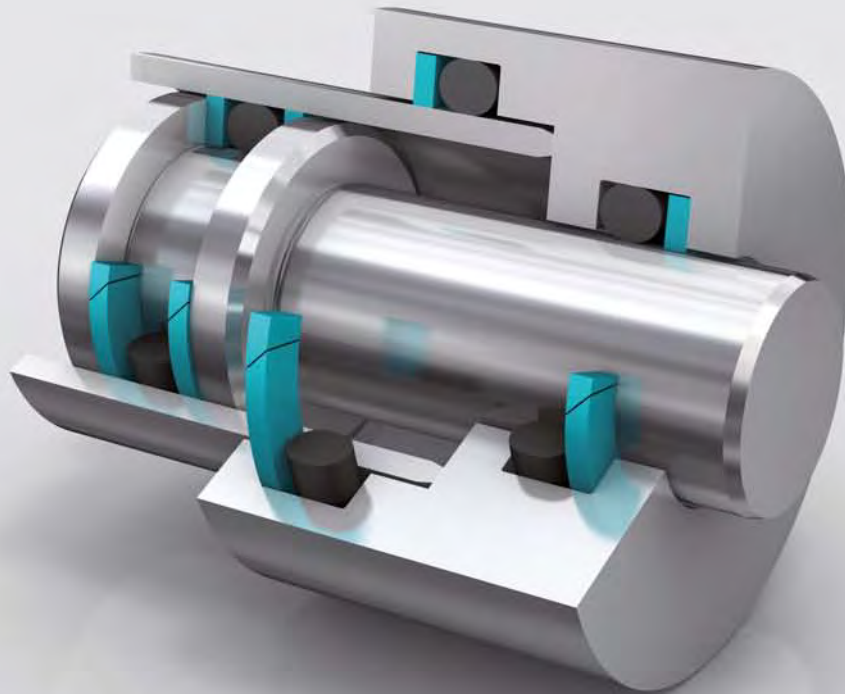


O-Rings and Back-up Rings





Your Partner for Sealing Technology

Trelleborg Sealing Solutions is a major international developer, manufacturer and supplier of seals, bearings and molded components in polymers. We are 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, silicone, 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.

Trelleborg Sealing Solutions facilities are certified according to current market-related quality standards. In addition to the established ISO 9001 standard, our facilities are certified to environmental, health and safety standards, as well as specific customer specifications. These certifications are in many cases prerequisites, allowing us to comply to all market segment requirements.

ISO 9001

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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Company Profile



Welcome to Trelleborg Sealing Solutions

SEALING TECHNOLOGY

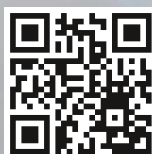
Trelleborg Sealing Solutions offers an outstandingly comprehensive sealing portfolio – a one-stop-shop providing the best in elastomer, silicone, thermoplastic, PTFE and composite technologies; solutions that feature in virtually every application conceivable within the aerospace, industrial and automotive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

A WORLDWIDE PRESENCE

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

COMMITMENT TO CUSTOMER, NEEDS LONG-TERM

Trelleborg Sealing Solutions is one of the world's foremost experts in polymer sealing technology. Using our expertise and experience, we facilitate customers in achieving cost-effective, durable solutions that match their specific business requirements.



Trelleborg Sealing Solutions -

Your Partner for Sealing Technology

Scan the QR-Code to watch the movie about our ability to add value and improve the business of our customers.

A world leader in engineered polymer solutions

THE TRELLEBORG GROUP



Trelleborg Coated Systems
Leading global supplier of unique customer solutions for polymer-coated fabrics deployed in a variety of industrial applications.



Trelleborg Industrial Solutions
Market leader in such industrial application areas as hose systems, industrial antivibration solutions and selected industrial sealing systems.



Trelleborg Offshore & Construction
Leading global supplier of polymer-based critical solutions for deployment in highly demanding environments.



Trelleborg Wheel Systems
Trelleborg Wheel Systems is a leading global supplier of tires and complete wheels for agricultural and forestry machines, materials handling and construction vehicles, and two-wheeled vehicles.



Trelleborg Sealing Solutions
One of the world's leading developers, manufacturers and suppliers of precision seals. It supports its aerospace, industrial and automotive customers through over 20 production facilities and more than 50 marketing companies globally.

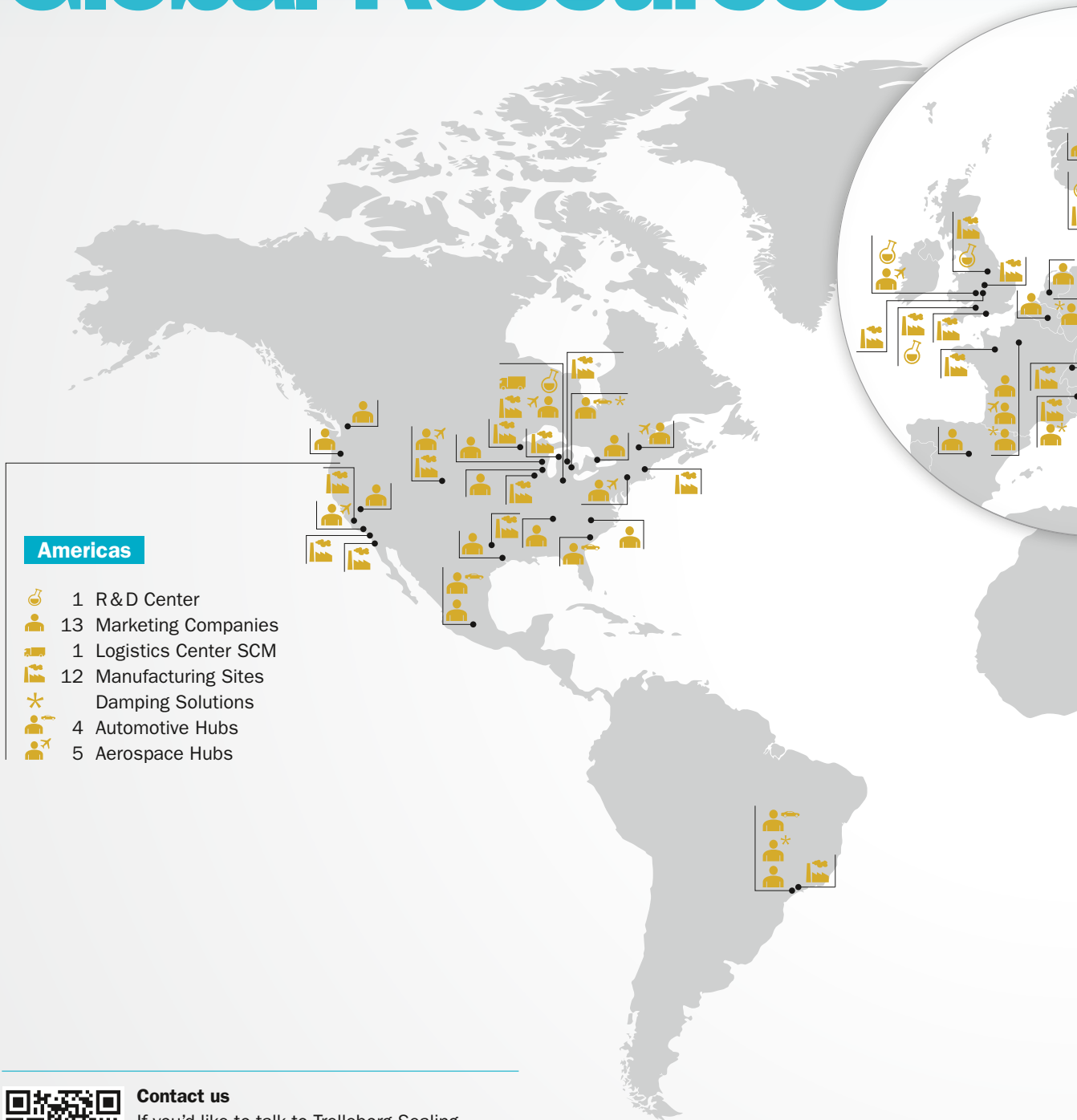
BLUE DIMENSION™



At Trelleborg we believe that the benefits of our solutions stretch beyond functionality and business performance.
For more information scan the QR-Code or visit the website:
www.trelleborg.com



Our Global Resources



Contact us

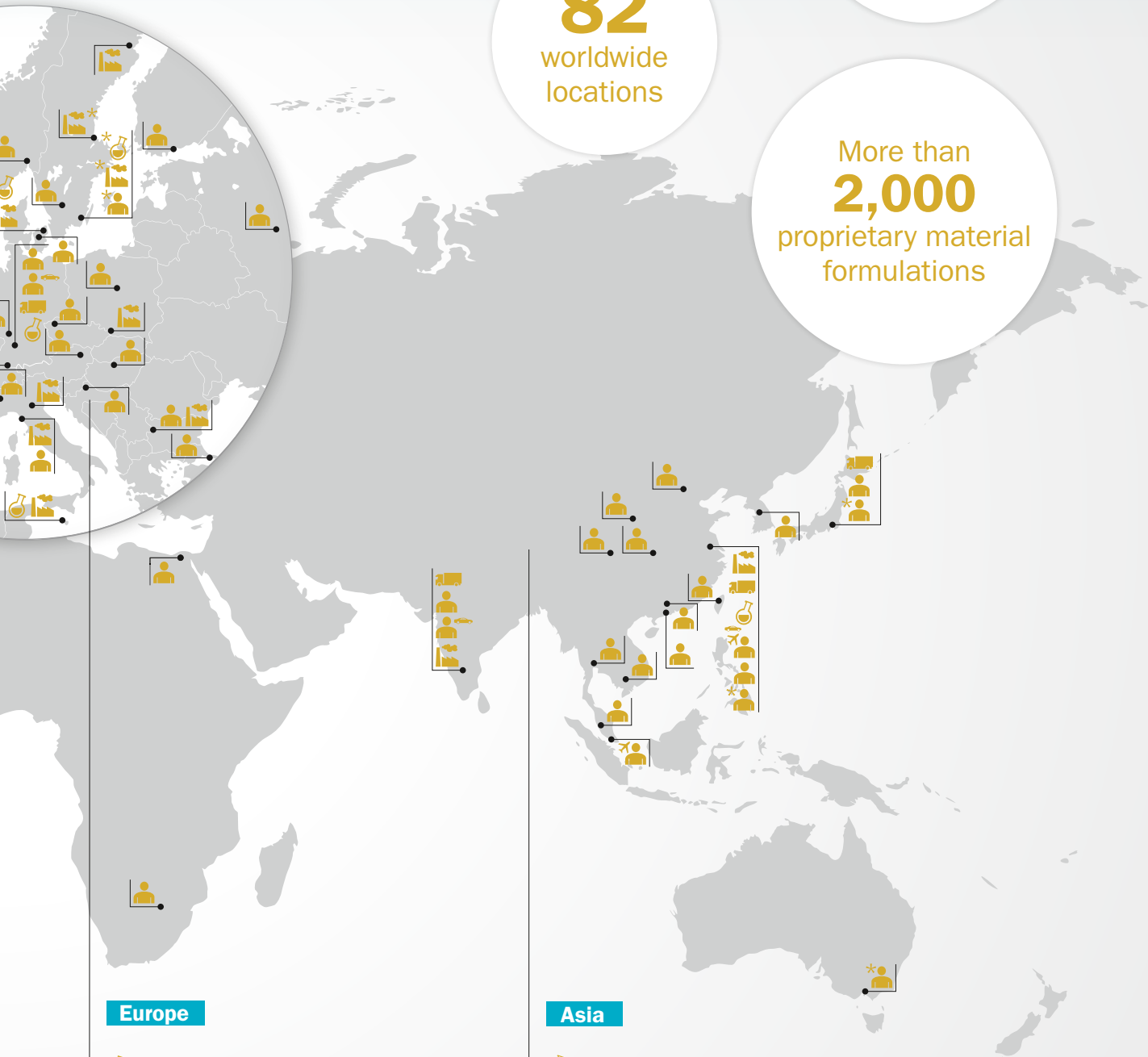
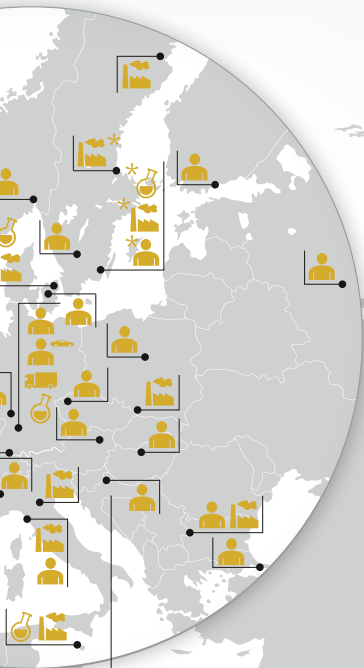
If you'd like to talk to Trelleborg Sealing Solutions, find your local contact at:

www.tss.trelleborg.com/worldwide

6,799
employees

82
worldwide
locations

More than
2,000
proprietary material
formulations



Europe

-  7 R&D Centers
-  22 Marketing Companies
-  1 Logistics Center SCM
-  17 Manufacturing Sites
-  Damping Solutions
-  1 Automotive Hub
-  2 Aerospace Hubs

Asia

-  1 R&D Center
-  16 Marketing Companies
-  3 Logistics Centers SCM
-  2 Manufacturing Sites
-  Damping Solutions
-  2 Automotive Hubs
-  2 Aerospace Hubs

Products, Brands & Materials

Decades of experience designing and manufacturing polymer solutions has led Trelleborg Sealing Solutions to develop, manufacture and supply a range of unique materials and proprietary product designs, many of which have become industry standards. Development is ongoing, ensuring that our solutions meet the changing needs of our customers, as well as the latest industry trends and regulations.

PRODUCTS



Fluid Sealing Systems



Static Seals



Bearings & Bushings



Rotary Seals



Medical Components



Pneumatic Seals



O-Rings



Engineered Molded Parts



Mechanical Face Seals (Heavy Duty Seals)



HiMod® FlatSeal™ Gaskets



Brake Shims, Tuned Absorbers, Rubore® seals



Assembly Units



Liquid Silicone Rubber (LSR)



Customized Aerospace Sealing



Tubing & Hose Sealing

WORLD RENOWNED NAMES UNITED

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

- American Variseal
- Automated Dynamics
- Busak+Shamban
- Dowty Seals
- Chase Walton
- Forsheda
- GNL
- Impervia
- Nordex
- Orkot
- Palmer Chenard
- Polypac
- SSF
- SF Medical
- Shamban
- Silcofab
- Silcotech
- Sil-Pro
- Skega
- Stefa
- Wills

PROPRIETARY MATERIALS

Ongoing development has yielded some of the most successful sealing and bearing materials available:

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



One-Stop-Shop for Sealing Solutions

Scan the QR-Code or visit our website to find out more about our portfolio of solutions for industry-specific needs and applications.

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Your Industry



Aerospace



Agriculture



Automotive



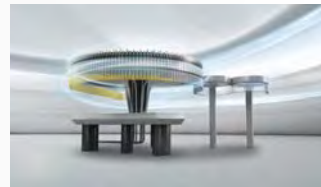
Construction & Mining Equipment



Fluid Power - Hydraulics



Fluid Power - Pneumatics



Food & Beverage



Healthcare & Medical



Manufacturing & Machine Tools



Marine Equipment & Construction



Oil & Gas



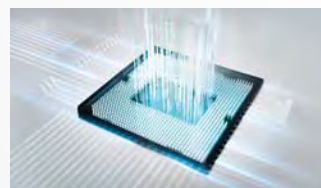
Processing Equipment



Renewable Energy & Power Generation



Robotics



Semiconductor



Water & Sanitary



Accelerating performance in your industry
Scan the QR-Code or visit our website to find out more about our tailor-made solutions for your industry.
www.tss.trelleborg.com



Films & Animations

SEEING IS BELIEVING

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



View at
[YouTube.com/trelleborgseals](https://www.youtube.com/trelleborgseals)
YouTube

View at
tss.trelleborg.com/films
TSS



Films and Animations online

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

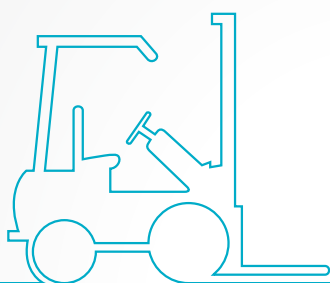


Simplify Your Business ServicePLUS

ServicePLUS aims at uniting various enhanced solutions across the entire value chain, simplifying the processes of engineering, logistics, manufacturing and aftermarket for the customer.



Engineering



Logistics



Manufacturing



Aftermarket



SPECIAL HANDLING

Special Handling bundles an assortment of individual packaging solutions together with additional services that optimize the mounting and handling of seals.



ADVANCED DELIVERY

Our Advanced Delivery services simplify your stock replenishment process by managing your different vendors and stock levels – be it through a Kanban system or complete C-Part Management.



ENGINEERING SUPPORT SERVICES

Trelleborg provides world-class expert support for your engineering needs, from extensive design & compound competence to leading edge product testing.



ASSEMBLY

Trelleborg is willing and able to offer pre-assembled parts put together by specially trained staff, delivered directly to you.



QUICKSEAL

QuickSeal covers your short-notice needs for sealing solutions, whether you require a prototype, functional sample or a small batch rapidly.



DIGITAL TOOLS

Online resources and apps developed to make an engineer's life easier.

Discover our wide range of digital tools at www.tss.trelleborg.com





Scan the QR-Code to
learn how you can
simplify your business
with ServicePLUS:



Design Support & Engineering Tools

ONLINE TOOLS MAKE LIFE EASIER

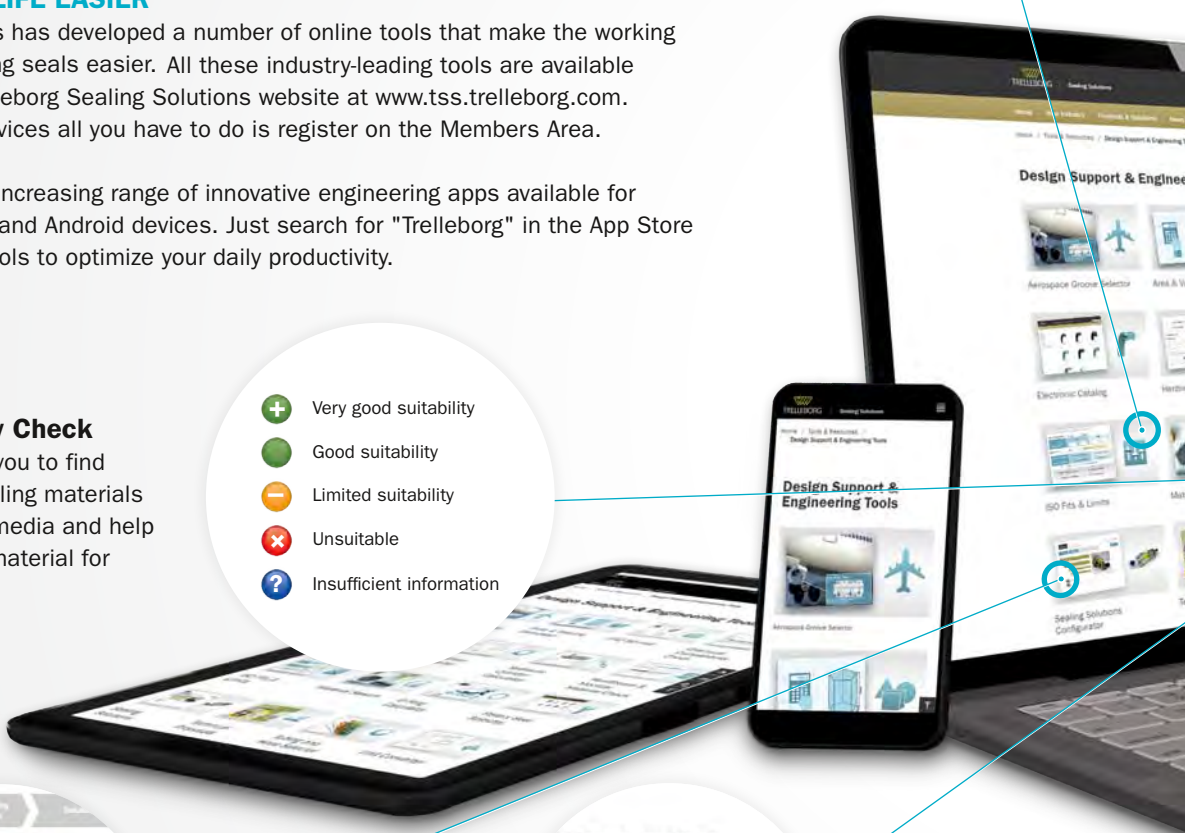
Trelleborg Sealing Solutions has developed a number of online tools that make the working life of an engineer specifying seals easier. All these industry-leading tools are available free-of-charge from the Trelleborg Sealing Solutions website at www.tss.trelleborg.com. To use these advanced services all you have to do is register on the Members Area.

There is also a continually increasing range of innovative engineering apps available for smartphones, both for iOS and Android devices. Just search for "Trelleborg" in the App Store or GooglePlay to find the tools to optimize your daily productivity.

Materials Search and Chemical Compatibility Check

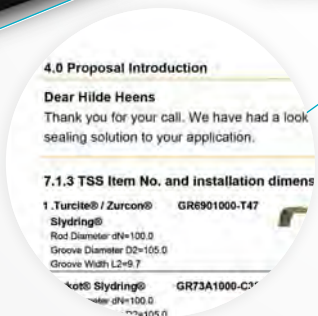
These two programs allow you to find out the compatibility of sealing materials with hundreds of different media and help identify the most suitable material for your application.

- + Very good suitability
- Good suitability
- Limited suitability
- ✗ Unsuitable
- ? Insufficient information



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.



Technical Proposals Online

Enhance your communication with Trelleborg Sealing Solutions with the Technical Proposals Online tool. Instantly access all your proposed solutions anywhere at any time and benefit from quicker dialog with our sealing specialists.



ISO Fits & Tolerances

Our Fits & Tolerances Calculator allows you to easily determine type of fits using the tolerances according to DIN ISO 286. In addition, upon entering the nominal diameter the tool calculates lower and upper limit deviations plus the maximum and minimum interferences dependent on the selected tolerance classes for bore and shaft.



Versatile CAD Service

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



Hydraulic System Calculator

Hydraulic System Calculator helps you design a solution around the cylinder which may involve motor, pump, orifice and pipe calculations. The application is in compliance with ISO 3320, ISO 3321 & ISO 4393.



Rotary Seal Selector

The Rotary Seal Selector allows you to search through the wide range of rotary seals and materials available based on application conditions and offers detailed information on installation and seal capabilities.

O-Ring Calculator

An industry-leading tool, the easy to use O-Ring calculator includes sizing capabilities, compression forces, design parameter recommendations and complete measurements. Results and comments may be printed, shared or filed as PDF.

Discover our design support and engineering tools at www.tss.trelleborg.com



Mobile Tools & Apps

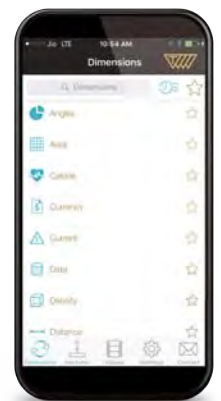
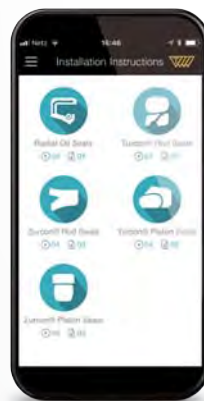
We understand the needs of engineers on the go. Check out our latest mobile tools and apps, ranging from an O-Ring calculator to unit and hardness converters. Just search for "Trelleborg" in the App Store or Google Play to find the tools to optimize your daily productivity.



MANY MORE APPS available



Discover our wide range of mobile tools and apps at www.tss.trelleborg.com



ISO Fits & Tolerances

Simply enter the nominal diameter and select the tolerance classes for bore and shaft to find the complete ISO fits definition with all relevant values including type of fit, with handy graphs to illustrate the classes by bore and shaft.



Mechanical Engineering Calculator

An excellent tool offers over 244 formulas in 16 categories, with more being added every update. Categories include the fields of mathematics, physics and mechanical engineering.



Aerospace Groove Selector

This app covers two of the most important SAE aerospace groove standards for hydraulic systems, AS4716 Rev B and AS5857 Rev A, making it really easy to find the size of grooves and hardware needed.



Installation Instructions

Videos demonstrate the best practice methods for installing seals, providing all relevant documentation within the interface, guiding you to a successful installation of Radial Oil Seals and Turcon® and Zurcon® rod and piston seals.



Unit & Hardness Converter

By simply selecting the dimension and entering the value for conversion, the app offers a wide range of engineering and scientific units for each dimension.



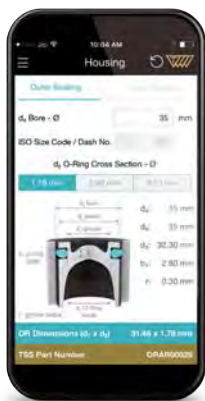
in the groove

Our *in the groove* magazine provides news, technical and product information on seals, as well as insights into the markets they are used in. The magazine is also available in print and as an interactive PDF.



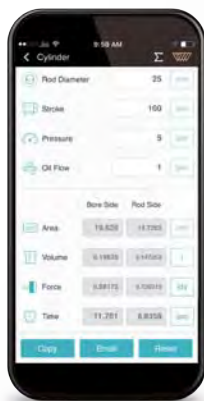
Rotary Seal Selector

Bring the popular Rotary Seal Selector webtool with you! Quickly search through Trelleborg Sealing Solutions rotary seals and materials for the optimum product for your application conditions while on the move.



O-Ring Selector

When a user enters installation specifications into the O-Ring Selector app, such as the bore or rod/shaft diameter, the app quickly calculates O-Ring and housing dimensions in both metric and inch.



Hydraulic System Calculator

Hydraulic System Calculator helps you design a solution around the cylinder which may involve motor, pump, orifice and pipe calculations. The application is in compliance with ISO 3320, ISO 3321 & ISO 4393.



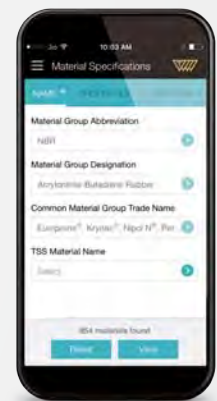
Area and Volume Calculator

Speeds up and simplifies calculating the area and volumes of more than 80 geometric shapes. The app supports both metric and imperial units and conveniently displays the formulas used. Fill your shape with solids or liquids, choosing from 1500 different materials, to calculate the weight.



Healthcare Materials

View a quick and easy overview of the compatibility of 34 materials with 35 chemical environments that are commonly encountered in the healthcare and medical industries. Select up to 20 materials and environments at once to produce a chart rating each material from "excellent" to "not recommended".



Sealing Materials Selector

Enter material specifications and required parameters, such as application temperature or hardness, to receive instant material proposals. The app features filters to limit searches based on chemical compatibility, institute approvals and product type and data sheets can be requested from within the interface.

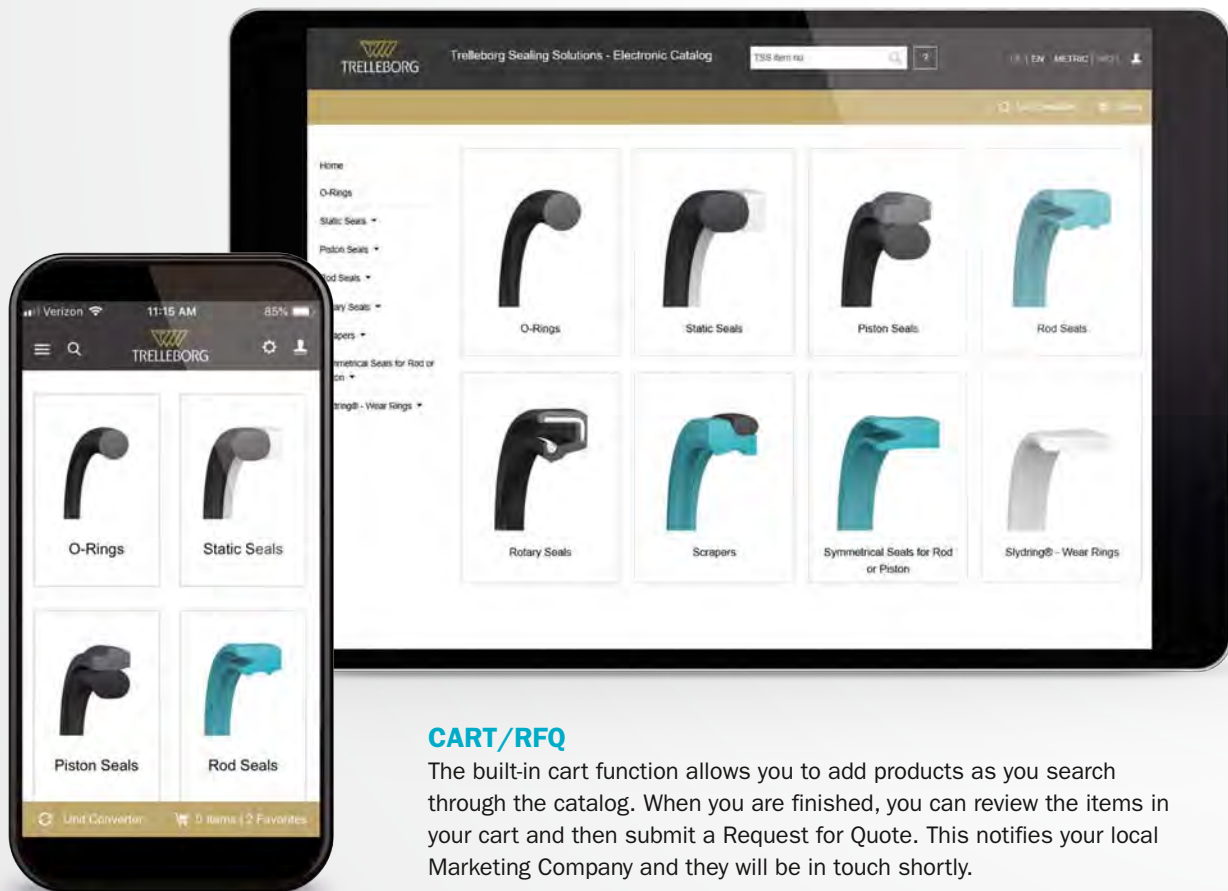
Electronic Catalog

Discover the Electronic Catalog online as an app or on our website



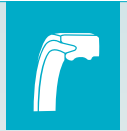
The Electronic Catalog is a user-friendly service that connects you to the broad range of products Trelleborg Sealing Solutions offers. The products are arranged based on product type and product group, making it easy to find the exact one you need.

Many functions are also included within the Electronic Catalog that allow you to understand product capabilities, compare similar seals, request a quote and much more. The Electronic Catalog is available from the Trelleborg Sealing Solutions website and in the App Store and GooglePlay for mobile use.



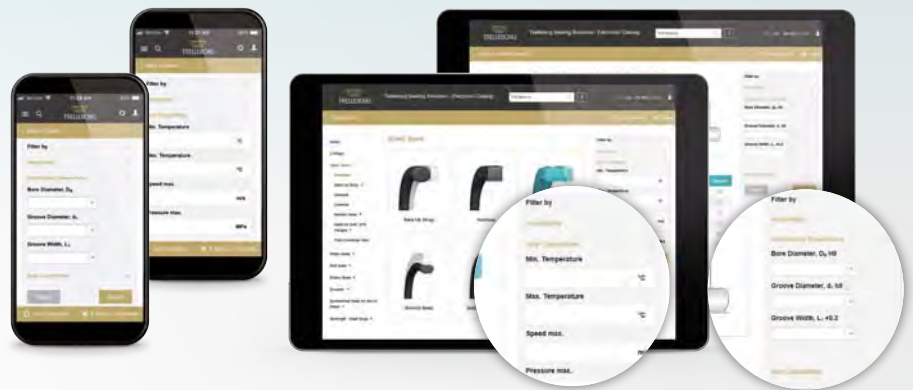
CART/RFQ

The built-in cart function allows you to add products as you search through the catalog. When you are finished, you can review the items in your cart and then submit a Request for Quote. This notifies your local Marketing Company and they will be in touch shortly.



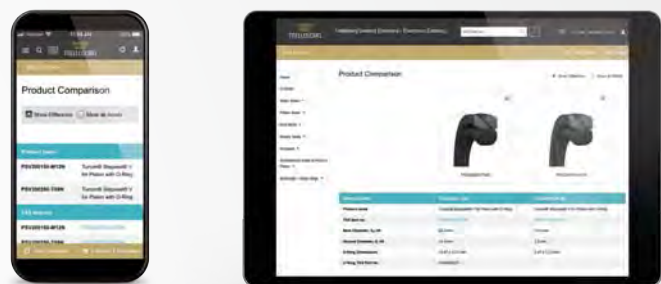
FILTERING

If you have specific operating conditions that the seal must meet and/or installation dimensions, the Electronic Catalog offers a filtering function within the product groups. Here you can input your temperatures, pressure, speed and various installation dimensions to filter products that can meet your needs.



PRODUCT COMPARISON

When looking through the catalog, you can choose to compare multiple products. The product comparison function allows you to select which products you are interested in, and then puts all relevant information into a table for your review. You can even choose to display all product details side by side or to only show the fields where they differ.



PRODUCT INFORMATION

Detailed product information is available for each part number. Once you select a specific part number, you will be able to see its installation dimensions, seal capabilities, related catalogs and other information. From this page, registered users can access the material data sheets that are applicable to the part number.



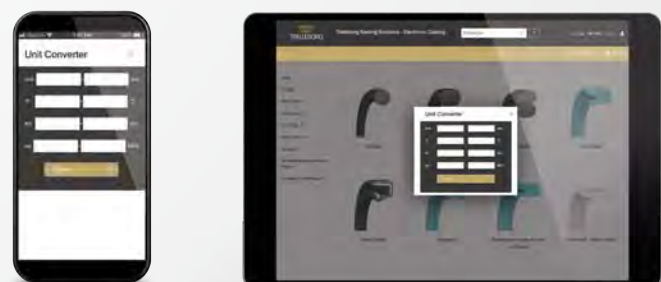
ADD TO FAVORITES

Do you have a part that you frequently look up or need information on? You can now save any of our part numbers as a favorite that is linked to your account. Anytime you log in to the Electronic Catalog, your favorites will be a click away!



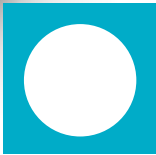
UNIT CONVERTER

If you are looking at a product and need to know the conversion between metric and imperial, you can use the Unit Converter tool that is available at the top of the screen for web users and at the bottom for mobile.



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O-Rings



DOUBLE-ACTING

STATIC AND PARTLY DYNAMIC SEALING APPLICATIONS

**MATERIAL:
ELASTOMERS, ZURCON® AND OTHERS**

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■ 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 broad range 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 characterized 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 approximately 0.35 mm (0.014 inch) to 40 mm (1.575 inch) and inside diameters up to 5,000 mm (196.850 inch) and more are available.

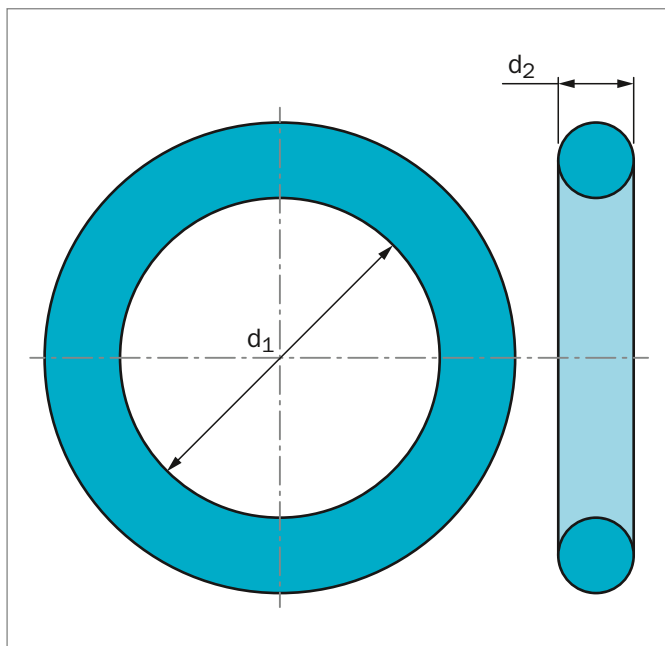


Figure 1: O-Ring dimensioning

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, failsafe 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 transmissions 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. This force is superimposed with 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 in all directions.

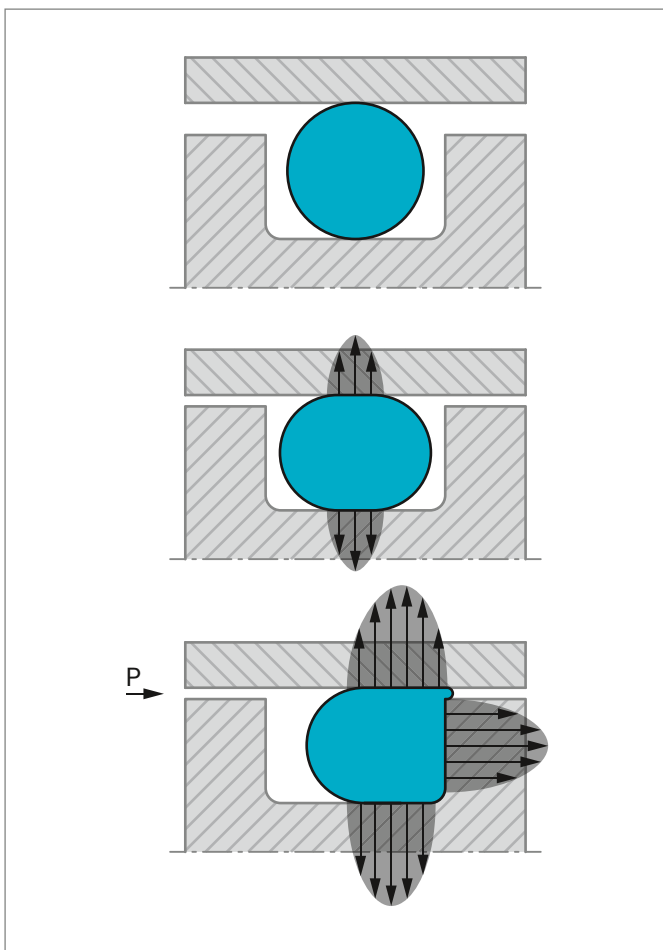


Figure 2: O-Ring sealing forces with and without system pressure



■ B Technical Information

■ B.1 Materials

B.1.1 ELASTOMERS

Equipment manufacturers and end users expect sealing systems to operate leak-free over a 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 most used material groups for seals are the elastomers. Compounds can be chosen according to the properties required, such as elasticity or chemical resistance.

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 Materials

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	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

* Selection of registered trade names
** Abbreviation not yet standardized

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



Designation	Trade Name*	Abbreviation		
		ISO 1629	ASTM D 1418	TSS
Perfluoro Rubber	Isolast® Kalrez®	FFKM	FFKM	J
Polyester Urethane Polyether Urethane	Zurcon® Adiprene® Pellethan® Vulcollan® Desmopan®	AU, EU	AU, EU	WU, Z
Chlorosulphonated Polyethylene Rubber	Hypalon®	CSM	CSM	WM
Polysulphide Elastomer	Thiokol®	-	TWT	WY
Epichlorohydrin Elastomer	Hydrin®	-	-	WO

* Selection of registered trade names
** Abbreviation not yet standardized.

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

Table 2: Important synthetic rubber groupings and their abbreviations

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



B.1.2 APPLICATION PARAMETERS OF ELASTOMERS

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

Elastomers can swell, shrink or harden and develop cracks or even tears. Figure 3 and Figure 4 illustrate the performance of various elastomers under different application parameters.

