM D 2240
Measurement for test samples
2. Durometer IRHD (International Rubber Hardness Degree) according to ISO 48 / ASTM 1414 and 1415
Measurement of test samples and finished parts

The hardness scale has a range of 0 (softest) to 100 (hardest). The measured values depend on the elastic qualities of the elastomers, especially on the tensile strength.

The test should be carried out at temperatures of $23 \pm 2 \text{ }^\circ\text{C}$ - not earlier than 16 hours after the last vulcanisation process (manufacturing stage). If other temperatures are being used this should be mentioned in the test report.

Tests should only be carried out with samples which have not been previously stressed mechanically.

Hardness tests according to Shore A / D

The hardness test device Shore A (indenter with pyramid base) is a sensible application in the hardness range 10 to 90. Samples with a larger hardness should be tested with the device Shore D (indenter with spike).

Test specimen:

Diameter min. 1.181 inches (30 mm)

Thickness min. .240 inches (6 mm)

Upper and lower sides smooth and flat

When thin material is being tested it can be layered providing minimal sample thickness is achieved by a maximum of 3 layers. All layers must be at minimum .080 inches (2 mm) thick.

The measurement is done at three different places at a defined distance and time.

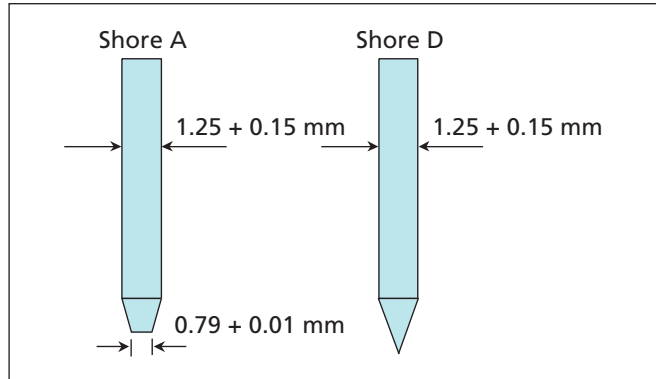


Figure 5 Indentor according to Shore A / D

Hardness test according to IRHD

The test of the Durometer according to IRHD is used with test samples as well as with finished goods.

The thickness of the test material has to be adjusted according to the range of hardness. According to ISO 48 there are two hardness ranges:

- Soft: 10 to 35 IRHD \Rightarrow Sample thickness
.394 to .591 inches
(10 to 15 mm) / procedure "L"
- Normal: over 35 IRHD \Rightarrow Sample thickness
.315 to .394 inches
(8 to 10 mm) / procedure "N"
Sample thickness
.059 to .098 inches
(1.5 to 2.5 mm) / procedure "M"

The hardness determined with finished parts or samples usually vary in hardness determined from specimen samples, especially those with a curved surface.

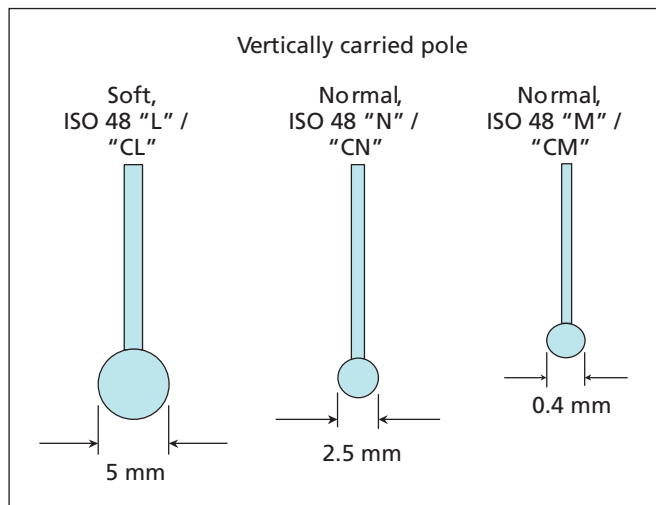


Figure 6 Indentor according to IRHD



Influencing parameters on the hardness test for polymer materials

Various sample thicknesses and geometries as well as various tests can show different hardness values even though the same materials have been used.

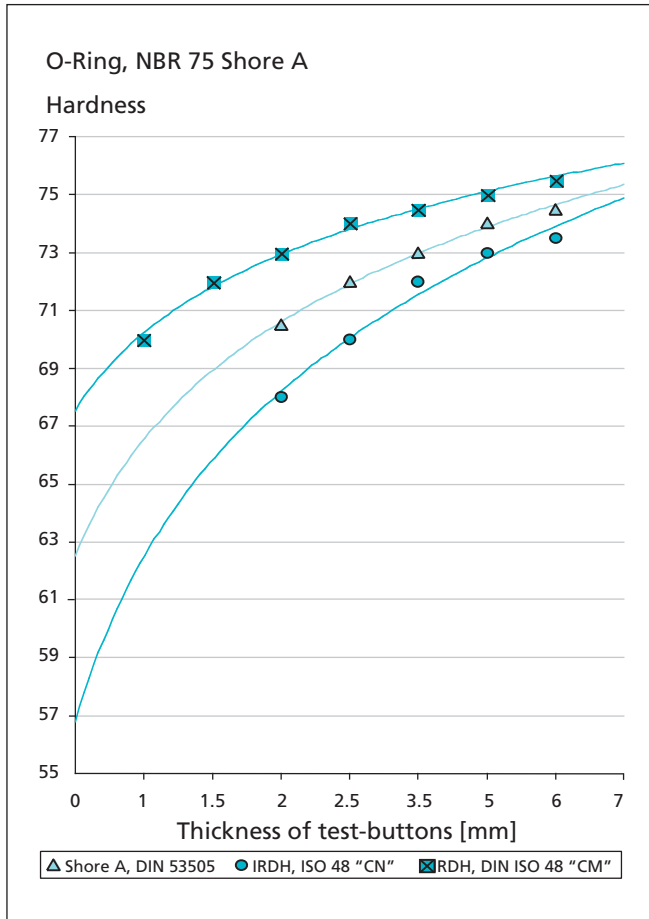


Figure 7 Ranges of hardness depending on sample thickness and test method

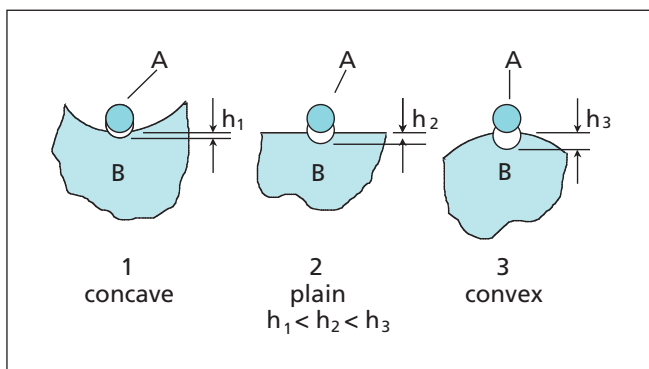


Figure 8 Range of hardness depending on surface geometry for the equivalent material characteristics

With equivalent material characteristics of the elastomer sample B, the indenter penetrates the deepest at the surface 3 (convex) and therefore establishes the softest area.

As the convex geometry (3) has a stronger effect on smaller width O-Rings, the tolerances on hardness for widths under 2.0 mm should be increased up to +5 / -8 IRHD based on the valid IRHD nominal value.

Compression set

An important parameter regarding the sealing capability is the compression set (CS) of the O-Ring material. Elastomers when under compression show aside from an elastic element also a permanent plastic deformation (Figure 9).

The compression set is determined in accordance with ISO 815 as follows:

- Standard test piece: Cylindrical disc, diameter .512 and height .236 inches (13 mm and height 6 mm)
- Deformation: 25 %
- Tension release time: 30 minutes

$$CS = \frac{h_0 - h_2}{h_0 - h_1} \cdot 100(\%)$$

- Where h_0 = Original height (cross section d_2)
- h_1 = Height in the compressed state
- h_2 = Height after tension release

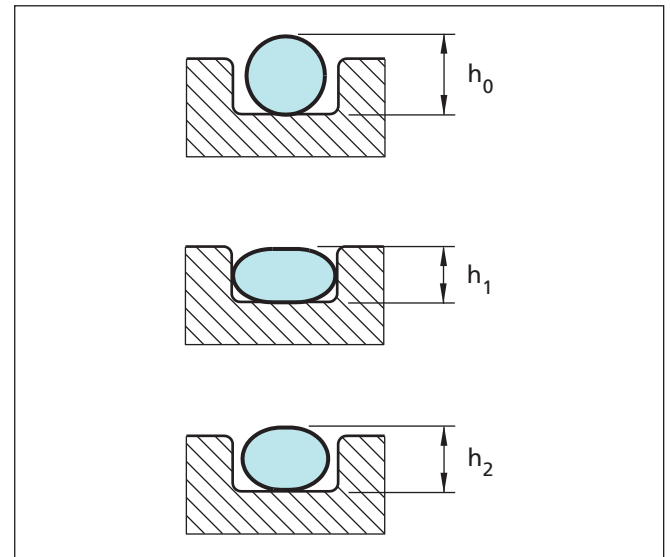


Figure 9 Illustration of the compression set



O-Ring

The accuracy of the measured value depends on:

- Test sample thickness
- Deformation
- Measurement deviations

Therefore the values which have been identified with the test sample cannot be transferred onto the finished part. The result of the measured finished parts are strongly influenced by geometrics and measurements as well as the measuring accuracy of the test equipment.

The following illustration shows the influence of various measuring deviations (in mm) in respect to the established compression set CS depending on the cross section of the measured O-Rings.

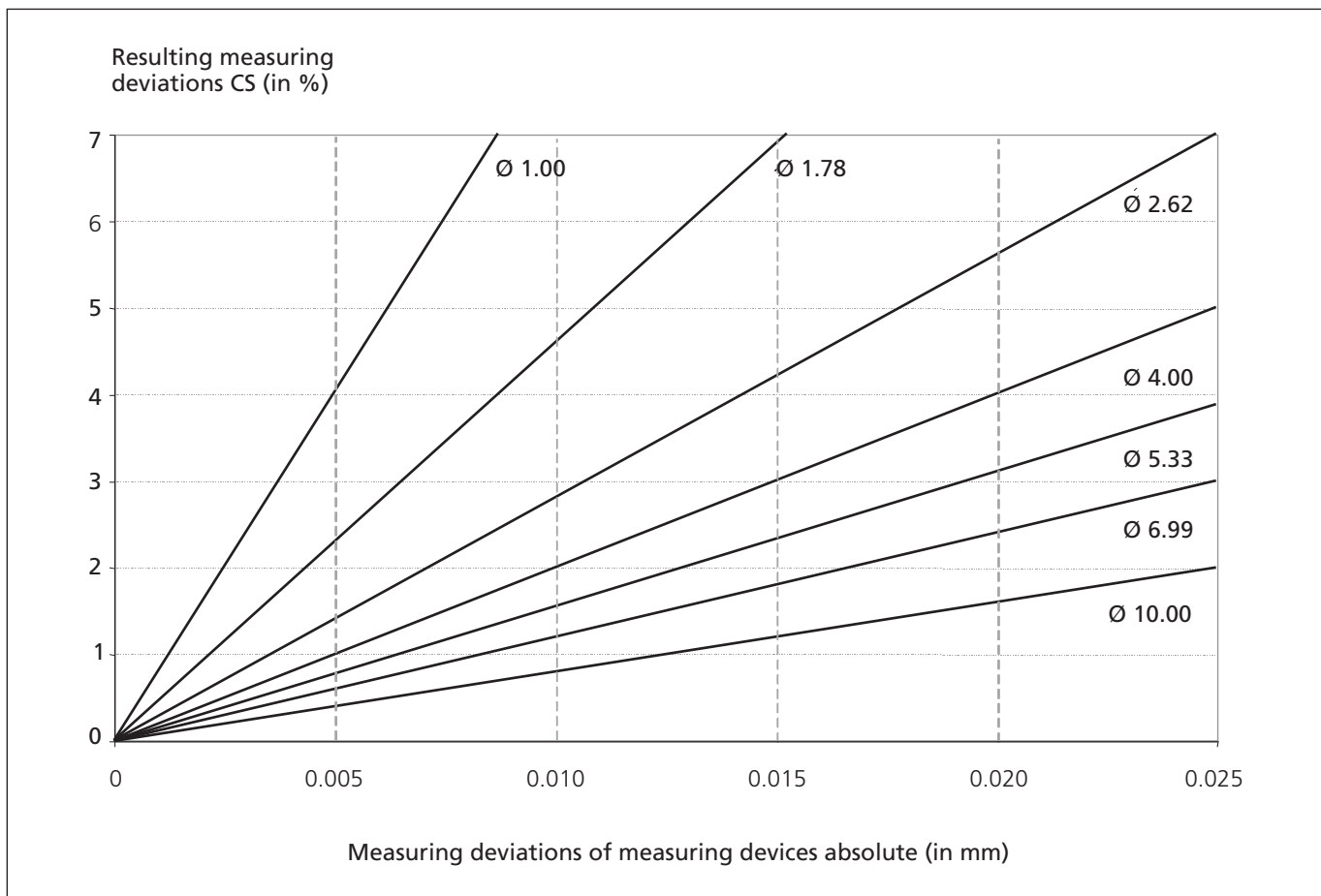


Figure 10 Measuring deviations CS depending on O-Ring cross section and measuring accuracy of the test equipment (schematic illustration)



B.1.4 Special requirements - authorities and approvals

Seals often have to meet the highest performance standards and the most stringent of environment and safety demands.

Also official authorities and associations make great demands on seals or materials which are to be used in their

industries. This is often the case if seals are used for water or gas applications.

The following table shows common authorities and their requirements.

Table 3 Authorities and approvals

Approval / Examination Certificate / Guideline	Application	Criteria / Standards	Tests / Examinations / Contents	Authorities / Associations	Institutes / Laboratories
ACS Licensing	Polymers exposed to drinking water	French Standard AFNOR XP P41-250, part 1-3 Synoptic Paper 1226	- Analysis of dispensing according "Synoptic" - Documents - "Storage test (microbe analysis)	ACS (Accréditation de conformité sanitaire)	3 certified test laboratories in France: Paris / Vandoeuvre / Lille
BAM Recommendation	Seals for the use in gas or oxygen fittings	- reactive behaviour with lubricants - limits for pressure and temperature (DIN 4060) - seals and components		BAM (Bundesanstalt für Materialforschung und -prüfung)	BAM, Berlin
BfR Recommendation (former: BgVV)	Polymers exposed to food	BfR Guidelines ("Polymers exposed to food") various paragraphs, depending on the application of the seal	- Chemical and physical tests - Biological tests - Sterilisation tests - Taste tests	BfR (Bundesanstalt für Risikobewertung)	BAM, Berlin HY (Hygiene-Institut, Gelsenkirchen)
DVGW Release for Gas	Seals for gas services and gas applications	EN 549 EN 682		DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	Test Laboratory for Gas, Karlsruhe, MPA NRW, Dortmund
DVGW W270 Recommendation	Materials exposed to drinking water	DVGW, worksheet W 270	Microbiological testing: reproduction of microorganisms on materials	DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	TZW, Karlsruhe HY (Hygiene Institution), Gelsenkirchen
FDA Guideline	Materials for food and pharmaceutical	"White List" (Register of permitted dispensing components), e.g. according to 21. CFR Part 177.2600	- Component test according "White List" - Extended for foods containing water or oil - Extraction test for polar / non polar solvents	FDA (Food and Drug Administration)	In house or external laboratories
International Military Releases	Applications for military devices	Various military specifications and standards depending on the application	Depending on application and specification		Various test laboratories
KTW Certificate ¹	Polymers exposed to drinking water, Cold- warm- and hot water	BfR Guidelines ("Polymers exposed to food") part 1.3.13	Extraction test Odour- and taste test Register of permitted components	DVGW, Bonn (Deutscher Verein des Gas- und Wasserfaches e.V.)	Environmental Hygiene Institute, Gelsenkirchen TZW, Karlsruhe BAM, Berlin



O-Ring

Approval / Examination Certificate / Guideline	Application	Criteria / Standards	Tests / Examinations / Contents	Authorities / Associations	Institutes / Laboratories
NSF Release	Food and Sanitary	NSF Standard criteria	Depending on application: - Test of components - Test of component group - Physical and chemical material tests - Toxicological and microbiological tests	NSF (National Sanitation Foundation)	NSF, USA UL, USA
Regulation (EC) 1935/2004	Food Products	Regulation (EU) 10/2011 Regulation (EC) 2023/2006 national regulations (e.g. BfR)	Amongst others: - Union list of authorized substances - Migration tests with limits for the total migration	EU	Different test laboratories
UL Listing	Application of seals for electrical equipment + appliances	UL-guidelines	Chemical comparability test Additional tests depending on application	UL (Underwriters Laboratory)	Underwriters laboratory in USA/England
USP Examination	For medical and pharmaceutical use	Different specifications: USP 26 et seqq., chapter 87, 88, Class I to VI,...	Depending on specification: - Intracutaneous reactive tests - Systemic Injections - Muscle implantations	USP (United States Pharmacopeia, USA)	Different authorized test laboratories
WRAS Release (former: WRC)	Polymers exposed to drinking water	British Standard BS 6920 BS 2494	Dispensing test Microbe test Extraction test Hot water test	WRAS (Water Regulations Advisory Scheme)	Various accredited test laboratories in England
18-03 3-A Sanitary	Food Products	18-03 3-A Sanitary Standards for multiple-use rubber and rubber-like materials used as product contact surfaces in dairy equipment	Chemical and physical properties according to Class I to III	Organisations: LAFIS, IAFP, USPHS, EHEDG, DIC	Various laboratories

¹ Date of validity May 2011, subject to change



B.1.5 Standard materials

The following tables show the physical properties of Trelleborg Sealing Solutions standard materials. They concern minimum values. That means that a standard material meets at least the given values. Many of the

Trelleborg Sealing Solutions materials (even when defined as standard) have better physical properties.

Table 4 Material specification for standard NBR

			NBR 50 Shore A	NBR 60 Shore A	NBR 70 Shore A	NBR 80 Shore A	NBR 90 Shore A	
TSS Material Code			N50	N60	N70	N80	N90	
Hardness	DIN 53 505 ASTM D 2240	Shore A	50 ± 5	60 ± 5	70 ± 5	80 ± 5	90 ± 5	
Tensile strength	DIN 53 504 ASTM D 412	MPa N/ mm ²	≥ 8	≥ 10	≥ 14	≥ 12	≥ 10	
Elongation at break	DIN 53 504 ASTM D 412	%	≥ 200	≥ 200	≥ 200	≥ 150	≥ 100	
Compression set	24h / 100 °C	DIN ISO 815B ASTM D 395B	%	< 30	< 30	< 25	< 30	
Heat aging	72h / 100 °C	DIN 53 508 ASTM D 573						
Change of hardness			Shore A	max. +8	max. +8	max. +8	max. +8	max. +8
Change of tensile strength			%	max. -25	max. -25	max. -25	max. -25	max. -30
Change of elongation at break			%	max. -25	max. -25	max. -25	max. -25	max. -30
Resistance in ASTM-OIL # 1	72h / 100 °C	DIN 53 521 ASTM D 471						
Change of hardness			Shore A	max. +6	max. +6	max. +6	max. +6	max. +6
Change of volume			%	max. -8	max. -8	max. -8	max. -8	max. -8
Resistance in ASTM-OIL # 3	72h / 100 °C	DIN 53 521 ASTM D 471						
Change of hardness			Shore A	max. -10	max. -10	max. -10	max. -10	max. -10
Change of volume			%	max. +15	max. +15	max. +15	max. +15	max. +15
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria.			-30 °C to +100 °C	-30 °C to +100 °C	-30 °C to +100 °C	-25 °C to +100 °C	-25 °C to +100 °C



O-Ring

Table 5 Material specification for standard EPDM

			EPDM 70 Shore A sulphur cured	EPDM 70 Shore A peroxide cured	EPDM 75 Shore A peroxide cured
TSS Material Code			E70	E80	E90
Hardness		DIN 53 505 ASTM D 2240	Shore A	70 ± 5	75 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm ²	≥ 10	≥ 10
Elongation at break		DIN 53 504 ASTM D 412	%	≥ 150	≥ 125
Compression set	24h / 100 °C	DIN ISO 815B ASTM D 395B	%	< 20	
	24h / 150 °C		%	< 30	< 30
Heat aging	72h / 100 °C	DIN 53 508 ASTM D 573		x	
	72h / 150 °C			x	x
Change of hardness			Shore A	max. +10	max. +10
Change of tensile strength			%	max. -10	max. -20
Change of elongation at break			%	max. -20	max. -20
Resistance in water	72h / 100 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max. -10	max. -3
Change of volume			%	max. +10	max. +3
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria.			-45 °C to +130 °C	-45 °C to +150 °C

Table 6 Material specification for standard VMQ

			VMQ 50 Shore A	VMQ 60 Shore A	VMQ 70 Shore A
TSS Material Code			S50T	S60	S70R
Hardness		DIN 53 505 ASTM D 2240	Shore A	50 ± 5	70 ± 5
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm ²	≥ 5	≥ 5
Elongation at break		DIN 53 504 ASTM D 412	%	≥ 150	≥ 100
Compression set	24h / 175 °C	DIN ISO 815B ASTM D 395B	%	< 35	< 35
Heat aging	72h / 225 °C	DIN 53 508 ASTM D 573			
Change of hardness			Shore A	max. +15	max. +15
Change of tensile strength			%	max. -40	max. -40
Change of elongation at break			%	max. -40	max. -40
Resistance in ASTM-Oil # 1	72h / 100 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max. -10	max. -10
Change of volume			%	max. +20	max. +20
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria.			-50 °C to +175 °C	-50 °C to +175 °C



Table 7 Material specification for standard FKM

			FKM 70 Shore A	FKM 75 Shore A	FKM 80 Shore A	FKM 90 Shore A	
TSS Material Code			V70	VC0	V80	V90	
Hardness	DIN 53 505 ASTM D 2240	Shore A	70 ± 5	75 ± 5	80 ± 5	90 ± 5	
Tensile strength	DIN 53 504 ASTM D 412	MPa N/mm ²	≥ 10	≥ 10	≥ 10	≥ 10	
Elongation at break	DIN 53 504 ASTM D 412	%	≥ 125	≥ 125	≥ 120	≥ 100	
Compression set	24h / 175 °C	DIN ISO 815B ASTM D 395B	%	< 20	< 20	< 20	
Heat aging	72h / 250 °C	DIN 53 508 ASTM D 573					
Change of hardness			Shore A	max. +10	max. +10	max. +10	max. +10
Change of tensile strength			%	max. -25	max. -25	max. -25	max. -25
Change of elongation at break			%	max. -25	max. -25	max. -25	max. -25
Resistance in ASTM-Oil # 3	72h / 150 °C	DIN 53 521 ASTM D 471					
Change of hardness			Shore A	max. -5	max. -5	max. -5	max. -5
Change of volume			%	max +5	max. +5	max. +5	max. +5
Resistance in ASTM-FUEL C	72h / RT	DIN 53 521 ASTM D 471					
Change of hardness			Shore A	max. -5	max. -5	max. -5	max. -5
Change of volume			%	max. +10	max. +10	max. +10	max. +10
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria.		-20 °C to +200 °C	-20 °C to +200 °C	-20 °C to +200 °C	-15 °C to +200 °C	



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Table 8 Material specification for standard HNBR

			HNBR 70 Shore A partially saturated	HNBR 75 Shore A partially saturated	
TSS Material Code			H70	HCO	
Hardness		DIN 53 505 ASTM D 2240	Shore A 70 ± 5	75 ± 5	
Tensile strength		DIN 53 504 ASTM D 412	MPa N/mm ² ≥ 15	≥ 15	
Elongation at break		DIN 53 504 ASTM D 412	% ≥ 250	≥ 250	
Compression set	24h / 125 °C	DIN ISO 815B ASTM D 395B	% < 35	< 35	
Heat aging	72h / 150 °C	DIN 53 508 ASTM D 573			
Change of hardness			Shore A	max. +10	max. +10
Change of tensile strength			%	max. -30	max. -30
Change of elongation at break			%	max. -30	max. -30
Resistance in ASTM-Oil # 1	72h / 150 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max. +10	max. +10
Change of volume			%	max. -10	max. -10
Resistance in ASTM-Oil # 3	72h / 150 °C	DIN 53 521 ASTM D 471			
Change of hardness			Shore A	max. -15	max. -15
Change of volume			%	max. +20	max. +20
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria.		-30 °C to +130 °C	-30 °C to +130 °C	

Table 9 Material specification for standard PTFE

			PTFE virgin	PTFE glass fibre 25 %	PTFE bronze 40 %	PTFE carbon 25 % graphite 25 %
TSS Material Code			PT00	PTGC	PTB4	PTKC
Hardness	DIN 53 505 ASTM D 2240	Shore D	55 ± 5	62 ± 5	65 ± 5	65 ± 5
Specific gravity	DIN EN ISO 1183-1 ASTM D 792	g/cm ³	2.17 ± 0.05	2.25 ± 0.05	3.10 ± 0.1	2.09 ± 0.04
Tensile strength	EN ISO 527	N/mm ²	≥ 20	≥ 12	≥ 20	≥ 11
Elongation at break	EN ISO 527	%	≥ 200	≥ 150	≥ 200	≥ 90

Trelleborg Sealing Solutions offers various materials, which provide additional advantages, in addition to the standard materials previously described. The advantages include a wide range of available molds, special operating temperature range, special media resistance and institutional approvals for the portable water, pharmaceutical and beverage industries.

The following table shows preferred materials, which are characterized by their wide spectrum of use. They can be used for standard applications as well as for special industrial applications.



Table 10 Preferred materials

Material Type	Hardness Shore A (± 5)	Color	Operating temperature range	Material code	Description
NBR Nitrile Butadiene Rubber	70	black	-30 °C to +100 °C	N7083	Preferable for sizes according to ISO 3601-1/AS 568 , preferably used for energizing elements, good overall performance
			-55 °C to +80 °C	N7T40	"Polar", extremely good low temperature properties , preferably used for static applications in mineral oil and for energizing elements, preferable for sizes according to ISO 3601-1/AS 568
			-30 °C to +100 °C	N7003	Preferable for metric sizes, good overall performance, wide range of molds available
			-30 °C to +100 °C	N7024	Good overall performance, preferable for large quantities
	90	black	-25 °C to +100 °C	N9002	Good overall performance, wide range of molds available
HNBR Hydrogenated Nitrile Butadiene Rubber	70	black	-30 °C to +140 °C	H7671	Good overall performance, wide range of molds available
			-25 °C to +140 °C	H7503	Wide range of operating temperature , good resistance to mineral oil, good overall performance
FKM Fluorocarbon Rubber	70	green	-20 °C to +200 °C	V70GA	Preferable for sizes according to ISO 3601-1/AS 568 , preferably used for energizing elements, good overall performance, DVGW DIN EN 549, BAM
			-20 °C to +200 °C	V70G2	Preferable for sizes according to ISO 3601-1/AS 568 , good overall performance
	75	black	-20 °C to +200 °C	VC009	Preferable for sizes according to BS 4518 (metric), standard FKM
			80	green	-20 °C to +200 °C
	black	-20 °C to +200 °C	V8003		Good overall performance, wide range of molds available
		-20 °C to +200 °C	V8605		For pharmaceutical and food and beverage industries, FDA 21.CFR § 177.2600, Regulation (EC) 1935/2004
	-20 °C to +200 °C	V8T41	For pharmaceutical and food and beverage industries, good steam resistance, FDA 21. CFR § 177.2600, USP Class VI, 3A Sanitary Number 18-03, Regulation (EC) 1935/2004		
		90	green	-15 °C to +200 °C	V90G1
black	-15 °C to +200 °C		V9670	Good overall performance, wide range of molds available	
EPDM Ethylene Propylene Diene Rubber	70	black	-45 °C to +150 °C	E7502	Peroxide cured, for pharmaceutical and food and beverage industries, KTW¹, WRAS, FDA 21.CFR § 177.2600, USP Class VI, USP 26, Regulation (EC) 1935/2004 , plasticizer content < 3 %
			-45 °C to +130 °C	E7002	Sulfur cured , standard EPDM, wide range of molds available
			-45 °C to +150 °C	E7T41	Peroxide cured, very low compression set in hot water / steam. Excellent resistance to ozone, can be used with copper and brass
			-45 °C to +150 °C	E7518	Peroxide cured, for the use in potable water: KTW¹, WRAS, FDA 21.CFR § 177.2600, NSF61, W270, EN 681, ACS, USP Class VI, USP 26, Regulation (EC) 1935/2004 , plasticizer content < 1%
VMQ Methyl Vinyl Silicon Rubber	60	red	-50 °C to +175 °C	S60R1	Good overall performance, wide range of molds available
	70	red	-50 °C to +175 °C	S70R2	Good overall performance, wide range of molds available

¹ Date of validity May 2011, subject to change

The stated operating temperatures exclude any kind of load. Actual operating temperatures may differ depending on media and load type. At time of publication the information contained in this literature, including availability or institutional approvals, is believed to be correct and accurate. Further materials are available on request.



B.2 Installation and design recommendations

The following design recommendations are mainly based on the recommendations given in the ISO 3601-2. They cannot be deployed for the special Isolast® materials. Please use the Isolast® brochure or contact our specialists for further details.

Use the Trelleborg Sealing Solutions O-Ring calculator to help design O-Ring housings. It can be downloaded from the Trelleborg Sealing Solutions website at www.tss.trelleborg.com.

B.2.1 Installation recommendations

General recommendations

Before starting installation, check the following points:

- Lead-in chamfers made according to drawing?
- Bores deburred and edges rounded?
- Machining residues, e.g. chips, dirt and foreign particles, removed?
- Screw thread tips covered?
- Seals and components greased or oiled?
Ensure media compatibility with the elastomer material. Trelleborg Sealing Solutions recommends to use the fluid to be sealed.
- Do not use lubricants with solid additives, e.g. molybdenum disulphide or zinc sulphide.

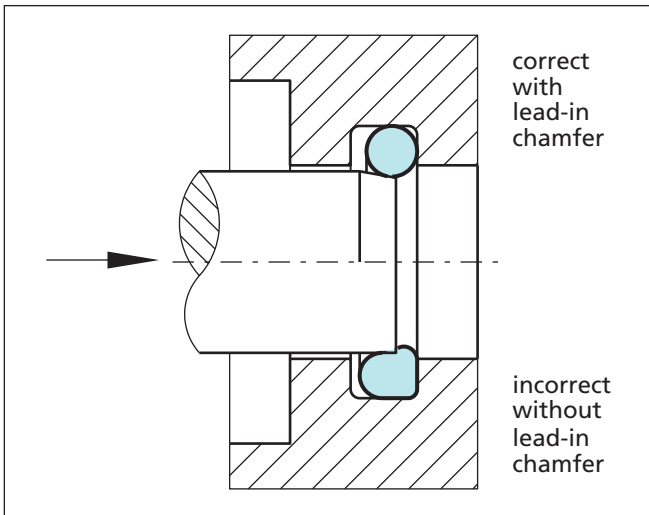


Figure 11 Rod installation with O-Ring

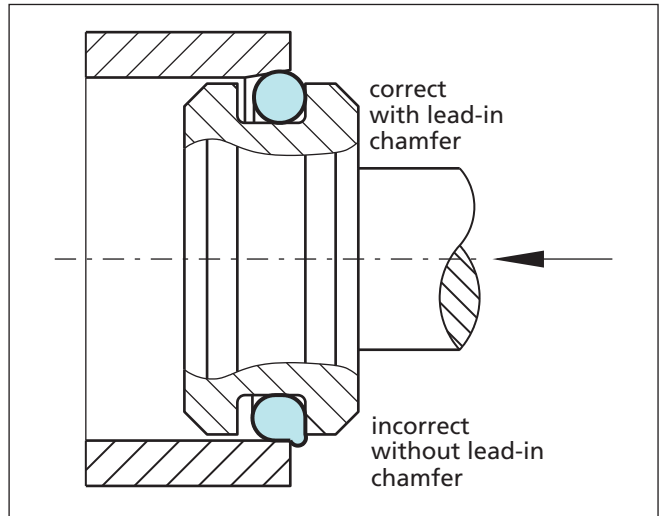


Figure 12 Piston installation with O-Ring

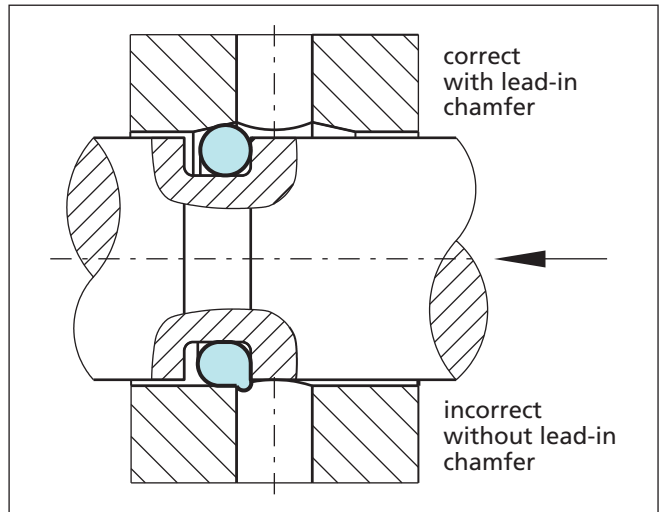


Figure 13 O-Ring installation over transverse bores



Manual installation

- Use tools without sharp edges!
- Ensure that the O-Ring is not twisted, use installation aids to assist correct positioning
- Use installation aids wherever possible
- Do not over stretch O-Rings
- Do not stretch O-Rings made out of cord at the joint.

Installation over threads, splines etc.

Should the O-Ring have to be stretched over threads, splines, keyways etc., then an assembly mandrel is essential. This mandrel can either be manufactured in a soft metal or a plastic material obviously without burrs or sharp edges.

Automatic installation

Automatic O-Ring installation requires good preparation. The surfaces of the O-Rings are frequently treated by several methods (see brochure "Flexcoat™ – Friction-free Running"). This offers a number of benefits during installation by

- Reducing the installation forces
- Non-stick effects, easy removal

The handling and installation of dimensionally unstable components requires a great deal of experience. Reliable automated installation thus demands special handling and packing of the O-Rings.

Please ask our specialists for further details.

B.2.2 Methods of installation and design of seal housing

Methods of installation

O-Rings can be used in components in a wide variety of ways.

During the design stage installation must be taken into consideration. In order to avoid damage during installation it should not be necessary to pass the O-Ring over edges or bores. When long sliding movements are involved, the seal seat should be recessed, if possible, or the O-Rings arranged so that they only have to travel short distances during installation to reduce risk of twisting.

Radial installation (static and dynamic)

Inner sealing (rod sealing)

The O-Ring size should be selected so that the O-Ring outside diameter ($d_1 + 2 \cdot d_2$) is at least equal to or larger than the groove outside diameter d_6 (Figure 14).

Outer sealing (piston sealing)

The O-Ring size should be selected so that the inside diameter d_1 is equal to or smaller than groove diameter d_3 (Figure 14).

Axial installation (static)

During axial-static installation, the direction of the pressure should be taken into consideration when choosing the O-Ring size (Figure 15). With internal pressure the O-Ring should be chosen so that the outside diameter of the O-Ring is larger than the outer groove diameter d_7 . With external pressure the O-Ring inside diameter is chosen smaller than the inner groove diameter d_8 .



O-Ring

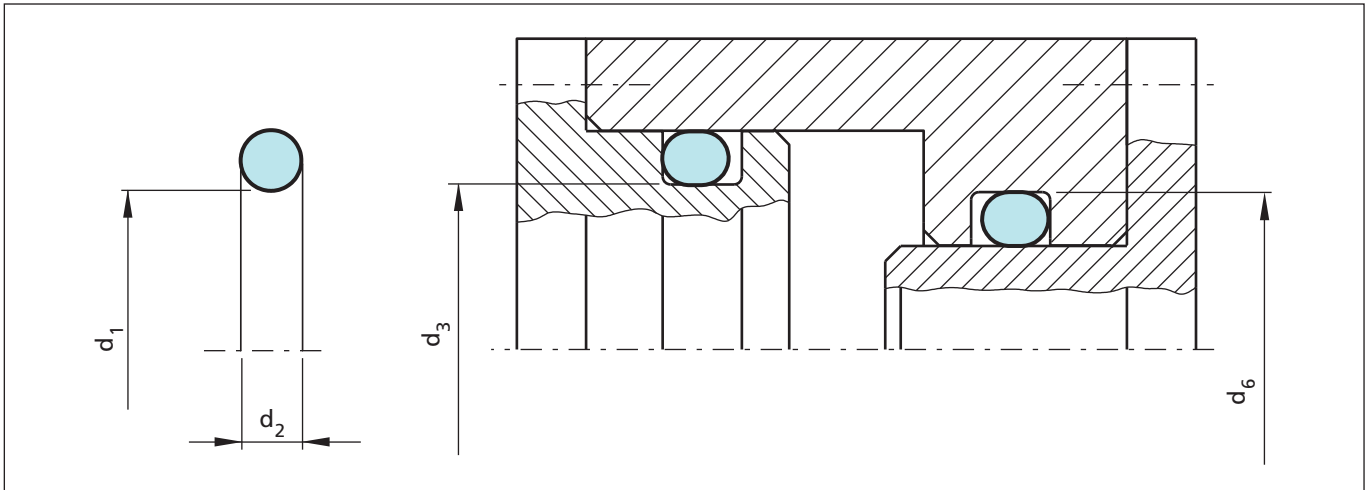


Figure 14 Radial installation, static and dynamic

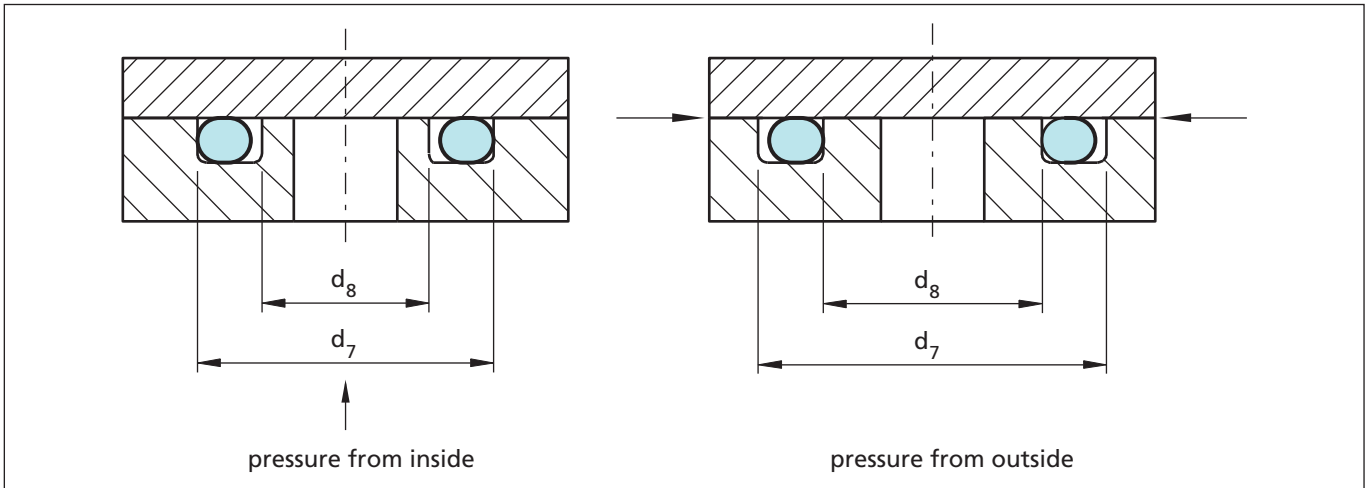


Figure 15 Axial installation, static



B.2.3 Elongation - outside diameter interference

Radial Installation, piston and rod sealing, static and dynamic

If the O-Ring is used as a piston seal (outer sealing), the nominal O-Ring inside diameter, d_1 (see Figure 14), should be stretched between 2 % and 5 % for dynamic applications and between 2 % and 8 % for static applications.

For O-Rings with a diameter d_1 smaller than 20 mm, this is not always possible so the stretch range is wider. To minimize this range and maximize stretch, it is necessary to minimize the tolerances of the housing diameter, d_3 (see Figure 14), and have a less stringent requirement for the minimum O-Ring stretch. In dynamic applications, it is important to keep the maximum stretch to 5 % or less to avoid detrimental effects on sealing performance. Exceeding these values will result in too great a decrease in the O-Ring cross section which can affect the service life of an O-Ring.

If the O-Ring is used as a rod seal (inner sealing), the O-Ring outside diameter ($d_1 + 2 \cdot d_2$) should be at least equal to or larger than the housing (groove) outside diameter d_6 (see Figure 14), to give interference on the outside diameter. The O-Ring outside diameter shall not exceed 3 % of the housing outside diameter for O-Rings with a diameter d_1 greater than 250 mm, or 5 % for O-Rings with a diameter d_1 smaller than 250 mm.

For O-Rings with a diameter d_1 smaller than 20 mm, this is not always possible due to tolerance issues and can result in a greater outside diameter interference. Exceeding these values will result in too great an increase in the O-Ring cross section which can affect the service life of an O-Ring.

Axial installation, static

If the O-Ring is used as a static axial seal, the direction of the pressure should be taken into consideration when choosing the O-Ring size (Figure 15). If the O-Ring is pressurized the groove should be designed so that, prior to the pressure being applied, the O-Ring is in contact with the groove wall that is away from the side that is pressurized.

If there is internal pressure, the O-Ring should be chosen so that the outside diameter ($d_1 + 2 \cdot d_2$) of the O-Ring is approximately 1 % to 2 % larger than the outer groove diameter d_7 .

If there is external pressure the O-Ring should be chosen so that the inside diameter d_1 of the O-Ring is approximately 1 % to 3 % smaller than the inner groove diameter d_8 .

Reduction in O-Ring cross section through elongation

When an O-Ring is stretched its cross section is reduced and flattened and when installed in the housing, its cross section is no longer circular. The percentage that the cross section is reduced depends on the percentage, S , that the inside diameter is stretched.

The percentage cross sectional reduction R resulting from diametric stretch for an O-Ring whose inside diameter is stretched between 0 % to 3 % (inclusive) is calculated in accordance with the following equation:

$$R = 0.01 + 1.06 \cdot S - 0.1 \cdot S^2 [\%]$$

The percentage cross sectional reduction R resulting from diametric stretch for an O-Ring whose inside diameter is stretched more than 3 % but less than 25 % is calculated in accordance with this equation:

$$R = 0.56 + 0.59 \cdot S - 0.0046 \cdot S^2 [\%]$$

For piston applications the percentage stretch S is calculated in accordance with:

$$S = \left(\frac{d_3 - d_1}{d_1} \right) \cdot 100 [\%]$$

with d_3 = housing inside diameter for piston applications.

For rod applications the percentage stretch S is calculated in accordance with:

$$S = \left(\frac{d_5 - d_1}{d_1} \right) \cdot 100 [\%]$$

with d_5 = rod diameter.

Example: For an O-Ring whose inside diameter is stretched 2 % the effective percentage cross section reduction is calculated as follows:

$$R = 0.01 + 1.06 \cdot 2 - 0.1 \cdot 2^2 [\%]$$

$$R = 1.73 \%$$



O-Ring as a rotary seal

In some applications, e.g. with short running periods, the O-Ring can also be used as a rotary seal for sealing shafts. In this case, the following points should be observed:

In order to be able to function as a rotary seal, O-Rings must be installed in accordance with specific guidelines, the rotary seal principle.

The rotary seal principle is based on the fact that an elongated elastomer ring contracts when heated (Joule effect). With the normal design criteria the O-Ring inside diameter d_1 will be slightly smaller than the shaft diameter, and the heat generated by friction would cause the ring to contract even more. This results in a higher pressure on the rotating shaft so that a lubricating film is prevented from forming under the seal and even higher friction occurs. The result would be increased wear and a premature failure of the seal.

Using the rotary seal principle, this is prevented by the seal ring being selected so that its inside diameter is approximately 2 to 5 % larger than the shaft diameter to be sealed. The installation in the groove means that the seal ring is compressed radially and is pressed against the shaft by the groove diameter. The seal ring is thus slightly corrugated in the groove, a fact which helps to improve the lubrication.

Special materials are available for rotary seal applications. Trelleborg Sealing Solutions does not recommend the use of O-Rings as rotary seals. Please contact your local Trelleborg Sealing Solutions company for further details.

B.2.4 Initial compression

An initial compression of the O-Ring cross section in the groove is essential to ensure its function as a primary or secondary sealing element (Figure 16). It serves to:

- Achieve the initial sealing capability
- Bridge production tolerances
- Assure defined frictional forces
- Compensate for the compression set
- Compensate for wear

Depending on the application, the following values are recommended for the initial compression as a proportion of the cross section (d_2):

Dynamic applications: 6 to 20 %
Static applications: 15 to 30 %

The design of the grooves can be based on the guide values for the initial compression shown in the diagrams in Figure 17 and Figure 18. These take into account the relationship between loads and cross sections according to ISO 3601-2.

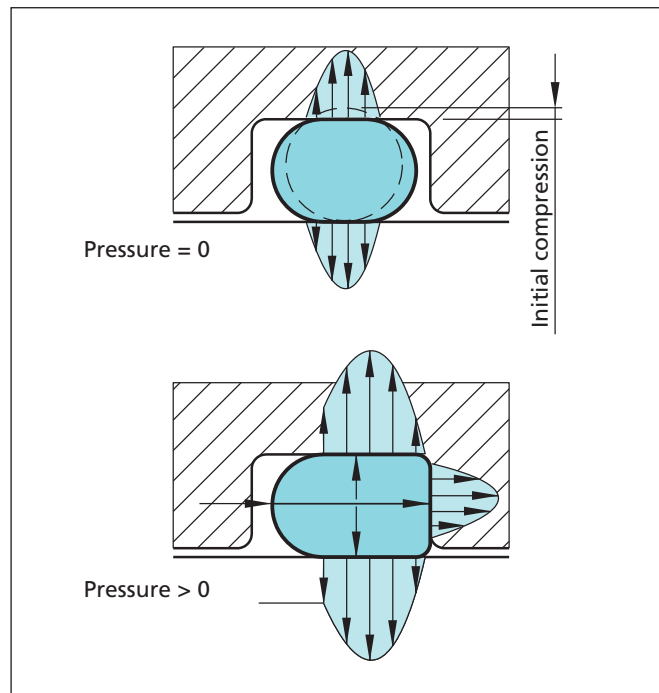


Figure 16 O-Ring contact pressure installed and under service pressure

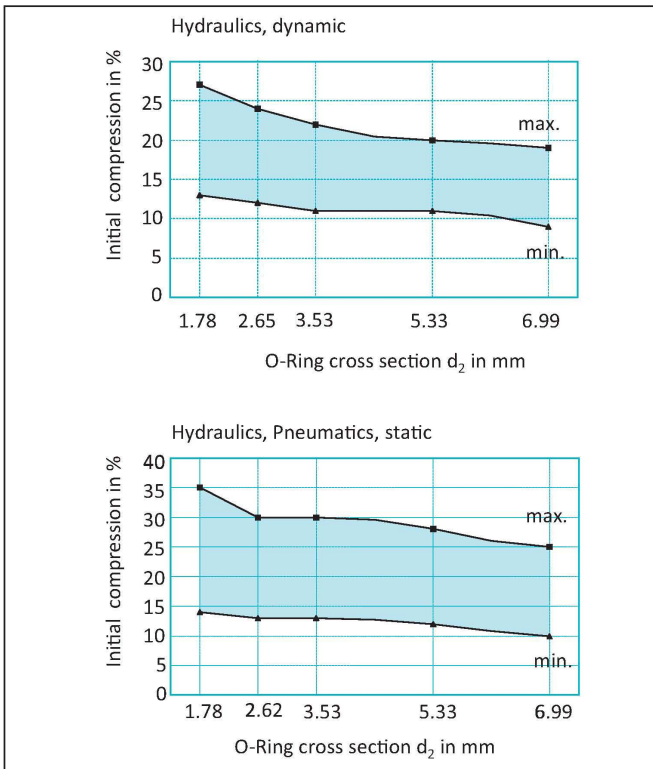


Figure 17 Permissible range of initial compression as a function of cross section, radial dynamic

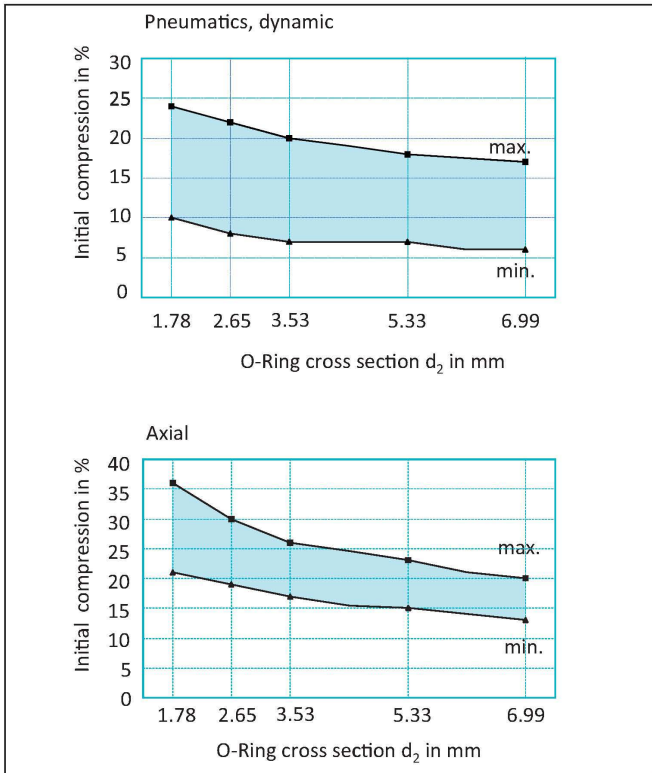


Figure 18 Permissible range of initial compression as a function of cross section, radial static and axial

Compression forces

The compression forces of O-Rings vary, depending among other things, on the extent of initial compression, the material, the material hardness, the O-Ring's inside diameter and its cross section.

Figures 19 – 21 show guide values for the uniform load of O-Rings taking into consideration the O-Ring's cross section, material type, material hardness and its compression.

These uniform loads can be used to estimate the total compression force to be applied for static installation of O-Rings.