ELASTOMER HEAT RESISTANCE / SWELLING IN OIL

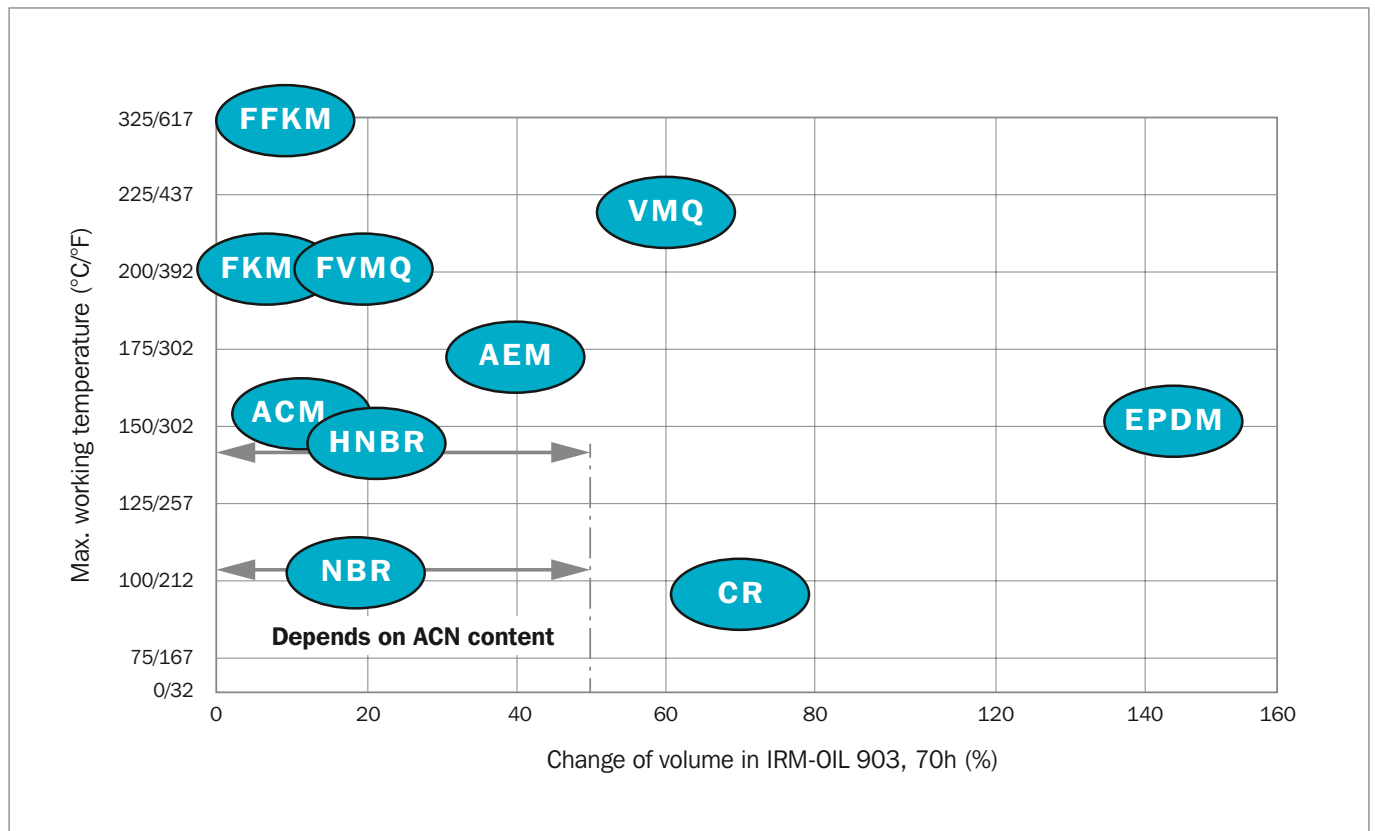


Figure 3: Change of volume in IRM-Oil 903 (old ASTM-Oil No. 3)



TEMPERATURE RANGE

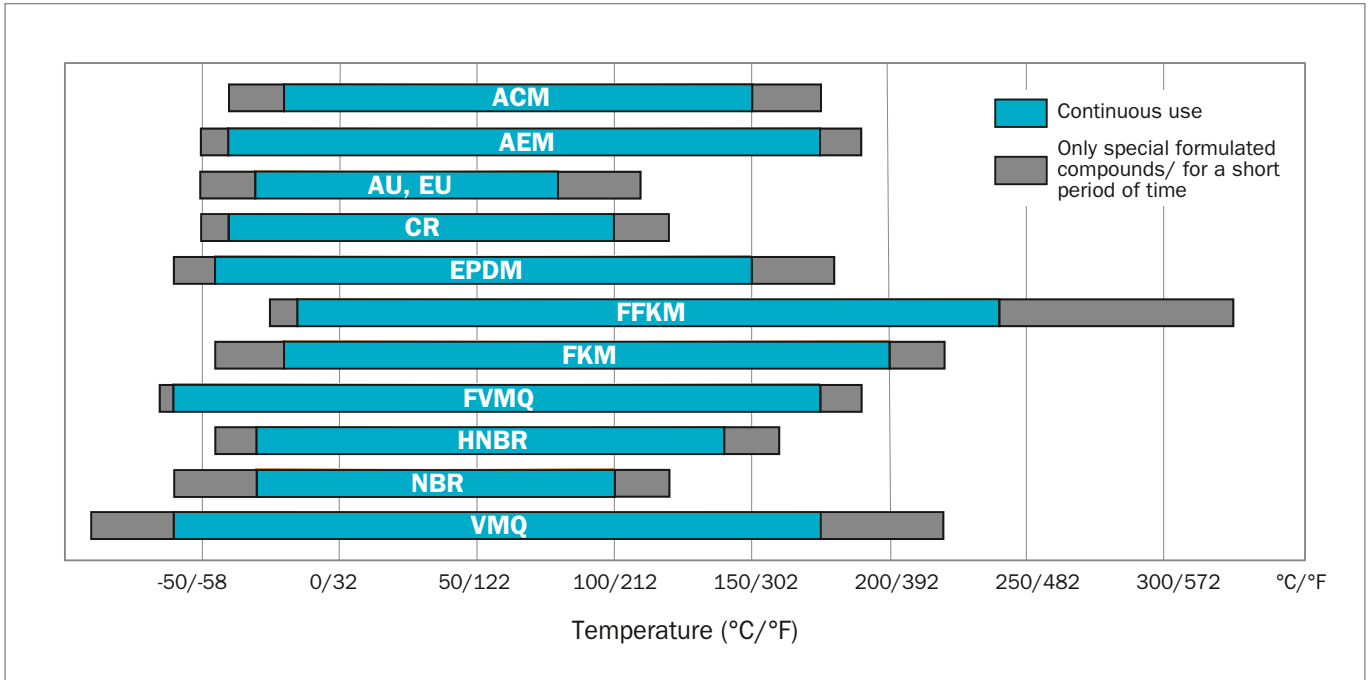


Figure 4: Temperature ranges of various elastomers. Temperature ranges only apply when used with compatible media.

Table 3: General field of application

Material and Properties	Applications	Operating Temperature			
		Normal		Short period	
		°C	°F	°C	°F
ACM (Polyacrylate Rubber) - Excellent resistance to ozone, weathering and hot air, although it shows only a medium physical strength - Low elasticity - Relatively limited low temperature capability	ACM is used in automotive applications which require special resistance to lubricants containing many additives (incl. sulfur) at high temperatures	-20 to +150 (special types -35 to +150)	-4 to +302 (special types -31 to +302)	up to +175	up to +347
CR (Chloroprene Rubber) - Good resistance to ozone, weathering, chemicals and aging - Good non-flammability - Good mechanical properties and cold flexibility.	CR is used in sealing applications involving refrigerants, outdoor applications and in the glue industry	-35 to +90 (special types -55 to +90)	-31 to +194 (special types -67 to +194)	up to +120	up to +248
EPDM (Ethylene Propylene Diene Rubber) - Good heat, ozone and aging resistance - High levels of elasticity - Good low temperature behavior - Good insulating properties.	EPDM can often be found in applications with brake fluids (based on glycol) and hot water	Peroxide cured EPDM Types			
		-45 to +150	-49 to +302	up to +175	up to +347
		Sulfur cured EPDM Types			
		-45 to +130	-49 to +266	up to +150	up to +302



Material and Properties	Applications	Operating Temperature			
		Normal		Short period	
		°C	°F	°C	°F
FFKM (Perfluoro Rubber) - Broad chemical resistance like PTFE - Good heat resistance - Low swelling with almost all media	FFKM is used in chemical and process industries and in all applications with either aggressive environments or high temperatures	-25 to +240	-13 to +464	up to +325	up to +617
FKM (Fluorocarbon Rubber) - Non-flammability, low gas permeability - Excellent resistance to ozone, weathering and aging	FKM is also often used with mineral based oils and greases at high temperatures	-20 to +200 (special types -40 to +200)	-4 to +392 (special types -40 to +392)	up to +230	up to +446
FVMQ (Fluorosilicone Rubber) - Good heat resistance and electrical properties - Very good low temperature flexibility - Excellent resistance to weather, ozone and UV rays - FVMQ shows a significantly better chemical resistance than standard silicone especially in hydrocarbons, aromatic mineral oils, fuel and low molecular aromatic hydrocarbons e.g. benzene and toluene	FVMQ is used in aerospace and automotive applications	-50 to +175	-58 to +347	up to +200	up to +392
HNBR (Hydrogenated Nitrile Butadiene Rubber) - HNBR is made via selective hydrogenation of NBR butadiene groups - The properties of HNBR rubber depend on the ACN content which ranges between 18% and 50%, as well as on the degree of saturation - Good mechanical properties	HNBR is used with mineral based oils and greases	-30 to +140 (special types -40 to +140)	-22 to +284 (special types -40 to +284)	up to +160	up to +320
IIR (Butyl Rubber) - Very low gas and moisture permeability - Good resistance to many organic and inorganic chemicals, ozone, weathering and aging - Excellent insulating properties	IIR is used for vacuum seals and membranes	-40 to +110	-40 to +230	up to +120	up to +248
NBR (Nitrile Butadiene Rubber) - The properties of nitrile rubber depend mainly on the ACN content, which ranges between 18% and 50% - Good mechanical properties	NBR is mostly used with mineral based oils and greases	-30 to +100 (special types -60 to +90)	-22 to +212 (special types -76 to +194)	up to +120	up to +248
Polyurethane (Zurcon® Polyurethane) - Excellent elastic properties and optimum abrasion resistance - Outstanding tensile strength, low compression set - Good resistance to O ₂ and O ₃	Polyurethane is mostly used for pneumatic and hydraulic seals	-50 to +110	-58 to +230	-	-



Material and Properties	Applications	Operating Temperature			
		Normal		Short period	
		°C	°F	°C	°F
VMQ (Silicone Rubber) - Excellent heat resistance, cold flexibility, dielectric properties - Good resistance to weather, ozone and UV rays - Specific VMQ formulations are resistant to aliphatic engine and gear oils, water up to +100 °C (+212 °F) and high-molecular-weight chlorinated hydrocarbons	VMQ is used for seals in food and medical applications	-50 to +175	-58 to +347	up to +230	up to +446

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 marketing company for further details.

It is important to recognize that when using this guide, the ratings shown are based on published data and immersion tests. These tests are conducted under laboratory conditions at room temperature predominantly and may not adequately represent 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 frequently 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 at a defined pressure.

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

1. Shore A / D in accordance with ISO 868 / ISO 7619-1 / ASTM D 2240 - Measurement for test samples
2. Durometer IRHD (International Rubber Hardness Degree) in accordance with 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 $23 \pm 2 \text{ }^\circ\text{C}$ ($73.4 \pm 2 \text{ }^\circ\text{F}$) - not earlier than 16 hours after the last vulcanization 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 in accordance with 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. 30 mm (1.181 inch)

Thickness min. 6 mm (0.240 inch)

Upper and lower sides smooth and flat

When thin material is being tested it can be layered to ensure a minimum sample thickness is achieved, up to a maximum of 3 layers. All layers must be at minimum 2 mm (0.080 inch) thick.

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

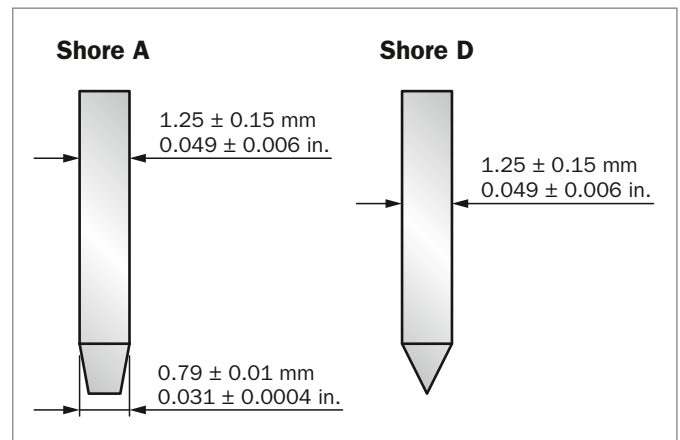


Figure 5: Indentor in accordance with Shore A / D

Hardness test in accordance with IRHD

The test of the Durometer in accordance with 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. In accordance with ISO 48, there are two hardness ranges:

- | | | |
|---------|-----------------------------------|-------------------------------------|
| Soft: | 10 to 35 IRHD | ⇒ Sample thickness |
| | 10 to 15 mm (0.394 to 0.591 inch) | procedure "L" |
| Normal: | over 35 IRHD | ⇒ Sample thickness |
| | 8 to 10 mm (0.315 to 0.394 inch) | procedure "N" |
| | Sample thickness | 1.5 to 2.5 mm (0.059 to 0.098 inch) |
| | | procedure "M" |

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

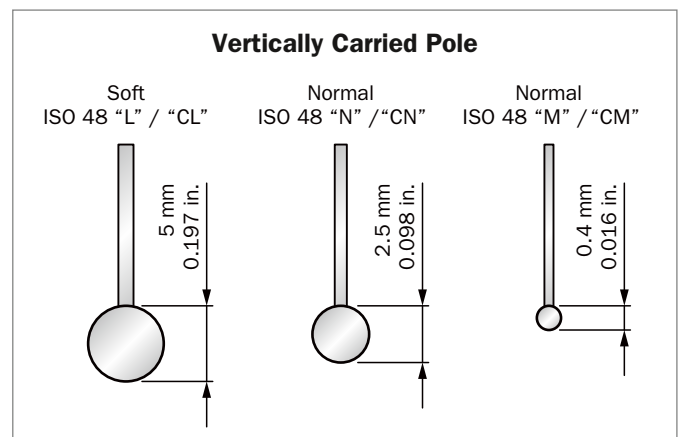


Figure 6: Indentor in accordance with IRHD



Influencing parameters on the hardness test for polymer materials

Various sample thicknesses, geometries and testing procedures can show different hardness values even though the same materials have been used.

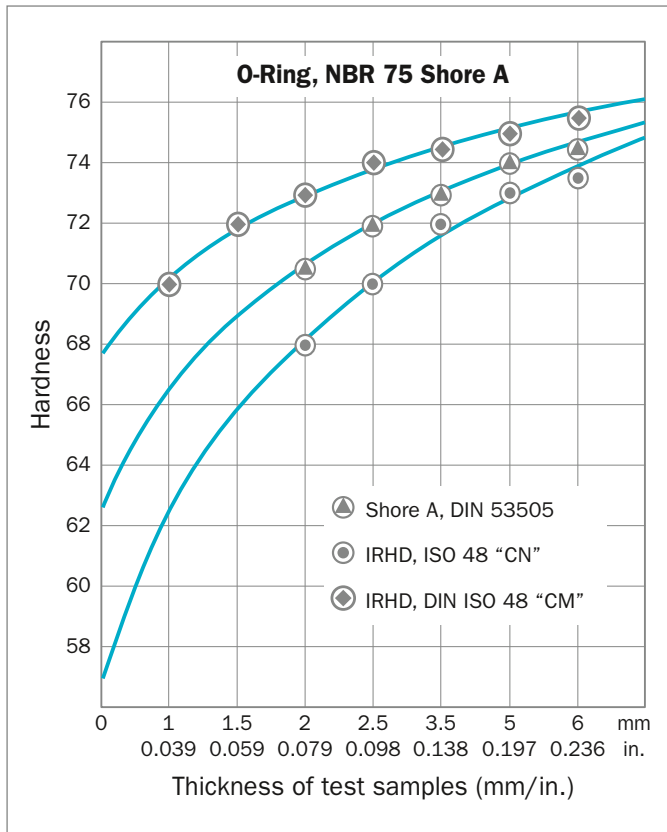


Figure 7: Ranges of hardness depending on sample thickness and test method

With equivalent material characteristics of the elastomer sample 3, the indenter penetrates the deepest at the surface (Figure 8) and therefore establishes the softest area.

As the convex geometry has a stronger effect on smaller width O-Rings, the tolerances on hardness for widths under 2.0 mm (0.079 inch) 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 also show permanent plastic deformation (Figure 9).

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

- Standard test piece: Cylindrical disc, diameter 13 mm (0.512 inch) and height 6 mm (0.236 inch)
- Deformation: 25%
- Tension release time: e.g. 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

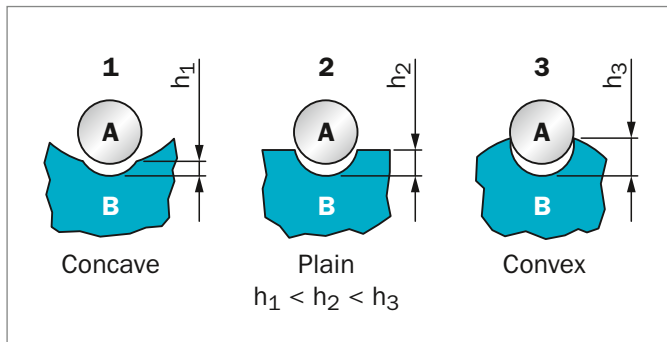


Figure 8: Range of hardness depending on surface geometry for the equivalent material characteristics

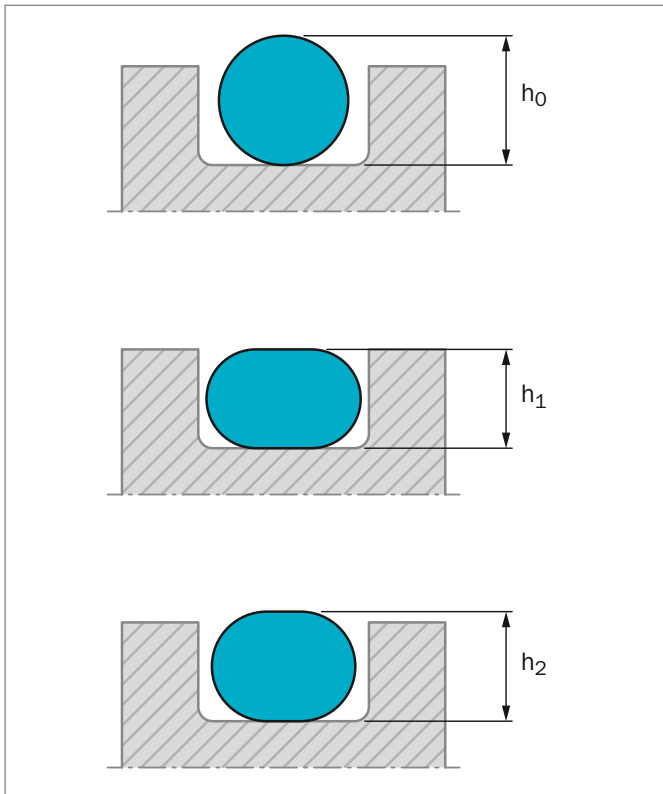


Figure 9: Illustration of the compression set

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 geometry and measurements as well as the measuring accuracy of the test equipment.

Figure 10 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.

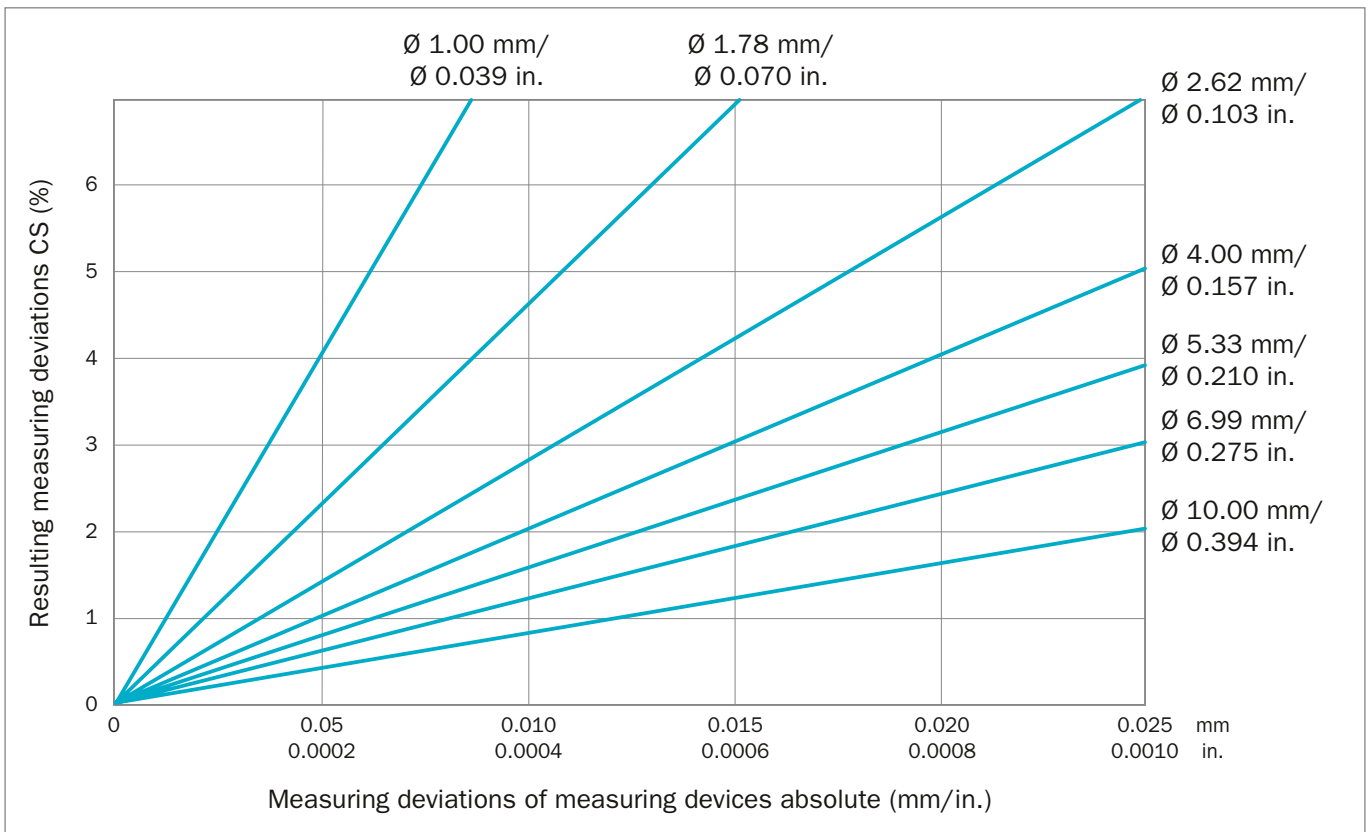


Figure 10: Compression set measuring deviations depending on O-Ring cross section and measuring accuracy of the test equipment (schematic illustration)



B.1.4 SPECIAL REQUIREMENTS - AUTHORITIES AND APPROVALS

Seals often have to meet the highest performance standards and the most stringent of environmental 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. For food applications, Trelleborg has introduced a range of materials designated FoodPro™, to mark their unique compatibility. The following tables show common authorities and their requirements.

Table 4: Legal Requirements and Institutional Approvals for Food Contact Materials

Reference	Standard/ Regulation/ Certification	Application	Criteria	Authority/ Association	Institutes/ Laboratories
Regulation (EC) 1935/2004	European Union: Framework regulation on materials and articles intended to come into contact with food	Any food contact material	Material has to be safe for the intended application, must not cause off-odor or off-flavor in the food and traceability required	European Parliament and Council	Accredited external institute
Regulation (EC) 2023/2006	European Union: Regulation on good manufacturing practice for materials and articles intended to come into contact with food	Any food contact material	Good manufacturing practice has to be applied when producing materials	EU Commission	Producer confirmation
Regulation (EU) 10/2011	European Union: Regulation on plastic materials and articles intended to come into contact with food	Plastic materials in contact with food (e.g. PTFE, UHMWPE)	Only listed substances to be used and migration limits and other restrictions to be respected	EU Commission	Accredited external institute
BfR XXI	Germany: Recommendations for food contact materials	Commodities based on natural and synthetic rubber	Migration conditions, migration limits and approved substances defined depending on intended application	Federal Institute for Risk Assessment (Bundesinstitut für Risikobewertung)	Accredited external institute
BfR XV		Silicones	List of approved substances, limitation for volatile organic and extractable components and peroxides		Accredited external institute
FDA CFR 21 § 177.2600	United States: FDA Code of Federal Regulations	Rubber articles intended for repeated use	List of cleared substances and extraction limits to be respected	United States Food and Drug Administration	Accredited external institute
FDA CFR 21 § 177.1550		Perfluorocarbon resins	List of cleared substances and testing guidance to be respected		Accredited external institute



Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
18-03 3-A Sanitary	United States: 3A Sanitary	18-03 3-A Sanitary Standards for multiple-use rubber and rubber-like materials used as product contact surfaces in dairy equipment	Material requirements of rubber materials as contact surface for milk products	United States: 3A Sanitary	Accredited external institute
NSF/ANSI Standard 51 (food) 20-27 3-A Sanitary	United States: NSF National Sanitation Foundation	Food equipment materials 20-27 3-A Sanitary Standards for multiple-use plastic materials	Depending on application: - Test of components - Test of component group - Physical and chemical material tests - Toxicological and microbiological tests Material requirements of plastics as contact surface in equipment for milk products	NSF (National Sanitation Foundation)	NSF, USA
GB 4806.1- 2016	National Food Safety Standards of the People´s Republic of China	General safety requirements for food contact materials and articles	Basic safety requirements defined	National Health Commission of the People´s Republic of China	Accredited Chinese laboratory
GB 4806.6- 2016		Food contact plastic resins	List of approved resins for food contact		
GB 4806.7- 2016		Food contact plastic materials and articles	Definition of chemical and physical indices for plastic materials		
GB 4806.11- 2016		Food contact rubber materials and articles	List of raw materials for rubber materials with requirements		
GB 9685-2016		Standard for the use of additives in food contact materials and articles	List of approved additives for specific materials with restrictions and migration test conditions and limitations		

Table 5: Legal Requirements and Institutional Approvals for Materials in Contact with Potable Water

Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
ELL Elastomer Guideline	Guideline for hygienic assessment of elastomers in contact with potable water	Materials exposed to cold, warm and hot drinking water	Extraction test, odor and taste test, register of permitted components	UBA Bundesum- weltamt (Federal environmental office)	TZW, Hygiene-Institut des Ruhrgebiets



Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
NSF/ANSI Standard 61 (Drinking Water)	United States: NSF National Sanitation Foundation	Drinking water contact plastic materials and articles in devices	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
British Standard BS 6920	British Standard: WRAS	Polymers exposed to drinking water	- Dispensing test - Microbe test - Extraction test - Hot water test	WRAS (Water Regulations Advisory Scheme)	Accredited external Institute in the UK
DVGW, Worksheet W 270, DIN EN 16421	DVGW W270	Materials exposed to drinking water	Microbiological testing and reproduction of microorganisms on materials	DVGW Bonn (Deutscher Verein des Gas- und Wasserfaches e. V.)	TZW, Hygiene-Institut des Ruhrgebiets
French Standard AFNOR XP P41-250, Part 1-3 Synoptic Paper 1226	ACS Licensing	Polymers exposed to drinking water	Formulation survey in accordance with positive list and cytotoxicity evaluation for seals thicker than 63 mm (2.48 inch)	ACS (Accréditation de conformité sanitaire)	Accredited external institute in France

Table 6: Legal Requirements and Institutional Approvals for Materials Intended for Medical and Pharmaceutical Use

Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
Different regulations: eg. USP chapter 87, 88, Class I to VI	USP (United Sates Pharmacopeia)	For medical and pharmaceutical use	Depending on specification, eg. cytotoxic reactions on cell cultures in vivo and in vitro	USP (United Sates Pharmacopeia)	Accredited external institute

Table 7: Legal Requirements and Institutional Approvals for Materials in Contact with Gas

Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
DIN EN 1797:2002-02	BAM Bundesanstalt für Material- forschung- und prüfung	Seals for use in gas or oxygen fittings	Reactive behavior with limits for pressure and temperature	European Parliament and the Council	BAM, Berlin



Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
EN 549	DVGW Release for Gas	Seals for gas services and gas applications	Physical testing	DVGW Bonn (Deutscher Verein des Gas- und Wasserfaches e. V.)	DVGW EBI, Karlsruhe

Table 8: Legal Requirements and Institutional Approvals for Materials in Electrical Equipment

Reference	Standard/ Regulation/ Certifi- cation	Application	Criteria	Authority/ Association	Institutes/ Laboratories
UL Guidelines	UL Listing	Application of seals for electrical equipment and applications	Chemical compatibility test, additional tests depending on application	UL (Underwriters Laboratory)	Accredited external institute



B.1.5 STANDARD MATERIALS

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

values. In practice, many of the materials (even when defined as standard) can have better physical properties than stated.

Table 9: Material specification for standard NBR

TSS Material Code			NBR 50	NBR 60	NBR 70	NBR 80	NBR 90	
			Shore A	Shore A	Shore A	Shore A	Shore A	
			N50	N60	N70	N80	N90	
Hardness		ISO 7619-1 ASTM D 2240	Shore A	50 ± 5	60 ± 5	70 ± 5	80 ± 5	90 ± 5
Tensile strength		ISO 37 ASTM D 412	MPa psi	≥ 8 ≥ 1,160	≥ 10 ≥ 1,450	≥ 14 ≥ 2,031	≥ 12 ≥ 1,740	≥ 10 ≥ 1,450
Elongation at break		ISO 37 ASTM D 412	%	≥ 200	≥ 200	≥ 200	≥ 150	≥ 100
Compression set	24h / 100 °C (212 °F)	ISO 815-1 A, specimen B ASTM D 395 B, specimen 2	%	< 30	< 30	< 25	< 30	< 30
Heat aging	72h / 100 °C (212 °F)	ISO 188 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
Immersion test in ASTM oil, IRM 901	72h / 100 °C (212 °F)	ISO 1817 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
Immersion test in ASTM oil, IRM 903	72h / 100 °C (212 °F)	ISO 1817 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				-30 °C to 100 °C -22 °F to 212 °F	-30 °C to 100 °C -22 °F to 212 °F	-30 °C to 100 °C -22 °F to 212 °F	-25 °C to 100 °C -13 °F to 212 °F	-25 °C to 100 °C -13 °F to 212 °F
Maximum and minimum operating temperatures depend on the specific application criteria								


Table 10: Material specification for standard EPDM

			EPDM 70 Shore A sulfur cured	EPDM 70 Shore A peroxide cured	EPDM 75 Shore A peroxide cured	
TSS Material Code			E70	E75	EC5	
Hardness		ISO 7619-1 ASTM D 2240	Shore A 70 ± 5	70 ± 5	75 ± 5	
Tensile strength		ISO 37 ASTM D 412	MPa psi ≥ 10 ≥ 1,450	≥ 10 ≥ 1,450	≥ 10 ≥ 1,450	
Elongation at break		ISO 37 ASTM D 412	% ≥ 150	≥ 125	≥ 125	
Compression set	24h / 100 °C (212 °F)	ISO 815-1 A, specimen B	% < 20			
	24h / 150 °C (302 °F)	ASTM D 395 B, specimen 2	% < 30	< 30	< 30	
Heat aging	72h / 100 °C (212 °F)	ISO 188 ASTM D 573		x		
	72h / 150 °C (302 °F)			x	x	
Change of hardness			Shore A max. +10	max. +10	max. +10	
Change of tensile strength			% max. -10	max. -20	max. -20	
Change of elongation at break			% max. -20	max. -20	max. -20	
Immersion test in water	72h / 100 °C (212 °F)	ISO 1817 ASTM D 471				
Change of hardness			Shore A max. -10	max. -3	max. -3	
Change of volume			% max. +10	max. +3	max. +3	
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria			-45 °C to 130 °C -49 °F to 266 °F	-45 °C to 150 °C -49 °F to 302 °F	-45 °C to 150 °C -49 °F to 302 °F

Table 11: Material specification for standard VMQ

			VMQ 50 Shore A	VMQ 60 Shore A	VMQ 70 Shore A
TSS Material Code			S50T	S60	S70R
Hardness		ISO 7619-1 ASTM D 2240	Shore A 50 ± 5	60 ± 5	70 ± 5
Tensile strength		ISO 37 ASTM D 412	MPa psi ≥ 5 ≥ 725	≥ 5 ≥ 725	≥ 5 ≥ 725
Elongation at break		ISO 37 ASTM D 412	% ≥ 150	≥ 100	≥ 100
Compression set	24h / 175 °C (347 F)	ISO 815-1 A, specimen B ASTM D 395 B, specimen 2	% < 35	< 35	< 35
Heat aging	72h / 225 °C (437 °F)	ISO 188 ASTM D 573			
Change of hardness			Shore A max. +15	max. +15	max. +15
Change of tensile strength			% max. -40	max. -40	max. -40
Change of elongation at break			% max. -40	max. -40	max. -40



				VMQ 50 Shore A	VMQ 60 Shore A	VMQ 70 Shore A
TSS Material Code				S50T	S60	S70R
Immersion test in ASTM oil, IRM 901	72h / 100 °C (212 °F)	ISO 1817 ASTM D 471				
Change of hardness			Shore A	max. -10	max. -10	max. -10
Change of volume			%	max. +20	max. +20	max. +20
Temperature range	Maximum and minimum operating temperatures depend on the specific application criteria			-50 °C to 175 °C -58 °F to 347 °F	-50 °C to 175 °C -58 °F to 347 °F	-50 °C to 175 °C -58 °F to 347 °F

Table 12: 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	VCO	V80	V90
Hardness		ISO 7619-1 ASTM D 2240	Shore A	70 ± 5	75 ± 5	80 ± 5	90 ± 5
Tensile strength		ISO 37 ASTM D 412	MPa psi	≥ 10 ≥ 1,450	≥ 10 ≥ 1,450	≥ 10 ≥ 1,450	≥ 10 ≥ 1,450
Elongation at break		ISO 37 ASTM D 412	%	≥ 125	≥ 125	≥ 120	≥ 100
Compression set	24h / 175 °C (347 °F)	ISO 815-1 A, specimen B ASTM D 395 B, specimen 2	%	< 20	< 20	< 20	< 20
Heat aging	72h / 250 °C (482 °F)	ISO 188 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
Immersion test in ASTM oil, IRM 903	72h / 150 °C (302 °F)	ISO 1817 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
Immersion test in ASTM fuel C	72h / at room temperature	ISO 1817 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 -4 °F to 392 °F	-20 °C to 200 °C -4 °F to 392 °F	-20 °C to 200 °C -4 °F to 392 °F	-15 °C to 200 °C -5 °F to 392 °F


Table 13: Material specification for standard HNBR

			HNBR 70 Shore A partially saturated	HNBR 75 Shore A partially saturated
TSS Material Code			H70	HCO
Hardness	ISO 7619-1 ASTM D 2240	Shore A	70 ± 5	75 ± 5
Tensile strength	ISO 37 ASTM D 412	MPa psi	≥ 15 ≥ 2,176	≥ 15 ≥ 2,176
Elongation at break	ISO 37 ASTM D 412	%	≥ 250	≥ 250
Compression set	24h / 125 °C (257 °F)	ISO 815-1 A, specimen B ASTM D 395 B, specimen 2	%	< 35
Heat aging	72h / 150 °C (302 °F)	ISO 188 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
Immersion test in ASTM oil, IRM 901	72h / 150 °C (302 °F)	ISO 1817 ASTM D 471		
Change of hardness		Shore A	max. +10	max. +10
Change of volume		%	max. -10	max. -10
Immersion test in ASTM oil, IRM 903	72h / 150 °C (302 °F)	ISO 1817 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 -22 °F to 266 °F	-30 °C to 130 °C -22 °F to 266 °F

Table 14: 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	ISO 7619-1 ASTM D 2240	Shore D	55 ± 5	62 ± 5	65 ± 5	65 ± 5
Density	EN ISO 1183-1 ASTM D 792	g/cm ³ Lbs./inch ³	2.17 ± 0.05 0.078 ± 0.0018	2.25 ± 0.05 0.081 ± 0.0018	3.10 ± 0.1 0.112 ± 0.036	2.09 ± 0.04 0.076 ± 0.0014
Tensile strength	EN ISO 527	MPa psi	≥ 20 ≥ 2,901	≥ 12 ≥ 1,740	≥ 20 ≥ 2,901	≥ 11 ≥ 1,595
Elongation at break	EN ISO 527	%	≥ 200	≥ 150	≥ 200	≥ 90



B.1.6 PREFERRED MATERIALS

Trelleborg Sealing Solutions offers various specialized materials that offer additional advantages to standard materials. O-Rings using these materials can be manufactured to use a wide range of available molds, have extended operating temperature and pressure ranges, improved media

resistance and institutional approvals for the portable water, pharmaceutical and beverage industries.

Table 15 shows preferred materials, which are characterized by their wide spectrum of use. They can be used for standard and special applications.

Table 15: Preferred materials

Material Type	Hardness Shore A (± 5)	Color	Operating temperature range	Material code	Description
NBR Nitrile Butadiene Rubber	70	●	-30 °C to +100 °C -22 °F to +212 °F	N7083	
		●		N7036	
		●		N7024	
		●		N7T40	
	90	●	-25 °C to +100 °C -13 °F to +212 °F	N9019	
				N9017	
HNBR Hydrogenated Nitrile Butadiene Rubber	70	●	-30 °C to +140 °C -22 °F to +284 °F	H7011	
FKM Fluorocarbon Rubber	70	●	-20 °C to +200 °C -4 °F to +392 °F	V70GA	
		●		VC001	
	●	VC303			
	80	●		V80G1	
		●		V8012	
		●		V8605	
		●		V8T14	
		●		V8T71	
		-43 °C to +200 °C +45 °F to +392 °F			



Material Type	Hardness Shore A (± 5)	Color	Operating temperature range	Material code	Description
FKM Fluorocarbon Rubber	90	●	-15 °C to +200 °C +5 °F to +392 °F	V90G2	
		●		V9005	
EPDM Ethylene Propylene Diene Rubber	70	●	-45 °C to +150 °C -49 °F to +302 °F	E7502	ISO
		●		E7T41	ISO
		●		E7581	
		●		E75F1	
		●		E7W26	
	80	●	-45 °C to +150 °C -49 °F to +302 °F	E85F1	
VMQ Methyl Vinyl Silicone Rubber	60	●	-50 °C to +175 °C -58 °F to +347 °F	S60R4	
	70	●		S70RE	
	70	●		S70RB	

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.

Energizer elements

Food applications

Potable water applications

Hot water & steam applications

Good cold flexibility

Improved cold flexibility

Excellent cold flexibility

Good heat resistance

Improved heat resistance

Excellent heat resistance

ISO3601-5 (carried out with test-sheets)



■ B.2 Installation and Design Recommendations

The following design recommendations are mainly based on the recommendations given in ISO 3601-2. They cannot be used with Isolast® materials. Please use the Isolast® brochure or contact your local Trelleborg Sealing Solutions marketing company for further details.

USEFUL TOOLS

Learn more about the layout of an O-Ring and its housing with the Trelleborg Sealing Solutions O-Ring e-Learning lessons. Use the O-Ring Calculator to help design O-Ring housings or the O-Ring Selector app to find defined housings in accordance with ISO 3601. All these tools 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 the 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.

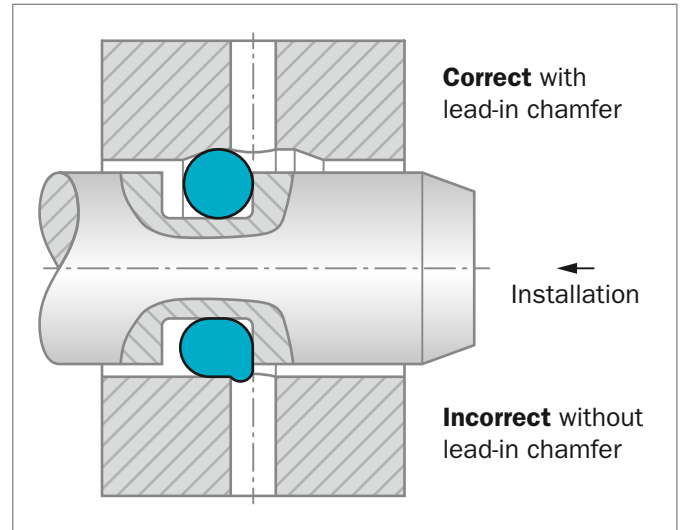


Figure 11: O-Ring installation over transverse bores

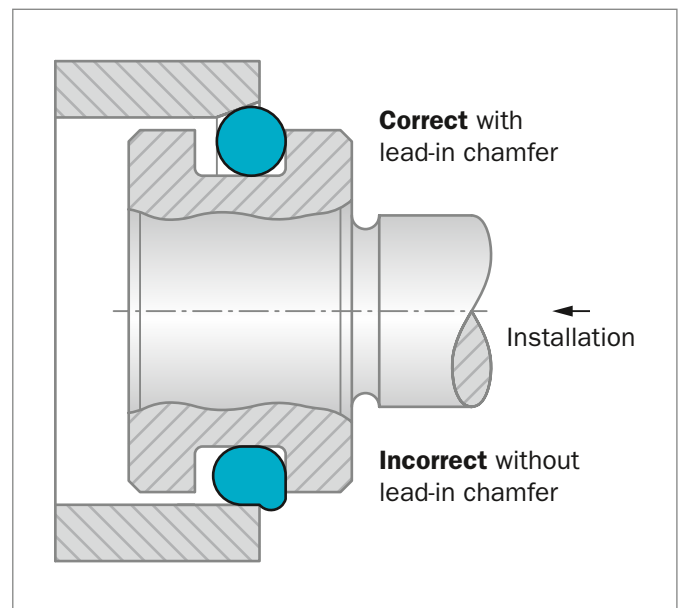


Figure 12: Piston installation with O-Ring

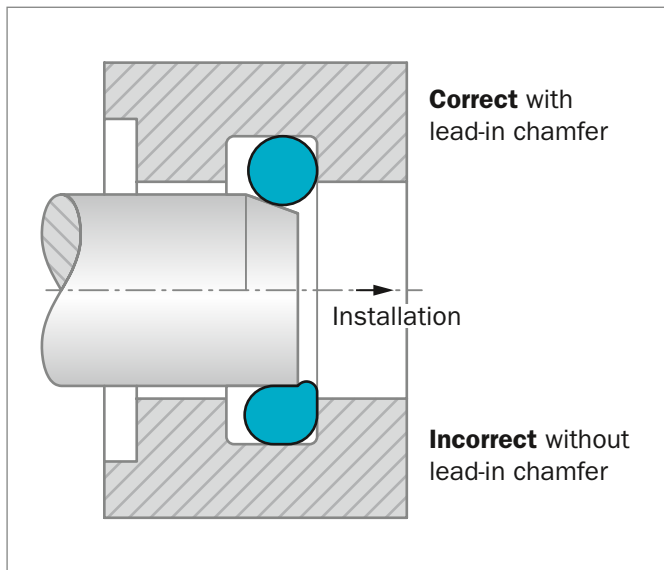


Figure 13: Rod installation with O-Ring

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 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 the Flexcoat™ – Friction-free Running brochure). This offers a number of benefits during installation by:

- Reducing installation forces
- Eliminating stick effects, easy removal

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

Please contact your local Trelleborg Sealing Solutions marketing company for more information.

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 equal to or larger than the outer groove diameter d_7 . With external pressure, the O-Ring inside diameter is chosen to be smaller than the inner groove diameter d_8 .

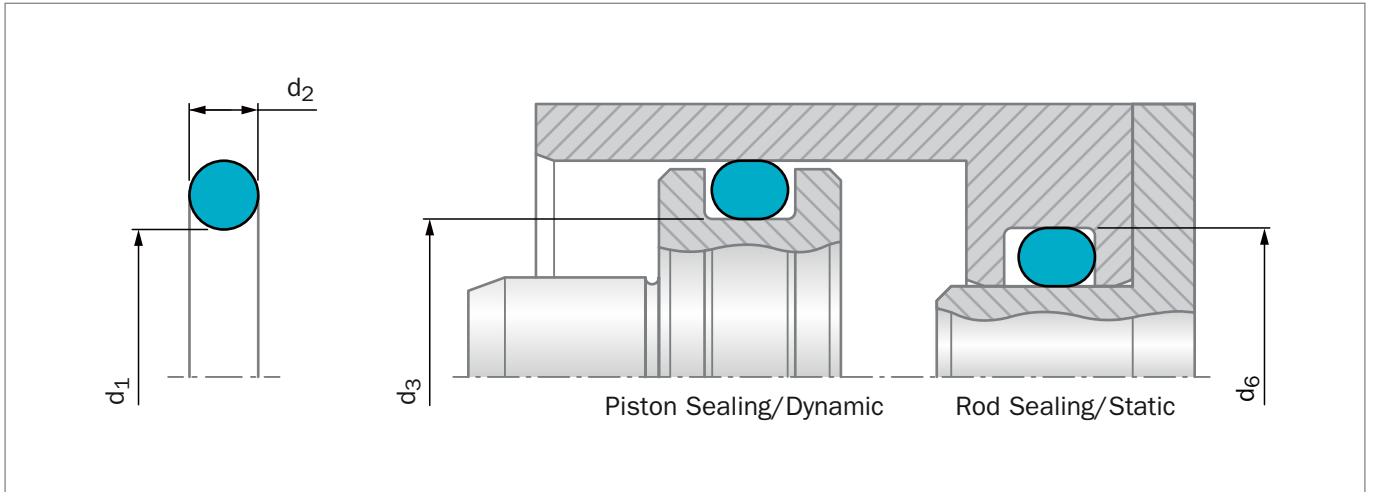


Figure 14: Radial installation, static and dynamic

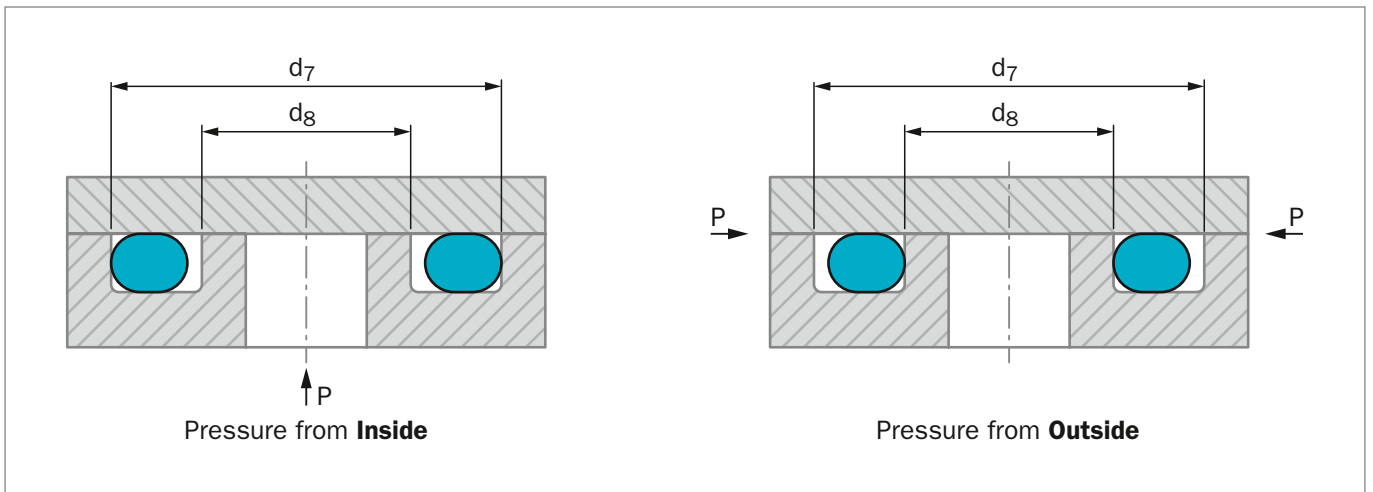


Figure 15: Axial installation, static



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 (0.787 inch), this is not always possible, so the stretch range is wider. To minimize this range and the maximum 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 service life.

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 (9.843 inch), or 5% for O-Rings with a diameter d_1 smaller than 250 mm (9.843 inch).

For O-Rings with a diameter d_1 smaller than 20 mm (0.787 inch), 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 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 .

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 equal to or larger (at most 1 to 2%) than the outer groove diameter d_7 .

Care should be taken with large O-Rings with inside diameters greater than approximately 50 mm (2 inch). The absolute

outside diameter interference should be evaluated and minimized to avoid the O-Ring bending and slipping out of the groove during assembly. In addition, the ratio between inside diameter and cross section and the O-Ring material should be taken into consideration. If in doubt, please contact your local Trelleborg Sealing Solutions marketing company.

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 such as those 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 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. 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 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 marketing 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 approximate values are recommended for the initial compression as a proportion of the cross section (d_2):

Radial dynamic applications:	6 to 27%
Axial static applications:	13 to 36%
Radial static applications:	10 to 35%

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

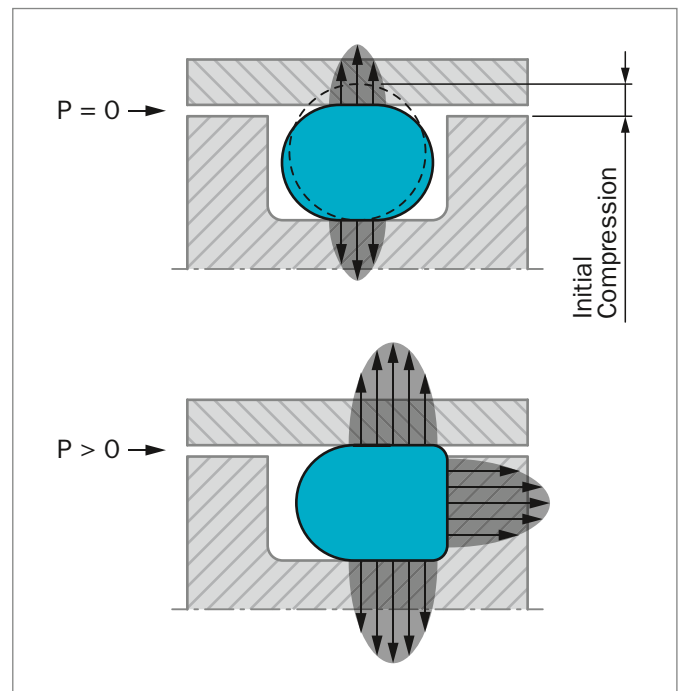


Figure 16: O-Ring contact pressure installed and under service pressure

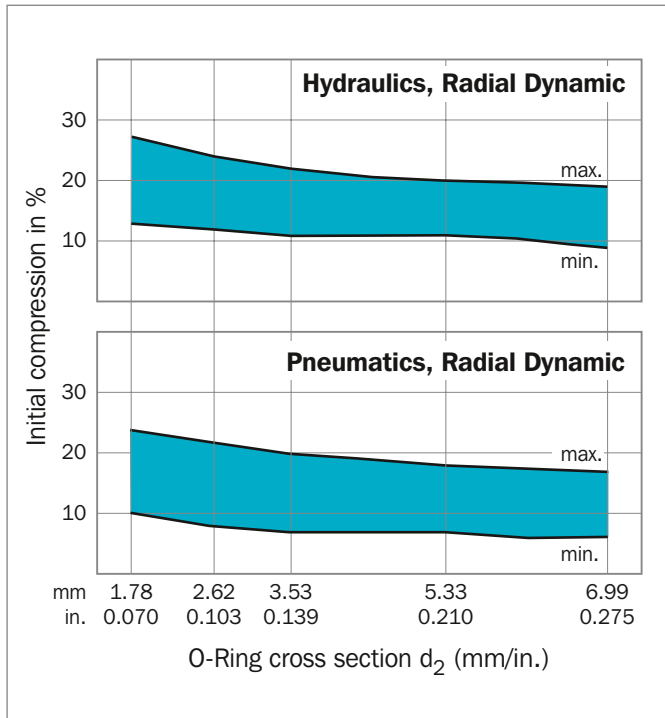


Figure 17: Permissible range of initial compression as a function of cross section, radial dynamic

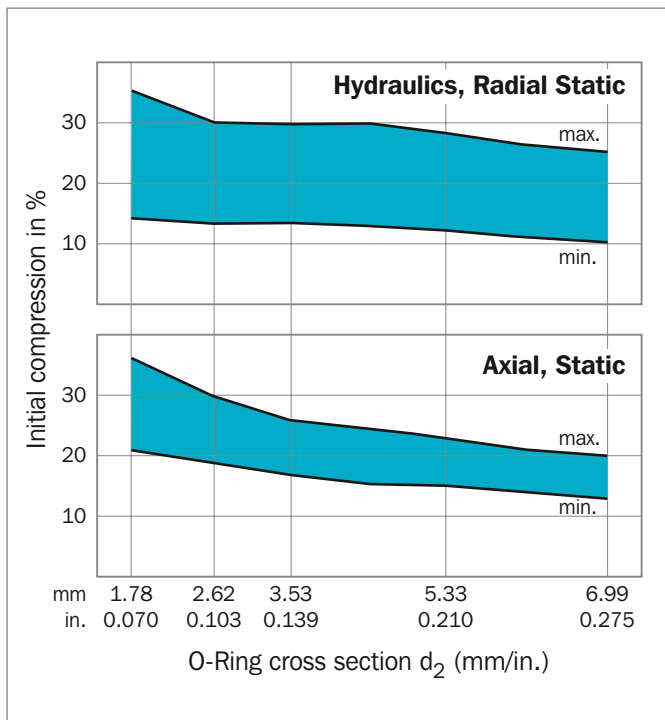


Figure 18: Permissible range of initial compression as a function of cross section, radial static and axial

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.

Figure 19 – Figure 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.

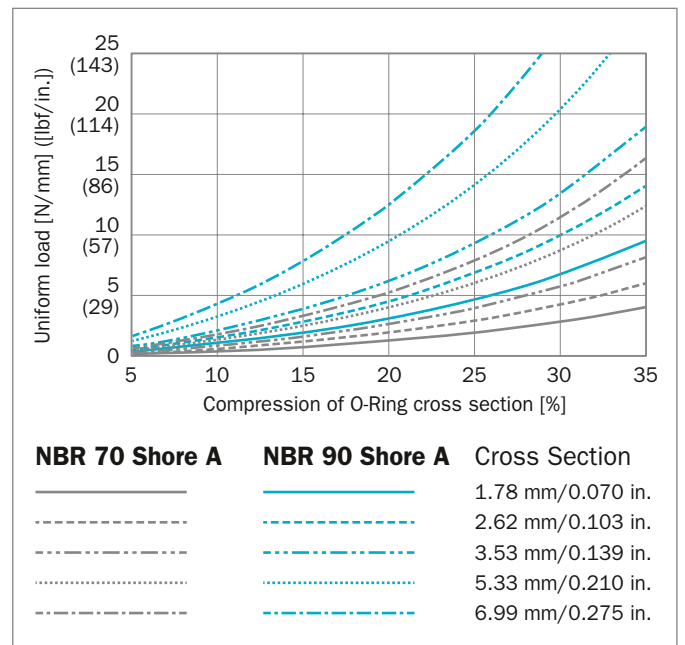


Figure 19: Guiding values for the uniform load [N/mm] ([lbf/inch]) of compressed O-Rings, material types NBR 70 Sh A and NBR 90 Sh A

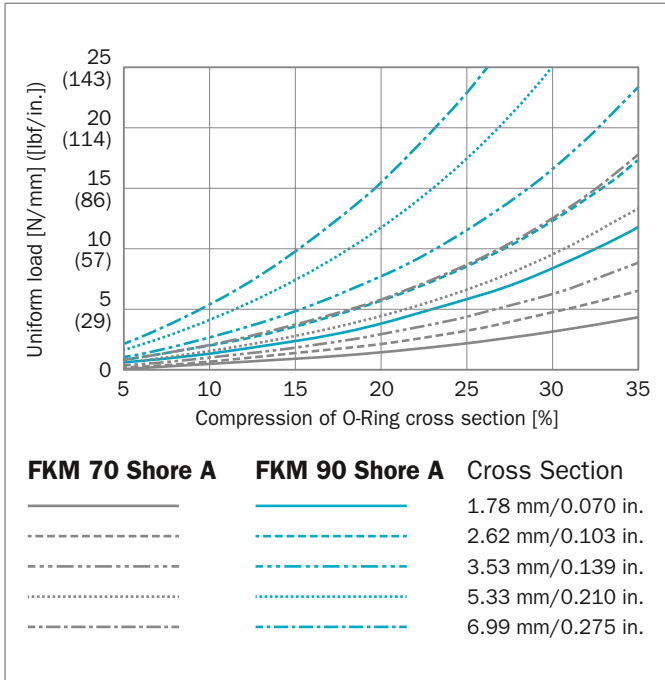


Figure 20: Guiding values for the uniform load [N/mm] ([lbf/in.]) of compressed O-Rings, material types FKM 70 Sh A and FKM 90 Sh A

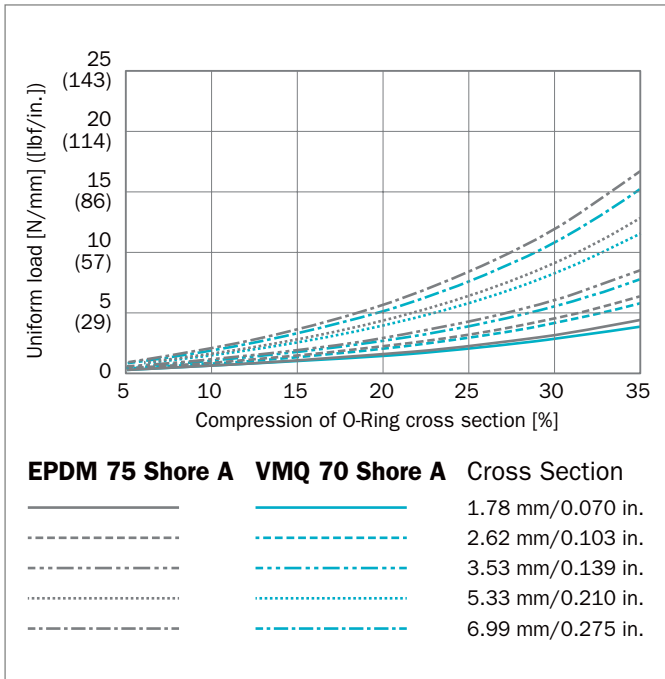


Figure 21: Guiding values for the uniform load [N/mm] ([lbf/in.]) of compressed O-Rings, material types EPDM 75 Sh A and VMQ 70 Sh

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 (725 psi) for O-Rings with inside diameter > 50 mm (1.969 inch) without Back-up Ring
- up to 10 MPa (1,450 psi) for O-Rings with inside diameter < 50 mm (1.969 inch) without Back-up Ring (depends on the material, the cross section and the clearance)
- up to 40 MPa (5,801 psi) with Back-up Ring
- up to 250 MPa (36,259 psi) with special Back-up Ring
- Please note the permissible extrusion gaps

Dynamic application

- Reciprocating up to 5 MPa (725 psi) without Back-up Ring
- Higher pressures with Back-up Ring

Speed

Reciprocating up to 0.5 m/s (1.64 ft/s)
 Rotating up to 0.5 m/s (1.64 ft/s)
 Depending on material and application.

Temperature

From -60 °C (-76 °F) to +325 °C (+617 °F)
 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, consult 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-Rings are squeezed during installation, lead-in chamfers and rounded edges must be provided (Figure 22 and Figure 23).

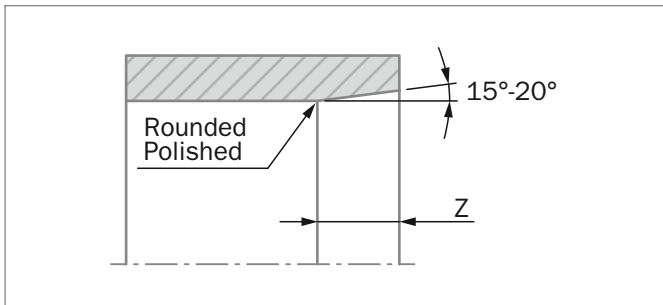


Figure 22: Lead-in chamfers for bores, tubes

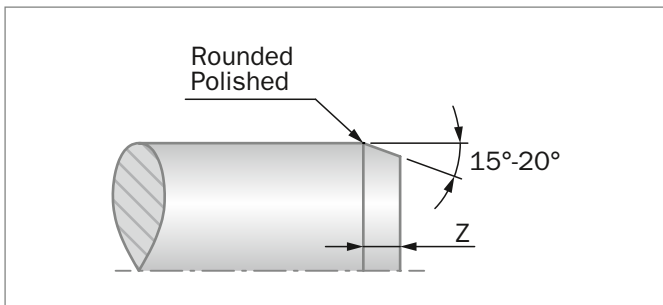


Figure 23: Lead-in chamfers for shafts, rods

The minimum length of the lead-in chamfer is listed in Table 16 and Table 17 as a function of the cross section d_2 .

Table 16: Lead-in – Metric

Lead-in chamfers length Z min.		O-Ring Cross-Section-Ø d_2
		mm
15°	20°	
1.1	0.9	up to 1.78 / 1.80
1.5	1.1	up to 2.62 / 2.65
1.8	1.4	up to 3.53 / 3.55
2.7	2.1	up to 5.33 / 5.35
3.6	2.8	up to 6.99 / 7.00
6.0	4.5	above 7.00

Table 17: Lead-in chamfers – Inch

Lead-in chamfers length Z min.		O-Ring Cross-Section-Ø d_2
		inch
15°	20°	
0.098	0.059	up to 0.071
0.118	0.079	up to 0.104
0.138	0.098	up to 0.140
0.177	0.138	up to 0.209
0.197	0.157	up to 0.276
0.236	0.177	above 0.276

The surface roughness of a lead-in chamfer is:

$$R_z \leq 6.3 \mu\text{m} \text{ (248 } \mu\text{inch)}$$

$$R_a \leq 0.8 \mu\text{m} \text{ (31.5 } \mu\text{inch)}$$

Radial clearance

The tolerances given in Table 26 and Table 27 and the maximum permissible radial clearance S (extrusion gap) given in Table 18 and Table 19 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).

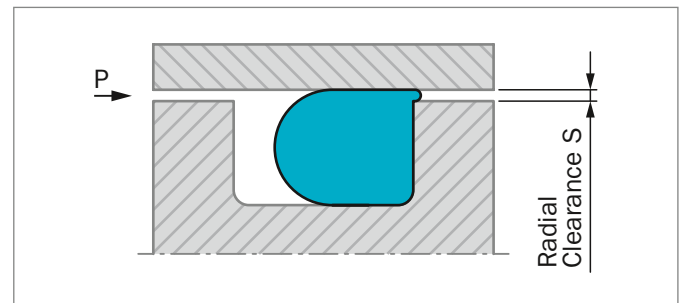


Figure 24: Radial clearance S

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 18 and Table 19 contain recommendations for the permissible clearance S as a function of O-Ring cross section and shore hardness. The tables are valid for elastomeric materials with the exception of polyurethane and FEP / PFA encapsulated O-Rings.

For pressure above 5 MPa (725 psi) for O-Rings with inside diameter > 50 mm (1.969 inch) and above 10 MPa (1,450 psi) for O-Rings with inside diameter < 50 mm (1.969 inch) we recommend the use of Back-up Rings.



Table 18: Radial clearance S – Metric

O-Ring Cross Section-Ø d ₂	up to 2	2 - 3	3 - 5	5 - 7	above 7
O-Ring materials with hardness of 70 Shore A					
Pressure MPa	Radial clearance S mm				
≤ 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-Ring materials with hardness of 90 Shore A					
Pressure MPa	Radial clearance S mm				
≤ 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

Table 19: Radial clearance S – Inch

O-Ring Cross Section-Ø d ₂	up to 0.079	0.079 - 0.118	0.118 - 0.197	0.197 - 0.276	above 0.276
O-Ring materials with hardness of 70 Shore A					
Pressure psi	Radial clearance S inch				
≤ 508	0.003	0.004	0.004	0.005	0.006
≤ 1015	0.002	0.003	0.003	0.004	0.004
≤ 1523	0.001	0.002	0.002	0.003	0.003
O-Ring materials with hardness of 90 Shore A					
Pressure psi	Radial clearance S inch				
≤ 508	0.005	0.006	0.008	0.009	0.010
≤ 1015	0.004	0.005	0.006	0.007	0.008
≤ 1523	0.003	0.004	0.004	0.005	0.006
≤ 2031	0.002	0.003	0.003	0.004	0.004
≤ 2538	0.002	0.002	0.003	0.003	0.004
≤ 3046	0.001	0.002	0.002	0.003	0.003
≤ 5076	0.001	0.001	0.001	0.002	0.002

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 the chapter on "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 Ra 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 20: Surface finish for O-Ring housing – Metric

Type of Load	Surface	R _t	Rz	Ra
µm				
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 Groove flanks, groove diameter	≤ 10.0 ≤ 16.0	≤ 6.3	≤ 1.6
	For pulsating pressures: Mating surface Groove flanks, groove diameter	≤ 6.3 ≤ 10.0	≤ 6.3	≤ 1.6

* spiralfree grinding



Table 21: Surface finish for O-Ring housing – Inch

Type of Load	Surface	R _t	Rz	Ra
μinch				
Radial-dynamic	Mating surface * (bore, rod, shaft)	≤ 100	≤ 60	≤ 16
	Groove flanks, groove diameter	≤ 400	≤ 250	≤ 60
Radial-static Axial-static	Mating surface	≤ 400	≤ 250	≤ 60
	Groove flanks, groove diameter	≤ 630	≤ 250	≤ 60
	For pulsating pressures: Mating surface	≤ 250	≤ 250	≤ 60
	Groove flanks, groove diameter	≤ 400		

* 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, such as overhead installation, in order to retain the O-Ring (Figure 25). The installation dimensions are summarised in Table 22/Table 23. The trapezoidal groove is only recommended for O-Ring cross section from 3.53 mm (0.139 inch). The inside diameter of the O-Ring results from the mean groove diameter minus the cross section.

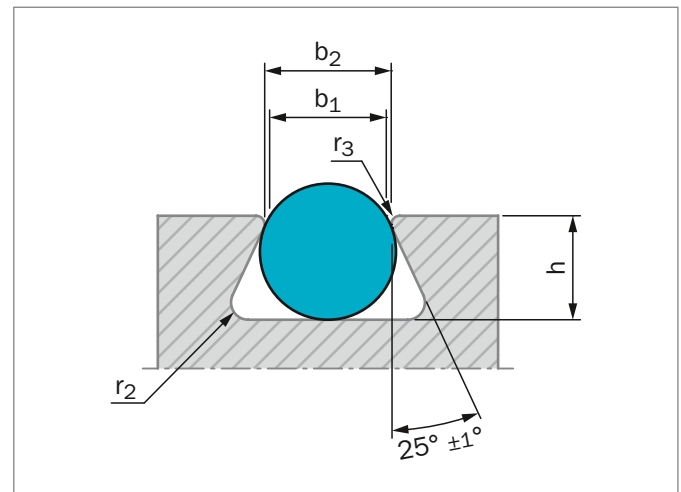


Figure 25: Installation in trapezoidal groove

Table 22: Installation dimensions for trapezoidal groove – Metric

O-Ring Cross-Section-Ø d ₂	Groove dimensions				
	Groove width b ₁ ±0.05	Groove width b ₂ ±0.05	Groove depth h ±0.05	Radius (max.)	
				r ₃	r ₂
mm					
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



Table 23: Installation dimensions for trapezoidal groove – Inch

O-Ring Cross-Section-Ø d_2	Groove dimensions				
	Groove width $b_1 \pm 0.002$	Groove width $b_2 \pm 0.002$	Groove depth $h \pm 0.002$	Radius (max.)	
	r_3	r_2			
inch					
0.139 / 0.140	0.114	0.126	0.114	0.010	0.031
0.157	0.134	0.146	0.126	0.010	0.031
0.197	0.169	0.181	0.165	0.010	0.031
0.210 / 0.209	0.181	0.193	0.181	0.010	0.031
0.224	0.187	0.207	0.189	0.016	0.031
0.236	0.199	0.219	0.201	0.016	0.031
0.276	0.236	0.256	0.236	0.016	0.063
0.315	0.270	0.293	0.272	0.020	0.063
0.331	0.285	0.309	0.287	0.020	0.063

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 18 and Table 19).

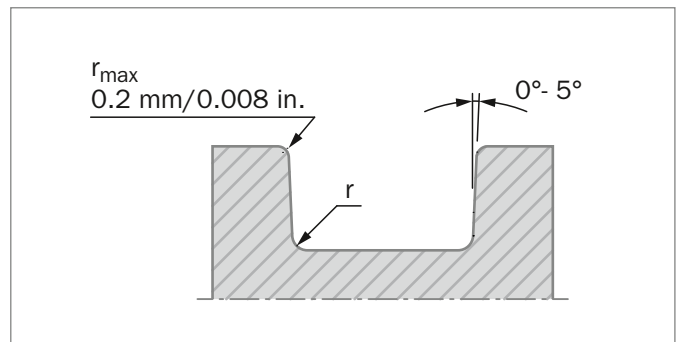


Figure 26: Groove specifications



HOUSING DIMENSIONS RECOMMENDATIONS

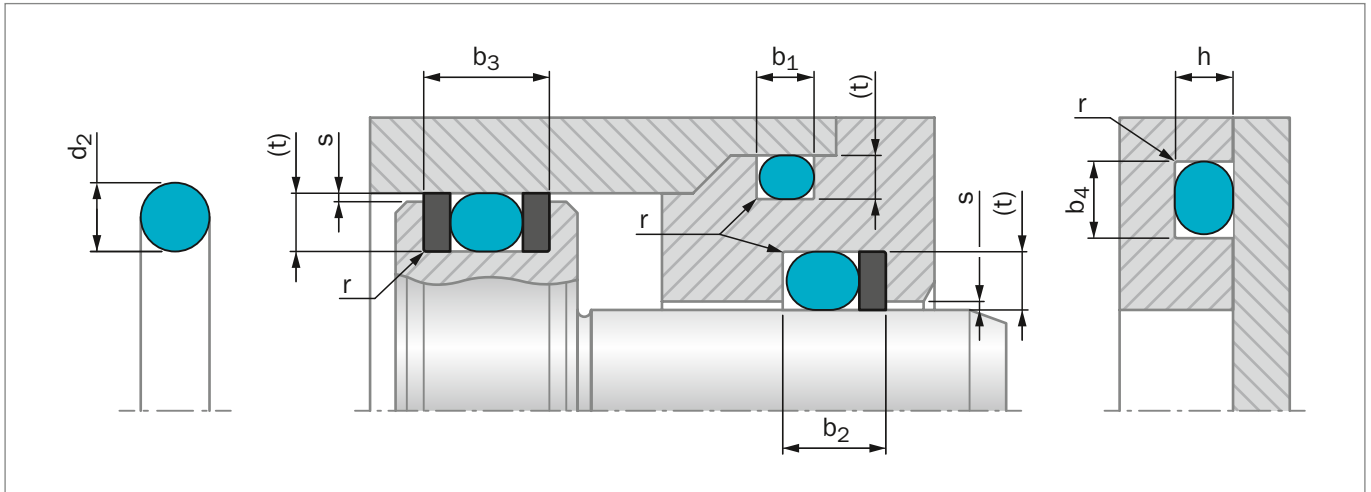


Figure 27: Installation drawing

For 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).

The generally recommended fit is H8/f7.

Table 24: Housing dimensions – Metric

O-Ring Cross-Section-Ø	Radial installation		Axial installation		Radius ¹⁾	
	Housing depth ²⁾		Groove width	Groove depth		Groove width
d_2	Dynamic (t)	Static (t)	$b_1 + 0.25$	$h + 0.1$	$b_4 + 0.2$	$r \pm 0.2$
mm						
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



O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.25	h +0.1	b ₄ +0.2	r ±0.2
mm						
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	1.90	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-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.25	h +0.1	b ₄ +0.2	r ±0.2
mm						
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 should always be $r = 0.25 \pm 0.2$ mm (0.010 ± 0.008 inch).

2) The given values for the housing depth are based on the nominal O-Ring cross section dimensions. The O-Ring inside diameter and its stretch are not considered. The given installation dimensions cannot be used for FFKM materials (Isolast®). Please use the Isolast® brochure or contact our specialists for further details.

Table 25: Housing dimensions – Inch

O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.010	h +0.004	b ₄ +0.008	r ±0.008
inch						
0.020	-	0.014	0.031	0.014	0.031	0.008
0.029	-	0.020	0.039	0.020	0.039	0.008
0.039	-	0.028	0.055	0.028	0.055	0.008
0.040	-	0.028	0.055	0.028	0.055	0.008
0.047	-	0.033	0.067	0.033	0.067	0.008
0.049	-	0.035	0.067	0.035	0.071	0.008
0.050	-	0.035	0.067	0.035	0.071	0.008
0.051	-	0.037	0.071	0.037	0.071	0.008
0.056	-	0.041	0.075	0.041	0.079	0.012
0.059	0.049	0.043	0.079	0.043	0.083	0.012
0.060	0.049	0.043	0.079	0.043	0.083	0.012
0.063	0.051	0.047	0.083	0.047	0.087	0.012
0.064	0.051	0.047	0.083	0.047	0.087	0.012
0.070*	0.057	0.051	0.094	0.051	0.102	0.012
0.071	0.057	0.051	0.094	0.051	0.102	0.012
0.072	0.059	0.053	0.098	0.053	0.102	0.012
0.075	0.061	0.055	0.102	0.055	0.106	0.012
0.078	0.065	0.059	0.106	0.059	0.110	0.012
0.079	0.065	0.059	0.106	0.059	0.110	0.012
0.082	0.069	0.061	0.110	0.061	0.114	0.012
0.083	0.069	0.061	0.110	0.061	0.114	0.012
0.087	0.073	0.063	0.118	0.063	0.118	0.012
0.089	0.075	0.067	0.118	0.067	0.122	0.012
0.091	0.077	0.069	0.122	0.069	0.122	0.012
0.092	0.077	0.069	0.122	0.069	0.122	0.012
0.094	0.081	0.071	0.126	0.071	0.130	0.012



O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.010	h +0.004	b ₄ +0.008	r ±0.008
inch						
0.097	0.083	0.073	0.130	0.073	0.134	0.012
0.098	0.085	0.075	0.130	0.075	0.134	0.012
0.103*	0.089	0.079	0.142	0.079	0.150	0.012
0.104	0.089	0.079	0.142	0.079	0.150	0.012
0.106	0.091	0.081	0.142	0.081	0.150	0.012
0.110	0.094	0.083	0.146	0.083	0.154	0.024
0.115	0.098	0.087	0.154	0.087	0.157	0.024
0.116	0.098	0.087	0.154	0.087	0.157	0.024
0.118	0.102	0.091	0.157	0.091	0.157	0.024
0.122	0.106	0.094	0.161	0.094	0.161	0.024
0.138	0.120	0.104	0.181	0.104	0.185	0.024
0.139*	0.122	0.106	0.189	0.106	0.197	0.024
0.140	0.122	0.106	0.189	0.106	0.197	0.024
0.142	0.124	0.110	0.189	0.110	0.201	0.024
0.157	0.138	0.122	0.205	0.122	0.209	0.024
0.177	0.157	0.138	0.228	0.138	0.232	0.024
0.197	0.173	0.157	0.260	0.157	0.264	0.024
0.209	0.185	0.169	0.280	0.169	0.287	0.024
0.210*	0.185	0.169	0.280	0.169	0.287	0.024
0.217	0.189	0.177	0.280	0.177	0.287	0.024
0.224	0.197	0.181	0.283	0.181	0.291	0.024
0.236	0.209	0.193	0.291	0.193	0.299	0.024
0.256	0.224	0.213	0.315	0.213	0.323	0.039
0.275*	0.240	0.228	0.374	0.228	0.382	0.039
0.276	0.240	0.228	0.374	0.228	0.382	0.039
0.295	0.260	0.248	0.382	0.248	0.390	0.039
0.315	0.280	0.264	0.386	0.264	0.394	0.039
0.331	0.295	0.280	0.394	0.280	0.406	0.039
0.354	0.319	0.303	0.417	0.303	0.429	0.059
0.374	0.339	0.323	0.433	0.323	0.449	0.059
0.394	0.358	0.339	0.457	0.339	0.472	0.079
0.472	0.433	0.417	0.531	0.417	0.551	0.079

* Preferred sizes

1) If a Back-up Ring is used, the recommended radius should always be $r = 0.25 \pm 0.2$ mm (0.010 ± 0.008 inch).

2) The given values for the housing depth are based on the nominal O-Ring cross section dimensions. The O-Ring inside diameter and its stretch are not considered. 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 QUALITY SPECIFICATIONS 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 in accordance with ISO 3601-1, class B and standard surface quality according to Trelleborg Sealing Solutions standard TBS-00005, based on ISO 3601-3, grade N.

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.

Unless otherwise defined the standard material specification chapter B.1.5 will be used.

ORDERING EXAMPLE

Type:	O-Ring, metric 40 x 3 (1.575 x 0.118 inch)
Dimensions:	Inside diameter $d_1 = 40.0$ mm (1.575 inch) Cross section $d_2 = 3.0$ mm (0.118 inch)
Material:	NBR 70 (Nitrile-Butadiene Rubber 70 Shore A)

TSS Article No.	OR 30 04000 - N70
TSS Article - Group	OR
Cross Section (mm) x 10	30
Inside Diameter (mm) x 100	04000
Quality Index (Standard)	-
Material Code (Standard)	N70



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.

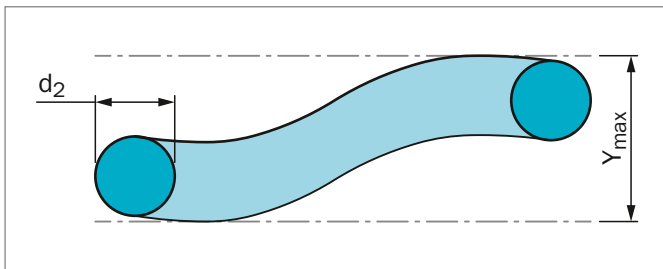


Figure 28: Flatness tolerance Y_{max}

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

$$1. Y_{max} = 1.5 * d_2 \quad \text{for } 0.11 < \frac{d_2}{d_1} \leq 0.21$$

$$2. Y_{max} = 1.3 * d_2 \quad \text{for } \frac{d_2}{d_1} > 0.21$$

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

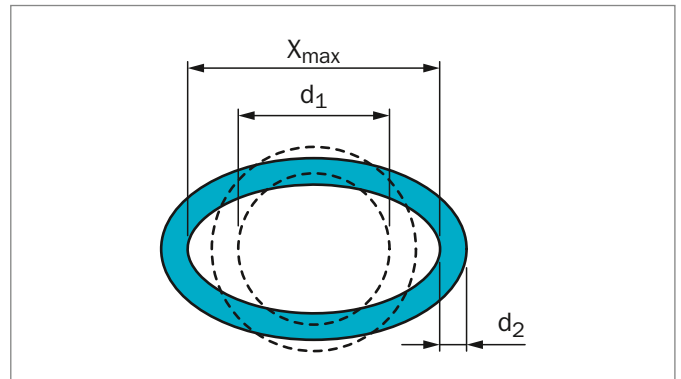


Figure 29: Roundness tolerance X_{max}

The roundness tolerance is calculated as follows:

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

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 deformation during handling, such as 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 in accordance with Trelleborg Sealing Solutions standard TBS-00024 in accordance with ISO 3601-1, class B. Precision O-Rings with reduced tolerances are also available. Please contact your local Trelleborg Sealing Solutions marketing company for more information.

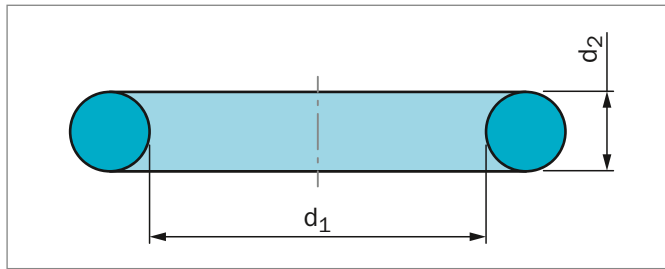


Figure 30: O-Ring dimensions

Tolerances for O-Ring cross sections d_2

Valid tolerances for elastomeric O-Ring cross sections d_2 are listed in the following Table 26 and Table 27.

Table 26: Tolerances for O-Ring cross sections d_2 in accordance with the TSS standard TBS-00024, complying with ISO 3601-1, class B, table A.1 – Metric

O-Ring Cross-Section-Ø				Tolerance
d_2				±
mm				
	d_2	≤	0.80	on request
0.80	<	d_2	≤ 2.25	0.08
2.25	<	d_2	≤ 3.15	0.09
3.15	<	d_2	≤ 4.50	0.10
4.50	<	d_2	≤ 6.30	0.13
6.30	<	d_2	≤ 8.40	0.15
8.40	<	d_2	≤ 10.00	0.20
10.00	<	d_2	≤ 12.00	0.25
12.00	<	d_2	≤ 14.00	0.28
	d_2	>	14.00	on request

Table 27: Tolerances for O-Ring cross sections d_2 in accordance with the TSS standard TBS-00024, complying with ISO 3601-1, class B, table A.1 – Inch

O-Ring Cross-Section-Ø				Tolerance
d_2				±
inch				
	d_2	≤	0.031	on request
0.031	<	d_2	≤ 0.089	0.003
0.089	<	d_2	≤ 0.124	0.004
0.124	<	d_2	≤ 0.177	0.004
0.177	<	d_2	≤ 0.248	0.005
0.248	<	d_2	≤ 0.331	0.006
0.331	<	d_2	≤ 0.394	0.008
0.394	<	d_2	≤ 0.472	0.010
0.472	<	d_2	≤ 0.551	0.011
	d_2	>	0.551	on request

TOLERANCES FOR O-RING INSIDE DIAMETERS d_1

Tolerances given in Trelleborg Sealing Solutions standard TBS-00024 in accordance with ISO 3601-1, class B apply for the elastomeric O-Rings inside diameters d_1 . The appropriate tolerances for the inside diameters d_1 in accordance with 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. For imperial unit systems, the tolerances must first be calculated based on the metric O-Ring dimensions and finally converted into the imperial unit system. The tolerances for the inside diameters d_1 up to 500 mm (19.685 inch) are listed in the following tables.