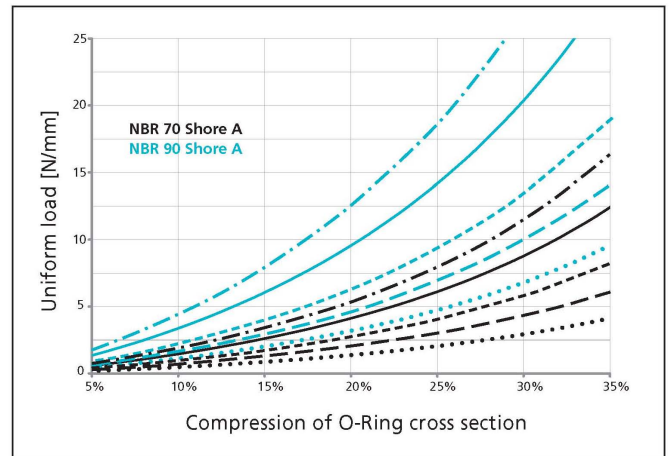
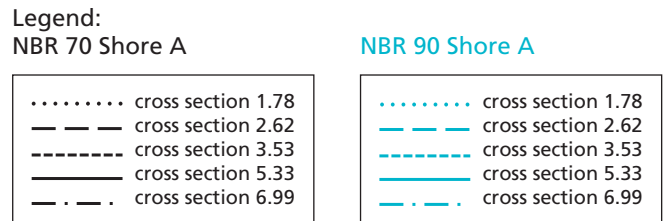


Figure 19 Guiding values for the uniform load [N/mm] of compressed O-Rings, material types NBR 70 Sh A and NBR 90 Sh A



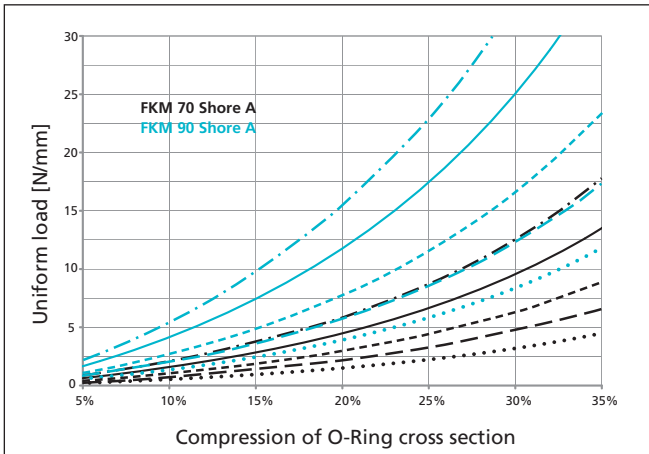


Figure 20 Guiding values for the uniform load [N/mm] of compressed O-Rings, material types FKM 70 Sh A and FKM 90 Sh A

Legend:

FKM 70 Shore A

FKM 90 Shore A

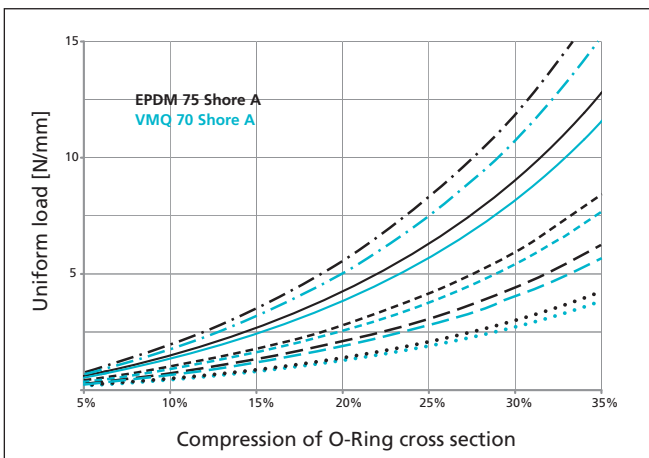
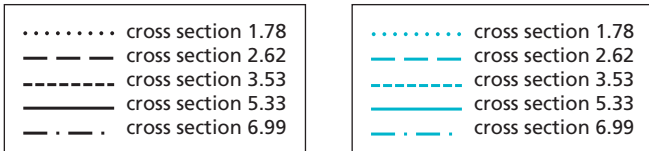
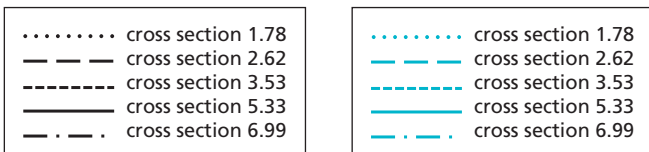


Figure 21 Guiding values for the uniform load [N/mm] of compressed O-Rings, material types EPDM 75 Sh A and VMQ 70 Sh

Legend:

EPDM 75 Shore A

VMQ 70 Shore A



B.2.5 Groove fill

It is important to consider groove fill of the O-Ring to avoid any detrimental effects on radial sealing performance. It is recommended that groove fill should not be more than 85 percent to allow for thermal expansion, volume swell due to fluid exposure and tolerance effects.

B.2.6 General technical data

O-Rings can be used in a wide range of applications. Temperature, pressure and media determine the choice of appropriate materials. In order to be able to assess the suitability of the O-Ring as a sealing element for a given application, the interaction of all the operating parameters have to be taken into consideration.

Working Pressure

Static application

- up to 5 MPa for O-Rings with inside diameter > 50 mm without Back-up Ring
 - up to 10 MPa for O-Rings with inside diameter < 50 mm without Back-up Ring (depends on the material, the cross section and the clearance)
 - up to 40 MPa with Back-up Ring
 - up to 250 MPa with special Back-up Ring
- Please note the permissible extrusion gaps.

Dynamic application

- Reciprocating up to 5 MPa without Back-up Ring
- Higher pressures with Back-up Ring

Speed

Reciprocating up to 0.5 m/s
Rotating up to 0.5 m/s
Depending on material and application.

Temperature

From -60 °C to +325 °C
Depending on material and media resistance.

When assessing the application criteria, the peak and continuous operating temperature and the running period must be taken into consideration. For rotating applications the temperature increase due to frictional heat must be taken into account.

Media

With the wide range of the available materials, each with different properties, it is possible to seal against practically all liquids, gases and chemicals. Please note when selecting the most suitable material the information in chapter "B.1 Materials".



B.2.7 Housing design and dimensions

Correct design can help to eliminate possible sources of damage and seal failure from the outset.

Since O-Ring are squeezed during installation, lead-in chamfers and rounded edges must be provided (Figure 22 and Figure 23).

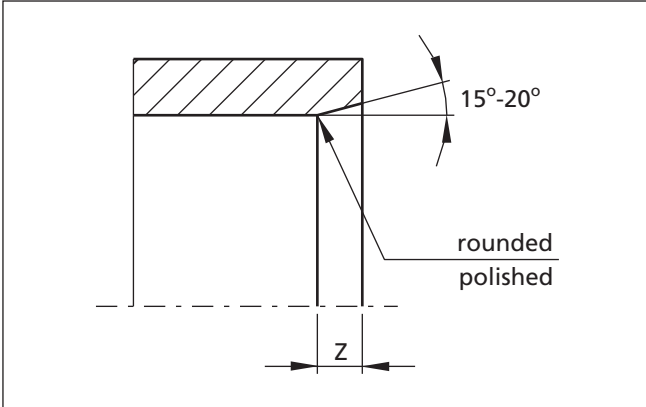


Figure 22 Lead-in chamfers for bores, tubes

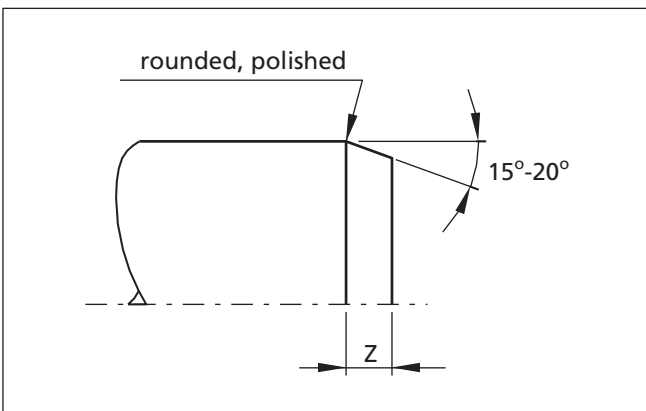


Figure 23 Lead-in chamfers for shafts, rods

The minimum length of the lead-in chamfer is listed in Table 11 as a function of the cross section d_2 .

Table 11 Lead-in chamfers

Lead-in chamfers length Z min.		O-Ring cross section d_2
15°	20°	
2.5	1.5	up to 1.78 1.80
3.0	2.0	up to 2.62 2.65
3.5	2.5	up to 3.53 3.55
4.5	3.5	up to 5.33 5.30
5.0	4.0	up to 7.00
6.0	4.5	above 7.00

The surface roughness of a lead-in chamfer is:
 $R_z \leq 6.3 \mu\text{m}$ $R_a \leq 0.8 \mu\text{m}$

Radial clearance

The tolerances given in Table 16 and the maximum permissible radial clearance S (extrusion gap) given in the Table 12 must be maintained.

If the clearance is too large, there is a risk of seal extrusion which can result in the destruction of the O-Ring (Figure 24).

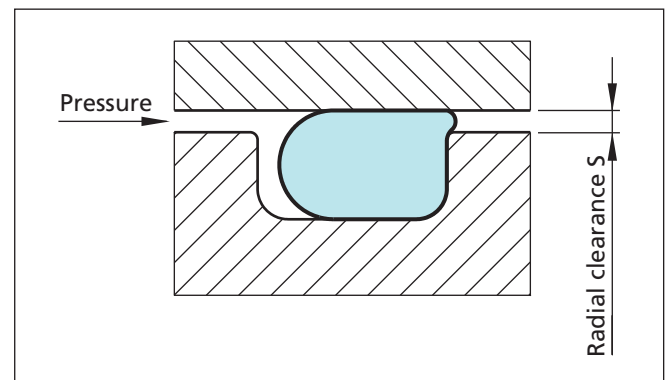


Figure 24 Radial clearance "S"

The permissible radial clearance S between the sealed parts depends on the system pressure, the cross section and the hardness of the O-Ring.

Table 12 contains recommendations for the permissible clearance S as a function of O-Ring cross section and shore hardness. The table is valid for elastomeric materials with the exception of polyurethane and FEP / PFA encapsulated O-Rings.

For pressure above 5 MPa for O-Rings with Inside diameter > 50 mm and above 10 MPa for O-Rings with Inside diameter < 50 mm we recommend the use of Back-up Rings.



Table 12 Radial clearance S

O-Ring cross section d_2	up to 2	2 - 3	3 - 5	5 - 7	above 7
O-Rings with hardness of 70 Shore A					
Pressure MPa	Radial clearance S				
≤ 3.50	0.08	0.09	0.10	0.13	0.15
≤ 7.00	0.05	0.07	0.08	0.09	0.10
≤ 10.50	0.03	0.04	0.05	0.07	0.08
O-Rings with hardness of 90 Shore A					
Pressure MPa	Radial clearance S				
≤ 3.50	0.13	0.15	0.20	0.23	0.25
≤ 7.00	0.10	0.13	0.15	0.18	0.20
≤ 10.50	0.07	0.09	0.10	0.13	0.15
≤ 14.00	0.05	0.07	0.08	0.09	0.10
≤ 17.50	0.04	0.05	0.07	0.08	0.09
≤ 21.00	0.03	0.04	0.05	0.07	0.08
≤ 35.00	0.02	0.03	0.03	0.04	0.04

These values assume that the parts are fitted concentrically to one another and do not expand under pressure. If this is not the case, the clearance should be kept correspondingly smaller.

For static applications we recommend a fit of H8/f7.

O-Rings made from polyurethane can bridge larger clearances thanks to their high extrusion resistance and greater dimensional stability. See also chapter "Polyurethane O-Rings".

Surfaces

Under pressure, elastomers adapt to irregular surfaces. For gas or liquid tight joints, however, certain minimum demands must be made on the surface quality of the surfaces to be sealed.

Fundamentally grooves, scratches, pit marks, concentric or spiral machining scores, etc. are not permissible. Higher demands must be placed on dynamic mating surfaces than on static surfaces.

At present no uniform definitions exist for describing the mating surfaces. In practice, the specification of the R_a value is not sufficient to permit an assessment of the surface quality. Our recommendations therefore contain amongst others various terms and definitions in accordance with DIN 4768 and DIN EN ISO 4287.

Table 13 Surface finish

Type of Load	Surface	$R_t \mu\text{m}$	$R_z \mu\text{m}$	$R_a \mu\text{m}$
Radial-dynamic	Mating surface * (bore, rod, shaft)	≤ 2.5	≤ 1.6	≤ 0.4
	Groove flanks, groove diameter	≤ 10.0	≤ 6.3	≤ 1.6
Radial-static Axial-static	Mating surface	≤ 10.0	≤ 6.3	≤ 1.6
	Groove flanks, groove diameter	≤ 16.0		
	For pulsating pressures			
	Mating surface	≤ 6.3	≤ 6.3	≤ 0.8
	Groove flanks, groove diameter	≤ 10.0		≤ 1.6

* spiralfree grinding

The above is for guidance only and covers the majority of sealing applications. However Trelleborg Sealing Solutions should be consulted in areas of particular concern.



Trapezoidal groove

The trapezoidal (dovetail) groove should only be used in special cases, e.g. overhead installation, in order to retain the O-Ring (Figure 25). The installation dimensions are summarised in Table 14. The trapezoidal groove is only recommended for O-Ring cross section from 3.53 mm. The inside diameter of the O-Ring results from the mean groove diameter minus the cross section.

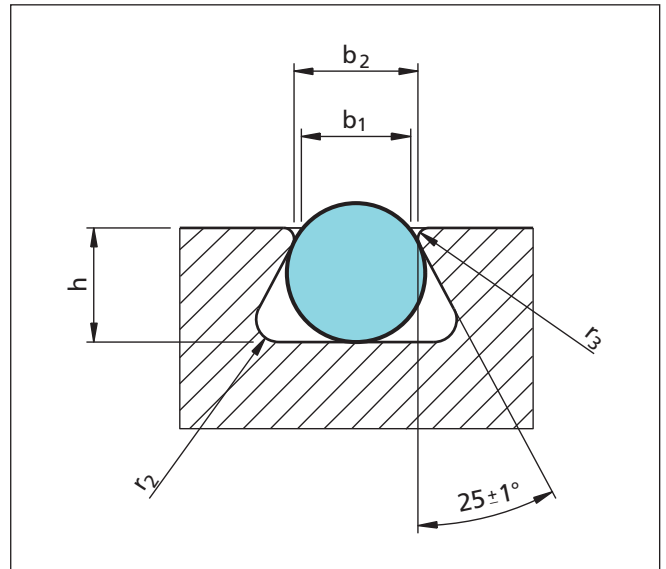


Figure 25 Installation in trapezoidal groove

Table 14 Installation dimensions for trapezoidal groove

O-Ring cross section d_2	Groove dimensions				
	Groove width $b_1 \pm 0.05$	Groove width $b_2 \pm 0.05$	Groove depth $h \pm 0.05$	Radius (max.)	
				r_3	r_2
3.53 3.55	2.90	3.20	2.90	0.25	0.80
4.00	3.40	3.70	3.20	0.25	0.80
5.00	4.30	4.60	4.20	0.25	0.80
5.33 5.30	4.60	4.90	4.60	0.25	0.80
5.70	4.75	5.25	4.80	0.40	0.80
6.00	5.05	5.55	5.10	0.40	0.80
7.00	6.00	6.50	6.00	0.40	1.60
8.00	6.85	7.45	6.90	0.50	1.60
8.40	7.25	7.85	7.30	0.50	1.60

Rectangular groove

A rectangular groove is preferred for all new designs. Designs with bevelled groove flanks up to 5° are permissible. If Back-up Rings are used, straight groove flanks are necessary.

To reduce risk of extrusion the radius r ideally should not exceed the maximum permissible radial clearance S (see Table 12).

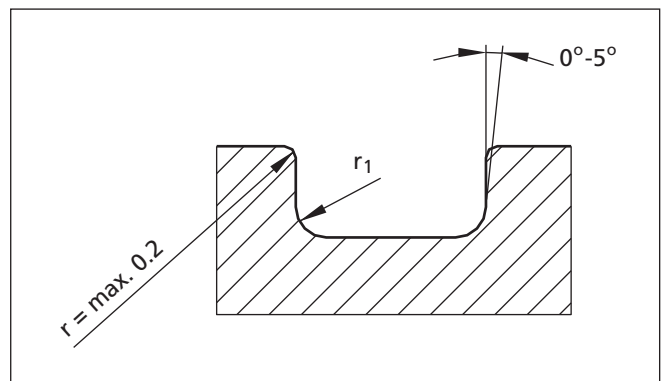


Figure 26 Groove specifications



O-Ring

Housing dimensions recommendations

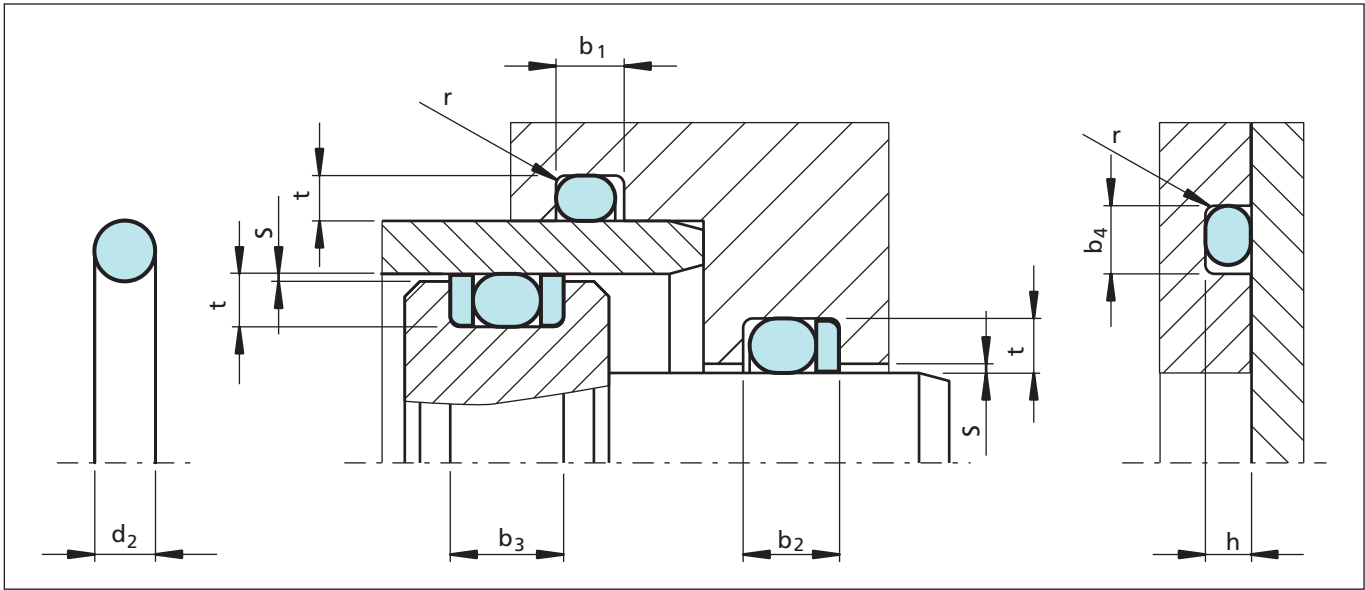


Figure 27 Installation drawing

Radial clearance S and surface finish see beginning of this chapter "B.2.7 Housing design and dimensions"

Groove width b_2 and b_3 : When using Back-up Rings the groove is to be widened by the corresponding Back-up Ring thickness (b_2 : one Back-up Ring, b_3 : two Back-up Rings).

Table 15 Housing dimensions

Cross section d_2	Radial installation			Axial installation		Radius ¹⁾ $r \pm 0.2$
	Housing depth		Groove width	Groove depth	Groove width	
	Dynamic t	Static t	$b_1 + 0.25$	$h + 0.1$	$b_4 + 0.2$	
0.50	-	0.35	0.80	0.35	0.80	0.20
0.74	-	0.50	1.00	0.50	1.00	0.20
1.00	-	0.70	1.40	0.70	1.40	0.20
1.02	-	0.70	1.40	0.70	1.40	0.20
1.20	-	0.85	1.70	0.85	1.70	0.20
1.25	-	0.90	1.70	0.90	1.80	0.20
1.27	-	0.90	1.70	0.90	1.80	0.20
1.30	-	0.95	1.80	0.95	1.80	0.20
1.42	-	1.05	1.90	1.05	2.00	0.30
1.50	1.25	1.10	2.00	1.10	2.10	0.30
1.52	1.25	1.10	2.00	1.10	2.10	0.30
1.60	1.30	1.20	2.10	1.20	2.20	0.30
1.63	1.30	1.20	2.10	1.20	2.20	0.30
1.78*	1.45	1.30	2.40	1.30	2.60	0.30
1.80	1.45	1.30	2.40	1.30	2.60	0.30
1.83	1.50	1.35	2.50	1.35	2.60	0.30



Cross section d_2	Radial installation			Axial installation		Radius ¹⁾ $r \pm 0.2$
	Housing depth		Groove width	Groove depth	Groove width	
	Dynamic t	Static t	$b_1 + 0.25$	$h + 0.1$	$b_4 + 0.2$	
1.90	1.55	1.40	2.60	1.40	2.70	0.30
1.98	1.65	1.50	2.70	1.50	2.80	0.30
2.00	1.65	1.50	2.70	1.50	2.80	0.30
2.08	1.75	1.55	2.80	1.55	2.90	0.30
2.10	1.75	1.55	2.80	1.55	2.90	0.30
2.20	1.85	1.60	3.00	1.60	3.00	0.30
2.26	1.90	1.70	3.00	1.70	3.10	0.30
2.30	1.95	1.75	3.10	1.75	3.10	0.30
2.34	1.95	1.75	3.10	1.75	3.10	0.30
2.40	2.05	1.80	3.20	1.80	3.30	0.30
2.46	2.10	1.85	3.30	1.85	3.40	0.30
2.50	2.15	1.90	3.30	1.85	3.40	0.30
2.62*	2.25	2.00	3.60	2.00	3.80	0.30
2.65	2.25	2.00	3.60	2.00	3.80	0.30
2.70	2.30	2.05	3.60	2.05	3.80	0.30
2.80	2.40	2.10	3.70	2.10	3.90	0.60
2.92	2.50	2.20	3.90	2.20	4.00	0.60
2.95	2.50	2.20	3.90	2.20	4.00	0.60
3.00	2.60	2.30	4.00	2.30	4.00	0.60
3.10	2.70	2.40	4.10	2.40	4.10	0.60
3.50	3.05	2.65	4.60	2.65	4.70	0.60
3.53*	3.10	2.70	4.80	2.70	5.00	0.60
3.55	3.10	2.70	4.80	2.70	5.00	0.60
3.60	3.15	2.80	4.80	2.80	5.10	0.60
4.00	3.50	3.10	5.20	3.10	5.30	0.60
4.50	4.00	3.50	5.80	3.50	5.90	0.60
5.00	4.40	4.00	6.60	4.00	6.70	0.60
5.30	4.70	4.30	7.10	4.30	7.30	0.60
5.33*	4.70	4.30	7.10	4.30	7.30	0.60
5.50	4.80	4.50	7.10	4.50	7.30	0.60
5.70	5.00	4.60	7.20	4.60	7.40	0.60
6.00	5.30	4.90	7.40	4.90	7.60	0.60
6.50	5.70	5.40	8.00	5.40	8.20	1.00
6.99*	6.10	5.80	9.50	5.80	9.70	1.00
7.00	6.10	5.80	9.50	5.80	9.70	1.00
7.50	6.60	6.30	9.70	6.30	9.90	1.00
8.00	7.10	6.70	9.80	6.70	10.00	1.00
8.40	7.50	7.10	10.00	7.10	10.30	1.00
9.00	8.10	7.70	10.60	7.70	10.90	1.50
9.50	8.60	8.20	11.00	8.20	11.40	1.50



O-Ring

Cross section d_2	Radial installation			Axial installation		Radius ¹⁾ $r \pm 0.2$
	Housing depth		Groove width	Groove depth	Groove width	
	Dynamic t	Static t	$b_1 + 0.25$	$h + 0.1$	$b_4 + 0.2$	
10.00	9.10	8.60	11.60	8.60	12.00	2.00
12.00	11.00	10.60	13.50	10.60	14.00	2.00

 * Preferred sizes

1) If a Back-up Ring is used the recommended radius r should always be $r = 0.25 \pm 0.2\text{mm}$.

The given installation dimensions cannot be used for FFKM materials (Isolast®). Please use the Isolast® brochure or contact our specialists for further details.



C Quality criteria and product range

C.1 Quality criteria

C.1.1 Standard quality

If no quality requirements are specified with an order, standard quality O-Rings are supplied.

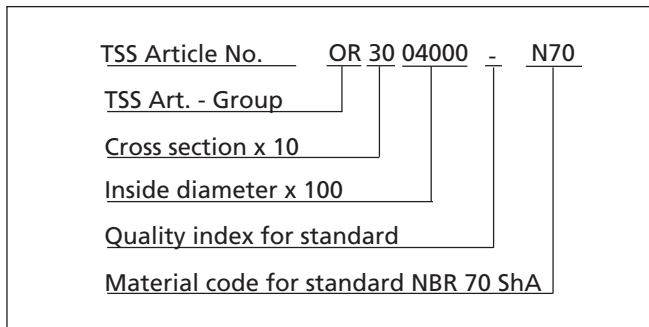
The standard quality is defined by a “-” as the 10th digit in the O-Ring article number.

A standard quality O-Ring has dimensional tolerances to Trelleborg Sealing Solutions standard TBS-00024 according to ISO 3601-1, class B and standard surface quality according to Trelleborg Sealing Solutions standard TBS-00005. based on ISO 3601-3, grade N.

Surface deviations are according to ISO 2859-1:2004-01 AQL 1.0 general inspection level II, normal inspection is standard. Higher quality levels are available on request.

If no material type or hardness are specified, the O-Ring will be delivered in a standard material for the material type requested. The material specifications of standard materials can be seen in chapter B.1.5 Standard materials.

Example:



C.1.2 Flatness and roundness

The flatness and roundness of O-Rings are not specified in either international O-Ring standard ISO 3601 or any other national O-Ring standards so these properties are not observed or limited during production unless specifically stated.

Generally O-Rings conforming to standard quality specifications can be assembled automatically, in some cases it can be important to specify flatness and roundness.

By implementing special process steps during production, the following equation and graphs show the possible limits in flatness and roundness of elastomeric O-Rings.

In general, the adherence to flatness and roundness depends on the material and on the dimension ratio of the O-Ring, and can be checked and approved in advance.

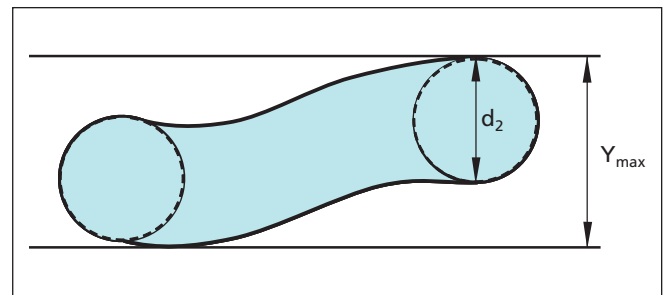


Figure 28 Flatness tolerance Y_{max}

The flatness tolerance depends on the dimension ratio and is calculated according to the following equations:

- $Y_{max}=1.5 * d_2$ for $0.11 < \frac{d_2}{d_1} \leq 0.21$
- $Y_{max}=1.3 * d_2$ for $\frac{d_2}{d_1} > 0.21$

For all other dimension ratios the flatness tolerance must be requested separately.

Not every material can be offered with these flatness tolerances. Please contact your local Trelleborg Sealing Solutions marketing company for further details.



Roundness

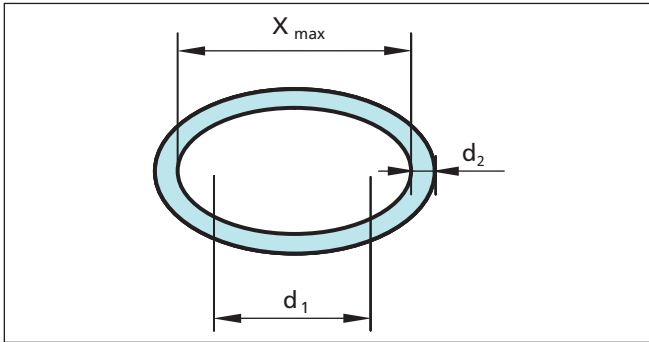


Figure 29 Roundness tolerance X_{max}

The roundness tolerance is calculated as follows:

$$X_{max} = (1.1 \cdot d_1) + 2 \cdot d_2$$

Not every material can be offered with these roundness tolerances. Please contact your local Trelleborg Sealing Solutions marketing company for further details.

The flexibility of elastomeric O-Rings can lead to deformations during handling e.g. after long storage times or when added to a vibrating conveyor. These deformations cannot be covered by these flatness and roundness specifications.

C.1.3 Dimension tolerances

During vulcanization, elastomers are subject to dimensional changes due to shrinkage. The degree of shrinkage depends on the material, mold geometry and on the vulcanization process. To meet dimensional tolerances molds need to be adapted to the material to be processed.

O-Ring molds are often designed for NBR 70 Shore A materials. If other materials are produced with these molds they may exhibit different dimensional tolerances due to the different shrinkage rates.

To guarantee high, constant quality levels, it might be necessary to produce new or additional molds accruing extra cost.

If deviations from tolerances are acceptable, O-Rings can be produced from existing molds to avoid the cost of producing molds. This must be confirmed in writing by the customer.

The following tables show the tolerances for the inside diameter (d_1) and cross section (d_2) of O-Rings. All tolerances given are according to Trelleborg Sealing Solutions standard TBS-00024 according to ISO 3601-1, class B.

Precision O-Rings with reduced tolerances are also available - please contact your local Trelleborg Sealing Solutions marketing company.

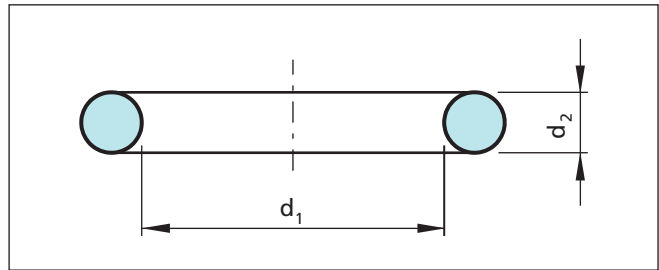


Figure 30 O-Ring dimensions

Tolerances for O-Ring cross sections d_2

Valid tolerances for elastomeric O-Ring cross sections d_2 are listed in the following Table 16.

Table 16 Tolerances for O-Ring cross sections d_2 according to the TSS standard TBS-00024, complying with ISO 3601-1, class B, table A.1

Cross section d_2			Tolerance \pm
	$d_2 \leq$	0.80	on request
0.80	$< d_2 \leq$	2.25	0.08
2.25	$< d_2 \leq$	3.15	0.09
3.15	$< d_2 \leq$	4.50	0.10
4.50	$< d_2 \leq$	6.30	0.13
6.30	$< d_2 \leq$	8.40	0.15
8.40	$< d_2 \leq$	10.00	0.21
10.00	$< d_2 \leq$	12.00	0.25
	$d_2 >$	12.00	on request

Tolerances for O-Ring inside diameters d_1

Tolerances given in Trelleborg Sealing Solutions standard TBS-00024 according to ISO 3601-1, class B apply for the elastomeric O-Rings inside diameters d_1 . The appropriate tolerances for the inside diameters d_1 according to ISO 3601-1, class B are calculated with the following equation:

$$\Delta d = \pm [d_1^{0.95} \times 0.009 + 0.11]$$

This equation applies only for metric dimensions. The tolerances for the inside diameters d_1 up to 600 mm are listed in the following table.



Table 17 Tolerances for inside diameters d_1 according to the TSS standard TBS-00024, complying with ISO 3601-1, class B

Inside diameter d_1				Tolerance \pm	
		d_1	\leq	1.71	0.12
1.71	<	d_1	\leq	2.93	0.13
2.93	<	d_1	\leq	4.17	0.14
4.17	<	d_1	\leq	5.44	0.15
5.44	<	d_1	\leq	6.72	0.16
6.72	<	d_1	\leq	8.01	0.17
8.01	<	d_1	\leq	9.31	0.18
9.31	<	d_1	\leq	10.62	0.19
10.62	<	d_1	\leq	11.94	0.20
11.94	<	d_1	\leq	13.27	0.21
13.27	<	d_1	\leq	14.61	0.22
14.61	<	d_1	\leq	15.95	0.23
15.95	<	d_1	\leq	17.29	0.24
17.29	<	d_1	\leq	18.64	0.25
18.64	<	d_1	\leq	20.00	0.26
20.00	<	d_1	\leq	21.36	0.27
21.36	<	d_1	\leq	22.73	0.28
22.73	<	d_1	\leq	24.10	0.29
24.10	<	d_1	\leq	25.47	0.30
25.47	<	d_1	\leq	26.85	0.31
26.85	<	d_1	\leq	28.23	0.32
28.23	<	d_1	\leq	29.61	0.33
29.61	<	d_1	\leq	31.00	0.34
31.00	<	d_1	\leq	32.39	0.35
32.39	<	d_1	\leq	33.78	0.36
33.78	<	d_1	\leq	35.18	0.37
35.18	<	d_1	\leq	36.58	0.38
36.58	<	d_1	\leq	37.98	0.39
37.98	<	d_1	\leq	39.38	0.40
39.38	<	d_1	\leq	40.79	0.41
40.79	<	d_1	\leq	42.20	0.42
42.20	<	d_1	\leq	43.61	0.43
43.61	<	d_1	\leq	45.02	0.44
45.02	<	d_1	\leq	46.44	0.45
46.44	<	d_1	\leq	47.86	0.46
47.86	<	d_1	\leq	49.28	0.47
49.28	<	d_1	\leq	50.70	0.48
50.70	<	d_1	\leq	52.12	0.49
52.12	<	d_1	\leq	53.55	0.50
53.55	<	d_1	\leq	54.98	0.51
54.98	<	d_1	\leq	56.41	0.52
56.41	<	d_1	\leq	57.84	0.53
57.84	<	d_1	\leq	59.27	0.54
59.27	<	d_1	\leq	60.71	0.55

Inside diameter d_1				Tolerance \pm	
60.71	<	d_1	\leq	62.14	0.56
62.14	<	d_1	\leq	63.58	0.57
63.58	<	d_1	\leq	65.02	0.58
65.02	<	d_1	\leq	66.47	0.59
66.47	<	d_1	\leq	67.91	0.60
67.91	<	d_1	\leq	69.35	0.61
69.35	<	d_1	\leq	70.80	0.62
70.80	<	d_1	\leq	72.25	0.63
72.25	<	d_1	\leq	73.70	0.64
73.70	<	d_1	\leq	75.15	0.65
75.15	<	d_1	\leq	76.60	0.66
76.60	<	d_1	\leq	78.05	0.67
78.05	<	d_1	\leq	79.51	0.68
79.51	<	d_1	\leq	80.97	0.69
80.97	<	d_1	\leq	82.42	0.70
82.42	<	d_1	\leq	83.88	0.71
83.88	<	d_1	\leq	85.34	0.72
85.34	<	d_1	\leq	86.80	0.73
86.80	<	d_1	\leq	88.27	0.74
88.27	<	d_1	\leq	89.73	0.75
89.73	<	d_1	\leq	91.20	0.76
91.20	<	d_1	\leq	92.66	0.77
92.66	<	d_1	\leq	94.13	0.78
94.13	<	d_1	\leq	95.60	0.79
95.60	<	d_1	\leq	97.07	0.80
97.07	<	d_1	\leq	98.54	0.81
98.54	<	d_1	\leq	100.01	0.82
100.01	<	d_1	\leq	101.48	0.83
101.48	<	d_1	\leq	102.96	0.84
102.96	<	d_1	\leq	104.43	0.85
104.43	<	d_1	\leq	105.91	0.86
105.91	<	d_1	\leq	107.39	0.87
107.39	<	d_1	\leq	108.86	0.88
108.86	<	d_1	\leq	110.34	0.89
110.34	<	d_1	\leq	111.82	0.90
111.82	<	d_1	\leq	113.30	0.91
113.30	<	d_1	\leq	114.79	0.92
114.79	<	d_1	\leq	116.27	0.93
116.27	<	d_1	\leq	117.75	0.94
117.75	<	d_1	\leq	119.24	0.95
119.24	<	d_1	\leq	120.72	0.96
120.72	<	d_1	\leq	122.21	0.97
122.21	<	d_1	\leq	123.70	0.98
123.70	<	d_1	\leq	125.19	0.99
125.19	<	d_1	\leq	126.68	1.00
126.68	<	d_1	\leq	128.17	1.01
128.17	<	d_1	\leq	129.66	1.02



O-Ring

Inside diameter d_1			Tolerance \pm	
129.66	<	d_1	\leq 131.15	1.03
131.15	<	d_1	\leq 132.64	1.04
132.64	<	d_1	\leq 134.14	1.05
134.14	<	d_1	\leq 135.63	1.06
135.63	<	d_1	\leq 137.13	1.07
137.13	<	d_1	\leq 138.62	1.08
138.62	<	d_1	\leq 140.12	1.09
140.12	<	d_1	\leq 141.62	1.10
141.62	<	d_1	\leq 143.12	1.11
143.12	<	d_1	\leq 144.62	1.12
144.62	<	d_1	\leq 146.12	1.13
146.12	<	d_1	\leq 147.62	1.14
147.62	<	d_1	\leq 149.12	1.15
149.12	<	d_1	\leq 150.62	1.16
150.62	<	d_1	\leq 152.13	1.17
152.13	<	d_1	\leq 153.63	1.18
153.63	<	d_1	\leq 155.13	1.19
155.13	<	d_1	\leq 156.64	1.20
156.64	<	d_1	\leq 158.15	1.21
158.15	<	d_1	\leq 159.65	1.22
159.65	<	d_1	\leq 161.16	1.23
161.16	<	d_1	\leq 162.67	1.24
162.67	<	d_1	\leq 164.18	1.25
164.18	<	d_1	\leq 165.69	1.26
165.69	<	d_1	\leq 167.20	1.27
167.20	<	d_1	\leq 168.71	1.28
168.71	<	d_1	\leq 170.22	1.29
170.22	<	d_1	\leq 171.73	1.30
171.73	<	d_1	\leq 173.25	1.31
173.25	<	d_1	\leq 174.76	1.32
174.76	<	d_1	\leq 176.28	1.33
176.28	<	d_1	\leq 177.79	1.34
177.79	<	d_1	\leq 179.31	1.35
179.31	<	d_1	\leq 180.82	1.36
180.82	<	d_1	\leq 182.34	1.37
182.34	<	d_1	\leq 183.86	1.38
183.86	<	d_1	\leq 185.38	1.39
185.38	<	d_1	\leq 186.89	1.40
186.89	<	d_1	\leq 188.41	1.41
188.41	<	d_1	\leq 189.93	1.42
189.93	<	d_1	\leq 191.45	1.43
191.45	<	d_1	\leq 192.98	1.44
192.98	<	d_1	\leq 194.50	1.45
194.50	<	d_1	\leq 196.02	1.46
196.02	<	d_1	\leq 197.54	1.47
197.54	<	d_1	\leq 199.07	1.48
199.07	<	d_1	\leq 200.59	1.49

Inside diameter d_1			Tolerance \pm	
200.59	<	d_1	\leq 202.12	1.50
202.12	<	d_1	\leq 203.64	1.51
203.64	<	d_1	\leq 205.17	1.52
205.17	<	d_1	\leq 206.69	1.53
206.69	<	d_1	\leq 208.22	1.54
208.22	<	d_1	\leq 209.75	1.55
209.75	<	d_1	\leq 211.28	1.56
211.28	<	d_1	\leq 212.81	1.57
212.81	<	d_1	\leq 214.34	1.58
214.34	<	d_1	\leq 215.87	1.59
215.87	<	d_1	\leq 217.40	1.60
217.40	<	d_1	\leq 218.93	1.61
218.93	<	d_1	\leq 220.46	1.62
220.46	<	d_1	\leq 221.99	1.63
221.99	<	d_1	\leq 223.52	1.64
223.52	<	d_1	\leq 225.06	1.65
225.06	<	d_1	\leq 226.59	1.66
226.59	<	d_1	\leq 228.12	1.67
228.12	<	d_1	\leq 229.66	1.68
229.66	<	d_1	\leq 231.19	1.69
231.19	<	d_1	\leq 232.73	1.70
232.73	<	d_1	\leq 234.27	1.71
234.27	<	d_1	\leq 235.80	1.72
235.80	<	d_1	\leq 237.34	1.73
237.34	<	d_1	\leq 238.88	1.74
238.88	<	d_1	\leq 240.42	1.75
240.42	<	d_1	\leq 241.95	1.76
241.95	<	d_1	\leq 243.49	1.77
243.49	<	d_1	\leq 245.03	1.78
245.03	<	d_1	\leq 246.57	1.79
246.57	<	d_1	\leq 248.11	1.80
248.11	<	d_1	\leq 249.66	1.81
249.66	<	d_1	\leq 251.20	1.82
251.20	<	d_1	\leq 252.74	1.83
252.74	<	d_1	\leq 254.28	1.84
254.28	<	d_1	\leq 255.82	1.85
255.82	<	d_1	\leq 257.37	1.86
257.37	<	d_1	\leq 258.91	1.87
258.91	<	d_1	\leq 260.46	1.88
260.46	<	d_1	\leq 262.00	1.89
262.00	<	d_1	\leq 263.55	1.90
263.55	<	d_1	\leq 265.09	1.91
265.09	<	d_1	\leq 266.64	1.92
266.64	<	d_1	\leq 268.18	1.93
268.18	<	d_1	\leq 269.73	1.94
269.73	<	d_1	\leq 271.28	1.95
271.28	<	d_1	\leq 272.83	1.96



Inside diameter d_1				Tolerance \pm
272.83	<	d_1	\leq 274.38	1.97
274.38	<	d_1	\leq 275.92	1.98
275.92	<	d_1	\leq 277.47	1.99
277.47	<	d_1	\leq 279.02	2.00
279.02	<	d_1	\leq 280.57	2.01
280.57	<	d_1	\leq 282.12	2.02
282.12	<	d_1	\leq 283.68	2.03
283.68	<	d_1	\leq 285.23	2.04
285.23	<	d_1	\leq 286.78	2.05
286.78	<	d_1	\leq 288.33	2.06
288.33	<	d_1	\leq 289.88	2.07
289.88	<	d_1	\leq 291.44	2.08
291.44	<	d_1	\leq 292.99	2.09
292.99	<	d_1	\leq 294.54	2.10
294.54	<	d_1	\leq 296.10	2.11
296.10	<	d_1	\leq 297.65	2.12
297.65	<	d_1	\leq 299.21	2.13
299.21	<	d_1	\leq 300.76	2.14
300.76	<	d_1	\leq 302.32	2.15
302.32	<	d_1	\leq 303.88	2.16
303.88	<	d_1	\leq 305.43	2.17
305.43	<	d_1	\leq 306.99	2.18
306.99	<	d_1	\leq 308.55	2.19
308.55	<	d_1	\leq 310.11	2.20
310.11	<	d_1	\leq 311.66	2.21
311.66	<	d_1	\leq 313.22	2.22
313.22	<	d_1	\leq 314.78	2.23
314.78	<	d_1	\leq 316.34	2.24
316.34	<	d_1	\leq 317.90	2.25
317.90	<	d_1	\leq 319.46	2.26
319.46	<	d_1	\leq 321.02	2.27
321.02	<	d_1	\leq 322.58	2.28
322.58	<	d_1	\leq 324.15	2.29
324.15	<	d_1	\leq 325.71	2.30
325.71	<	d_1	\leq 327.27	2.31
327.27	<	d_1	\leq 328.83	2.32
328.83	<	d_1	\leq 330.39	2.33
330.39	<	d_1	\leq 331.96	2.34
331.96	<	d_1	\leq 333.52	2.35
333.52	<	d_1	\leq 335.09	2.36
335.09	<	d_1	\leq 336.65	2.37
336.65	<	d_1	\leq 338.21	2.38
338.21	<	d_1	\leq 339.78	2.39
339.78	<	d_1	\leq 341.35	2.40
341.35	<	d_1	\leq 342.91	2.41
342.91	<	d_1	\leq 344.48	2.42
344.48	<	d_1	\leq 346.04	2.43

Inside diameter d_1				Tolerance \pm
346.04	<	d_1	\leq 347.61	2.44
347.61	<	d_1	\leq 349.18	2.45
349.18	<	d_1	\leq 350.75	2.46
350.75	<	d_1	\leq 352.31	2.47
352.31	<	d_1	\leq 353.88	2.48
353.88	<	d_1	\leq 355.45	2.49
355.45	<	d_1	\leq 357.02	2.50
357.02	<	d_1	\leq 358.59	2.51
358.59	<	d_1	\leq 360.16	2.52
360.16	<	d_1	\leq 361.73	2.53
361.73	<	d_1	\leq 363.30	2.54
363.30	<	d_1	\leq 364.87	2.55
364.87	<	d_1	\leq 366.44	2.56
366.44	<	d_1	\leq 368.01	2.57
368.01	<	d_1	\leq 369.58	2.58
369.58	<	d_1	\leq 371.16	2.59
371.16	<	d_1	\leq 372.73	2.60
372.73	<	d_1	\leq 374.30	2.61
374.30	<	d_1	\leq 375.87	2.62
375.87	<	d_1	\leq 377.45	2.63
377.45	<	d_1	\leq 379.02	2.64
379.02	<	d_1	\leq 380.59	2.65
380.59	<	d_1	\leq 382.17	2.66
382.17	<	d_1	\leq 383.74	2.67
383.74	<	d_1	\leq 385.32	2.68
385.32	<	d_1	\leq 386.89	2.69
386.89	<	d_1	\leq 388.47	2.70
388.47	<	d_1	\leq 390.05	2.71
390.05	<	d_1	\leq 391.62	2.72
391.62	<	d_1	\leq 393.20	2.73
393.20	<	d_1	\leq 394.78	2.74
394.78	<	d_1	\leq 396.35	2.75
396.35	<	d_1	\leq 397.93	2.76
397.93	<	d_1	\leq 399.51	2.77
399.51	<	d_1	\leq 401.09	2.78
401.09	<	d_1	\leq 402.66	2.79
402.66	<	d_1	\leq 404.24	2.80
404.24	<	d_1	\leq 405.82	2.81
405.82	<	d_1	\leq 407.40	2.82
407.40	<	d_1	\leq 408.98	2.83
408.98	<	d_1	\leq 410.56	2.84
410.56	<	d_1	\leq 412.14	2.85
412.14	<	d_1	\leq 413.72	2.86
413.72	<	d_1	\leq 415.30	2.87
415.30	<	d_1	\leq 416.89	2.88
416.89	<	d_1	\leq 418.47	2.89
418.47	<	d_1	\leq 420.05	2.90



O-Ring

Inside diameter d_1			Tolerance \pm	
420.05	<	d_1	\leq 421.63	2.91
421.63	<	d_1	\leq 423.21	2.92
423.21	<	d_1	\leq 424.80	2.93
424.80	<	d_1	\leq 426.38	2.94
426.38	<	d_1	\leq 427.96	2.95
427.96	<	d_1	\leq 429.55	2.96
429.55	<	d_1	\leq 431.13	2.97
431.13	<	d_1	\leq 432.71	2.98
432.71	<	d_1	\leq 434.30	2.99
434.30	<	d_1	\leq 435.88	3.00
435.88	<	d_1	\leq 437.47	3.01
437.47	<	d_1	\leq 439.05	3.02
439.05	<	d_1	\leq 440.64	3.03
440.64	<	d_1	\leq 442.22	3.04
442.22	<	d_1	\leq 443.81	3.05
443.81	<	d_1	\leq 445.40	3.06
445.40	<	d_1	\leq 446.98	3.07
446.98	<	d_1	\leq 448.57	3.08
448.57	<	d_1	\leq 450.16	3.09
450.16	<	d_1	\leq 451.75	3.10
451.75	<	d_1	\leq 453.33	3.11
453.33	<	d_1	\leq 454.92	3.12
454.92	<	d_1	\leq 456.51	3.13
456.51	<	d_1	\leq 458.10	3.14
458.10	<	d_1	\leq 459.69	3.15
459.69	<	d_1	\leq 461.28	3.16
461.28	<	d_1	\leq 462.87	3.17
462.87	<	d_1	\leq 464.46	3.18
464.46	<	d_1	\leq 466.05	3.19
466.05	<	d_1	\leq 467.64	3.20
467.64	<	d_1	\leq 469.23	3.21
469.23	<	d_1	\leq 470.82	3.22
470.82	<	d_1	\leq 472.41	3.23
472.41	<	d_1	\leq 474.00	3.24
474.00	<	d_1	\leq 475.59	3.25
475.59	<	d_1	\leq 477.19	3.26
477.19	<	d_1	\leq 478.78	3.27
478.78	<	d_1	\leq 480.37	3.28
480.37	<	d_1	\leq 481.96	3.29
481.96	<	d_1	\leq 483.56	3.30
483.56	<	d_1	\leq 485.15	3.31
485.15	<	d_1	\leq 486.74	3.32
486.74	<	d_1	\leq 488.34	3.33
488.34	<	d_1	\leq 489.93	3.34
489.93	<	d_1	\leq 491.52	3.35
491.52	<	d_1	\leq 493.12	3.36
493.12	<	d_1	\leq 494.71	3.37

Inside diameter d_1			Tolerance \pm	
494.71	<	d_1	\leq 496.31	3.38
496.31	<	d_1	\leq 497.90	3.39
497.90	<	d_1	\leq 499.50	3.40
499.50	<	d_1	\leq 500.00	3.41
		d_1	> 500.00	according to equation



C.1.4 Surface quality acceptance criteria

ISO 3601-3 defines and classifies surface imperfections on O-Rings and specifies the maximum acceptable limits for these imperfections depending on the defined Grade.

Grade N (general purpose)

Grade N identifies surface acceptance criteria for O-Rings intended for general industrial use.

Grade S (special)

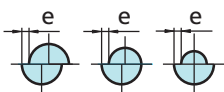
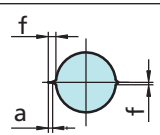
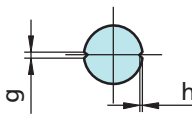
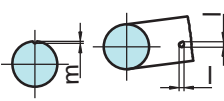
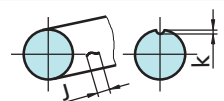
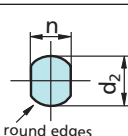
Grade S identifies surface quality acceptance criteria for O-Rings intended for applications requiring a higher level of quality with respect to tolerances of surface

imperfections, e.g. for safety relevant components in automotive engineering.

The following Table 18 defines standard form and surface deviations of Trelleborg Sealing Solutions elastomeric O-Rings according to the TSS standard TBS-00005, based on ISO 3601:2005, grade N (general purpose).