Table 28: Tolerances for inside diameters d_1 in accordance with the TSS standard TBS-00024, complying with ISO 3601-1, class B – Metric

O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d_1				\pm	d_1				\pm		
mm					mm						
	d_1	\leq	1.71	0.12	52.12	<	d_1	\leq	53.55	0.50	
1.71	<	d_1	\leq	2.93	0.13	53.55	<	d_1	\leq	54.98	0.51
2.93	<	d_1	\leq	4.17	0.14	54.98	<	d_1	\leq	56.41	0.52
4.17	<	d_1	\leq	5.44	0.15	56.41	<	d_1	\leq	57.84	0.53
5.44	<	d_1	\leq	6.72	0.16	57.84	<	d_1	\leq	59.27	0.54
6.72	<	d_1	\leq	8.01	0.17	59.27	<	d_1	\leq	60.71	0.55
8.01	<	d_1	\leq	9.31	0.18	60.71	<	d_1	\leq	62.14	0.56
9.31	<	d_1	\leq	10.62	0.19	62.14	<	d_1	\leq	63.58	0.57
10.62	<	d_1	\leq	11.94	0.20	63.58	<	d_1	\leq	65.02	0.58
11.94	<	d_1	\leq	13.27	0.21	65.02	<	d_1	\leq	66.47	0.59
13.27	<	d_1	\leq	14.61	0.22	66.47	<	d_1	\leq	67.91	0.60
14.61	<	d_1	\leq	15.95	0.23	67.91	<	d_1	\leq	69.35	0.61
15.95	<	d_1	\leq	17.29	0.24	69.35	<	d_1	\leq	70.80	0.62
17.29	<	d_1	\leq	18.64	0.25	70.80	<	d_1	\leq	72.25	0.63
18.64	<	d_1	\leq	20.00	0.26	72.25	<	d_1	\leq	73.70	0.64
20.00	<	d_1	\leq	21.36	0.27	73.70	<	d_1	\leq	75.15	0.65
21.36	<	d_1	\leq	22.73	0.28	75.15	<	d_1	\leq	76.60	0.66
22.73	<	d_1	\leq	24.10	0.29	76.60	<	d_1	\leq	78.05	0.67
24.10	<	d_1	\leq	25.47	0.30	78.05	<	d_1	\leq	79.51	0.68
25.47	<	d_1	\leq	26.85	0.31	79.51	<	d_1	\leq	80.97	0.69
26.85	<	d_1	\leq	28.23	0.32	80.97	<	d_1	\leq	82.42	0.70
28.23	<	d_1	\leq	29.61	0.33	82.42	<	d_1	\leq	83.88	0.71
29.61	<	d_1	\leq	31.00	0.34	83.88	<	d_1	\leq	85.34	0.72
31.00	<	d_1	\leq	32.39	0.35	85.34	<	d_1	\leq	86.80	0.73
32.39	<	d_1	\leq	33.78	0.36	86.80	<	d_1	\leq	88.27	0.74
33.78	<	d_1	\leq	35.18	0.37	88.27	<	d_1	\leq	89.73	0.75
35.18	<	d_1	\leq	36.58	0.38	89.73	<	d_1	\leq	91.20	0.76
36.58	<	d_1	\leq	37.98	0.39	91.20	<	d_1	\leq	92.66	0.77
37.98	<	d_1	\leq	39.38	0.40	92.66	<	d_1	\leq	94.13	0.78
39.38	<	d_1	\leq	40.79	0.41	94.13	<	d_1	\leq	95.60	0.79
40.79	<	d_1	\leq	42.20	0.42	95.60	<	d_1	\leq	97.07	0.80
42.20	<	d_1	\leq	43.61	0.43	97.07	<	d_1	\leq	98.54	0.81
43.61	<	d_1	\leq	45.02	0.44	98.54	<	d_1	\leq	100.01	0.82
45.02	<	d_1	\leq	46.44	0.45	100.01	<	d_1	\leq	101.48	0.83
46.44	<	d_1	\leq	47.86	0.46	101.48	<	d_1	\leq	102.96	0.84
47.86	<	d_1	\leq	49.28	0.47	102.96	<	d_1	\leq	104.43	0.85
49.28	<	d_1	\leq	50.70	0.48	104.43	<	d_1	\leq	105.91	0.86
50.70	<	d_1	\leq	52.12	0.49	105.91	<	d_1	\leq	107.39	0.87



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
mm					mm						
107.39	<	d ₁	≦	108.86	0.88	167.20	<	d ₁	≦	168.71	1.28
108.86	<	d ₁	≦	110.34	0.89	168.71	<	d ₁	≦	170.22	1.29
110.34	<	d ₁	≦	111.82	0.90	170.22	<	d ₁	≦	171.73	1.30
111.82	<	d ₁	≦	113.30	0.91	171.73	<	d ₁	≦	173.25	1.31
113.30	<	d ₁	≦	114.79	0.92	173.25	<	d ₁	≦	174.76	1.32
114.79	<	d ₁	≦	116.27	0.93	174.76	<	d ₁	≦	176.28	1.33
116.27	<	d ₁	≦	117.75	0.94	176.28	<	d ₁	≦	177.79	1.34
117.75	<	d ₁	≦	119.24	0.95	177.79	<	d ₁	≦	179.31	1.35
119.24	<	d ₁	≦	120.72	0.96	179.31	<	d ₁	≦	180.82	1.36
120.72	<	d ₁	≦	122.21	0.97	180.82	<	d ₁	≦	182.34	1.37
122.21	<	d ₁	≦	123.70	0.98	182.34	<	d ₁	≦	183.86	1.38
123.70	<	d ₁	≦	125.19	0.99	183.86	<	d ₁	≦	185.38	1.39
125.19	<	d ₁	≦	126.68	1.00	185.38	<	d ₁	≦	186.89	1.40
126.68	<	d ₁	≦	128.17	1.01	186.89	<	d ₁	≦	188.41	1.41
128.17	<	d ₁	≦	129.66	1.02	188.41	<	d ₁	≦	189.93	1.42
129.66	<	d ₁	≦	131.15	1.03	189.93	<	d ₁	≦	191.45	1.43
131.15	<	d ₁	≦	132.64	1.04	191.45	<	d ₁	≦	192.98	1.44
132.64	<	d ₁	≦	134.14	1.05	192.98	<	d ₁	≦	194.50	1.45
134.14	<	d ₁	≦	135.63	1.06	194.50	<	d ₁	≦	196.02	1.46
135.63	<	d ₁	≦	137.13	1.07	196.02	<	d ₁	≦	197.54	1.47
137.13	<	d ₁	≦	138.62	1.08	197.54	<	d ₁	≦	199.07	1.48
138.62	<	d ₁	≦	140.12	1.09	199.07	<	d ₁	≦	200.59	1.49
140.12	<	d ₁	≦	141.62	1.10	200.59	<	d ₁	≦	202.12	1.50
141.62	<	d ₁	≦	143.12	1.11	202.12	<	d ₁	≦	203.64	1.51
143.12	<	d ₁	≦	144.62	1.12	203.64	<	d ₁	≦	205.17	1.52
144.62	<	d ₁	≦	146.12	1.13	205.17	<	d ₁	≦	206.69	1.53
146.12	<	d ₁	≦	147.62	1.14	206.69	<	d ₁	≦	208.22	1.54
147.62	<	d ₁	≦	149.12	1.15	208.22	<	d ₁	≦	209.75	1.55
149.12	<	d ₁	≦	150.62	1.16	209.75	<	d ₁	≦	211.28	1.56
150.62	<	d ₁	≦	152.13	1.17	211.28	<	d ₁	≦	212.81	1.57
152.13	<	d ₁	≦	153.63	1.18	212.81	<	d ₁	≦	214.34	1.58
153.63	<	d ₁	≦	155.13	1.19	214.34	<	d ₁	≦	215.87	1.59
155.13	<	d ₁	≦	156.64	1.20	215.87	<	d ₁	≦	217.40	1.60
156.64	<	d ₁	≦	158.15	1.21	217.40	<	d ₁	≦	218.93	1.61
158.15	<	d ₁	≦	159.65	1.22	218.93	<	d ₁	≦	220.46	1.62
159.65	<	d ₁	≦	161.16	1.23	220.46	<	d ₁	≦	221.99	1.63
161.16	<	d ₁	≦	162.67	1.24	221.99	<	d ₁	≦	223.52	1.64
162.67	<	d ₁	≦	164.18	1.25	223.52	<	d ₁	≦	225.06	1.65
164.18	<	d ₁	≦	165.69	1.26	225.06	<	d ₁	≦	226.59	1.66
165.69	<	d ₁	≦	167.20	1.27	226.59	<	d ₁	≦	228.12	1.67



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
mm					mm						
228.12	<	d ₁	≦	229.66	1.68	289.88	<	d ₁	≦	291.44	2.08
229.66	<	d ₁	≦	231.19	1.69	291.44	<	d ₁	≦	292.99	2.09
231.19	<	d ₁	≦	232.73	1.70	292.99	<	d ₁	≦	294.54	2.10
232.73	<	d ₁	≦	234.27	1.71	294.54	<	d ₁	≦	296.10	2.11
234.27	<	d ₁	≦	235.80	1.72	296.10	<	d ₁	≦	297.65	2.12
235.80	<	d ₁	≦	237.34	1.73	297.65	<	d ₁	≦	299.21	2.13
237.34	<	d ₁	≦	238.88	1.74	299.21	<	d ₁	≦	300.76	2.14
238.88	<	d ₁	≦	240.42	1.75	300.76	<	d ₁	≦	302.32	2.15
240.42	<	d ₁	≦	241.95	1.76	302.32	<	d ₁	≦	303.88	2.16
241.95	<	d ₁	≦	243.49	1.77	303.88	<	d ₁	≦	305.43	2.17
243.49	<	d ₁	≦	245.03	1.78	305.43	<	d ₁	≦	306.99	2.18
245.03	<	d ₁	≦	246.57	1.79	306.99	<	d ₁	≦	308.55	2.19
246.57	<	d ₁	≦	248.11	1.80	308.55	<	d ₁	≦	310.11	2.20
248.11	<	d ₁	≦	249.66	1.81	310.11	<	d ₁	≦	311.66	2.21
249.66	<	d ₁	≦	251.20	1.82	311.66	<	d ₁	≦	313.22	2.22
251.20	<	d ₁	≦	252.74	1.83	313.22	<	d ₁	≦	314.78	2.23
252.74	<	d ₁	≦	254.28	1.84	314.78	<	d ₁	≦	316.34	2.24
254.28	<	d ₁	≦	255.82	1.85	316.34	<	d ₁	≦	317.90	2.25
255.82	<	d ₁	≦	257.37	1.86	317.90	<	d ₁	≦	319.46	2.26
257.37	<	d ₁	≦	258.91	1.87	319.46	<	d ₁	≦	321.02	2.27
258.91	<	d ₁	≦	260.46	1.88	321.02	<	d ₁	≦	322.58	2.28
260.46	<	d ₁	≦	262.00	1.89	322.58	<	d ₁	≦	324.15	2.29
262.00	<	d ₁	≦	263.55	1.90	324.15	<	d ₁	≦	325.71	2.30
263.55	<	d ₁	≦	265.09	1.91	325.71	<	d ₁	≦	327.27	2.31
265.09	<	d ₁	≦	266.64	1.92	327.27	<	d ₁	≦	328.83	2.32
266.64	<	d ₁	≦	268.18	1.93	328.83	<	d ₁	≦	330.39	2.33
268.18	<	d ₁	≦	269.73	1.94	330.39	<	d ₁	≦	331.96	2.34
269.73	<	d ₁	≦	271.28	1.95	331.96	<	d ₁	≦	333.52	2.35
271.28	<	d ₁	≦	272.83	1.96	333.52	<	d ₁	≦	335.09	2.36
272.83	<	d ₁	≦	274.38	1.97	335.09	<	d ₁	≦	336.65	2.37
274.38	<	d ₁	≦	275.92	1.98	336.65	<	d ₁	≦	338.21	2.38
275.92	<	d ₁	≦	277.47	1.99	338.21	<	d ₁	≦	339.78	2.39
277.47	<	d ₁	≦	279.02	2.00	339.78	<	d ₁	≦	341.35	2.40
279.02	<	d ₁	≦	280.57	2.01	341.35	<	d ₁	≦	342.91	2.41
280.57	<	d ₁	≦	282.12	2.02	342.91	<	d ₁	≦	344.48	2.42
282.12	<	d ₁	≦	283.68	2.03	344.48	<	d ₁	≦	346.04	2.43
283.68	<	d ₁	≦	285.23	2.04	346.04	<	d ₁	≦	347.61	2.44
285.23	<	d ₁	≦	286.78	2.05	347.61	<	d ₁	≦	349.18	2.45
286.78	<	d ₁	≦	288.33	2.06	349.18	<	d ₁	≦	350.75	2.46
288.33	<	d ₁	≦	289.88	2.07	350.75	<	d ₁	≦	352.31	2.47



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
mm					mm						
352.31	<	d ₁	≦	353.88	2.48	415.30	<	d ₁	≦	416.89	2.88
353.88	<	d ₁	≦	355.45	2.49	416.89	<	d ₁	≦	418.47	2.89
355.45	<	d ₁	≦	357.02	2.50	418.47	<	d ₁	≦	420.05	2.90
357.02	<	d ₁	≦	358.59	2.51	420.05	<	d ₁	≦	421.63	2.91
358.59	<	d ₁	≦	360.16	2.52	421.63	<	d ₁	≦	423.21	2.92
360.16	<	d ₁	≦	361.73	2.53	423.21	<	d ₁	≦	424.80	2.93
361.73	<	d ₁	≦	363.30	2.54	424.80	<	d ₁	≦	426.38	2.94
363.30	<	d ₁	≦	364.87	2.55	426.38	<	d ₁	≦	427.96	2.95
364.87	<	d ₁	≦	366.44	2.56	427.96	<	d ₁	≦	429.55	2.96
366.44	<	d ₁	≦	368.01	2.57	429.55	<	d ₁	≦	431.13	2.97
368.01	<	d ₁	≦	369.58	2.58	431.13	<	d ₁	≦	432.71	2.98
369.58	<	d ₁	≦	371.16	2.59	432.71	<	d ₁	≦	434.30	2.99
371.16	<	d ₁	≦	372.73	2.60	434.30	<	d ₁	≦	435.88	3.00
372.73	<	d ₁	≦	374.30	2.61	435.88	<	d ₁	≦	437.47	3.01
374.30	<	d ₁	≦	375.87	2.62	437.47	<	d ₁	≦	439.05	3.02
375.87	<	d ₁	≦	377.45	2.63	439.05	<	d ₁	≦	440.64	3.03
377.45	<	d ₁	≦	379.02	2.64	440.64	<	d ₁	≦	442.22	3.04
379.02	<	d ₁	≦	380.59	2.65	442.22	<	d ₁	≦	443.81	3.05
380.59	<	d ₁	≦	382.17	2.66	443.81	<	d ₁	≦	445.40	3.06
382.17	<	d ₁	≦	383.74	2.67	445.40	<	d ₁	≦	446.98	3.07
383.74	<	d ₁	≦	385.32	2.68	446.98	<	d ₁	≦	448.57	3.08
385.32	<	d ₁	≦	386.89	2.69	448.57	<	d ₁	≦	450.16	3.09
386.89	<	d ₁	≦	388.47	2.70	450.16	<	d ₁	≦	451.75	3.10
388.47	<	d ₁	≦	390.05	2.71	451.75	<	d ₁	≦	453.33	3.11
390.05	<	d ₁	≦	391.62	2.72	453.33	<	d ₁	≦	454.92	3.12
391.62	<	d ₁	≦	393.20	2.73	454.92	<	d ₁	≦	456.51	3.13
393.20	<	d ₁	≦	394.78	2.74	456.51	<	d ₁	≦	458.10	3.14
394.78	<	d ₁	≦	396.35	2.75	458.10	<	d ₁	≦	459.69	3.15
396.35	<	d ₁	≦	397.93	2.76	459.69	<	d ₁	≦	461.28	3.16
397.93	<	d ₁	≦	399.51	2.77	461.28	<	d ₁	≦	462.87	3.17
399.51	<	d ₁	≦	401.09	2.78	462.87	<	d ₁	≦	464.46	3.18
401.09	<	d ₁	≦	402.66	2.79	464.46	<	d ₁	≦	466.05	3.19
402.66	<	d ₁	≦	404.24	2.80	466.05	<	d ₁	≦	467.64	3.20
404.24	<	d ₁	≦	405.82	2.81	467.64	<	d ₁	≦	469.23	3.21
405.82	<	d ₁	≦	407.40	2.82	469.23	<	d ₁	≦	470.82	3.22
407.40	<	d ₁	≦	408.98	2.83	470.82	<	d ₁	≦	472.41	3.23
408.98	<	d ₁	≦	410.56	2.84	472.41	<	d ₁	≦	474.00	3.24
410.56	<	d ₁	≦	412.14	2.85	474.00	<	d ₁	≦	475.59	3.25
412.14	<	d ₁	≦	413.72	2.86	475.59	<	d ₁	≦	477.19	3.26
413.72	<	d ₁	≦	415.30	2.87	477.19	<	d ₁	≦	478.78	3.27



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
mm					mm						
478.78	<	d ₁	≤	480.37	3.28	494.71	<	d ₁	≤	496.31	3.38
480.37	<	d ₁	≤	481.96	3.29	496.31	<	d ₁	≤	497.90	3.39
481.96	<	d ₁	≤	483.56	3.30	497.90	<	d ₁	≤	499.50	3.40
483.56	<	d ₁	≤	485.15	3.31	499.50	<	d ₁	≤	500.00	3.41
485.15	<	d ₁	≤	486.74	3.32			d ₁	>	500.00	using equation
486.74	<	d ₁	≤	488.34	3.33						
488.34	<	d ₁	≤	489.93	3.34						
489.93	<	d ₁	≤	491.52	3.35						
491.52	<	d ₁	≤	493.12	3.36						
493.12	<	d ₁	≤	494.71	3.37						

Table 29: Tolerances for O-Ring inside diameter d₁ in accordance with the TSS standard TBS-00024, complying with ISO 3601-1, class B, table A.1 – Inch

O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
inch					inch						
		d ₁	≤	0.067	0.005	1.275	<	d ₁	≤	1.330	0.014
0.067	<	d ₁	≤	0.115	0.005	1.330	<	d ₁	≤	1.385	0.015
0.115	<	d ₁	≤	0.164	0.006	1.385	<	d ₁	≤	1.440	0.015
0.164	<	d ₁	≤	0.214	0.006	1.440	<	d ₁	≤	1.495	0.015
0.214	<	d ₁	≤	0.265	0.006	1.495	<	d ₁	≤	1.550	0.016
0.265	<	d ₁	≤	0.315	0.007	1.550	<	d ₁	≤	1.606	0.016
0.315	<	d ₁	≤	0.367	0.007	1.606	<	d ₁	≤	1.661	0.017
0.367	<	d ₁	≤	0.418	0.007	1.661	<	d ₁	≤	1.717	0.017
0.418	<	d ₁	≤	0.470	0.008	1.717	<	d ₁	≤	1.772	0.017
0.470	<	d ₁	≤	0.522	0.008	1.772	<	d ₁	≤	1.828	0.018
0.522	<	d ₁	≤	0.575	0.009	1.828	<	d ₁	≤	1.884	0.018
0.575	<	d ₁	≤	0.628	0.009	1.884	<	d ₁	≤	1.940	0.019
0.628	<	d ₁	≤	0.681	0.009	1.940	<	d ₁	≤	1.996	0.019
0.681	<	d ₁	≤	0.734	0.010	1.996	<	d ₁	≤	2.052	0.019
0.734	<	d ₁	≤	0.787	0.010	2.052	<	d ₁	≤	2.108	0.020
0.787	<	d ₁	≤	0.841	0.011	2.108	<	d ₁	≤	2.165	0.020
0.841	<	d ₁	≤	0.895	0.011	2.165	<	d ₁	≤	2.221	0.020
0.895	<	d ₁	≤	0.949	0.011	2.221	<	d ₁	≤	2.277	0.021
0.949	<	d ₁	≤	1.003	0.012	2.277	<	d ₁	≤	2.333	0.021
1.003	<	d ₁	≤	1.057	0.012	2.333	<	d ₁	≤	2.390	0.022
1.057	<	d ₁	≤	1.111	0.013	2.390	<	d ₁	≤	2.446	0.022
1.111	<	d ₁	≤	1.166	0.013	2.446	<	d ₁	≤	2.503	0.022
1.166	<	d ₁	≤	1.220	0.013	2.503	<	d ₁	≤	2.560	0.023
1.220	<	d ₁	≤	1.275	0.014	2.560	<	d ₁	≤	2.617	0.023



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
inch					inch						
2.617	<	d ₁	≅	2.674	0.024	4.929	<	d ₁	≅	4.987	0.039
2.674	<	d ₁	≅	2.730	0.024	4.987	<	d ₁	≅	5.046	0.040
2.730	<	d ₁	≅	2.787	0.024	5.046	<	d ₁	≅	5.105	0.040
2.787	<	d ₁	≅	2.844	0.025	5.105	<	d ₁	≅	5.163	0.041
2.844	<	d ₁	≅	2.902	0.025	5.163	<	d ₁	≅	5.222	0.041
2.902	<	d ₁	≅	2.959	0.026	5.222	<	d ₁	≅	5.281	0.041
2.959	<	d ₁	≅	3.016	0.026	5.281	<	d ₁	≅	5.340	0.042
3.016	<	d ₁	≅	3.073	0.026	5.340	<	d ₁	≅	5.399	0.042
3.073	<	d ₁	≅	3.130	0.027	5.399	<	d ₁	≅	5.457	0.043
3.130	<	d ₁	≅	3.188	0.027	5.457	<	d ₁	≅	5.517	0.043
3.188	<	d ₁	≅	3.245	0.028	5.517	<	d ₁	≅	5.576	0.043
3.245	<	d ₁	≅	3.302	0.028	5.576	<	d ₁	≅	5.635	0.044
3.302	<	d ₁	≅	3.360	0.028	5.635	<	d ₁	≅	5.694	0.044
3.360	<	d ₁	≅	3.417	0.029	5.694	<	d ₁	≅	5.753	0.044
3.417	<	d ₁	≅	3.475	0.029	5.753	<	d ₁	≅	5.812	0.045
3.475	<	d ₁	≅	3.533	0.030	5.812	<	d ₁	≅	5.871	0.045
3.533	<	d ₁	≅	3.591	0.030	5.871	<	d ₁	≅	5.930	0.046
3.591	<	d ₁	≅	3.648	0.030	5.930	<	d ₁	≅	5.989	0.046
3.648	<	d ₁	≅	3.706	0.031	5.989	<	d ₁	≅	6.048	0.046
3.706	<	d ₁	≅	3.764	0.031	6.048	<	d ₁	≅	6.107	0.047
3.764	<	d ₁	≅	3.822	0.031	6.107	<	d ₁	≅	6.167	0.047
3.822	<	d ₁	≅	3.880	0.032	6.167	<	d ₁	≅	6.226	0.048
3.880	<	d ₁	≅	3.937	0.032	6.226	<	d ₁	≅	6.285	0.048
3.937	<	d ₁	≅	3.995	0.033	6.285	<	d ₁	≅	6.345	0.048
3.995	<	d ₁	≅	4.054	0.033	6.345	<	d ₁	≅	6.404	0.049
4.054	<	d ₁	≅	4.111	0.033	6.404	<	d ₁	≅	6.464	0.049
4.111	<	d ₁	≅	4.170	0.034	6.464	<	d ₁	≅	6.523	0.050
4.170	<	d ₁	≅	4.228	0.034	6.523	<	d ₁	≅	6.583	0.050
4.228	<	d ₁	≅	4.286	0.035	6.583	<	d ₁	≅	6.642	0.050
4.286	<	d ₁	≅	4.344	0.035	6.642	<	d ₁	≅	6.702	0.051
4.344	<	d ₁	≅	4.402	0.035	6.702	<	d ₁	≅	6.761	0.051
4.402	<	d ₁	≅	4.461	0.036	6.761	<	d ₁	≅	6.821	0.052
4.461	<	d ₁	≅	4.519	0.036	6.821	<	d ₁	≅	6.880	0.052
4.519	<	d ₁	≅	4.578	0.037	6.880	<	d ₁	≅	6.940	0.052
4.578	<	d ₁	≅	4.636	0.037	6.940	<	d ₁	≅	7.000	0.053
4.636	<	d ₁	≅	4.694	0.037	7.000	<	d ₁	≅	7.059	0.053
4.694	<	d ₁	≅	4.753	0.038	7.059	<	d ₁	≅	7.119	0.054
4.753	<	d ₁	≅	4.811	0.038	7.119	<	d ₁	≅	7.179	0.054
4.811	<	d ₁	≅	4.870	0.039	7.179	<	d ₁	≅	7.239	0.054
4.870	<	d ₁	≅	4.929	0.039	7.239	<	d ₁	≅	7.298	0.055



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
inch					inch						
7.298	<	d ₁	≅	7.358	0.055	9.707	<	d ₁	≅	9.768	0.071
7.358	<	d ₁	≅	7.418	0.056	9.768	<	d ₁	≅	9.829	0.071
7.418	<	d ₁	≅	7.478	0.056	9.829	<	d ₁	≅	9.890	0.072
7.478	<	d ₁	≅	7.537	0.056	9.890	<	d ₁	≅	9.950	0.072
7.537	<	d ₁	≅	7.598	0.057	9.950	<	d ₁	≅	10.011	0.072
7.598	<	d ₁	≅	7.657	0.057	10.011	<	d ₁	≅	10.072	0.073
7.657	<	d ₁	≅	7.717	0.057	10.072	<	d ₁	≅	10.133	0.073
7.717	<	d ₁	≅	7.777	0.058	10.133	<	d ₁	≅	10.193	0.074
7.777	<	d ₁	≅	7.837	0.058	10.193	<	d ₁	≅	10.254	0.074
7.837	<	d ₁	≅	7.897	0.059	10.254	<	d ₁	≅	10.315	0.074
7.897	<	d ₁	≅	7.957	0.059	10.315	<	d ₁	≅	10.376	0.075
7.957	<	d ₁	≅	8.017	0.059	10.376	<	d ₁	≅	10.437	0.075
8.017	<	d ₁	≅	8.078	0.060	10.437	<	d ₁	≅	10.498	0.076
8.078	<	d ₁	≅	8.137	0.060	10.498	<	d ₁	≅	10.558	0.076
8.137	<	d ₁	≅	8.198	0.061	10.558	<	d ₁	≅	10.619	0.076
8.198	<	d ₁	≅	8.258	0.061	10.619	<	d ₁	≅	10.680	0.077
8.258	<	d ₁	≅	8.318	0.061	10.680	<	d ₁	≅	10.741	0.077
8.318	<	d ₁	≅	8.378	0.062	10.741	<	d ₁	≅	10.802	0.078
8.378	<	d ₁	≅	8.439	0.062	10.802	<	d ₁	≅	10.863	0.078
8.439	<	d ₁	≅	8.499	0.063	10.863	<	d ₁	≅	10.924	0.078
8.499	<	d ₁	≅	8.559	0.063	10.924	<	d ₁	≅	10.985	0.079
8.559	<	d ₁	≅	8.619	0.063	10.985	<	d ₁	≅	11.046	0.079
8.619	<	d ₁	≅	8.680	0.064	11.046	<	d ₁	≅	11.107	0.080
8.680	<	d ₁	≅	8.740	0.064	11.107	<	d ₁	≅	11.169	0.080
8.740	<	d ₁	≅	8.800	0.065	11.169	<	d ₁	≅	11.230	0.080
8.800	<	d ₁	≅	8.861	0.065	11.230	<	d ₁	≅	11.291	0.081
8.861	<	d ₁	≅	8.921	0.065	11.291	<	d ₁	≅	11.352	0.081
8.921	<	d ₁	≅	8.981	0.066	11.352	<	d ₁	≅	11.413	0.081
8.981	<	d ₁	≅	9.042	0.066	11.413	<	d ₁	≅	11.474	0.082
9.042	<	d ₁	≅	9.102	0.067	11.474	<	d ₁	≅	11.535	0.082
9.102	<	d ₁	≅	9.163	0.067	11.535	<	d ₁	≅	11.596	0.083
9.163	<	d ₁	≅	9.223	0.067	11.596	<	d ₁	≅	11.657	0.083
9.223	<	d ₁	≅	9.283	0.068	11.657	<	d ₁	≅	11.719	0.083
9.283	<	d ₁	≅	9.344	0.068	11.719	<	d ₁	≅	11.780	0.084
9.344	<	d ₁	≅	9.405	0.069	11.780	<	d ₁	≅	11.841	0.084
9.405	<	d ₁	≅	9.465	0.069	11.841	<	d ₁	≅	11.902	0.085
9.465	<	d ₁	≅	9.526	0.069	11.902	<	d ₁	≅	11.964	0.085
9.526	<	d ₁	≅	9.586	0.070	11.964	<	d ₁	≅	12.025	0.085
9.586	<	d ₁	≅	9.647	0.070	12.025	<	d ₁	≅	12.086	0.086
9.647	<	d ₁	≅	9.707	0.070	12.086	<	d ₁	≅	12.148	0.086



O-Ring Inside-Ø				Tolerance	O-Ring Inside-Ø				Tolerance		
d ₁				±	d ₁				±		
inch					inch						
12.148	<	d ₁	≅	12.209	0.087	14.613	<	d ₁	≅	14.674	0.102
12.209	<	d ₁	≅	12.270	0.087	14.674	<	d ₁	≅	14.736	0.103
12.270	<	d ₁	≅	12.331	0.087	14.736	<	d ₁	≅	14.798	0.103
12.331	<	d ₁	≅	12.393	0.088	14.798	<	d ₁	≅	14.860	0.104
12.393	<	d ₁	≅	12.454	0.088	14.860	<	d ₁	≅	14.922	0.104
12.454	<	d ₁	≅	12.516	0.089	14.922	<	d ₁	≅	14.984	0.104
12.516	<	d ₁	≅	12.577	0.089	14.984	<	d ₁	≅	15.046	0.105
12.577	<	d ₁	≅	12.639	0.089	15.046	<	d ₁	≅	15.108	0.105
12.639	<	d ₁	≅	12.700	0.090	15.108	<	d ₁	≅	15.170	0.106
12.700	<	d ₁	≅	12.762	0.090	15.170	<	d ₁	≅	15.232	0.106
12.762	<	d ₁	≅	12.823	0.091	15.232	<	d ₁	≅	15.294	0.106
12.823	<	d ₁	≅	12.885	0.091	15.294	<	d ₁	≅	15.356	0.107
12.885	<	d ₁	≅	12.946	0.091	15.356	<	d ₁	≅	15.418	0.107
12.946	<	d ₁	≅	13.007	0.092	15.418	<	d ₁	≅	15.480	0.107
13.007	<	d ₁	≅	13.069	0.092	15.480	<	d ₁	≅	15.543	0.108
13.069	<	d ₁	≅	13.131	0.093	15.543	<	d ₁	≅	15.604	0.108
13.131	<	d ₁	≅	13.193	0.093	15.604	<	d ₁	≅	15.667	0.109
13.193	<	d ₁	≅	13.254	0.093	15.667	<	d ₁	≅	15.729	0.109
13.254	<	d ₁	≅	13.315	0.094	15.729	<	d ₁	≅	15.791	0.109
13.315	<	d ₁	≅	13.377	0.094	15.791	<	d ₁	≅	15.853	0.110
13.377	<	d ₁	≅	13.439	0.094	15.853	<	d ₁	≅	15.915	0.110
13.439	<	d ₁	≅	13.500	0.095	15.915	<	d ₁	≅	15.977	0.111
13.500	<	d ₁	≅	13.562	0.095	15.977	<	d ₁	≅	16.039	0.111
13.562	<	d ₁	≅	13.624	0.096	16.039	<	d ₁	≅	16.102	0.111
13.624	<	d ₁	≅	13.685	0.096	16.102	<	d ₁	≅	16.164	0.112
13.685	<	d ₁	≅	13.747	0.096	16.164	<	d ₁	≅	16.226	0.112
13.747	<	d ₁	≅	13.809	0.097	16.226	<	d ₁	≅	16.288	0.113
13.809	<	d ₁	≅	13.870	0.097	16.288	<	d ₁	≅	16.350	0.113
13.870	<	d ₁	≅	13.932	0.098	16.350	<	d ₁	≅	16.413	0.113
13.932	<	d ₁	≅	13.994	0.098	16.413	<	d ₁	≅	16.475	0.114
13.994	<	d ₁	≅	14.056	0.098	16.475	<	d ₁	≅	16.537	0.114
14.056	<	d ₁	≅	14.118	0.099	16.537	<	d ₁	≅	16.600	0.115
14.118	<	d ₁	≅	14.180	0.099	16.600	<	d ₁	≅	16.662	0.115
14.180	<	d ₁	≅	14.241	0.100	16.662	<	d ₁	≅	16.724	0.115
14.241	<	d ₁	≅	14.303	0.100	16.724	<	d ₁	≅	16.787	0.116
14.303	<	d ₁	≅	14.365	0.100	16.787	<	d ₁	≅	16.849	0.116
14.365	<	d ₁	≅	14.427	0.101	16.849	<	d ₁	≅	16.911	0.117
14.427	<	d ₁	≅	14.489	0.101	16.911	<	d ₁	≅	16.974	0.117
14.489	<	d ₁	≅	14.550	0.102	16.974	<	d ₁	≅	17.036	0.117
14.550	<	d ₁	≅	14.613	0.102	17.036	<	d ₁	≅	17.098	0.118



O-Ring Inside-Ø				Tolerance
d ₁				±
inch				
17.098	<	d ₁	≦ 17.161	0.118
17.161	<	d ₁	≦ 17.223	0.119
17.223	<	d ₁	≦ 17.285	0.119
17.285	<	d ₁	≦ 17.348	0.119
17.348	<	d ₁	≦ 17.410	0.120
17.410	<	d ₁	≦ 17.473	0.120
17.473	<	d ₁	≦ 17.535	0.120
17.535	<	d ₁	≦ 17.598	0.121
17.598	<	d ₁	≦ 17.660	0.121
17.660	<	d ₁	≦ 17.723	0.122
17.723	<	d ₁	≦ 17.785	0.122
17.785	<	d ₁	≦ 17.848	0.122
17.848	<	d ₁	≦ 17.910	0.123
17.910	<	d ₁	≦ 17.973	0.123
17.973	<	d ₁	≦ 18.035	0.124
18.035	<	d ₁	≦ 18.098	0.124
18.098	<	d ₁	≦ 18.161	0.124
18.161	<	d ₁	≦ 18.223	0.125
18.223	<	d ₁	≦ 18.286	0.125
18.286	<	d ₁	≦ 18.348	0.126
18.348	<	d ₁	≦ 18.411	0.126
18.411	<	d ₁	≦ 18.474	0.126
18.474	<	d ₁	≦ 18.536	0.127
18.536	<	d ₁	≦ 18.599	0.127

O-Ring Inside-Ø				Tolerance
d ₁				±
inch				
18.599	<	d ₁	≦ 18.661	0.128
18.661	<	d ₁	≦ 18.724	0.128
18.724	<	d ₁	≦ 18.787	0.128
18.787	<	d ₁	≦ 18.850	0.129
18.850	<	d ₁	≦ 18.912	0.129
18.912	<	d ₁	≦ 18.975	0.130
18.975	<	d ₁	≦ 19.038	0.130
19.038	<	d ₁	≦ 19.100	0.130
19.100	<	d ₁	≦ 19.163	0.131
19.163	<	d ₁	≦ 19.226	0.131
19.226	<	d ₁	≦ 19.289	0.131
19.289	<	d ₁	≦ 19.351	0.132
19.351	<	d ₁	≦ 19.414	0.132
19.414	<	d ₁	≦ 19.477	0.133
19.477	<	d ₁	≦ 19.540	0.133
19.540	<	d ₁	≦ 19.602	0.133
19.602	<	d ₁	≦ 19.665	0.134
19.665	<	d ₁	≦ 19.685	0.134
		d ₁	> 19.685	using 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.

Table 30/Table 31 define standard form and surface deviations of Trelleborg Sealing Solutions elastomeric O-Rings in accordance with the TSS standard TBS-00005, based on ISO 3601-3, grade N (general purpose).

If no quality requirements are specified with the order, O-Rings are supplied with standard specification in accordance with Table 30/Table 31.



Table 30: Standard surface specification for O-Rings in accordance with the Trelleborg Sealing Solutions standard TBS-00005, based on ISO 3601-3, grade N – Metric

Standard Form and Surface Deviations, Grade N												
mm												
Type of defects in accordance with TSS standard TBS-00005***	Schematic illustration		Maximum acceptable limits in accordance with TSS standard TBS-00005*** (mm), Grade N									
			O-Ring Cross-Section-Ø d ₂									
			≤ 0.80	≤ 2.25	≤ 3.15	≤ 4.50	≤ 6.30	≤ 8.40	≤ 10.00	≤ 12.00	≤ 14.00	> 14.00
1. Offset		e	by agreement	0.08	0.10	0.13	0.15	0.15	0.19	0.22	0.25	by agreement
2. Flash		x		0.10	0.12	0.14	0.16	0.18	0.20	0.23	0.26	
		y		0.10	0.12	0.14	0.16	0.18	0.20	0.23	0.26	
3. Backrind		g		0.18	0.27	0.36	0.53	0.70	0.90	1.10	1.30	
		u		0.08	0.08	0.10	0.10	0.13	0.16	0.16	0.18	
4. Non-fills and indentations		w		0.60	0.80	1.00	1.30	1.70	2.20	2.50	2.80	
		t		0.08	0.08	0.10	0.10	0.13	0.15	0.16	0.18	
5. Flow marks (radial orientation is not permitted)		v**		1.50	1.50	6.50	6.50	6.50	6.50	8.50	8.50	
		k		or 0.05 x d ₁ *								
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 visible under 2-times-magnification								
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 O-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 interconnected												
c) there are more than three that are separated from each other by a distance that is less than the maximum length of an imperfection												
all dimensions in mm		* d ₁ = Inside Diameter	** whichever is the greater				*** based on ISO 3601-3					



Table 31: Standard surface specification for O-Rings in accordance with the Trelleborg Sealing Solutions standard TBS-00005, based on ISO 3601-3, grade N – Inch

Standard Form and Surface Deviations, Grade N												
inch												
Type of defects in accordance with TSS standard TBS-00005***	Schematic illustration		Maximum acceptable limits in accordance with TSS standard TBS-00005*** (inch), Grade N									
			O-Ring Cross-Section-Ø d ₂									
			≤ .031	≤ .089	≤ .124	≤ .177	≤ .248	≤ .331	≤ .394	≤ .472	≤ .551	> .551
1. Offset		e	by agreement	0.003	0.004	0.005	0.006	0.006	0.008	0.009	0.010	by agreement
2. Flash		x		0.004	0.005	0.006	0.006	0.007	0.008	0.009	0.010	
		y		0.004	0.005	0.006	0.006	0.007	0.008	0.009	0.010	
3. Backrind		g		0.007	0.011	0.014	0.021	0.028	0.035	0.004	0.051	
		u		0.003	0.003	0.004	0.004	0.005	0.006	0.006	0.007	
4. Non-fills and indentations		w		0.024	0.031	0.039	0.051	0.067	0.087	0.098	0.110	
		t		0.003	0.003	0.004	0.004	0.005	0.006	0.006	0.007	
5. Flow marks (radial orientation is not permitted)		v**		0.059	0.059	0.256	0.256	0.256	0.256	0.335	0.335	
		k		or 0.05 x d ₁ *								
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 visible under 2-times-magnification								
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 O-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 0.984 inch length of circumference,												
b) they interconnected												
c) there are more than three that are separated from each other by a distance that is less than the maximum length of an imperfection												
all dimensions in inch			* d ₁ = Inside Diameter			** whichever is the greater			*** based on ISO 3601-3			



Table 32/Table 33 defines restricted form and surface deviations of Trelleborg Sealing Solutions elastomeric O-Rings in accordance with the TSS standard TBS-00005, based on ISO 3601-3, grade S (special).

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

Table 32: Surface specification with reduced tolerances for O-Rings in accordance with the Trelleborg Sealing Solutions standard TBS-00005, based on ISO 3601-3, grade S – Metric

		Restricted form and surface deviations, Grade S										
		mm										
Type of defects in accordance with TSS standard TBS-00005***	Schematic illustration		Maximum acceptable limits in accordance with TSS standard TBS-00005*** (mm), Grade S									
			O-Ring Cross-Section- $\varnothing d_2$									
				≤ 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		x		0.10	0.10	0.13	0.15	0.15	0.18	0.20		
		y		0.10	0.10	0.13	0.15	0.15	0.18	0.20		
3. Backrind		g		0.10	0.15	0.20	0.20	0.30	0.50	0.75		
		u		0.05	0.08	0.10	0.10	0.13	0.13	0.15		
4. Non-fills and indentations		w		0.15	0.25	0.40	0.63	1.00	1.50	2.00		
		t		0.08	0.08	0.10	0.10	0.13	0.13	0.15		
5. Flow marks (radial orientation is not permitted)		v**		1.50	1.50	5.00	5.00	5.00	5.00	7.00		
		k		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 visible under 2-times-magnification									
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 O-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 interconnected									
			c) there are more than three that are separated from each other by a distance that is less than the maximum length of an imperfection									
all dimensions in mm		* d_1 = Inside Diameter	** whichever is the greater				*** based on ISO 3601-3					



Table 33: Surface specification with reduced tolerances for O-Rings in accordance with the Trelleborg Sealing Solutions standard TBS-00005, based on ISO 3601-3, grade S – Inch

Restricted form and surface deviations, Grade S															
inch															
Type of defects in accordance with TSS standard TBS-00005***	Schematic illustration		Maximum acceptable limits in accordance with TSS standard TBS-00005*** (inch), Grade S												
			O-Ring Cross-Section- Ø d ₂												
			≤ .031	≤ .089	≤ .124	≤ .177	≤ .248	≤ .331	≤ .394	≤ .591	> .591				
1. Offset		e	0.003	0.003	0.004	0.005	0.005	0.006	0.008	by agreement					
2. Flash		x	0.004	0.004	0.005	0.006	0.006	0.007	0.008						
		y	0.004	0.004	0.005	0.006	0.006	0.007	0.008						
3. Backrind		g	0.004	0.006	0.008	0.008	0.012	0.020	0.030						
		u	0.002	0.003	0.004	0.004	0.005	0.005	0.006						
4. Non-fills and indentations		w	0.006	0.010	0.016	0.025	0.039	0.059	0.079						
		t	0.003	0.003	0.004	0.004	0.005	0.005	0.006						
5. Flow marks (radial orientation is not permitted)		v**	0.059	0.059	0.197	0.197	0.197	0.197	0.276						
		k	or 0.05 x d ₁ *								0.002	0.002	0.002	0.002	0.002
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 visible under 2-times-magnification												
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 O-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 0.984 inch length of circumference,															
b) they interconnected															
c) there are more than three that are separated from each other by a distance that is less than the maximum length of an imperfection															
all dimensions in inch	* d ₁ = Inside Diameter	** whichever is the greater	*** based on ISO 3601-3												

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.

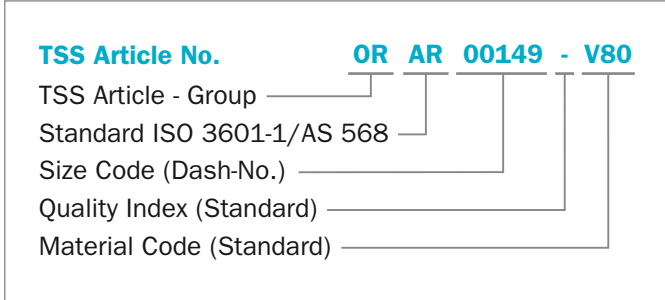
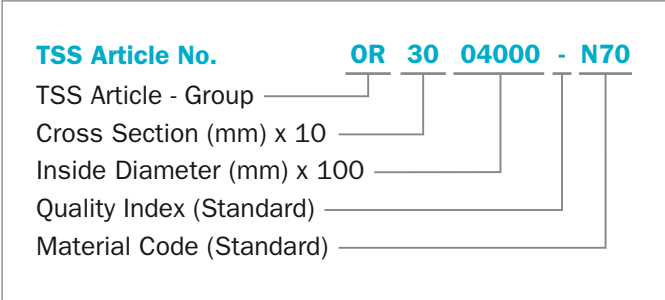
For the dimensions given, molds generally exist for some materials. Due to different shrinkage factors of various materials, it may not be possible to process certain materials with the existing molds. To guarantee consistently high quality levels, it might be necessary to produce new or additional molds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

ORDERING EXAMPLE 1

Type:	O-Ring, metric 40 x 3 mm (1.575 x 0.118 inch)
Dimensions:	Inside diameter $d_1 = 40.0$ mm (1.575 inch) Cross section $d_2 = 3.0$ mm (0.118 inch)
Material:	NBR 70 (Nitrile-Butadiene Rubber 70 Shore A)

ORDERING EXAMPLE 2

Type:	O-Ring, ISO 3601-1 and AS 568 reference no. 149
Dimensions:	Inside diameter $d_1 = 71.12$ mm (2.800 inch) Cross section $d_2 = 2.62$ mm (0.103 inch)
Material:	FKM 80 (Fluorocarbon Rubber 80 Shore A)



For O-Ring dimensions and TSS part numbers see the following tables.
For elastomer type codes for standard product orders see Table 1 (last column).
The required Shore A hardness must be given with the order.

When a special material is required, the exact five-digit Trelleborg Sealing Solutions material code must be given with the order. Please refer to the information provided in Table 15 or contact your local Trelleborg Sealing Solutions company.

C.2.1 O-RING DIMENSIONS IN ACCORDANCE WITH ISO 3601-1 AND AS 568

The following tables show the preferred O-Ring dimensions in accordance with 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 in accordance with ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the table below.

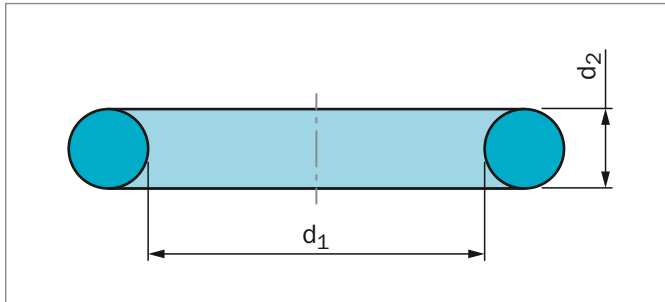


Figure 31: O-Ring dimensions



Table 34: ISO3601-1 Class B O-Rings - Metric and Inch

TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00001	001	0.74	0.12	1.02	0.08	0.029	0.005	0.040	0.003
ORAR00002	002	1.07	0.12	1.27		0.042	0.005	0.050	
ORAR00003	003	1.42	0.12	1.52		0.056	0.005	0.060	
ORAR00004	004	1.78	0.13	1.78		0.070	0.005	0.070	
ORAR00005	005	2.57	0.13	1.78		0.101	0.005	0.070	
ORAR00006	006	2.90	0.13	1.78		0.114	0.005	0.070	
ORAR00007	007	3.68	0.14	1.78		0.145	0.006	0.070	
ORAR00008	008	4.47	0.15	1.78		0.176	0.006	0.070	
ORAR00009	009	5.28	0.15	1.78		0.208	0.006	0.070	
ORAR00010	010	6.07	0.16	1.78		0.239	0.006	0.070	
ORAR00011	011	7.65	0.17	1.78		0.301	0.007	0.070	
ORAR00012	012	9.25	0.18	1.78		0.364	0.007	0.070	
ORAR00013	013	10.82	0.20	1.78		0.426	0.008	0.070	
ORAR00014	014	12.42	0.21	1.78		0.489	0.008	0.070	
ORAR00015	015	14.00	0.22	1.78		0.551	0.009	0.070	
ORAR00016	016	15.60	0.23	1.78	0.614	0.009	0.070		
ORAR00017	017	17.17	0.24	1.78	0.676	0.010	0.070		
ORAR00018	018	18.77	0.26	1.78	0.739	0.010	0.070		
ORAR00019	019	20.35	0.27	1.78	0.801	0.011	0.070	0.003	
ORAR00020	020	21.95	0.28	1.78	0.864	0.011	0.070		
ORAR00021	021	23.52	0.29	1.78	0.926	0.011	0.070		
ORAR00022	022	25.12	0.30	1.78	0.989	0.012	0.070		
ORAR00023	023	26.70	0.31	1.78	1.051	0.012	0.070		
ORAR00024	024	28.30	0.33	1.78	1.114	0.013	0.070		
ORAR00025	025	29.87	0.34	1.78	1.176	0.013	0.070		
ORAR00026	026	31.47	0.35	1.78	1.239	0.014	0.070		
ORAR00027	027	33.05	0.36	1.78	1.301	0.014	0.070		
ORAR00028	028	34.65	0.37	1.78	1.364	0.015	0.070		
ORAR00029	029	37.82	0.39	1.78	1.489	0.016	0.070		
ORAR00030	030	41.00	0.42	1.78	1.614	0.016	0.070		
ORAR00031	031	44.17	0.44	1.78	1.739	0.017	0.070		
ORAR00032	032	47.35	0.46	1.78	1.864	0.018	0.070		
ORAR00033	033	50.52	0.48	1.78	1.989	0.019	0.070		
ORAR00034	034	53.70	0.51	1.78	2.114	0.020	0.070		
ORAR00035	035	56.87	0.53	1.78	2.239	0.021	0.070		
ORAR00036	036	60.05	0.55	1.78	2.364	0.022	0.070		



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00037	037	63.22	0.57	1.78	0.08	2.489	0.023	0.070	0.003
ORAR00038	038	66.40	0.59	1.78		2.614	0.023	0.070	
ORAR00039	039	69.57	0.62	1.78		2.739	0.024	0.070	
ORAR00040	040	72.75	0.64	1.78		2.864	0.025	0.070	
ORAR00041	041	75.92	0.66	1.78		2.989	0.026	0.070	
ORAR00042	042	82.27	0.70	1.78		3.239	0.028	0.070	
ORAR00043	043	88.62	0.75	1.78		3.489	0.029	0.070	
ORAR00044	044	94.97	0.79	1.78		3.739	0.031	0.070	
ORAR00045	045	101.32	0.83	1.78		3.989	0.033	0.070	
ORAR00046	046	107.67	0.88	1.78		4.239	0.035	0.070	
ORAR00047	047	114.02	0.92	1.78		4.489	0.036	0.070	
ORAR00048	048	120.37	0.96	1.78		4.739	0.038	0.070	
ORAR00049	049	126.72	1.01	1.78		4.989	0.040	0.070	
ORAR00050	050	133.07	1.05	1.78		5.239	0.041	0.070	
ORAR00102	102	1.24	0.12	2.62	0.09	0.049	0.005	0.103	0.004
ORAR00103	103	2.06	0.13	2.62		0.081	0.005	0.103	
ORAR00104	104	2.84	0.13	2.62		0.112	0.005	0.103	
ORAR00105	105	3.63	0.14	2.62		0.143	0.006	0.103	
ORAR00106	106	4.42	0.15	2.62		0.174	0.006	0.103	
ORAR00107	107	5.23	0.15	2.62		0.206	0.006	0.103	
ORAR00108	108	6.02	0.16	2.62		0.237	0.006	0.103	
ORAR00109	109	7.59	0.17	2.62		0.299	0.007	0.103	
ORAR00110	110	9.19	0.18	2.62		0.362	0.007	0.103	
ORAR00111	111	10.77	0.20	2.62		0.424	0.008	0.103	
ORAR00112	112	12.37	0.21	2.62		0.487	0.008	0.103	
ORAR00113	113	13.94	0.22	2.62		0.549	0.009	0.103	
ORAR00114	114	15.54	0.23	2.62		0.612	0.009	0.103	
ORAR00115	115	17.12	0.24	2.62		0.674	0.010	0.103	
ORAR00116	116	18.72	0.26	2.62		0.737	0.010	0.103	
ORAR00117	117	20.29	0.27	2.62		0.799	0.011	0.103	
ORAR00118	118	21.89	0.28	2.62		0.862	0.011	0.103	
ORAR00119	119	23.47	0.29	2.62		0.924	0.011	0.103	
ORAR00120	120	25.07	0.30	2.62		0.987	0.012	0.103	
ORAR00121	121	26.64	0.31	2.62		1.049	0.012	0.103	
ORAR00122	122	28.24	0.33	2.62		1.112	0.013	0.103	
ORAR00123	123	29.82	0.34	2.62		1.174	0.013	0.103	
ORAR00124	124	31.42	0.35	2.62		1.237	0.014	0.103	
ORAR00125	125	32.99	0.36	2.62		1.299	0.014	0.103	
ORAR00126	126	34.59	0.37	2.62		1.362	0.015	0.103	
ORAR00127	127	36.17	0.38	2.62		1.424	0.015	0.103	



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00128	128	37.77	0.39	2.62	0.09	1.487	0.015	0.103	0.004
ORAR00129	129	39.34	0.40	2.62		1.549	0.016	0.103	
ORAR00130	130	40.94	0.42	2.62		1.612	0.016	0.103	
ORAR00131	131	42.52	0.43	2.62		1.674	0.017	0.103	
ORAR00132	132	44.12	0.44	2.62		1.737	0.017	0.103	
ORAR00133	133	45.69	0.45	2.62		1.799	0.018	0.103	
ORAR00134	134	47.29	0.46	2.62		1.862	0.018	0.103	
ORAR00135	135	48.90	0.47	2.62		1.925	0.019	0.103	
ORAR00136	136	50.47	0.48	2.62		1.987	0.019	0.103	
ORAR00137	137	52.07	0.49	2.62		2.050	0.019	0.103	
ORAR00138	138	53.64	0.51	2.62		2.112	0.020	0.103	
ORAR00139	139	55.25	0.52	2.62		2.175	0.020	0.103	
ORAR00140	140	56.82	0.53	2.62		2.237	0.021	0.103	
ORAR00141	141	58.42	0.54	2.62		2.300	0.021	0.103	
ORAR00142	142	59.99	0.55	2.62		2.362	0.022	0.103	
ORAR00143	143	61.60	0.56	2.62		2.425	0.022	0.103	
ORAR00144	144	63.17	0.57	2.62		2.487	0.023	0.103	
ORAR00145	145	64.77	0.58	2.62		2.550	0.023	0.103	
ORAR00146	146	66.34	0.59	2.62		2.612	0.023	0.103	
ORAR00147	147	67.95	0.61	2.62		2.675	0.024	0.103	
ORAR00148	148	69.52	0.62	2.62		2.737	0.024	0.103	
ORAR00149	149	71.12	0.63	2.62		2.800	0.025	0.103	
ORAR00150	150	72.69	0.64	2.62		2.862	0.025	0.103	
ORAR00151	151	75.87	0.66	2.62		2.987	0.026	0.103	
ORAR00152	152	82.22	0.70	2.62		3.237	0.028	0.103	
ORAR00153	153	88.57	0.75	2.62		3.487	0.029	0.103	
ORAR00154	154	94.92	0.79	2.62		3.737	0.031	0.103	
ORAR00155	155	101.27	0.83	2.62		3.987	0.033	0.103	
ORAR00156	156	107.62	0.88	2.62		4.237	0.035	0.103	
ORAR00157	157	113.97	0.92	2.62		4.487	0.036	0.103	
ORAR00158	158	120.32	0.96	2.62		4.737	0.038	0.103	
ORAR00159	159	126.67	1.00	2.62	4.987	0.040	0.103		
ORAR00160	160	133.02	1.05	2.62	5.237	0.041	0.103		
ORAR00161	161	139.37	1.09	2.62	5.487	0.043	0.103		
ORAR00162	162	145.72	1.13	2.62	5.737	0.045	0.103		
ORAR00163	163	152.07	1.17	2.62	5.987	0.046	0.103		
ORAR00164	164	158.42	1.22	2.62	6.237	0.048	0.103		
ORAR00165	165	164.77	1.26	2.62	6.487	0.050	0.103		
ORAR00166	166	171.12	1.30	2.62	6.737	0.051	0.103		
ORAR00167	167	177.47	1.34	2.62	6.987	0.053	0.103		



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00168	168	183.82	1.38	2.62	0.09	7.237	0.055	0.103	0.004
ORAR00169	169	190.17	1.43	2.62		7.487	0.056	0.103	
ORAR00170	170	196.52	1.47	2.62		7.737	0.058	0.103	
ORAR00171	171	202.87	1.51	2.62		7.987	0.059	0.103	
ORAR00172	172	209.22	1.55	2.62		8.237	0.061	0.103	
ORAR00173	173	215.57	1.59	2.62		8.487	0.063	0.103	
ORAR00174	174	221.92	1.63	2.62		8.737	0.064	0.103	
ORAR00175	175	228.27	1.68	2.62		8.987	0.066	0.103	
ORAR00176	176	234.62	1.72	2.62		9.237	0.068	0.103	
ORAR00177	177	240.97	1.76	2.62		9.487	0.069	0.103	
ORAR00178	178	247.32	1.80		9.737	0.071	0.103		
ORAR00201	201	4.34	0.15	3.53	0.10	0.171	0.006	0.139	0.004
ORAR00202	202	5.94	0.16	3.53		0.234	0.006	0.139	
ORAR00203	203	7.52	0.17	3.53		0.296	0.007	0.139	
ORAR00204	204	9.12	0.18	3.53		0.359	0.007	0.139	
ORAR00205	205	10.69	0.20	3.53		0.421	0.008	0.139	
ORAR00206	206	12.29	0.21	3.53		0.484	0.008	0.139	
ORAR00207	207	13.87	0.22	3.53		0.546	0.009	0.139	
ORAR00208	208	15.47	0.23	3.53		0.609	0.009	0.139	
ORAR00209	209	17.04	0.24	3.53		0.671	0.010	0.139	
ORAR00210	210	18.64	0.25	3.53		0.734	0.010	0.139	
ORAR00211	211	20.22	0.27	3.53		0.796	0.010	0.139	
ORAR00212	212	21.82	0.28	3.53		0.859	0.011	0.139	
ORAR00213	213	23.39	0.29	3.53		0.921	0.011	0.139	
ORAR00214	214	24.99	0.30	3.53		0.984	0.012	0.139	
ORAR00215	215	26.57	0.31	3.53		1.046	0.012	0.139	
ORAR00216	216	28.17	0.32	3.53		1.109	0.013	0.139	
ORAR00217	217	29.74	0.34	3.53		1.171	0.013	0.139	
ORAR00218	218	31.34	0.35	3.53		1.234	0.014	0.139	
ORAR00219	219	32.92	0.36	3.53		1.296	0.014	0.139	
ORAR00220	220	34.52	0.37	3.53		1.359	0.015	0.139	
ORAR00221	221	36.09	0.38	3.53	1.421	0.015	0.139		
ORAR00222	222	37.69	0.39	3.53	1.484	0.015	0.139		
ORAR00223	223	40.87	0.42	3.53	1.609	0.016	0.139		
ORAR00224	224	44.04	0.44	3.53	1.734	0.017	0.139		
ORAR00225	225	47.22	0.46	3.53	1.859	0.018	0.139		
ORAR00226	226	50.39	0.48	3.53	1.984	0.019	0.139		
ORAR00227	227	53.57	0.51	3.53	2.109	0.020	0.139		
ORAR00228	228	56.74	0.53	3.53	2.234	0.021	0.139		
ORAR00229	229	59.92	0.55	3.53	2.359	0.022	0.139		



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00230	230	63.09	0.57	3.53	0.10	2.484	0.023	0.139	0.004
ORAR00231	231	66.27	0.59	3.53		2.609	0.023	0.139	
ORAR00232	232	69.44	0.62	3.53		2.734	0.024	0.139	
ORAR00233	233	72.62	0.64	3.53		2.859	0.025	0.139	
ORAR00234	234	75.79	0.66	3.53		2.984	0.026	0.139	
ORAR00235	235	78.97	0.68	3.53		3.109	0.027	0.139	
ORAR00236	236	82.14	0.70	3.53		3.234	0.028	0.139	
ORAR00237	237	85.32	0.72	3.53		3.359	0.029	0.139	
ORAR00238	238	88.49	0.75	3.53		3.484	0.029	0.139	
ORAR00239	239	91.67	0.77	3.53		3.609	0.030	0.139	
ORAR00240	240	94.84	0.79	3.53		3.734	0.031	0.139	
ORAR00241	241	98.02	0.81	3.53		3.859	0.032	0.139	
ORAR00242	242	101.19	0.83	3.53		3.984	0.033	0.139	
ORAR00243	243	104.37	0.85	3.53		4.109	0.034	0.139	
ORAR00244	244	107.54	0.88	3.53		4.234	0.034	0.139	
ORAR00245	245	110.72	0.90	3.53		4.359	0.035	0.139	
ORAR00246	246	113.89	0.92	3.53		4.484	0.036	0.139	
ORAR00247	247	117.07	0.94	3.53		4.609	0.037	0.139	
ORAR00248	248	120.24	0.96	3.53		4.734	0.038	0.139	
ORAR00249	249	123.42	0.98	3.53		4.859	0.039	0.139	
ORAR00250	250	126.59	1.00	3.53		4.984	0.040	0.139	
ORAR00251	251	129.77	1.03	3.53		5.109	0.040	0.139	
ORAR00252	252	132.94	1.05	3.53		5.234	0.041	0.139	
ORAR00253	253	136.12	1.07	3.53		5.359	0.042	0.139	
ORAR00254	254	139.29	1.09	3.53		5.484	0.043	0.139	
ORAR00255	255	142.47	1.11	3.53		5.609	0.044	0.139	
ORAR00256	256	145.64	1.13	3.53		5.734	0.045	0.139	
ORAR00257	257	148.82	1.15	3.53		5.859	0.045	0.139	
ORAR00258	258	151.99	1.17	3.53		5.984	0.046	0.139	
ORAR00259	259	158.34	1.22	3.53	6.234	0.048	0.139		
ORAR00260	260	164.69	1.26	3.53	6.484	0.050	0.139		
ORAR00261	261	171.04	1.30	3.53	6.734	0.051	0.139		
ORAR00262	262	177.39	1.34	3.53	6.984	0.053	0.139		
ORAR00263	263	183.74	1.38	3.53	7.234	0.054	0.139		
ORAR00264	264	190.09	1.43	3.53	7.484	0.056	0.139		
ORAR00265	265	196.44	1.47	3.53	7.734	0.058	0.139		
ORAR00266	266	202.79	1.51	3.53	7.984	0.059	0.139		
ORAR00267	267	209.14	1.55	3.53	8.234	0.061	0.139		
ORAR00268	268	215.49	1.59	3.53	8.484	0.063	0.139		
ORAR00269	269	221.84	1.63	3.53	8.734	0.064	0.139		



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00270	270	228.19	1.68	3.53	0.10	8.984	0.066	0.139	0.004
ORAR00271	271	234.54	1.72	3.53		9.234	0.068	0.139	
ORAR00272	272	240.89	1.76	3.53		9.484	0.069	0.139	
ORAR00273	273	247.24	1.80	3.53		9.734	0.071	0.139	
ORAR00274	274	253.59	1.84	3.53		9.984	0.072	0.139	
ORAR00275	275	266.29	1.92	3.53		10.484	0.076	0.139	
ORAR00276	276	278.99	2.00	3.53		10.984	0.079	0.139	
ORAR00277	277	291.69	2.09	3.53		11.484	0.082	0.139	
ORAR00278	278	304.39	2.17	3.53		11.984	0.085	0.139	
ORAR00279	279	329.79	2.33	3.53		12.984	0.092	0.139	
ORAR00280	280	355.19	2.49	3.53		13.984	0.098	0.139	
ORAR00281	281	380.59	2.65	3.53		14.984	0.105	0.139	
ORAR00282	282	405.26	2.81	3.53		15.955	0.111	0.139	
ORAR00283	283	430.66	2.97	3.53		16.955	0.117	0.139	
ORAR00284	284	456.06	3.13	3.53	17.955	0.123	0.139		
ORAR00309	309	10.46	0.19	5.33	0.13	0.412	0.008	0.210	0.005
ORAR00310	310	12.07	0.21	5.33		0.475	0.008	0.210	
ORAR00311	311	13.64	0.22	5.33		0.537	0.009	0.210	
ORAR00312	312	15.24	0.23	5.33		0.600	0.009	0.210	
ORAR00313	313	16.81	0.24	5.33		0.662	0.010	0.210	
ORAR00314	314	18.42	0.25	5.33		0.725	0.010	0.210	
ORAR00315	315	19.99	0.26	5.33		0.787	0.010	0.210	
ORAR00316	316	21.59	0.28	5.33		0.850	0.011	0.210	
ORAR00317	317	23.16	0.29	5.33		0.912	0.011	0.210	
ORAR00318	318	24.77	0.30	5.33		0.975	0.012	0.210	
ORAR00319	319	26.34	0.31	5.33		1.037	0.012	0.210	
ORAR00320	320	27.94	0.32	5.33		1.100	0.013	0.210	
ORAR00321	321	29.51	0.33	5.33		1.162	0.013	0.210	
ORAR00322	322	31.12	0.35	5.33		1.225	0.014	0.210	
ORAR00323	323	32.69	0.36	5.33		1.287	0.014	0.210	
ORAR00324	324	34.29	0.37	5.33		1.350	0.015	0.210	
ORAR00325	325	37.47	0.39	5.33		1.475	0.015	0.210	
ORAR00326	326	40.64	0.41	5.33		1.600	0.016	0.210	
ORAR00327	327	43.82	0.44	5.33		1.725	0.017	0.210	
ORAR00328	328	46.99	0.46	5.33		1.850	0.018	0.210	
ORAR00329	329	50.17	0.48	5.33	1.975	0.019	0.210		
ORAR00330	330	53.34	0.50	5.33	2.100	0.020	0.210		
ORAR00331	331	56.52	0.53	5.33	2.225	0.021	0.210		
ORAR00332	332	59.69	0.55	5.33	2.350	0.022	0.210		
ORAR00333	333	62.87	0.57	5.33	2.475	0.022	0.210		



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00334	334	66.04	0.59	5.33	0.13	2.600	0.023	0.210	0.005
ORAR00335	335	69.22	0.61	5.33		2.725	0.024	0.210	
ORAR00336	336	72.39	0.64	5.33		2.850	0.025	0.210	
ORAR00337	337	75.57	0.66	5.33		2.975	0.026	0.210	
ORAR00338	338	78.74	0.68	5.33		3.100	0.027	0.210	
ORAR00339	339	81.92	0.70	5.33		3.225	0.028	0.210	
ORAR00340	340	85.09	0.72	5.33		3.350	0.028	0.210	
ORAR00341	341	88.27	0.74	5.33		3.475	0.029	0.210	
ORAR00342	342	91.44	0.77	5.33		3.600	0.030	0.210	
ORAR00343	343	94.62	0.79	5.33		3.725	0.031	0.210	
ORAR00344	344	97.79	0.81	5.33		3.850	0.032	0.210	
ORAR00345	345	100.97	0.83	5.33		3.975	0.033	0.210	
ORAR00346	346	104.14	0.85	5.33		4.100	0.034	0.210	
ORAR00347	347	107.32	0.87	5.33		4.225	0.034	0.210	
ORAR00348	348	110.49	0.90	5.33		4.350	0.035	0.210	
ORAR00349	349	113.67	0.92	5.33		4.475	0.036	0.210	
ORAR00350	350	116.84	0.94	5.33		4.600	0.037	0.210	
ORAR00351	351	120.02	0.96	5.33		4.725	0.038	0.210	
ORAR00352	352	123.19	0.98	5.33		4.850	0.039	0.210	
ORAR00353	353	126.37	1.00	5.33		4.975	0.039	0.210	
ORAR00354	354	129.54	1.02	5.33		5.100	0.040	0.210	
ORAR00355	355	132.72	1.05	5.33		5.225	0.041	0.210	
ORAR00356	356	135.89	1.07	5.33		5.350	0.042	0.210	
ORAR00357	357	139.07	1.09	5.33		5.475	0.043	0.210	
ORAR00358	358	142.24	1.11	5.33		5.600	0.044	0.210	
ORAR00359	359	145.42	1.13	5.33		5.725	0.045	0.210	
ORAR00360	360	148.59	1.15	5.33		5.850	0.045	0.210	
ORAR00361	361	151.77	1.17	5.33		5.975	0.046	0.210	
ORAR00362	362	158.12	1.21	5.33		6.225	0.048	0.210	
ORAR00363	363	164.47	1.26	5.33		6.475	0.049	0.210	
ORAR00364	364	170.82	1.30	5.33		6.725	0.051	0.210	
ORAR00365	365	177.17	1.34	5.33		6.975	0.053	0.210	
ORAR00366	366	183.52	1.38	5.33		7.225	0.054	0.210	
ORAR00367	367	189.87	1.42	5.33	7.475	0.056	0.210		
ORAR00368	368	196.22	1.47	5.33	7.725	0.058	0.210		
ORAR00369	369	202.57	1.51	5.33	7.975	0.059	0.210		
ORAR00370	370	208.92	1.55	5.33	8.225	0.061	0.210		
ORAR00371	371	215.27	1.59	5.33	8.475	0.063	0.210		
ORAR00372	372	221.62	1.63	5.33	8.725	0.064	0.210		
ORAR00373	373	227.97	1.67	5.33	8.975	0.066	0.210		



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00374	374	234.32	1.72	5.33	0.13	9.225	0.068	0.210	0.005
ORAR00375	375	240.67	1.76	5.33		9.475	0.069	0.210	
ORAR00376	376	247.02	1.80	5.33		9.725	0.071	0.210	
ORAR00377	377	253.37	1.76	5.33		9.975	0.072	0.210	
ORAR00378	378	266.07	1.92	5.33		10.475	0.076	0.210	
ORAR00379	379	278.77	2.00	5.33		10.975	0.079	0.210	
ORAR00380	380	291.47	2.09	5.33		11.475	0.082	0.210	
ORAR00381	381	304.17	2.17	5.33		11.975	0.085	0.210	
ORAR00382	382	329.57	2.33	5.33		12.975	0.092	0.210	
ORAR00383	383	354.97	2.49	5.33		13.975	0.098	0.210	
ORAR00384	384	380.37	2.65	5.33		14.975	0.104	0.210	
ORAR00385	385	405.26	2.81	5.33		15.955	0.111	0.210	
ORAR00386	386	430.66	2.97	5.33		16.955	0.117	0.210	
ORAR00387	387	456.06	3.13	5.33		17.955	0.123	0.210	
ORAR00388	388	481.46	3.29	5.33		18.955	0.130	0.210	
ORAR00389	389	506.86	3.45	5.33		19.955	0.136	0.210	
ORAR00390	390	532.26	3.61	5.33		20.955	0.142	0.210	
ORAR00391	391	557.66	3.77	5.33		21.955	0.148	0.210	
ORAR00392	392	582.68	3.92	5.33		22.940	0.154	0.210	
ORAR00393	393	608.08	4.08	5.33		23.940	0.161	0.210	
ORAR00394	394	633.48	4.24	5.33	24.940	0.167	0.210		
ORAR00395	395	658.88	4.40	5.33	25.940	0.173	0.210		
ORAR00425	425	113.67	0.92	6.99	0.15	4.475	0.036	0.275	0.006
ORAR00426	426	116.84	0.94	6.99		4.600	0.037	0.275	
ORAR00427	427	120.02	0.96	6.99		4.725	0.038	0.275	
ORAR00428	428	123.19	0.98	6.99		4.850	0.039	0.275	
ORAR00429	429	126.37	1.00	6.99		4.975	0.039	0.275	
ORAR00430	430	129.54	1.02	6.99		5.100	0.040	0.275	
ORAR00431	431	132.72	1.05	6.99		5.225	0.041	0.275	
ORAR00432	432	135.89	1.07	6.99		5.350	0.042	0.275	
ORAR00433	433	139.07	1.09	6.99		5.475	0.043	0.275	
ORAR00434	434	142.24	1.11	6.99		5.600	0.044	0.275	
ORAR00435	435	145.42	1.13	6.99		5.725	0.045	0.275	
ORAR00436	436	148.59	1.15	6.99		5.850	0.045	0.275	
ORAR00437	437	151.77	1.17	6.99		5.975	0.046	0.275	
ORAR00438	438	158.12	1.21	6.99		6.225	0.046	0.275	
ORAR00439	439	164.47	1.26	6.99		6.475	0.049	0.275	
ORAR00440	440	170.82	1.30	6.99		6.725	0.051	0.275	
ORAR00441	441	177.17	1.34	6.99		6.975	0.053	0.275	
ORAR00442	442	183.52	1.38	6.99		7.225	0.054	0.275	



TSS Part-No.	Size Code ISO 3601-1 AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
ORAR00443	443	189.87	1.42	6.99	0.15	7.475	0.056	0.275	0.006
ORAR00444	444	196.22	1.47	6.99		7.725	0.058	0.275	
ORAR00445	445	202.57	1.51	6.99		7.975	0.059	0.275	
ORAR00446	446	215.27	1.59	6.99		8.475	0.063	0.275	
ORAR00447	447	227.97	1.67	6.99		8.975	0.066	0.275	
ORAR00448	448	240.67	1.76	6.99		9.475	0.069	0.275	
ORAR00449	449	253.37	1.84	6.99		9.975	0.072	0.275	
ORAR00450	450	266.07	1.92	6.99		10.475	0.076	0.275	
ORAR00451	451	278.77	2.00	6.99		10.975	0.079	0.275	
ORAR00452	452	291.47	2.09	6.99		11.475	0.082	0.275	
ORAR00453	453	304.17	2.17	6.99		11.975	0.085	0.275	
ORAR00454	454	316.87	2.25	6.99		12.475	0.089	0.275	
ORAR00455	455	329.57	2.33	6.99		12.975	0.092	0.275	
ORAR00456	456	342.27	2.41	6.99		13.475	0.095	0.275	
ORAR00457	457	354.97	2.49	6.99		13.975	0.098	0.275	
ORAR00458	458	367.67	2.57	6.99		14.475	0.101	0.275	
ORAR00459	459	380.37	2.65	6.99		14.975	0.104	0.275	
ORAR00460	460	393.07	2.73	6.99		15.475	0.108	0.275	
ORAR00461	461	405.26	2.81	6.99		15.955	0.111	0.275	
ORAR00462	462	417.96	2.89	6.99		16.455	0.114	0.275	
ORAR00463	463	430.66	2.97	6.99		16.955	0.117	0.275	
ORAR00464	464	443.36	3.05	6.99		17.455	0.120	0.275	
ORAR00465	465	456.06	3.13	6.99		17.955	0.123	0.275	
ORAR00466	466	468.76	3.21	6.99		18.455	0.126	0.275	
ORAR00467	467	481.46	3.29	6.99		18.955	0.130	0.275	
ORAR00468	468	494.16	3.37	6.99		19.455	0.133	0.275	
ORAR00469	469	506.86	3.45	6.99		19.955	0.136	0.275	
ORAR00470	470	532.26	3.61	6.99	20.955	0.142	0.275		
ORAR00471	471	557.66	3.77	6.99	21.955	0.148	0.275		
ORAR00472	472	582.68	3.92	6.99	22.940	0.154	0.275		
ORAR00473	473	608.08	4.08	6.99	23.940	0.161	0.275		
ORAR00474	474	633.48	4.24	6.99	24.940	0.167	0.275		
ORAR00475	475	658.88	4.40	6.99	25.940	0.173	0.275		



C.2.2 O-RING DIMENSIONS IN ACCORDANCE WITH SWEDISH STANDARD SMS 1586

The following four tables show O-Ring dimensions in accordance with Swedish standard SMS 1586.

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

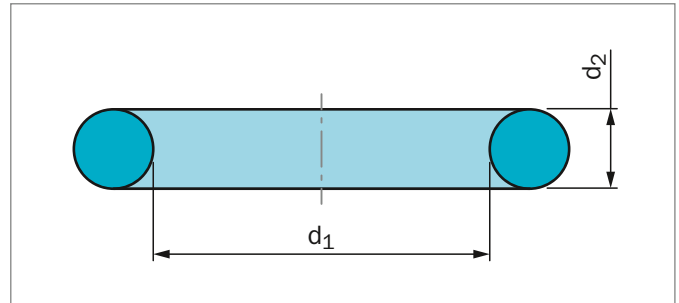


Figure 32: O-Ring dimensions

Table 35: O-Ring dimensions in accordance with SMS 1586, table 1 (dynamic use) with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø			
	d_1	Tolerance \pm	d_2	Tolerance \pm	d_1	Tolerance \pm	d_2	Tolerance \pm		
	mm				inch					
OR2400330	3.30	0.14	2.40	0.09	0.130	0.005	0.094	0.004		
OR2400430	4.30	0.15	2.40		0.169	0.006	0.094			
OR2400530	5.30	0.15	2.40		0.209	0.006	0.094			
OR2400630	6.30	0.16	2.40		0.248	0.006	0.094			
OR2400730	7.30	0.17	2.40		0.287	0.007	0.094			
OR2400830	8.30	0.18	2.40		0.327	0.007	0.094			
OR2400930	9.30	0.18	2.40		0.366	0.007	0.094			
OR2401030	10.30	0.19	2.40		0.406	0.008	0.094			
OR2401130	11.30	0.20	2.40		0.445	0.008	0.094			
OR2401230	12.30	0.21	2.40		0.484	0.008	0.094			
OR2401330	13.30	0.22	2.40		0.524	0.008	0.094			
OR2401430	14.30	0.22	2.40		0.563	0.009	0.094			
OR2401530	15.30	0.23	2.40		0.602	0.009	0.094			
OR2401630	16.30	0.24	2.40		0.642	0.009	0.094			
OR2401730	17.30	0.25	2.40		0.681	0.010	0.094			
OR3001920	19.20	0.26	3.00		0.09	0.756	0.010		0.118	0.004
OR3002220	22.20	0.28	3.00			0.874	0.011		0.118	
OR3002420	24.20	0.30	3.00	0.953		0.012	0.118			
OR3002620	26.20	0.31	3.00	1.031		0.012	0.118			
OR3002920	29.20	0.33	3.00	1.150		0.013	0.118			
OR3003220	32.20	0.35	3.00	1.268		0.014	0.118			
OR3003420	34.20	0.37	3.00	1.346		0.014	0.118			
OR3003620	36.20	0.38	3.00	1.425		0.015	0.118			
OR3003920	39.20	0.40	3.00	1.543		0.016	0.118			
OR3004220	42.20	0.42	3.00	1.661		0.017	0.118			
OR3004420	44.20	0.44	3.00	1.740	0.017	0.118				
OR5704420	44.20	0.44	5.70	0.13	1.740	0.017	0.224	0.005		
OR5704920	49.20	0.47	5.70		1.937	0.019	0.224			



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR5705420	54.20	0.51	5.70	0.13	2.134	0.020	0.224	0.005
OR5705920	59.20	0.54	5.70		2.331	0.021	0.224	
OR5706420	64.20	0.58	5.70		2.528	0.023	0.224	
OR5706920	69.20	0.61	5.70		2.724	0.024	0.224	
OR5707420	74.20	0.65	5.70		2.921	0.026	0.224	
OR5707920	79.20	0.68	5.70		3.118	0.027	0.224	
OR5708410	84.10	0.72	5.70		3.311	0.028	0.224	
OR5708910	89.10	0.75	5.70		3.508	0.030	0.224	
OR5709410	94.10	0.78	5.70		3.705	0.031	0.224	
OR5709910	99.10	0.82	5.70		3.902	0.032	0.224	
OR5710410	104.10	0.85	5.70		4.098	0.034	0.224	
OR5710910	109.10	0.89	5.70		4.295	0.035	0.224	
OR5711430	114.30	0.92	5.70		4.500	0.036	0.224	
OR5711930	119.30	0.96	5.70		4.697	0.038	0.224	
OR5712430	124.30	0.99	5.70		4.894	0.039	0.224	
OR5712930	129.30	1.02	5.70		5.091	0.040	0.224	
OR5713430	134.30	1.06	5.70		5.287	0.042	0.224	
OR5713930	139.30	1.09	5.70		5.484	0.043	0.224	
OR5714430	144.30	1.12	5.70		5.681	0.044	0.224	
OR8414410	144.10	1.12	8.40		0.15	5.673	0.044	
OR8414910	149.10	1.15	8.40	5.870		0.045	0.331	
OR8415410	154.10	1.19	8.40	6.067		0.047	0.331	
OR8415910	159.10	1.22	8.40	6.264		0.048	0.331	
OR8416410	164.10	1.25	8.40	6.461		0.049	0.331	
OR8416910	169.10	1.29	8.40	6.657		0.051	0.331	
OR8417410	174.10	1.32	8.40	6.854		0.052	0.331	
OR8417910	179.10	1.35	8.40	7.051		0.053	0.331	
OR8418410	184.10	1.39	8.40	7.248		0.055	0.331	
OR8418910	189.10	1.42	8.40	7.445		0.056	0.331	
OR8419410	194.10	1.45	8.40	7.642		0.057	0.331	
OR8419910	199.10	1.49	8.40	7.839		0.058	0.331	
OR8420910	209.10	1.55	8.40	8.232		0.061	0.331	
OR8421910	219.10	1.62	8.40	8.626		0.064	0.331	
OR8422910	229.10	1.68	8.40	9.020		0.066	0.331	
OR8423910	239.10	1.75	8.40	9.413		0.069	0.331	
OR8424910	249.10	1.81	8.40	9.807		0.071	0.331	



Table 36: O-Ring dimensions in accordance with SMS 1586, table 2 (static use) with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR1600310	3.10	0.14	1.60	0.08	0.122	0.005	0.063	0.003
OR1600410	4.10	0.14	1.60		0.161	0.006	0.063	
OR1600510	5.10	0.15	1.60		0.201	0.006	0.063	
OR1600610	6.10	0.16	1.60		0.240	0.006	0.063	
OR1600710	7.10	0.17	1.60		0.280	0.007	0.063	
OR1600810	8.10	0.18	1.60		0.319	0.007	0.063	
OR1600910	9.10	0.18	1.60		0.358	0.007	0.063	
OR1601010	10.10	0.19	1.60		0.398	0.008	0.063	
OR1601110	11.10	0.20	1.60		0.437	0.008	0.063	
OR1601210	12.10	0.21	1.60		0.476	0.008	0.063	
OR1601310	13.10	0.21	1.60		0.516	0.008	0.063	
OR1601410	14.10	0.22	1.60		0.555	0.009	0.063	
OR1601510	15.10	0.23	1.60		0.594	0.009	0.063	
OR1601610	16.10	0.24	1.60		0.634	0.009	0.063	
OR1601710	17.10	0.24	1.60		0.673	0.010	0.063	
OR1601810	18.10	0.25	1.60		0.713	0.010	0.063	
OR1601910	19.10	0.26	1.60		0.752	0.010	0.063	
OR1602210	22.10	0.28	1.60		0.870	0.011	0.063	
OR1602510	25.10	0.30	1.60		0.988	0.012	0.063	
OR1602710	27.10	0.32	1.60		1.067	0.012	0.063	
OR1602910	29.10	0.33	1.60	1.146	0.013	0.063		
OR1603210	32.10	0.35	1.60	1.264	0.014	0.063		
OR1603510	35.10	0.37	1.60	1.382	0.015	0.063		
OR1603710	37.10	0.39	1.60	1.461	0.015	0.063		
OR3004950	49.50	0.48	3.00	0.09	1.949	0.019	0.118	0.004
OR3005450	54.50	0.51	3.00		2.146	0.020	0.118	
OR3005950	59.50	0.55	3.00		2.343	0.022	0.118	
OR3006450	64.50	0.58	3.00		2.539	0.023	0.118	
OR3006950	69.50	0.62	3.00		2.736	0.024	0.118	
OR3007450	74.50	0.65	3.00		2.933	0.026	0.118	
OR3007950	79.50	0.68	3.00		3.130	0.027	0.118	
OR3008450	84.50	0.72	3.00		3.327	0.028	0.118	
OR3008950	89.50	0.75	3.00		3.524	0.030	0.118	
OR3009450	94.50	0.79	3.00		3.720	0.031	0.118	
OR3009950	99.50	0.82	3.00		3.917	0.032	0.118	
OR3010450	104.50	0.86	3.00		4.114	0.034	0.118	
OR3010950	109.50	0.89	3.00		4.311	0.035	0.118	
OR3011450	114.50	0.92	3.00		4.508	0.036	0.118	
OR3011950	119.50	0.96	3.00		4.705	0.038	0.118	
OR3012450	124.50	0.99	3.00		4.902	0.039	0.118	