If no quality requirements are specified with the order, O-Rings are supplied with standard specification according to Table 18.

Table 18 Standard surface specification for O-Rings according to the TSS standard TBS-00005, based on ISO 3601-3:2005, grade N

		Standard form and surface deviations, grade N		maximum acceptable limits according to TSS standard TBS-00005***, Grade N																		
Type of defects according to TSS standard TBS-00005***		Schematic illustration		Cross section d_2																		
				≤ 0.80	≤ 2.25	≤ 3.15	≤ 4.50	≤ 6.30	≤ 8.40	≤ 10.00	≤ 15.00	> 15.00										
1.	Offset		e	by agreement	0.08	0.10	0.13	0.15	0.15	0.20	0.25	by agreement										
2.	Flash		f a		0.10	0.12	0.14	0.16	0.18	0.20	0.25		When the flash can be differentiated, it shall not exceed 0.07 mm									
3.	Backrind		g h		0.18	0.27	0.36	0.53	0.70	0.90	1.20		0.08	0.08	0.10	0.10	0.13	0.13	0.15			
4.	Non-fills and indentations		l m		0.60	0.80	1.00	1.30	1.70	2.00	2.50		0.08	0.08	0.10	0.10	0.13	0.13	0.15			
5.	Flow marks (radial orientation is not permitted)		j** k		1.50	1.50	6.50	6.50	6.50	6.50	6.50		8.00	or $0.05 \times d_1^*$		0.08	0.08	0.08	0.08	0.08	0.10	0.10
6.	Area of excessive trimming (radial tool marks not allowed)		n		Trimming is allowed provided the dimension n is not reduced below the minimum diameter d_2 for the O-Ring																	
7.	Foreign material (embedded in the surface)	-	-		not permitted when viewed 2-times-magnified																	
8.	Straightness tolerance	-	-		-																	
9.	Roundness	-	-		-																	
10.	The O-Ring surface shall be free from cracks, ruptures, blisters and other imperfections that are greater than the limits given in the table when inspected at 2-times-magnification with adequate illumination. The unstretched Ring is viewed.																					
11.	Flow marks, non-fills and indentations within the limits given in the table shall not be allowed if a) there are more than three in any 25 mm length of circumference, b) they interconnect c) there are more than three that are separated from each other by a distance that is less than the maximum length of such imperfection																					

all dimensions in mm

* d_1 = Inside Diameter

** whichever is the greater

*** based on ISO 3601-3:2005



O-Ring

The following Table 19 defines restricted form and surface deviations of Trelleborg Sealing Solutions elastomeric O-Rings according to the TSS standard TBS-00005, based on ISO 3601:2005, grade S (special).

The permissible flaw sizes are very limited. This demands a greater process technology and stricter quality control procedures.

Table 19 Surface specification with reduced tolerances for O-Rings according to the TSS standard TBS-00005, based on ISO 3601-3:2005, grade S

		Restricted form and surface deviations, grade S		maximum acceptable limits according to TSS standard TBS-00005***, Grade S																
Type of defects according to TSS standard TBS-00005***		Schematic illustration		Cross section d_2																
				≤ 0.80	≤ 2.25	≤ 3.15	≤ 4.50	≤ 6.30	≤ 8.40	≤ 10.00	≤ 15.00	> 15.00								
1.	Offset		e	by agreement	0.08	0.08	0.10	0.12	0.13	0.15	0.20	by agreement								
2.	Flash		f a		0.10	0.10	0.13	0.15	0.15	0.18	0.20		When the flash can be differentiated, it shall not exceed 0.05 mm							
3.	Backrind		g h		0.10	0.15	0.20	0.20	0.30	0.50	0.75									
4.	Non-fills and indentations		l m		0.05	0.08	0.10	0.10	0.13	0.13	0.15									
5.	Flow marks (radial orientation is not permitted)		j** k		0.15	0.25	0.40	0.63	1.00	1.50	2.00									
					0.08	0.08	0.10	0.10	0.13	0.13	0.15		1.50	1.50	5.00	5.00	5.00	5.00	5.00	7.00
					or $0.05 \times d_1^*$															
					0.05	0.05	0.05	0.05	0.05	0.08	0.08									
6.	Area of excessive trimming (radial tool marks not allowed)		n		Trimming is allowed provided the dimension n is not reduced below the minimum diameter d_2 for the O-Ring															
7.	Foreign material (embedded in the surface)		-		not permitted when viewed 2-times-magnified															
8.	Straightness tolerance		-		-															
9.	Roundness		-	-																
10.	The O-Ring surface shall be free from cracks, ruptures, blisters and other imperfections that are greater than the limits given in the table when inspected at 2-times-magnification with adequate illumination. The unstretched Ring is viewed.																			
11.	Flow marks, non-fills and indentations within the limits given in the table shall not be allowed if a) there are more than three in any 25 mm length of circumference, b) they interconnect c) there are more than three that are separated from each other by a distance that is less than the maximum length of such imperfection																			

all dimensions in mm

* d_1 = Inside Diameter

** whichever is the greater

*** based on ISO 3601-3:2005

For surface deviations ISO 2859-1:2004-01 AQL 1,0 general inspection level II, normal inspection, is supplied as standard. Higher quality levels are available on request.

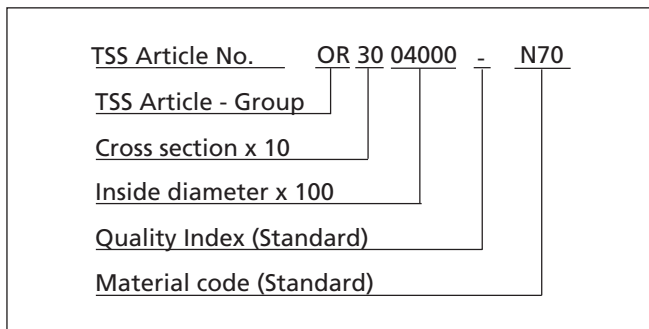


C.2 Product range

The following tables provide a summary of available O-Ring dimensions, Trelleborg Sealing Solutions part numbers and valid standards. The tables represent a guide to common dimensions with or without a valid standard but does not include a complete range of sizes, which is more extensive. Special dimensions are also available on request. Contact your local Trelleborg Sealing Solutions marketing company for further details.

Ordering example 1

O-Ring, metric 40 x 3
 Dimensions: Inside diameter = 40.0 mm
 Cross section = 3.0 mm
 Material: NBR 70
 (Nitrile-Butadiene Rubber
 70 Shore A)



O-Ring dimensions and TSS part numbers see following tables.

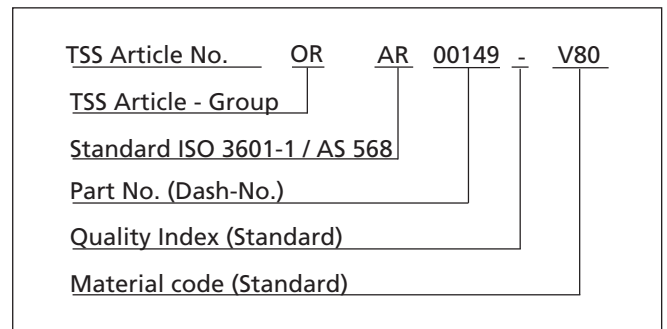
Elastomer type codes for standard product order see Table 1 (last column).

The required Shore A hardness must be given with the order.

For the dimensions given molds generally exist. Due to different shrinkage factors of various materials, it may not be possible to process certain materials with the existing molds. To guarantee high constant quality levels, it might be necessary to produce new or additional molds accruing extra costs.

Ordering example 2

O-Ring, ISO 3601-1 and AS 568 reference no. 149
 Dimensions: Inside diameter = 71.12 mm
 Cross section = 2.62 mm
 Material: FKM 80
 (Fluorocarbon Rubber
 80 Shore A)



When a special material is required the exact five-digit Trelleborg Sealing Solutions material code must be given with the order. In this respect please refer to the information provided in Table 10 Preferred materials or contact your local Trelleborg Sealing Solutions company.

C.2.1 O-Ring dimensions according to ISO 3601-1 and AS 568

The following table shows the preferred O-Ring dimensions according to the international standard ISO 3601-1 and the American standard AS 568, including appropriate reference numbers.

For all O-Ring inside diameters d_1 and cross sections d_2 the tolerances according to ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the table below.

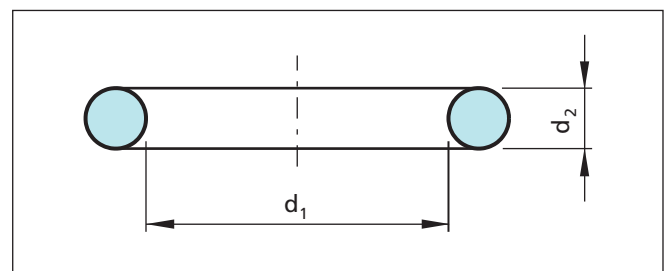


Figure 31 O-Ring dimensions



O-Ring

Table 20 Preferred O-Ring dimensions according to ISO 3601-1 and AS 568 with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00001	001	0.74	0.12	1.02	0.08
ORAR00002	002	1.07	0.12	1.27	
ORAR00003	003	1.42	0.12	1.52	
ORAR00004	004	1.78	0.13	1.78	0.08
ORAR00005	005	2.57	0.13	1.78	
ORAR00006	006	2.90	0.13	1.78	
ORAR00007	007	3.68	0.14	1.78	
ORAR00008	008	4.47	0.15	1.78	
ORAR00009	009	5.28	0.15	1.78	
ORAR00010	010	6.07	0.16	1.78	
ORAR00011	011	7.65	0.17	1.78	
ORAR00012	012	9.25	0.18	1.78	
ORAR00013	013	10.82	0.20	1.78	
ORAR00014	014	12.42	0.21	1.78	
ORAR00015	015	14.00	0.22	1.78	
ORAR00016	016	15.60	0.23	1.78	
ORAR00017	017	17.17	0.24	1.78	
ORAR00018	018	18.77	0.26	1.78	
ORAR00019	019	20.35	0.27	1.78	
ORAR00020	020	21.95	0.28	1.78	
ORAR00021	021	23.52	0.29	1.78	
ORAR00022	022	25.12	0.30	1.78	
ORAR00023	023	26.70	0.31	1.78	
ORAR00024	024	28.30	0.33	1.78	
ORAR00025	025	29.87	0.34	1.78	
ORAR00026	026	31.47	0.35	1.78	
ORAR00027	027	33.05	0.36	1.78	
ORAR00028	028	34.65	0.37	1.78	
ORAR00029	029	37.82	0.39	1.78	
ORAR00030	030	41.00	0.42	1.78	
ORAR00031	031	44.17	0.44	1.78	
ORAR00032	032	47.35	0.46	1.78	
ORAR00033	033	50.52	0.48	1.78	
ORAR00034	034	53.70	0.51	1.78	
ORAR00035	035	56.87	0.53	1.78	

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section		
		d ₁	Tolerance ±	d ₂	Tolerance ±	
ORAR00036	036	60.05	0.55	1.78	0.08	
ORAR00037	037	63.22	0.57	1.78		
ORAR00038	038	66.40	0.59	1.78		
ORAR00039	039	69.57	0.62	1.78		
ORAR00040	040	72.75	0.64	1.78		
ORAR00041	041	75.92	0.66	1.78		
ORAR00042	042	82.27	0.70	1.78		
ORAR00043	043	88.62	0.75	1.78		
ORAR00044	044	94.97	0.79	1.78		
ORAR00045	045	101.32	0.83	1.78		
ORAR00046	046	107.67	0.88	1.78		
ORAR00047	047	114.02	0.92	1.78		
ORAR00048	048	120.37	0.96	1.78		
ORAR00049	049	126.72	1.01	1.78		
ORAR00050	050	133.07	1.05	1.78		
ORAR00102	102	1.24	0.12	2.62		0.09
ORAR00103	103	2.06	0.13	2.62		
ORAR00104	104	2.84	0.13	2.62		
ORAR00105	105	3.63	0.14	2.62		
ORAR00106	106	4.42	0.15	2.62		
ORAR00107	107	5.23	0.15	2.62		
ORAR00108	108	6.02	0.16	2.62		
ORAR00109	109	7.59	0.17	2.62		
ORAR00110	110	9.19	0.18	2.62		
ORAR00111	111	10.77	0.20	2.62		
ORAR00112	112	12.37	0.21	2.62		
ORAR00113	113	13.94	0.22	2.62		
ORAR00114	114	15.54	0.23	2.62		
ORAR00115	115	17.12	0.24	2.62		
ORAR00116	116	18.72	0.26	2.62		
ORAR00117	117	20.30	0.27	2.62		
ORAR00118	118	21.89	0.28	2.62		
ORAR00119	119	23.47	0.29	2.62		
ORAR00120	120	25.07	0.30	2.62		
ORAR00121	121	26.64	0.31	2.62		
ORAR00122	122	28.24	0.33	2.62		
ORAR00123	123	29.82	0.34	2.62		



TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00124	124	31.42	0.35	2.62	0.09
ORAR00125	125	32.99	0.36	2.62	
ORAR00126	126	34.59	0.37	2.62	
ORAR00127	127	36.17	0.38	2.62	
ORAR00128	128	37.77	0.39	2.62	
ORAR00129	129	39.34	0.40	2.62	
ORAR00130	130	40.94	0.42	2.62	
ORAR00131	131	42.52	0.43	2.62	
ORAR00132	132	44.12	0.44	2.62	
ORAR00133	133	45.69	0.45	2.62	
ORAR00134	134	47.29	0.46	2.62	
ORAR00135	135	48.90	0.47	2.62	
ORAR00136	136	50.47	0.48	2.62	
ORAR00137	137	52.07	0.49	2.62	
ORAR00138	138	53.64	0.51	2.62	
ORAR00139	139	55.25	0.52	2.62	
ORAR00140	140	56.82	0.53	2.62	
ORAR00141	141	58.42	0.54	2.62	
ORAR00142	142	59.99	0.55	2.62	
ORAR00143	143	61.60	0.56	2.62	
ORAR00144	144	63.17	0.57	2.62	
ORAR00145	145	64.77	0.58	2.62	
ORAR00146	146	66.34	0.59	2.62	
ORAR00147	147	67.95	0.61	2.62	
ORAR00148	148	69.52	0.62	2.62	
ORAR00149	149	71.12	0.63	2.62	
ORAR00150	150	72.69	0.64	2.62	
ORAR00151	151	75.87	0.66	2.62	
ORAR00152	152	82.22	0.70	2.62	
ORAR00153	153	88.57	0.75	2.62	
ORAR00154	154	94.92	0.79	2.62	
ORAR00155	155	101.27	0.83	2.62	
ORAR00156	156	107.62	0.88	2.62	
ORAR00157	157	113.97	0.92	2.62	
ORAR00158	158	120.32	0.96	2.62	
ORAR00159	159	126.67	1.00	2.62	
ORAR00160	160	133.02	1.05	2.62	
ORAR00161	161	139.37	1.09	2.62	

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section		
		d ₁	Tolerance ±	d ₂	Tolerance ±	
ORAR00162	162	145.72	1.13	2.62	0.09	
ORAR00163	163	152.07	1.17	2.62		
ORAR00164	164	158.42	1.22	2.62		
ORAR00165	165	164.77	1.26	2.62		
ORAR00166	166	171.12	1.30	2.62		
ORAR00167	167	177.47	1.34	2.62		
ORAR00168	168	183.82	1.38	2.62		
ORAR00169	169	190.17	1.43	2.62		
ORAR00170	170	196.52	1.47	2.62		
ORAR00171	171	202.87	1.51	2.62		
ORAR00172	172	209.22	1.55	2.62		
ORAR00173	173	215.57	1.59	2.62		
ORAR00174	174	221.92	1.63	2.62		
ORAR00175	175	228.27	1.68	2.62		
ORAR00176	176	234.62	1.72	2.62		
ORAR00177	177	240.97	1.76	2.62		
ORAR00178	178	247.32	1.80	2.62		
ORAR00201	201	4.34	0.15	3.53		0.10
ORAR00202	202	5.94	0.16	3.53		
ORAR00203	203	7.52	0.17	3.53		
ORAR00204	204	9.12	0.18	3.53		
ORAR00205	205	10.69	0.20	3.53		
ORAR00206	206	12.29	0.21	3.53		
ORAR00207	207	13.87	0.22	3.53		
ORAR00208	208	15.47	0.23	3.53		
ORAR00209	209	17.04	0.24	3.53		
ORAR00210	210	18.64	0.25	3.53		
ORAR00211	211	20.22	0.27	3.53		
ORAR00212	212	21.82	0.28	3.53		
ORAR00213	213	23.39	0.29	3.53		
ORAR00214	214	24.99	0.30	3.53		
ORAR00215	215	26.57	0.31	3.53		
ORAR00216	216	28.17	0.32	3.53		
ORAR00217	217	29.74	0.34	3.53		
ORAR00218	218	31.34	0.35	3.53		
ORAR00219	219	32.92	0.36	3.53		
ORAR00220	220	34.52	0.37	3.53		



O-Ring

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00221	221	36.09	0.38	3.53	0.10
ORAR00222	222	37.69	0.39	3.53	
ORAR00223	223	40.87	0.42	3.53	
ORAR00224	224	44.04	0.44	3.53	
ORAR00225	225	47.22	0.46	3.53	
ORAR00226	226	50.39	0.48	3.53	
ORAR00227	227	53.57	0.51	3.53	
ORAR00228	228	56.74	0.53	3.53	
ORAR00229	229	59.92	0.55	3.53	
ORAR00230	230	63.09	0.57	3.53	
ORAR00231	231	66.27	0.59	3.53	
ORAR00232	232	69.44	0.62	3.53	
ORAR00233	233	72.62	0.64	3.53	
ORAR00234	234	75.79	0.66	3.53	
ORAR00235	235	78.97	0.68	3.53	
ORAR00236	236	82.14	0.70	3.53	
ORAR00237	237	85.32	0.72	3.53	
ORAR00238	238	88.49	0.75	3.53	
ORAR00239	239	91.67	0.77	3.53	
ORAR00240	240	94.84	0.79	3.53	
ORAR00241	241	98.02	0.81	3.53	
ORAR00242	242	101.19	0.83	3.53	
ORAR00243	243	104.37	0.85	3.53	
ORAR00244	244	107.54	0.88	3.53	
ORAR00245	245	110.72	0.90	3.53	
ORAR00246	246	113.89	0.92	3.53	
ORAR00247	247	117.07	0.94	3.53	
ORAR00248	248	120.24	0.96	3.53	
ORAR00249	249	123.42	0.98	3.53	
ORAR00250	250	126.59	1.00	3.53	
ORAR00251	251	129.77	1.03	3.53	
ORAR00252	252	132.94	1.05	3.53	
ORAR00253	253	136.12	1.07	3.53	
ORAR00254	254	139.29	1.09	3.53	
ORAR00255	255	142.47	1.11	3.53	
ORAR00256	256	145.64	1.13	3.53	
ORAR00257	257	148.82	1.15	3.53	
ORAR00258	258	151.99	1.17	3.53	

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section		
		d ₁	Tolerance ±	d ₂	Tolerance ±	
ORAR00259	259	158.34	1.22	3.53	0.10	
ORAR00260	260	164.69	1.26	3.53		
ORAR00261	261	171.04	1.30	3.53		
ORAR00262	262	177.39	1.34	3.53		
ORAR00263	263	183.74	1.38	3.53		
ORAR00264	264	190.09	1.43	3.53		
ORAR00265	265	196.44	1.47	3.53		
ORAR00266	266	202.79	1.51	3.53		
ORAR00267	267	209.14	1.55	3.53		
ORAR00268	268	215.49	1.59	3.53		
ORAR00269	269	221.84	1.63	3.53		
ORAR00270	270	228.19	1.68	3.53		
ORAR00271	271	234.54	1.72	3.53		
ORAR00272	272	240.89	1.76	3.53		
ORAR00273	273	247.24	1.80	3.53		
ORAR00274	274	253.59	1.84	3.53		
ORAR00275	275	266.29	1.92	3.53		
ORAR00276	276	278.99	2.00	3.53		
ORAR00277	277	291.69	2.09	3.53		
ORAR00278	278	304.39	2.17	3.53		
ORAR00279	279	329.79	2.33	3.53		
ORAR00280	280	355.19	2.49	3.53		
ORAR00281	281	380.59	2.65	3.53		
ORAR00282	282	405.26	2.81	3.53		
ORAR00283	283	430.66	2.97	3.53		
ORAR00284	284	456.06	3.13	3.53		
ORAR00309	309	10.46	0.19	5.33		0.13
ORAR00310	310	12.07	0.21	5.33		
ORAR00311	311	13.64	0.22	5.33		
ORAR00312	312	15.24	0.23	5.33		
ORAR00313	313	16.81	0.24	5.33		
ORAR00314	314	18.42	0.25	5.33		
ORAR00315	315	19.99	0.26	5.33		
ORAR00316	316	21.59	0.28	5.33		
ORAR00317	317	23.16	0.29	5.33		
ORAR00318	318	24.77	0.30	5.33		
ORAR00319	319	26.34	0.31	5.33		



TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00320	320	27.94	0.32	5.33	0.13
ORAR00321	321	29.51	0.33	5.33	
ORAR00322	322	31.12	0.35	5.33	
ORAR00323	323	32.69	0.36	5.33	
ORAR00324	324	34.29	0.37	5.33	
ORAR00325	325	37.47	0.39	5.33	
ORAR00326	326	40.64	0.41	5.33	
ORAR00327	327	43.82	0.44	5.33	
ORAR00328	328	46.99	0.46	5.33	
ORAR00329	329	50.17	0.48	5.33	
ORAR00330	330	53.34	0.50	5.33	
ORAR00331	331	56.52	0.53	5.33	
ORAR00332	332	59.69	0.55	5.33	
ORAR00333	333	62.87	0.57	5.33	
ORAR00334	334	66.04	0.59	5.33	
ORAR00335	335	69.22	0.61	5.33	
ORAR00336	336	72.39	0.64	5.33	
ORAR00337	337	75.57	0.66	5.33	
ORAR00338	338	78.74	0.68	5.33	
ORAR00339	339	81.92	0.70	5.33	
ORAR00340	340	85.09	0.72	5.33	
ORAR00341	341	88.27	0.74	5.33	
ORAR00342	342	91.44	0.77	5.33	
ORAR00343	343	94.62	0.79	5.33	
ORAR00344	344	97.79	0.81	5.33	
ORAR00345	345	100.97	0.83	5.33	
ORAR00346	346	104.14	0.85	5.33	
ORAR00347	347	107.32	0.87	5.33	
ORAR00348	348	110.49	0.90	5.33	
ORAR00349	349	113.67	0.92	5.33	
ORAR00350	350	116.84	0.94	5.33	
ORAR00351	351	120.02	0.96	5.33	
ORAR00352	352	123.19	0.98	5.33	
ORAR00353	353	126.37	1.00	5.33	
ORAR00354	354	129.54	1.02	5.33	
ORAR00355	355	132.72	1.05	5.33	
ORAR00356	356	135.89	1.07	5.33	
ORAR00357	357	139.07	1.09	5.33	

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00358	358	142.24	1.11	5.33	0.13
ORAR00359	359	145.42	1.13	5.33	
ORAR00360	360	148.59	1.15	5.33	
ORAR00361	361	151.77	1.17	5.33	
ORAR00362	362	158.12	1.21	5.33	
ORAR00363	363	164.47	1.26	5.33	
ORAR00364	364	170.82	1.30	5.33	
ORAR00365	365	177.17	1.34	5.33	
ORAR00366	366	183.52	1.38	5.33	
ORAR00367	367	189.87	1.42	5.33	
ORAR00368	368	196.22	1.47	5.33	
ORAR00369	369	202.57	1.51	5.33	
ORAR00370	370	208.92	1.55	5.33	
ORAR00371	371	215.27	1.59	5.33	
ORAR00372	372	221.62	1.63	5.33	
ORAR00373	373	227.97	1.67	5.33	
ORAR00374	374	234.32	1.72	5.33	
ORAR00375	375	240.67	1.76	5.33	
ORAR00376	376	247.02	1.80	5.33	
ORAR00377	377	253.37	1.84	5.33	
ORAR00378	378	266.07	1.92	5.33	
ORAR00379	379	278.77	2.00	5.33	
ORAR00380	380	291.47	2.09	5.33	
ORAR00381	381	304.17	2.17	5.33	
ORAR00382	382	329.57	2.33	5.33	
ORAR00383	383	354.97	2.49	5.33	
ORAR00384	384	380.37	2.65	5.33	
ORAR00385	385	405.26	2.81	5.33	
ORAR00386	386	430.66	2.97	5.33	
ORAR00387	387	456.06	3.13	5.33	
ORAR00388	388	481.46	3.29	5.33	
ORAR00389	389	506.86	3.45	5.33	
ORAR00390	390	532.26	3.61	5.33	
ORAR00391	391	557.66	3.77	5.33	
ORAR00392	392	582.68	3.92	5.33	
ORAR00393	393	608.08	4.08	5.33	
ORAR00394	394	633.48	4.24	5.33	
ORAR00395	395	658.88	4.40	5.33	



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TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00425	425	113.67	0.92	6.99	0.15
ORAR00426	426	116.84	0.94	6.99	
ORAR00427	427	120.02	0.96	6.99	
ORAR00428	428	123.19	0.98	6.99	
ORAR00429	429	126.37	1.00	6.99	
ORAR00430	430	129.54	1.02	6.99	
ORAR00431	431	132.72	1.05	6.99	
ORAR00432	432	135.89	1.07	6.99	
ORAR00433	433	139.07	1.09	6.99	
ORAR00434	434	142.24	1.11	6.99	
ORAR00435	435	145.42	1.13	6.99	
ORAR00436	436	148.59	1.15	6.99	
ORAR00437	437	151.77	1.17	6.99	
ORAR00438	438	158.12	1.21	6.99	
ORAR00439	439	164.47	1.26	6.99	
ORAR00440	440	170.82	1.30	6.99	
ORAR00441	441	177.17	1.34	6.99	
ORAR00442	442	183.52	1.38	6.99	
ORAR00443	443	189.87	1.42	6.99	
ORAR00444	444	196.22	1.47	6.99	
ORAR00445	445	202.57	1.51	6.99	
ORAR00446	446	215.27	1.59	6.99	
ORAR00447	447	227.97	1.67	6.99	
ORAR00448	448	240.67	1.76	6.99	
ORAR00449	449	253.37	1.84	6.99	
ORAR00450	450	266.07	1.92	6.99	
ORAR00451	451	278.77	2.00	6.99	
ORAR00452	452	291.47	2.09	6.99	
ORAR00453	453	304.17	2.17	6.99	
ORAR00454	454	316.87	2.25	6.99	
ORAR00455	455	329.57	2.33	6.99	
ORAR00456	456	342.27	2.41	6.99	
ORAR00457	457	354.97	2.49	6.99	
ORAR00458	458	367.67	2.57	6.99	
ORAR00459	459	380.37	2.65	6.99	
ORAR00460	460	393.07	2.73	6.99	

TSS Part-No.	Ident-No. ISO 3601-1 AS 568	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
ORAR00461	461	405.26	2.81	6.99	0.15
ORAR00462	462	417.96	2.89	6.99	
ORAR00463	463	430.66	2.97	6.99	
ORAR00464	464	443.36	3.05	6.99	
ORAR00465	465	456.06	3.13	6.99	
ORAR00466	466	468.76	3.21	6.99	
ORAR00467	467	481.46	3.29	6.99	
ORAR00468	468	494.16	3.37	6.99	
ORAR00469	469	506.86	3.45	6.99	
ORAR00470	470	532.26	3.61	6.99	
ORAR00471	471	557.66	3.77	6.99	
ORAR00472	472	582.68	3.92	6.99	
ORAR00473	473	608.08	4.08	6.99	
ORAR00474	474	633.48	4.24	6.99	
ORAR00475	475	658.88	4.40	6.99	



C.2.2 O-Ring dimensions according to Swedish standard SMS 1586

The following two tables show the O-Ring dimensions according to Swedish standard SMS 1586.

For all O-Ring inside diameters d_1 and cross sections d_2 the tolerances according to ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the tables below.

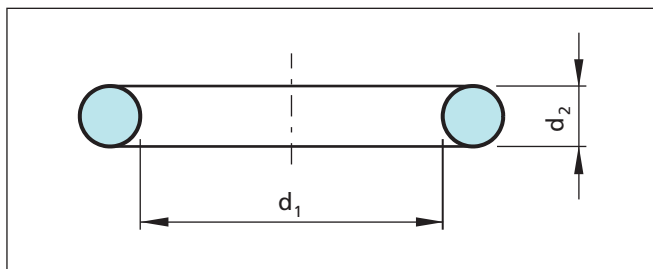


Figure 32 O-Ring dimensions

Table 21 O-Ring dimensions according to SMS 1586, table 1 (dynamic use) with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Inside-Ø		Cross section	
	d_1	Tolerance ±	d_2	Tolerance ±
OR2400330	3.30	0.14	2.40	0.09
OR2400430	4.30	0.15	2.40	
OR2400530	5.30	0.15	2.40	
OR2400630	6.30	0.16	2.40	
OR2400730	7.30	0.17	2.40	
OR2400830	8.30	0.18	2.40	
OR2400930	9.30	0.18	2.40	
OR2401030	10.30	0.19	2.40	
OR2401130	11.30	0.20	2.40	
OR2401230	12.30	0.21	2.40	
OR2401330	13.30	0.22	2.40	
OR2401430	14.30	0.22	2.40	
OR2401530	15.30	0.23	2.40	
OR2401630	16.30	0.24	2.40	
OR2401730	17.30	0.25	2.40	
OR3001920	19.20	0.26	3.00	
OR3002220	22.20	0.28	3.00	
OR3002420	24.20	0.30	3.00	
OR3002620	26.20	0.31	3.00	
OR3002920	29.20	0.33	3.00	

TSS Part-No.	Inside-Ø		Cross section	
	d_1	Tolerance ±	d_2	Tolerance ±
OR3003220	32.20	0.35	3.00	0.09
OR3003420	34.20	0.37	3.00	
OR3003620	36.20	0.38	3.00	
OR3003920	39.20	0.40	3.00	
OR3004220	42.20	0.42	3.00	
OR3004420	44.20	0.44	3.00	
OR5704420	44.20	0.44	5.70	0.13
OR5704920	49.20	0.47	5.70	
OR5705420	54.20	0.51	5.70	
OR5705920	59.20	0.54	5.70	
OR5706420	64.20	0.58	5.70	
OR5706920	69.20	0.61	5.70	
OR5707420	74.20	0.65	5.70	
OR5707920	79.20	0.68	5.70	
OR5708410	84.10	0.72	5.70	
OR5708910	89.10	0.75	5.70	
OR5709410	94.10	0.78	5.70	
OR5709910	99.10	0.82	5.70	
OR5710410	104.10	0.85	5.70	
OR5710910	109.10	0.89	5.70	
OR5711430	114.30	0.92	5.70	
OR5711930	119.30	0.96	5.70	
OR5712430	124.30	0.99	5.70	
OR5712930	129.30	1.02	5.70	
OR5713430	134.30	1.06	5.70	
OR5713930	139.30	1.09	5.70	
OR5714430	144.30	1.12	5.70	
OR8414410	144.10	1.12	8.40	0.15
OR8414910	149.10	1.15	8.40	
OR8415410	154.10	1.19	8.40	
OR8415910	159.10	1.22	8.40	
OR8416410	164.10	1.25	8.40	
OR8416910	169.10	1.29	8.40	
OR8417410	174.10	1.32	8.40	
OR8417910	179.10	1.35	8.40	
OR8418410	184.10	1.39	8.40	
OR8418910	189.10	1.42	8.40	



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TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR8419410	194.10	1.45	8.40	0.15
OR8419910	199.10	1.49	8.40	
OR8420910	209.10	1.55	8.40	
OR8421910	219.10	1.62	8.40	
OR8422910	229.10	1.68	8.40	
OR8423910	239.10	1.75	8.40	
OR8424910	249.10	1.81	8.40	

Table 22 O-Ring dimensions according to SMS 1586, table 2 (static use) with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR1600310	3.10	0.14	1.60	0.08
OR1600410	4.10	0.14	1.60	
OR1600510	5.10	0.15	1.60	
OR1600610	6.10	0.16	1.60	
OR1600710	7.10	0.17	1.60	
OR1600810	8.10	0.18	1.60	
OR1600910	9.10	0.18	1.60	
OR1601010	10.10	0.19	1.60	
OR1601110	11.10	0.20	1.60	
OR1601210	12.10	0.21	1.60	
OR1601310	13.10	0.21	1.60	
OR1601410	14.10	0.22	1.60	
OR1601510	15.10	0.23	1.60	
OR1601610	16.10	0.24	1.60	
OR1601710	17.10	0.24	1.60	
OR1601810	18.10	0.25	1.60	
OR1601910	19.10	0.26	1.60	
OR1602210	22.10	0.28	1.60	
OR1602510	25.10	0.30	1.60	
OR1602710	27.10	0.32	1.60	
OR1602910	29.10	0.33	1.60	
OR1603210	32.10	0.35	1.60	
OR1603510	35.10	0.37	1.60	
OR1603710	37.10	0.39	1.60	

TSS Part-No.	Inside-Ø		Cross section		
	d ₁	Tolerance ±	d ₂	Tolerance ±	
OR3004950	49.50	0.48	3.00	0.09	
OR3005450	54.50	0.51	3.00		
OR3005950	59.50	0.55	3.00		
OR3006450	64.50	0.58	3.00		
OR3006950	69.50	0.62	3.00		
OR3007450	74.50	0.65	3.00		
OR3007950	79.50	0.68	3.00		
OR3008450	84.50	0.72	3.00		
OR3008950	89.50	0.75	3.00		
OR3009450	94.50	0.79	3.00		
OR3009950	99.50	0.82	3.00		
OR3010450	104.50	0.86	3.00		
OR3010950	109.50	0.89	3.00		
OR3011450	114.50	0.92	3.00		
OR3011950	119.50	0.96	3.00		
OR3012450	124.50	0.99	3.00		
OR3012950	129.50	1.02	3.00		
OR3013450	134.50	1.06	3.00		
OR3013950	139.50	1.09	3.00		
OR3014450	144.50	1.12	3.00		
OR5714930	149.30	1.16	5.70		0.13
OR5715430	154.30	1.19	5.70		
OR5715930	159.30	1.22	5.70		
OR5716430	164.30	1.26	5.70		
OR5716930	169.30	1.29	5.70		
OR5717430	174.30	1.32	5.70		
OR5717930	179.30	1.35	5.70		
OR5718430	184.30	1.39	5.70		
OR5718930	189.30	1.42	5.70		
OR5719430	194.30	1.45	5.70		
OR5719930	199.30	1.49	5.70		
OR5720930	209.30	1.55	5.70		
OR5721930	219.30	1.62	5.70		
OR5722930	229.30	1.68	5.70		
OR5723930	239.30	1.75	5.70		
OR5724930	249.30	1.81	5.70		
OR5725930	259.30	1.88	5.70		
OR5726930	269.30	1.94	5.70		
OR5727930	279.30	2.01	5.70		



TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR5728930	289.30	2.07	5.70	0.13
OR5729930	299.30	2.14	5.70	
OR5731930	319.30	2.26	5.70	
OR5733930	339.30	2.39	5.70	
OR5735930	359.30	2.52	5.70	
OR5737930	379.30	2.65	5.70	
OR5739930	399.30	2.77	5.70	
OR5741930	419.30	2.90	5.70	
OR5743930	439.30	3.03	5.70	
OR5745930	459.30	3.15	5.70	
OR5747930	479.30	3.28	5.70	
OR5749930	499.30	3.40	5.70	

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross section		
		d ₁	Tolerance ±	d ₂	Tolerance ±	
OR1900580	P6	5.80	0.16	1.90	0.08	
OR1900680	P7	6.80	0.17	1.90		
OR1900780	P8	7.80	0.17	1.90		
OR1900880	P9	8.80	0.18	1.90		
OR1900980	P10	9.80	0.19	1.90		
OR2400980	P10A	9.80	0.19	2.40	0.09	
OR2401080	P11	10.80	0.20	2.40		
OR2401100	P11.2	11.00	0.20	2.40		
OR2401180	P12	11.80	0.20	2.40		
OR2401230	P12.5	12.30	0.21	2.40		
OR2401380	P14	13.80	0.22	2.40		
OR2401480	P15	14.80	0.23	2.40		
OR2401580	P16	15.80	0.23	2.40		
OR2401780	P18	17.80	0.25	2.40		
OR2401980	P20	19.80	0.26	2.40		
OR2402080	P21	20.80	0.27	2.40		
OR2402180	P22	21.80	0.28	2.40		
OR3502170	P22A	21.70	0.28	3.50		0.10
OR3502210	P22.4	22.10	0.28	3.50		
OR3502378	P24	23.78	0.29	3.50		
OR3502470	P25	24.70	0.30	3.50		
OR3502520	P25.5	25.20	0.30	3.50		
OR3502570	P26	25.70	0.31	3.50		
OR3502770	P28	27.70	0.32	3.50		
OR3502870	P29	28.70	0.33	3.50		
OR3502920	P29.5	29.20	0.33	3.50		
OR3502970	P30	29.70	0.34	3.50		
OR3503070	P31	30.70	0.34	3.50		
OR3503120	P31.5	31.20	0.35	3.50		
OR3503170	P32	31.70	0.35	3.50		
OR3503370	P34	33.70	0.36	3.50		
OR3503470	P35	34.70	0.37	3.50		
OR3503520	P35.5	35.20	0.38	3.50		
OR3503570	P36	35.70	0.38	3.50		
OR3503770	P38	37.70	0.39	3.50		
OR3503870	P39	38.70	0.40	3.50		
OR3503970	P40	39.70	0.41	3.50		
OR3504070	P41	40.70	0.41	3.50		

C.2.3 O-Ring dimensions according to Japanese standard JIS B 2401

The following two tables show O-Ring dimensions according to the Japanese standard JIS B 2401 for dynamic use (P) and for static use (G).

For all O-Ring inside diameters d₁ and cross sections d₂ the tolerances according to ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the tables below.

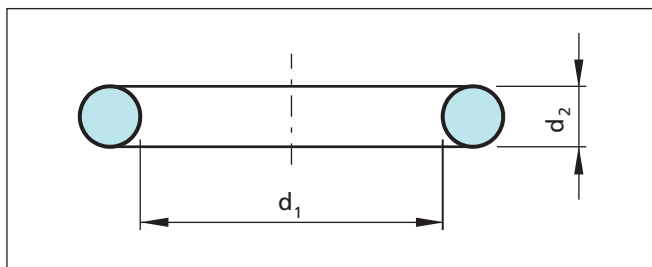


Figure 33 O-Ring dimensions

Table 23 O-Ring dimensions according to JIS B 2401 for dynamic use (P) with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
OR1900280	P3	2.80	0.13	1.90	0.08
OR1900380	P4	3.80	0.14	1.90	
OR1900480	P5	4.80	0.15	1.90	



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TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
OR3504170	P42	41.70	0.42	3.50	0.10
OR3504370	P44	43.70	0.44	3.50	
OR3504470	P45	44.70	0.44	3.50	
OR3504570	P46	45.70	0.45	3.50	
OR3504770	P48	47.70	0.46	3.50	
OR3504870	P49	48.70	0.47	3.50	
OR3504970	P50	49.70	0.48	3.50	
OR5704760	P48A	47.60	0.46	5.70	0.13
OR5704960	P50A	49.60	0.48	5.70	
OR5705160	P52	51.60	0.49	5.70	
OR5705260	P53	52.60	0.50	5.70	
OR5705460	P55	54.60	0.51	5.70	
OR5705560	P56	55.60	0.52	5.70	
OR5705760	P58	57.60	0.53	5.70	
OR5705960	P60	59.60	0.55	5.70	
OR5706160	P62	61.60	0.56	5.70	
OR5706260	P63	62.60	0.57	5.70	
OR5706460	P65	64.60	0.58	5.70	
OR5706660	P67	66.60	0.60	5.70	
OR5706960	P70	69.60	0.62	5.70	
OR5707060	P71	70.60	0.62	5.70	
OR5707460	P75	74.60	0.65	5.70	
OR5707960	P80	79.60	0.69	5.70	
OR5708460	P85	84.60	0.72	5.70	
OR5708960	P90	89.60	0.75	5.70	
OR5709460	P95	94.60	0.79	5.70	
OR5709960	P100	99.60	0.82	5.70	
OR5710160	P102	101.60	0.84	5.70	
OR5710460	P105	104.60	0.86	5.70	
OR5710960	P110	109.60	0.89	5.70	
OR5711160	P112	111.60	0.90	5.70	
OR5711460	P115	114.60	0.92	5.70	
OR5711960	P120	119.60	0.96	5.70	
OR5712460	P125	124.60	0.99	5.70	
OR5712960	P130	129.60	1.02	5.70	
OR5713160	P13	131.6	1.0	5.7	
OR5713460	P135	134.60	1.06	5.70	
OR5713960	P140	139.60	1.09	5.70	
OR5714460	P145	144.60	1.12	5.70	
OR5714960	P150	149.60	1.16	5.70	

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
OR8414950	P150A	149.50	1.16	8.40	0.15
OR8415450	P155	154.50	1.19	8.40	
OR8415950	P160	159.50	1.22	8.40	
OR8416450	P165	164.50	1.26	8.40	
OR8416950	P170	169.50	1.29	8.40	
OR8417450	P175	174.50	1.32	8.40	
OR8417950	P180	179.50	1.36	8.40	
OR8418450	P185	184.50	1.39	8.40	
OR8418950	P190	189.50	1.42	8.40	
OR8419450	P195	194.50	1.45	8.40	
OR8419950	P200	199.50	1.49	8.40	
OR8420450	P205	204.50	1.52	8.40	
OR8420850	P209	208.50	1.55	8.40	
OR8420950	P210	209.50	1.55	8.40	
OR8421450	P215	214.50	1.59	8.40	
OR8421950	P220	219.50	1.62	8.40	
OR8422450	P225	224.50	1.65	8.40	
OR8422950	P230	229.50	1.68	8.40	
OR8423450	P235	234.50	1.72	8.40	
OR8423950	P240	239.50	1.75	8.40	
OR8424450	P245	244.50	1.78	8.40	
OR8424950	P250	249.50	1.81	8.40	
OR8425450	P255	254.50	1.85	8.40	
OR8425950	P260	259.50	1.88	8.40	
OR8426450	P265	264.50	1.91	8.40	
OR8426950	P270	269.50	1.94	8.40	
OR8427450	P275	274.50	1.98	8.40	
OR8427950	P280	279.50	2.01	8.40	
OR8428450	P285	284.50	2.04	8.40	
OR8428950	P290	289.50	2.07	8.40	
OR8429450	P295	294.50	2.10	8.40	
OR8429950	P300	299.50	2.14	8.40	
OR8431450	P315	314.50	2.23	8.40	
OR8431950	P320	319.50	2.27	8.40	
OR8433450	P335	334.50	2.36	8.40	
OR8433950	P340	339.50	2.39	8.40	
OR8435450	P355	354.50	2.49	8.40	
OR8435950	P360	359.50	2.52	8.40	
OR8437450	P375	374.50	2.62	8.40	
OR8438450	P385	384.50	2.68	8.40	
OR8439950	P400	399.50	2.77	8.40	



Table 24 O-Ring dimensions according to JIS B 2401 for static use (G) with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
OR3102440	G25	24.40	0.30	3.10	0.09
OR3102940	G30	29.40	0.33	3.10	
OR3103440	G35	34.40	0.37	3.10	
OR3103940	G40	39.40	0.41	3.10	
OR3104440	G45	44.40	0.44	3.10	
OR3104940	G50	49.40	0.48	3.10	
OR3105440	G55	54.40	0.51	3.10	
OR3105940	G60	59.40	0.55	3.10	
OR3106440	G65	64.40	0.58	3.10	
OR3106940	G70	69.40	0.62	3.10	
OR3107440	G75	74.40	0.65	3.10	
OR3107940	G80	79.40	0.68	3.10	
OR3108440	G85	84.40	0.72	3.10	
OR3108940	G90	89.40	0.75	3.10	
OR3109440	G95	94.40	0.79	3.10	
OR3109940	G100	99.40	0.82	3.10	
OR3110440	G105	104.40	0.85	3.10	
OR3110940	G110	109.40	0.89	3.10	
OR3111440	G115	114.40	0.92	3.10	
OR3111940	G120	119.40	0.96	3.10	
OR3112440	G125	124.40	0.99	3.10	
OR3112940	G130	129.40	1.02	3.10	
OR3113440	G135	134.40	1.06	3.10	
OR3113940	G140	139.40	1.09	3.10	0.09
OR3114440	G145	144.40	1.12	3.10	
OR5714930	G150	149.30	1.16	5.70	0.13
OR5715430	G155	154.30	1.19	5.70	
OR5715930	G160	159.30	1.22	5.70	
OR5716430	G165	164.30	1.26	5.70	
OR5716930	G170	169.30	1.29	5.70	
OR5717430	G175	174.30	1.32	5.70	
OR5717930	G180	179.30	1.35	5.70	
OR5718430	G185	184.30	1.39	5.70	
OR5718930	G190	189.30	1.42	5.70	
OR5719430	G195	194.30	1.45	5.70	
OR5719930	G200	199.30	1.49	5.70	
OR5720930	G210	209.30	1.55	5.70	

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross section	
		d ₁	Tolerance ±	d ₂	Tolerance ±
OR5721930	G220	219.30	1.62	5.70	0.13
OR5722930	G230	229.30	1.68	5.70	
OR5723930	G240	239.30	1.75	5.70	
OR5724930	G250	249.30	1.81	5.70	
OR5725930	G260	259.30	1.88	5.70	
OR5726930	G270	269.30	1.94	5.70	
OR5727930	G280	279.30	2.01	5.70	
OR5728930	G290	289.30	2.07	5.70	
OR5729930	G300	299.30	2.14	5.70	



C.2.4 O-Ring dimensions for straight thread tube fittings according to AS 568

The following table shows the O-Ring dimensions for straight thread tube fittings according to AS 568.

For all O-Ring inside diameters d_1 and cross sections d_2 the tolerances according to ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the tables below.

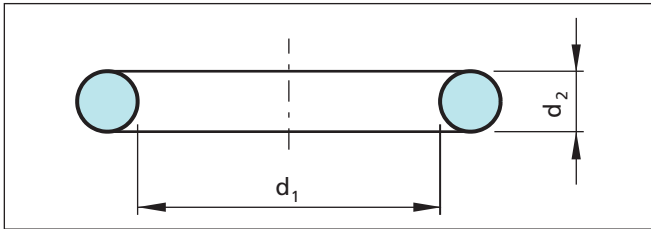


Figure 34 O-Ring dimensions

Table 25 O-Ring dimensions for straight thread tube fittings according to AS 568 with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Ident-No. AS 568	Inside-Ø		Cross section		Tube size Outside diameter (OD) inch
		d_1	Tolerance ±	d_2	Tolerance ±	
ORAR00901	901	4.70	0.15	1.42	0.08	3/32
ORAR00902	902	6.07	0.16	1.63	0.08	1/8
ORAR00903	903	7.65	0.17	1.63	0.08	3/16
ORAR00904	904	8.92	0.18	1.83	0.08	1/4
ORAR00905	905	10.52	0.19	1.83	0.08	5/16
ORAR00906	906	11.89	0.20	1.98	0.08	3/8
ORAR00907	907	13.46	0.22	2.08	0.08	7/16
ORAR00908	908	16.36	0.24	2.20	0.08	1/2
ORAR00909	909	17.93	0.25	2.46	0.09	9/16
ORAR00910	910	19.18	0.26	2.46	0.09	5/8
ORAR00911	911	21.92	0.28	2.95	0.09	11/16
ORAR00912	912	23.47	0.29	2.95	0.09	3/4
ORAR00913	913	25.04	0.30	2.95	0.09	13/16
ORAR00914	914	26.62	0.31	2.95	0.09	7/8
ORAR00916	916	29.74	0.34	2.95	0.09	1
ORAR00918	918	34.42	0.37	2.95	0.09	1 1/8
ORAR00920	920	37.47	0.39	3.00	0.09	1 1/4
ORAR00924	924	43.69	0.44	3.00	0.09	1 1/2
ORAR00928	928	53.09	0.50	3.00	0.09	1 3/4
ORAR00932	932	59.36	0.55	3.00	0.09	1 3/4

C.2.5 O-Ring dimensions for metric thread with conical recess according to ISO 6149

The following table shows the O-Ring dimensions for metric thread with conical recess according to ISO 6149.

For all O-Ring inside diameters d_1 and cross sections d_2 the tolerances according to ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the tables below.

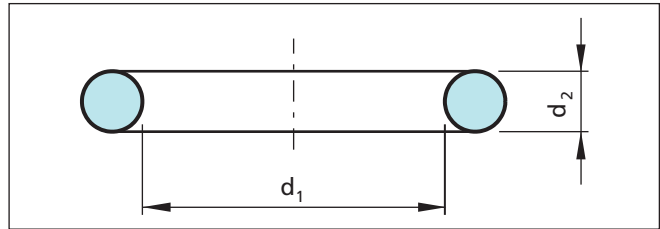


Figure 35 O-Ring dimensions

Table 26 O-Ring dimensions for metric thread with conical recess according to ISO 6149 with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Inside-Ø		Cross section		Thread (metric)
	d_1	Tolerance ±	d_2	Tolerance ±	
OR1600610	6.10	0.16	1.6	0.08	M8 x 1
OR1600810	8.10	0.18	1.6		M10 x 1
OR2200930	9.30	0.18	2.2	0.08	M12 x 1.5
OR2201130	11.30	0.20	2.2		M14 x 1.5
OR2201330	13.30	0.22	2.2		M16 x 1.5
OR2201530	15.30	0.23	2.2		M18 x 1.5
OR2201730	17.30	0.25	2.2		M20 x 1.5
OR2201930	19.30	0.26	2.2		M22 x 1.5
OR2902360	23.60	0.29	2.9	0.09	M27 x 2
OR2902960	29.60	0.33	2.9		M33 x 2
OR2903860	38.60	0.40	2.9		M42 x 2
OR2904460	44.60	0.44	2.9		M48 x 2
OR2905660	56.60	0.53	2.9		M60 x 2



C.2.6 Preferred metric O-Ring dimensions

The following table shows preferred metric O-Ring dimensions unrelated to national or international O-Ring standards.

For all O-Ring inside diameters d_1 and cross sections d_2 the tolerances according to ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the tables below.