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR3012950	129.50	1.02	3.00	0.09	5.098	0.040	0.118	0.004
OR3013450	134.50	1.06	3.00		5.295	0.042	0.118	
OR3013950	139.50	1.09	3.00		5.492	0.043	0.118	
OR3014450	144.50	1.12	3.00		5.689	0.044	0.118	
OR5714930	149.30	1.16	5.70	0.13	5.878	0.046	0.224	0.005
OR5715430	154.30	1.19	5.70		6.075	0.047	0.224	
OR5715930	159.30	1.22	5.70		6.272	0.048	0.224	
OR5716430	164.30	1.26	5.70		6.469	0.049	0.224	
OR5716930	169.30	1.29	5.70		6.665	0.051	0.224	
OR5717430	174.30	1.32	5.70		6.862	0.052	0.224	
OR5717930	179.30	1.35	5.70		7.059	0.053	0.224	
OR5718430	184.30	1.39	5.70		7.256	0.055	0.224	
OR5718930	189.30	1.42	5.70		7.453	0.056	0.224	
OR5719430	194.30	1.45	5.70		7.650	0.057	0.224	
OR5719930	199.30	1.49	5.70		7.846	0.059	0.224	
OR5720930	209.30	1.55	5.70		8.240	0.061	0.224	
OR5721930	219.30	1.62	5.70		8.634	0.064	0.224	
OR5722930	229.30	1.68	5.70		9.028	0.066	0.224	
OR5723930	239.30	1.75	5.70		9.421	0.069	0.224	
OR5724930	249.30	1.81	5.70		9.815	0.071	0.224	
OR5725930	259.30	1.88	5.70		10.209	0.074	0.224	
OR5726930	269.30	1.94	5.70		10.602	0.076	0.224	
OR5727930	279.30	2.01	5.70		10.996	0.079	0.224	
OR5728930	289.30	2.07	5.70		11.390	0.082	0.224	
OR5729930	299.30	2.14	5.70		11.783	0.084	0.224	
OR5731930	319.30	2.26	5.70		12.571	0.089	0.224	
OR5733930	339.30	2.39	5.70		13.358	0.094	0.224	
OR5735930	359.30	2.52	5.70		14.146	0.099	0.224	
OR5737930	379.30	2.65	5.70	14.933	0.104	0.224		
OR5739930	399.30	2.77	5.70	15.720	0.109	0.224		
OR5741930	419.30	2.90	5.70	16.508	0.114	0.224		
OR5743930	439.30	3.03	5.70	17.295	0.119	0.224		
OR5745930	459.30	3.15	5.70	18.083	0.124	0.224		
OR5747930	479.30	3.28	5.70	18.870	0.129	0.224		
OR5749930	499.30	3.40	5.70	19.657	0.134	0.224		



C.2.3 O-RING DIMENSIONS IN ACCORDANCE WITH JAPANESE STANDARD JIS B 2401

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

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

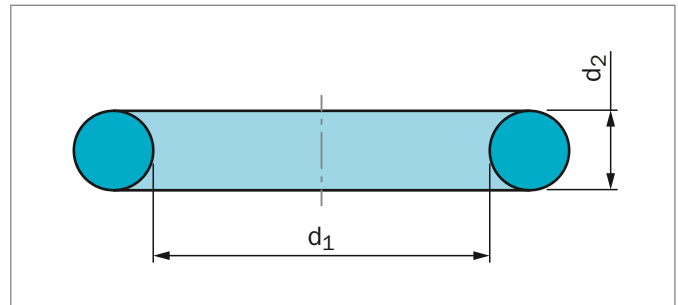


Figure 33: O-Ring dimensions

Table 37: O-Ring dimensions in accordance with JIS B 2401 for dynamic use (P) with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d_1	Tolerance \pm	d_2	Tolerance \pm	d_1	Tolerance \pm	d_2	Tolerance \pm
		mm				inch			
OR1900280	P3	2.80	0.13	1.90	0.08	0.110	0.005	0.075	0.003
OR1900380	P4	3.80	0.14	1.90		0.150	0.006	0.075	
OR1900480	P5	4.80	0.15	1.90		0.189	0.006	0.075	
OR1900580	P6	5.80	0.16	1.90		0.228	0.006	0.075	
OR1900680	P7	6.80	0.17	1.90		0.268	0.007	0.075	
OR1900780	P8	7.80	0.17	1.90		0.307	0.007	0.075	
OR1900880	P9	8.80	0.18	1.90		0.346	0.007	0.075	
OR1900980	P10	9.80	0.19	1.90	0.386	0.007	0.075		
OR2400980	P10A	9.80	0.19	2.40	0.09	0.386	0.007	0.094	0.004
OR2401080	P11	10.80	0.20	2.40		0.425	0.008	0.094	
OR2401100	P11.2	11.00	0.20	2.40		0.433	0.008	0.094	
OR2401180	P12	11.80	0.20	2.40		0.465	0.008	0.094	
OR2401230	P12.5	12.30	0.21	2.40		0.484	0.008	0.094	
OR2401380	P14	13.80	0.22	2.40		0.543	0.009	0.094	
OR2401480	P15	14.80	0.23	2.40		0.583	0.009	0.094	
OR2401580	P16	15.80	0.23	2.40		0.622	0.009	0.094	
OR2401780	P18	17.80	0.25	2.40		0.701	0.010	0.094	
OR2401980	P20	19.80	0.26	2.40		0.780	0.010	0.094	
OR2402080	P21	20.80	0.27	2.40	0.819	0.011	0.094		
OR2402180	P22	21.80	0.28	2.40	0.858	0.011	0.094		
OR3502170	P22A	21.70	0.28	3.50	0.10	0.854	0.011	0.138	0.004
OR3502210	P22.4	22.10	0.28	3.50		0.870	0.011	0.138	
OR3502370	P24	23.70	0.29	3.50		0.936	0.012	0.138	
OR3502470	P25	24.70	0.30	3.50		0.972	0.012	0.138	
OR3502520	P25.5	25.20	0.30	3.50		0.992	0.012	0.138	
OR3502570	P26	25.70	0.31	3.50		1.012	0.012	0.138	
OR3502770	P28	27.70	0.32	3.50		1.091	0.013	0.138	
OR3502870	P29	28.70	0.33	3.50		1.130	0.013	0.138	



TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
OR3502920	P29.5	29.20	0.33	3.50	0.10	1.150	0.013	0.138	0.004
OR3502970	P30	29.70	0.34	3.50		1.169	0.013	0.138	
OR3503070	P31	30.70	0.34	3.50		1.209	0.013	0.138	
OR3503120	P31.5	31.20	0.35	3.50		1.228	0.014	0.138	
OR3503170	P32	31.70	0.35	3.50		1.248	0.014	0.138	
OR3503370	P34	33.70	0.36	3.50		1.327	0.014	0.138	
OR3503470	P35	34.70	0.37	3.50		1.366	0.015	0.138	
OR3503520	P35.5	35.20	0.38	3.50		1.386	0.015	0.138	
OR3503570	P36	35.70	0.38	3.50		1.406	0.015	0.138	
OR3503770	P38	37.70	0.39	3.50		1.484	0.015	0.138	
OR3503870	P39	38.70	0.40	3.50		1.524	0.016	0.138	
OR3503970	P40	39.70	0.41	3.50		1.563	0.016	0.138	
OR3504070	P41	40.70	0.41	3.50		1.602	0.016	0.138	
OR3504170	P42	41.70	0.42	3.50		1.642	0.017	0.138	
OR3504370	P44	43.70	0.44	3.50		1.720	0.017	0.138	
OR3504470	P45	44.70	0.44	3.50		1.760	0.017	0.138	
OR3504570	P46	45.70	0.45	3.50		1.799	0.018	0.138	
OR3504770	P48	47.70	0.46	3.50		1.878	0.018	0.138	
OR3504870	P49	48.70	0.47	3.50		1.917	0.019	0.138	
OR3504970	P50	49.70	0.48	3.50		1.957	0.019	0.138	
OR5704760	P48A	47.60	0.46	5.70	0.13	1.874	0.018	0.224	0.005
OR5704960	P50A	49.60	0.48	5.70		1.953	0.019	0.224	
OR5705160	P52	51.60	0.49	5.70		2.031	0.019	0.224	
OR5705260	P53	52.60	0.50	5.70		2.071	0.020	0.224	
OR5705460	P55	54.60	0.51	5.70		2.150	0.020	0.224	
OR5705560	P56	55.60	0.52	5.70		2.189	0.020	0.224	
OR5705760	P58	57.60	0.53	5.70		2.268	0.021	0.224	
OR5705960	P60	59.60	0.55	5.70		2.346	0.022	0.224	
OR5706160	P62	61.60	0.56	5.70		2.425	0.022	0.224	
OR5706260	P63	62.60	0.57	5.70		2.465	0.022	0.224	
OR5706460	P65	64.60	0.58	5.70		2.543	0.023	0.224	
OR5706660	P67	66.60	0.60	5.70		2.622	0.023	0.224	
OR5706960	P70	69.60	0.62	5.70		2.740	0.024	0.224	
OR5707060	P71	70.60	0.62	5.70		2.780	0.025	0.224	
OR5707460	P75	74.60	0.65	5.70		2.937	0.026	0.224	
OR5707960	P80	79.60	0.69	5.70		3.134	0.027	0.224	
OR5708460	P85	84.60	0.72	5.70		3.331	0.028	0.224	
OR5708960	P90	89.60	0.75	5.70		3.528	0.030	0.224	
OR5709460	P95	94.60	0.79	5.70		3.724	0.031	0.224	
OR5709960	P100	99.60	0.82	5.70		3.921	0.032	0.224	
OR5710160	P102	101.60	0.84	5.70	4.000	0.033	0.224		
OR5710460	P105	104.60	0.86	5.70	4.118	0.034	0.224		



TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
OR5710960	P110	109.60	0.89	5.70	0.13	4.315	0.035	0.224	0.005
OR5711160	P112	111.60	0.90	5.70		4.394	0.036	0.224	
OR5711460	P115	114.60	0.92	5.70		4.512	0.036	0.224	
OR5711960	P120	119.60	0.96	5.70		4.709	0.038	0.224	
OR5712460	P125	124.60	0.99	5.70		4.906	0.039	0.224	
OR5712960	P130	129.60	1.02	5.70		5.102	0.040	0.224	
OR5713160	P132	131.60	1.04	5.70		5.181	0.041	0.224	
OR5713460	P135	134.60	1.06	5.70		5.299	0.042	0.224	
OR5713960	P140	139.60	1.09	5.70		5.496	0.043	0.224	
OR5714460	P145	144.60	1.12	5.70		5.693	0.044	0.224	
OR5714960	P150	149.60	1.16	5.70		5.890	0.046	0.224	
OR8414950	P150A	149.50	1.16	8.40		0.15	5.886	0.046	
OR8415450	P155	154.50	1.19	8.40	6.083		0.047	0.331	
OR8415950	P160	159.50	1.22	8.40	6.280		0.048	0.331	
OR8416450	P165	164.50	1.26	8.40	6.476		0.049	0.331	
OR8416950	P170	169.50	1.29	8.40	6.673		0.051	0.331	
OR8417450	P175	174.50	1.32	8.40	6.870		0.052	0.331	
OR8417950	P180	179.50	1.36	8.40	7.067		0.053	0.331	
OR8418450	P185	184.50	1.39	8.40	7.264		0.055	0.331	
OR8418950	P190	189.50	1.36	8.40	7.461		0.056	0.331	
OR8419450	P195	194.50	1.45	8.40	7.657		0.057	0.331	
OR8419950	P200	199.50	1.49	8.40	7.854		0.059	0.331	
OR8420450	P205	204.50	1.52	8.40	8.051		0.060	0.331	
OR8420850	P209	208.50	1.55	8.40	8.209		0.061	0.331	
OR8420950	P210	209.50	1.55	8.40	8.248		0.061	0.331	
OR8421450	P215	214.50	1.59	8.40	8.445		0.062	0.331	
OR8421950	P220	219.50	1.62	8.40	8.642		0.064	0.331	
OR8422450	P225	224.50	1.65	8.40	8.839		0.065	0.331	
OR8422950	P230	229.50	1.68	8.40	9.035		0.066	0.331	
OR8423450	P235	234.50	1.72	8.40	9.232		0.068	0.331	
OR8423950	P240	239.50	1.75	8.40	9.429		0.069	0.331	
OR8424450	P245	244.50	1.78	8.40	9.626		0.070	0.331	
OR8424950	P250	249.50	1.81	8.40	9.823		0.071	0.331	
OR8425450	P255	254.50	1.85	8.40	10.020		0.073	0.331	
OR8425950	P260	259.50	1.88	8.40	10.217		0.074	0.331	
OR8426450	P265	264.50	1.91	8.40	10.413		0.075	0.331	
OR8426950	P270	269.50	1.94	8.40	10.610		0.077	0.331	
OR8427450	P275	274.50	1.98	8.40	10.807		0.078	0.331	
OR8427950	P280	279.50	2.01	8.40	11.004		0.079	0.331	
OR8428450	P285	284.50	2.04	8.40	11.201	0.080	0.331		
OR8428950	P290	289.50	2.07	8.40	11.398	0.082	0.331		
OR8429450	P295	294.50	2.10	8.40	11.594	0.083	0.331		



TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
OR8429950	P300	299.50	2.14	8.40	0.15	11.791	0.084	0.331	0.006
OR8431450	P315	314.50	2.23	8.40		12.382	0.088	0.331	
OR8431950	P320	319.50	2.27	8.40		12.579	0.089	0.331	
OR8433450	P335	334.50	2.36	8.40		13.169	0.093	0.331	
OR8433950	P340	339.50	2.39	8.40		13.366	0.094	0.331	
OR8435450	P355	354.50	2.49	8.40		13.957	0.098	0.331	
OR8435950	P360	359.50	2.52	8.40		14.154	0.099	0.331	
OR8437450	P375	374.50	2.62	8.40		14.744	0.103	0.331	
OR8438450	P385	384.50	2.68	8.40		15.138	0.106	0.331	
OR8439950	P400	399.50	2.77	8.40		15.728	0.109	0.331	



Table 38: O-Ring dimensions in accordance with JIS B 2401 for static use (G) with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
OR3102440	G25	24.40	0.30	3.10		0.961	0.012	0.122	
OR3102940	G30	29.40	0.33	3.10		1.157	0.013	0.122	
OR3103440	G35	34.40	0.37	3.10		1.354	0.015	0.122	
OR3103940	G40	39.40	0.41	3.10		1.551	0.016	0.122	
OR3104440	G45	44.40	0.44	3.10		1.748	0.017	0.122	
OR3104940	G50	49.40	0.48	3.10		1.945	0.019	0.122	
OR3105440	G55	54.40	0.51	3.10		2.142	0.020	0.122	
OR3105940	G60	59.40	0.55	3.10		2.339	0.021	0.122	
OR3106440	G65	64.40	0.58	3.10		2.535	0.023	0.122	
OR3106940	G70	69.40	0.62	3.10		2.732	0.024	0.122	
OR3107440	G75	74.40	0.65	3.10		2.929	0.026	0.122	
OR3107940	G80	79.40	0.68	3.10		3.126	0.027	0.122	
OR3108440	G85	84.40	0.72	3.10	0.09	3.323	0.028	0.122	0.004
OR3108940	G90	89.40	0.75	3.10		3.520	0.030	0.122	
OR3109440	G95	94.40	0.79	3.10		3.717	0.031	0.122	
OR3109940	G100	99.40	0.82	3.10		3.913	0.032	0.122	
OR3110440	G105	104.40	0.85	3.10		4.110	0.034	0.122	
OR3110940	G110	109.40	0.89	3.10		4.307	0.035	0.122	
OR3111440	G115	114.40	0.92	3.10		4.504	0.036	0.122	
OR3111940	G120	119.40	0.96	3.10		4.701	0.038	0.122	
OR3112440	G125	124.40	0.99	3.10		4.898	0.039	0.122	
OR3112940	G130	129.40	1.02	3.10		5.094	0.040	0.122	
OR3113440	G135	134.40	1.06	3.10		5.291	0.042	0.122	
OR3113940	G140	139.40	1.09	3.10		5.488	0.043	0.122	
OR3114440	G145	144.40	1.12	3.10		5.685	0.044	0.122	
OR5714930	G150	149.30	1.16	5.70		5.878	0.046	0.224	
OR5715430	G155	154.30	1.19	5.70		6.075	0.047	0.224	
OR5715930	G160	159.30	1.22	5.70		6.272	0.048	0.224	
OR5716430	G165	164.30	1.26	5.70		6.469	0.049	0.224	
OR5716930	G170	169.30	1.29	5.70		6.665	0.051	0.224	
OR5717430	G175	174.30	1.32	5.70		6.862	0.052	0.224	
OR5717930	G180	179.30	1.35	5.70	0.13	7.059	0.053	0.224	0.005
OR5718430	G185	184.30	1.39	5.70		7.256	0.055	0.224	
OR5718930	G190	189.30	1.42	5.70		7.453	0.056	0.224	
OR5719430	G195	194.30	1.45	5.70		7.650	0.057	0.224	
OR5719930	G200	199.30	1.49	5.70		7.846	0.059	0.224	
OR5720930	G210	209.30	1.55	5.70		8.240	0.061	0.224	
OR5721930	G220	219.30	1.62	5.70		8.634	0.064	0.224	



TSS Part-No.	Ident-No. JIS B 2401	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
		d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
		mm				inch			
OR5722930	G230	229.30	1.68	5.70	0.13	9.028	0.066	0.224	0.005
OR5723930	G240	239.30	1.75	5.70		9.421	0.069	0.224	
OR5724930	G250	249.30	1.81	5.70		9.815	0.071	0.224	
OR5725930	G260	259.30	1.88	5.70		10.209	0.074	0.224	
OR5726930	G270	269.30	1.94	5.70		10.602	0.076	0.224	
OR5727930	G280	279.30	2.01	5.70		10.996	0.079	0.224	
OR5728930	G290	289.30	2.07	5.70		11.390	0.082	0.224	
OR5729930	G300	299.30	2.14	5.70		11.783	0.084	0.224	



C.2.4 O-RING DIMENSIONS FOR STRAIGHT THREAD TUBE FITTINGS IN ACCORDANCE WITH AS 568

The following table shows the O-Ring dimensions for straight thread tube fittings in accordance with AS 568.

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

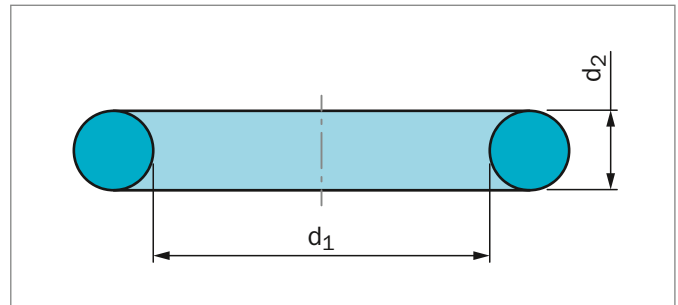


Figure 34: O-Ring dimensions

Table 39: O-Ring dimensions for straight thread tube fittings in accordance with AS 568 with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part- No.	Dash- No. AS 568	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø		Tube size
		d_1	Toler- ance \pm	d_2	Toler- ance \pm	d_1	Toler- ance \pm	d_2	Toler- ance \pm	Out- side-Ø (OD) inch
ORAR00901	901	4.70	0.15	1.42	0.08	0.185	0.006	0.056	0.003	3/32
ORAR00902	902	6.07	0.16	1.63	0.08	0.239	0.006	0.064	0.003	1/8
ORAR00903	903	7.65	0.17	1.63	0.08	0.301	0.007	0.064	0.003	3/16
ORAR00904	904	8.92	0.18	1.83	0.08	0.351	0.007	0.072	0.003	1/4
ORAR00905	905	10.52	0.19	1.83	0.08	0.414	0.008	0.072	0.003	5/16
ORAR00906	906	11.89	0.20	1.98	0.08	0.468	0.008	0.078	0.003	3/8
ORAR00907	907	13.46	0.22	2.08	0.08	0.530	0.009	0.082	0.003	7/16
ORAR00908	908	16.36	0.24	2.21	0.08	0.644	0.009	0.087	0.003	1/2
ORAR00909	909	17.93	0.25	2.46	0.09	0.706	0.010	0.097	0.004	9/16
ORAR00910	910	19.18	0.26	2.46	0.09	0.755	0.010	0.097	0.004	5/8
ORAR00911	911	21.92	0.28	2.95	0.09	0.863	0.011	0.116	0.004	11/16
ORAR00912	912	23.47	0.29	2.95	0.09	0.924	0.011	0.116	0.004	3/4
ORAR00913	913	25.04	0.30	2.95	0.09	0.986	0.012	0.116	0.004	13/16
ORAR00914	914	26.62	0.31	2.95	0.09	1.048	0.012	0.116	0.004	7/8
ORAR00916	916	29.74	0.34	2.95	0.09	1.171	0.013	0.116	0.004	1
ORAR00918	918	34.42	0.37	2.95	0.09	1.355	0.015	0.116	0.004	11/8
ORAR00920	920	37.47	0.39	3.00	0.09	1.475	0.015	0.118	0.004	11/4
ORAR00924	924	43.69	0.44	3.00	0.09	1.720	0.017	0.118	0.004	11/2
ORAR00928	928	53.09	0.50	3.00	0.09	2.090	0.020	0.118	0.004	13/4
ORAR00932	932	59.36	0.55	3.00	0.09	2.337	0.021	0.118	0.004	13/4



C.2.5 O-RING DIMENSIONS FOR METRIC THREAD WITH CONICAL RECESS IN ACCORDANCE WITH ISO 6149

The following table shows the O-Ring dimensions for metric thread with a conical recess in accordance with ISO 6149.

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

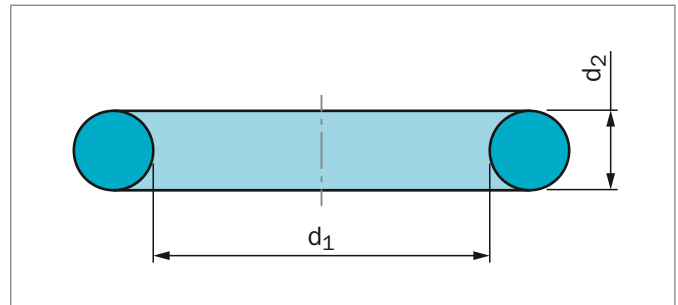


Figure 35: O-Ring dimensions

Table 40: O-Ring dimensions for metric thread with conical recess in accordance with ISO 6149 with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø		Thread (metric)
	d_1	Tolerance ±	d_2	Tolerance ±	d_1	Tolerance ±	d_2	Tolerance ±	
	mm				inch				
OR1600610	6.10	0.16	1.6	0.08	0.240	0.006	0.063	0.003	M8 x 1
OR1600810	8.10	0.18	1.6		0.319	0.007	0.063		M10 x 1
OR2200930	9.30	0.18	2.2	0.08	0.366	0.007	0.087	0.003	M12 x 1.5
OR2201130	11.30	0.20	2.2		0.445	0.008	0.087		M14 x 1.5
OR2201330	13.30	0.22	2.2		0.524	0.008	0.087		M16 x 1.5
OR2201530	15.30	0.23	2.2		0.602	0.087	0.087		M18 x 1.5
OR2201730	17.30	0.25	2.2		0.681	0.087	0.087		M20 x 1.5
OR2201930	19.30	0.26	2.2		0.760	0.087	0.087		M22 x 1.5
OR2902360	23.60	0.29	2.9		0.929	0.011	0.114		M27 x 2
OR2902960	29.60	0.33	2.9	1.165	0.013	0.114	M33 x 2		
OR2903860	38.60	0.40	2.9	0.09	1.520	0.016	0.114	0.004	M42 x 2
OR2904460	44.60	0.44	2.9		1.756	0.017	0.114		M48 x 2
OR2905660	56.60	0.53	2.9		2.228	0.021	0.114		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 in accordance with ISO 3601-1, class B are valid. The appropriate tolerance values for each dimension are listed in the tables below.

Table 41: Preferred metric O-Ring dimensions with valid tolerances in accordance with ISO 3601-1, class B – Metric and Inch

TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d_1	Tolerance \pm	d_2	Tolerance \pm	d_1	Tolerance \pm	d_2	Tolerance \pm
	mm				inch			
OR1000150	1.50	0.12	1.00	0.08	0.059	0.005	0.039	0.003
OR1000200	2.00	0.13	1.00		0.079	0.005	0.039	
OR1000250	2.50	0.13	1.00		0.098	0.005	0.039	
OR1000350	3.50	0.14	1.00		0.138	0.005	0.039	
OR1000400	4.00	0.14	1.00		0.157	0.006	0.039	
OR1000450	4.50	0.15	1.00		0.177	0.006	0.039	
OR1000600	6.00	0.16	1.00		0.236	0.006	0.039	
OR1000700	7.00	0.17	1.00		0.276	0.007	0.039	
OR1000800	8.00	0.17	1.00		0.315	0.007	0.039	
OR1000850	8.50	0.18	1.00		0.335	0.007	0.039	
OR1001000	10.00	0.19	1.00		0.394	0.007	0.039	
OR1001100	11.00	0.20	1.00		0.433	0.008	0.039	
OR1001200	12.00	0.21	1.00		0.472	0.008	0.039	
OR1001300	13.00	0.21	1.00		0.512	0.008	0.039	
OR1001500	15.00	0.23	1.00		0.591	0.009	0.039	
OR1001600	16.00	0.24	1.00		0.630	0.009	0.039	
OR1001800	18.00	0.25	1.00		0.709	0.010	0.039	
OR1002000	20.00	0.26	1.00		0.787	0.010	0.039	
OR1002200	22.00	0.28	1.00		0.866	0.011	0.039	
OR1002300	23.00	0.29	1.00		0.906	0.011	0.039	
OR1003000	30.00	0.34	1.00	1.181	0.013	0.039		
OR1003400	34.00	0.37	1.00	1.339	0.014	0.039		
OR1003800	38.00	0.40	1.00	1.496	0.016	0.039		
OR1004000	40.00	0.41	1.00	1.575	0.016	0.039		
OR1200180	1.80	0.13	1.20	0.08	0.071	0.005	0.047	0.003
OR1200250	2.50	0.13	1.20		0.098	0.005	0.047	
OR1200300	3.00	0.14	1.20		0.118	0.005	0.047	
OR1200350	3.50	0.14	1.20		0.138	0.005	0.047	
OR1200400	4.00	0.14	1.20		0.157	0.006	0.047	
OR1200500	5.00	0.15	1.20		0.197	0.006	0.047	
OR1200600	6.00	0.16	1.20		0.236	0.006	0.047	
OR4U01600	16.00	0.24	1.25	0.08	0.630	0.009	0.049	0.003
OR1301000	10.00	0.19	1.30	0.08	0.394	0.007	0.051	0.003
OR1500300	3.00	0.14	1.50	0.08	0.118	0.005	0.059	0.003



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR1500350	3.50	0.14	1.50	0.08	0.138	0.005	0.059	0.003
OR1500400	4.00	0.14	1.50		0.157	0.006	0.059	
OR1500450	4.50	0.15	1.50		0.177	0.006	0.059	
OR1500500	5.00	0.15	1.50		0.197	0.006	0.059	
OR1500600	6.00	0.16	1.50		0.236	0.006	0.059	
OR1500650	6.50	0.16	1.50		0.256	0.006	0.059	
OR1500700	7.00	0.17	1.50		0.276	0.007	0.059	
OR1500750	7.50	0.17	1.50		0.295	0.007	0.059	
OR1500800	8.00	0.17	1.50		0.315	0.007	0.059	
OR1500850	8.50	0.18	1.50		0.335	0.007	0.059	
OR1500900	9.00	0.18	1.50		0.354	0.007	0.059	
OR1501000	10.00	0.19	1.50		0.394	0.007	0.059	
OR1501050	10.50	0.19	1.50		0.413	0.008	0.059	
OR1501100	11.00	0.20	1.50		0.433	0.008	0.059	
OR1501200	12.00	0.21	1.50		0.472	0.008	0.059	
OR1501300	13.00	0.21	1.50		0.512	0.008	0.059	
OR1501400	14.00	0.22	1.50		0.551	0.009	0.059	
OR1501500	15.00	0.23	1.50		0.591	0.009	0.059	
OR1501600	16.00	0.24	1.50		0.630	0.009	0.059	
OR1501700	17.00	0.24	1.50		0.669	0.010	0.059	
OR1501900	19.00	0.26	1.50		0.748	0.010	0.059	
OR1502000	20.00	0.26	1.50		0.787	0.010	0.059	
OR1502300	23.00	0.29	1.50		0.906	0.011	0.059	
OR1502400	24.00	0.29	1.50		0.945	0.012	0.059	
OR1502600	26.00	0.31	1.50		1.024	0.012	0.059	
OR1502700	27.00	0.32	1.50		1.063	0.012	0.059	
OR1502800	28.00	0.32	1.50		1.102	0.013	0.059	
OR1503000	30.00	0.34	1.50		1.181	0.013	0.059	
OR1503200	32.00	0.35	1.50		1.260	0.014	0.059	
OR1503500	35.00	0.37	1.50		1.378	0.015	0.059	
OR1503600	36.00	0.38	1.50		1.417	0.015	0.059	
OR1504000	40.00	0.41	1.50		1.575	0.016	0.059	
OR1504200	42.00	0.42	1.50		1.654	0.017	0.059	
OR1504500	45.00	0.44	1.50		1.772	0.018	0.059	
OR1504700	47.00	0.46	1.50		1.850	0.018	0.059	
OR1505000	50.00	0.48	1.50		1.969	0.019	0.059	
OR1505200	52.00	0.49	1.50		2.047	0.019	0.059	
OR1505400	54.00	0.51	1.50	2.126	0.020	0.059		
OR1505500	55.00	0.52	1.50	2.165	0.020	0.059		
OR1506000	60.00	0.55	1.50	2.362	0.022	0.059		
OR1600660	6.60	0.16	1.60	0.260	0.006	0.063	0.003	
OR1600800	8.00	0.17	1.60	0.315	0.007	0.063		



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
ORIA00710	7.10	0.17	1.80	0.08	0.280	0.007	0.071	0.003
ORIA00900	9.00	0.18	1.80		0.354	0.007	0.071	
ORIA01050	10.50	0.19	1.80		0.413	0.008	0.071	
ORIA01900	19.00	0.26	1.80		0.748	0.010	0.071	
OR2000350	3.50	0.14	2.00	0.08	0.138	0.005	0.079	0.003
OR2000400	4.00	0.14	2.00		0.157	0.006	0.079	
OR2000500	5.00	0.15	2.00		0.197	0.006	0.079	
OR2000800	8.00	0.17	2.00		0.315	0.007	0.079	
OR2000900	9.00	0.18	2.00		0.354	0.007	0.079	
OR2001000	10.00	0.19	2.00		0.394	0.007	0.079	
OR2001100	11.00	0.20	2.00		0.433	0.008	0.079	
OR2001150	11.50	0.20	2.00		0.453	0.008	0.079	
OR2001200	12.00	0.21	2.00		0.472	0.008	0.079	
OR2001300	13.00	0.21	2.00		0.512	0.008	0.079	
OR2001400	14.00	0.22	2.00		0.551	0.009	0.079	
OR2001500	15.00	0.23	2.00		0.591	0.009	0.079	
OR2001600	16.00	0.24	2.00		0.630	0.009	0.079	
OR2001700	17.00	0.24	2.00		0.669	0.010	0.079	
OR2001800	18.00	0.25	2.00		0.709	0.010	0.079	
OR2001900	19.00	0.26	2.00		0.748	0.010	0.079	
OR2002000	20.00	0.26	2.00		0.787	0.010	0.079	
OR2002100	21.00	0.27	2.00		0.827	0.011	0.079	
OR2002200	22.00	0.28	2.00		0.866	0.011	0.079	
OR2002300	23.00	0.29	2.00		0.906	0.011	0.079	
OR2002400	24.00	0.29	2.00		0.945	0.012	0.079	
OR2002600	26.00	0.31	2.00		1.024	0.012	0.079	
OR2002700	27.00	0.32	2.00		1.063	0.012	0.079	
OR2003100	31.00	0.34	2.00		1.220	0.014	0.079	
OR2003200	32.00	0.35	2.00		1.260	0.014	0.079	
OR2003300	33.00	0.36	2.00		1.299	0.014	0.079	
OR2003500	35.00	0.37	2.00		1.378	0.015	0.079	
OR2003600	36.00	0.38	2.00	1.417	0.015	0.079		
OR2003800	38.00	0.40	2.00	1.496	0.016	0.079		
OR2004000	40.00	0.41	2.00	1.575	0.016	0.079		
OR2004200	42.00	0.42	2.00	1.654	0.017	0.079		
OR2004400	44.00	0.44	2.00	1.732	0.017	0.079		
OR2004500	45.00	0.44	2.00	1.772	0.018	0.079		
OR2004600	46.00	0.45	2.00	1.811	0.018	0.079		
OR2004700	47.00	0.46	2.00	1.850	0.018	0.079		
OR2004800	48.00	0.47	2.00	1.890	0.018	0.079		
OR2005000	50.00	0.48	2.00	1.969	0.019	0.079		
OR2005200	52.00	0.49	2.00	2.047	0.019	0.079		



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR2006000	60.00	0.55	2.00	0.08	2.362	0.022	0.079	0.003
OR2006200	62.00	0.56	2.00		2.441	0.022	0.079	
OR2007000	70.00	0.62	2.00		2.756	0.024	0.079	
OR2007600	76.00	0.66	2.00		2.992	0.026	0.079	
OR2008000	80.00	0.69	2.00		3.150	0.027	0.079	
OR2008300	83.00	0.71	2.00		3.268	0.028	0.079	
OR2008500	85.00	0.72	2.00		3.346	0.028	0.079	
OR2009000	90.00	0.76	2.00		3.543	0.030	0.079	
OR2009500	95.00	0.79	2.00		3.740	0.031	0.079	
OR2010500	105.00	0.86	2.00		4.134	0.034	0.079	
OR2011000	110.00	0.89	2.00		4.331	0.035	0.079	
OR2012800	128.00	1.01	2.00	5.039	0.040	0.079		
OR2101540	15.40	0.23	2.10	0.08	0.606	0.009	0.083	0.003
OR2101940	19.40	0.26	2.10		0.764	0.010	0.083	
OR2200930	9.30	0.18	2.20	0.08	0.366	0.007	0.087	0.003
OR2201130	11.30	0.20	2.20		0.445	0.008	0.087	
OR2201330	13.30	0.22	2.20		0.524	0.008	0.087	
OR2201530	15.30	0.23	2.20		0.602	0.009	0.087	
OR2201930	19.30	0.26	2.20		0.760	0.010	0.087	
OR2401460	14.60	0.22	2.40	0.09	0.575	0.009	0.094	0.004
OR2401930	19.30	0.26	2.40		0.760	0.010	0.094	
OR2402030	20.30	0.27	2.40		0.799	0.011	0.094	
OR2402130	21.30	0.27	2.40		0.839	0.011	0.094	
OR2402230	22.30	0.28	2.40		0.878	0.011	0.094	
OR2402330	23.30	0.29	2.40		0.917	0.011	0.094	
OR2402530	25.30	0.30	2.40		0.996	0.012	0.094	
OR2402730	27.30	0.32	2.40		1.075	0.013	0.094	
OR2500700	7.00	0.17	2.50	0.09	0.276	0.007	0.098	0.004
OR2500900	9.00	0.18	2.50		0.354	0.007	0.098	
OR2501000	10.00	0.19	2.50		0.394	0.007	0.098	
OR2501100	11.00	0.20	2.50		0.433	0.008	0.098	
OR2501200	12.00	0.21	2.50		0.472	0.008	0.098	
OR2501400	14.00	0.22	2.50		0.551	0.009	0.098	
OR2501500	15.00	0.23	2.50		0.591	0.009	0.098	
OR2501700	17.00	0.24	2.50		0.669	0.010	0.098	
OR2501800	18.00	0.25	2.50		0.709	0.010	0.098	
OR2501900	19.00	0.26	2.50		0.748	0.010	0.098	
OR2502200	22.00	0.28	2.50		0.866	0.011	0.098	
OR2502400	24.00	0.29	2.50		0.945	0.012	0.098	
OR2502500	25.00	0.30	2.50		0.984	0.012	0.098	
OR2502700	27.00	0.32	2.50		1.063	0.012	0.098	
OR2502800	28.00	0.32	2.50		1.102	0.013	0.098	



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR2502900	29.00	0.33	2.50	0.09	1.142	0.013	0.098	0.004
OR2503000	30.00	0.34	2.50		1.181	0.013	0.098	
OR2503200	32.00	0.35	2.50		1.260	0.014	0.098	
OR2503300	33.00	0.36	2.50		1.299	0.014	0.098	
OR2503400	34.00	0.37	2.50		1.339	0.014	0.098	
OR2503600	36.00	0.38	2.50		1.417	0.015	0.098	
OR2503800	38.00	0.40	2.50		1.496	0.016	0.098	
OR2504000	40.00	0.41	2.50		1.575	0.016	0.098	
OR2504200	42.00	0.42	2.50		1.654	0.017	0.098	
OR2504500	45.00	0.44	2.50		1.772	0.018	0.098	
OR2504600	46.00	0.45	2.50		1.811	0.018	0.098	
OR2505000	50.00	0.48	2.50		1.969	0.019	0.098	
OR2505500	55.00	0.52	2.50		2.165	0.020	0.098	
OR2505700	57.00	0.53	2.50		2.244	0.021	0.098	
OR2506500	65.00	0.58	2.50		2.559	0.023	0.098	
OR2507000	70.00	0.62	2.50		2.756	0.024	0.098	
OR2507200	72.00	0.63	2.50		2.835	0.025	0.098	
OR2508000	80.00	0.69	2.50	3.150	0.027	0.098		
OR2701050	10.50	0.19	2.70	0.09	0.413	0.008	0.106	0.004
OR2802370	23.70	0.29	2.80	0.09	0.933	0.011	0.110	0.004
OR3000800	8.00	0.17	3.00	0.09	0.315	0.007	0.118	0.004
OR3000900	9.00	0.18	3.00		0.354	0.007	0.118	
OR3000950	9.50	0.19	3.00		0.374	0.007	0.118	
OR3001000	10.00	0.19	3.00		0.394	0.007	0.118	
OR3001100	11.00	0.20	3.00		0.433	0.008	0.118	
OR3001200	12.00	0.21	3.00		0.472	0.008	0.118	
OR3001400	14.00	0.22	3.00		0.551	0.009	0.118	
OR3001600	16.00	0.24	3.00		0.630	0.009	0.118	
OR3001800	18.00	0.25	3.00		0.709	0.010	0.118	
OR3002000	20.00	0.26	3.00		0.787	0.010	0.118	
OR3002100	21.00	0.27	3.00		0.827	0.011	0.118	
OR3002150	21.50	0.28	3.00		0.846	0.011	0.118	
OR3002200	22.00	0.28	3.00		0.866	0.011	0.118	
OR3002300	23.00	0.29	3.00		0.906	0.011	0.118	
OR3002400	24.00	0.29	3.00		0.945	0.012	0.118	
OR3002500	25.00	0.30	3.00		0.984	0.012	0.118	
OR3002600	26.00	0.31	3.00		1.024	0.012	0.118	
OR3002800	28.00	0.32	3.00	1.102	0.013	0.118		
OR3002900	29.00	0.33	3.00	1.142	0.013	0.118		
OR3003000	30.00	0.34	3.00	1.181	0.013	0.118		
OR3003200	32.00	0.35	3.00	1.260	0.014	0.118		
OR3003250	32.50	0.36	3.00	1.280	0.014	0.118		



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR3003400	34.00	0.37	3.00	0.09	1.339	0.014	0.118	0.004
OR3003700	37.00	0.39	3.00		1.457	0.015	0.118	
OR3003800	38.00	0.40	3.00		1.496	0.016	0.118	
OR3003900	39.00	0.40	3.00		1.535	0.016	0.118	
OR3004000	40.00	0.41	3.00		1.575	0.016	0.118	
OR3004100	41.00	0.42	3.00		1.614	0.016	0.118	
OR3004300	43.00	0.43	3.00		1.693	0.017	0.118	
OR3004400	44.00	0.44	3.00		1.732	0.017	0.118	
OR3004500	45.00	0.44	3.00		1.772	0.018	0.118	
OR3004600	46.00	0.45	3.00		1.811	0.018	0.118	
OR3004800	48.00	0.47	3.00		1.890	0.018	0.118	
OR3004900	49.00	0.47	3.00		1.929	0.019	0.118	
OR3005000	50.00	0.48	3.00		1.969	0.019	0.118	
OR3005200	52.00	0.49	3.00		2.047	0.019	0.118	
OR3005400	54.00	0.51	3.00		2.126	0.020	0.118	
OR3005500	55.00	0.52	3.00		2.165	0.020	0.118	
OR3005700	57.00	0.53	3.00		2.244	0.021	0.118	
OR3005800	58.00	0.54	3.00		2.283	0.021	0.118	
OR3005900	59.00	0.54	3.00		2.323	0.021	0.118	
OR3006000	60.00	0.55	3.00		2.362	0.022	0.118	
OR3006200	62.00	0.56	3.00		2.441	0.022	0.118	
OR3006300	63.00	0.57	3.00		2.480	0.022	0.118	
OR3006500	65.00	0.58	3.00		2.559	0.023	0.118	
OR3006900	69.00	0.61	3.00		2.717	0.024	0.118	
OR3007000	70.00	0.62	3.00		2.756	0.024	0.118	
OR3007500	75.00	0.65	3.00		2.953	0.026	0.118	
OR3009000	90.00	0.76	3.00		3.543	0.030	0.118	
OR3009600	96.00	0.80	3.00		3.780	0.031	0.118	
OR3010000	100.00	0.82	3.00		3.937	0.032	0.118	
OR3010500	105.00	0.86	3.00		4.134	0.034	0.118	
OR3011000	110.00	0.89	3.00	4.331	0.035	0.118		
OR3011500	115.00	0.93	3.00	4.528	0.036	0.118		
OR3012000	120.00	0.96	3.00	4.724	0.038	0.118		
OR3013200	132.00	1.04	3.00	5.197	0.041	0.118		
OR3013500	135.00	1.06	3.00	5.315	0.042	0.118		
OR3014000	140.00	1.09	3.00	5.512	0.043	0.118		
OR3016000	160.00	1.23	3.00	6.299	0.048	0.118		
OR3020000	200.00	1.49	3.00	7.874	0.059	0.118		
OR3501000	10.00	0.19	3.50	0.394	0.007	0.138	0.004	
OR3501300	13.00	0.21	3.50	0.512	0.008	0.138		
OR3501600	16.00	0.24	3.50	0.630	0.009	0.138		
OR4003000	30.00	0.34	4.00	0.10	1.181	0.013	0.157	0.004



TSS Part-No.	Inside-Ø		Cross-Section-Ø		Inside-Ø		Cross-Section-Ø	
	d ₁	Tolerance ±	d ₂	Tolerance ±	d ₁	Tolerance ±	d ₂	Tolerance ±
	mm				inch			
OR4004000	40.00	0.41	4.00	0.10	1.575	0.016	0.157	0.004
OR4004200	42.00	0.42	4.00		1.654	0.017	0.157	
OR4005000	50.00	0.48	4.00		1.969	0.019	0.157	
OR4006000	60.00	0.55	4.00		2.362	0.022	0.157	
OR4007200	72.00	0.63	4.00		2.835	0.025	0.157	
OR5010000	100.00	0.82	5.00	0.13	3.937	0.032	0.197	0.005

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■ D Special O-Rings

■ D.1 Isolast® (FFKM) O-Rings

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

■ D.2 FEP/PFA Encapsulated O-Rings

DESCRIPTION

FEP/PFA Encapsulated O-Rings combine the resilience and sealing force of an elastomer with the chemical resistance of PTFE or FFKM. They consist of an elastomeric core of silicone or FKM with a seamless, thin encapsulation of FEP or PFA. The required elasticity, pretension and dimensional stability is provided by the elastomer core, while the seamless FEP/PFA encapsulation ensures reliable sealing and high resistance to aggressive media.

FEP/PFA Encapsulated O-Rings are primarily used in low pressure static or slow moving dynamic applications. This seal type is recommended for non-abrasive contact surfaces and non-abrasive media only. Preconditions for the use of FEP/PFA Encapsulated O-Rings are low press-in assembly forces and limited O-Ring elongation.

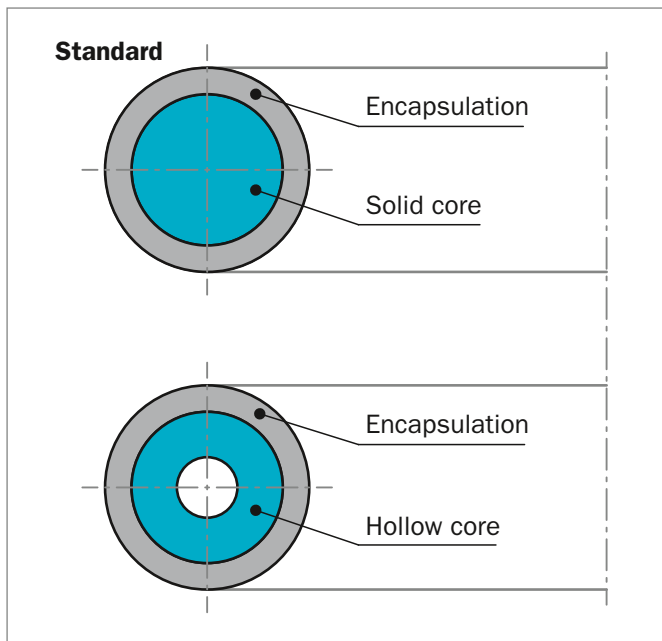


Figure 36: Different versions of FEP/PFA O-Ring

MARKET SEGMENTS

- Aerospace
- Chemical processing industries
- Dye and paint manufacturing
- Food processing industries (for food applications, Trelleborg Sealing Solutions offers FoodPro™ FEP encapsulated O-Rings in specific food approved grades)
- Gasoline and chemical transport
- Oil refineries
- Photochemical
- Polymer production
- Refrigeration engineering
- Semi-conductor manufacturing

APPLICATIONS

- Access covers
- Autoclaves
- Cartridge filters
- Chemical reactor vessels
- Cryogenics
- Gas compressors
- Heat exchangers
- Hose couplings
- Mechanical seals
- Pipelines
- Pressure vessels
- Pumps and valves





Figure 37: Typical application and installation for FEP/PFA Encapsulated O-Rings

ADVANTAGES

- Outstanding chemical and corrosion resistance
- Reliable, cost-effective and high-performance sealing for many critical applications
- Broad temperature range from -60°C (-76°F) to 260°C (500°F), depending on core material choice
- Perfect suited for use in the food, chemical and pharmaceutical industries
- Physiologically safe (can be sterilized)
- Low permeation rate
- Low friction coefficient prevents adhesion or stick-slip effects (self-lubricating, smooth surface)
- Excellent for high purity processes due to low leach-out
- Good resistance to pressure, deformation and compression
- Square and rectangular cross section are available on demand

MATERIAL DATA

Hardness (Shore A)

Hardness is determined by the core material and its design.

- 90-95 ShA: FEP / PFA with solid FKM core
- 85-90 ShA: FEP / PFA with solid silicone core
- 75-80 ShA: FEP / PFA with hollow silicone core

Temperature range

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

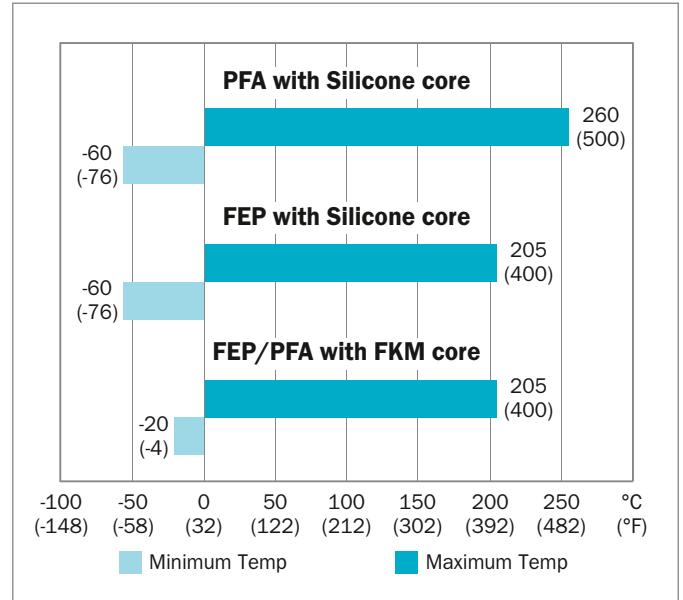


Figure 38: Temperature range

Gas permeability

FEP / PFA encapsulations have a much lower gas permeation rate than most other plastics. Highly corrosive gases usually don't chemically attack the FEP / PFA encapsulation, but may eventually permeate through and damage the elastomer core. In general, permeation increases with temperature, pressure, and surface contact area and decreases with increased film thickness.

Table 42: Gas permeability rates with a FEP Encapsulated O-Ring (film thickness of 25 µm/0.984 inch)

Gas	Permeability Rate [cm ³ /(m ² .24h.atm)]
Carbon Dioxide	25.9 x 10 ³
Hydrogen	34.1 x 10 ³
Nitrogen	5.0 x 10 ³
Oxygen	11.6 x 10 ³

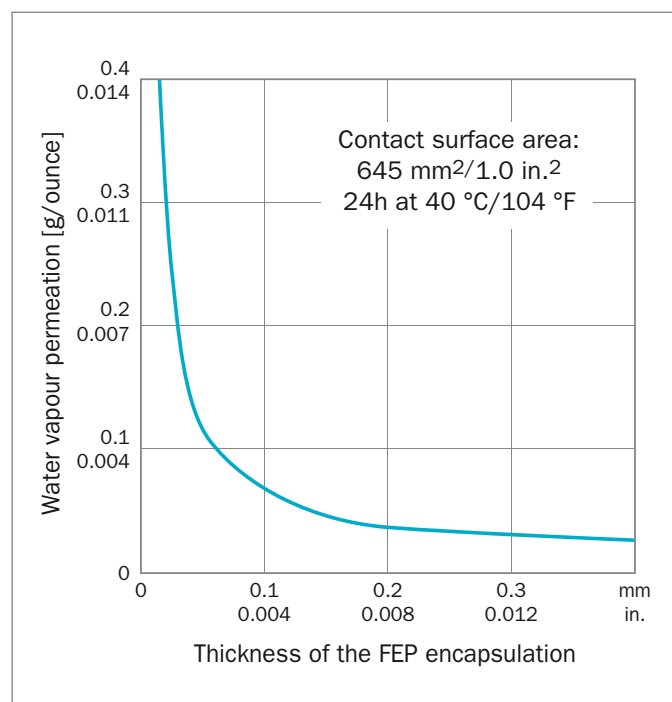


Figure 39: Water vapor permeation for FEP encapsulated O-Rings

Chemical resistance

The FEP / PFA encapsulation is resistant to nearly all chemicals within standard application temperature ranges.

Table 43: Examples of media compatible with FEP/PFA Encapsulated O-Rings

Abietic acid	Butyl acetate
Acetic acid	Butyl methacrylate
Acetic anhydride	Calcium chloride
Acetone	Carbon disulfide
Acetophenone	Cetane
Acrylic anhydride	Chlorine
Alkyl methacrylate	Chloroacetic acid
Ammonia, liquid	Chloroform
Ammonium chloride	Chlorosulfonic acid
Aniline	Chromic acid
Aqua regia	Cyclohexane
Benzoyl chloride	Cyclohexanone
Benzoyl peroxide	Dibutyl phthalate
Benzyl alcohol	Dibutyl sebacate
Borax	Diesel
Boric acid	Diethyl carbonate
Bromine	Dimethyl ether
N-Butyl amine	Dimethyl formamide

Di-isobutyl adipate	Nitric acid
Dimethylformamide	Nitrobenzene
Dimethylhydrazine	Oils (animal and vegetable)
Dioxane	Oleum
Ethyl acetate	Ozone
Ethyl alcohol	Pentachloro-benzamide
Ethyl ether	Pentachloride
Ethyl hexanoate	Perchloroethylene
Ethyl bromide	Perfluoroxylenes
Ethyl glycol	Phenol
Ferric chloride	Phosphoric acid
Ferric phosphate	Phosphorus
Fluoronitrobenzene	Phthalic acid
Formaldehyde	Pinene
Formic acid	Piperidine
Furane	Polyacrylonitrile
Freons	Potassium acetate
Gasoline	Potassium hydroxide < 50%
Hexachloroethane	Potassiumpermanganate
Hexane	Pyridine
Hydrazine	Soap and detergents
Hydrochloric acid	Sodium fluoride
Hydrocyanic acid	Sodium hydroxide < 80%
Hydrofluoric acid concentrate	Sodium hypochlorite
Hydrogen peroxide	Sodium peroxide
Isocyanates	Solvents, aliphatic & aromatic
Isopropyl alcohol	Stannous chloride
Lead compounds	Sulphur
Magnesium chloride	Sulphuric acid
Mercury	Tetrabromoethane
Methyl ethyl ketone	Tetrachloroethylene
Methacrylic acid	Trichloroethylene
Methanol	Trichloroacetic acid
Methyl methacrylate	Tricresyl phosphate
Napthalene	Triethanolamine
Napthols	Turpentine
2-Nitro-butanol	Unleaded fuel
Nitrogen tetroxide	Vinyl methacrylate
Nitromethane	Water
N-Octadecyl alcohol	Zinc chloride

Some chemicals, when in high concentrations, are reactive. This is especially the case when high temperatures are involved.



If specifying FEP/PFA Encapsulated O-Rings with the following media, please contact your local Trelleborg Sealing Solutions marketing company for guidance:

- Aluminum chloride
- Amines
- Complex halogen compounds
- Fluorine
- Metal hydrides such as Borane
- Molten alkali metals
- 80% NaOH or KOH
- 70% nitric acid

Encapsulation Material Comparison

FEP encapsulation:

- Fluorinated ethylene propylene
- High resistance to most chemicals
- High corrosion resistance
- Low friction coefficient
- Low compression set

Ordering information:

- VZ00G: TSS code for FEP + solid FKM core
- SZ00G: TSS code for FEP + solid Silicone core

PFA encapsulation:

- Perfluoroalkoxy-copolymer
- Similar performance as FEP
- Better performance above 200°C (392°F)
- Better mechanical strength
- Better cracking resistance
- Longer service life

Ordering information:

- VZ01G: TSS code for PFA + solid FKM core
- SZ01G: TSS code for PFA + solid Silicone core

Table 44: Thickness of FEP/PFA encapsulation (metric)

O-Ring Cross-Section-Ø d ₂	Thickness of the FEP/PFA Sheath
mm	
1.78 - 2.00	0.203
2.40 - 3.00	0.254
3.53 - 4.00	0.305
5.00	0.381
5.33 - 10.00	0.508
12.00 - 20.00	0.762

Table 45: Thickness of FEP/PFA encapsulation (inch)

O-Ring Cross-Section-Ø d ₂	Thickness of the FEP/PFA Sheath
inch	
0.070 - 0.078	0.008
0.095 - 0.118	0.010
0.139 - 0.157	0.012
0.196	0.015
0.210 - 0.393	0.020
0.472 - 0.787	0.030

Table 46: Materials and their related compliances and approvals

Seals often have to meet the highest performance standards and the most stringent of the environmental and safety demands. Also official authorities and associations make great demands on seals or materials.

	FEP/PFA	FKM core	Silicone core
FDA	X	X	X
EC 1935/2004	X		
3A Sanitary	X		
USP	X		X
RoHS/REACH	X	X	X
ADIfree	X		



DESIGN RECOMMENDATIONS

FEP/PFA encapsulated O-Rings are designed to be used in the same standard O-Ring grooves and housings as elastomeric seals.

Lead-in chamfer

As FEP/PFA O-Rings are squeezed during installation, lead-in chamfers and rounded edges are necessary

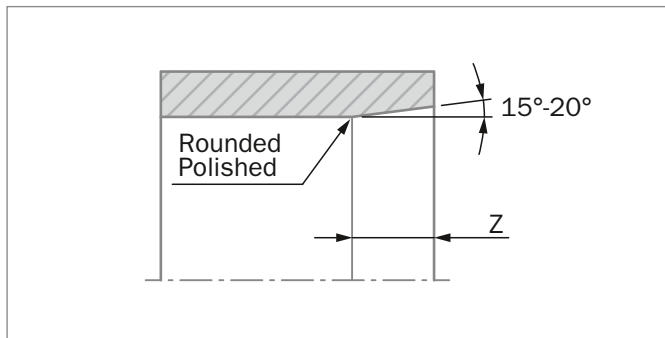


Figure 40: Lead-in chamfers for boxes, tubes

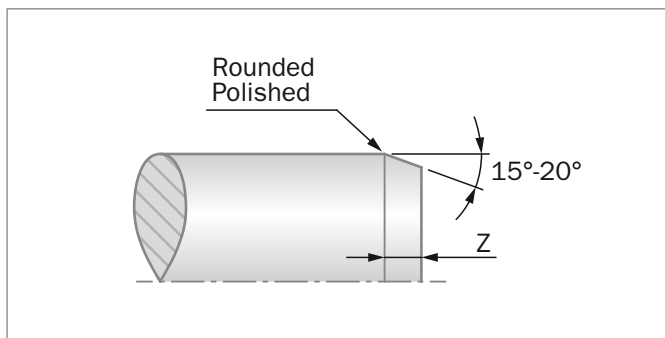


Figure 41: Lead-in chamfers for shafts, rods

Table 47: Lead-in chamfers (Metric)

Lead-in chamfers length Z min.		O-Ring Cross-Section-Ø d2
mm		
15°	20°	
1.1	0.9	up to 1.78 / 1.80
1.5	1.1	up to 2.62 / 2.65
1.8	1.4	up to 3.53 / 3.55
2.7	2.1	up to 5.33 / 5.35
3.6	2.8	up to 6.99 / 7.00
6.0	4.5	above 7.00

Table 48: Lead-in chamfers (Inch)

Lead-in chamfers length Z min.		O-Ring Cross-Section-Ø d2
inch		
15°	20°	
0.098	0.059	up to 0.071
0.118	0.079	up to 0.104
0.138	0.098	up to 0.140
0.177	0.138	up to 0.209
0.197	0.157	up to 0.276
0.236	0.177	above 0.276

Radial clearance (maximum)

The maximum permissible radial clearance between the sealed parts depends on system pressure, cross section and the hardness of the O-Ring. If the clearance is too large, there is a risk of extrusion which can result in destruction of the O-Ring. The recommended values assume that the parts are fitted concentrically and do not expand under pressure.

Table 49: Maximum permissible radial clearance depending on pressure, material and design choice.

Max pressure	FEP / PFA solid FKM core	FEP / PFA solid Silicone core	FEP / PFA hollow Silicone core
0.5 Mpa / 100 psi	0.46 mm / 0.018 inch	0.38 mm / 0.015 inch	0.28 mm / 0.011 inch
1.5 Mpa / 250 psi	0.41 mm / 0.016 inch	0.36 mm / 0.014 inch	0.25 mm / 0.010 inch
3.5 Mpa / 500 psi	0.36 mm / 0.014 inch	0.30 mm / 0.012 inch	0.23 mm / 0.009 inch
5 Mpa / 750 psi	0.30 mm / 0.012 inch	0.25 mm / 0.010 inch	0.20 mm / 0.008 inch
7 Mpa / 1000 psi	0.28 mm / 0.011 inch	0.23 mm / 0.009 inch	0.15 mm / 0.006 inch
10 Mpa / 1500 psi	0.23 mm / 0.009 inch	0.15 mm / 0.006 inch	0.10 mm / 0.004 inch
13 Mpa / 2000 psi	0.15 mm / 0.006 inch	0.13 mm / 0.005 inch	0.08 mm / 0.003 inch
20 Mpa / 3000 psi	0.10 mm / 0.004 inch	0.08 mm / 0.003 inch	0.03 mm / 0.001 inch

We recommend using a Back-up Ring when:

- Pressure is greater than 5 MPa (725 psi) for O-Rings with inside diameters above 50 mm (1.969 inch).
- Pressure is greater than 10 Mpa (1,450 psi) for O-Rings with inside diameters below 50 mm (1.969 inch).



Surface finish for housing

Scratches, pit marks, machining scores, etc. on the sealing surface are not permissible.

Table 50: Surface finish for O-Ring housing (Metric)

Type of Load	Surface	R _t	Rz	Ra
µm				
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 pilsating pressures:	≤ 6.3 ≤ 10.0	≤ 6.3	≤ 1.6
	Mating surface			
	Groove flanks, groove diameter			

* Spiralfree grinding

Table 51: Surface finish for O-Ring housing (Inch)

Type of Load	Surface	R _t	Rz	Ra
µm				
Radial-dynamic	Mating surface * (bore, rod, shaft)	≤ 100	≤ 60	≤ 16
	Groove flanks, groove diameter	≤ 400	≤ 250	≤ 60
Radial-static Axial-static	Mating surface	≤ 400	≤ 250	≤ 60
	Groove flanks, groove diameter	≤ 630		
	For pilsating pressures:	≤ 250 ≤ 400	≤ 250	≤ 60
	Mating surface			
	Groove flanks, groove diameter			

* Spiralfree grinding

Rectangular groove

A rectangular groove is preferred for all new housing 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 should not exceed the maximum permissible radial clearance.

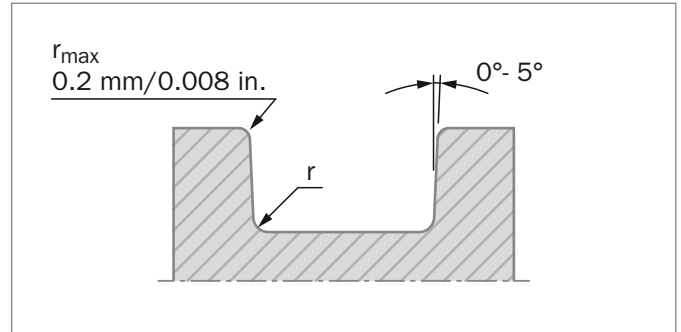


Figure 42: Rectangular housing groove design cross section

Initial compression FEP/PFA Encapsulated O-Ring

Initial compression of the O-Ring cross section is essential to ensure its function. It serves to:

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

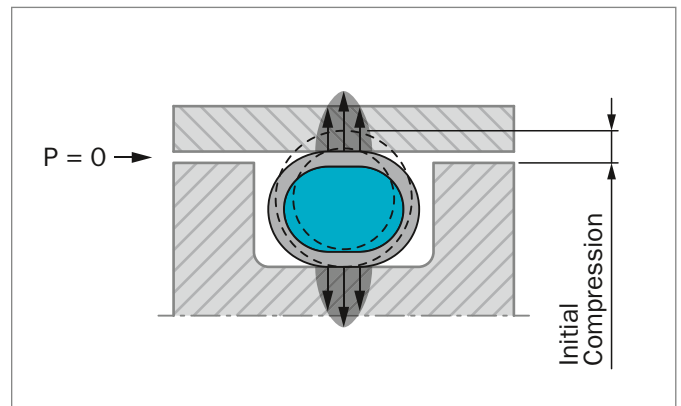


Figure 43: Initial compression forces acting on the FEP/PFA Encapsulated O-Ring

Recommended initial compression for FEP/PFA Encapsulated O-Rings:

- Static applications: 15 to 20%
- Dynamic applications: 10 to 15%

Compression force

The compression force varies depending upon, for example, the extent of initial compression, material properties and O-Ring dimensions. FEP/PFA Encapsulated O-Rings with a hollow core have approximately 50% less compression force than those with a solid core.

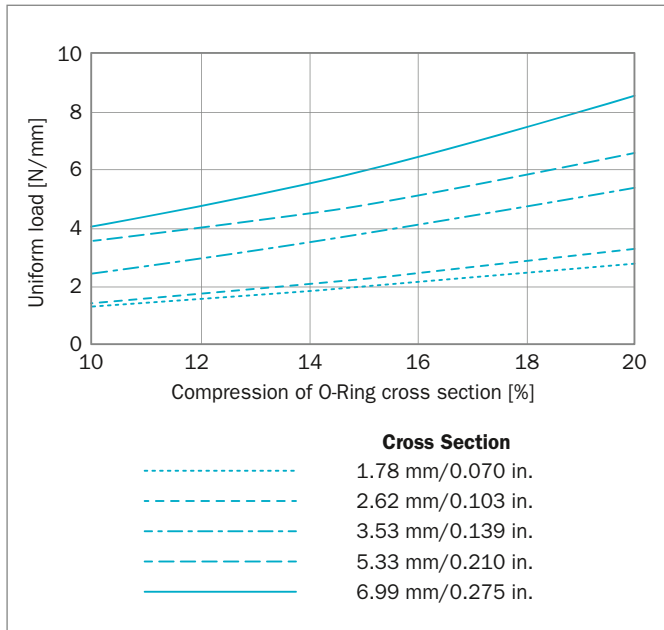


Figure 44: Guiding values for the uniform load [N/mm] of compressed FEP/PFA solid core encapsulated O-Rings



HOUSING DIMENSIONS RECOMMENDATIONS

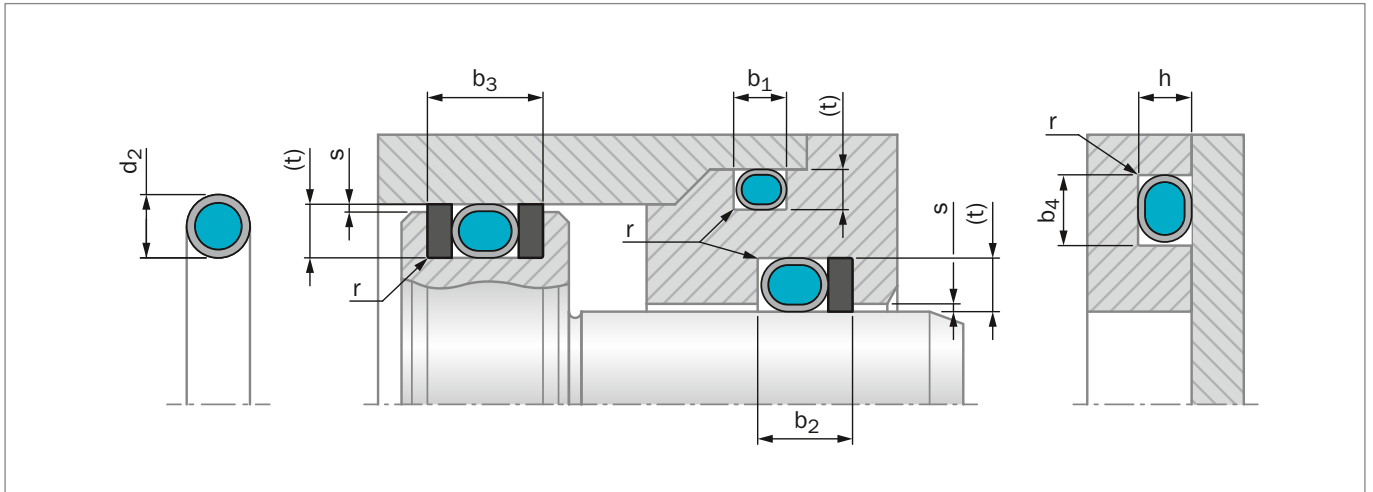


Figure 45: Installation drawing

Table 52: Housing dimensions – Metric

O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.25	h +0.1	b ₄ +0.2	r ±0.2
mm						
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
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



O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.25	h +0.1	b ₄ +0.2	r ±0.2
mm						
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	1.90	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
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 should always be $r = 0.25 \pm 0.2$ mm (0.010 ± 0.008 inch).

2) The given values for the housing depth are based on the nominal O-Ring cross section dimensions. The O-Ring inside diameter and its stretch are not considered. The given installation dimensions cannot be used for FFKM materials (Isolast®). Please use the Isolast® brochure or contact our specialists for further details.



Table 53: Housing dimensions – Inch

O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.010	h +0.004	b ₄ +0.008	r ±0.008
inch						
0.020	-	0.014	0.031	0.014	0.031	0.008
0.029	-	0.020	0.039	0.020	0.039	0.008
0.039	-	0.028	0.055	0.028	0.055	0.008
0.040	-	0.028	0.055	0.028	0.055	0.008
0.047	-	0.033	0.067	0.033	0.067	0.008
0.049	-	0.035	0.067	0.035	0.071	0.008
0.050	-	0.035	0.067	0.035	0.071	0.008
0.051	-	0.037	0.071	0.037	0.071	0.008
0.056	-	0.041	0.075	0.041	0.079	0.012
0.059	0.049	0.043	0.079	0.043	0.083	0.012
0.060	0.049	0.043	0.079	0.043	0.083	0.012
0.063	0.051	0.047	0.083	0.047	0.087	0.012
0.064	0.051	0.047	0.083	0.047	0.087	0.012
0.070*	0.057	0.051	0.094	0.051	0.102	0.012
0.071	0.057	0.051	0.094	0.051	0.102	0.012
0.072	0.059	0.053	0.098	0.053	0.102	0.012
0.075	0.061	0.055	0.102	0.055	0.106	0.012
0.078	0.065	0.059	0.106	0.059	0.110	0.012
0.079	0.065	0.059	0.106	0.059	0.110	0.012
0.082	0.069	0.061	0.110	0.061	0.114	0.012
0.083	0.069	0.061	0.110	0.061	0.114	0.012
0.087	0.073	0.063	0.118	0.063	0.118	0.012
0.089	0.075	0.067	0.118	0.067	0.122	0.012
0.091	0.077	0.069	0.122	0.069	0.122	0.012
0.092	0.077	0.069	0.122	0.069	0.122	0.012
0.094	0.081	0.071	0.126	0.071	0.130	0.012
0.097	0.083	0.073	0.130	0.073	0.134	0.012
0.098	0.085	0.075	0.130	0.075	0.134	0.012
0.103*	0.089	0.079	0.142	0.079	0.150	0.012
0.104	0.089	0.079	0.142	0.079	0.150	0.012
0.106	0.091	0.081	0.142	0.081	0.150	0.012
0.110	0.094	0.083	0.146	0.083	0.154	0.024
0.115	0.098	0.087	0.154	0.087	0.157	0.024
0.116	0.098	0.087	0.154	0.087	0.157	0.024
0.118	0.102	0.091	0.157	0.091	0.157	0.024
0.122	0.106	0.094	0.161	0.094	0.161	0.024
0.138	0.120	0.104	0.181	0.104	0.185	0.024
0.139*	0.122	0.106	0.189	0.106	0.197	0.024



O-Ring Cross-Section-Ø	Radial installation			Axial installation		Radius ¹⁾
	Housing depth ²⁾		Groove width	Groove depth	Groove width	
d ₂	Dynamic (t)	Static (t)	b ₁ +0.010	h +0.004	b ₄ +0.008	r ±0.008
inch						
0.140	0.122	0.106	0.189	0.106	0.197	0.024
0.142	0.124	0.110	0.189	0.110	0.201	0.024
0.157	0.138	0.122	0.205	0.122	0.209	0.024
0.177	0.157	0.138	0.228	0.138	0.232	0.024
0.197	0.173	0.157	0.260	0.157	0.264	0.024
0.209	0.185	0.169	0.280	0.169	0.287	0.024
0.210*	0.185	0.169	0.280	0.169	0.287	0.024
0.217	0.189	0.177	0.280	0.177	0.287	0.024
0.224	0.197	0.181	0.283	0.181	0.291	0.024
0.236	0.209	0.193	0.291	0.193	0.299	0.024
0.256	0.224	0.213	0.315	0.213	0.323	0.039
0.275*	0.240	0.228	0.374	0.228	0.382	0.039
0.276	0.240	0.228	0.374	0.228	0.382	0.039
0.295	0.260	0.248	0.382	0.248	0.390	0.039
0.315	0.280	0.264	0.386	0.264	0.394	0.039
0.331	0.295	0.280	0.394	0.280	0.406	0.039
0.354	0.319	0.303	0.417	0.303	0.429	0.059
0.374	0.339	0.323	0.433	0.323	0.449	0.059
0.394	0.358	0.339	0.457	0.339	0.472	0.079
0.472	0.433	0.417	0.531	0.417	0.551	0.079

* Preferred sizes

1) If a Back-up Ring is used, the recommended radius should always be $r = 0.25 \pm 0.2$ mm (0.010 ± 0.008 inch).

2) The given values for the housing depth are based on the nominal O-Ring cross section dimensions. The O-Ring inside diameter and its stretch are not considered. The given installation dimensions cannot be used for FFKM materials (Isolast®). Please use the Isolast® brochure or contact our specialists for further details.



ASSEMBLY

Axial sealing

In case of axial sealing applications, e.g. flanges, there is no need for any special precautions.

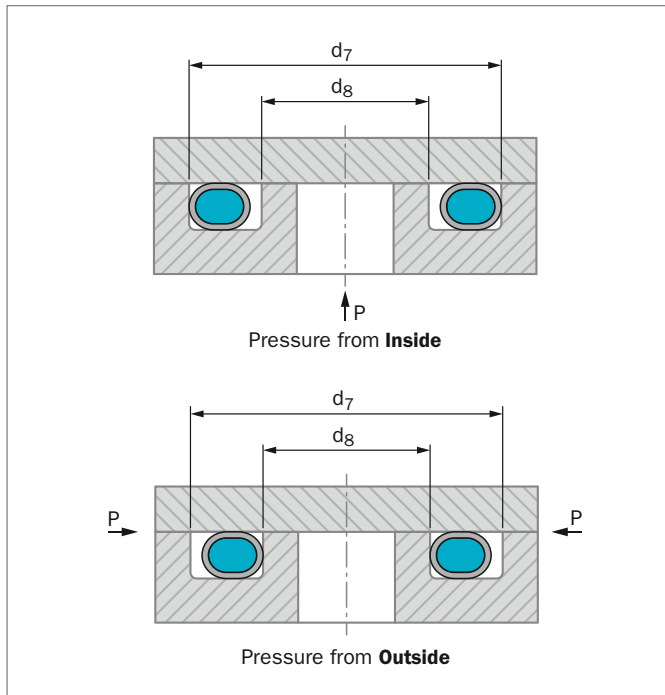


Figure 46: Axial sealing

Radial sealing - split grooves

Split grooves for radial piston or rod seal applications offer the same easy installation as axial sealing applications

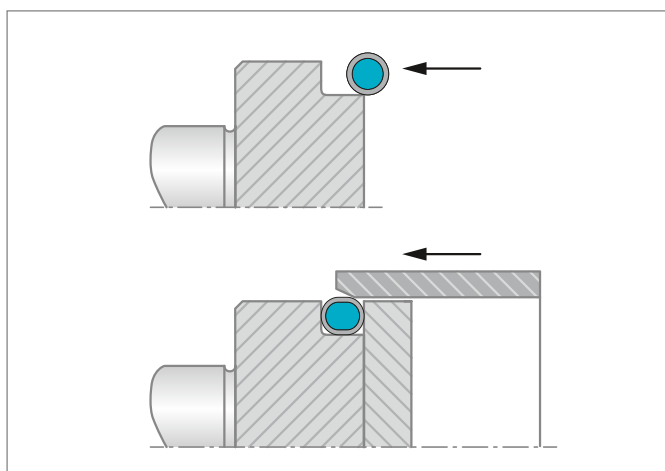


Figure 47: Radial sealing - Split grooves

Radial sealing - solid grooves

Recommendations for assembly:

- Clean, if possible, lubricated housing surface
- Soften the encapsulation by immersing the O-Ring in hot water 60° - 80°C (140° - 180°F)

- Install the O-Ring immediately after warming
- Prevent bending and overstretching
- For outer sealing, position the O-Ring on the installation cone and push it firmly and constantly up the cone until it snaps into the groove. Push the resizing tool over the seal and move the tool axially.

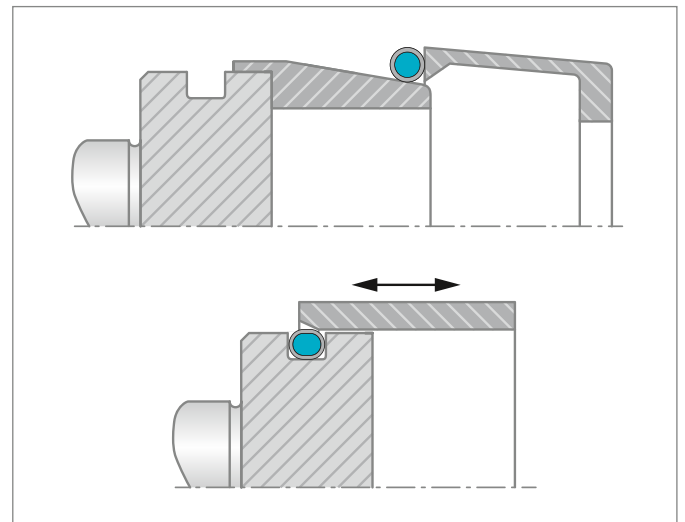


Figure 48: Radial outer sealing - Solid grooves

- For inner sealing place a section of the O-Ring within the groove and work the remaining seal in place by carefully pushing the blunt end of the installation tool. Use the chamfered end of the tool to resize the seal by pushing axially.

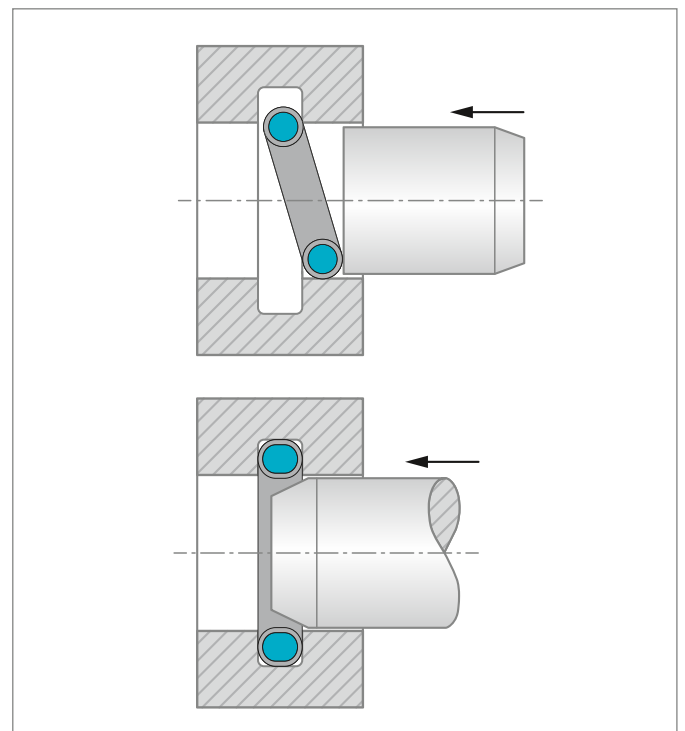


Figure 49: Radial inner sealing - Solid grooves



DIMENSIONS AND TOLERANCES

FEP/PFA Encapsulated O-Rings are manufactured in the same sizes as most elastomer O-Rings. The product range covers nearly all important national and international standards, including:

- ISO 3601
- AS 568
- BS 1806
- JIS B2401
- SMS 1586
- NFT 47-502

Table 54 and Table 55 show the tolerances for inside diameters (d_1). Table 56 and Table 57 show the smallest inside diameters available for different cross-sections (d_2) and their appropriate tolerances.

Table 54: Tolerances for inside diameters d_1 - Metric

Tolerances Inside diameter d_1	
Inside diameter d_1	Tolerance +/-
mm	mm
≤ 12.7	0.20
≤ 25.4	0.25
≤ 38.1	0.30
≤ 50.8	0.45
≤ 63.5	0.55
≤ 88.9	0.61
≤ 101.6	0.71
≤ 127.0	0.76
≤ 152.4	0.94
≤ 177.8	1.02
≤ 203.2	1.14
≤ 254.0	1.40
≤ 330.2	1.52
≤ 406.4	1.78
≤ 800	2.00
≤ 1000	2.00
≤ 1500	2.75
≤ 2000	3.90
≤ 2500	9.00
≤ 3000	11.25
≤ 3500	13.50
≤ 4000	15.75

Tolerances Inside diameter d_1	
Inside diameter d_1	Tolerance +/-
mm	mm
≤ 4500	18.00
≤ 5000	20.25
≤ 5500	22.50
≤ 6000	24.75

Table 55: Tolerances for inside diameters d_1 - Inch

Tolerances Inside diameter d_1	
Inside diameter d_1	Tolerance +/-
inch	inch
≤ 0.5	0.01
≤ 1.0	0.01
≤ 1.5	0.01
≤ 2.0	0.02
≤ 2.5	0.02
≤ 3.5	0.02
≤ 4.0	0.03
≤ 5.0	0.03
≤ 6.0	0.04
≤ 7.0	0.04
≤ 8.0	0.04
≤ 10	0.06
≤ 13	0.06
≤ 16	0.07
≤ 31.496	0.08
≤ 39.370	0.08
≤ 59.055	0.11
≤ 78.740	0.15
≤ 98.425	0.35
≤ 118.110	0.44
≤ 137.795	0.53
≤ 157.480	0.62
≤ 177.165	0.71
≤ 196.850	0.80
≤ 216.535	0.89
≤ 236.220	0.97



Table 56: Standard and special tolerances for cross-section-Ø d₂ with minimum or maximum O-Ring Inside-Ø

Tolerance cross section diameter d ₂						
Cross section diameter d ₂	Standard		Special			
	Tolerance cross section d ₂	Minimum Inside diameter d ₁ (≥)	Tolerance cross section d ₂	Maximum Inside diameter d ₁ (<)		
mm	mm	mm	mm	mm	mm	
1.50 - 2.50	-0,08	0,12	16	-0,14	0,19	16
2,62	-0,08	0,12	18	-0,14	0,19	18
3,00	-0,08	0,12	22	-0,16	0,22	22
3,15	-0,08	0,15	22	-0,16	0,22	22
3.50 / 3.53	-0,08	0,15	24	-0,18	0,25	24
3.80 - 4.00	-0,10	0,18	32	-0,21	0,28	32
4,30	-0,10	0,18	35	-0,21	0,28	35
4.50 - 4.75	-0,10	0,18	37	-0,21	0,28	37
5.00 - 5.33	-0,13	0,20	37	-0,25	0,32	37
5,50	-0,13	0,20	48	-0,25	0,32	48
5,70	-0,13	0,20	52	-0,25	0,32	52
6,00	-0,13	0,20	53	-0,25	0,32	53
6,30	-0,13	0,20	55	-0,25	0,32	55
6,50	-0,15	0,23	55	-0,29	0,36	55
6.99 - 7.00	-0,15	0,23	60	-0,29	0,36	60
7,50	-0,16	0,24	75	-0,32	0,42	75
8,00	-0,16	0,24	85	-0,32	0,42	85
8,40	-0,16	0,24	105	-0,32	0,42	105
9.00 - 9.50	-0,16	0,24	110	-0,35	0,50	110
10,00	-0,17	0,26	125	-0,35	0,50	125
11,00	-0,17	0,26	135	-0,40	0,55	135
12,00	-0,17	0,26	145	-0,40	0,55	145
12,70	-0,17	0,26	170	-0,40	0,55	170
14,00	-0,19	0,29	250	-0,40	0,55	250
15.00 - 16.00	-0,19	0,29	280	-0,45	0,60	280
18,00	-0,20	0,30	340	-0,50	0,70	340
19,00	-0,21	0,32	340	-0,55	0,75	340
20,00	-0,21	0,32	370	-0,60	0,80	370
25,40	-1,00	1,20	230			
31,70	-1,00	1,20	400			

Table 57: Standard and special tolerances for cross-section-Ø d₂ with minimum or maximum O-Ring Inside-Ø

Tolerance cross section diameter d ₂						
Cross section diameter d ₂	Standard		Special			
	Tolerance cross section d ₂	Minimum Inside diameter d ₁ (≥)	Tolerance cross section d ₂	Maximum Inside diameter d ₁ (<)		
inch	inch	inch	inch	inch	inch	
0.059 - 0.098	-0,003	0,005	0,630	-0,006	0,007	0,630
0,103	-0,003	0,005	0,709	-0,006	0,007	0,709
0,118	-0,003	0,005	0,866	-0,006	0,009	0,866
0,124	-0,003	0,006	0,866	-0,006	0,009	0,866
0.138 / 0.139	-0,003	0,006	0,945	-0,007	0,010	0,945
0.150 - 0.157	-0,004	0,007	1,260	-0,008	0,011	1,260
0,169	-0,004	0,007	1,378	-0,008	0,011	1,378
0.177 - 0.187	-0,004	0,007	1,457	-0,008	0,011	1,457
0.197 - 0.210	-0,005	0,008	1,457	-0,010	0,013	1,457
0,217	-0,005	0,008	1,890	-0,010	0,013	1,890
0,224	-0,005	0,008	2,047	-0,010	0,013	2,047
0,236	-0,005	0,008	2,087	-0,010	0,013	2,087
0,248	-0,005	0,008	2,165	-0,010	0,013	2,165
0,256	-0,006	0,009	2,165	-0,011	0,014	2,165
0.275 - 0.276	-0,006	0,009	2,362	-0,011	0,014	2,362
0,295	-0,006	0,009	2,953	-0,013	0,017	2,953
0,315	-0,006	0,009	3,346	-0,013	0,017	3,346
0,331	-0,006	0,009	4,134	-0,013	0,017	4,134
0.354 - 0.374	-0,006	0,009	4,331	-0,014	0,020	4,331
0,394	-0,007	0,010	4,921	-0,014	0,020	4,921
0,433	-0,007	0,010	5,315	-0,016	0,022	5,315
0,472	-0,007	0,010	5,709	-0,016	0,022	5,709
0,500	-0,007	0,010	6,693	-0,016	0,022	6,693
0,551	-0,007	0,011	9,843	-0,016	0,022	9,843
0.591 - 0.630	-0,007	0,011	11,024	-0,018	0,024	11,024
0,709	-0,008	0,012	13,386	-0,020	0,028	13,386
0,748	-0,008	0,013	13,386	-0,022	0,030	13,386
0,787	-0,008	0,013	14,567	-0,024	0,031	14,567
1,000	-0,039	0,047	9,055			
1,248	-0,039	0,047	15,748			



SERVICE PLUS

Trelleborg Sealing Solutions can print markings or identifiers on to the core of the FEP/PFA Encapsulated O-Rings, such as brand-names, article numbers and more.