Table 27 Preferred metric O-Ring dimensions with valid tolerances according to ISO 3601-1, class B

TSS Part-No.	Inside-Ø		Cross section	
	d_1	Tolerance \pm	d_2	Tolerance \pm
OR1000150	1.50	0.12	1.00	0.08
OR1000200	2.00	0.13	1.00	
OR1000250	2.50	0.13	1.00	
OR1000350	3.50	0.14	1.00	
OR1000400	4.00	0.14	1.00	
OR1000450	4.50	0.15	1.00	
OR1000600	6.00	0.16	1.00	
OR1000700	7.00	0.17	1.00	
OR1000800	8.00	0.17	1.00	
OR1000850	8.50	0.18	1.00	
OR1001000	10.00	0.19	1.00	
OR1001100	11.00	0.20	1.00	
OR1001200	12.00	0.21	1.00	
OR1001300	13.00	0.21	1.00	
OR1001500	15.00	0.23	1.00	
OR1001600	16.00	0.24	1.00	
OR1001800	18.00	0.25	1.00	
OR1002000	20.00	0.26	1.00	
OR1002200	22.00	0.28	1.00	
OR1002300	23.00	0.29	1.00	
OR1003000	30.00	0.34	1.00	
OR1003400	34.00	0.37	1.00	
OR1003800	38.00	0.40	1.00	
OR1004000	40.00	0.41	1.00	
OR1200180	1.80	0.13	1.20	0.08
OR1200250	2.50	0.13	1.20	
OR1200300	3.00	0.14	1.20	
OR1200350	3.50	0.14	1.20	
OR1200400	4.00	0.14	1.20	
OR1200500	5.00	0.15	1.20	

TSS Part-No.	Inside-Ø		Cross section	
	d_1	Tolerance \pm	d_2	Tolerance \pm
OR1200600	6.00	0.16	1.20	0.08
OR4U01600	16.00	0.24	1.25	0.08
OR1301000	10.00	0.19	1.30	0.08
OR1500300	3.00	0.14	1.50	0.08
OR1500350	3.50	0.14	1.50	
OR1500400	4.00	0.14	1.50	
OR1500450	4.50	0.15	1.50	
OR1500500	5.00	0.15	1.50	
OR1500600	6.00	0.16	1.50	
OR1500650	6.50	0.16	1.50	
OR1500700	7.00	0.17	1.50	
OR1500750	7.50	0.17	1.50	
OR1500800	8.00	0.17	1.50	
OR1500850	8.50	0.18	1.50	
OR1500900	9.00	0.18	1.50	
OR1501000	10.00	0.19	1.50	
OR1501050	10.50	0.19	1.50	
OR1501100	11.00	0.20	1.50	
OR1501200	12.00	0.21	1.50	
OR1501300	13.00	0.21	1.50	
OR1501400	14.00	0.22	1.50	
OR1501500	15.00	0.23	1.50	
OR1501600	16.00	0.24	1.50	
OR1501700	17.00	0.24	1.50	
OR1501900	19.00	0.26	1.50	
OR1502000	20.00	0.26	1.50	
OR1502300	23.00	0.29	1.50	
OR1502400	24.00	0.29	1.50	
OR1502600	26.00	0.31	1.50	
OR1502700	27.00	0.32	1.50	
OR1502800	28.00	0.32	1.50	
OR1503000	30.00	0.34	1.50	
OR1503200	32.00	0.35	1.50	
OR1503500	35.00	0.37	1.50	
OR1503600	36.00	0.38	1.50	
OR1504000	40.00	0.41	1.50	
OR1504200	42.00	0.42	1.50	



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TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR1504500	45.00	0.44	1.50	0.08
OR1504700	47.00	0.46	1.50	
OR1505000	50.00	0.48	1.50	
OR1505200	52.00	0.49	1.50	
OR1505400	54.00	0.51	1.50	
OR1505500	55.00	0.52	1.50	
OR1506000	60.00	0.55	1.50	
OR1600660	6.60	0.16	1.60	0.08
OR1600800	8.00	0.17	1.60	
ORIA00710	7.10	0.17	1.80	0.08
ORIA00900	9.00	0.18	1.80	
ORIA01050	10.50	0.19	1.80	
ORIA01900	19.00	0.26	1.80	
OR2000350	3.50	0.14	2.00	0.08
OR2000400	4.00	0.14	2.00	
OR2000500	5.00	0.15	2.00	
OR2000800	8.00	0.17	2.00	
OR2000900	9.00	0.18	2.00	
OR2001000	10.00	0.19	2.00	
OR2001100	11.00	0.20	2.00	
OR2001150	11.50	0.20	2.00	
OR2001200	12.00	0.21	2.00	
OR2001300	13.00	0.21	2.00	
OR2001400	14.00	0.22	2.00	
OR2001500	15.00	0.23	2.00	
OR2001600	16.00	0.24	2.00	
OR2001700	17.00	0.24	2.00	
OR2001800	18.00	0.25	2.00	
OR2001900	19.00	0.26	2.00	
OR2002000	20.00	0.26	2.00	
OR2002100	21.00	0.27	2.00	
OR2002200	22.00	0.28	2.00	
OR2002300	23.00	0.29	2.00	
OR2002400	24.00	0.29	2.00	
OR2002600	26.00	0.31	2.00	
OR2002700	27.00	0.32	2.00	
OR2003100	31.00	0.34	2.00	
OR2003200	32.00	0.35	2.00	

TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR2003300	33.00	0.36	2.00	0.08
OR2003500	35.00	0.37	2.00	
OR2003600	36.00	0.38	2.00	
OR2003800	38.00	0.40	2.00	
OR2004000	40.00	0.41	2.00	
OR2004200	42.00	0.42	2.00	
OR2004400	44.00	0.44	2.00	
OR2004500	45.00	0.44	2.00	
OR2004600	46.00	0.45	2.00	
OR2004700	47.00	0.46	2.00	
OR2004800	48.00	0.47	2.00	
OR2005000	50.00	0.48	2.00	
OR2005200	52.00	0.49	2.00	
OR2006000	60.00	0.55	2.00	
OR2006200	62.00	0.56	2.00	
OR2007000	70.00	0.62	2.00	
OR2007600	76.00	0.66	2.00	
OR2008000	80.00	0.69	2.00	
OR2008300	83.00	0.71	2.00	
OR2008500	85.00	0.72	2.00	
OR2009000	90.00	0.76	2.00	
OR2009500	95.00	0.79	2.00	
OR2010500	105.00	0.86	2.00	
OR2011000	110.00	0.89	2.00	
OR2012800	128.00	1.01	2.00	
OR2101540	15.40	0.23	2.10	0.08
OR2101940	19.40	0.26	2.10	
OR2200930	9.30	0.18	2.20	0.08
OR2201130	11.30	0.20	2.20	
OR2201330	13.30	0.22	2.20	
OR2201530	15.30	0.23	2.20	
OR2201930	19.30	0.26	2.20	
OR2401460	14.60	0.22	2.40	0.09
OR2401930	19.30	0.26	2.40	
OR2402030	20.30	0.27	2.40	
OR2402130	21.30	0.27	2.40	
OR2402230	22.30	0.28	2.40	
OR2402330	23.30	0.29	2.40	



TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR2402530	25.30	0.30	2.40	0.09
OR2402730	27.30	0.32	2.40	
OR2500700	7.00	0.17	2.50	0.09
OR2500900	9.00	0.18	2.50	
OR2501000	10.00	0.19	2.50	
OR2501100	11.00	0.20	2.50	
OR2501200	12.00	0.21	2.50	
OR2501400	14.00	0.22	2.50	
OR2501500	15.00	0.23	2.50	
OR2501700	17.00	0.24	2.50	
OR2501800	18.00	0.25	2.50	
OR2501900	19.00	0.26	2.50	
OR2502200	22.00	0.28	2.50	
OR2502400	24.00	0.29	2.50	
OR2502500	25.00	0.30	2.50	
OR2502700	27.00	0.32	2.50	
OR2502800	28.00	0.32	2.50	
OR2502900	29.00	0.33	2.50	
OR2503000	30.00	0.34	2.50	
OR2503200	32.00	0.35	2.50	
OR2503300	33.00	0.36	2.50	
OR2503400	34.00	0.37	2.50	
OR2503600	36.00	0.38	2.50	
OR2503800	38.00	0.40	2.50	
OR2504000	40.00	0.41	2.50	
OR2504200	42.00	0.42	2.50	
OR2504500	45.00	0.44	2.50	
OR2504600	46.00	0.45	2.50	
OR2505000	50.00	0.48	2.50	
OR2505500	55.00	0.52	2.50	
OR2505700	57.00	0.53	2.50	
OR2506500	65.00	0.58	2.50	
OR2507000	70.00	0.62	2.50	
OR2507200	72.00	0.63	2.50	
OR2508000	80.00	0.69	2.50	
OR2701050	10.50	0.19	2.70	0.09
OR2802370	23.70	0.29	2.80	0.09

TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR3000800	8.00	0.17	3.00	0.09
OR3000900	9.00	0.18	3.00	
OR3000950	9.50	0.19	3.00	
OR3001000	10.00	0.19	3.00	
OR3001100	11.00	0.20	3.00	
OR3001200	12.00	0.21	3.00	
OR3001400	14.00	0.22	3.00	
OR3001600	16.00	0.24	3.00	
OR3001800	18.00	0.25	3.00	
OR3002000	20.00	0.26	3.00	
OR3002100	21.00	0.27	3.00	
OR3002150	21.50	0.28	3.00	
OR3002200	22.00	0.28	3.00	
OR3002300	23.00	0.29	3.00	
OR3002400	24.00	0.29	3.00	
OR3002500	25.00	0.30	3.00	
OR3002600	26.00	0.31	3.00	
OR3002800	28.00	0.32	3.00	
OR3002900	29.00	0.33	3.00	
OR3003000	30.00	0.34	3.00	
OR3003200	32.00	0.35	3.00	
OR3003250	32.50	0.36	3.00	
OR3003400	34.00	0.37	3.00	
OR3003700	37.00	0.39	3.00	
OR3003800	38.00	0.40	3.00	
OR3003900	39.00	0.40	3.00	
OR3004000	40.00	0.41	3.00	
OR3004100	41.00	0.42	3.00	
OR3004300	43.00	0.43	3.00	
OR3004400	44.00	0.44	3.00	
OR3004500	45.00	0.44	3.00	
OR3004600	46.00	0.45	3.00	
OR3004800	48.00	0.47	3.00	
OR3004900	49.00	0.47	3.00	
OR3005000	50.00	0.48	3.00	
OR3005200	52.00	0.49	3.00	
OR3005400	54.00	0.51	3.00	
OR3005500	55.00	0.52	3.00	
OR3005700	57.00	0.53	3.00	
OR3005800	58.00	0.54	3.00	



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TSS Part-No.	Inside-Ø		Cross section	
	d ₁	Tolerance ±	d ₂	Tolerance ±
OR3005900	59.00	0.54	3.00	0.09
OR3006000	60.00	0.55	3.00	
OR3006200	62.00	0.56	3.00	
OR3006300	63.00	0.57	3.00	
OR3006500	65.00	0.58	3.00	
OR3006900	69.00	0.61	3.00	
OR3007000	70.00	0.62	3.00	
OR3007500	75.00	0.65	3.00	
OR3009000	90.00	0.76	3.00	
OR3009600	96.00	0.80	3.00	
OR3010000	100.00	0.82	3.00	
OR3010500	105.00	0.86	3.00	
OR3011000	110.00	0.89	3.00	
OR3011500	115.00	0.93	3.00	
OR3012000	120.00	0.96	3.00	
OR3013200	132.00	1.04	3.00	
OR3013500	135.00	1.06	3.00	
OR3014000	140.00	1.09	3.00	
OR3016000	160.00	1.23	3.00	
OR3020000	200.00	1.49	3.00	
OR3501000	10.00	0.19	3.50	0.10
OR3501300	13.00	0.21	3.50	
OR3501600	16.00	0.24	3.50	
OR4003000	30.00	0.34	4.00	0.10
OR4004000	40.00	0.41	4.00	
OR4004200	42.00	0.42	4.00	
OR4005000	50.00	0.48	4.00	
OR4006000	60.00	0.55	4.00	
OR4007200	72.00	0.63	4.00	
OR5010000	100.00	0.82	5.00	0.13



C.3 O-Ring seal sets

The rapid availability of spare parts is very important during the servicing maintenance and repair of machines and equipment.

We offer a variety of standard ranges which are supplied in sturdy cases as a set with foam inlays.

Table 28 O-Ring Set, Type A

390 O-Rings in 24 different sizes according to ISO 3601-1 / AS 568			
TSS Article No. ORSETAASS-N7		(NBR 70)	
Quantity	Dimensions (mm)	Quantity	Dimensions (mm)
30	2.90 x 1.78	10	18.77 x 1.78
30	3.69 x 1.78	15	9.20 x 2.62
30	4.47 x 1.78	15	10.78 x 2.62
30	5.28 x 1.78	15	12.37 x 2.62
30	6.07 x 1.78	10	17.12 x 2.62
30	7.65 x 1.78	10	18.72 x 2.62
30	9.25 x 1.78	10	20.30 x 2.62
20	10.82 x 1.78	5	18.64 x 3.53
20	12.42 x 1.78	5	20.22 x 3.53
10	14.00 x 1.78	5	21.82 x 3.53
10	15.60 x 1.78	5	23.38 x 3.53
10	17.17 x 1.78	5	24.99 x 3.53

Table 30 O-Ring Set, Type B

295 O-Rings in 24 different sizes according to ISO 3601-1 / AS 568			
TSS Article No. ORSETBASS-N7		(NBR 70)	
Quantity	Dimensions (mm)	Quantity	Dimensions (mm)
15	20.35 x 1.78	15	34.52 x 3.53
15	21.95 x 1.78	10	36.09 x 3.53
15	25.07 x 2.62	10	37.69 x 3.53
15	26.64 x 2.62	10	40.87 x 3.53
15	28.24 x 2.62	10	44.04 x 3.53
15	29.82 x 2.62	10	47.22 x 3.53
15	31.42 x 2.62	10	50.39 x 3.53
15	32.99 x 2.62	10	37.47 x 5.33
15	34.59 x 2.62	10	40.64 x 5.33
15	29.74 x 3.53	10	43.82 x 5.33
15	31.34 x 3.53	5	46.99 x 5.33
15	32.92 x 3.53	5	50.17 x 5.33

Table 29 O-Ring Set, Type C

380 O-Rings in 24 different sizes, common metric sizes			
TSS Article No. ORSETCMET-N7		(NBR 70)	
Quantity	Dimensions (mm)	Quantity	Dimensions (mm)
20	4.00 x 2.00	15	10.30 x 2.40
20	6.00 x 2.00	15	11.20 x 2.40
20	8.00 x 2.00	15	12.30 x 2.40
20	10.00 x 2.00	15	13.30 x 2.40
20	12.00 x 2.00	15	14.30 x 2.40
20	3.30 x 2.40	10	10.00 x 3.00
20	4.30 x 2.40	10	12.00 x 3.00
20	5.30 x 2.40	10	14.00 x 3.00
20	6.30 x 2.40	10	16.00 x 3.00
20	7.30 x 2.40	10	18.00 x 3.00
20	8.30 x 2.40	10	19.20 x 3.00
20	9.20 x 2.40	5	20.00 x 3.00

Table 31 O-Ring Set, Type D

295 O-Rings in 24 different sizes, common metric sizes			
TSS Article No. ORSETDMET-N7		(NBR 70)	
Quantity	Dimensions (mm)	Quantity	Dimensions (mm)
15	18.00 x 2.00	15	35.00 x 4.00
15	20.00 x 2.00	15	38.00 x 4.00
15	25.00 x 3.00	15	40.00 x 4.00
15	26.20 x 3.00	10	42.00 x 4.00
15	28.00 x 3.00	10	45.00 x 4.00
15	29.20 x 3.00	10	46.00 x 4.00
15	32.20 x 3.00	10	48.00 x 4.00
15	34.20 x 3.00	10	35.00 x 5.00
15	36.20 x 3.00	10	40.00 x 5.00
15	30.00 x 4.00	10	45.00 x 5.00
15	32.00 x 4.00	5	48.00 x 5.00
15	34.00 x 4.00	5	50.00 x 5.00



D Special O-Rings

D.1 Isolast® (FFKM) O-Rings

Information about our Isolast® (FFKM) O-Rings are available either in our special Isolast® brochure or through your local Trelleborg Sealing Solutions company.

D.2 FEP/PFA encapsulated O-Rings

FEP/PFA encapsulated O-Rings consist of an elastomer inner ring and a seamless FEP/PFA sheath which surrounds the elastomer ring.

Similar to PTFE O-Rings FEP/PFA encapsulated O-Rings are used wherever the chemical resistance of normal elastomer O-Rings are not sufficient.

The required elasticity is provided by the elastomer ring, the chemical resistance by the seamless FEP/PFA sheath.

Advantages

- Very good chemical resistance to most liquids and chemicals, with the exception of liquid alkaline metals and some fluorine compounds
- Temperature application range from approx. -60 °C up to +200 °C (depending on the material for the inner ring)
- Can be used with foodstuffs, pharmaceutical and medicinal products
- Physiologically safe and can be sterilised
- Low friction, no adhesion or stick-slip effect
- Adequate elastic behaviour for improved sealability.

Versions

Standard versions:	Elastomer O-Ring with FEP sheath
Special versions:	Hollow elastomer ring with FEP sheath
	Elastomer O-Ring with PFA sheath

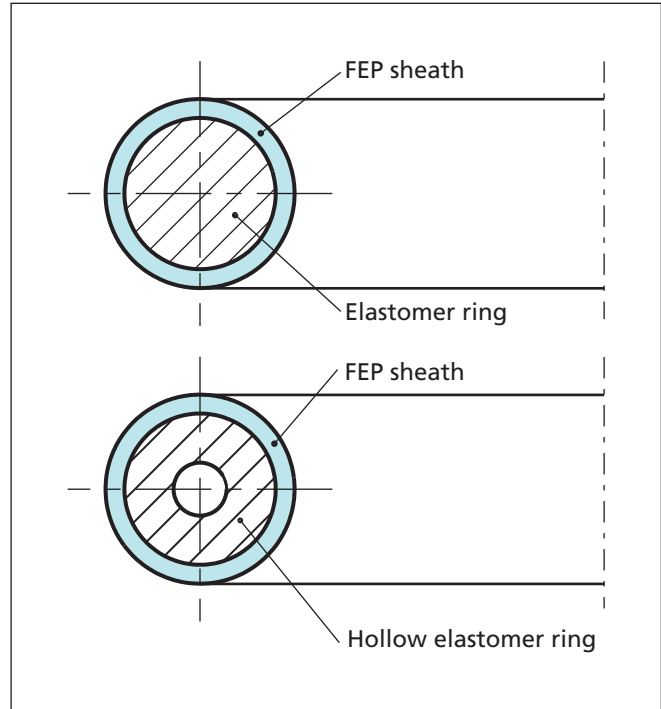


Figure 36 Different versions of FEP/PFA O-Ring

Applications

Fields of application

FEP encapsulated O-Rings are ideally suited for use in the chemical, petrochemicals, medical technology, foodstuffs, water, sewage and similar sectors of industry. A typical application for FEP encapsulated O-Rings is the sealing of valve spindles and as secondary sealing elements for mechanical seals.

FEP encapsulated O-Rings are used primarily as static seals. They are also suitable for use as sealing elements for slow switching and rotary movements.

Technical data

Working pressure:	up to 25 MPa
Temperature:	-60 °C up to +200 °C - depending on the elastomer material
Media:	Practically all liquids, gases and chemicals



Materials

FEP sheath

FEP is the abbreviated designation for Tetrafluoroethylene-hexafluoropropylene. This material has similar properties to those of Polytetrafluoroethylene (PTFE). It also has a very high chemical resistance and exhibits a good resistance to abrasion.

In contrast to PTFE, however, FEP is thermoplastically moldable. This allows the material to be processed to form flexible semifinished products, such as thin-walled hoses.

PFA sheath

PFA is the abbreviation for Perfluoralkoxy. This material is a type of Fluoropolymer with properties similar to Polytetrafluoroethylene (PTFE). Differing from PTFE, like FEP, PFA it is melt-processable but shares PTFE's useful properties of low coefficient of friction and non-reactivity.

PFA is preferable to FEP in high temperature situations. PFA is more affected by water absorption and weathering than FEP, but is superior in terms of salt spray resistance.

Inner ring

A choice of three materials is available for the elastomer inner rings with FEP encapsulation and two materials for the inner ring with PFA encapsulation. The choice of the material also determines the service temperature range.

- Fluorocarbon rubber (FKM),
temperature range -20 °C up to +200 °C
material code with FEP sheath: VZ00R
material code with PFA sheath: VZ01R
- Silicone Rubber (VMQ),
temperature range: -50 °C up to +175 °C
material code with FEP sheath: SZ00R
material code with PFA sheath: SZ01R
- Ethylene Propylen Dien Rubber,
temperature range: -45 °C up to +150 °C
material code with FEP sheath: EZ00R

The specified temperature ranges are limits which must always be considered in conjunction with the medium to be sealed and the working pressure. The permissible continuous operating temperatures are always lower than the given upper limits.

Design recommendations

FEP encapsulated O-Rings are fully interchangeable with standard O-Ring seals. There is no need to modify the groove dimensions. The FEP sheath is relatively thin-walled.

All the specifications given in this catalogue therefore refer to the installation dimensions of elastomer O-Rings.

As a result of the FEP sheath, the O-Rings are less flexible than elastomer O-Rings. They have limited stretch and higher permanent deformation.

Split grooves are recommended, especially for outside sealing FEP encapsulated O-Rings, in order to avoid overstretching during installation.

The general information on the construction, design and surfaces given for the elastomer O-Rings applies also to FEP encapsulated O-Rings.

At higher pressures, additional concave Back-up Rings should be used.

Application in gases

Where the O-Ring is used to seal gases, the permeation rate must be taken into consideration. In this case the material of the inner ring must also have a good resistance to the medium to be sealed. The permeation rate depends on the exposed surface area, the temperature, the working pressure and the thickness of the FEP sheath.

The thickness of the FEP sheath can be found in Table 32.

Compliances and approvals

The FEP-sheath of material VZ00R, SZ00R and EZ00R is in compliance with the following regulations governing plastic materials for food contact applications:

- Commission Directive 2002/72/EC and amendments 2004/1/EC, 2004/19/EC 2005/79/EC, 2007/19/EC, 2008/39/EC, Reg. (EC) 975/2009
- Requirement of the German Food and Feed Code, LFGB and regulation (EC) 1935/2004, article 5

OML (Overall Migration Limits):

Migration testing was done according to 82/711/EEC and 85/572/EEC and amendments. The OML was below the required limit of 10 mg/dm² in aqueous, acidic and fatty food in repeated contact.

Sensory Tests:

The material meets the requirements of the LFGB and Regulation (EC) 1935/2004 for aqueous, acidic and fatty food in repeated contact. Test condition: 30 min at 95 °C. Surface volume ratio: 30 cm²/1000 ml.

Both the FEP and the PFA sheath are also in compliance with the FDA Regulation 21 CFR Part 177.1550.

Table 32 Thickness of the FEP and PFA sheath

O-Ring		Thickness of the FEP/PFA Sheath
Cross section d ₂	Tolerance ±	
1.78 1.80	0.10	0.20
2.62 2.65	0.10	0.30
3.53 3.55	0.12	0.38
5.34 5.30	0.25	0.50
7.00	0.38	0.50



The diagram (Figure 37) gives guide values for the permeation of different gases.

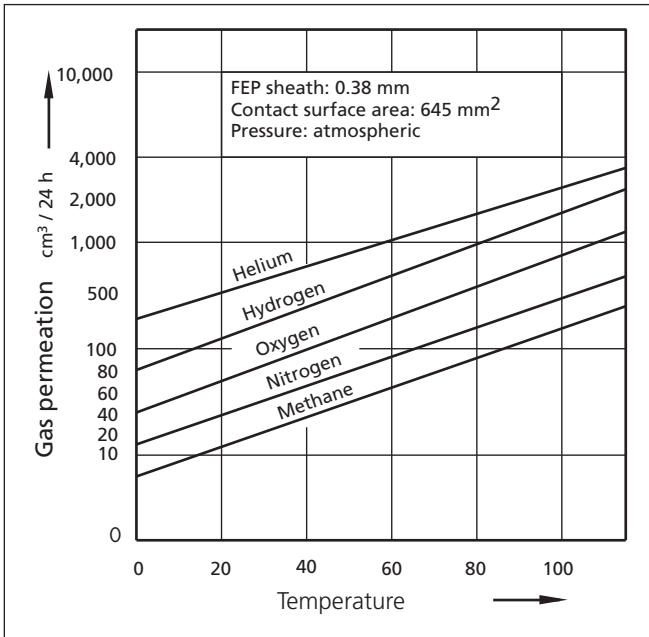


Figure 37 Gas permeation rates for FEP O-Rings

The diagram (Figure 38) gives guide values for the permeation of water vapour.

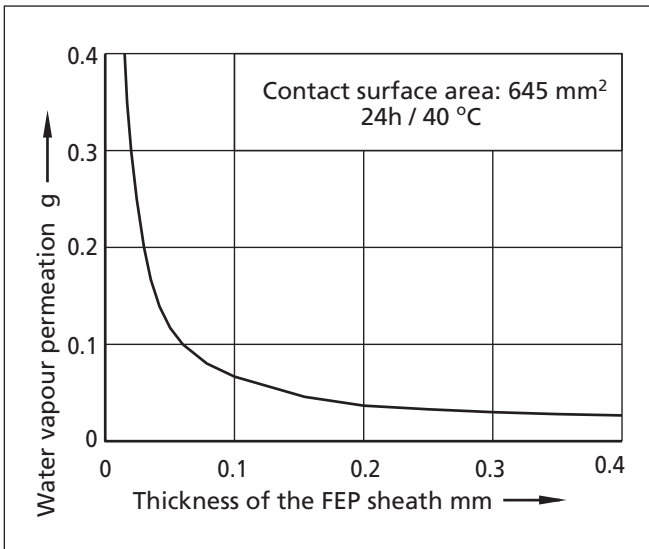


Figure 38 Water vapour permeation for FEP O-Rings

Methods of installation

The same recommendations apply to the installation of FEP/PFA encapsulated O-Rings as for standard elastomer O-Rings. It should be noted, however, that the O-Rings have only limited stretch due to the FEP/PFA sheath.

If, for design reasons, a split groove is not possible, auxiliary tools must be used for installation.

For inside sealing applications (e.g. rod), FEP/PFA encapsulated O-Rings can be installed with larger diameters without tools. On no account should the seal ring be forced into the groove (e. g. by bending), otherwise the sealing function cannot be assured.

Dimensions

FEP/PFA encapsulated O-Rings are available in the same sizes as the elastomer O-Rings. Table 34 shows the smallest available inside diameters for the different cord diameters.

Table 33 Tolerances inside diameter (d_1)

Inside diameter d_1	Tolerance \pm
$d_1 > 7.64$	not available
$7.64 \leq d_1 \leq 30.00$	0.25
$30.00 < d_1 \leq 130.00$	0.38
$130.00 < d_1 \leq 170.00$	0.51
$170.00 < d_1 \leq 380.00$	0.64
$380.00 < d_1 \leq 650.00$	0.76
$650.00 < d_1 \leq 1000.00$	1.52
$d_1 > 1000.00$	on request

Table 34 Smallest available sizes and cross section tolerances

O-Ring		Minimum inside diameter d_2
Cross section d_2	Tolerance \pm	
1.60	0.10	7.60
1.78		7.64
2.00		8.00
2.40		9.30
2.50		10.00
2.62		9.19
2.80		10.50
3.00	0.13	10.00
3.10		10.00
3.20		12.00
3.53		12.00
3.75		12.00
		12.00



O-Ring		Minimum inside diameter d_2	
Cross section d_2	Tolerance \pm		
4.00	0.25	12.00	
4.20		15.00	
4.50		15.00	
4.70		18.00	
5.00		18.00	
5.33		18.42	
5.50		30.00	
5.70		30.00	
6.00		30.00	
6.30		41.00	
6.50	0.38	41.00	
7.00		41.00	
7.50		101.60	
8.00		70.00	
8.40		102.00	
9.00		0.51	102.00
9.50			102.00
10.00			108.00
10.50			127.00
11.00			127.00
12.00	152.40		
12.70	177.80		
13.00	254.00		
14.00	254.00		
15.00	254.00		
16.00	305.00		
18.00	422.00		
19.00	422.00		
20.00	508.00		

Ordering example

O-Ring, PFA encapsulated
 ISO 3601 resp. AS 568 reference no. 356
 Dimensions: Inside diameter $d_1 = 135.89$ mm
 Cross section $d_2 = 5.33$ mm

Material of the inner ring: Fluorocarbon Rubber (FKM)

TSS Article No.	O FAR00356	-	VZ01R
TSS Part No.			
Quality Index (Standard)			
Material Code (Standard)			

O-Ring dimensions and TSS Part No. see Tables 20-27, pages 58-72.

Housing dimensions, see Table 15, page 46.

Ordering can also be made according to O-Ring dimensions and material.

Ordering example

O-Ring 30 x 3, FEP encapsulated

Dimensions: Inside diameter $d_1 = 30.0$ mm
 Cross section $d_2 = 3.0$ mm

Material of the inner ring: Silicone Rubber (VMQ)

TSS Article No.	OF3003000	-	SZ00R
TSS Part No.			
Quality Index (Standard)			
Material Code (Standard)			



D.3 PTFE O-Rings

O-Rings in Polytetrafluoroethylene (PTFE) are closed, circular rings with annular cross section. The dimensions are - as with the elastomer O-Ring - characterised by the inside diameter d_1 and the cord diameter d_2 (Figure 39). PTFE O-Rings are not molded but produced by machining. The rings can therefore be manufactured in all sizes.

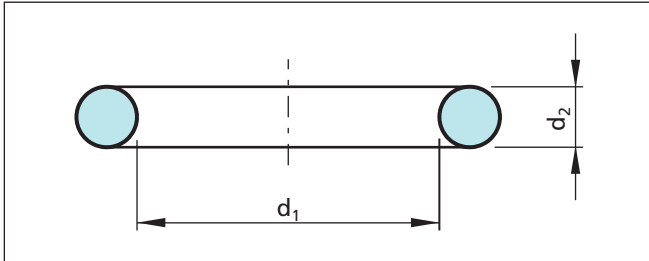


Figure 39 O-Ring dimensions

Advantages

- Very good chemical resistance, compatible with most liquids and chemicals, with the exception of liquid alkaline metals and some fluorine compounds.
- Wide temperature range from approx. -200 °C up to +260 °C
- Suitable for contact with foodstuffs, pharmaceutical and medicinal products
- Physiologically safe, can be sterilised
- Low friction, no adhesion
- Available for all diameters up to approx. 1,000 mm.

Applications

Fields of application

PTFE O-Rings are used wherever the chemical and thermal resistance of the normal elastomer O-Rings is no longer sufficient. These are primarily applications in the chemical industry, foodstuffs industry, pharmaceuticals and medical technology. PTFE O-Rings are used only as static seals, e.g. on flange connections, on covers, etc.

Technical data

Working pressure:	Up to 25 MPa
Temperature:	-60 °C up to +200 °C - depending on the elastomer material
Media:	Practically all liquids, gases and chemicals

Materials

Standard material: Virgin, unfilled PTFE (polytetrafluoroethylene), Material Code PT00

PTFE is a partially crystalline thermoplastic characterised by a very high chemical and thermal resistance. PTFE has the highest resistance to chemicals of all plastics and can be used for almost any application. It has a slightly limited resistance to molten alkaline metals, to elementary fluorine and to certain halogen materials.

The material undergoes no changes on exposure to ageing, light and ozone. The water absorption rate is less than 0.01 %.

Design recommendations

PTFE O-Rings have low elasticity. The O-Ring size should therefore be chosen to suit the nominal diameter (rod or bore) to be sealed. Installation in axial easily accessible and radial split grooves is to be preferred.

The general information on the construction, design and surfaces given for the elastomer O-Rings applies also to PTFE O-Rings.

Methods of installation

PTFE O-Ring can only be stretched or compressed to a very limited extent during installation.

During installation, e.g. on flanges, the cold flow tendency of the thermoplastic PTFE should be taken into consideration. Under pressure, PTFE deforms plastically also in the cold state, i.e. a permanent deformation takes place. If flange seals are not tightened sufficiently to give metal/metal contact, the elastic deformation and thus the elastic tension can deteriorate.

Installation recommendations

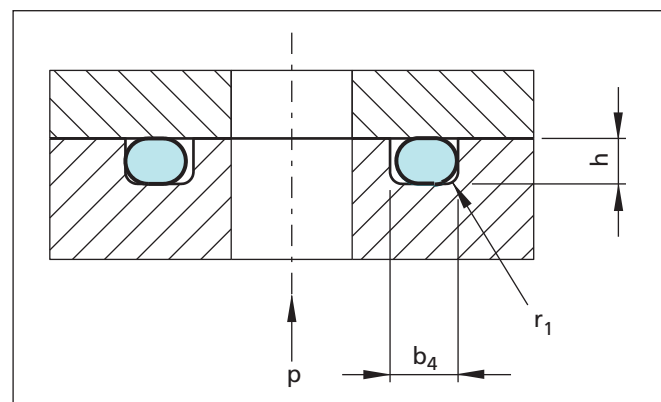


Figure 40 Axial installation, static, inside pressure



Table 35 Installation dimensions

Cross section d_2	Groove dimensions		Radius r_1
	Groove depth $h +0.05$	Groove width $b_4 +0.1$	
1.50	1.30	1.7	0.2
1.60	1.40	1.8	0.3
1.78 1.80	1.60	2.0	0.4
2.00	1.80	2.2	0.5
2.40	2.15	2.6	0.5
2.50	2.25	2.8	0.5
2.62 2.65	2.35	2.9	0.6
3.00	2.70	3.3	0.8
3.53 3.55	3.15	3.9	1.0
4.00	3.60	4.4	1.0
5.00	4.50	5.5	1.0
5.33 5.30	4.80	5.9	1.2
5.70	5.10	6.3	1.2
6.00	5.60	6.6	1.2
7.00	6.30	7.7	1.5
8.00	7.20	8.8	1.5
8.40	7.55	9.2	2.0

Available dimensions

PTFE O-Rings are available in the same dimensions as the elastomer O-Rings. See O-Ring dimensions, Tables 20-27, pages 58-72.

Ordering Example

O-Ring, 40 x 3

Dimensions: Inside diameter $d_1 = 40.0$ mm
 Cross section $d_2 = 3.0$ mm

O-Ring dimensions and TSS Part No. see Tables 20-27, pages 58-72.

Ordering can also be made according to O-Ring dimensions and material.

TSS Article No.	OR3004000	-	PT00
TSS Part No.			
Quality Index (Standard)			
Material Code (Standard)			

D.4 Polyurethane O-Rings

Polyurethane is becoming more and more widely used as a sealing material due to its exceptionally high abrasion resistance and high extrusion resistance.

The polyurethane materials from Trelleborg Sealing Solutions have a number of improved properties.

Polyurethane is therefore an ideal material for O-Rings and sealing elements.

The outstanding properties of the materials play a major role particularly in our Zurcon® materials.

Polyurethane O-Rings are available in dimensions to American Standard AS 568 (see dimension list, Table 36, page 80).

The dimensions are given with the inside diameter " d_1 " and the cord diameter " d_2 " (Figure 41, page 80).

Advantages

The main advantages of a polyurethane material for O-Rings compared with other elastomer are the outstanding mechanical properties:

- High abrasion and wear resistance tolerates aggressive operating conditions
- High extrusion resistance allows increased pressures or extrusion gaps
- Good mechanical properties improve service life
- Low friction reduces breakout forces on start up

Applications

Fields of application

Polyurethane O-Rings are especially suited wherever O-Rings are subject to dynamic loads.

This includes for example, applications in hydraulics, pneumatics and in a wide range of other critical areas. In many cases, polyurethane O-Rings are used instead of NBR in view of their high mechanical strengths.

Due to their particularly high abrasion resistance, polyurethane O-Rings are more suitable than other materials in applications where bores have to be crossed or where frequent opening and closing is demanded, e.g. plug connectors and couplings.

Polyurethane O-Rings in 70 Shore A hardness material WU7TI can, with advance, be used in applications such as pneumatics where low compression set and low friction are essential.



Technical data

Working pressure:	Static up to approx. 60 MPa without Back-up Ring (depending on the extrusion gap) Dynamic up to 25 MPa
Speed:	Reciprocating up to 0.2 m/s
Temperature:	-45 °C up to +100 °C depending on the material
Media:	Hydraulic fluids and mineral oil-based greases and air.

Materials

The most important characteristics of these polyurethanes are:

- High tensile strength
- Low compression set
- Very good cold flexibility
- Constant shear modulus even at high temperatures
- Resistant to weathering and ageing
- High damping properties
- Low gas permeability
- Good hydrolysis resistance
- High tear propagation resistance
- Free from substances which hinder paint coverage

Polyurethane materials are resistant in:
Mineral oils and greases, oxygen, ozone.

Polyurethane compounds are not resistant in:
Esters, aromatic and chlorinated hydrocarbons, concentrated acids and lyes.

Polyurethane O-Rings are available on request in the following grades:

Polyurethane, 70 Shore A
Material code WU7T1

Polyurethane, 92 Shore A
Material code WU9T2

Polyurethane, 93 Shore A, Zurcon®:
Material code Z22 and Z24

Polyurethane, 94 Shore A, Zurcon®:
Material code Z20

Depending on the production method Zurcon® O-Rings can have an injection point on the inside diameter. This marking is placed at a 45° angle from the flash.

Design instructions

The same design rules apply to polyurethane O-Rings as to other elastomer O-Rings, i.e. the same installation dimensions (groove depth, groove width), see Table 15, page 46.

Radial clearance

In view of the high extrusion resistance of polyurethane, larger clearances can be bridged with polyurethane O-Rings than with other elastomers, without the additional installation of Back-up Rings.

The permissible radial clearance is depending on the used material, on the O-Ring cross section and on the application properties, e. g. the temperature.

O-Ring dimensions

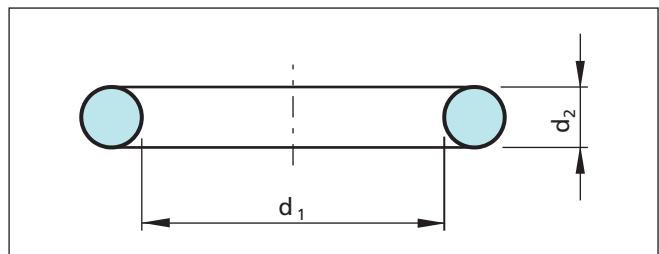


Figure 41 O-Ring dimensions

Table 36 Dimensions according to ISO 3601-1 / AS 568 (Further sizes on request)

TSS Part No.	Inside-Ø d_1	Cross section d_2
ORAR00005	2.57	1.78
ORAR00006	2.90	1.78
ORAR00008	4.47	1.78
ORAR00009	5.28	1.78
ORAR00010	6.07	1.78
ORAR00011	7.65	1.78
ORAR00012	9.25	1.78
ORAR00013	10.82	1.78
ORAR00014	12.42	1.78
ORAR00015	14.00	1.78
ORAR00017	17.17	1.78
ORAR00018	18.77	1.78
ORAR00019	20.35	1.78
ORAR00020	21.95	1.78
ORAR00022	25.12	1.78
ORAR00023	26.70	1.78
ORAR00025	29.87	1.78



TSS Part No.	Inside-Ø d ₁	Cross section d ₂
ORAR00027	33.05	1.78
ORAR00029	37.82	1.78
ORAR00034	53.70	1.78
ORAR00036	60.05	1.78
ORAR00039	69.57	1.78
ORAR00040	72.75	1.78
ORAR00041	75.92	1.78
ORAR00045	101.32	1.78
ORAR00046	107.67	1.78
ORAR00047	114.02	1.78
ORAR00050	133.07	1.78
ORAR00110	9.19	2.62
ORAR00111	10.77	2.62
ORAR00112	12.37	2.62
ORAR00113	13.94	2.62
ORAR00114	15.54	2.62
ORAR00115	17.12	2.62
ORAR00116	18.72	2.62
ORAR00117	20.29	2.62
ORAR00118	21.89	2.62
ORAR00119	23.47	2.62
ORAR00120	25.07	2.62
ORAR00122	28.24	2.62
ORAR00124	31.42	2.62
ORAR00125	32.99	2.62
ORAR00126	34.59	2.62
ORAR00127	36.17	2.62
ORAR00128	37.77	2.62
ORAR00129	39.34	2.62
ORAR00132	44.12	2.62
ORAR00133	45.69	2.62
ORAR00134	47.29	2.62
ORAR00135	48.90	2.62
ORAR00136	50.47	2.62
ORAR00137	52.07	2.62
ORAR00138	53.64	2.62
ORAR00141	58.42	2.62
ORAR00142	59.99	2.62
ORAR00145	64.77	2.62
ORAR00146	66.34	2.62
ORAR00147	67.95	2.62

TSS Part No.	Inside-Ø d ₁	Cross section d ₂
ORAR00210	18.64	3.53
ORAR00211	20.22	3.53
ORAR00213	23.39	3.53
ORAR00214	24.99	3.53
ORAR00215	26.57	3.53
ORAR00216	28.17	3.53
ORAR00217	29.74	3.53
ORAR00218	31.34	3.53
ORAR00220	34.52	3.53
ORAR00222	37.69	3.53
ORAR00224	44.04	3.53
ORAR00225	47.22	3.53
ORAR00226	50.39	3.53
ORAR00227	53.57	3.53
ORAR00228	56.74	3.53
ORAR00229	59.92	3.53
ORAR00230	63.09	3.53
ORAR00231	66.27	3.53
ORAR00232	69.44	3.53
ORAR00234	75.79	3.53
ORAR00235	78.97	3.53
ORAR00236	82.14	3.53
ORAR00237	85.32	3.53
ORAR00238	88.49	3.53
ORAR00239	91.67	3.53
ORAR00240	94.84	3.53
ORAR00325	37.47	5.33
ORAR00326	40.64	5.33
ORAR00327	43.82	5.33
ORAR00328	46.99	5.33
ORAR00329	50.17	5.33
ORAR00330	53.34	5.33
ORAR00331	56.52	5.33
ORAR00332	59.69	5.33
ORAR00334	66.04	5.33
ORAR00336	72.39	5.33
ORAR00337	75.57	5.33
ORAR00338	78.74	5.33
ORAR00339	81.92	5.33
ORAR00340	85.09	5.33

Tolerances based on ISO 3601-1, class B. See Table 16 and 17, pages 50-51.



Ordering Example

O-Ring, ISO 3601 resp. AS 568, ref. 214

Dimensions: Inside diameter $d_1 = 30.0$ mm
Cross section $d_2 = 3.0$ mm

Material: Polyurethane (AU 70 Shore A)

O-Ring dimensions and TSS Part No. see Table 36.

Installation dimensions, see Table 15, page 46.

Ordering can also be made according to O-Ring dimensions and material.

TSS Article No.	ORAR00214	-	WU7T1
TSS Part No.			
Quality Index (Standard)			
Material code (Standard)			

D.5 Fleximold™ O-Rings - large dimensions

Trelleborg Sealing Solutions has developed a new proprietary manufacturing technology, FlexiMold™ that allows the manufacture of large, high quality O-Rings without the lead time and cost associated with dedicated tooling.

Compared to conventional techniques such as the splicing of extruded cord, the FlexiMold™ process ensures full visual and dimensional integrity. It also gives the circular form stability of a molded O-Ring, along with its intended thermal and chemical resistance capability.

Large O-Rings are used across all process industries including Chemical and Hydrocarbon, Pharmaceutical, Food & Beverage, the Electronics industry, in particular the production of flat panel displays applications.

Features

- Infinite diameter capability
- No tooling charges for standard cross sections
- High quality, tight tolerances
- Full performance integrity of an O-Ring
- Available in many elastomer types

Materials

- Isolast® FFKM
- Resifluor™ High Performance Fluoroelastomers
- FKM, EPDM, HNBR and others
- FDA, USP Class VI, EDR type compounds available

Dimensions

The Fleximold™ technology is recommended for O-Rings with inside diameters $d_1 > 500$ mm. The tolerances according to ISO 3601-1, class B apply for the inside diameters of Fleximold™ O-Rings.

Standard cross sections for Fleximold™ O-Rings are listed in the table below. Further cross sections are available on request. Other seal profiles may be requested.



Table 37 Available standard cross sections and valid tolerances according to ISO 3601-1, class B, table A.1

Cross section	
d_2	Tolerance \pm
3.00	0.09
3.10	0.09
3.50	0.10
3.53	0.10
3.55	0.10
4.00	0.10
5.00	0.13
5.30	0.13
5.33	0.13
5.70	0.13
6.99	0.15
7.00	0.15
8.00	0.15
8.40	0.15
10.00	0.21

D.6 Round cord rings (butt vulcanized)

Round cords are produced by extrusion. They are supplied as cut lengths. The most common materials are NBR 70 Shore A, EPDM 65 Shore A and FKM 75 Shore A. Other materials are available on request.

In contrast to mold-vulcanized O-Rings, round cord rings made from continuously extruded cord can be made up to any desired diameter.

The junction point always has poorer mechanical properties than the basic material. For this reason, round cord rings should be used with caution for dynamic applications, gaseous media or vacuum.

The O-Ring tolerances according to ISO 3601-1 (resp. TBS-00024) are applicable for the inside diameter d_1 but not for the cross section d_2 . Tolerances for the cross sections see tables below.

For the use of round cord rings in high-vacuum applications it is recommendable to use FKM. In that case the joint has to be manufactured in a special high-vacuum quality and has to be ordered accordingly. Please contact your local Trelleborg Sealing Solutions company for further details.

The tolerances stated are valid for round cord rings (butt-vulcanized) only and refer to the cross section. Due to the applied pressure during the vulcanisation process the junction point can be thinner than the cord. In general this has no negative effect on the sealing function.

The article number of round cord rings starts with OV.

Table 38 Available cross sections and valid tolerances for NBR 70 Shore A

Cross section d_2	Tolerance
1.00	± 0.20
1.50	
1.78	
2.00	
2.50	
3.00	± 0.25
3.20	
3.53	
4.00	
4.75	± 0.35
5.00	
5.33	
5.70	
6.00	
6.40	± 0.40
7.00	
7.50	
8.00	
8.40	
9.00	
9.50	
10.00	
11.00	± 0.50
12.00	
12.70	
13.00	
14.00	
15.00	
16.00	
18.00	± 0.70
20.00	
22.00	
25.00	
30.00	± 0.80



Table 39 Available cross sections and valid tolerances for EPDM 70 Shore A

Cross section d ₂	Tolerance
2.00 2.50	± 0.30
3.00 3.50 4.00	± 0.35
5.00 5.30 5.70	± 0.40
6.00	± 0.45
7.00 8.00 9.00 9.50 10.00	± 0.50
11.00 12.00 13.00 14.00 15.00	± 0.70
18.00 20.00	± 0.90

Table 40 Available cross sections and valid tolerances for FKM 75 Shore A

Cross section d ₂	Tolerance
1.78 2.00	+ 0.3 / - 0.1
2.60 3.00 3.50	+ 0.3 / - 0.2
4.00 4.50 5.00 5.30 5.70 6.00	+ 0.4 / - 0.3

Cross section d ₂	Tolerance
6.50 7.00 8.00 8.40 9.00	+ 0.5 / - 0.3
10.00 11.00 12.00 14.00 15.00	+ 0.6 / - 0.4
18.00 20.00	+ 0.8 / - 0.6

D.7 O-Ring surface finishing

In many cases standard elastomeric O-Rings cannot be used without a modified surface. Friction can be one of the reasons. Also the possible contamination of the systems through extraction of material components is often not acceptable.

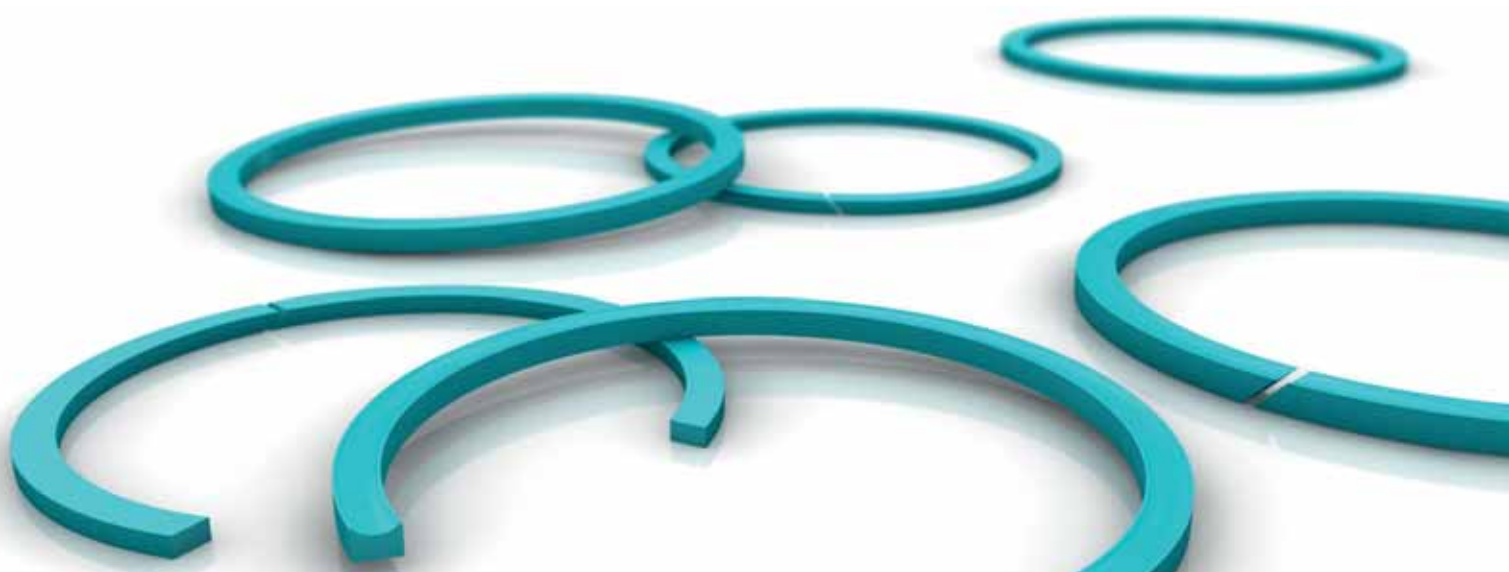
Therefore O-Rings can be surface-treated by special ways of cleaning, dipping, spraying or coating in order to reduce friction and adhesion, achieve permanent lubrication or facilitate installation.

Depending on the desired effect several high-quality surface treatments or coatings can be used.

For further details regarding surface treatments, coatings and cleaning of seals please refer to the separate brochures "Flexcoat™ – Friction-free Running" or "Flexclean™ – Technical Cleanliness for seals" or contact your local Trelleborg Sealing Solutions company.

Part II

Back-up Ring



Protective and supporting element

Static and dynamic applications, high pressure

Material:
PTFE, Elastomers and others



A General information

Back-up Rings have no intended sealing function. Instead, as their name indicates, they are protective and supporting elements made from extrusion-resistant materials which generally have a rectangular cross section. They are installed in a groove together with an elastomeric sealing element preferably with a corresponding O-Ring in static applications.

Due to the tight fit of the Back-up Ring in the housing, they prevent extrusion of the pressurised elastomeric sealing element into the sealing gap.

Application examples

- Injection molding machines
- Machine tools
- Presses
- Excavators
- Agricultural machines
- Valves for hydraulic circuits

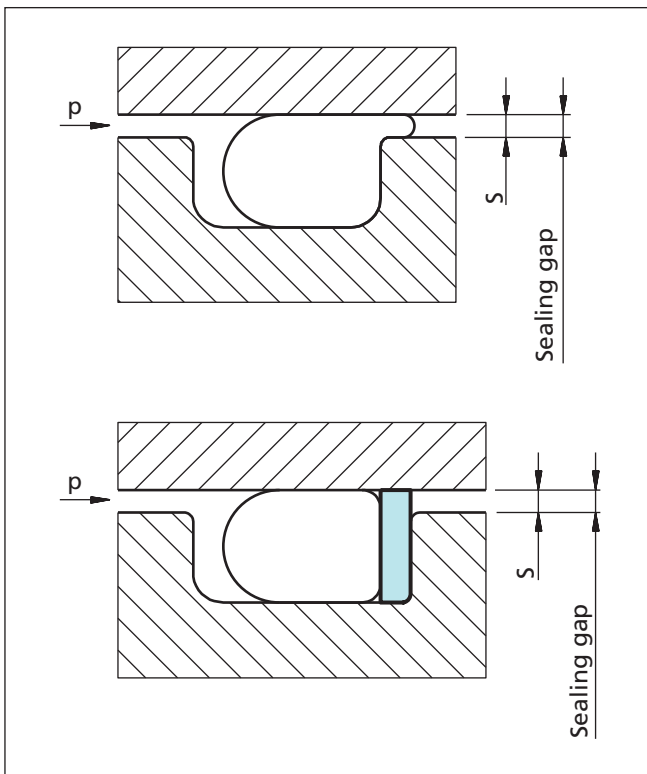


Figure 1 O-Ring installation with and without Back-up Ring

Advantages

- Use of O-Rings in high pressure applications
- Use of O-Ring materials with a low hardness
- Compensation of radial sealing gaps
- Use for internal and external sealing applications
- Reciprocating and rotating movements possible
- Compensation for large temperature fluctuations
- Static and dynamic applications



B Back-up Ring types

B.1 Overview

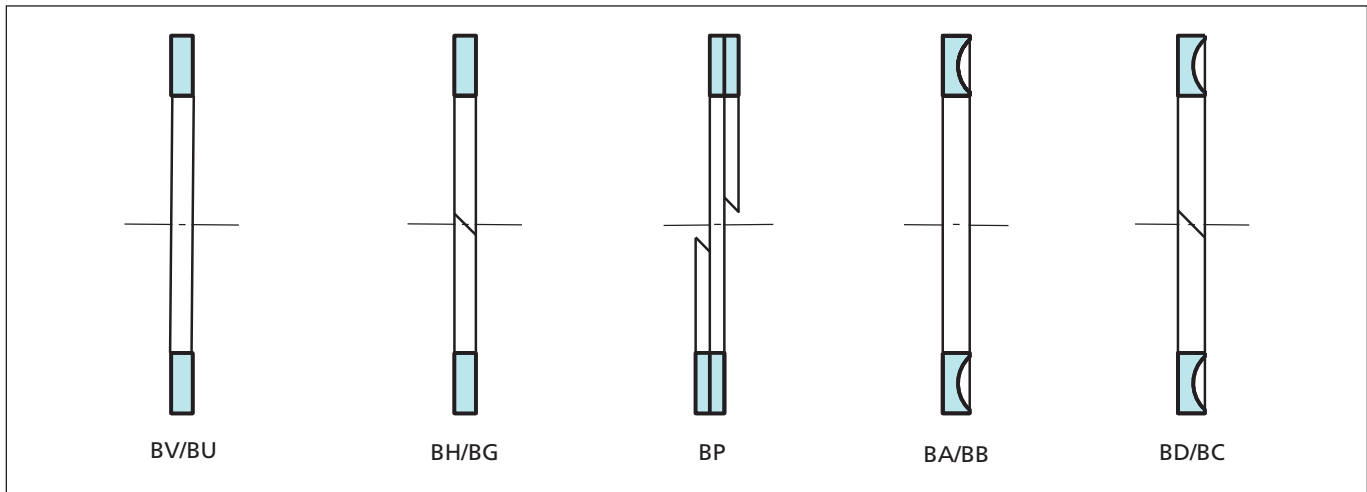


Figure 2 Back-up Ring types

External sealing (piston)

Type BV

- Rectangular, uncut, PTFE

Type BH

- Rectangular, cut, PTFE

Type BD

- Concave, cut, PTFE

Type BP

- Spiral, PTFE

Type BB

- Concave, uncut, NBR + FKM

Type BA

- Concave, uncut, PTFE

Internal sealing (rod)

Type BU

- Rectangular, uncut, PTFE

Type BG

- Rectangular, cut, PTFE

Type BC

- Concave, cut, PTFE

Type BP

- Spiral, PTFE

Type BB

- Concave, uncut, NBR + FKM + PTFE



B.2 Back-up Ring types for external sealing (piston)

Back-up Ring types, uncut

Type BV

- Rectangular cross section
- Material: PTFE
- Static and dynamic use
- Reciprocating and rotating movements possible

Type BB

- Concave cross section
- Material: NBR, FKM
- The large contact surface protects the O-Ring against deformation in case of high pulsating pressure
- Dimensional stability of the O-Ring improves the sealing force and increases the service life
- Preferably for static use
- Reciprocating movements possible

Type BA

- Concave cross section
- Material: PTFE
- The large contact surface protects the O-Ring against deformation in case of high pulsating pressure
- Dimensional stability of the O-Ring improves the sealing force and increases the service life
- Static and dynamic use
- Reciprocating and rotating movements possible

Snap-back Back-up Ring, special Type

- Easy installation in closed grooves due to the snap-back effect of the material
- The dimensions are different compared to the standard Back-up Rings. Production only on request according to drawing

Back-up Ring types, cut

Type BH

- Rectangular cross section
- Material: PTFE
- Cut angle of 30° or 45°
- Static and dynamic use
- Reciprocating and rotating movements possible
- Preferred for installations in a closed groove where uncut Back-up Rings are not suitable

Type BD

- Concave cross-section
- Material: PTFE
- Cut angle of 30° or 45°
- The large contact surface protects the O-Ring against deformation in case of high pulsating pressure
- Dimensional stability of the O-Ring improves the sealing force and increases the service life
- Static and dynamic use
- Reciprocating movements possible
- Preferred for installations in a closed groove where uncut Back-up Rings are not suitable

Back-up Ring types, spiral

Type BP

- Rectangular cross section
- Material: PTFE
- Cut angle of 30° or 45°
- Consists as standard two spiral windings which are cut at the ends at an angle
- Static and dynamic use
- For reciprocating movements only
- Preferred for installations in a closed groove where uncut Back-up Ring are not suitable
- Compensation of large temperature changes and tolerances without difficulties by a screw-like elongation and contraction. Easy Installation in closed grooves for external sealing applications
- The dimensions are different compared to standard Back-up Rings



B.3 Back-up Ring types for internal sealing (rod)

Back-up Ring types, uncut

Type BU

- Rectangular cross section
- Material: PTFE
- Static and dynamic use
- Reciprocating and rotating movements possible

Type BB

- Concave cross-section
- Material: PTFE, NBR, FKM
- The large contact surface protects the O-Ring against deformation in case of high pulsating pressure
- Dimensional stability of the O-Ring improves the sealing force and increases the service life
- Static and dynamic use
- Reciprocating movements possible

Back-up Ring types, cut

Type BG

- Rectangular cross section
- Material: PTFE
- Cut angle of 30° or 45°
- Static and dynamic use
- Reciprocating and rotating movement possible
- Preferred for installations in closed grooves where uncut Back-up Rings are not suitable

Type BC

- Concave cross-section
- Material: PTFE
- Cut angle of 30° or 45°
- The large contact surface protects the O-Ring against deformation in case of high pulsating pressure
- Dimensional stability of the O-Ring improves the sealing force and increases the service life
- Static and dynamic use
- Reciprocating movements possible
- Preferred for installations in a closed groove where uncut Back-up Rings are not suitable

Back-up Ring type, spiral

Type BP

- Rectangular cross section
- Material: PTFE
- Cut angle of 30° or 45°
- Consists as standard two spiral windings which are cut at the ends at an angle
- Static and dynamic use
- For reciprocating movements only
- Preferred for installations in a closed groove where uncut Back-up Rings are not suitable
- Compensation of large temperature changes and tolerances without difficulties by a screw-like elongation and contraction



C Technical information

C.1 Materials

Back-up Rings are as standard manufactured from virgin PTFE. In view of the unfavourable cold flow behaviour of virgin PTFE, these Back-up Rings are used only for low to medium loads. For higher load requirements, filled PTFE materials (with glassfibre, bronze, carbon, etc.) have to be used. For sealing against high pressures, Back-up Rings made from specially modified thermoplastic materials are used.

For the series production of larger quantities, injection molded Back-up Rings can be manufactured, e.g. NBR 90 Shore A, FKM 90 Shore A, or thermoplastic elastomers (TPE) on request.

Table 1 Back-up Ring materials

Base material	Material code	Type					Dynamic application
		BU/BV	BG/BH	BP	BB/BA	BC/BD	Pressure MPa
PTFE (virgin) - standard	PT00	•	•	•	•	•	25
PTFE - glassfibre-filled	PTGB	•	•	•	•	•	40
PTFE, carbon-filled	PTKC	•	•	•	•	•	40
PTFE, bronze-filled	PTB4	•	•	•	•	•	40
TPE-E	PR	•	•	-	•	•	30
NBR, 90 Shore A	N9	-	-	-	•	-	20
FKM, 90 Shore A	V9	-	-	-	•	-	20

C.2 Technical data

Static applications: Up to approx. 250 MPa depending on the Back-up Ring material and sealing gap

Dynamic applications: Reciprocating up to approx. 40 MPa
Oscillating/slowly rotating up to approx. 15 MPa

Speed: Reciprocating or rotating up to approx. 2 m/s depending on the material

Operating temperature: -200 °C up to +260 °C depending on the material

Important Note:

The application limits for pressure and temperature given in this catalogue are maximum values. During practical applications it should be remembered that due to the interaction of operating parameters, the maximum values must be set correspondingly lower.



C.3 Design recommendations

The recommendations for O-Rings are generally valid for the use of Back-up Rings. This applies to the groove design, surface roughness, lead-in chamfers, etc.

When the pressure is applied from one side only, it is sufficient to install a Back-up Ring on the downstream side of the O-Ring. When the seal is exposed to pressure from both sides, two Back-up Rings - one on each side of the O-Ring - have to be used.

Permissible sealing gap

The use of Back-up Rings allows the service pressure and/or permissible radial clearance specified in this catalogue, Part I: O-Ring, chapter B.2.7 Housing design and dimensions, to be increased.

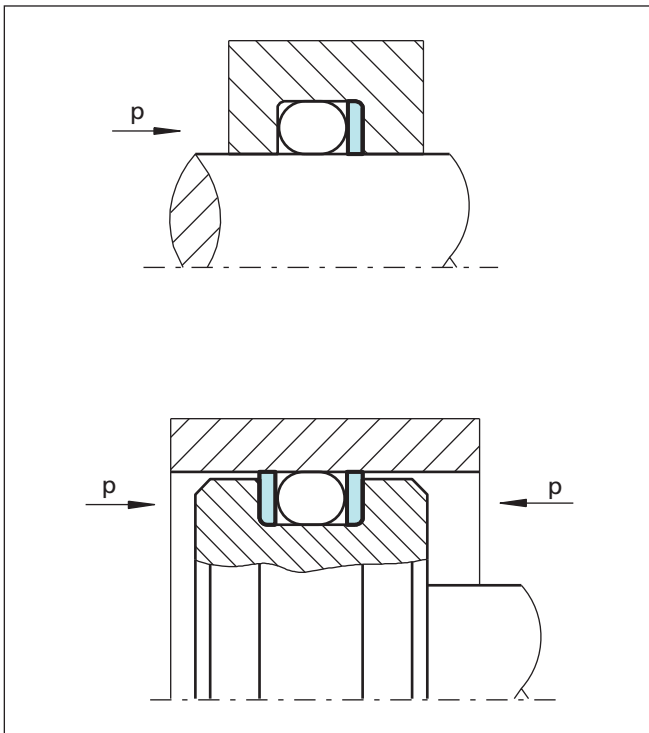


Figure 3 Back-up Ring installation, depending on the direction of the pressure



D Installation recommendations and Back-up Ring dimensions

D.1 External sealing (piston), static and dynamic applications

D.1.1 Rectangular Back-up Ring types, uncut (BV), and cut (BH), material PTFE

The following figure and tables include installation recommendations and Back-up Ring dimensions for external sealing applications with the rectangular Back-up Ring types BV (uncut) and BH (cut).

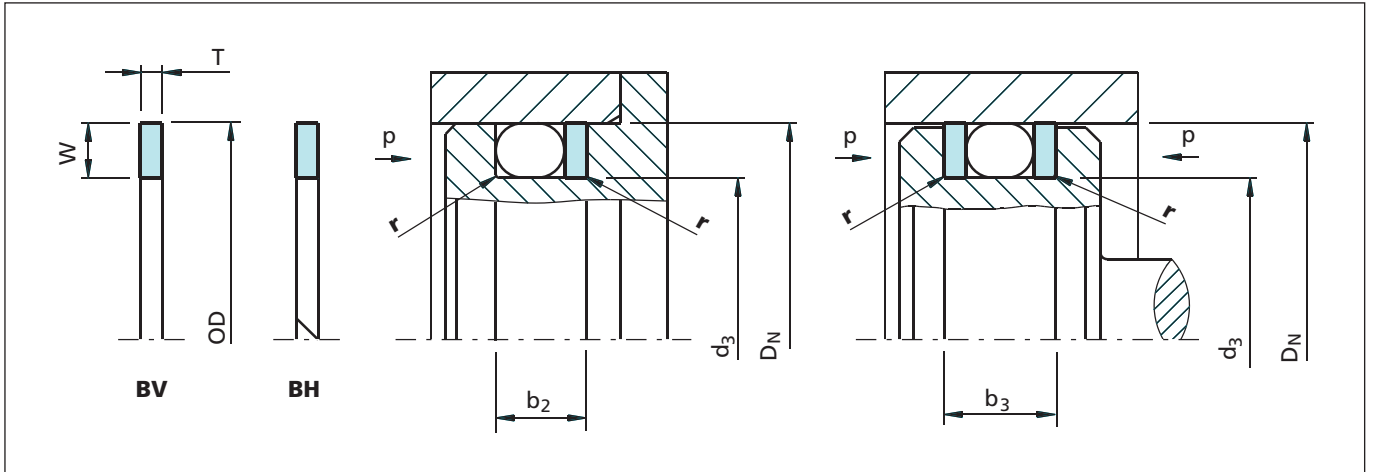


Figure 4 Installation drawing external sealing, rectangular Back-up Ring types

Table 2 Installation dimensions for rectangular Back-up Ring types, uncut and cut, external sealing

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter		Groove width		Radius $r \pm 0.2$
	Dynamic	Static		Dynamic $d_3 \text{ h9}$	Static $d_3 \text{ h9}$	$b_2 + 0.2$	$b_3 + 0.2$	
1.50	1.25	1.10	1.0	$D_N - 2.5$	$D_N - 2.2$	3.0	4.0	0.25
1.60	1.30	1.20	1.0	$D_N - 2.6$	$D_N - 2.4$	3.1	4.1	0.25
1.78	1.45	1.30	1.4	$D_N - 2.9$	$D_N - 2.6$	3.8	5.2	0.25
1.80	1.45	1.30	1.4	$D_N - 2.9$	$D_N - 2.6$	3.8	5.2	0.25
2.00	1.65	1.50	1.4	$D_N - 3.3$	$D_N - 3.0$	4.1	5.5	0.25
2.40	2.05	1.80	1.4	$D_N - 4.1$	$D_N - 3.6$	4.6	6.0	0.25
2.50	2.15	1.90	1.4	$D_N - 4.3$	$D_N - 3.8$	4.7	6.1	0.25
2.62	2.25	2.00	1.4	$D_N - 4.5$	$D_N - 4.0$	5.0	6.4	0.25
2.65	2.25	2.00	1.4	$D_N - 4.5$	$D_N - 4.0$	5.0	6.4	0.25
3.00	2.60	2.30	1.4	$D_N - 5.2$	$D_N - 4.6$	5.4	6.8	0.25
3.53	3.10	2.70	1.4	$D_N - 6.2$	$D_N - 5.4$	6.2	7.6	0.25
3.55	3.10	2.70	1.4	$D_N - 6.2$	$D_N - 5.4$	6.2	7.6	0.25
4.00	3.50	3.10	1.7	$D_N - 7.0$	$D_N - 6.2$	6.9	8.6	0.25
5.00	4.40	4.00	1.7	$D_N - 8.8$	$D_N - 8.0$	8.3	10.0	0.25
5.30	4.70	4.30	1.7	$D_N - 9.4$	$D_N - 8.6$	9.0	10.9	0.25
5.33	4.70	4.30	1.7	$D_N - 9.4$	$D_N - 8.6$	9.0	10.9	0.25
5.70	5.00	4.60	1.7	$D_N - 10.0$	$D_N - 9.2$	9.0	11.0	0.25
6.00	5.30	4.90	1.7	$D_N - 10.6$	$D_N - 9.8$	9.3	11.2	0.25



Back-up Ring

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter		Groove width		Radius
	Dynamic	Static	T	Dynamic d_3 h9	Static d_3 h9	$b_2 +0.2$	$b_3 +0.2$	$r \pm 0.2$
7.00	6.10	5.80	2.5	$D_N - 12.2$	$D_N - 11.6$	12.3	15.1	0.25
8.00	7.10	6.70	2.5	$D_N - 14.2$	$D_N - 13.4$	12.6	15.4	0.25
8.40	7.50	7.10	2.5	$D_N - 15.0$	$D_N - 14.2$	12.8	15.6	0.25

Ordering Example

Back-up Ring: Rectangular type BH (cut)
for O-Ring seal

Application: Static, external sealing

Bore diameter: $D_N = 40.00$ mm

O-Ring cross section: $d_2 = 2.62$ mm

Back-up Ring material: PTFE, glassfibre filled (25 %)

Material code see page 91

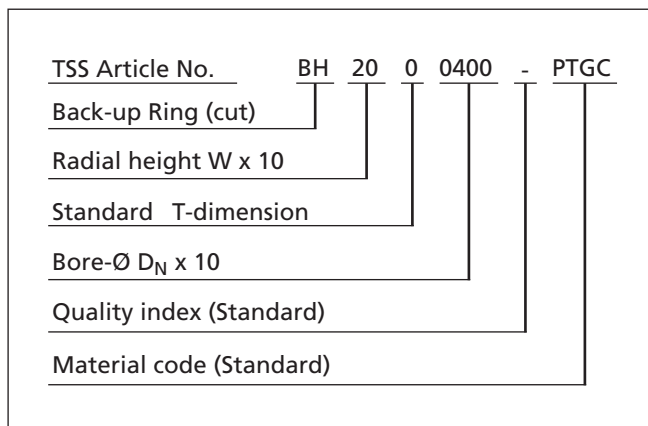


Table 3 Preferred series for static applications, rectangular Back-up Ring types BV (uncut) and BH (cut), external sealing, material PTFE

Bore \varnothing	Groove \varnothing	Groove width		Radius	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$			$r \pm 0.2$	OD x W x T		Uncut (BV)
D_N H8	d_3 h9								
6.0	3.4	3.8	5.2	0.25	6.0 x 1.3 x 1.4	BV1300060	BH1300060	ORAR00006	2.90 x 1.78
6.0	3.8	3.0	4.0	0.25	6.0 x 1.1 x 1.0	BV1100060	BH1100060	OR1500350	3.50 x 1.50
8.0	5.8	3.0	4.0	0.25	8.0 x 1.1 x 1.0	BV1100080	BH1100080	OR1500550	5.50 x 1.50
10.0	7.8	3.0	4.0	0.25	10.0 x 1.1 x 1.0	BV1100100	BH1100100	OR1500750	7.50 x 1.50
12.0	9.0	4.1	5.5	0.25	12.0 x 1.5 x 1.4	BV1500120	BH1500120	OR2000850	8.50 x 2.00
12.0	9.4	3.8	5.2	0.25	12.0 x 1.3 x 1.4	BV1300120	BH1300120	ORAR00012	9.25 x 1.78
14.0	11.0	4.1	5.5	0.25	14.0 x 1.5 x 1.4	BV1500140	BH1500140	OR2001000	10.00 x 2.00
14.0	11.4	3.8	5.2	0.25	14.0 x 1.3 x 1.4	BV1300140	BH1300140	ORAR00013	10.82 x 1.78
15.0	12.0	4.1	5.5	0.25	15.0 x 1.5 x 1.4	BV1500150	BH1500150	OR2001100	11.00 x 2.00
15.0	12.4	3.8	5.2	0.25	15.0 x 1.3 x 1.4	BV1300150	BH1300150	ORAR00014	12.42 x 1.78
16.0	13.0	4.1	5.5	0.25	16.0 x 1.5 x 1.4	BV1500160	BH1500160	OR2001200	12.00 x 2.00
16.0	13.4	3.8	5.2	0.25	16.0 x 1.3 x 1.4	BV1300160	BH1300160	ORAR00015	14.00 x 1.78
18.0	15.0	4.1	5.5	0.25	18.0 x 1.5 x 1.4	BV1500180	BH1500180	OR2001400	14.00 x 2.00
18.0	15.4	3.8	5.2	0.25	18.0 x 1.3 x 1.4	BV1300180	BH1300180	ORAR00016	15.60 x 1.78
20.0	17.0	4.1	5.5	0.25	20.0 x 1.5 x 1.4	BV1500200	BH1500200	OR2001600	16.00 x 2.00

Back-up Ring



Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$			$r \pm 0.2$	OD x W x T		
20.0	17.4	3.8	5.2	0.25	20.0 x 1.3 x 1.4	BV1300200	BH1300200	ORAR00017	17.17 x 1.78
22.0	19.0	4.1	5.5	0.25	22.0 x 1.5 x 1.4	BV1500220	BH1500220	OR2001600	16.00 x 2.00
22.0	19.4	3.8	5.2	0.25	22.0 x 1.3 x 1.4	BV1300220	BH1300220	ORAR00018	18.77 x 1.78
25.0	22.0	4.1	5.5	0.25	25.0 x 1.5 x 1.4	BV1500250	BH1500250	OR2002100	21.00 x 2.00
25.0	22.4	3.8	5.2	0.25	25.0 x 1.3 x 1.4	BV1300250	BH1300250	ORAR00020	21.95 x 1.78
28.0	23.4	5.4	6.8	0.25	28.0 x 2.3 x 1.4	BV2300280	BH2300280	OR3002200	22.00 x 3.00
28.0	24.0	5.0	6.4	0.25	28.0 x 2.0 x 1.4	BV2000280	BH2000280	ORAR00119	23.47 x 2.62
30.0	25.4	5.4	6.8	0.25	30.0 x 2.3 x 1.4	BV2300300	BH2300300	OR3002400	24.00 x 2.00
30.0	26.0	5.0	6.4	0.25	30.0 x 2.0 x 1.4	BV2000300	BH2000300	ORAR00120	25.07 x 2.62
32.0	27.4	5.4	6.8	0.25	32.0 x 2.3 x 1.4	BV2300320	BH2300320	OR3002600	26.00 x 3.00
32.0	28.0	5.0	6.4	0.25	32.0 x 2.0 x 1.4	BV2000320	BH2000320	ORAR00121	26.64 x 2.62
35.0	30.4	5.4	6.8	0.25	35.0 x 2.3 x 1.4	BV2300350	BH2300350	OR3002900	29.30 x 3.00
35.0	31.0	5.0	6.4	0.25	35.0 x 2.0 x 1.4	BV2000350	BH2000350	ORAR00123	29.82 x 2.62
40.0	35.4	5.4	6.8	0.25	40.0 x 2.3 x 1.4	BV2300400	BH2300400	OR3003400	34.00 x 3.00
40.0	36.0	5.0	6.4	0.25	40.0 x 2.0 x 1.4	BV2000400	BH2000400	ORAR00126	34.59 x 2.62
42.0	37.4	5.4	6.8	0.25	42.0 x 2.3 x 1.4	BV2300420	BH2300420	OR3003600	36.00 x 3.00
42.0	38.0	5.0	6.4	0.25	42.0 x 2.0 x 1.4	BV2000420	BH2000420	ORAR00127	36.17 x 2.62
45.0	40.0	5.4	6.8	0.25	45.0 x 2.3 x 1.4	BV2300450	BH2300450	OR3003900	39.00 x 3.00
45.0	41.0	5.0	6.4	0.25	45.0 x 2.0 x 1.4	BV2000450	BH2000450	ORAR00129	39.34 x 2.62
48.0	41.8	6.9	8.6	0.25	48.0 x 3.1 x 1.7	BV3100480	BH3100480	OR4004000	40.00 x 4.00
48.0	42.6	6.2	7.6	0.25	48.0 x 2.7 x 1.4	BV2700480	BH2700480	ORAR00223	40.87 x 3.53
50.0	43.8	6.9	8.6	0.25	50.0 x 3.1 x 1.7	BV3100500	BH3100500	OR4004200	42.00 x 4.00
50.0	44.6	6.2	7.6	0.25	50.0 x 2.7 x 1.4	BV2700500	BH2700500	ORAR00224	44.04 x 3.53
52.0	45.8	6.9	8.6	0.25	52.0 x 3.1 x 1.7	BV3100520	BH3100520	OR4004400	44.00 x 4.00
52.0	46.6	6.2	7.6	0.25	52.0 x 2.7 x 1.4	BV2700520	BH2700520	ORAR00224	44.04 x 3.53
55.0	48.8	6.9	8.6	0.25	55.0 x 3.1 x 1.7	BV3100550	BH3100550	OR4004700	47.00 x 4.00
55.0	49.6	6.2	7.6	0.25	55.0 x 2.7 x 1.4	BV2700550	BH2700550	ORAR00225	47.22 x 3.53
60.0	53.8	6.9	8.6	0.25	60.0 x 3.1 x 1.7	BV3100600	BH3100600	OR4005200	52.00 x 4.00
60.0	54.6	6.2	7.6	0.25	60.0 x 2.7 x 1.4	BV2700600	BH2700600	ORAR00227	53.57 x 3.53
63.0	56.8	6.9	8.6	0.25	63.0 x 3.1 x 1.7	BV3100630	BH3100630	OR4005500	55.00 x 4.00
63.0	57.6	6.2	7.6	0.25	63.0 x 2.7 x 1.4	BV2700630	BH2700630	ORAR00228	56.74 x 3.53
65.0	58.8	6.9	8.6	0.25	65.0 x 3.1 x 1.7	BV3100650	BH3100650	OR4005700	57.00 x 4.00
65.0	59.6	6.2	7.6	0.25	65.0 x 2.7 x 1.4	BV2700650	BH2700650	ORAR00228	56.74 x 3.53
70.0	63.8	6.9	8.6	0.25	70.0 x 3.1 x 1.7	BV3100700	BH3100700	OR4006200	62.00 x 4.00
70.0	64.6	6.2	7.6	0.25	70.0 x 2.7 x 1.4	BV2700700	BH2700700	ORAR00230	63.09 x 3.53
75.0	68.8	6.9	8.6	0.25	75.0 x 3.1 x 1.7	BV3100750	BH3100750	OR4006700	67.00 x 4.00



Back-up Ring

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$			$r \pm 0.2$	OD x W x T		
75.0	69.6	6.2	7.6	0.25	75.0 x 2.7 x 1.4	BV2700750	BH2700750	ORAR00231	66.27 x 3.53
80.0	73.8	6.9	8.6	0.25	80.0 x 3.1 x 1.7	BV3100800	BH3100800	OR4007200	72.00 x 4.00
80.0	74.6	6.2	7.6	0.25	80.0 x 2.7 x 1.4	BV2700800	BH2700800	ORAR00233	72.62 x 3.53
85.0	78.8	6.9	8.6	0.25	85.0 x 3.1 x 1.7	BV3100850	BH3100850	OR4007700	77.00 x 4.00
85.0	79.6	6.2	7.6	0.25	85.0 x 2.7 x 1.4	BV2700850	BH2700850	ORAR00235	78.97 x 3.53
90.0	81.4	9.0	10.9	0.25	90.0 x 4.3 x 1.7	BV4300900	BH4300900	ORAR00338	78.74 x 5.33
90.0	82.0	8.3	10.0	0.25	90.0 x 4.0 x 1.7	BV4000900	BH4000900	OR5008000	80.00 x 5.00
95.0	86.4	9.0	10.9	0.25	95.0 x 4.3 x 1.7	BV4300950	BH4300950	ORAR00340	85.09 x 5.33
95.0	87.0	8.3	10.0	0.25	95.0 x 4.0 x 1.7	BV4000950	BH4000950	OR5008000	80.00 x 5.00
100.0	91.4	9.0	10.9	0.25	100.0 x 4.3 x 1.7	BV4301000	BH4301000	ORAR00342	91.44 x 5.33
100.0	92.0	8.3	10.0	0.25	100.0 x 4.0 x 1.7	BV4001000	BH4001000	OR5009000	90.00 x 5.00
105.0	96.4	9.0	10.9	0.25	105.0 x 4.3 x 1.7	BV4301050	BH4301050	ORAR00343	94.62 x 5.33
105.0	97.0	8.3	10.0	0.25	105.0 x 4.0 x 1.7	BV4001050	BH4001050	OR5009500	95.00 x 5.00
110.0	101.4	9.0	10.9	0.25	110.0 x 4.3 x 1.7	BV4301100	BH4301100	ORAR00345	100.97 x 5.33
110.0	102.0	8.3	10.0	0.25	110.0 x 4.0 x 1.7	BV4001100	BH4001100	OR5010000	100.00 x 5.00
115.0	106.4	9.0	10.9	0.25	115.0 x 4.3 x 1.7	BV4301150	BH4301150	ORAR00346	104.14 x 5.33
115.0	107.0	8.3	10.0	0.25	115.0 x 4.0 x 1.7	BV4001150	BH4001150	OR5010500	105.00 x 5.00
120.0	111.4	9.0	10.9	0.25	120.0 x 4.3 x 1.7	BV4301200	BH4301200	ORAR00348	110.49 x 5.33
120.0	112.0	8.3	10.0	0.25	120.0 x 4.0 x 1.7	BV4001200	BH4001200	OR5011000	110.00 x 5.00
125.0	116.4	9.0	10.9	0.25	125.0 x 4.3 x 1.7	BV4301250	BH4301250	ORAR00349	113.67 x 5.33
125.0	117.0	8.3	10.0	0.25	125.0 x 4.0 x 1.7	BV4001250	BH4001250	OR5011500	115.00 x 5.00
130.0	121.4	9.0	10.9	0.25	130.0 x 4.3 x 1.7	BV4301300	BH4301300	ORAR00351	120.02 x 5.33
130.0	122.0	8.3	10.0	0.25	130.0 x 4.0 x 1.7	BV4001300	BH4001300	OR5012000	120.00 x 5.00
135.0	123.4	12.3	15.1	0.25	135.0 x 5.8 x 2.5	BV5801350	BH5801350	ORAR00427	120.02 x 6.99
140.0	128.4	12.3	15.1	0.25	140.0 x 5.8 x 2.5	BV5801400	BH5801400	ORAR00429	126.37 x 6.99
150.0	138.4	12.3	15.1	0.25	150.0 x 5.8 x 2.5	BV5801500	BH5801500	ORAR00432	135.89 x 6.99
160.0	148.4	12.3	15.1	0.25	160.0 x 5.8 x 2.5	BV5801600	BH5801600	ORAR00435	145.42 x 6.99
170.0	158.4	12.3	15.1	0.25	170.0 x 5.8 x 2.5	BV5801700	BH5801700	ORAR00438	158.12 x 6.99
180.0	168.4	12.3	15.1	0.25	180.0 x 5.8 x 2.5	BV5801800	BH5801800	ORAR00439	164.47 x 6.99
190.0	178.4	12.3	15.1	0.25	190.0 x 5.8 x 2.5	BV5801900	BH5801900	ORAR00441	177.17 x 6.99
200.0	188.4	12.3	15.1	0.25	200.0 x 5.8 x 2.5	BV5802000	BH5802000	ORAR00442	183.52 x 6.99
210.0	198.4	12.3	15.1	0.25	210.0 x 5.8 x 2.5	BV5802100	BH5802100	ORAR00444	196.22 x 6.99
220.0	208.4	12.3	15.1	0.25	220.0 x 5.8 x 2.5	BV5802200	BH5802200	ORAR00445	202.57 x 6.99
230.0	218.4	12.3	15.1	0.25	230.0 x 5.8 x 2.5	BV5802300	BH5802300	ORAR00446	215.27 x 6.99
240.0	228.4	12.3	15.1	0.25	240.0 x 5.8 x 2.5	BV5802400	BH5802400	ORAR00447	227.97 x 6.99
250.0	238.4	12.3	15.1	0.25	250.0 x 5.8 x 2.5	BV5802500	BH5802500	ORAR00448	240.67 x 6.99

Back-up Ring



Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$			$r \pm 0.2$	OD x W x T		
280.0	268.4	12.3	15.1	0.25	280.0 x 5.8 x 2.5	BV5802800	BH5802800	ORAR00450	266.07 x 6.99
300.0	288.4	12.3	15.1	0.25	300.0 x 5.8 x 2.5	BV5803000	BH5803000	ORAR00451	278.77 x 6.99
320.0	308.4	12.3	15.1	0.25	320.0 x 5.8 x 2.5	BV5803200	BH5803200	ORAR00453	304.17 x 6.99
350.0	338.4	12.3	15.1	0.25	350.0 x 5.8 x 2.5	BV5803500	-	ORAR00455	329.57 x 6.99
400.0	388.4	12.3	15.1	0.25	400.0 x 5.8 x 2.5	BV5804000	-	ORAR00459	380.37 x 6.99
420.0	408.4	12.3	15.1	0.25	420.0 x 5.8 x 2.5	BV5804200	-	ORAR00461	405.26 x 6.99
450.0	438.4	12.3	15.1	0.25	450.0 x 5.8 x 2.5	BV5804500	-	ORAR00463	430.66 x 6.99
480.0	468.4	12.3	15.1	0.25	480.0 x 5.8 x 2.5	BV5804800	-	ORAR00465	456.06 x 6.99
500.0	488.4	12.3	15.1	0.25	500.0 x 5.8 x 2.5	BV5805000	-	ORAR00467	481.46 x 6.99

Further sizes on request

This table shows the possible range of available dimensions (Back-up Rings). However, these dimensions are not always stock items.



Back-up Ring

D.1.2 Concave Back-up Ring types, uncut (BA) and cut (BD), material PTFE

The following figure and tables include installation recommendations and Back-up Ring dimensions for external sealing applications with the concave Back-up Ring types BA (uncut) and BD (cut).

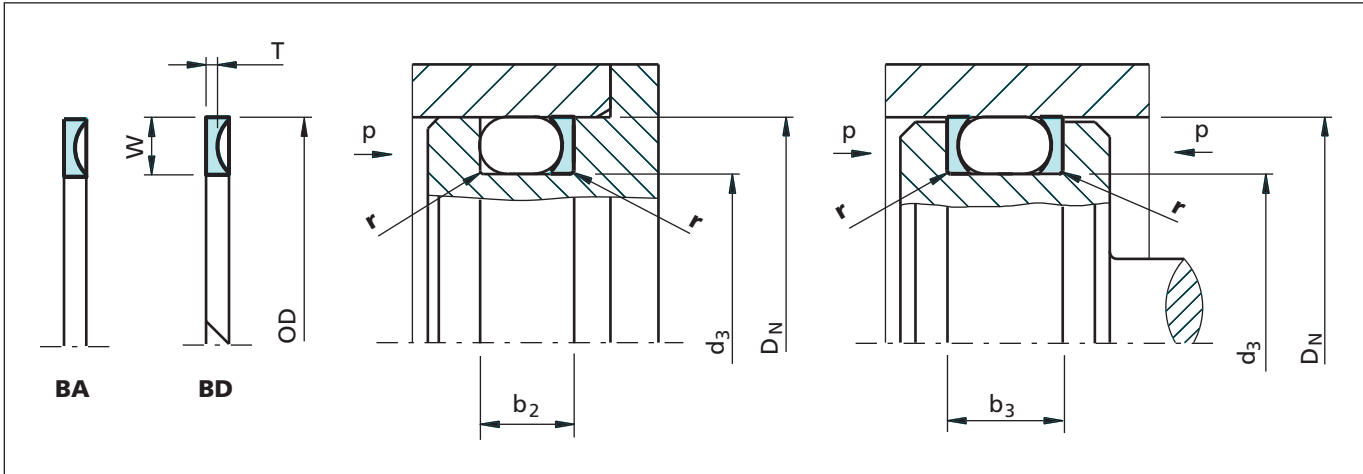


Figure 5 Installation drawing external sealing, concave Back-up Ring types

Table 4 Installation dimensions for concave Back-up Ring types, uncut and cut, external sealing

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter		Groove width		Radius
	Dynamic	Static	T	Dynamic d_3 h9	Static d_3 h9	$b_2 + 0.2$	$b_3 + 0.2$	$r \pm 0.2$
1.50	1.25	1.10	1.0	$D_N - 2.5$	$D_N - 2.2$	3.0	4.0	0.25
1.60	1.30	1.20	1.0	$D_N - 2.6$	$D_N - 2.4$	3.1	4.1	0.25
1.78	1.45	1.30	1.4	$D_N - 2.9$	$D_N - 2.6$	3.8	5.2	0.25
1.80	1.45	1.30	1.4	$D_N - 2.9$	$D_N - 2.6$	3.8	5.2	0.25
2.00	1.65	1.50	1.4	$D_N - 3.3$	$D_N - 3.0$	4.1	5.5	0.25
2.40	2.05	1.80	1.4	$D_N - 4.1$	$D_N - 3.6$	4.6	6.0	0.25
2.50	2.15	1.90	1.4	$D_N - 4.3$	$D_N - 3.8$	4.7	6.1	0.25
2.62	2.25	2.00	1.4	$D_N - 4.5$	$D_N - 4.0$	5.0	6.4	0.25
2.65	2.25	2.00	1.4	$D_N - 4.5$	$D_N - 4.0$	5.0	6.4	0.25
3.00	2.60	2.30	1.4	$D_N - 5.2$	$D_N - 4.6$	5.4	6.8	0.25
3.53	3.10	2.70	1.4	$D_N - 6.2$	$D_N - 5.4$	6.2	7.6	0.25
3.55	3.10	2.70	1.4	$D_N - 6.2$	$D_N - 5.4$	6.2	7.6	0.25
4.00	3.50	3.10	1.7	$D_N - 7.0$	$D_N - 6.2$	6.9	8.6	0.25
5.00	4.40	4.00	1.7	$D_N - 8.8$	$D_N - 8.0$	8.3	10.0	0.25
5.30	4.70	4.30	1.7	$D_N - 9.4$	$D_N - 8.6$	9.0	10.9	0.25
5.33	4.70	4.30	1.7	$D_N - 9.4$	$D_N - 8.6$	9.0	10.9	0.25
5.70	5.00	4.60	1.7	$D_N - 10.0$	$D_N - 9.2$	9.0	11.0	0.25
6.00	5.30	4.90	1.7	$D_N - 10.6$	$D_N - 9.8$	9.3	11.2	0.25
7.00	6.10	5.80	2.5	$D_N - 12.2$	$D_N - 11.6$	12.3	15.1	0.25
8.00	7.10	6.70	2.5	$D_N - 14.2$	$D_N - 13.4$	12.6	15.4	0.25
8.40	7.50	7.10	2.5	$D_N - 15.0$	$D_N - 14.2$	12.8	15.6	0.25



Ordering Example

Back-up Ring: Concave, type BD (cut)
for O-Ring seal
Application: Static, external sealing
Bore diameter: $D_N = 40.00$ mm
O-Ring cross section: $d_2 = 2.62$ mm
Back-up Ring material: PTFE, bronze filled (10 %)
Material code see page 91

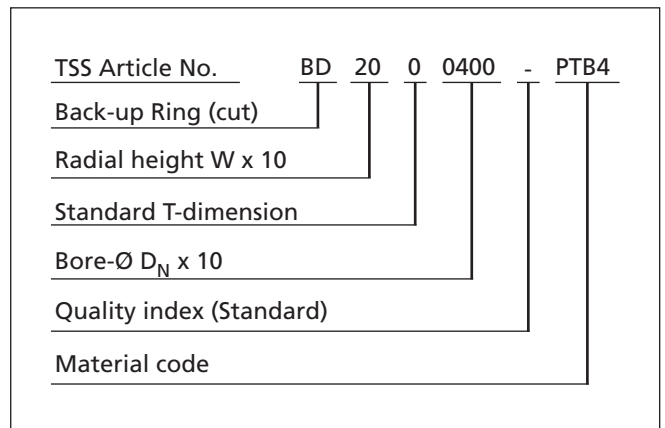


Table 5 Preferred series for static applications, concave Back-up Ring type BD (cut), external sealing, material PTFE

Bore Ø D_N H8	Groove Ø d_3 h9	Groove width		Radius $r \pm 0.2$	Back-up Ring dimension OD x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 + 0.2$	$b_3 + 0.2$					$d_1 \times d_2$
6.0	3.4	3.8	5.2	0.25	6.0 x 1.3 x 1.4	BD1300060	ORAR00006	2.90 x 1.78
6.0	3.8	3.0	4.0	0.25	6.0 x 1.1 x 1.0	BD1100060	OR1500350	3.50 x 1.50
8.0	5.8	3.0	4.0	0.25	8.0 x 1.1 x 1.0	BD1100080	OR1500550	5.50 x 1.50
10.0	7.8	3.0	4.0	0.25	10.0 x 1.1 x 1.0	BD1100100	OR1500750	7.50 x 1.50
12.0	9.0	4.1	5.5	0.25	12.0 x 1.5 x 1.4	BD1500120	OR2000850	8.50 x 2.00
12.0	9.4	3.8	5.2	0.25	12.0 x 1.3 x 1.4	BD1300120	ORAR00012	9.25 x 1.78
14.0	11.0	4.1	5.5	0.25	14.0 x 1.5 x 1.4	BD1500140	OR2001000	10.00 x 2.00
14.0	11.4	3.8	5.2	0.25	14.0 x 1.3 x 1.4	BD1300140	ORAR00013	10.82 x 1.78
15.0	12.0	4.1	5.5	0.25	15.0 x 1.5 x 1.4	BD1500150	OR2001100	11.00 x 2.00
15.0	12.4	3.8	5.2	0.25	15.0 x 1.3 x 1.4	BD1300150	ORAR00014	12.42 x 1.78
16.0	13.0	4.1	5.5	0.25	16.0 x 1.5 x 1.4	BD1500160	OR2001200	12.00 x 2.00
16.0	13.4	3.8	5.2	0.25	16.0 x 1.3 x 1.4	BD1300160	ORAR00015	14.00 x 1.78
18.0	15.0	4.1	5.5	0.25	18.0 x 1.5 x 1.4	BD1500180	OR2001400	14.00 x 2.00
18.0	15.4	3.8	5.2	0.25	18.0 x 1.3 x 1.4	BD1300180	ORAR00016	15.60 x 1.78
20.0	17.0	4.1	5.5	0.25	20.0 x 1.5 x 1.4	BD1500200	OR2001600	16.00 x 2.00
20.0	17.4	3.8	5.2	0.25	20.0 x 1.3 x 1.4	BD1300200	ORAR00017	17.17 x 1.78
22.0	19.0	4.1	5.5	0.25	22.0 x 1.5 x 1.4	BD1500220	OR2001600	16.00 x 2.00
22.0	19.4	3.8	5.2	0.25	22.0 x 1.3 x 1.4	BD1300220	ORAR00018	18.77 x 1.78
25.0	22.0	4.1	5.5	0.25	25.0 x 1.5 x 1.4	BD1500250	OR2002100	21.00 x 2.00
25.0	22.4	3.8	5.2	0.25	25.0 x 1.3 x 1.4	BD1300250	ORAR00020	21.95 x 1.78
28.0	23.4	5.4	6.8	0.25	28.0 x 2.3 x 1.4	BD2300280	OR3002200	22.00 x 3.00
28.0	24.0	5.0	6.4	0.25	28.0 x 2.0 x 1.4	BD2000280	ORAR00119	23.47 x 2.62
30.0	25.4	5.4	6.8	0.25	30.0 x 2.3 x 1.4	BD2300300	OR3002400	24.00 x 2.00
30.0	26.0	5.0	6.4	0.25	30.0 x 2.0 x 1.4	BD2000300	ORAR00120	25.07 x 2.62



Back-up Ring

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
32.0	27.4	5.4	6.8	0.25	32.0 x 2.3 x 1.4	BD2300320	OR3002600	26.00 x 3.00
32.0	28.0	5.0	6.4	0.25	32.0 x 2.0 x 1.4	BD2000320	ORAR00121	26.64 x 2.62
35.0	30.4	5.4	6.8	0.25	35.0 x 2.3 x 1.4	BD2300350	OR3002900	29.30 x 3.00
35.0	31.0	5.0	6.4	0.25	35.0 x 2.0 x 1.4	BD2000350	ORAR00123	29.82 x 2.62
40.0	35.4	5.4	6.8	0.25	40.0 x 2.3 x 1.4	BD2300400	OR3003400	34.00 x 3.00
40.0	36.0	5.0	6.4	0.25	40.0 x 2.0 x 1.4	BD2000400	ORAR00126	34.59 x 2.62
42.0	37.4	5.4	6.8	0.25	42.0 x 2.3 x 1.4	BD2300420	OR3003600	36.00 x 3.00
42.0	38.0	5.0	6.4	0.25	42.0 x 2.0 x 1.4	BD2000420	ORAR00127	36.17 x 2.62
45.0	40.0	5.4	6.8	0.25	45.0 x 2.3 x 1.4	BD2300450	OR3003900	39.00 x 3.00
45.0	41.0	5.0	6.4	0.25	45.0 x 2.0 x 1.4	BD2000450	ORAR00129	39.34 x 2.62
48.0	41.8	6.9	8.6	0.25	48.0 x 3.1 x 1.7	BD3100480	OR4004000	40.00 x 4.00
48.0	42.6	6.2	7.6	0.25	48.0 x 2.7 x 1.4	BD2700480	ORAR00223	40.87 x 3.53
50.0	43.8	6.9	8.6	0.25	50.0 x 3.1 x 1.7	BD3100500	OR4004200	42.00 x 4.00
50.0	44.6	6.2	7.6	0.25	50.0 x 2.7 x 1.4	BD2700500	ORAR00224	44.04 x 3.53
52.0	45.8	6.9	8.6	0.25	52.0 x 3.1 x 1.7	BD3100520	OR4004400	44.00 x 4.00
52.0	46.6	6.2	7.6	0.25	52.0 x 2.7 x 1.4	BD2700520	ORAR00224	44.04 x 3.53
55.0	48.8	6.9	8.6	0.25	55.0 x 3.1 x 1.7	BD3100550	OR4004700	47.00 x 4.00
55.0	49.6	6.2	7.6	0.25	55.0 x 2.7 x 1.4	BD2700550	ORAR00225	47.22 x 3.53
60.0	53.8	6.9	8.6	0.25	60.0 x 3.1 x 1.7	BD3100600	OR4005200	52.00 x 4.00
60.0	54.6	6.2	7.6	0.25	60.0 x 2.7 x 1.4	BD2700600	ORAR00227	53.57 x 3.53
63.0	56.8	6.9	8.6	0.25	63.0 x 3.1 x 1.7	BD3100630	OR4005500	55.00 x 4.00
63.0	57.6	6.2	7.6	0.25	63.0 x 2.7 x 1.4	BD2700630	ORAR00228	56.74 x 3.53
65.0	58.8	6.9	8.6	0.25	65.0 x 3.1 x 1.7	BD3100650	OR4005700	57.00 x 4.00
65.0	59.6	6.2	7.6	0.25	65.0 x 2.7 x 1.4	BD2700650	ORAR00228	56.74 x 3.53
70.0	63.8	6.9	8.6	0.25	70.0 x 3.1 x 1.7	BD3100700	OR4006200	62.00 x 4.00
70.0	64.6	6.2	7.6	0.25	70.0 x 2.7 x 1.4	BD2700700	ORAR00230	63.09 x 3.53
75.0	68.8	6.9	8.6	0.25	75.0 x 3.1 x 1.7	BD3100750	OR4006700	67.00 x 4.00
75.0	69.6	6.2	7.6	0.25	75.0 x 2.7 x 1.4	BD2700750	ORAR00231	66.27 x 3.53
80.0	73.8	6.9	8.6	0.25	80.0 x 3.1 x 1.7	BD3100800	OR4007200	72.00 x 4.00
80.0	74.6	6.2	7.6	0.25	80.0 x 2.7 x 1.4	BD2700800	ORAR00233	72.62 x 3.53
85.0	78.8	6.9	8.6	0.25	85.0 x 3.1 x 1.7	BD3100850	OR4007700	77.00 x 4.00
85.0	79.6	5.2	7.6	0.25	85.0 x 2.7 x 1.4	BD2700850	ORAR00235	78.97 x 3.53
90.0	81.4	9.0	10.9	0.25	90.0 x 4.3 x 1.7	BD4300900	ORAR00338	78.74 x 5.33
90.0	82.0	8.3	10.0	0.25	90.0 x 4.0 x 1.7	BD4000900	OR5008000	80.00 x 5.00
95.0	86.4	9.0	10.9	0.25	95.0 x 4.3 x 1.7	BD4300950	ORAR00340	85.09 x 5.33
95.0	87.0	8.3	10.0	0.25	95.0 x 4.0 x 1.7	BD4000950	OR5008000	80.00 x 5.00

Back-up Ring



Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
100.0	91.4	9.0	10.9	0.25	100.0 x 4.3 x 1.7	BD4301000	ORAR00342	91.44 x 5.33
100.0	92.0	8.3	10.0	0.25	100.0 x 4.0 x 1.7	BD4001000	OR5009000	90.00 x 5.00
105.0	96.4	9.0	10.9	0.25	105.0 x 4.3 x 1.7	BD4301050	ORAR00343	94.62 x 5.33
105.0	97.0	8.3	10.0	0.25	105.0 x 4.0 x 1.7	BD4001050	OR5009500	95.00 x 5.00
110.0	101.4	9.0	10.9	0.25	110.0 x 4.3 x 1.7	BD4301100	ORAR00345	100.97 x 5.33
110.0	102.0	8.3	10.0	0.25	110.0 x 4.0 x 1.7	BD4001100	OR5010000	100.00 x 5.00
115.0	106.4	9.0	10.9	0.25	115.0 x 4.3 x 1.7	BD4301150	ORAR00346	104.14 x 5.33
115.0	107.0	8.3	10.0	0.25	115.0 x 4.0 x 1.7	BD4001150	OR5010500	105.00 x 5.00
120.0	111.4	9.0	10.9	0.25	120.0 x 4.3 x 1.7	BD4301200	ORAR00348	110.49 x 5.33
120.0	112.0	8.3	10.0	0.25	120.0 x 4.0 x 1.7	BD4001200	OR5011000	110.00 x 5.00
125.0	116.4	9.0	10.9	0.25	125.0 x 4.3 x 1.7	BD4301250	ORAR00349	113.67 x 5.33
125.0	117.0	8.3	10.0	0.25	125.0 x 4.0 x 1.7	BD4001250	OR5011500	115.00 x 5.00
130.0	121.4	9.0	10.9	0.25	130.0 x 4.3 x 1.7	BD4301300	ORAR00351	120.02 x 5.33
130.0	122.0	8.3	10.0	0.25	130.0 x 4.0 x 1.7	BD4001300	OR5012000	120.00 x 5.00
135.0	123.4	12.3	15.1	0.25	135.0 x 5.8 x 2.5	BD5801350	ORAR00427	120.02 x 6.99
140.0	128.4	12.3	15.1	0.25	140.0 x 5.8 x 2.5	BD5801400	ORAR00429	126.37 x 6.99
150.0	138.4	12.3	15.1	0.25	150.0 x 5.8 x 2.5	BD5801500	ORAR00432	135.89 x 6.99
160.0	148.4	12.3	15.1	0.25	160.0 x 5.8 x 2.5	BD5801600	ORAR00435	145.42 x 6.99
170.0	158.4	12.3	15.1	0.25	170.0 x 5.8 x 2.5	BD5801700	ORAR00438	158.12 x 6.99
180.0	168.4	12.3	15.1	0.25	180.0 x 5.8 x 2.5	BD5801800	ORAR00439	164.47 x 6.99
190.0	178.4	12.3	15.1	0.25	190.0 x 5.8 x 2.5	BD5801900	ORAR00441	177.17 x 6.99
200.0	188.4	12.3	15.1	0.25	200.0 x 5.8 x 2.5	BD5802000	ORAR00442	183.52 x 6.99
210.0	198.4	12.3	15.1	0.25	210.0 x 5.8 x 2.5	BD5802100	ORAR00444	196.22 x 6.99
220.0	208.4	12.3	15.1	0.25	220.0 x 5.8 x 2.5	BD5802200	ORAR00445	202.57 x 6.99
230.0	218.4	12.3	15.1	0.25	230.0 x 5.8 x 2.5	BD5802300	ORAR00446	215.27 x 6.99
240.0	228.4	12.3	15.1	0.25	240.0 x 5.8 x 2.5	BD5802400	ORAR00447	227.97 x 6.99
250.0	238.4	12.3	15.1	0.25	250.0 x 5.8 x 2.5	BD5802500	ORAR00448	240.67 x 6.99
280.0	268.4	12.3	15.1	0.25	280.0 x 5.8 x 2.5	BD5802800	ORAR00450	266.07 x 6.99
300.0	288.4	12.3	15.1	0.25	300.0 x 5.8 x 2.5	BD5803000	ORAR00451	278.77 x 6.99
320.0	308.4	12.3	15.1	0.25	320.0 x 5.8 x 2.5	BD5803200	ORAR00453	304.17 x 6.99
350.0	338.4	12.3	15.1	0.25	350.0 x 5.8 x 2.5	BD5803500	ORAR00455	329.57 x 6.99
400.0	388.4	12.3	15.1	0.25	400.0 x 5.8 x 2.5	BD5804000	ORAR00459	380.37 x 6.99
420.0	408.4	12.3	15.1	0.25	420.0 x 5.8 x 2.5	BD5804200	ORAR00461	405.26 x 6.99
450.0	438.4	12.3	15.1	0.25	450.0 x 5.8 x 2.5	BD5804500	ORAR00463	430.66 x 6.99
480.0	468.4	12.3	15.1	0.25	480.0 x 5.8 x 2.5	BD5804800	ORAR00465	456.06 x 6.99
500.0	488.4	12.3	15.1	0.25	500.0 x 5.8 x 2.5	BD5805000	ORAR00467	481.46 x 6.99

Further sizes on request

This table shows the possible range of available dimensions (Back-up Rings). However, these dimensions are not always stock items.



Back-up Ring

D.1.3 Spiral Back-up Ring types (BP), material PTFE

The following figure and tables include installation recommendations and Back-up Ring dimensions for external sealing applications with the spiral Back-up Ring types BP.

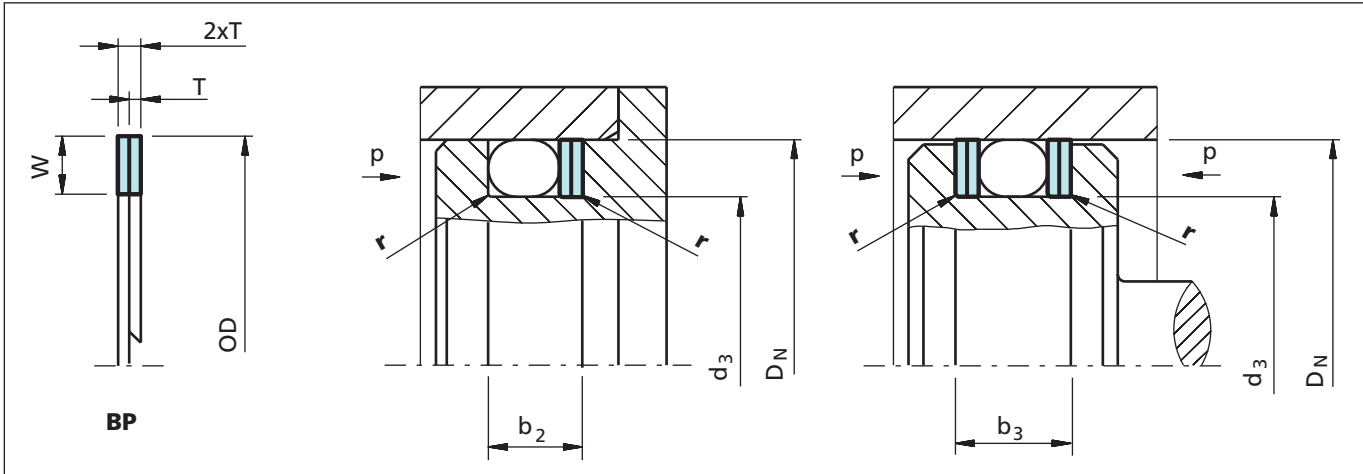


Figure 6 Installation drawing external sealing, spiral Back-up Ring type

Table 6 Installation dimensions for the spiral Back-up Ring type, external sealing

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter		Groove width		Radius
	Dynamic	Static	T	Dynamic d_3 h9	Static d_3 h9	$b_2 + 0.2$	$b_3 + 0.2$	$r \pm 0.2$
1.50	1.25	1.10	0.50	$D_N - 2.5$	$D_N - 2.2$	3.0	4.0	0.25
1.60	1.30	1.20	0.50	$D_N - 2.6$	$D_N - 2.4$	3.1	4.1	0.25
1.78	1.45	1.30	0.70	$D_N - 2.9$	$D_N - 2.6$	3.8	5.2	0.25
1.80	1.45	1.30	0.70	$D_N - 2.9$	$D_N - 2.6$	3.8	5.2	0.25
2.00	1.65	1.50	0.70	$D_N - 3.3$	$D_N - 3.0$	4.1	5.5	0.25
2.40	2.05	1.80	0.70	$D_N - 4.1$	$D_N - 3.6$	4.6	6.0	0.25
2.50	2.15	1.90	0.70	$D_N - 4.3$	$D_N - 3.8$	4.7	6.1	0.25
2.62	2.25	2.00	0.70	$D_N - 4.5$	$D_N - 4.0$	5.0	6.4	0.25
2.65	2.25	2.00	0.70	$D_N - 4.5$	$D_N - 4.0$	5.0	6.4	0.25
3.00	2.60	2.30	0.70	$D_N - 5.2$	$D_N - 4.6$	5.4	6.8	0.25
3.53	3.10	2.70	0.70	$D_N - 6.2$	$D_N - 5.4$	6.2	7.6	0.25
3.55	3.10	2.70	0.70	$D_N - 6.2$	$D_N - 5.4$	6.2	7.6	0.25
4.00	3.50	3.10	0.85	$D_N - 7.0$	$D_N - 6.2$	6.9	8.6	0.25
5.00	4.40	4.00	0.85	$D_N - 8.8$	$D_N - 8.0$	8.3	10.0	0.25
5.30	4.70	4.30	0.85	$D_N - 9.4$	$D_N - 8.6$	9.0	10.9	0.25
5.33	4.70	4.30	0.85	$D_N - 9.4$	$D_N - 8.6$	9.0	10.9	0.25
5.70	5.00	4.60	0.85	$D_N - 10.0$	$D_N - 9.2$	9.0	11.0	0.25
6.00	5.30	4.90	0.85	$D_N - 10.6$	$D_N - 9.8$	9.3	11.2	0.25
7.00	6.10	5.80	1.25	$D_N - 12.2$	$D_N - 11.6$	12.3	15.1	0.25
8.00	7.10	6.70	1.25	$D_N - 14.2$	$D_N - 13.4$	12.6	15.4	0.25
8.40	7.50	7.10	1.25	$D_N - 15.0$	$D_N - 14.2$	12.8	15.6	0.25



Ordering Example

Back-up Ring: Type BP (spiral)
for O-Ring seal
Application: Dynamic, external sealing
Bore diameter: $D_N = 120.00$ mm
Groove diameter: $d_3 = 111.20$ mm
O-Ring cross section: $d_2 = 5.00$ mm
Back-up Ring material: PTFE, virgin
Material code see page 91

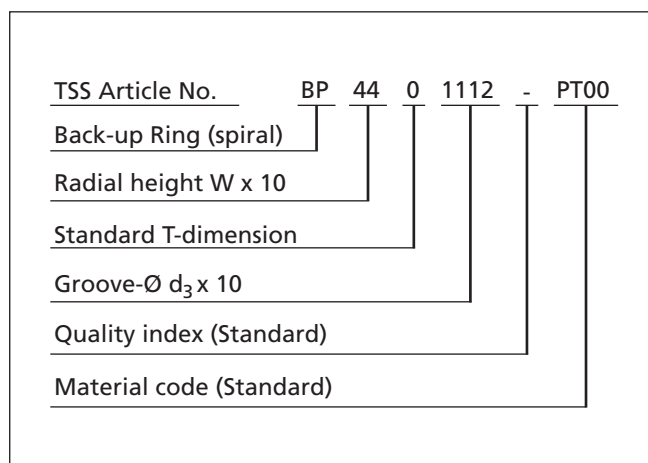


Table 7 Preferred series for dynamic application, spiral Back-up Ring type BP, external sealing, material PTFE

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b_2 -0.2	b_3 -0.2					
D_N H8	d_3 h9							
6.0	3.1	3.8	5.2	0.25	6.0 x 1.45 x 0.70	BP14H00031	ORAR00006	2.90 x 1.78
6.0	3.5	3.0	4.0	0.25	6.0 x 1.25 x 0.50	BP12H00035	OR1500300	3.00 x 1.50
8.0	5.1	3.8	5.2	0.25	8.0 x 1.45 x 0.70	BP14H00051	ORAR00008	4.47 x 1.78
8.0	5.5	3.0	4.0	0.25	8.0 x 1.25 x 0.50	BP12H00055	OR1500500	5.00 x 1.50
10.0	7.1	3.8	5.2	0.25	10.0 x 1.45 x 0.70	BP14H00071	ORAR00011	7.65 x 1.78
10.0	7.5	3.0	4.0	0.25	10.0 x 1.45 x 0.50	BP12H00075	OR1500700	7.00 x 1.50
12.0	8.7	4.1	5.5	0.25	12.0 x 1.65 x 0.70	BP16H00087	OR2000800	8.00 x 2.00
12.0	9.1	3.8	5.2	0.25	12.0 x 1.45 x 0.70	BP14H00091	ORAR00012	9.25 x 1.78
14.0	10.7	4.1	5.5	0.25	14.0 x 1.65 x 0.70	BP16H00107	OR2001000	10.00 x 2.00
14.0	11.1	3.8	5.2	0.25	14.0 x 1.45 x 0.70	BP14H00111	ORAR00013	10.82 x 1.78
15.0	11.7	4.1	5.5	0.25	15.0 x 1.65 x 0.70	BP16H00117	OR2001100	11.00 x 2.00
15.0	12.1	3.8	5.2	0.25	15.0 x 1.45 x 0.70	BP14H00121	ORAR00014	12.42 x 1.78
16.0	12.7	4.1	5.5	0.25	16.0 x 1.65 x 0.70	BP16H00127	OR2001200	12.00 x 2.00
16.0	13.1	3.8	5.2	0.25	16.0 x 1.45 x 0.70	BP14H00131	ORAR00015	14.00 x 1.78
18.0	14.7	4.1	5.5	0.25	18.0 x 1.65 x 0.70	BP16H00147	OR2001400	14.00 x 2.00
18.0	15.1	3.8	5.2	0.25	18.0 x 1.45 x 0.70	BP14H00151	ORAR00016	15.60 x 1.78
20.0	16.7	4.1	5.5	0.25	20.0 x 1.65 x 0.70	BP16H00167	OR2001600	16.00 x 2.00
20.0	17.1	3.8	5.2	0.25	20.0 x 1.45 x 0.70	BP14H00171	ORAR00017	17.17 x 1.78
22.0	18.7	4.1	5.5	0.25	22.0 x 1.65 x 0.70	BP16H00187	OR2001800	18.00 x 2.00
22.0	19.1	3.8	5.2	0.25	22.0 x 1.45 x 0.70	BP14H00191	ORAR00018	18.77 x 1.78
25.0	21.7	4.1	5.5	0.25	25.0 x 1.65 x 0.70	BP16H00217	OR2002100	21.00 x 2.00
25.0	22.1	3.8	5.2	0.25	25.0 x 1.45 x 0.70	BP14H00221	ORAR00020	21.95 x 1.78
28.0	22.8	5.4	6.8	0.25	28.0 x 2.60 x 0.70	BP2600228	OR3002200	22.00 x 3.00
28.0	23.5	5.0	6.4	0.25	28.0 x 2.25 x 0.70	BP22H00235	ORAR00119	23.47 x 2.62



Back-up Ring

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ -0.2	b ₃ -0.2					
30.0	24.8	5.4	6.8	0.25	30.0 x 2.60 x 0.70	BP2600248	OR3002400	24.00 x 3.00
30.0	25.5	5.0	6.4	0.25	30.0 x 2.25 x 0.70	BP22H00255	ORAR00120	25.07 x 2.62
32.0	26.8	5.4	6.8	0.25	26.8 x 2.60 x 0.70	BP2600268	OR3002600	26.00 x 3.00
32.0	27.5	5.0	6.4	0.25	32.0 x 2.65 x 0.70	BP26H00275	ORAR00121	26.64 x 2.62
35.0	29.8	5.4	6.8	0.25	35.0 x 2.60 x 0.70	BP2600298	OR3002900	29.00 x 3.00
35.0	30.5	5.0	6.4	0.25	35.0 x 2.25 x 0.70	BP22H00305	ORAR00123	29.82 x 2.62
40.0	34.8	5.4	6.8	0.25	40.0 x 2.60 x 0.70	BP2600348	OR3003400	34.00 x 3.00
40.0	35.5	5.0	6.4	0.25	40.0 x 2.25 x 0.70	BP22H00355	ORAR00126	34.59 x 2.62
42.0	36.8	5.4	6.8	0.25	42.0 x 2.60 x 0.70	BP2600368	OR3003600	36.00 x 3.00
42.0	37.5	5.0	6.4	0.25	42.0 x 2.25 x 0.70	BP22H00375	ORAR00127	36.17 x 2.62
45.0	39.8	5.4	6.8	0.25	45.0 x 2.60 x 0.70	BP2600398	OR3003900	39.00 x 3.00
45.0	40.5	5.0	6.4	0.25	45.0 x 2.25 x 0.70	BP22H00405	ORAR00129	39.34 x 2.62
48.0	41.0	6.9	8.6	0.25	48.0 x 3.50 x 0.85	BP3500410	OR4004000	40.00 x 4.00
48.0	41.8	6.2	7.6	0.25	48.0 x 3.10 x 0.70	BP31D0418	ORAR00223	40.87 x 3.53
50.0	43.0	6.9	8.6	0.25	50.0 x 3.50 x 0.85	BP3500430	OR4004200	42.00 x 4.00
50.0	43.8	6.2	7.6	0.25	50.0 x 3.10 x 0.70	BP31D0438	ORAR00224	44.04 x 3.53
52.0	45.0	6.9	8.6	0.25	52.0 x 3.50 x 0.85	BP3500450	OR4004400	44.00 x 4.00
52.0	45.8	6.2	7.6	0.25	52.0 x 3.10 x 0.70	BP31D0458	ORAR00224	44.04 x 3.53
55.0	48.0	6.9	8.6	0.25	55.0 x 3.50 x 0.85	BP3500480	OR4004700	47.00 x 4.00
55.0	48.8	6.2	7.6	0.25	55.0 x 3.10 x 0.70	BP31D0488	ORAR00225	47.22 x 3.53
60.0	53.0	6.9	8.6	0.25	60.0 x 3.50 x 0.85	BP3500530	OR4005200	52.00 x 4.00
60.0	53.8	6.2	7.6	0.25	60.0 x 3.10 x 0.70	BP31D0538	ORAR00227	53.57 x 3.53
63.0	56.0	6.9	8.6	0.25	63.0 x 3.50 x 0.85	BP3500560	OR4005500	55.00 x 4.00
63.0	56.8	6.2	7.6	0.25	63.0 x 3.10 x 0.70	BP31D0568	ORAR00228	56.74 x 3.53
65.0	58.0	6.9	8.6	0.25	65.0 x 3.50 x 0.85	BP3500580	OR4005700	57.00 x 4.00
65.0	58.8	6.2	7.6	0.25	65.0 x 3.10 x 0.70	BP31D0588	ORAR00228	56.74 x 3.53
70.0	63.0	6.9	8.6	0.25	70.0 x 3.50 x 0.85	BP3500630	OR4006200	62.00 x 4.00
70.0	63.8	6.2	7.6	0.25	70.0 x 3.10 x 0.70	BP31D0638	ORAR00230	63.09 x 3.53
75.0	68.0	6.9	8.6	0.25	75.0 x 3.50 x 0.85	BP3500680	OR4006700	67.00 x 4.00
75.0	68.8	6.2	7.6	0.25	75.0 x 3.10 x 0.70	BP31D0688	ORAR00231	66.27 x 3.53
80.0	73.0	6.9	8.6	0.25	80.0 x 3.50 x 0.85	BP3500730	OR4007200	72.00 x 4.00
80.0	73.8	6.2	7.6	0.25	80.0 x 3.10 x 0.70	BP31D0738	ORAR00233	72.62 x 3.53
85.0	78.0	6.9	8.6	0.25	85.0 x 3.50 x 0.85	BP3500780	OR4007700	77.00 x 4.00
85.0	78.8	6.2	7.6	0.25	85.0 x 3.10 x 0.70	BP31D0788	ORAR00235	78.97 x 3.53
90.0	80.6	9.0	10.9	0.25	90.0 x 4.70 x 0.85	BP4700806	ORAR00338	78.74 x 5.33
90.0	81.2	8.3	10.0	0.25	90.0 x 4.40 x 0.85	BP4400812	OR5008000	80.00 x 5.00

Back-up Ring



Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 -0.2$	$b_3 -0.2$					
95.0	85.6	9.0	10.9	0.25	95.0 x 4.70 x 0.85	BP4700856	ORAR00340	85.09 x 5.33
95.0	86.2	8.3	10.0	0.25	95.0 x 4.40 x 0.85	BP4400862	OR5008500	85.00 x 5.00
100.0	90.6	9.0	10.9	0.25	100.0 x 4.70 x 0.85	BP4700906	ORAR00342	91.44 x 5.33
100.0	91.2	8.3	10.0	0.25	100.0 x 4.40 x 0.85	BP4400912	OR5009000	90.00 x 5.00
105.0	95.6	9.0	10.9	0.25	105.0 x 4.70 x 0.85	BP4700956	ORAR00343	94.62 x 5.33
105.0	96.2	8.3	10.0	0.25	105.0 x 4.40 x 0.85	BP4400962	OR5009500	95.00 x 5.00
110.0	100.6	9.0	10.9	0.25	110.0 x 4.70 x 0.85	BP4701006	ORAR00345	100.97 x 5.33
110.0	101.2	8.3	10.0	0.25	110.0 x 4.40 x 0.85	BP4401012	OR5010000	100.00 x 5.00
115.0	105.6	9.0	10.9	0.25	115.0 x 4.70 x 0.85	BP4701056	ORAR00346	104.14 x 5.33
115.0	106.2	8.3	10.0	0.25	115.0 x 4.40 x 0.85	BP4401062	OR5010500	105.00 x 5.00
120.0	110.6	9.0	10.9	0.25	120.0 x 4.70 x 0.85	BP4701106	ORAR00348	110.49 x 5.33
120.0	111.2	8.3	10.0	0.25	120.0 x 4.40 x 0.85	BP4401112	OR5011000	110.00 x 5.00
125.0	115.6	9.0	10.9	0.25	125.0 x 4.70 x 0.85	BP4701156	ORAR00349	113.67 x 5.33
125.0	116.2	8.3	10.0	0.25	125.0 x 4.40 x 0.85	BP4401162	OR5011500	115.00 x 5.00
130.0	120.6	9.0	10.9	0.25	130.0 x 4.70 x 0.85	BP4701206	ORAR00351	120.02 x 5.33
130.0	121.2	8.3	10.0	0.25	130.0 x 4.40 x 0.85	BP4401212	OR5012000	120.00 x 5.00
135.0	122.8	12.3	15.1	0.25	135.0 x 6.10 x 1.25	BP6101228	ORAR00427	120.02 x 6.99
140.0	127.8	12.3	15.1	0.25	140.0 x 6.10 x 1.25	BP6101278	ORAR00429	126.37 x 6.99
150.0	137.8	12.3	15.1	0.25	150.0 x 6.10 x 1.25	BP6101378	ORAR00432	135.89 x 6.99
160.0	147.8	12.3	15.1	0.25	160.0 x 6.10 x 1.25	BP6101478	ORAR00435	145.42 x 6.99
170.0	157.8	12.3	15.1	0.25	170.0 x 6.10 x 1.25	BP6101578	ORAR00438	158.12 x 6.99
180.0	167.8	12.3	15.1	0.25	180.0 x 6.10 x 1.25	BP6101678	ORAR00439	164.47 x 6.99
190.0	177.8	12.3	15.1	0.25	190.0 x 6.10 x 1.25	BP6101778	ORAR00441	177.17 x 6.99
200.0	187.8	12.3	15.1	0.25	200.0 x 6.10 x 1.25	BP6101878	ORAR00442	183.52 x 6.99
210.0	197.8	12.3	15.1	0.25	210.0 x 6.10 x 1.25	BP6101978	ORAR00444	196.22 x 6.99
220.0	207.8	12.3	15.1	0.25	220.0 x 6.10 x 1.25	BP6102078	ORAR00445	202.57 x 6.99
230.0	217.8	12.3	15.1	0.25	230.0 x 6.10 x 1.25	BP6102178	ORAR00446	215.27 x 6.99
240.0	227.8	12.3	15.1	0.25	240.0 x 6.10 x 1.25	BP6102278	ORAR00447	227.97 x 6.99
250.0	237.8	12.3	15.1	0.25	250.0 x 6.10 x 1.25	BP6102378	ORAR00448	240.67 x 6.99
280.0	267.8	12.3	15.1	0.25	280.0 x 6.10 x 1.25	BP6102678	ORAR00450	266.07 x 6.99
300.0	287.8	12.3	15.1	0.25	300.0 x 6.10 x 1.25	BP6102878	ORAR00451	278.77 x 6.99
320.0	307.8	12.3	15.1	0.25	320.0 x 6.10 x 1.25	BP6103078	ORAR00453	304.17 x 6.99
350.0	337.8	12.3	15.1	0.25	350.0 x 6.10 x 1.25	BP6103378	ORAR00455	329.57 x 6.99
400.0	387.8	12.3	15.1	0.25	400.0 x 6.10 x 1.25	BP6103878	ORAR00459	380.37 x 6.99
420.0	407.8	12.3	15.1	0.25	420.0 x 6.10 x 1.25	BP6104078	ORAR00461	405.26 x 6.99
450.0	437.8	12.3	15.1	0.25	450.0 x 6.10 x 1.25	BP6104378	ORAR00463	430.66 x 6.99



Back-up Ring

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 - 0.2$	$b_3 - 0.2$					$d_1 \times d_2$
$D_N H8$	$d_3 h9$			$r \pm 0.2$	OD x W x T			
480.0	467.8	12.3	15.1	0.25	480.0 x 6.10 x 1.25	BP6104678	ORAR00465	456.06 x 6.99
500.0	487.8	12.3	15.1	0.25	500.0 x 6.10 x 1.25	BP6104878	ORAR00467	481.46 x 6.99

Further sizes on request

This table shows the possible range of available dimensions (Back-up Rings). However, these dimensions are not always stock items.



D.2 Internal sealing (rod), static and dynamic applications

D.2.1 Rectangular Back-up Ring types, uncut (BU), and cut (BG), material PTFE

The following figure and tables include installation recommendations and Back-up Ring dimensions for internal sealing applications with the rectangular Back-up Ring types BU (uncut) and BG (cut).

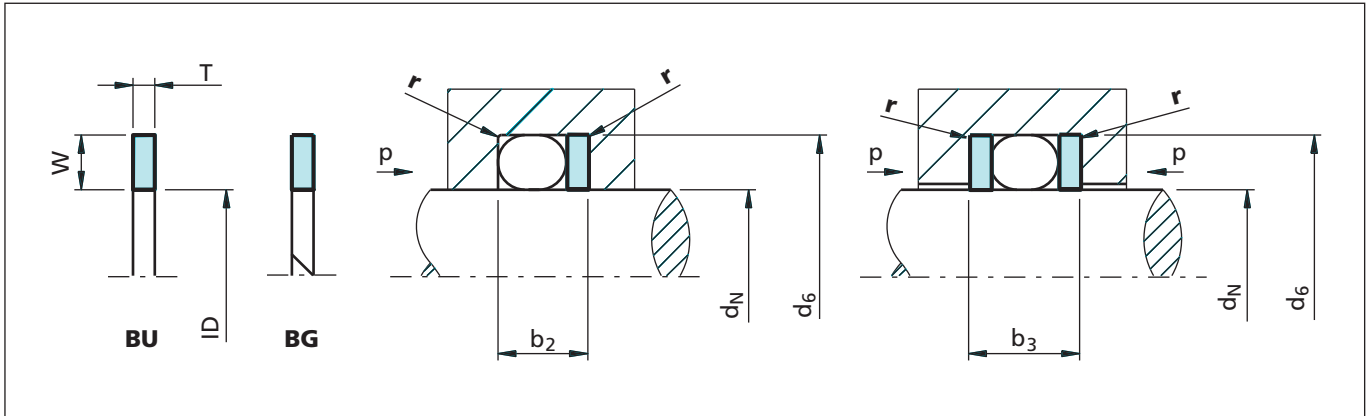


Figure 7 Installation drawing internal sealing, rectangular Back-up Ring types

Table 8 Installation dimensions for rectangular Back-up Ring types, uncut and cut, internal sealing

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter		Groove width		Radius
	Dynamic	Static	T	Dynamic d_6 h9	Static d_6 h9	$b_2 + 0.2$	$b_3 + 0.2$	$r \pm 0.2$
1.50	1.25	1.10	1.0	$d_N + 2.5$	$d_N + 2.2$	3.0	4.0	0.25
1.60	1.30	1.20	1.0	$d_N + 2.6$	$d_N + 2.4$	3.1	4.1	0.25
1.78	1.45	1.30	1.4	$d_N + 2.9$	$d_N + 2.6$	3.8	5.2	0.25
1.80	1.45	1.30	1.4	$d_N + 2.9$	$d_N + 2.6$	3.8	5.2	0.25
2.00	1.65	1.50	1.4	$d_N + 3.3$	$d_N + 3.0$	4.1	5.5	0.25
2.40	2.05	1.80	1.4	$d_N + 4.1$	$d_N + 3.6$	4.6	6.0	0.25
2.50	2.15	1.90	1.4	$d_N + 4.3$	$d_N + 3.8$	4.7	6.1	0.25
2.62	2.25	2.00	1.4	$d_N + 4.5$	$d_N + 4.0$	5.0	6.4	0.25
2.65	2.25	2.00	1.4	$d_N + 4.5$	$d_N + 4.0$	5.0	6.4	0.25
3.00	2.60	2.30	1.4	$d_N + 5.2$	$d_N + 4.6$	5.4	6.8	0.25
3.53	3.10	2.70	1.4	$d_N + 6.2$	$d_N + 5.4$	6.2	7.6	0.25
3.55	3.10	2.70	1.4	$d_N + 6.2$	$d_N + 5.4$	6.2	7.6	0.25
4.00	3.50	3.10	1.7	$d_N + 7.0$	$d_N + 6.2$	6.9	8.6	0.25
5.00	4.40	4.00	1.7	$d_N + 8.8$	$d_N + 8.0$	8.3	10.0	0.25
5.30	4.70	4.30	1.7	$d_N + 9.4$	$d_N + 8.6$	9.0	10.9	0.25
5.33	4.70	4.30	1.7	$d_N + 9.4$	$d_N + 8.6$	9.0	10.9	0.25
5.70	5.00	4.60	1.7	$d_N + 10.0$	$d_N + 9.2$	9.0	11.0	0.25
6.00	5.30	4.90	1.7	$d_N + 10.6$	$d_N + 9.8$	9.3	11.2	0.25
7.00	6.10	5.80	2.5	$d_N + 12.2$	$d_N + 11.6$	12.3	15.1	0.25
8.00	7.10	6.70	2.5	$d_N + 14.2$	$d_N + 13.4$	12.6	15.4	0.25
8.40	7.50	7.10	2.5	$d_N + 15.0$	$d_N + 14.2$	12.8	15.6	0.25



Back-up Ring

Ordering Example

Back-up Ring: Type BU (uncut)
for O-Ring seal
Application: Static, external sealing
Rod diameter: $d_N = 25.00$ mm
O-Ring cross section: $d_2 = 2.62$ mm
Back-up Ring material: PTFE, virgin
Material code see page 91

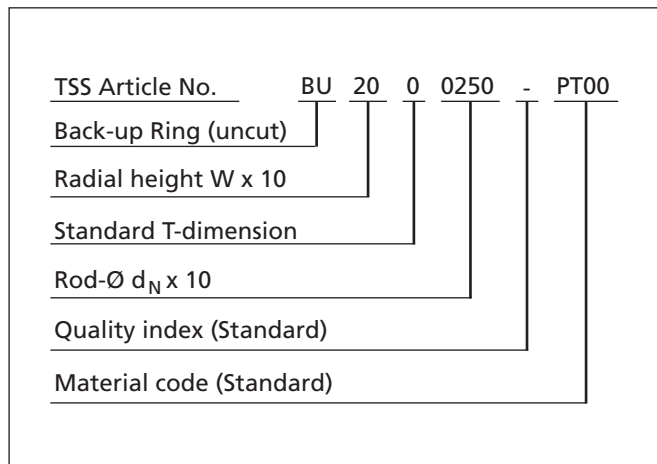


Table 9 Preferred series for static application, rectangular Back-up Ring type BU (uncut), internal sealing, material PTFE

Rod Ø d_N f7	Groove Ø d_6 H9	Groove width		Radius $r \pm 0.2$	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 + 0.2$	$b_3 + 0.2$					$d_1 \times d_2$
4.0	6.2	3.0	4.0	0.25	4.0 x 1.1 x 1.4	BU11L0040	OR1500400	4.00 x 1.50
4.0	6.6	3.8	5.2	0.25	4.0 x 1.3 x 1.4	BU1300040	ORAR00007	3.68 x 1.78
5.0	7.2	3.0	4.0	0.25	5.0 x 1.1 x 1.4	BU1100050	OR1500500	5.00 x 1.50
5.0	7.6	3.8	5.2	0.25	5.0 x 1.3 x 1.4	BU1300050	ORAR00008	4.47 x 1.78
6.0	8.2	3.0	4.0	0.25	6.0 x 1.1 x 1.4	BU1100060	OR1500600	6.00 x 1.50
6.0	8.6	3.8	5.2	0.25	6.0 x 1.3 x 1.4	BU1300060	ORAR00010	6.07 x 1.78
8.0	10.6	3.8	5.2	0.25	8.0 x 1.3 x 1.4	BU1300080	ORAR00011	7.65 x 1.78
8.0	11.0	4.1	5.5	0.25	8.0 x 1.5 x 1.4	BU1500080	OR2000800	8.00 x 2.00
10.0	12.6	3.8	5.2	0.25	10.0 x 1.3 x 1.4	BU1300100	ORAR00013	10.82 x 1.78
10.0	13.0	4.1	5.5	0.25	10.0 x 1.5 x 1.4	BU1500100	OR2001000	10.00 x 2.00
12.0	14.6	3.8	5.2	0.25	12.0 x 1.3 x 1.4	BU1300120	ORAR00014	12.42 x 1.78
12.0	15.0	4.1	5.5	0.25	12.0 x 1.5 x 1.4	BU1500120	OR2001200	12.00 x 2.00
14.0	16.6	3.8	5.2	0.25	14.0 x 1.3 x 1.4	BU1300140	ORAR00015	14.00 x 1.78
14.0	17.0	4.1	5.5	0.25	14.0 x 1.5 x 1.4	BU1500140	OR2001400	14.00 x 2.00
15.0	17.6	3.8	5.2	0.25	15.0 x 1.3 x 1.4	BU1300150	ORAR00016	15.60 x 1.78
15.0	18.0	4.1	5.5	0.25	15.0 x 1.5 x 1.4	BU1500150	OR2001500	15.00 x 2.00
16.0	18.6	3.8	5.2	0.25	16.0 x 1.3 x 1.4	BU1300160	ORAR00016	15.60 x 1.78
16.0	19.0	4.1	5.5	0.25	16.0 x 1.5 x 1.4	BU1500160	OR2001600	16.00 x 2.00
18.0	20.6	3.8	5.2	0.25	18.0 x 1.3 x 1.4	BU1300180	ORAR00018	18.77 x 1.78
18.0	21.0	4.1	5.5	0.25	18.0 x 1.5 x 1.4	BU1500180	OR2001800	18.00 x 2.00
20.0	22.6	3.8	5.2	0.25	20.0 x 1.3 x 1.4	BU1300200	ORAR00019	20.35 x 1.78
20.0	23.0	4.1	5.5	0.25	20.0 x 1.5 x 1.4	BU1500200	OR2002000	20.00 x 2.00
22.0	26.0	5.0	6.4	0.25	22.0 x 2.0 x 1.4	BU2000220	ORAR00118	21.89 x 2.62
22.0	26.6	5.4	6.8	0.25	22.0 x 2.3 x 1.4	BU2300220	OR3002200	22.00 x 3.00

Back-up Ring



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
25.0	29.0	5.0	6.4	0.25	25.0 x 2.0 x 1.4	BU2000250	ORAR00120	25.07 x 2.62
25.0	29.6	5.4	6.8	0.25	25.0 x 2.3 x 1.4	BU2300250	OR3002500	25.00 x 3.00
28.0	32.0	5.0	6.4	0.25	28.0 x 2.0 x 1.4	BU2000280	ORAR00122	28.24 x 2.62
28.0	32.6	5.4	6.8	0.25	28.0 x 2.3 x 1.4	BU2300280	OR3002800	28.00 x 2.00
30.0	34.0	5.0	6.4	0.25	30.0 x 2.0 x 1.4	BU2000300	ORAR00123	29.83 x 2.62
30.0	34.6	5.4	6.8	0.25	30.0 x 2.3 x 1.4	BU2300300	OR3003000	30.00 x 3.00
32.0	36.0	5.0	6.4	0.25	32.0 x 2.0 x 1.4	BU2000320	ORAR00125	31.42 x 2.62
32.0	36.6	5.4	6.8	0.25	32.0 x 2.3 x 1.4	BU2300320	OR3003200	32.00 x 3.00
35.0	39.0	5.0	6.4	0.25	35.0 x 2.0 x 1.4	BU2000350	ORAR00126	34.59 x 2.62
35.0	39.6	5.4	6.8	0.25	35.0 x 2.3 x 1.4	BU2300350	OR3003500	35.00 x 3.00
36.0	40.0	5.0	6.4	0.25	36.0 x 2.0 x 1.4	BU2000360	ORAR00127	36.17 x 2.62
36.0	40.6	5.4	6.8	0.25	36.0 x 2.3 x 1.4	BU2300360	OR3003600	36.00 x 3.00
40.0	45.4	6.2	7.6	0.25	40.0 x 2.7 x 1.4	BU2700400	ORAR00223	40.87 x 3.53
40.0	46.1	6.9	8.6	0.25	40.0 x 3.1 x 1.7	BU3100400	OR4004000	40.00 x 4.00
42.0	47.4	6.2	7.6	0.25	42.0 x 2.7 x 1.4	BU2700420	ORAR00223	40.87 x 3.53
42.0	48.2	6.9	8.6	0.25	42.0 x 3.1 x 1.7	BU3100420	OR4004200	42.00 x 4.00
45.0	50.4	6.2	7.6	0.25	45.0 x 2.7 x 1.4	BU2700450	ORAR00224	44.04 x 3.53
45.0	51.2	6.9	8.6	0.25	45.0 x 3.1 x 1.7	BU3100450	OR4004500	45.00 x 4.00
48.0	53.4	6.2	7.6	0.25	48.0 x 2.7 x 1.4	BU2700480	ORAR00225	47.22 x 3.53
48.0	54.2	6.9	8.6	0.25	48.0 x 3.1 x 1.7	BU3100480	OR4004800	48.00 x 4.00
50.0	55.4	6.2	7.6	0.25	50.0 x 2.7 x 1.4	BU2700500	ORAR00226	50.39 x 3.53
50.0	56.2	6.9	8.6	0.25	50.0 x 3.1 x 1.7	BU3100500	OR4005000	50.00 x 4.00
52.0	57.4	6.2	7.6	0.25	52.0 x 2.7 x 1.4	BU2700520	ORAR00226	50.39 x 3.53
52.0	58.2	6.9	8.6	0.25	52.0 x 3.1 x 1.7	BU3100520	OR4005200	52.00 x 4.00
55.0	60.4	6.2	7.6	0.25	55.0 x 2.7 x 1.4	BU2700550	ORAR00227	53.57 x 3.53
55.0	61.2	6.9	8.6	0.25	55.0 x 3.1 x 1.7	BU3100550	OR4005500	55.00 x 4.00
56.0	61.4	6.2	7.6	0.25	56.0 x 2.7 x 1.4	BU2700560	ORAR00228	56.74 x 3.53
56.0	62.2	6.9	8.6	0.25	56.0 x 3.1 x 1.7	BU3100560	OR4005600	56.00 x 4.00
60.0	65.4	6.2	7.6	0.25	60.0 x 2.7 x 1.4	BU2700600	ORAR00229	59.92 x 3.53
60.0	66.2	6.9	8.6	0.25	60.0 x 3.1 x 1.7	BU3100600	OR4006000	60.00 x 4.00
63.0	68.4	6.2	7.6	0.25	63.0 x 2.7 x 1.4	BU2700630	ORAR00230	63.09 x 3.53
63.0	69.2	6.9	8.6	0.25	63.0 x 3.1 x 1.7	BU3100630	OR4006300	60.00 x 4.00
65.0	70.4	6.2	7.6	0.25	65.0 x 2.7 x 1.4	BU2700650	ORAR00231	66.27 x 3.53
65.0	71.2	6.9	8.6	0.25	65.0 x 3.1 x 1.7	BU3100650	OR4006500	65.40 x 4.00
70.0	75.4	6.2	7.6	0.25	70.0 x 2.7 x 1.4	BU2700700	ORAR00232	69.44 x 3.53
70.0	76.2	6.9	8.6	0.25	70.0 x 3.1 x 1.7	BU3100700	OR4007000	70.00 x 4.00
75.0	80.4	6.2	7.6	0.25	75.0 x 2.7 x 1.4	BU2700750	ORAR00234	75.79 x 3.53



Back-up Ring

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
75.0	81.2	6.9	8.6	0.25	75.0 x 3.1 x 1.7	BU3100750	OR4007500	75.00 x 4.00
80.0	88.0	8.3	10.0	0.25	80.0 x 4.0 x 1.7	BU4000800	OR5008000	80.00 x 5.00
80.0	93.6	9.0	10.9	0.25	80.0 x 4.3 x 1.7	BU4300800	ORAR00339	81.92 x 5.33
85.0	88.6	9.0	10.9	0.25	85.0 x 4.0 x 1.7	BU4000850	OR5008500	85.00 x 5.00
85.0	93.0	8.3	10.0	0.25	85.0 x 4.3 x 1.7	BU4300850	ORAR00340	85.09 x 5.33
90.0	98.0	8.3	10.0	0.25	90.0 x 4.0 x 1.7	BU4000900	OR5009000	90.00 x 5.00
90.0	98.6	9.0	10.9	0.25	90.0 x 4.3 x 1.7	BU4300900	ORAR00342	91.44 x 5.33
95.0	103.0	8.3	10.0	0.25	95.0 x 4.0 x 1.7	BU4000950	OR5009500	95.00 x 5.00
95.0	103.6	9.0	10.9	0.25	95.0 x 4.3 x 1.7	BU4300950	ORAR00343	94.62 x 5.33
100.0	108.0	8.3	10.0	0.25	100.0 x 4.0 x 1.7	BU4001000	OR5010000	100.00 x 5.00
100.0	108.6	9.0	10.9	0.25	100.0 x 4.3 x 1.7	BU4301000	ORAR00345	100.97 x 5.33
105.0	113.0	8.3	10.0	0.25	105.0 x 4.0 x 1.7	BU4001050	OR5010500	105.00 x 5.00
105.0	113.6	9.0	10.9	0.25	105.0 x 4.3 x 1.7	BU4301050	ORAR00346	104.14 x 5.33
110.0	118.0	8.3	10.0	0.25	110.0 x 4.0 x 1.7	BU4001100	OR5011000	110.00 x 5.00
110.0	118.6	9.0	10.9	0.25	110.0 x 4.3 x 1.7	BU4301100	ORAR00348	110.49 x 5.33
115.0	123.0	8.3	10.0	0.25	115.0 x 4.0 x 1.7	BU4001150	OR5011500	115.00 x 5.00
115.0	123.6	9.0	10.9	0.25	115.0 x 4.3 x 1.7	BU4301150	ORAR00349	113.67 x 5.33
120.0	128.0	8.3	10.0	0.25	120.0 x 4.0 x 1.7	BU4001200	OR5012000	120.00 x 5.00
120.0	128.6	9.0	10.9	0.25	120.0 x 4.3 x 1.7	BU4301200	ORAR00351	120.02 x 5.33
125.0	133.0	8.3	10.0	0.25	125.0 x 4.0 x 1.7	BU4001250	OR5012500	125.00 x 5.00
125.0	133.6	9.0	10.9	0.25	125.0 x 4.3 x 1.7	BU4301250	ORAR00353	126.37 x 5.33
130.0	138.0	8.3	10.0	0.25	130.0 x 4.0 x 1.7	BU4001300	OR5013000	130.00 x 5.00
130.0	138.6	9.0	10.9	0.25	130.0 x 4.3 x 1.7	BU4301300	ORAR00354	129.54 x 5.33
135.0	146.6	12.3	15.1	0.25	135.0 x 5.8 x 2.5	BU5801350	ORAR00432	135.89 x 6.99
140.0	151.6	12.3	15.1	0.25	140.0 x 5.8 x 2.5	BU5801400	ORAR00433	139.07 x 6.99
150.0	161.6	12.3	15.1	0.25	150.0 x 5.8 x 2.5	BU5801500	ORAR00437	151.77 x 6.99
160.0	171.6	12.3	15.1	0.25	160.0 x 5.8 x 2.5	BU5801600	ORAR00438	158.12 x 6.99
170.0	181.6	12.3	15.1	0.25	170.0 x 5.8 x 2.5	BU5801700	ORAR00440	170.82 x 6.99
180.0	191.6	12.3	15.1	0.25	180.0 x 5.8 x 2.5	BU5801800	ORAR00442	183.52 x 6.99
190.0	201.6	12.3	15.1	0.25	190.0 x 5.8 x 2.5	BU5801900	ORAR00443	189.87 x 6.99
200.0	211.6	12.3	15.1	0.25	200.0 x 5.8 x 2.5	BU5802000	ORAR00445	202.57 x 6.99
210.0	221.6	12.3	15.1	0.25	210.0 x 5.8 x 2.5	BU5802100	ORAR00446	215.27 x 6.99
220.0	231.6	12.3	15.1	0.25	220.0 x 5.8 x 2.5	BU5802200	ORAR00446	215.27 x 6.99
230.0	241.6	12.3	15.1	0.25	230.0 x 5.8 x 2.5	BU5802300	ORAR00447	227.97 x 6.99
240.0	251.6	12.3	15.1	0.25	240.0 x 5.8 x 2.5	BU5802400	ORAR00448	240.67 x 6.99
250.0	261.6	12.3	15.1	0.25	250.0 x 5.8 x 2.5	BU5802500	ORAR00449	253.37 x 6.99

Back-up Ring



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
280.0	291.6	12.3	15.1	0.25	280.0 x 5.8 x 2.5	BU5802800	ORAR00451	278.77 x 6.99
300.0	311.6	12.3	15.1	0.25	300.0 x 5.8 x 2.5	BU5803000	ORAR00453	304.17 x 6.99
320.0	331.6	12.3	15.1	0.25	320.0 x 5.8 x 2.5	BU5803200	ORAR00454	316.87 x 6.99
350.0	361.6	12.3	15.1	0.25	350.0 x 5.8 x 2.5	BU5803500	ORAR00457	354.97 x 6.99
360.0	371.6	12.3	15.1	0.25	360.0 x 5.8 x 2.5	BU5803600	ORAR00457	354.97 x 6.99
400.0	411.6	12.3	15.1	0.25	400.0 x 5.8 x 2.5	BU5804000	ORAR00461	405.26 x 6.99

Further sizes on request

This table shows the possible range of available dimensions (Back-up Rings). However, these dimensions are not always stock items.



Back-up Ring

D.2.2 Concave Back-up Ring types, uncut (BB) and cut (BC), material PTFE

The following figure and tables include installation recommendations and Back-up Ring dimensions for internal sealing applications with the concave Back-up Ring types BB (uncut) and BC (cut).

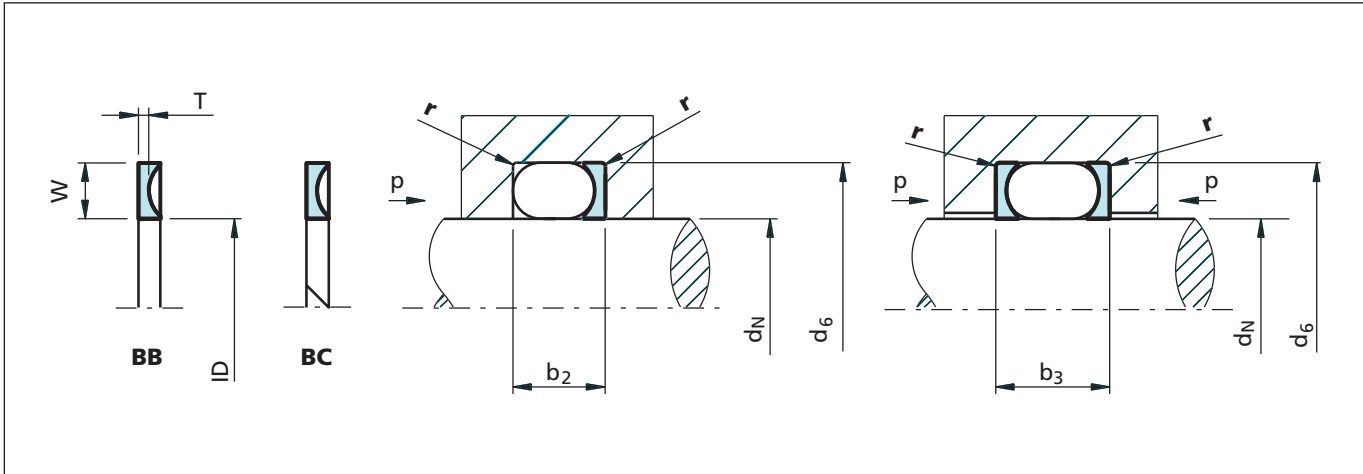


Figure 8 Installation drawing internal sealing, concave Back-up Ring types

Table 10 Installation dimensions for concave Back-up Ring types, uncut and cut, internal sealing

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter		Groove width		Radius
	Dynamic	Static	T	Dynamic $d_N + h_9$	Static $d_N + h_9$	$b_2 + 0.2$	$b_3 + 0.2$	$r \pm 0.2$
1.50	1.25	1.10	1.0	$d_N + 2.5$	$d_N + 2.2$	3.0	4.0	0.25
1.60	1.30	1.20	1.0	$d_N + 2.6$	$d_N + 2.4$	3.1	4.1	0.25
1.78	1.45	1.30	1.4	$d_N + 2.9$	$d_N + 2.6$	3.8	5.2	0.25
1.80	1.45	1.30	1.4	$d_N + 2.9$	$d_N + 2.6$	3.8	5.2	0.25
2.00	1.65	1.50	1.4	$d_N + 3.3$	$d_N + 3.0$	4.1	5.5	0.25
2.40	2.05	1.80	1.4	$d_N + 4.1$	$d_N + 3.6$	4.6	6.0	0.25
2.50	2.15	1.90	1.4	$d_N + 4.3$	$d_N + 3.8$	4.7	6.1	0.25
2.62	2.25	2.00	1.4	$d_N + 4.5$	$d_N + 4.0$	5.0	6.4	0.25
2.65	2.25	2.00	1.4	$d_N + 4.5$	$d_N + 4.0$	5.0	6.4	0.25
3.00	2.60	2.30	1.4	$d_N + 5.2$	$d_N + 4.6$	5.4	6.8	0.25
3.53	3.10	2.70	1.4	$d_N + 6.2$	$d_N + 5.4$	6.2	7.6	0.25
3.55	3.10	2.70	1.4	$d_N + 6.2$	$d_N + 5.4$	6.2	7.6	0.25
4.00	3.50	3.10	1.7	$d_N + 7.0$	$d_N + 6.2$	6.9	8.6	0.25
5.00	4.40	4.00	1.7	$d_N + 8.8$	$d_N + 8.0$	8.3	10.0	0.25
5.30	4.70	4.30	1.7	$d_N + 9.4$	$d_N + 8.6$	9.0	10.9	0.25
5.33	4.70	4.30	1.7	$d_N + 9.4$	$d_N + 8.6$	9.0	10.9	0.25
5.70	5.00	4.60	1.7	$d_N + 10.0$	$d_N + 9.2$	9.0	11.0	0.25
6.00	5.30	4.90	1.7	$d_N + 10.6$	$d_N + 9.8$	9.3	11.2	0.25
7.00	6.10	5.80	2.5	$d_N + 12.2$	$d_N + 11.6$	12.3	15.1	0.25
8.00	7.10	6.70	2.5	$d_N + 14.2$	$d_N + 13.4$	12.6	15.4	0.25
8.40	7.50	7.10	2.5	$d_N + 15.0$	$d_N + 14.2$	12.8	15.6	0.25



Ordering Example

Back-up Ring: Concave, type BB (uncut)
for O-Ring seal
Application: Static, external sealing
Rod diameter: $d_N = 50.00$ mm
O-Ring cross section: $d_2 = 3.53$ mm
Back-up Ring material: PTFE, glassfibre-filled (25 %)
Material code see page 91

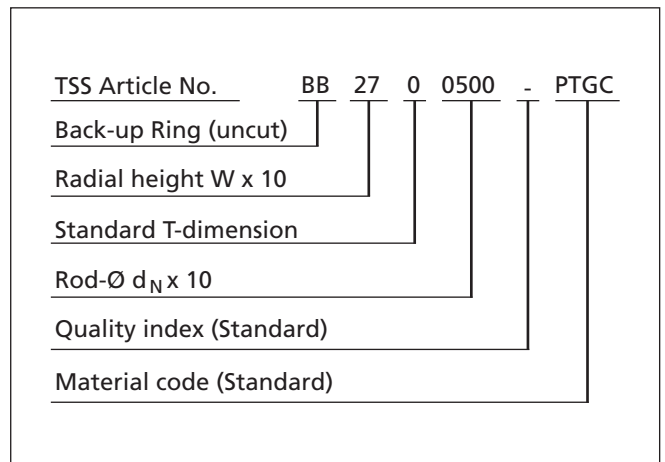


Table 11 Preferred series for static application, concave Back-up Ring type BB (uncut), internal sealing, material PTFE

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$					
4.0	6.2	3.0	4.0	0.25	4.0 x 1.1 x 1.4	BB1100040	OR1500400	4.00 x 1.50
4.0	6.6	3.8	5.2	0.25	4.0 x 1.3 x 1.4	BB1300040	ORAR00007	3.68 x 1.78
5.0	7.2	3.0	4.0	0.25	5.0 x 1.1 x 1.4	BB1100050	OR1500500	5.00 x 1.50
5.0	7.6	3.8	5.2	0.25	5.0 x 1.3 x 1.4	BB1300050	ORAR00008	4.47 x 1.78
6.0	8.2	3.0	4.0	0.25	6.0 x 1.1 x 1.4	BB1100060	OR1500600	6.00 x 1.50
6.0	8.6	3.8	5.2	0.25	6.0 x 2.3 x 1.4	BB1300060	ORAR00010	6.07 x 1.78
8.0	10.6	3.8	5.2	0.25	8.0 x 1.3 x 1.4	BB1300080	ORAR00011	7.65 x 1.78
8.0	11.0	4.1	5.5	0.25	8.0 x 1.5 x 1.4	BB1500080	OR2000800	8.00 x 2.00
10.0	12.6	3.8	5.2	0.25	10.0 x 1.3 x 1.4	BB1300100	ORAR00013	10.82 x 1.78
10.0	13.0	4.1	5.5	0.25	10.0 x 1.5 x 1.4	BB1500100	OR2001000	10.00 x 2.00
12.0	14.6	3.8	5.2	0.25	12.0 x 1.3 x 1.4	BB1300120	ORAR00014	12.42 x 1.78
12.0	15.0	4.1	5.5	0.25	12.0 x 1.5 x 1.4	BB1500120	OR2001200	12.00 x 2.00
14.0	16.6	3.8	5.2	0.25	14.0 x 1.3 x 1.4	BB1300140	ORAR00015	14.00 x 1.78
14.0	17.0	4.1	5.5	0.25	14.0 x 1.5 x 1.4	BB1500140	OR2001400	14.00 x 2.00
15.0	17.6	3.8	5.2	0.25	15.0 x 1.3 x 1.4	BB1300150	ORAR00016	15.60 x 1.78
15.0	18.0	4.1	5.5	0.25	15.0 x 1.5 x 1.4	BB1500150	OR2001500	15.00 x 2.00
16.0	18.6	3.8	5.2	0.25	16.0 x 1.3 x 1.4	BB1300160	ORAR00016	15.60 x 1.78
16.0	19.0	4.1	5.5	0.25	16.0 x 1.5 x 1.4	BB1500160	OR2001600	16.00 x 2.00
18.0	20.6	3.8	5.2	0.25	18.0 x 1.3 x 1.4	BB1300180	ORAR00018	18.77 x 1.78
18.0	21.0	4.1	5.5	0.25	18.0 x 1.5 x 1.4	BB1500180	OR2001800	18.00 x 2.00
20.0	22.6	3.8	5.2	0.25	20.0 x 1.3 x 1.4	BB1300200	ORAR00019	20.35 x 1.78
20.0	23.0	4.1	5.5	0.25	20.0 x 1.5 x 1.4	BB1500200	OR2002000	20.00 x 2.00
22.0	26.0	5.0	6.4	0.25	22.0 x 2.0 x 1.4	BB2000220	ORAR00118	21.89 x 2.62
22.0	26.6	5.4	6.8	0.25	22.0 x 2.3 x 1.4	BB2300220	OR3002200	22.00 x 3.00



Back-up Ring

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
25.0	29.0	5.0	6.4	0.25	25.0 x 2.0 x 1.4	BB2000250	ORAR00120	25.07 x 2.62
25.0	29.6	5.4	6.8	0.25	25.0 x 2.3 x 1.4	BB2300250	OR3002500	25.00 x 3.00
28.0	32.0	5.0	6.4	0.25	28.0 x 2.0 x 1.4	BB2000280	ORAR00122	28.24 x 2.62
28.0	32.6	5.4	6.8	0.25	28.0 x 2.3 x 1.4	BB2300280	OR3002800	28.00 x 2.00
30.0	34.0	5.0	6.4	0.25	30.0 x 2.0 x 1.4	BB2000300	ORAR00123	29.83 x 2.62
30.0	34.6	5.4	6.8	0.25	30.0 x 2.3 x 1.4	BB2300300	OR3003000	30.00 x 3.00
32.0	36.0	5.0	6.4	0.25	32.0 x 2.0 x 1.4	BB2000320	ORAR00125	31.42 x 2.62
32.0	36.6	5.4	6.8	0.25	32.0 x 2.3 x 1.4	BB2300320	OR3003200	32.00 x 3.00
35.0	39.0	5.0	6.4	0.25	35.0 x 2.0 x 1.4	BB2000350	ORAR00126	34.59 x 2.62
35.0	39.6	5.4	6.8	0.25	35.0 x 2.3 x 1.4	BB2300350	OR3003500	35.00 x 3.00
36.0	40.0	5.0	6.4	0.25	36.0 x 2.0 x 1.4	BB2000360	ORAR00127	36.17 x 2.62
36.0	40.6	5.4	6.8	0.25	36.0 x 2.3 x 1.4	BB2300360	OR3003600	36.00 x 3.00
40.0	45.4	6.2	7.6	0.25	40.0 x 2.7 x 1.4	BB2700400	ORAR00223	40.87 x 3.53
40.0	46.2	6.9	8.6	0.25	40.0 x 3.1 x 1.7	BB3100400	OR4004000	40.00 x 4.00
42.0	47.4	6.2	7.6	0.25	42.0 x 2.7 x 1.4	BB2700420	ORAR00223	40.87 x 3.53
42.0	48.2	6.9	8.6	0.25	42.0 x 3.1 x 1.7	BB3100420	OR4004200	42.00 x 4.00
45.0	50.4	6.2	7.6	0.25	45.0 x 2.7 x 1.4	BB2700450	ORAR00224	44.04 x 3.53
45.0	51.2	6.9	8.6	0.25	45.0 x 3.1 x 1.7	BB3100450	OR4004500	45.00 x 4.00
48.0	53.4	6.2	7.6	0.25	48.0 x 2.7 x 1.4	BB2700480	ORAR00225	47.22 x 3.53
48.0	54.2	6.9	8.6	0.25	48.0 x 3.1 x 1.7	BB3100480	OR4004800	48.00 x 4.00
50.0	55.4	6.2	7.6	0.25	50.0 x 2.7 x 1.4	BB2700500	ORAR00226	50.39 x 3.53
50.0	56.2	6.9	8.6	0.25	50.0 x 3.1 x 1.7	BB3100500	OR4005000	50.00 x 4.00
52.0	57.4	6.2	7.6	0.25	52.0 x 2.7 x 1.4	BB2700520	ORAR00226	50.39 x 3.53
52.0	58.2	6.9	8.6	0.25	52.0 x 3.1 x 1.7	BB3100520	OR4005200	52.00 x 4.00
55.0	60.4	6.2	7.6	0.25	55.0 x 2.7 x 1.4	BB2700550	ORAR00227	53.57 x 3.53
55.0	61.2	6.9	8.6	0.25	55.0 x 3.1 x 1.7	BB3100550	OR4005500	55.00 x 4.00
56.0	61.4	6.2	7.6	0.25	56.0 x 2.7 x 1.4	BB2700560	ORAR00228	56.74 x 3.53
56.0	62.2	6.9	8.6	0.25	56.0 x 3.1 x 1.7	BB3100560	OR4005600	56.00 x 4.00
60.0	65.4	6.2	7.6	0.25	60.0 x 2.7 x 1.4	BB2700600	ORAR00229	59.92 x 3.53
60.0	66.2	6.9	8.6	0.25	60.0 x 3.1 x 1.7	BB3100600	OR4006000	60.00 x 4.00
63.0	68.4	6.2	7.6	0.25	63.0 x 2.7 x 1.4	BB2700630	ORAR00230	63.09 x 3.53
63.0	69.2	6.9	8.6	0.25	63.0 x 3.1 x 1.7	BB3100630	OR4006300	60.00 x 4.00
65.0	70.4	6.2	7.6	0.25	65.0 x 2.7 x 1.4	BB2700650	ORAR00231	66.27 x 3.53
65.0	71.2	6.9	8.6	0.25	65.0 x 3.1 x 1.7	BB3100650	OR4006500	65.40 x 4.00
70.0	75.4	6.2	7.6	0.25	70.0 x 2.7 x 1.4	BB2700700	ORAR00232	69.44 x 3.53
70.0	76.2	6.9	8.6	0.25	70.0 x 3.1 x 1.7	BB3100700	OR4007000	70.00 x 4.00



Back-up Ring



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
75.0	80.4	6.2	7.6	0.25	75.0 x 2.7 x 1.4	BB2700750	ORAR00234	75.79 x 3.53
75.0	81.2	6.9	8.6	0.25	75.0 x 3.1 x 1.7	BB3100750	OR4007500	75.00 x 4.00
80.0	88.0	8.3	10.0	0.25	80.0 x 4.0 x 1.7	BB4000800	OR5008000	80.00 x 5.00
80.0	88.6	9.0	10.9	0.25	80.0 x 4.3 x 1.7	BB4300800	ORAR00339	81.92 x 5.33
85.0	93.0	8.3	10.0	0.25	85.0 x 4.0 x 1.7	BB4000850	OR5008500	85.00 x 5.00
85.0	93.6	9.0	10.9	0.25	85.0 x 4.3 x 1.7	BB4300850	ORAR00340	85.09 x 5.33
90.0	98.0	8.3	10.0	0.25	90.0 x 4.0 x 1.7	BB4000900	OR5009000	90.00 x 5.00
90.0	98.6	9.0	10.9	0.25	90.0 x 4.3 x 1.7	BB4300900	ORAR00342	91.44 x 5.33
95.0	103.0	8.3	10.0	0.25	95.0 x 4.0 x 1.7	BB4000950	OR5009500	95.00 x 5.00
95.0	103.6	9.0	10.9	0.25	95.0 x 4.3 x 1.7	BB4300950	ORAR00343	94.62 x 5.33
100.0	108.0	8.3	10.0	0.25	100.0 x 4.0 x 1.7	BB4001000	OR5010000	100.00 x 5.00
100.0	108.6	9.0	10.9	0.25	100.0 x 4.3 x 1.7	BB4301000	ORAR00345	100.97 x 5.33
105.0	113.0	8.3	10.0	0.25	105.0 x 4.0 x 1.7	BB4001050	OR5010500	105.00 x 5.00
105.0	113.6	9.0	10.9	0.25	105.0 x 4.3 x 1.7	BB4301050	ORAR00346	104.14 x 5.33
110.0	118.0	8.3	10.0	0.25	110.0 x 4.0 x 1.7	BB4001100	OR5011000	110.00 x 5.00
110.0	118.6	9.0	10.9	0.25	110.0 x 4.3 x 1.7	BB4301100	ORAR00348	110.49 x 5.33
115.0	123.0	8.3	10.0	0.25	115.0 x 4.0 x 1.7	BB4001150	OR5011500	115.00 x 5.00
115.0	123.6	9.0	10.9	0.25	115.0 x 4.3 x 1.7	BB4301150	ORAR00349	113.67 x 5.33
120.0	128.0	8.3	10.0	0.25	120.0 x 4.0 x 1.7	BB4001200	OR5012000	120.00 x 5.00
120.0	128.6	9.0	10.9	0.25	120.0 x 4.3 x 1.7	BB4301200	ORAR00351	120.02 x 5.33
125.0	133.0	8.3	10.0	0.25	125.0 x 4.0 x 1.7	BB4001250	OR5012500	125.00 x 5.00
125.0	133.6	9.0	10.9	0.25	125.0 x 4.3 x 1.7	BB4301250	ORAR00353	126.37 x 5.33
130.0	138.0	8.3	10.0	0.25	130.0 x 4.0 x 1.7	BB4001300	OR5013000	130.00 x 5.00
130.0	138.6	9.0	10.9	0.25	130.0 x 4.3 x 1.7	BB4301300	ORAR00354	129.54 x 5.33
135.0	146.6	12.3	15.1	0.25	135.0 x 5.8 x 2.5	BB5801350	ORAR00432	135.89 x 6.99
140.0	151.6	12.3	15.1	0.25	140.0 x 5.8 x 2.5	BB5801400	ORAR00433	139.07 x 6.99
150.0	161.6	12.3	15.1	0.25	150.0 x 5.8 x 2.5	BB5801500	ORAR00437	151.77 x 6.99
160.0	171.6	12.3	15.1	0.25	160.0 x 5.8 x 2.5	BB5801600	ORAR00438	158.12 x 6.99
170.0	181.6	12.3	15.1	0.25	170.0 x 5.8 x 2.5	BB5801700	ORAR00440	170.82 x 6.99
180.0	191.6	12.3	15.1	0.25	180.0 x 5.8 x 2.5	BB5801800	ORAR00442	183.52 x 6.99
190.0	201.6	12.3	15.1	0.25	190.0 x 5.8 x 2.5	BB5801900	ORAR00443	189.87 x 6.99
200.0	211.6	12.3	15.1	0.25	200.0 x 5.8 x 2.5	BB5802000	ORAR00445	202.57 x 6.99
210.0	221.6	12.3	15.1	0.25	210.0 x 5.8 x 2.5	BB5802100	ORAR00446	215.27 x 6.99
220.0	231.6	12.3	15.1	0.25	220.0 x 5.8 x 2.5	BB5802200	ORAR00446	215.27 x 6.99
230.0	241.6	12.3	15.1	0.25	230.0 x 5.8 x 2.5	BB5802300	ORAR00447	227.97 x 6.99
240.0	251.6	12.3	15.1	0.25	240.0 x 5.8 x 2.5	BB5802400	ORAR00448	240.67 x 6.99



Back-up Ring

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 + 0.2$	$b_3 + 0.2$					$d_1 \times d_2$
d_N f7	d_6 H9			$r \pm 0.2$	ID x W x T			
250.0	261.6	12.3	15.1	0.25	250.0 x 5.8 x 2.5	BB5802500	ORAR00449	253.37 x 6.99
280.0	291.6	12.3	15.1	0.25	280.0 x 5.8 x 2.5	BB5802800	ORAR00451	278.77 x 6.99
300.0	311.6	12.3	15.1	0.25	300.0 x 5.8 x 2.5	BB5803000	ORAR00453	304.17 x 6.99
320.0	331.6	12.3	15.1	0.25	320.0 x 5.8 x 2.5	BB5803200	ORAR00454	316.87 x 6.99
350.0	361.6	12.3	15.1	0.25	350.0 x 5.8 x 2.5	BB5803500	ORAR00457	354.97 x 6.99
360.0	371.6	12.3	15.1	0.25	360.0 x 5.8 x 2.5	BB5803600	ORAR00457	354.97 x 6.99
400.0	411.6	12.3	15.1	0.25	400.0 x 5.8 x 2.5	BB5804000	ORAR00461	405.26 x 6.99

Further sizes on request

This table shows the possible range of available dimensions (Back-up Rings). However, these dimensions are not always stock items.



D.2.3 Spiral Back-up Ring types (BP), material PTFE

The following figure and tables include installation recommendations and Back-up Ring dimensions for internal sealing applications with the spiral Back-up Ring type BP.

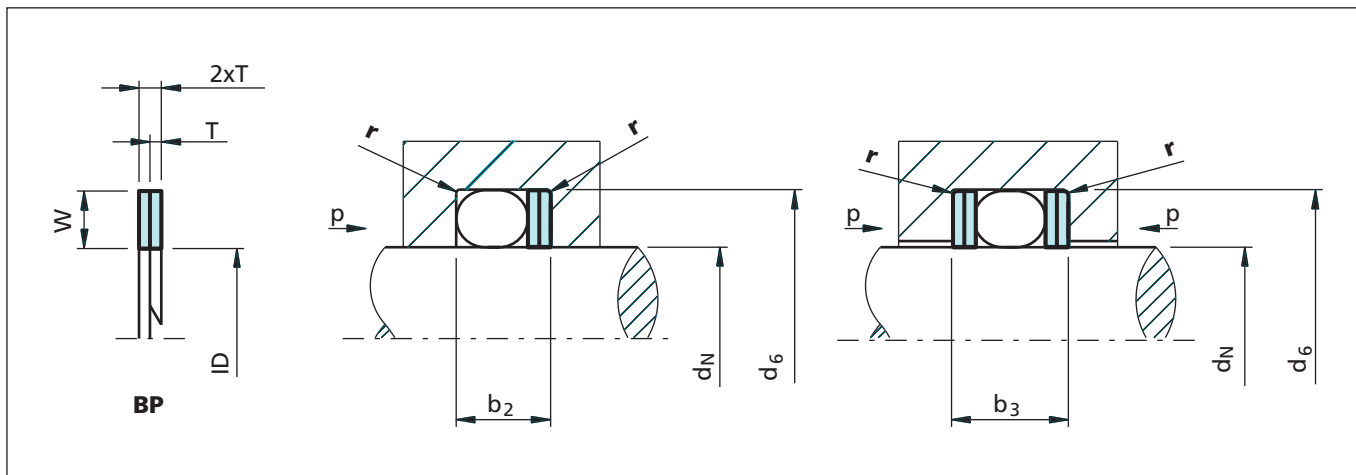


Figure 9 Installation drawing internal sealing, spiral Back-up Ring type

Table 12 Installation dimensions for the spiral Back-up Ring type, internal sealing

O-Ring cross section d_2	Back-up Ring cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter		Groove width		Radius
	Dynamic	Static	T	Dynamic $d_N + h_9$	Static $d_6 + h_9$	$b_2 + 0.2$	$b_3 + 0.2$	$r \pm 0.2$
1.50	1.25	1.10	0.50	$d_N + 2.5$	$d_N + 2.2$	3.0	4.0	0.25
1.60	1.30	1.20	0.50	$d_N + 2.6$	$d_N + 2.4$	3.1	4.1	0.25
1.78	1.45	1.30	0.70	$d_N + 2.9$	$d_N + 2.6$	3.8	5.2	0.25
1.80	1.45	1.30	0.70	$d_N + 2.9$	$d_N + 2.6$	3.8	5.2	0.25
2.00	1.65	1.50	0.70	$d_N + 3.3$	$d_N + 3.0$	4.1	5.5	0.25
2.40	2.05	1.80	0.70	$d_N + 4.1$	$d_N + 3.6$	4.6	6.0	0.25
2.50	2.15	1.90	0.70	$d_N + 4.3$	$d_N + 3.8$	4.7	6.1	0.25
2.62	2.25	2.00	0.70	$d_N + 4.5$	$d_N + 4.0$	5.0	6.4	0.25
2.65	2.25	2.00	0.70	$d_N + 4.5$	$d_N + 4.0$	5.0	6.4	0.25
3.00	2.60	2.30	0.70	$d_N + 5.2$	$d_N + 4.6$	5.4	6.8	0.25
3.53	3.10	2.70	0.70	$d_N + 6.2$	$d_N + 5.4$	6.2	7.6	0.25
3.55	3.10	2.70	0.70	$d_N + 6.2$	$d_N + 5.4$	6.2	7.6	0.25
4.00	3.50	3.10	0.85	$d_N + 7.0$	$d_N + 6.2$	6.9	8.6	0.25
5.00	4.40	4.00	0.85	$d_N + 8.8$	$d_N + 8.0$	8.3	10.0	0.25
5.30	4.70	4.30	0.85	$d_N + 9.4$	$d_N + 8.6$	9.0	10.9	0.25
5.33	4.70	4.30	0.85	$d_N + 9.4$	$d_N + 8.6$	9.0	10.9	0.25
5.70	5.00	4.60	0.85	$d_N + 10.0$	$d_N + 9.2$	9.0	11.0	0.25
6.00	5.30	4.90	0.85	$d_N + 10.6$	$d_N + 9.8$	9.3	11.2	0.25
7.00	6.10	5.80	1.25	$d_N + 12.2$	$d_N + 11.6$	12.3	15.1	0.25
8.00	7.10	6.70	1.25	$d_N + 14.2$	$d_N + 13.4$	12.6	15.4	0.25
8.40	7.50	7.10	1.25	$d_N + 15.0$	$d_N + 14.2$	12.8	15.6	0.25



Back-up Ring

Ordering Example

Back-up Ring: Type BP (spiral)
for O-Ring seal
Application: Dynamic, internal sealing
Rod diameter: $d_N = 56.00$ mm
O-Ring cross section: $d_2 = 3.53$ mm
Back-up Ring material: PTFE, bronze-filled (40 %)
Material code see page 91

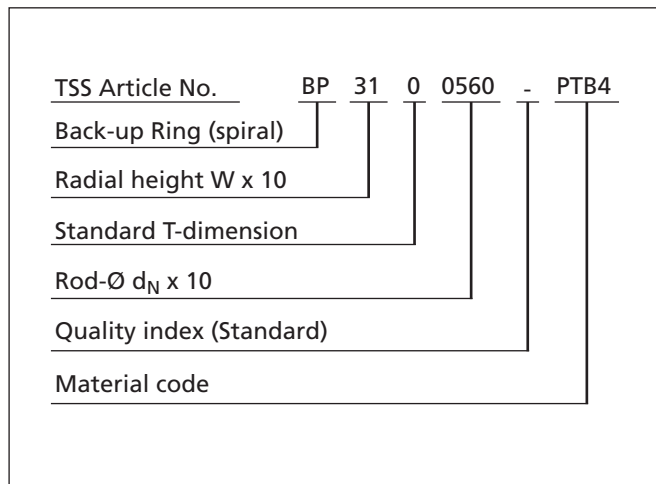


Table 13 Preferred series for dynamic application, spiral Back-up Ring type BP, internal sealing, material PTFE

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 + 0.2$	$b_3 + 0.2$					
4.0	6.5	3.0	4.0	0.25	4.0 x 1.25 x 0.50	BP12H00040	OR1500400	4.00 x 1.50
4.0	6.9	3.8	5.2	0.25	4.0 x 1.45 x 0.70	BP14H00040	ORAR00007	3.68 x 1.78
5.0	7.5	3.0	4.0	0.25	5.0 x 1.25 x 0.50	BP12H00050	OR1500500	5.00 x 1.50
5.0	7.9	3.8	5.2	0.25	5.0 x 1.45 x 0.70	BP14H00050	ORAR00008	4.47x 1.78
6.0	8.5	3.0	4.0	0.25	6.0 x 1.25 x 0.50	BP12H00060	OR1500600	6.00 x 1.50
6.0	8.9	3.8	5.2	0.25	6.0 x 1.45 x 0.70	BP14H00060	ORAR00010	6.07 x 1.78
8.0	10.9	3.8	5.2	0.25	8.0 x 1.45 x 0.70	BP14H00080	ORAR00011	7.65 x 1.78
8.0	11.3	4.1	5.5	0.25	8.0 x 1.65 x 0.70	BP16H00080	OR2000800	8.00 x 2.00
10.0	12.9	3.8	5.2	0.25	10.0 x 1.45 x 0.70	BP14H00100	ORAR00013	10.82 x 1.78
10.0	13.3	4.1	5.5	0.25	10.0 x 1.65 x 0.70	BP16H00100	OR2001000	10.00 x 2.00
12.0	14.9	3.8	5.2	0.25	12.0 x 1.45 x 0.70	BP14H00120	ORAR00014	12.42 x 1.78
12.0	15.3	4.1	5.5	0.25	12.0 x 1.65 x 0.70	BP16H00120	OR2001200	12.00 x 2.00
14.0	16.9	3.8	5.2	0.25	14.0 x 1.45 x 0.70	BP14H00140	ORAR00015	14.00 x 1.78
14.0	17.3	4.1	5.5	0.25	14.0 x 1.65 x 0.70	BP16H00140	OR2001400	14.00 x 2.00
15.0	17.9	3.8	5.2	0.25	15.0 x 1.45 x 0.70	BP14H00150	ORAR00016	15.60 x 1.78
15.0	18.3	4.1	5.5	0.25	15.0 x 1.65 x 0.70	BP16H00150	OR2001500	15.00 x 2.00
16.0	18.9	3.8	5.2	0.25	16.0 x 1.45 x 0.70	BP14H00160	ORAR00016	15.60 x 1.78
16.0	19.3	4.1	5.5	0.25	16.0 x 1.65 x 0.70	BP16H00160	OR2001600	16.00 x 2.00
18.0	20.9	3.8	5.2	0.25	18.0 x 1.45 x 0.70	BP14H00180	ORAR00018	18.77 x 1.78
18.0	21.3	4.1	5.5	0.25	18.0 x 1.65 x 0.70	BP16H00180	OR2001800	18.00 x 2.00
20.0	22.9	3.8	5.2	0.25	20.0 x 1.45 x 0.70	BP14H00200	ORAR00019	20.35 x 1.78
20.0	23.3	4.1	5.5	0.25	20.0 x 1.65 x 0.70	BP16H00200	OR2002000	20.00 x 2.00
22.0	26.5	5.0	6.4	0.25	22.0 x 2.25 x 0.70	BP22H00220	ORAR00118	21.89 x 2.62
22.0	27.2	5.4	6.8	0.25	22.0 x 2.60 x 0.70	BP2600220	OR3002200	22.00 x 3.00

Back-up Ring



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
25.0	29.5	5.0	6.4	0.25	25.0 x 2.25 x 0.70	BP22H00250	ORAR00120	25.07 x 2.62
25.0	30.2	5.4	6.8	0.25	25.0 x 2.60 x 0.70	BP2600250	OR3002500	25.00 x 3.00
28.0	32.5	5.0	6.4	0.25	28.0 x 2.25 x 0.70	BP22H00280	ORAR00122	28.24 x 2.62
28.0	33.2	5.4	6.8	0.25	28.0 x 2.60 x 0.70	BP2600280	OR3002800	28.00 x 3.00
30.0	34.5	5.0	6.4	0.25	30.0 x 2.25 x 0.70	BP22H00300	ORAR00123	29.83 x 2.62
30.0	35.2	5.4	6.8	0.25	30.0 x 2.60 x 0.70	BP2600300	OR3003000	30.00 x 3.00
32.0	36.5	5.0	6.4	0.25	32.0 x 2.25 x 0.70	BP22H00320	ORAR00125	31.42 x 2.62
32.0	37.2	5.4	6.8	0.25	32.0 x 2.60 x 0.70	BP2600320	OR3003200	32.00 x 3.00
35.0	39.5	5.0	6.4	0.25	35.0 x 2.25 x 0.70	BP22H00350	ORAR00126	24.59 x 2.62
35.0	40.2	5.4	6.8	0.25	35.0 x 2.60 x 0.70	BP2600350	OR3003500	35.00 x 3.00
36.0	40.5	5.0	6.4	0.25	36.0 x 2.25 x 0.70	BP22H00360	ORAR00127	36.17 x 2.62
36.0	41.2	5.4	6.8	0.25	36.0 x 2.60 x 0.70	BP2600360	OR3003600	36.00 x 3.00
40.0	46.2	6.2	7.6	0.25	40.0 x 3.10 x 0.70	BP31D0400	ORAR00223	40.87 x 3.53
40.0	47.0	6.9	8.6	0.25	40.0 x 3.50 x 0.85	BP3500400	OR4004000	40.00 x 4.00
42.0	48.2	6.2	7.6	0.25	42.0 x 3.10 x 0.70	BP31D0420	ORAR00223	40.87 x 3.53
42.0	49.0	6.9	8.6	0.25	42.0 x 3.50 x 0.70	BP35D0420	OR4004200	42.00 x 2.00
45.0	51.2	6.2	7.6	0.25	45.0 x 3.10 x 0.70	BP31D0450	ORAR00224	44.04 x 3.53
45.0	52.0	6.9	8.6	0.25	45.0 x 3.50 x 0.85	BP3500450	OR4004500	45.00 x 4.00
48.0	54.2	6.2	7.6	0.25	48.0 x 3.10 x 0.70	BP31D0480	ORAR00225	47.22 x 3.53
48.0	55.0	6.9	8.6	0.25	48.0 x 3.50 x 0.85	BP3500480	OR4004800	48.00 x 4.00
50.0	56.2	6.2	7.6	0.25	50.0 x 3.10 x 0.70	BP31D0500	ORAR00226	50.39 x 3.53
50.0	57.0	6.9	8.6	0.25	50.0 x 3.50 x 0.85	BP3500500	OR4005000	50.00 x 4.00
52.0	58.2	6.2	7.6	0.25	52.0 x 3.10 x 0.70	BP31D0520	ORAR00226	50.39 x 3.53
52.0	59.0	6.9	8.6	0.25	52.0 x 3.50 x 0.85	BP3500520	OR4005200	52.00 x 4.00
55.0	61.2	6.2	7.6	0.25	55.0 x 3.10 x 0.70	BP31D0550	ORAR00227	53.57 x 3.53
55.0	62.0	6.9	8.6	0.25	55.0 x 3.50 x 0.85	BP3500550	OR4005500	55.00 x 4.00
56.0	62.2	6.2	7.6	0.25	56.0 x 3.10 x 0.70	BP31D0560	ORAR00228	56.74 x 3.53
56.0	63.0	6.9	8.6	0.25	56.0 x 3.50 x 0.85	BP3500560	OR4005600	56.00 x 4.00
60.0	66.2	6.2	7.6	0.25	60.0 x 3.10 x 0.70	BP31D0600	ORAR00229	59.92 x 3.53
60.0	97.0	6.9	8.6	0.25	60.0 x 3.50 x 0.85	BP3500600	OR4006000	60.00 x 4.00
63.0	69.2	6.2	7.6	0.25	63.0 x 3.10 x 0.70	BP31D0630	ORAR00230	63.09 x 3.53
63.0	70.0	6.9	8.6	0.25	63.0 x 3.50 x 0.85	BP3500630	OR4006300	63.00 x 4.00
65.0	71.2	6.2	7.6	0.25	65.0 x 3.10 x 0.70	BP31D0650	ORAR00231	66.27 x 3.53
65.0	72.0	6.9	8.6	0.25	65.0 x 3.50 x 0.85	BP3500650	OR4006500	65.00 x 4.00
70.0	76.2	6.2	7.6	0.25	70.0 x 3.10 x 0.70	BP31D0700	ORAR00232	69.44 x 3.53
70.0	77.0	6.9	8.6	0.25	70.0 x 3.50 x 0.85	BP3500700	OR4007000	70.00 x 4.00
75.0	81.2	6.2	7.6	0.25	75.0 x 3.10 x 0.70	BP31D0750	ORAR00234	75.79 x 3.53



Back-up Ring

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
75.0	82.0	6.9	8.6	0.25	75.0 x 3.50 x 0.85	BP3500750	OR4007500	75.00 x 4.00
80.0	88.8	8.3	10.0	0.25	80.0 x 4.40 x 0.85	BP4400800	OR5008000	80.00 x 5.00
80.0	89.4	9.0	10.9	0.25	80.0 x 4.70 x 0.85	BP4700800	ORAR00339	81.92 x 5.33
85.0	93.8	8.3	10.0	0.25	85.0 x 4.40 x 0.85	BP4400850	OR5008500	85.00 x 5.00
85.0	94.4	9.0	10.9	0.25	85.0 x 4.70 x 0.85	BP4700850	ORAR00340	85.09 x 5.33
90.0	98.8	8.3	10.0	0.25	90.0 x 4.40 x 0.85	BP4400900	OR5009000	90.00 x 5.00
90.0	99.4	9.0	10.9	0.25	90.0 x 4.70 x 0.85	BP4700900	ORAR00342	91.44 x 5.33
95.0	103.8	8.3	10.0	0.25	95.0 x 4.40 x 0.85	BP4400950	OR5009500	95.00 x 5.00
95.0	104.4	9.0	10.9	0.25	95.0 x 4.70 x 0.85	BP4700950	ORAR00343	94.62 x 5.33
100.0	108.8	8.3	10.0	0.25	100.0 x 4.40 x 0.85	BP4401000	OR5010000	100.00 x 5.00
100.0	109.4	9.0	10.9	0.25	100.0 x 4.70 x 0.85	BP4701000	ORAR00345	100.97 x 5.33
105.0	113.8	8.3	10.0	0.25	105.0 x 4.40 x 0.85	BP4401050	OR5010500	105.00 x 5.00
105.0	114.4	9.0	10.9	0.25	105.0 x 4.70 x 0.85	BP4701050	ORAR00346	104.14 x 5.33
110.0	118.8	8.3	10.0	0.25	110.0 x 4.40 x 0.85	BP4401100	OR5011000	110.00 x 5.00
110.0	119.4	9.0	10.9	0.25	110.0 x 4.70 x 0.85	BP4701100	ORAR00348	110.49 x 5.33
115.0	123.8	8.3	10.0	0.25	115.0 x 4.40 x 0.85	BP4401150	OR5011500	115.00 x 5.00
115.0	124.4	9.0	10.9	0.25	115.0 x 4.70 x 0.85	BP4701150	ORAR00349	113.67 x 5.33
120.0	128.8	8.3	10.0	0.25	120.0 x 4.40 x 0.85	BP4401200	OR5012000	120.00 x 5.00
120.0	129.4	9.0	10.9	0.25	120.0 x 4.70 x 0.85	BP4701200	ORAR00351	120.02 x 5.33
125.0	133.8	8.3	10.0	0.25	125.0 x 4.40 x 0.85	BP4401250	OR5012500	125.00 x 5.00
125.0	134.4	9.0	10.9	0.25	125.0 x 4.70 x 0.85	BP4701250	ORAR00353	126.37 x 5.33
130.0	138.8	8.3	10.0	0.25	130.0 x 4.40 x 0.85	BP4401300	OR5013000	130.00 x 5.00
130.0	139.4	9.0	10.9	0.25	130.0 x 4.70 x 0.85	BP4701300	ORAR00354	129.54 x 5.33
135.0	147.2	12.3	15.1	0.25	135.0 x 6.10 x 1.25	BP6101350	ORAR00432	135.89 x 6.99
140.0	152.2	12.3	15.1	0.25	140.0 x 6.10 x 1.25	BP6101400	ORAR00433	139.07 x 6.99
150.0	162.2	12.3	15.1	0.25	150.0 x 6.10 x 1.25	BP6101500	ORAR00437	151.77 x 6.99
160.0	172.2	12.3	15.1	0.25	160.0 x 6.10 x 1.25	BP6101600	ORAR00438	158.12 x 6.99
170.0	182.2	12.3	15.1	0.25	170.0 x 6.10 x 1.25	BP6101700	ORAR00440	170.82 x 6.99
180.0	192.2	12.3	15.1	0.25	180.0 x 6.10 x 1.25	BP6101800	ORAR00442	183.52 x 6.99
190.0	202.2	12.3	15.1	0.25	190.0 x 6.10 x 1.25	BP6101900	ORAR00443	189.87 x 6.99
200.0	212.2	12.3	15.1	0.25	200.0 x 6.10 x 1.25	BP6102000	ORAR00445	202.57 x 6.99
210.0	222.2	12.3	15.1	0.25	210.0 x 6.10 x 1.25	BP6102100	ORAR00446	215.27 x 6.99
220.0	232.2	12.3	15.1	0.25	220.0 x 6.10 x 1.25	BP6102200	ORAR00446	215.27 x 6.99
230.0	242.2	12.3	15.1	0.25	230.0 x 6.10 x 1.25	BP6102300	ORAR00447	227.97 x 6.99
240.0	252.2	12.3	15.1	0.25	240.0 x 6.10 x 1.25	BP6102400	ORAR00448	240.67 x 6.99
250.0	262.2	12.3	15.1	0.25	250.0 x 6.10 x 1.25	BP6102500	ORAR00449	253.37 x 6.99

Back-up Ring



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$					
280.0	292.2	12.3	15.1	0.25	280.0 x 6.10 x 1.25	BP6102800	ORAR00451	278.77 x 6.99
300.0	312.2	12.3	15.1	0.25	300.0 x 6.10 x 1.25	BP6103000	ORAR00453	304.17 x 6.99
320.0	332.2	12.3	15.1	0.25	320.0 x 6.10 x 1.25	BP6103200	ORAR00454	316.87 x 6.99
350.0	362.2	12.3	15.1	0.25	350.0 x 6.10 x 1.25	BP6103500	ORAR00457	354.97 x 6.99
360.0	372.2	12.3	15.1	0.25	360.0 x 6.10 x 1.25	BP6103600	ORAR00457	354.97 x 6.99
400.0	412.2	12.3	15.1	0.25	400.0 x 6.10 x 1.25	BP6104000	ORAR00461	405.26 x 6.99

Further sizes on request

This table shows the possible range of available dimensions (Back-up Rings). However, these dimensions are not always stock items.



Back-up Ring

D.3 External (piston) and internal (rod) sealing, static applications only

D.3.1 Concave Back-up Ring type (BB), material NBR and FKM for O-Rings according to ISO 3601-1 / AS 568

The following figure and tables include installation recommendations and Back-up Ring dimensions for internal and external sealing applications with the concave Back-up Ring type BB (uncut), material NBR and FKM.

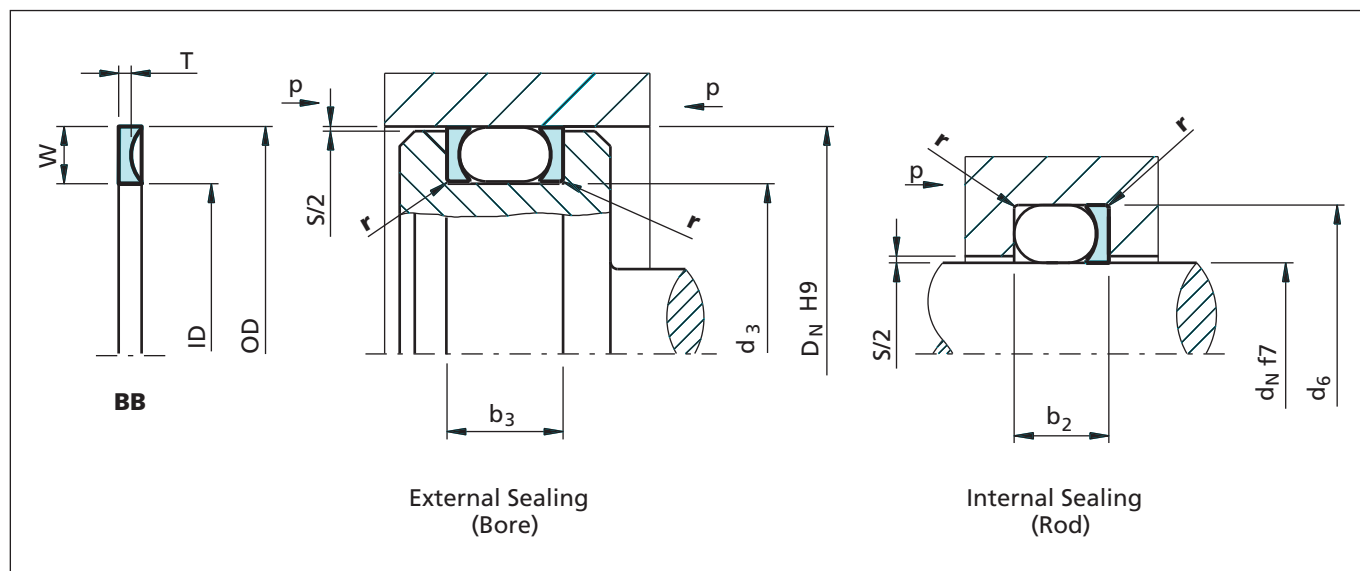


Figure 10 Installation drawing internal and external sealing, concave Back-up Ring type BB

Table 14 Installation dimensions for the concave Back-up Ring type BB, material NBR and FKM

O-Ring cross section according to ISO 3601-1 AS 568 C	Ident-No. ISO 3601-1 AS 568	Back-up Ring cross section		Groove dimensions					
		Radial height	Thickness	Groove diameter		Groove width		Radius	Diametrical clearance
				external	internal	$b_2 + 0.2$	$b_3 + 0.2$		
d_2		W	T	$d_3 - 0.1$	$d_6 + 0.1$	$b_2 + 0.2$	$b_3 + 0.2$	$r \pm 0.2$	S max.
1.78	004 to 050	1.35	1.14	$D_N - 2.9$	$d_N + 2.9$	3.6	5.0	0.25	0.12
2.62	102 to 178	2.18	1.14	$D_N - 4.5$	$d_N + 4.5$	4.5	5.9	0.25	0.12
3.53	201 to 284	3.00	1.02	$D_N - 6.2$	$d_N + 6.2$	5.6	7.0	0.25	0.15
5.33	309 to 395	4.65	1.52	$D_N - 9.4$	$d_N + 9.4$	7.9	9.6	0.25	0.15
7.00	425 to 475	5.99	2.44	$D_N - 12.2$	$d_N + 12.2$	10.7	13.2	0.25	0.20



Ordering Example

Back-up Ring: Concave type BB (uncut)
for O-Ring seal
Application: Static, external sealing
Bore diameter: $D_N = 38.00$ mm
O-Ring cross section: $d_2 = 1.78$ mm
Back-up Ring material: NBR 90 Shore A
Material code see page 91

TSS Article No.	BB	P8	0B028	-	N90
Back-up Ring (uncut)					
TSS Series No.					
Dimension code based on ISO 3601/AS 568					
Quality index (Standard)					
Material code (Standard)					

Table 15 Preferred series for static application, concave Back-up Ring type BB (uncut), based on O-Ring series according to ISO 3601-1 / AS 568 internal sealing, material NBR and FKM

Rod \varnothing	Bore \varnothing	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.2$	$b_3 +0.2$					
2.0	5.2	3.6	5.0	0.25	2.44 x 5.14 x 1.14	BBP80B004	ORAR00004	1.78 x 1.78
2.5	6.0	3.6	5.0	0.25	3.24 x 5.94 x 1.14	BBP80B005	ORAR00005	2.57 x 1.78
3.0	6.5	3.6	5.0	0.25	3.56 x 6.26 x 1.14	BBP80B006	ORAR00006	2.90 x 1.78
4.0	7.0	3.6	5.0	0.25	4.74 x 7.04 x 1.14	BBP80B007	ORAR00007	3.68 x 1.78
5.0	8.0	3.6	5.0	0.25	5.13 x 7.83 x 1.14	BBP80B008	ORAR00008	4.47 x 1.78
5.5	9.0	3.6	5.0	0.25	5.94 x 8.64 x 1.14	BBP80B009	ORAR00009	5.28 x 1.78
6.5	10.0	3.6	5.0	0.25	6.73 x 9.43 x 1.14	BBP80B010	ORAR00010	6.07 x 1.78
8.0	11.0	3.6	5.0	0.25	8.31 x 11.01 x 1.14	BBP80B011	ORAR00011	7.65 x 1.78
9.5	13.0	3.6	5.0	0.25	9.91 x 12.61 x 1.14	BBP80B012	ORAR00012	9.25 x 1.78
11.0	14.0	3.6	5.0	0.25	11.56 x 14.26 x 1.14	BBP80B013	ORAR00013	10.82 x 1.78
13.0	16.0	3.6	5.0	0.25	13.16 x 15.86 x 1.14	BBP80B014	ORAR00014	12.42 x 1.78
14.0	17.0	3.6	5.0	0.25	14.73 x 17.43 x 1.14	BBP80B015	ORAR00015	14.00 x 1.78
16.0	19.0	3.6	5.0	0.25	16.33 x 19.03 x 1.14	BBP80B016	ORAR00016	15.60 x 1.78
17.0	21.0	3.6	5.0	0.25	17.91 x 20.61 x 1.14	BBP80B017	ORAR00017	17.17 x 1.78
19.0	22.0	3.6	5.0	0.25	19.51 x 22.21 x 1.14	BBP80B018	ORAR00018	18.77 x 1.78
20.0	24.0	3.6	5.0	0.25	21.08 x 23.78 x 1.14	BBP80B019	ORAR00019	20.35 x 1.78
22.0	25.0	3.6	5.0	0.25	22.68 x 25.38 x 1.14	BBP80B020	ORAR00020	21.95 x 1.78
24.0	27.0	3.6	5.0	0.25	24.26 x 26.96 x 1.14	BBP80B021	ORAR00021	23.52 x 1.78
25.0	29.0	3.6	5.0	0.25	25.86 x 28.56 x 1.14	BBP80B022	ORAR00022	25.12 x 1.78
27.0	30.0	3.6	5.0	0.25	27.43 x 30.13 x 1.14	BBP80B023	ORAR00023	26.70 x 1.78
29.0	32.0	3.6	5.0	0.25	29.03 x 31.73 x 1.14	BBP80B024	ORAR00024	28.30 x 1.78
30.0	33.0	3.6	5.0	0.25	30.61 x 33.31 x 1.14	BBP80B025	ORAR00025	29.87 x 1.78
32.0	35.0	3.6	5.0	0.25	32.21 x 34.91 x 1.14	BBP80B026	ORAR00026	31.47 x 1.78
33.0	36.5	3.6	5.0	0.25	33.78 x 36.48 x 1.14	BBP80B027	ORAR00027	33.05 x 1.78
35.0	38.0	3.6	5.0	0.25	35.38 x 38.08 x 1.14	BBP80B028	ORAR00028	34.65 x 1.78
38.0	41.0	3.6	5.0	0.25	38.56 x 41.26 x 1.14	BBP80B029	ORAR00029	37.82 x 1.78
41.0	44.5	3.6	5.0	0.25	41.73 x 44.43 x 1.14	BBP80B030	ORAR00030	41.00 x 1.78



Back-up Ring

Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
44.5	48.0	3.6	5.0	0.25	44.91 x 47.61 x 1.14	BBP80B031	ORAR00031	44.17 x 1.78
48.0	51.0	3.6	5.0	0.25	48.08 x 50.78 x 1.14	BBP80B032	ORAR00032	47.35 x 1.78
51.0	54.0	3.6	5.0	0.25	51.26 x 53.96 x 1.14	BBP80B033	ORAR00033	50.52 x 1.78
54.0	57.0	3.6	5.0	0.25	54.53 x 57.13 x 1.14	BBP80B034	ORAR00034	53.70 x 1.78
57.0	60.0	3.6	5.0	0.25	57.61 x 60.31 x 1.14	BBP80B035	ORAR00035	56.87 x 1.78
60.0	63.5	3.6	5.0	0.25	60.78 x 63.48 x 1.14	BBP80B036	ORAR00036	60.05 x 1.78
63.0	67.0	3.6	5.0	0.25	63.96 x 66.66 x 1.14	BBP80B037	ORAR00037	63.22 x 1.78
67.0	70.0	3.6	5.0	0.25	67.13 x 69.83 x 1.14	BBP80B038	ORAR00038	66.40 x 1.78
70.0	73.0	3.6	5.0	0.25	70.31 x 73.01 x 1.14	BBP80B039	ORAR00039	69.57 x 1.78
73.0	76.0	3.6	5.0	0.25	73.48 x 76.18 x 1.14	BBP80B040	ORAR00040	72.75 x 1.78
76.0	80.0	3.6	5.0	0.25	76.66 x 79.36 x 1.14	BBP80B041	ORAR00041	75.92 x 1.78
83.0	86.0	3.6	5.0	0.25	83.01 x 85.71 x 1.14	BBP80B042	ORAR00042	82.27 x 1.78
89.0	92.0	3.6	5.0	0.25	89.36 x 92.06 x 1.14	BBP80B043	ORAR00043	88.62 x 1.78
95.0	99.0	3.6	5.0	0.25	95.71 x 98.41 x 1.14	BBP80B044	ORAR00044	94.97 x 1.78
102.0	105.0	3.6	5.0	0.25	102.06 x 104.76 x 1.14	BBP80B045	ORAR00045	101.32 x 1.78
108.0	111.0	3.6	5.0	0.25	108.41 x 111.11 x 11.4	BBP80B046	ORAR00046	107.67 x 1.78
114.0	118.0	3.6	5.0	0.25	114.76 x 117.46 x 1.14	BBP80B047	ORAR00047	114.02 x 1.78
121.0	124.0	3.6	5.0	0.25	121.11 x 123.81 x 1.14	BBP80B048	ORAR00048	120.37 x 1.78
127.0	130.0	3.6	5.0	0.25	127.46 x 130.16 x 1.14	BBP80B049	ORAR00049	126.72 x 1.78
133.0	137.0	3.6	5.0	0.25	133.81 x 136.50 x 1.14	BBP80B050	ORAR00050	133.07 x 1.78
1.6	6.3	4.5	5.9	0.25	1.96 x 6.32 x 1.14	BBP80B102	ORAR00102	1.24 x 2.62
2.5	7.0	4.5	5.9	0.25	2.77 x 7.13 x 1.14	BBP80B103	ORAR00103	2.06 x 2.62
3.0	8.0	4.5	5.9	0.25	3.56 x 7.92 x 1.14	BBP80B104	ORAR00104	2.84 x 2.62
4.0	9.0	4.5	5.9	0.25	4.34 x 8.70 x 1.14	BBP80B105	ORAR00105	3.63 x 2.62
5.0	9.5	4.5	5.9	0.25	5.13 x 9.49 x 1.14	BBP80B106	ORAR00106	4.42 x 2.62
5.5	10.0	4.5	5.9	0.25	5.94 x 10.30 x 1.14	BBP80B107	ORAR00107	5.23 x 2.62
6.5	11.0	4.5	5.9	0.25	6.73 x 11.09 x 1.14	BBP80B108	ORAR00108	6.02 x 2.62
8.0	13.0	4.5	5.9	0.25	8.31 x 12.67 x 1.14	BBP80B109	ORAR00109	7.59 x 2.62
9.5	14.0	4.5	5.9	0.25	9.91 x 14.27 x 1.14	BBP80B110	ORAR00110	9.19 x 2.62
11.0	16.0	4.5	5.9	0.25	11.48 x 15.84 x 1.14	BBP80B111	ORAR00111	10.77 x 2.62
13.0	17.0	4.5	5.9	0.25	13.08 x 17.44 x 1.14	BBP80B112	ORAR00112	12.37 x 2.62
14.0	19.0	4.5	5.9	0.25	14.66 x 19.02 x 1.14	BBP80B113	ORAR00113	13.94 x 2.62
16.0	21.0	4.5	5.9	0.25	16.26 x 20.62 x 1.14	BBP80B114	ORAR00114	15.54 x 2.62
17.0	22.0	4.5	5.9	0.25	17.83 x 22.19 x 1.14	BBP80B115	ORAR00115	17.12 x 2.62
19.0	24.0	4.5	5.9	0.25	19.43 x 23.79 x 1.14	BBP80B116	ORAR00116	18.72 x 2.62
20.0	25.0	4.5	5.9	0.25	21.11 x 25.47 x 1.14	BBP80B117	ORAR00117	20.29 x 2.62

Back-up Ring



Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
22.0	27.0	4.5	5.9	0.25	22.68 x 27.04 x 1.14	BBP80B118	ORAR00118	21.89 x 2.62
24.0	29.0	4.5	5.9	0.25	24.28 x 28.64 x 1.14	BBP80B119	ORAR00119	23.47 x 2.62
25.0	30.0	4.5	5.9	0.25	25.86 x 30.22 x 1.14	BBP80B120	ORAR00120	25.07 x 2.62
27.0	32.0	4.5	5.9	0.25	27.46 x 31.82 x 1.14	BBP80B121	ORAR00121	26.64 x 2.62
29.0	33.0	4.5	5.9	0.25	29.03 x 33.39 x 1.14	BBP80B122	ORAR00122	28.24 x 2.62
30.0	35.0	4.5	5.9	0.25	30.63 x 34.99 x 1.14	BBP80B123	ORAR00123	29.82 x 2.62
32.0	36.5	4.5	5.9	0.25	32.21 x 36.57 x 1.14	BBP80B124	ORAR00124	31.42 x 2.62
33.0	38.0	4.5	5.9	0.25	33.81 x 38.17 x 1.14	BBP80B125	ORAR00125	32.99 x 2.62
35.0	40.0	4.5	5.9	0.25	35.38 x 39.74 x 1.14	BBP80B126	ORAR00126	34.59 x 2.62
36.5	41.0	4.5	5.9	0.25	36.98 x 41.34 x 1.14	BBP80B127	ORAR00127	36.17 x 2.62
38.0	43.0	4.5	5.9	0.25	38.56 x 42.92 x 1.14	BBP80B128	ORAR00128	37.77 x 2.62
40.0	44.5	4.5	5.9	0.25	40.16 x 44.52 x 1.14	BBP80B129	ORAR00129	39.34 x 2.62
41.0	46.0	4.5	5.9	0.25	41.73 x 46.09 x 1.14	BBP80B130	ORAR00130	40.94 x 2.62
43.0	48.0	4.5	5.9	0.25	43.33 x 47.69 x 1.14	BBP80B131	ORAR00131	42.52 x 2.62
44.5	50.0	4.5	5.9	0.25	44.91 x 49.27 x 1.14	BBP80B132	ORAR00132	44.12 x 2.62
46.0	51.0	4.5	5.9	0.25	46.51 x 50.87 x 1.14	BBP80B133	ORAR00133	45.69 x 2.62
48.0	52.0	4.5	5.9	0.25	48.08 x 52.44 x 1.14	BBP80B134	ORAR00134	47.29 x 2.62
49.0	54.0	4.5	5.9	0.25	49.86 x 54.04 x 1.14	BBP80B135	ORAR00135	48.90 x 2.62
51.0	55.5	4.5	5.9	0.25	51.26 x 55.62 x 1.14	BBP80B136	ORAR00136	50.47 x 2.62
52.0	57.0	4.5	5.9	0.25	52.86 x 57.22 x 1.14	BBP80B137	ORAR00137	52.07 x 2.62
54.0	58.0	4.5	5.9	0.25	54.43 x 58.79 x 1.14	BBP80B138	ORAR00138	53.64 x 2.62
55.0	60.0	4.5	5.9	0.25	56.03 x 60.39 x 1.14	BBP80B139	ORAR00139	55.25 x 2.62
57.0	62.0	4.5	5.9	0.25	57.61 x 61.97 x 1.14	BBP80B140	ORAR00140	56.82 x 2.62
59.0	63.5	4.5	5.9	0.25	59.21 x 63.57 x 1.14	BBP80B141	ORAR00141	58.42 x 2.62
60.0	65.0	4.5	5.9	0.25	60.78 x 65.14 x 1.14	BBP80B142	ORAR00142	59.99 x 2.62
62.0	67.0	4.5	5.9	0.25	62.38 x 66.74 x 1.14	BBP80B143	ORAR00143	61.60 x 2.62
63.0	68.0	4.5	5.9	0.25	63.96 x 68.32 x 1.14	BBP80B144	ORAR00144	63.17 x 2.62
65.0	70.0	4.5	5.9	0.25	65.56 x 69.92 x 1.14	BBP80B145	ORAR00145	64.77 x 2.62
67.0	71.0	4.5	5.9	0.25	67.13 x 71.49 x 1.14	BBP80B146	ORAR00146	66.34 x 2.62
68.0	73.0	4.5	5.9	0.25	68.73 x 73.09 x 1.14	BBP80B147	ORAR00147	67.95 x 2.62
70.0	75.0	4.5	5.9	0.25	70.31 x 74.67 x 1.14	BBP80B148	ORAR00148	69.52 x 2.62
71.0	76.0	4.5	5.9	0.25	71.91 x 76.27 x 1.14	BBP80B149	ORAR00149	71.12 x 2.62
73.0	78.0	4.5	5.9	0.25	73.48 x 77.84 x 1.14	BBP80B150	ORAR00150	72.69 x 2.62
76.0	81.0	4.5	5.9	0.25	76.66 x 81.02 x 1.14	BBP80B151	ORAR00151	75.87 x 2.62
83.0	87.0	4.5	5.9	0.25	83.01 x 87.37 x 1.14	BBP80B152	ORAR00152	82.22 x 2.62
89.0	94.0	4.5	5.9	0.25	89.36 x 93.72 x 1.14	BBP80B153	ORAR00153	88.57 x 2.62
95.0	100.0	4.5	5.9	0.25	95.71 x 100.07 x 1.14	BBP80B154	ORAR00154	94.92 x 2.62



Back-up Ring

Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
102.0	106.0	4.5	5.9	0.25	102.06 x 106.42 x 1.14	BBP80B155	ORAR00155	101.27 x 2.62
108.0	113.0	4.5	5.9	0.25	108.41 x 112.77 x 1.14	BBP80B156	ORAR00156	107.62 x 2.62
114.0	119.0	4.5	5.9	0.25	114.76 x 119.12 x 1.14	BBP80B157	ORAR00157	113.97 x 2.62
121.0	125.0	4.5	5.9	0.25	121.11 x 125.47 x 1.14	BBP80B158	ORAR00158	120.32 x 2.62
127.0	132.0	4.5	5.9	0.25	127.46 x 131.82 x 1.14	BBP80B159	ORAR00159	126.67 x 2.62
133.0	138.0	4.5	5.9	0.25	133.81 x 138.17 x 1.14	BBP80B160	ORAR00160	133.02 x 2.62
140.0	144.0	4.5	5.9	0.25	140.16 x 144.52 x 1.14	BBP80B161	ORAR00161	139.37 x 2.62
146.0	151.0	4.5	5.9	0.25	146.51 x 150.87 x 1.14	BBP80B162	ORAR00162	145.72 x 2.62
152.0	157.0	4.5	5.9	0.25	152.86 x 157.22 x 1.14	BBP80B163	ORAR00163	152.07 x 2.62
159.0	164.0	4.5	5.9	0.25	159.21 x 163.57 x 1.14	BBP80B164	ORAR00164	158.42 x 2.62
165.0	170.0	4.5	5.9	0.25	165.56 x 169.92 x 1.14	BBP80B165	ORAR00165	164.77 x 2.62
172.0	176.0	4.5	5.9	0.25	171.91 x 176.27 x 1.14	BBP80B166	ORAR00166	171.12 x 2.62
178.0	183.0	4.5	5.9	0.25	178.25 x 182.61 x 1.14	BBP80B167	ORAR00167	177.47 x 2.62
184.0	189.0	4.5	5.9	0.25	184.61 x 188.97 x 1.14	BBP80B168	ORAR00168	183.82 x 2.62
190.0	195.0	4.5	5.9	0.25	190.96 x 195.32 x 1.14	BBP80B169	ORAR00169	190.17 x 2.62
197.0	202.0	4.5	5.9	0.25	197.31 x 201.67 x 1.14	BBP80B170	ORAR00170	196.52 x 2.62
203.0	208.0	4.5	5.9	0.25	203.66 x 208.02 x 1.14	BBP80B171	ORAR00171	202.87 x 2.62
210.0	214.0	4.5	5.9	0.25	210.01 x 214.37 x 1.14	BBP80B172	ORAR00172	209.22 x 2.62
216.0	221.0	4.5	5.9	0.25	216.36 x 220.72 x 1.14	BBP80B173	ORAR00173	215.57 x 2.62
222.0	227.0	4.5	5.9	0.25	222.71 x 227.07 x 1.14	BBP80B174	ORAR00174	221.92 x 2.62
229.0	233.0	4.5	5.9	0.25	229.06 x 233.42 x 1.14	BBP80B175	ORAR00175	228.27 x 2.62
235.0	240.0	4.5	5.9	0.25	235.41 x 239.77 x 1.14	BBP80B176	ORAR00176	234.62 x 2.62
241.0	246.0	4.5	5.9	0.25	241.76 x 246.12 x 1.14	BBP80B177	ORAR00177	240.97 x 2.62
248.0	252.0	4.5	5.9	0.25	248.11 x 252.47 x 1.14	BBP80B178	ORAR00178	247.32 x 2.62
5.0	11.0	5.6	7.0	0.25	5.13 x 11.13 x 1.02	BBP80B201	ORAR00201	4.34 x 3.53
6.5	13.0	5.6	7.0	0.25	6.73 x 12.73 x 1.02	BBP80B202	ORAR00202	5.94 x 3.53
8.0	14.0	5.6	7.0	0.25	8.30 x 14.30 x 1.02	BBP80B203	ORAR00203	7.52 x 3.53
9.5	16.0	5.6	7.0	0.25	9.90 x 15.90 x 1.02	BBP80B204	ORAR00204	9.12 x 3.53
11.0	17.0	5.6	7.0	0.25	11.56 x 17.56 x 1.02	BBP80B205	ORAR00205	10.69 x 3.53
13.0	19.0	5.6	7.0	0.25	13.16 x 19.16 x 1.02	BBP80B206	ORAR00206	12.29 x 3.53
14.0	21.0	5.6	7.0	0.25	14.73 x 20.73 x 1.02	BBP80B207	ORAR00207	13.87 x 3.53
16.0	22.0	5.6	7.0	0.25	16.33 x 22.33 x 1.02	BBP80B208	ORAR00208	15.47 x 3.53
17.0	24.0	5.6	7.0	0.25	17.90 x 23.90 x 1.02	BBP80B209	ORAR00209	17.04 x 3.53
19.0	25.0	5.6	7.0	0.25	19.46 x 25.46 x 1.02	BBP80B210	ORAR00210	18.64 x 3.53
20.0	27.0	5.6	7.0	0.25	21.03 x 27.03 x 1.02	BBP80B211	ORAR00211	20.22 x 3.53
22.0	29.0	5.6	7.0	0.25	22.63 x 28.63 x 1.02	BBP80B212	ORAR00212	21.82 x 3.53

Back-up Ring



Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
24.0	30.0	5.6	7.0	0.25	24.21 x 30.21 x 1.02	BBP80B213	ORAR00213	23.39 x 3.53
25.0	32.0	5.6	7.0	0.25	25.81 x 31.81 x 1.02	BBP80B214	ORAR00214	25.00 x 3.53
27.0	33.0	5.6	7.0	0.25	27.38 x 33.38 x 1.02	BBP80B215	ORAR00215	26.57 x 3.53
29.0	35.0	5.6	7.0	0.25	28.98 x 34.98 x 1.02	BBP80B216	ORAR00216	28.17 x 3.53
30.0	36.5	5.6	7.0	0.25	30.56 x 36.56 x 1.02	BBP80B217	ORAR00217	29.74 x 3.53
32.0	38.0	5.6	7.0	0.25	32.16 x 38.16 x 1.02	BBP80B218	ORAR00218	31.34 x 3.53
33.0	40.0	5.6	7.0	0.25	33.88 x 39.88 x 1.02	BBP80B219	ORAR00219	32.92 x 3.53
35.0	41.0	5.6	7.0	0.25	35.50 x 41.50 x 1.02	BBP80B220	ORAR00220	34.52 x 3.53
36.0	43.0	5.6	7.0	0.25	37.06 x 43.06 x 1.02	BBP80B221	ORAR00221	36.09 x 3.53
38.0	44.5	5.6	7.0	0.25	38.66 x 44.66 x 1.02	BBP80B222	ORAR00222	37.69 x 3.53
41.0	48.0	5.6	7.0	0.25	41.83 x 47.83 x 1.02	BBP80B223	ORAR00223	40.87 x 3.53
44.5	51.0	5.6	7.0	0.25	45.01 x 51.01 x 1.02	BBP80B224	ORAR00224	44.04 x 3.53
48.0	54.0	5.6	7.0	0.25	48.18 x 54.18 x 1.02	BBP80B225	ORAR00225	47.22 x 3.53
51.0	57.0	5.6	7.0	0.25	51.36 x 57.36 x 1.02	BBP80B226	ORAR00226	50.39 x 3.53
54.0	60.0	5.6	7.0	0.25	54.53 x 60.53 x 1.02	BBP80B227	ORAR00227	53.57 x 3.53
57.0	63.5	5.6	7.0	0.25	57.71 x 63.71 x 1.02	BBP80B228	ORAR00228	56.74 x 3.53
60.0	67.0	5.6	7.0	0.25	60.88 x 68.88 x 1.02	BBP80B229	ORAR00229	59.92 x 3.53
63.5	70.0	5.6	7.0	0.25	64.06 x 70.06 x 1.02	BBP80B230	ORAR00230	63.09 x 3.53
67.0	73.0	5.6	7.0	0.25	66.83 x 72.83 x 1.02	BBP80B231	ORAR00231	66.27 x 3.53
70.0	76.0	5.6	7.0	0.25	70.00 x 76.00 x 1.02	BBP80B232	ORAR00232	69.44 x 3.53
73.0	79.0	5.6	7.0	0.25	73.18 x 79.18 x 1.02	BBP80B233	ORAR00233	72.62 x 3.53
76.0	83.0	5.6	7.0	0.25	76.35 x 82.35 x 1.02	BBP80B234	ORAR00234	75.79 x 3.53
79.5	86.0	5.6	7.0	0.25	79.53 x 85.53 x 1.02	BBP80B235	ORAR00235	78.97 x 3.53
83.0	89.0	5.6	7.0	0.25	82.70 x 88.70 x 1.02	BBP80B236	ORAR00236	82.14 x 3.53
86.0	92.0	5.6	7.0	0.25	85.88 x 91.88 x 1.02	BBP80B237	ORAR00237	85.32 x 3.53
90.0	95.0	5.6	7.0	0.25	89.05 x 95.05 x 1.02	BBP80B238	ORAR00238	88.49 x 3.53
92.0	98.0	5.6	7.0	0.25	92.23 x 98.23 x 1.02	BBP80B239	ORAR00239	91.67 x 3.53
95.0	102.0	5.6	7.0	0.25	95.40 x 101.40 x 1.02	BBP80B240	ORAR00240	94.84 x 3.53
98.0	105.0	5.6	7.0	0.25	98.58 x 104.58 x 1.02	BBP80B241	ORAR00241	98.02 x 3.53
102.0	108.0	5.6	7.0	0.25	101.75 x 107.75 x 1.02	BBP80B242	ORAR00242	101.19 x 3.53
105.0	111.0	5.6	7.0	0.25	104.93 x 110.93 x 1.02	BBP80B243	ORAR00243	104.37 x 3.53
108.0	114.0	5.6	7.0	0.25	108.10 x 114.10 x 1.02	BBP80B244	ORAR00244	107.54 x 3.53
111.0	118.0	5.6	7.0	0.25	111.28 x 117.28 x 1.02	BBP80B245	ORAR00245	110.72 x 3.53
114.0	121.0	5.6	7.0	0.25	114.45 x 120.45 x 1.02	BBP80B246	ORAR00246	113.89 x 3.53
118.0	124.0	5.6	7.0	0.25	117.63 x 123.63 x 1.02	BBP80B247	ORAR00247	117.07 x 3.53
121.0	127.0	5.6	7.0	0.25	121.11 x 127.11 x 1.02	BBP80B248	ORAR00248	120.24 x 3.53
124.0	130.0	5.6	7.0	0.25	124.28 x 130.28 x 1.02	BBP80B249	ORAR00249	123.42 x 3.53



Back-up Ring

Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
127.0	133.0	5.6	7.0	0.25	127.46 x 133.46 x 1.02	BBP80B250	ORAR00250	126.59 x 3.53
130.0	136.5	5.6	7.0	0.25	130.63 x 136.63 x 1.02	BBP80B251	ORAR00251	129.77 x 3.53
133.0	140.0	5.6	7.0	0.25	133.81 x 139.81 x 1.02	BBP80B252	ORAR00252	132.94 x 3.53
136.5	143.0	5.6	7.0	0.25	136.98 x 142.98 x 1.02	BBP80B253	ORAR00253	136.12 x 3.53
140.0	146.0	5.6	7.0	0.25	140.16 x 146.16 x 1.02	BBP80B254	ORAR00254	139.29 x 3.53
143.0	150.0	5.6	7.0	0.25	143.33 x 149.33 x 1.02	BBP80B255	ORAR00255	142.47 x 3.53
146.0	152.0	5.6	7.0	0.25	146.51 x 152.51 x 1.02	BBP80B256	ORAR00256	145.64 x 3.53
149.0	156.0	5.6	7.0	0.25	149.68 x 155.68 x 1.02	BBP80B257	ORAR00257	148.82 x 3.53
152.0	159.0	5.6	7.0	0.25	152.86 x 158.86 x 1.02	BBP80B258	ORAR00258	151.99 x 3.53
159.0	165.0	5.6	7.0	0.25	159.21 x 165.21 x 1.02	BBP80B259	ORAR00259	158.34 x 3.53
165.0	172.0	5.6	7.0	0.25	165.56 x 171.56 x 1.02	BBP80B260	ORAR00260	164.69 x 3.53
172.0	190.5	5.6	7.0	0.25	184.61 x 190.61 x 1.02	BBP80B263	ORAR00261	171.04 x 3.53
178.0	178.0	5.6	7.0	0.25	171.91 x 177.91 x 1.02	BBP80B261	ORAR00262	177.39 x 3.53
184.0	184.0	5.6	7.0	0.25	178.26 x 184.26 x 1.02	BBP80B262	ORAR00263	183.74 x 3.53
190.5	197.0	5.6	7.0	0.25	190.96 x 196.96 x 1.02	BBP80B264	ORAR00264	190.09 x 3.53
197.0	203.0	5.6	7.0	0.25	197.31 x 203.31 x 1.02	BBP80B265	ORAR00265	196.44 x 3.53
203.0	210.0	5.6	7.0	0.25	203.66 x 209.66 x 1.02	BBP80B266	ORAR00266	202.79 x 3.53
210.0	215.9	5.6	7.0	0.25	210.01 x 216.01 x 1.02	BBP80B267	ORAR00267	209.14 x 3.53
215.9	222.3	5.6	7.0	0.25	216.36 x 222.36 x 1.02	BBP80B268	ORAR00268	215.49 x 3.53
222.3	229.0	5.6	7.0	0.25	222.71 x 228.71 x 1.02	BBP80B269	ORAR00269	221.84 x 3.53
228.6	235.0	5.6	7.0	0.25	229.06 x 235.06 x 1.02	BBP80B270	ORAR00270	228.19 x 3.53
235.0	241.0	5.6	7.0	0.25	235.41 x 241.41 x 1.02	BBP80B271	ORAR00271	234.54 x 3.53
241.0	248.0	5.6	7.0	0.25	241.76 x 247.76 x 1.02	BBP80B272	ORAR00272	240.89 x 3.53
248.0	254.0	5.6	7.0	0.25	248.11 x 254.11 x 1.02	BBP80B273	ORAR00273	247.24 x 3.53
254.0	260.0	5.6	7.0	0.25	254.46 x 260.46 x 1.02	BBP80B274	ORAR00274	253.59 x 3.53
267.0	273.0	5.6	7.0	0.25	267.16 x 273.16 x 1.02	BBP80B275	ORAR00275	266.29 x 3.53
280.0	286.0	5.6	7.0	0.25	279.86 x 285.86 x 1.02	BBP80B276	ORAR00276	278.99 x 3.53
292.0	299.0	5.6	7.0	0.25	292.56 x 298.56 x 1.02	BBP80B277	ORAR00277	291.69 x 3.53
305.0	311.0	5.6	7.0	0.25	305.26 x 311.26 x 1.02	BBP80B278	ORAR00278	304.39 x 3.53
330.0	336.0	5.6	7.0	0.25	330.66 x 336.66 x 1.02	BBP80B279	ORAR00279	329.79 x 3.53
356.0	362.0	5.6	7.0	0.25	356.05 x 362.05 x 1.02	BBP80B280	ORAR00280	355.19 x 3.53
381.0	387.0	5.6	7.0	0.25	381.46 x 387.46 x 1.02	BBP80B281	ORAR00281	380.59 x 3.53
406.0	413.0	5.6	7.0	0.25	406.12 x 412.12 x 1.02	BBP80B282	ORAR00282	405.26 x 3.53
432.0	438.0	5.6	7.0	0.25	431.52 x 437.52 x 1.02	BBP80B283	ORAR00283	430.66 x 3.53
457.0	464.0	5.6	7.0	0.25	456.92 x 462.92 x 1.02	BBP80B284	ORAR00284	456.06 x 3.53
11.0	21.0	7.9	9.6	0.25	11.43 x 20.73 x 1.52	BBP80B309	ORAR00309	10.46 x 5.33

Back-up Ring



Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
13.0	22.0	7.9	9.6	0.25	13.03 x 22.33 x 1.52	BBP80B310	ORAR00310	12.07 x 5.33
14.0	24.0	7.9	9.6	0.25	14.60 x 23.90 x 1.52	BBP80B311	ORAR00311	13.64 x 5.33
16.0	25.0	7.9	9.6	0.25	16.20 x 25.50 x 1.52	BBP80B312	ORAR00312	15.24 x 5.33
17.0	27.0	7.9	9.6	0.25	17.78 x 27.08 x 1.52	BBP80B313	ORAR00313	16.81 x 5.33
19.0	29.0	7.9	9.6	0.25	19.38 x 28.68 x 1.52	BBP80B314	ORAR00314	18.42 x 5.33
20.0	30.0	7.9	9.6	0.25	20.96 x 30.26 x 1.52	BBP80B315	ORAR00315	19.99 x 5.33
22.0	32.0	7.9	9.6	0.25	22.56 x 31.86 x 1.52	BBP80B316	ORAR00316	21.59 x 5.33
24.0	33.0	7.9	9.6	0.25	24.13 x 33.43 x 1.52	BBP80B317	ORAR00317	23.16 x 5.33
25.0	35.0	7.9	9.6	0.25	25.73 x 35.03 x 1.52	BBP80B318	ORAR00318	24.77 x 5.33
27.0	36.5	7.9	9.6	0.25	27.31 x 36.61 x 1.52	BBP80B319	ORAR00319	26.34 x 5.33
29.0	38.0	7.9	9.6	0.25	28.91 x 38.21 x 1.52	BBP80B320	ORAR00320	27.94 x 5.33
30.0	40.0	7.9	9.6	0.25	30.42 x 39.72 x 1.52	BBP80B321	ORAR00321	29.51 x 5.33
32.0	41.0	7.9	9.6	0.25	32.08 x 41.38 x 1.52	BBP80B322	ORAR00322	31.12 x 5.33
33.0	43.0	7.9	9.6	0.25	33.43 x 42.73 x 1.52	BBP80B323	ORAR00323	32.69 x 5.33
35.0	44.5	7.9	9.6	0.25	35.26 x 44.56 x 1.52	BBP80B324	ORAR00324	34.29 x 5.33
38.0	48.0	7.9	9.6	0.25	38.43 x 47.73 x 1.52	BBP80B325	ORAR00325	37.47 x 5.33
41.0	51.0	7.9	9.6	0.25	41.61 x 50.91 x 1.52	BBP80B326	ORAR00326	40.64 x 5.33
44.5	54.0	7.9	9.6	0.25	44.78 x 54.08 x 1.52	BBP80B327	ORAR00327	43.82 x 5.33
48.0	57.0	7.9	9.6	0.25	47.96 x 57.26 x 1.52	BBP80B328	ORAR00328	46.99 x 5.33
51.0	60.0	7.9	9.6	0.25	51.13 x 60.43 x 1.52	BBP80B329	ORAR00329	50.17 x 5.33
54.0	63.5	7.9	9.6	0.25	54.31 x 63.61 x 1.52	BBP80B330	ORAR00330	53.34 x 5.33
57.0	67.0	7.9	9.6	0.25	57.61 x 66.91 x 1.52	BBP80B331	ORAR00331	56.52 x 5.33
60.0	70.0	7.9	9.6	0.25	60.78 x 70.08 x 1.52	BBP80B332	ORAR00332	59.69 x 5.33
64.0	73.0	7.9	9.6	0.25	63.96 x 73.26 x 1.52	BBP80B333	ORAR00333	62.87 x 5.33
67.0	76.0	7.9	9.6	0.25	67.13 x 76.43 x 1.52	BBP80B334	ORAR00334	66.04 x 5.33
70.0	80.0	7.9	9.6	0.25	70.31 x 79.61 x 1.52	BBP80B335	ORAR00335	69.22 x 5.33
73.0	83.0	7.9	9.6	0.25	73.48 x 82.78 x 1.52	BBP80B336	ORAR00336	72.39 x 5.33
76.0	86.0	7.9	9.6	0.25	76.66 x 85.96 x 1.52	BBP80B337	ORAR00337	75.57 x 5.33
80.0	89.0	7.9	9.6	0.25	79.83 x 89.13 x 1.52	BBP80B338	ORAR00338	78.74 x 5.33
83.0	92.0	7.9	9.6	0.25	83.13 x 92.43 x 1.52	BBP80B339	ORAR00339	81.92 x 5.33
86.0	95.0	7.9	9.6	0.25	86.31 x 95.61 x 1.52	BBP80B340	ORAR00340	85.09 x 5.33
90.0	98.0	7.9	9.6	0.25	89.48 x 98.78 x 1.52	BBP80B341	ORAR00341	88.27 x 5.33
92.0	102.0	7.9	9.6	0.25	92.66 x 101.96 x 1.52	BBP80B342	ORAR00342	91.44 x 5.33
95.0	105.0	7.9	9.6	0.25	95.83 x 105.13 x 1.52	BBP80B343	ORAR00343	94.62 x 5.33
98.0	108.0	7.9	9.6	0.25	99.01 x 108.31 x 1.52	BBP80B344	ORAR00344	97.79 x 5.33
102.0	111.0	7.9	9.6	0.25	102.31 x 111.61 x 1.52	BBP80B345	ORAR00345	100.97 x 5.33
105.0	114.0	7.9	9.6	0.25	105.49 x 114.79 x 1.52	BBP80B346	ORAR00346	104.14 x 5.33



Back-up Ring

Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
108.0	118.0	7.9	9.6	0.25	108.66 x 117.96 x 1.52	BBP80B347	ORAR00347	107.32 x 5.33
111.0	121.0	7.9	9.6	0.25	111.84 x 121.14 x 1.52	BBP80B348	ORAR00348	110.49 x 5.33
114.0	124.0	7.9	9.6	0.25	115.01 x 124.31 x 1.52	BBP80B349	ORAR00349	113.67 x 5.33
115.0	130.0	7.9	9.6	0.25	121.36 x 130.66 x 1.52	BBP80B351	ORAR00351	120.02 x 5.33
118.0	127.0	7.9	9.6	0.25	118.19 x 127.49 x 1.52	BBP80B350	ORAR00350	116.84 x 5.33
124.0	133.0	7.9	9.6	0.25	124.54 x 133.84 x 1.52	BBP80B352	ORAR00352	123.19 x 5.33
127.0	137.0	7.9	9.6	0.25	127.71 x 137.01 x 1.52	BBP80B353	ORAR00353	126.37 x 5.33
130.0	140.0	7.9	9.6	0.25	130.89 x 140.19 x 1.52	BBP80B354	ORAR00354	129.54 x 5.33
134.0	143.0	7.9	9.6	0.25	134.09 x 143.39 x 1.52	BBP80B355	ORAR00355	132.72 x 5.33
137.0	146.0	7.9	9.6	0.25	137.24 x 146.54 x 1.52	BBP80B356	ORAR00356	135.89 x 5.33
140.0	150.0	7.9	9.6	0.25	140.41 x 149.71 x 1.52	BBP80B357	ORAR00357	139.07 x 5.33
143.0	152.0	7.9	9.6	0.25	143.59 x 152.89 x 1.52	BBP80B358	ORAR00358	142.24 x 5.33
146.0	156.0	7.9	9.6	0.25	146.76 x 156.06 x 1.52	BBP80B359	ORAR00359	145.42 x 5.33
150.0	159.0	7.9	9.6	0.25	149.94 x 159.24 x 1.52	BBP80B360	ORAR00360	148.49 x 5.33
152.0	162.0	7.9	9.6	0.25	153.11 x 162.41 x 1.52	BBP80B361	ORAR00361	151.77 x 5.33
159.0	168.0	7.9	9.6	0.25	159.46 x 168.76 x 1.52	BBP80B362	ORAR00362	158.12 x 5.33
165.0	175.0	7.9	9.6	0.25	165.81 x 175.11 x 1.52	BBP80B363	ORAR00363	164.47 x 5.33
172.0	181.0	7.9	9.6	0.25	172.16 x 181.46 x 1.52	BBP80B364	ORAR00364	170.82 x 5.33
178.0	187.0	7.9	9.6	0.25	178.51 x 187.81 x 1.52	BBP80B365	ORAR00365	177.17 x 5.33
184.0	194.0	7.9	9.6	0.25	184.86 x 194.16 x 1.52	BBP80B366	ORAR00366	183.52 x 5.33
191.0	200.0	7.9	9.6	0.25	191.21 x 200.51 x 1.52	BBP80B367	ORAR00367	189.87 x 5.33
197.0	206.0	7.9	9.6	0.25	197.56 x 206.86 x 1.52	BBP80B368	ORAR00368	196.22 x 5.33
203.0	213.0	7.9	9.6	0.25	203.91 x 213.21 x 1.52	BBP80B369	ORAR00369	202.57 x 5.33
210.0	220.0	7.9	9.6	0.25	210.26 x 219.56 x 1.52	BBP80B370	ORAR00370	208.92 x 5.33
216.0	225.0	7.9	9.6	0.25	216.61 x 225.91 x 1.52	BBP80B371	ORAR00371	215.27 x 5.33
222.0	232.0	7.9	9.6	0.25	222.96 x 232.26 x 1.52	BBP80B372	ORAR00372	221.62 x 5.33
229.0	238.0	7.9	9.6	0.25	229.31 x 238.61 x 1.52	BBP80B373	ORAR00373	227.97 x 5.33
235.0	244.5	7.9	9.6	0.25	235.66 x 244.96 x 1.52	BBP80B374	ORAR00374	234.32 x 5.33
241.0	251.0	7.9	9.6	0.25	242.01 x 251.31 x 1.52	BBP80B375	ORAR00375	240.67 x 5.33
248.0	257.0	7.9	9.6	0.25	248.36 x 257.66 x 1.52	BBP80B376	ORAR00376	247.02 x 5.33
254.0	264.0	7.9	9.6	0.25	254.71 x 264.01 x 1.52	BBP80B377	ORAR00377	253.37 x 5.33
267.0	276.0	7.9	9.6	0.25	267.41 x 276.71 x 1.52	BBP80B378	ORAR00378	266.07 x 5.33
280.0	290.0	7.9	9.6	0.25	280.11 x 289.41 x 1.52	BBP80B379	ORAR00379	278.77 x 5.33
292.0	302.0	7.9	9.6	0.25	292.81 x 302.11 x 1.52	BBP80B380	ORAR00380	291.47 x 5.33
305.0	315.0	7.9	9.6	0.25	305.51 x 314.81 x 1.52	BBP80B381	ORAR00381	304.17 x 5.33
330.0	340.0	7.9	9.6	0.25	330.91 x 340.21 x 1.52	BBP80B382	ORAR00382	329.57 x 5.33
356.0	366.0	7.9	9.6	0.25	356.31 x 365.61 x 1.52	BBP80B383	ORAR00383	354.97 x 5.33

Back-up Ring



Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
381.0	390.5	7.9	9.6	0.25	381.71 x 391.01 x 1.52	BBP80B384	ORAR00384	380.37 x 5.33
407.0	416.0	7.9	9.6	0.25	406.60 x 415.90 x 1.52	BBP80B385	ORAR00385	405.26 x 5.33
432.0	441.0	7.9	9.6	0.25	432.00 x 441.30 x 1.52	BBP80B386	ORAR00386	430.66 x 5.33
457.0	467.0	7.9	9.6	0.25	457.40 x 466.70 x 1.52	BBP80B387	ORAR00387	456.06 x 5.33
483.0	492.0	7.9	9.6	0.25	482.75 x 492.05 x 1.52	BBP80B388	ORAR00388	481.38 x 5.33
508.0	518.0	7.9	9.6	0.25	508.15 x 517.45 x 1.52	BBP80B389	ORAR00389	506.78 x 5.33
533.0	543.0	7.9	9.6	0.25	533.55 x 542.85 x 1.52	BBP80B390	ORAR00390	532.18 x 5.33
559.0	568.0	7.9	9.6	0.25	558.95 x 568.25 x 1.52	BBP80B391	ORAR00391	557.58 x 5.33
584.0	593.0	7.9	9.6	0.25	584.02 x 593.32 x 1.52	BBP80B392	ORAR00392	582.68 x 5.33
610.0	619.0	7.9	9.6	0.25	609.42 x 618.72 x 1.52	BBP80B393	ORAR00393	608.08 x 5.33
635.0	644.0	7.9	9.6	0.25	634.82 x 644.12 x 1.52	BBP80B394	ORAR00394	633.48 x 5.33
660.0	670.0	7.9	9.6	0.25	660.22 x 669.52 x 1.52	BBP80B395	ORAR00395	658.88 x 5.33
114.0	128.0	10.7	13.2	0.25	115.60 x 127.58 x 2.44	BBP80B425	ORAR00425	113.67 x 6.99
118.0	131.0	10.7	13.2	0.25	118.77 x 130.75 x 2.44	BBP80B426	ORAR00426	116.84 x 6.99
121.0	134.0	10.7	13.2	0.25	121.95 x 133.93 x 2.44	BBP80B427	ORAR00427	120.02 x 6.99
124.0	137.0	10.7	13.2	0.25	125.20 x 137.18 x 2.44	BBP80B428	ORAR00428	123.19 x 6.99
127.0	140.0	10.7	13.2	0.25	128.30 x 140.28 x 2.44	BBP80B429	ORAR00429	126.37 x 6.99
130.0	143.0	10.7	13.2	0.25	131.47 x 143.45 x 2.44	BBP80B430	ORAR00430	129.54 x 6.99
134.0	147.0	10.7	13.2	0.25	134.65 x 146.63 x 2.44	BBP80B431	ORAR00431	132.72 x 6.99
137.0	150.0	10.7	13.2	0.25	137.82 x 149.80 x 2.44	BBP80B432	ORAR00432	135.89 x 6.99
140.0	152.0	10.7	13.2	0.25	141.00 x 152.98 x 2.44	BBP80B433	ORAR00433	139.07 x 6.99
143.0	156.0	10.7	13.2	0.25	144.17 x 156.15 x 2.44	BBP80B434	ORAR00434	142.24 x 6.99
146.0	159.0	10.7	13.2	0.25	147.35 x 159.33 x 2.44	BBP80B435	ORAR00435	145.42 x 6.99
150.0	162.0	10.7	13.2	0.25	150.52 x 162.50 x 2.44	BBP80B436	ORAR00436	148.59 x 6.99
153.0	165.0	10.7	13.2	0.25	153.70 x 165.68 x 2.44	BBP80B437	ORAR00437	151.77 x 6.99
159.0	172.0	10.7	13.2	0.25	159.36 x 171.34 x 2.44	BBP80B438	ORAR00438	158.12 x 6.99
165.0	178.0	10.7	13.2	0.25	165.71 x 177.69 x 2.44	BBP80B439	ORAR00439	164.47 x 6.99
172.0	184.0	10.7	13.2	0.25	172.06 x 184.04 x 2.44	BBP80B440	ORAR00440	170.82 x 6.99
178.0	190.5	10.7	13.2	0.25	178.41 x 190.39 x 2.44	BBP80B441	ORAR00441	177.17 x 6.99
185.0	197.0	10.7	13.2	0.25	184.76 x 196.74 x 2.44	BBP80B442	ORAR00442	183.52 x 6.99
190.0	203.0	10.7	13.2	0.25	191.11 x 203.09 x 2.44	BBP80B443	ORAR00443	189.87 x 6.99
197.0	210.0	10.7	13.2	0.25	197.46 x 209.44 x 2.44	BBP80B444	ORAR00444	196.22 x 6.99
203.0	216.0	10.7	13.2	0.25	203.81 x 215.79 x 2.44	BBP80B445	ORAR00445	202.57 x 6.99
216.0	229.0	10.7	13.2	0.25	216.51 x 228.49 x 2.44	BBP80B446	ORAR00446	215.27 x 6.99
229.0	241.0	10.7	13.2	0.25	229.21 x 241.19 x 2.44	BBP80B447	ORAR00447	227.97 x 6.99
241.0	254.0	10.7	13.2	0.25	241.91 x 253.89 x 2.44	BBP80B448	ORAR00448	240.67 x 6.99



Back-up Ring

Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.2	b ₃ +0.2					
254.0	267.0	10.7	13.2	0.25	254.61 x 266.59 x 2.44	BBP80B449	ORAR00449	253.37 x 6.99
267.0	280.0	10.7	13.2	0.25	267.31 x 279.29 x 2.44	BBP80B450	ORAR00450	266.07 x 6.99
280.0	292.0	10.7	13.2	0.25	280.01 x 291.99 x 2.44	BBP80B451	ORAR00451	278.77 x 6.99
292.0	305.0	10.7	13.2	0.25	292.71 x 304.69 x 2.44	BBP80B452	ORAR00452	291.47 x 6.99
305.0	218.0	10.7	13.2	0.25	305.41 x 317.39 x 2.44	BBP80B453	ORAR00453	304.17 x 6.99
318.0	330.0	10.7	13.2	0.25	318.11 x 330.09 x 2.44	BBP80B454	ORAR00454	316.87 x 6.99
330.0	343.0	10.7	13.2	0.25	330.81 x 342.79 x 2.44	BBP80B455	ORAR00455	329.57 x 6.99
343.0	356.0	10.7	13.2	0.25	343.51 x 355.49 x 2.44	BBP80B456	ORAR00456	342.47 x 6.99
356.0	368.0	10.7	13.2	0.25	356.21 x 361.09 x 2.44	BBP80B457	ORAR00457	354.97 x 6.99
368.0	381.0	10.7	13.2	0.25	368.91 x 380.89 x 2.44	BBP80B458	ORAR00458	367.67 x 6.99
381.0	394.0	10.7	13.2	0.25	381.61 x 393.51 x 2.44	BBP80B459	ORAR00459	380.37 x 6.99
394.0	406.0	10.7	13.2	0.25	394.31 x 406.29 x 2.44	BBP80B460	ORAR00460	393.07 x 6.99
407.0	419.0	10.7	13.2	0.25	406.50 x 418.48 x 2.44	BBP80B461	ORAR00461	405.26 x 6.99
420.0	432.0	10.7	13.2	0.25	419.20 x 431.18 x 2.44	BBP80B462	ORAR00462	417.96 x 6.99
432.0	444.5	10.7	13.2	0.25	431.90 x 443.88 x 2.44	BBP80B463	ORAR00463	430.66 x 6.99
445.0	457.0	10.7	13.2	0.25	444.60 x 456.58 x 2.44	BBP80B464	ORAR00464	443.36 x 6.99
458.0	470.0	10.7	13.2	0.25	457.30 x 469.28 x 2.44	BBP80B465	ORAR00465	456.06 x 6.99
470.0	483.0	10.7	13.2	0.25	470.00 x 481.98 x 2.44	BBP80B466	ORAR00466	468.76 x 6.99
483.0	495.0	10.7	13.2	0.25	482.70 x 494.68 x 2.44	BBP80B467	ORAR00467	481.38 x 6.99
495.0	508.0	10.7	13.2	0.25	495.40 x 507.38 x 2.44	BBP80B468	ORAR00468	494.16 x 6.99
508.0	521.0	10.7	13.2	0.25	508.10 x 520.08 x 2.44	BBP80B469	ORAR00469	506.86 x 6.99
533.0	546.0	10.7	13.2	0.25	533.50 x 545.80 x 2.44	BBP80B470	ORAR00470	532.26 x 6.99
559.0	572.0	10.7	13.2	0.25	558.90 x 570.88 x 2.44	BBP80B471	ORAR00471	557.66 x 6.99
584.0	597.0	10.7	13.2	0.25	584.30 x 596.28 x 2.44	BBP80B472	ORAR00472	582.68 x 6.99
610.0	622.0	10.7	13.2	0.25	609.70 x 621.68 x 2.44	BBP80B473	ORAR00473	608.08 x 6.99
635.0	648.0	10.7	13.2	0.25	635.10 x 647.08 x 2.44	BBP80B474	ORAR00474	633.48 x 6.99
660.0	673.0	10.7	13.2	0.25	660.50 x 672.48 x 2.44	BBP80B475	ORAR00475	658.88 x 6.99

Part III

General quality criteria and storage guidelines



A General quality criteria

The cost-effective use of seals and bearings is highly influenced by the quality criteria applied in production. Seals and bearings from Trelleborg Sealing Solutions are continuously monitored according to strict quality standards from material acquisition through to delivery.

Certification of our production plants in accordance with international standards QS 9000/ISO 9000 meets the specific requirements for quality control and management of purchasing, production and marketing functions.

Our quality policy is consistently controlled by strict procedures and guidelines which are implemented within all strategic areas of the company.

All testing of materials and products is performed in accordance with accepted test standards and specifications, e.g. random sample testing in accordance with ISO 2859-1:2004-01 AQL 1,0 general inspection level II, normal inspection.

Inspection specifications correspond to standards applicable to individual product groups (e.g. for O-Rings: ISO 3601).

Our sealing materials are produced free of chlorofluorinated hydrocarbons and carcinogenic elements.

B Guidelines for the storage of polymer products based on ISO 2230

Many polymer products and components are stored for long periods of time before being put into service, so it is important they are stored in conditions that minimize unwanted changes in properties. Such changes may result from degradation, in which case they may include excessive hardening, softening, cracking, crazing and other surface effects. Other changes may be caused by deformation, contamination or mechanical damage.

Packaging

Unless otherwise specified in the appropriate product specification, rubber products should be enclosed in individual sealed envelopes. The packaging should be carried out in an atmosphere in which the relative humidity is less than 70 %, or if polyurethanes are being packed, less than 65 %. Where there is serious risk of ingress of moisture (e.g. rubber-metal-bonded parts), aluminum foil/paper/polyethylene laminate or other similar means of protection should be used to ensure protection from ingress of moisture.

Temperature

The storage temperature should be below 25 °C and the products should be stored away from direct sources of heat such as boilers, radiators and direct sunlight. If the storage temperature is below 15 °C, care should be

exercised during handling of stored products, as they may have stiffened and have become susceptible to distortion if not handled carefully.

Humidity

The relative humidity should be such that, given in the variations of temperature in storage, condensation does not occur. In all cases, the relative humidity of the atmosphere in storage should be less than 70 %, or if polyurethanes are being stored, less than 65 %.

Light

Rubber should be protected from light sources, in particular direct sunlight or intense light having a high ultraviolet content. It is advisable that any windows of storage rooms be covered with a red or orange coating or screen.

Radiation

Precautions should be taken to protect stored products from all sources of ionizing radiation likely to cause damage to the products.

Ozone

Ozone has a particularly harmful effect on rubber. Storage rooms should not contain any equipment that is capable of generating ozone, such as mercury vapor lamps or high-voltage electrical equipment giving rise to electric sparks or electrical discharges. Combustion gases and organic vapors should also be excluded, as they may give rise to ozone via photo-chemical processes. When equipment such as a fork-lift truck is used to handle large rubber products, care needs to be taken to ensure this equipment is not a source of pollution that may affect the rubber. Combustion gases should be considered separately. While they are responsible for generating ground-level ozone, they may also contain unburned fuel which, by condensing on rubber products, can cause additional deterioration.

Deformation

Rubber should be stored free from tension, compressive stresses or other causes of deformation. Where products are packaged in a strain-free condition, they should be stored in their original packaging. In case of doubt, the manufacturer's advice should be sought. It is advisable that rings of large internal diameter are formed into three equal loops so as to avoid creasing or twisting. It is not possible to achieve this condition by forming just two loops.

Contact with liquids and semi-liquid materials

Rubber should not be allowed to come into contact with liquid or semi-liquid materials (for example, petrol, greases, acids, disinfectants, cleaning fluids) or their vapors at any time during storage, unless these materials are by design an integral part of the product or the manufacturer's packaging. When rubber products are received coated with their operational media, they should be stored in this condition.

Contact with metals

Certain metals and their alloys (in particular, copper and manganese) are known to have harmful effects on some rubbers. Rubber should not be stored in contact with such metals except when bonded to them. They should be protected by wrapping in, or by separation with, a suitable material, e.g. paper or polyethylene.

Contact with dusting powder

Dusting powders should only be used for the packaging of rubber items in order to prevent adhesion. In such cases, the minimum quantity of powder to prevent adhesion should be used. Any powder used should be free from any constituent that would have a harmful effect on the rubber or the subsequent application of the rubber.

Contact between different products

Contact between products made from rubbers of different compositions should be avoided. This includes products of the same type but differing in color.

Rubber-to-metal bonded products

The metal part of rubber-to-metal bonded products should not come into contact with the rubber of other products. Preservative used on the metal should be of a type that will not adversely affect the rubber or the bond to such an extent that it does not comply with the product specification.

Storage life

This is the maximum period of time that a rubber product, appropriately packaged, may be stored. After this time the product is regarded as unserviceable for the purposes for which it was originally manufactured. The storage life of a rubber product is influenced by its shape and size as well as its composition. Thick products usually undergo slower changes through degradation than thinner ones.

Initial storage period

This is the maximum period, starting from the time of manufacture, for which a rubber product, appropriately packaged, may be stored under specified conditions before a sample needs to be inspected or re-tested.

Extension storage period

This is the period for which a rubber product, appropriately packaged, may be stored after the initial storage period, before further inspection and re-testing is necessary.

Assembly

These are products or components containing more than one element, one or more of which is made of rubber. Generally it is not recommended to store elastomeric products in an assembled condition. If it is necessary to do so, the units should be checked more often. The inspection interval depends on the design and geometry of the components.

Inspection before extension storage

Before any items are to be stored for an extension period, representative samples of each type should be selected for inspection at the end of the appropriate initial storage period. Inspection should be in accordance with the relevant product specification.

Visual inspection

Inspect each of the items for the following:

1. Permanent distortions, such as creases or flats.
2. Mechanical damage, such as cuts, tears, abraded areas or delaminated plies.
3. Surface cracking when viewed under a microscope at x10 magnification.
4. Changes in surface condition, such as hardening, softening or tackiness.

Assessment at the end of the initial period

If, following the visual inspection procedure the items are not satisfactory, they should not be stored for an extended period. If the items are satisfactory and are stored for an extended period a record should be kept of the date initial storage began as well as the date the extended storage period began. Items stored for an extended period should be inspected and tested at, or before, the expiry of the extension storage period before they are put into service or stored for a further extended period.

Table 1 Initial and extension storage periods for unassembled components

Material group	Initial storage period	Extension storage period
AU, EU, NR, SBR	5 years	2 years
ACM, AEM, CR, ECO, HNBR, IIR, NBR	7 years	3 years
CSM, EPDM, FKM, FMQ, FVMQ	10 years	5 years
FFKM e.g. Isolast®	20 years	5 years
Zurcon®	10 years	5 years
PTFE	unlimited	

Note 1: If the storage temperature is over or under 25 °C this will influence the storage time. Storage at 10 °C higher will reduce the storage time by about 50 %. Storage at 10 °C lower will increase the storage time by around 100 %.

Note 2: In application areas such as aerospace the storage periods can differ from this specification. These specific storage conditions have to be agreed between the supplier and the buyer.

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