TSS Article No. OF 30 03000 - SZ00G

TSS Article - Group ————
 Cross Section (mm) x 10 ————
 Inside Diameter (mm) x 100 ————
 Quality Index (Standard) ————
 Material Code (VMQ, FEP encapsulated) ————

ORDERING EXAMPLES

ORDERING EXAMPLE 1

Type:	O-Ring, PFA encapsulated ISO 3601 resp. AS 568 reference no. 356
Dimensions:	Inside diameter $d_1 = 135.89$ mm (5.350 inch) Cross section $d_2 = 5.33$ mm (0.210 inch)
Material of the inner ring:	Fluorocarbon Rubber (FKM)

TSS Article No. OF AR 00356 - VZ01G

TSS Article - Group ————
 Standard ISO 3601-1/AS 568 ————
 Size Code (Dash-No.) ————
 Quality Index (Standard) ————
 Material Code (FKM, PFA encapsulated) ————

ORDERING EXAMPLE 2

Type:	O-Ring 30 x 3, FEP encapsulated
Dimensions:	Inside diameter $d_1 = 30.0$ mm (1.181 inch) Cross section $d_2 = 3.0$ mm (0.118 inch)
Material of the inner ring:	Silicone Rubber (VMQ)



■ 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 - characterized by the inside diameter d_1 and the cord diameter d_2 (Figure 50). PTFE O-Rings are not molded but produced by machining. The rings can therefore be manufactured in all sizes.

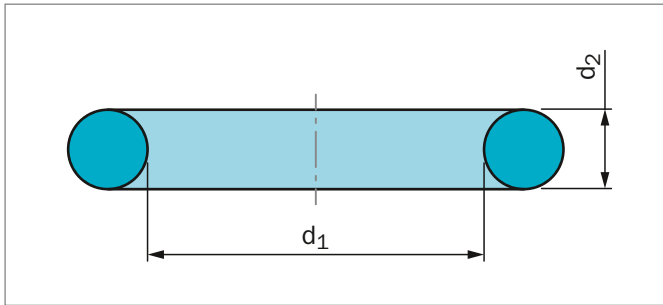


Figure 50: O-Ring dimensions

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 approximately -200 °C (-328 °F), up to +200 °C (+392 °F), partly even up to +260 °C (+500 °F) depending on the application
- Suitable for contact with foodstuffs, pharmaceutical and medicinal products
- Physiologically safe, can be sterilized
- Low friction, no adhesion
- Available for all diameters up to approximately 1,000 mm (39.370 inch).

APPLICATIONS

Fields of application

PTFE O-Rings are used wherever the chemical and thermal resistance of the normal elastomer O-Ring 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 (3,656 psi)
Temperature:	-60 °C (-76 °F) up to +260 °C (+500 °F) depending on the application parameters
Media:	Practically all liquids, gases and chemicals

MATERIALS

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

PTFE is a partially crystalline thermoplastic characterized 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 aging, 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 easily accessible axial and radial split grooves are 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-Rings can only be stretched or compressed to a very limited extent during installation.

During installation, such as on flanges, the cold flow tendency of the thermoplastic PTFE should be taken into consideration. Under pressure, PTFE deforms plastically even 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

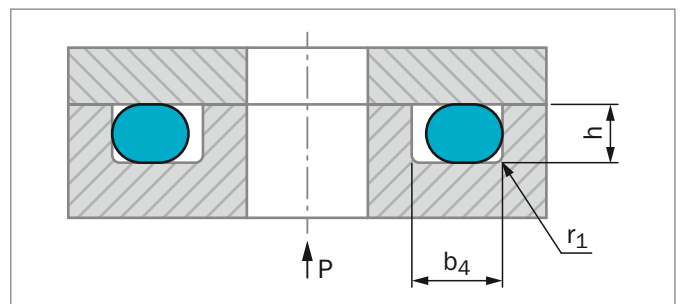


Figure 51: Axial installation, static, inside pressure

**Table 58: Installation Dimensions – Metric**

Cross- Section-Ø d_2	Groove dimensions		Radius r_1
	Groove depth $h +0.05$	Groove width $b_4 +0.1$	
mm			
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

Table 59: Installation Dimensions – Inch

Cross- Section-Ø d_2	Groove dimensions		Radius r_1
	Groove depth $h +0.002$	Groove width $b_4 +0.04$	
inch			
0.059	0.051	0.067	0.008
0.063	0.055	0.071	0.012
0.070 / 0.071	0.063	0.079	0.016
0.079	0.071	0.087	0.020
0.094	0.085	0.102	0.020
0.098	0.089	0.110	0.020
0.103 / 0.104	0.093	0.114	0.024
0.118	0.106	0.130	0.031
0.139/0.140	0.124	0.154	0.039
0.157	0.142	0.173	0.039
0.197	0.177	0.217	0.039
0.210 / 0.209	0.189	0.232	0.047
0.224	0.201	0.248	0.047
0.236	0.220	0.260	0.047
0.276	0.248	0.303	0.059
0.315	0.283	0.346	0.059
0.331	0.297	0.362	0.079

AVAILABLE DIMENSIONS

PTFE O-Rings are available in the same dimensions as elastomer O-Rings. See O-Ring dimensions, Table 34 - Table 42, page 80 - page 101.

ORDERING EXAMPLE

Type:	O-Ring, 40 x 3 mm (1.575 x 0.118 inch)
Dimensions:	Inside diameter $d_1 = 40.0$ mm (1.575 inch) Cross section $d_2 = 3.0$ mm (0.118 inch)

TSS Article No.	OR 30 004000 - PT00
TSS Article - Group	OR
Cross Section (mm) x 10	30
Inside Diameter (mm) x 100	004000
Quality Index (Standard)	-
Material Code (Standard)	PT00

For O-Ring dimensions and TSS Part No. see Table 34 - Table 41, page 80 - page 101.

Ordering numbers can also be made using the O-Ring dimensions and material.



■ 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 making it ideal for O-Rings and other sealing elements.

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

Polyurethane O-Rings are available in dimensions in accordance with ISO 3601-1/AS 568 (see Table 34/Table 35, Seite 80 - Seite 124).

The dimensions are given with the inside diameter d_1 and the cross section diameter d_2 (Figure 52, Seite 127).

ADVANTAGES

The main advantages of a polyurethane material for O-Rings compared with other elastomers 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 can include 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 be used in applications such as pneumatics where low compression set and low friction are essential.

TECHNICAL DATA

Working pressure:	Static up to approximately 60 MPa (8,702 psi) without Back-up Ring depending on the extrusion gap Dynamic up to 25 MPa (3,626 psi)
Speed:	Reciprocating up to 0.2 m/s (0.65 ft/s)
Temperature:	-45 °C (-49 °F) up to +100 °C (+212 °F) depending on the material
Media:	Hydraulic fluids, 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 aging
- High damping properties
- Low gas permeability
- Good hydrolysis resistance
- High tear propagation resistance
- Free from substances which hinder paint coverage

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

Polyurethane compounds are not resistant to:
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 24, Seite 59.

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 depends on the material, O-Ring cross section and application properties, such as the temperature.

O-RING DIMENSIONS

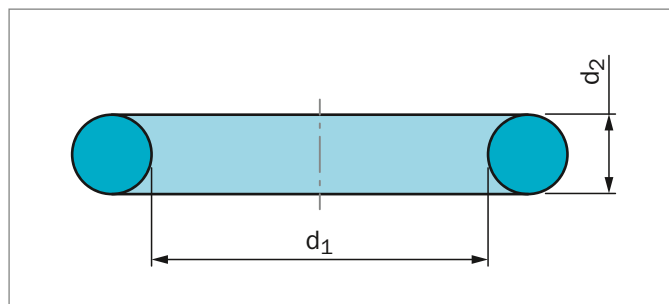


Figure 52: O-Ring dimensions

Table 60: Available dimensions in accordance with ISO 3601-1/AS 568 (Further sizes on request) – Metric and Inch

TSS Part No.	Inside-Ø	Cross-Section-Ø	Inside-Ø	Cross-Section-Ø
	d ₁	d ₂	d ₁	d ₂
	mm		inch	
ORAR00005	2.57	1.78	0.101	0.070
ORAR00006	2.90	1.78	0.114	0.070
ORAR00008	4.47	1.78	0.176	0.070
ORAR00009	5.28	1.78	0.208	0.070
ORAR00010	6.07	1.78	0.239	0.070
ORAR00011	7.65	1.78	0.301	0.070
ORAR00012	9.25	1.78	0.364	0.070
ORAR00013	10.82	1.78	0.426	0.070
ORAR00014	12.42	1.78	0.489	0.070
ORAR00015	14.00	1.78	0.551	0.070
ORAR00017	17.17	1.78	0.676	0.070
ORAR00018	18.77	1.78	0.739	0.070
ORAR00019	20.35	1.78	0.801	0.070
ORAR00020	21.95	1.78	0.864	0.070

TSS Part No.	Inside-Ø	Cross-Section-Ø	Inside-Ø	Cross-Section-Ø
	d ₁	d ₂	d ₁	d ₂
	mm		inch	
ORAR00022	25.12	1.78	0.989	0.070
ORAR00023	26.70	1.78	1.051	0.070
ORAR00025	29.87	1.78	1.176	0.070
ORAR00027	33.05	1.78	1.301	0.070
ORAR00029	37.82	1.78	1.489	0.070
ORAR00034	53.70	1.78	2.114	0.070
ORAR00036	60.05	1.78	2.364	0.070
ORAR00039	69.57	1.78	2.739	0.070
ORAR00040	72.75	1.78	2.864	0.070
ORAR00041	75.92	1.78	2.989	0.070
ORAR00045	101.32	1.78	3.989	0.070
ORAR00046	107.67	1.78	4.239	0.070
ORAR00047	114.02	1.78	4.489	0.070
ORAR00050	133.07	1.78	5.239	0.070
ORAR00110	9.19	2.62	0.362	0.103
ORAR00111	10.77	2.62	0.424	0.103
ORAR00112	12.37	2.62	0.487	0.103
ORAR00113	13.94	2.62	0.549	0.103
ORAR00114	15.54	2.62	0.612	0.103
ORAR00115	17.12	2.62	0.674	0.103
ORAR00116	18.72	2.62	0.737	0.103
ORAR00117	20.29	2.62	0.799	0.103
ORAR00118	21.89	2.62	0.862	0.103
ORAR00119	23.47	2.62	0.924	0.103
ORAR00120	25.07	2.62	0.987	0.103
ORAR00122	28.24	2.62	1.112	0.103
ORAR00124	31.42	2.62	1.237	0.103
ORAR00125	32.99	2.62	1.299	0.103
ORAR00126	34.59	2.62	1.362	0.103
ORAR00127	36.17	2.62	1.424	0.103
ORAR00128	37.77	2.62	1.487	0.103
ORAR00129	39.34	2.62	1.549	0.103
ORAR00132	44.12	2.62	1.737	0.103
ORAR00133	45.69	2.62	1.799	0.103
ORAR00134	47.29	2.62	1.862	0.103
ORAR00135	48.90	2.62	1.925	0.103
ORAR00136	50.47	2.62	1.987	0.103
ORAR00137	52.07	2.62	2.050	0.103
ORAR00138	53.64	2.62	2.112	0.103
ORAR00141	58.42	2.62	2.300	0.103
ORAR00142	59.99	2.62	2.362	0.103
ORAR00145	64.77	2.62	2.550	0.103
ORAR00146	66.34	2.62	2.612	0.103

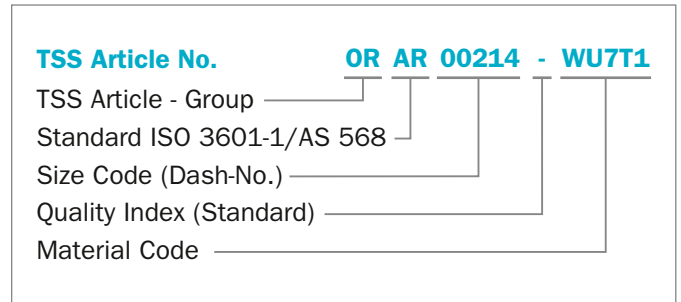


TSS Part No.	Inside-Ø	Cross-Section-Ø	Inside-Ø	Cross-Section-Ø
	d ₁	d ₂	d ₁	d ₂
	mm		inch	
ORAR00210	18.64	3.53	0.734	0.139
ORAR00211	20.22	3.53	0.796	0.139
ORAR00213	23.39	3.53	0.921	0.139
ORAR00214	24.99	3.53	0.984	0.139
ORAR00215	26.57	3.53	1.046	0.139
ORAR00216	28.17	3.53	1.109	0.139
ORAR00217	29.74	3.53	1.171	0.139
ORAR00218	31.34	3.53	1.234	0.139
ORAR00220	34.52	3.53	1.359	0.139
ORAR00222	37.69	3.53	1.484	0.139
ORAR00224	44.04	3.53	1.734	0.139
ORAR00225	47.22	3.53	1.859	0.139
ORAR00226	50.39	3.53	1.984	0.139
ORAR00227	53.57	3.53	2.109	0.139
ORAR00228	56.74	3.53	2.234	0.139
ORAR00229	59.92	3.53	2.359	0.139
ORAR00230	63.09	3.53	2.484	0.139
ORAR00231	66.27	3.53	2.609	0.139
ORAR00232	69.44	3.53	2.734	0.139
ORAR00234	75.79	3.53	2.984	0.139
ORAR00235	78.97	3.53	3.109	0.139
ORAR00236	82.14	3.53	3.234	0.139
ORAR00237	85.32	3.53	3.359	0.139
ORAR00238	88.49	3.53	3.484	0.139
ORAR00239	91.67	3.53	3.609	0.139
ORAR00240	94.84	3.53	3.734	0.139
ORAR00325	37.47	5.33	1.475	0.210
ORAR00326	40.64	5.33	1.600	0.210
ORAR00327	43.82	5.33	1.725	0.210
ORAR00328	46.99	5.33	1.850	0.210
ORAR00329	50.17	5.33	1.975	0.210
ORAR00330	53.34	5.33	2.100	0.210
ORAR00331	56.52	5.33	2.225	0.210
ORAR00332	59.69	5.33	2.350	0.210
ORAR00334	66.04	5.33	2.600	0.210
ORAR00336	72.39	5.33	2.850	0.210
ORAR00337	75.57	5.33	2.975	0.210
ORAR00338	78.74	5.33	3.100	0.210
ORAR00339	81.92	5.33	3.225	0.210
ORAR00340	85.09	5.33	3.350	0.210

Tolerances based on ISO 3601-1, class B. See Table 26 - Table 31, Seite 65 - Seite 76.

ORDERING EXAMPLE

Type:	O-Ring, ISO 3601 / AS 568, ref. 214
Dimensions:	Inside diameter d ₁ = 30.0 mm (1.181 inch) Cross section d ₂ = 3.0 mm (0.118 inch)
Material:	Polyurethane (AU 70 Shore A)



For O-Ring dimensions and TSS Part No. see Table 60.

For installation dimensions, see Table 24, Seite 59.

Ordering numbers can also be made using the O-Ring dimensions and material.



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 the 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, and electronics (in particular the production of flat panel displays).

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
- Clean room class 100 washing & packing possible

MATERIALS

- Isolast® FFKM
- Resifluor™ High Performance Fluoroelastomers
- FKM, EPDM, HNBR and others
- FDA, USP Class VI, NORSOK M-710 compliant RGD compounds available
- XploR™ advanced elastomers especially developed for oil and gas applications

DIMENSIONS

The Fleximold™ technology is recommended for O-Rings with inside diameters $d_1 > 600$ mm (23.622 inch). The tolerances in accordance with 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 following table. Further cross sections are available on request. Other seal profiles may be requested.

Table 61: Available standard cross-section- \emptyset and valid tolerances in accordance with ISO 3601-1, class B, table A.1 – Metric and Inch

Cross-Section- \emptyset			
d_2	Tolerance \pm	d_2	Tolerance \pm
mm		inch	
3.00	0.09	0.118	0.004
3.10	0.09	0.122	0.004
3.50	0.10	0.138	0.004
3.53	0.10	0.139	0.004
3.55	0.10	0.140	0.004
4.00	0.10	0.157	0.004
5.00	0.13	0.197	0.005
5.30	0.13	0.209	0.005
5.33	0.13	0.210	0.005
5.70	0.13	0.224	0.005
6.99	0.15	0.275	0.006
7.00	0.15	0.276	0.006
8.00	0.15	0.315	0.006
8.40	0.15	0.331	0.006
10.00	0.21	0.394	0.008
12.00	0.25	0.472	0.010



D.6 SPECIAL OVERSIZED O-RINGS

With a unique, innovative and highly automated production technology, we can offer large O-Rings in nearly unlimited diameters combined with a outstanding range of cross-sections.

FEATURES

- No mold costs for standard cross sections
- No minimum order volume
- Short delivery time due to semi-finished O-Rings available from stock (in standard materials)
- No dimensional limits for the O-Ring inside diameter
- Mechanical properties comparable to traditional molding systems
- Standard surface quality based on ISO3601-3 Grade N (Grade S on demand)
- Special visual inspection machines for 100% surface quality control
- Printing of customized information onto the O-Rings

MATERIALS

NBR, FKM, EPDM and others

DIMENSIONS

For O-Ring inside diameters > 200 mm (7.874 inch)
Dimensional O-Ring tolerances for inside diameters based on ISO3601-1 Class B

Table 62: Standard cross-sections and tolerances

Cross-Section-Ø d ₂	Tolerance +/-	Cross-Section-Ø d ₂	Tolerance +/-
mm		inch	
2.62	± 0.08	0.103	0.003
3.00	± 0.09	0.118	0.003
3.53	± 0.10	0.139	0.004
4.00	± 0.10	0.157	0.004
4.50	± 0.10	0.177	0.004
5.00	± 0.13	0.197	0.005
5.33	± 0.13	0.210	0.005
5.50	± 0.13	0.216	0.005
5.70	± 0.15	0.224	0.006
6.00	± 0.15	0.236	0.006
6.35	± 0.15	0.250	0.006
6.50	± 0.15	0.256	0.006
7.00	± 0.15	0.276	0.006
7.50	± 0.15	0.295	0.006
8.00	± 0.18	0.315	0.007
8.40	± 0.18	0.331	0.007
8.50	± 0.18	0.334	0.007
9.00	± 0.20	0.354	0.008
9.52	± 0.20	0.375	0.008
10.00	± 0.20	0.394	0.008
10.82	± 0.20	0.425	0.008
11.00	± 0.20	0.433	0.008
12.00	± 0.22	0.472	0.009
12.70	± 0.23	0.499	0.009
13.00	± 0.23	0.512	0.009
14.00	± 0.25	0.551	0.010
14.40	± 0.26	0.566	0.010
15.00	± 0.27	0.591	0.011
16.00	± 0.28	0.630	0.011
17.00	± 0.30	0.669	0.012
18.00	± 0.32	0.709	0.013
19.00	± 0.34	0.747	0.013
20.00	± 0.36	0.787	0.014
22.00	± 0.38	0.865	0.015
24.00	± 0.42	0.944	0.017
25.00	± 0.43	0.983	0.017
26.00	± 0.44	1.022	0.017
28.00	± 0.49	1.100	0.019
30.00	± 0.54	1.179	0.021
40.00	± 0.72	1.572	0.028
60.00	± 1.08	2.362	0.043



D.7 ROUND CORD RINGS (BUTT VULCANIZED)

Round cords are produced by butt jointing extruded round cords using a special vulcanization process. They are supplied as cut lengths. The most common materials are NBR 70 Shore A, EPDM 70 Shore A and FKM 75 Shore A. Other materials are available on request.

In contrast to mold-vulcanized O-Rings, round rings made from continuously extruded cord can be made up to any desired diameter > 50 mm (1.969 inch).

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 conditions.

The tolerances of the cut O-Ring length are acc. to ISO3302-1 L1. For tolerances of the cross sections, d_2 see the tables below.

When using round cord rings in high-vacuum applications, it is recommended to use FKM. In these cases the joint has to be manufactured to a special high-vacuum quality and has to be ordered accordingly. Please contact your local Trelleborg Sealing Solutions marketing 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 vulcanization 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.

IMPORTANT NOTE

The mechanical properties of the joint are slightly poorer than those of the basic material.

Thus in application and testing the joint should only be stretched and must not be folded. A guiding value for the maximum bending radius at the joint is $\leq \frac{1}{4}$ of the inside diameter of the round cord ring.

Table 63: Available cross-section- \emptyset and valid tolerances for NBR 70 Shore A – Metric and Inch

Cross-Section- \emptyset d_2	Tolerance	Cross-Section- \emptyset d_2	Tolerance
mm		inch	
1.00	+ 0.2 / - 0	0.039	+ 0.008
1.50	+ 0.2 / - 0.1	0.059	+ 0.008 /
1.78		0.070	- 0.004
2.00	+ 0.3 / - 0.1	0.079	+ 0.012 /
2.50		0.098	- 0.004
3.00	+ 0.35 / - 0.15	0.118	+ 0.014 / - 0.006
3.20		0.126	
3.53		0.139	
4.00		0.157	
4.75	+ 0.45 / - 0.2	0.187	+ 0.018 / - 0.008
5.00		0.197	
5.33		0.210	
5.70		0.224	
6.00		0.236	
6.40		0.252	
7.00	+ 0.50 / - 0.2	0.276	+ 0.02 / - 0.008
7.50		0.295	
8.00		0.315	
8.40		0.331	
9.00		0.354	
9.50		0.374	
10.00	+ 0.55 / - 0.3	0.394	+ 0.022 / - 0.012
11.00		0.433	
12.00		0.472	
12.70		0.500	
13.00	+ 0.6 / - 0.3	0.512	+ 0.024 / - 0.012
14.00		0.551	
15.00		0.591	
16.00		0.630	
18.00	+ 0.8 / - 0.4	0.709	+ 0.031 / - 0.016
20.00	+ 0.8 / - 0.5	0.787	+ 0.031 / - 0.02
22.00		0.866	
25.00		0.984	
30.00		1.181	



Table 64: Available cross-section-ø and valid tolerances for EPDM 70 Shore A – Metric and Inch

Cross-Section-ø d ₂	Tolerance	Cross-Section-ø d ₂	Tolerance
mm		inch	
2.00	+ 0.3 / - 0.1	0.079	+ 0.012 / - 0.004
2.50		0.098	
3.00	+ 0.35 / - 0.15	0.118	+ 0.014 /
3.50		0.138	- 0.006
4.00		0.157	
5.00	+ 0.4 / - 0.25	0.197	+ 0.016 /
5.30		0.209	- 0.01
5.70		0.224	
6.00	+ 0.45 / - 0.25	0.236	+ 0.018 / - 0.01
7.00	+ 0.5 / - 0.25	0.276	+ 0.02 / - 0.01
8.00	+ 0.50 / - 0.3	0.315	
9.00		0.354	+ 0.02 /
9.50		0.374	- 0.012
10.00		0.394	
11.00		0.433	
12.00	+ 0.7 / - 0.3	0.472	
13.00		0.512	+ 0.028 /
14.00		0.551	- 0.012
15.00		0.591	
18.00		0.709	
20.00		+ 0.9 / - 0.5	0.787

Table 65: Available cross-section-ø and valid tolerances for FKM 75 Shore A – Metric and Inch

Cross-Section-ø d ₂	Tolerance	Cross-Section-ø d ₂	Tolerance
mm		inch	
1.78	+ 0.3 / - 0.1	0.08	+ 0.012 /
2.00		0.10	- 0.004
2.60		0.12	+ 0.012 /
3.00	+ 0.3 / - 0.2	0.14	- 0.008
3.50		0.16	+ 0.016 /
4.00	+ 0.4 / - 0.2	0.18	- 0.008
4.50			

Cross-Section-ø d ₂	Tolerance	Cross-Section-ø d ₂	Tolerance
mm		inch	
5.00	+ 0.4 / - 0.3	0.20	
5.30		0.21	
5.70		0.22	+ 0.016 /
6.00		0.24	- 0.012
6.50		0.26	
7.00	+ 0.5 / - 0.3	0.28	
8.00		0.31	+ 0.020 /
8.40		0.33	- 0.012
9.00		0.35	
10.00	+ 0.55 / - 0.35	0.39	+ 0.022 /
11.00		0.43	- 0.014
12.00		0.47	
14.00	+ 0.6 / - 0.4	0.55	+ 0.024 /
15.00		0.59	- 0.016
18.00		0.71	
20.00		+ 0.8 / - 0.6	0.79

D.8 O-RING SURFACE FINISHING

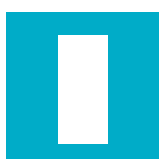
In many cases standard elastomeric O-Rings cannot be used without a modified surface. This may be necessary to reduce friction, eliminate potential contamination of the system, mark seals, or ensure tightness in special applications.

To prevent problems, O-Rings can be surface-treated by special cleaning, treatment, coating or trimming in order to ease assembly, to ensure function and long service-life.

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

For further details regarding surface finishing of seals please refer to the separate brochures Flexcoat™ – Friction-free Running, Flexclean™ – Technical Cleanliness for seals or Flexfinish™ - Finishing solution for large diameter O-Rings or contact your local Trelleborg Sealing Solutions marketing company.

Back-Up Rings



**PROTECTIVE AND SUPPORTING
ELEMENT**

**STATIC AND DYNAMIC APPLICATIONS, HIGH
PRESSURE**

**MATERIAL:
PTFE, ELASTOMERS AND OTHERS**

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■ E 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 pressurized elastomeric sealing element into the sealing gap.

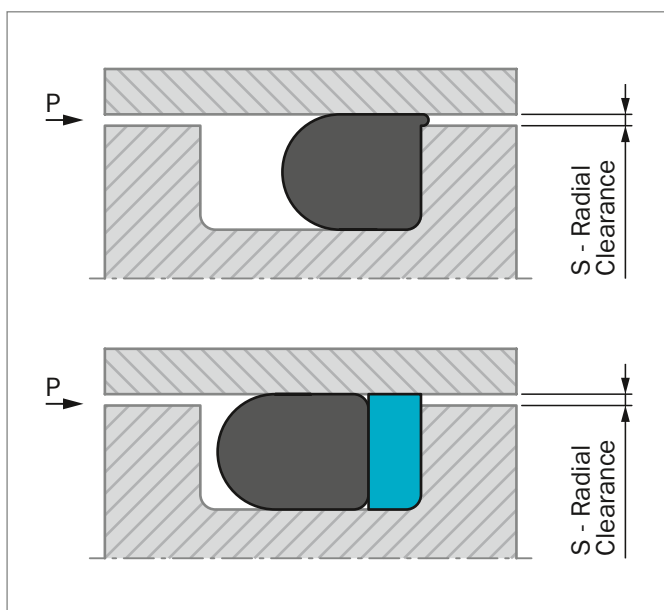


Figure 53: O-Ring installation with and without Back-up Ring

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

APPLICATION EXAMPLES

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



■ F Back-up Ring Types

■ F.1 Overview

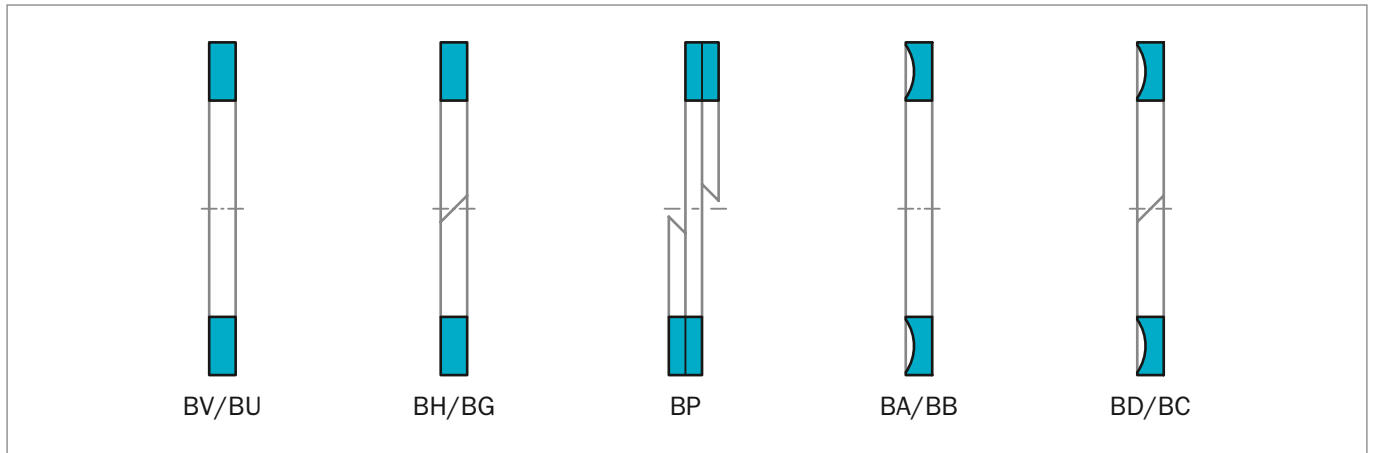


Figure 54: Back-up Ring types

External sealing (piston)

Type BV

- Rectangular, uncut, PTFE

Type BH

- Rectangular, cut, PTFE

Type BP

- Spiral, PTFE

Type BA

- Concave, uncut, PTFE

Type BB

- Concave, uncut, NBR + FKM

Type BD

- Concave, cut, PTFE

Internal sealing (rod)

Type BU

- Rectangular, uncut, PTFE

Type BG

- Rectangular, cut, PTFE

Type BP

- Spiral, PTFE

Type BB

- Concave, uncut, PTFE

Type BB

- Concave, uncut, NBR + FKM

Type BC

- Concave, cut, PTFE



■ F.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 pressures
- 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 pressures
- 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

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 pressures
- 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 of 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 through 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
- Recommended only if service diameter does not exceed 40 times the radial groove depth



■ F.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 pressures
- 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 pressures
- 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 of 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 through a screw-like elongation and contraction
- Recommended only if service diameter does not exceed 40 times the radial groove depth



■ G Technical Information

■ G.1 Materials

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

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 66: Back-up Ring materials

Base material	Material code	Type					Dynamic application	
		BU/BV	BG/BH	BP	BB/BA	BC/BD	Pressure	
							MPa	psi
PTFE (virgin) - standard	PT00	•	•	•	•	•	25	3,626
PTFE - glassfibre-filled	PTGB	•	•	•	•	•	40	5,801
PTFE, carbon-filled	PTKC	•	•	•	•	•	40	5,801
PTFE, bronze-filled	PTB4	•	•	•	•	•	40	5,801
TPE-E	PR	•	•	-	•	•	30	4,351
NBR, 90 Shore A	N962N	-	-	-	•	-	20	2,901
FKM, 90 Shore A	V96E1	-	-	-	•	-	20	2,901

■ G.2 Technical Data

Static applications:	Up to approximately 250 MPa (36,259 psi) depending on the Back-up Ring material and sealing gap
Dynamic applications:	Reciprocating up to approximately 40 MPa (5,801 psi) Oscillating/slowly rotating up to approximately 15 MPa (2,176 psi)
Speed:	Reciprocating or rotating up to approximately 2 m/s (4.474 mph) depending on the material
Operating temperature:	-200 °C (-328 °F) up to +260 °C (+500 °F) depending on the material

IMPORTANT NOTE

The application limits for pressure and temperature given in this catalog 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.



■ G.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 catalog, Part I: O-Ring, chapter B.2.7 Housing design and dimensions, to be increased.

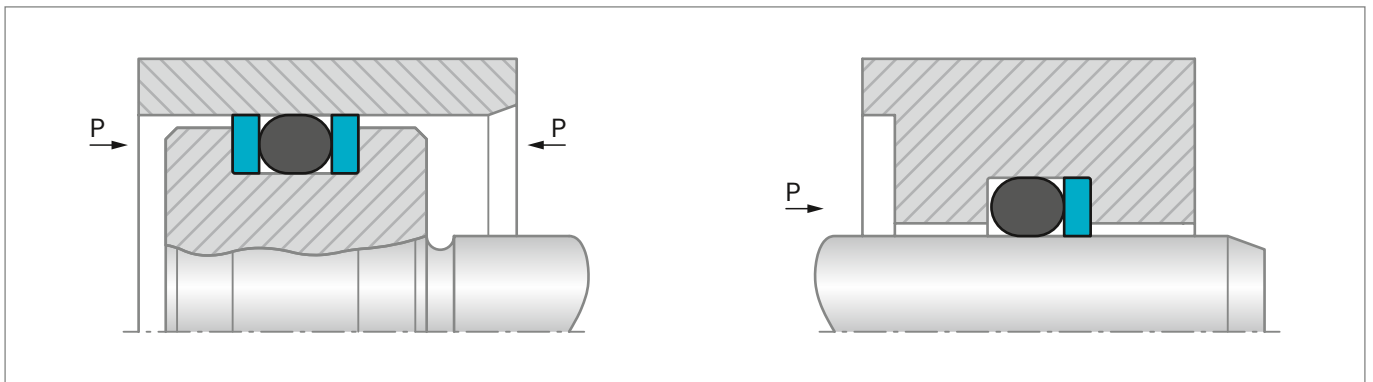


Figure 55: Back-up Ring installation, depending on the direction of the pressure



■ H Installation Recommendations and Back-up Ring Dimensions

■ H.1 External sealing (Piston), static and dynamic applications

H.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).

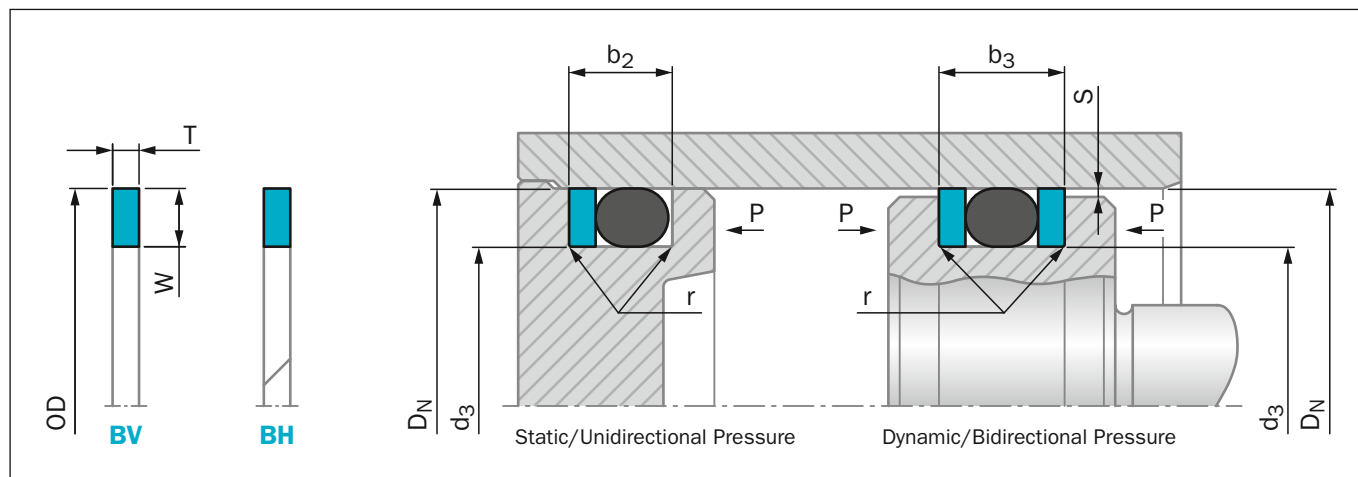


Figure 56: Installation drawing external sealing, rectangular Back-up Ring types

Table 67: Installation dimensions for rectangular Back-up Ring types, uncut and cut, External sealing, material PTFE – Metric

O-Ring Cross-Section- Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness	Groove diameter d ₃ h9		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.25	b ₃ +0.25	r ±0.2
mm								
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



O-Ring Cross-Section- Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₃ h9		Groove width		Radius r ±0.2
	Dynamic	Static		Dynamic	Static	b ₂ +0.25	b ₃ +0.25	
mm								
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
6.99	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

Table 68: Installation dimensions for rectangular Back-up Ring types, uncut and cut, External sealing, material PTFE – Inch

O-Ring Cross-Section- Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₃ h9		Groove width		Radius r ±0.008
	Dynamic	Static		Dynamic	Static	b ₂ +0.010	b ₃ +0.010	
inch								
0.059	0.049	0.043	0.039	D _N - 0.098	D _N - 0.087	0.118	0.157	0.010
0.063	0.051	0.047	0.039	D _N - 0.102	D _N - 0.094	0.122	0.161	0.010
0.070	0.057	0.051	0.055	D _N - 0.114	D _N - 0.102	0.150	0.205	0.010
0.071	0.057	0.051	0.055	D _N - 0.114	D _N - 0.102	0.150	0.205	0.010
0.079	0.065	0.059	0.055	D _N - 0.130	D _N - 0.118	0.161	0.217	0.010
0.094	0.081	0.071	0.055	D _N - 0.161	D _N - 0.142	0.181	0.236	0.010
0.098	0.085	0.075	0.055	D _N - 0.169	D _N - 0.150	0.185	0.240	0.010
0.103	0.089	0.079	0.055	D _N - 0.177	D _N - 0.157	0.197	0.252	0.010
0.104	0.089	0.079	0.055	D _N - 0.177	D _N - 0.157	0.197	0.252	0.010
0.118	0.102	0.091	0.055	D _N - 0.205	D _N - 0.181	0.213	0.268	0.010
0.139	0.122	0.106	0.055	D _N - 0.244	D _N - 0.213	0.244	0.299	0.010
0.140	0.122	0.106	0.055	D _N - 0.244	D _N - 0.213	0.244	0.299	0.010
0.157	0.138	0.122	0.067	D _N - 0.276	D _N - 0.244	0.272	0.339	0.010
0.197	0.173	0.157	0.067	D _N - 0.346	D _N - 0.315	0.327	0.394	0.010
0.209	0.185	0.169	0.067	D _N - 0.370	D _N - 0.339	0.354	0.429	0.010
0.210	0.185	0.169	0.067	D _N - 0.370	D _N - 0.339	0.354	0.429	0.010
0.224	0.197	0.181	0.067	D _N - 0.394	D _N - 0.362	0.354	0.433	0.010
0.236	0.209	0.193	0.067	D _N - 0.417	D _N - 0.386	0.366	0.441	0.010
0.275	0.240	0.228	0.098	D _N - 0.480	D _N - 0.457	0.484	0.594	0.010
0.315	0.280	0.264	0.098	D _N - 0.559	D _N - 0.528	0.496	0.606	0.010
0.331	0.295	0.280	0.098	D _N - 0.591	D _N - 0.559	0.504	0.614	0.010


ORDERING EXAMPLE

Back-up Ring:	Rectangular type BH (cut) for O-Ring seal
Application:	Static, external sealing
Bore diameter:	$D_N = 40.00$ mm (1.575 inch)
O-Ring Cross-Section:	$d_2 = 2.62$ mm (0.103 inch)
Back-up Ring material:	PTFE, glassfiber filled (25%)

TSS Article No. BH 20 0 0400 - PTGC

Back-Up Ring (Cut)	BH	20	0	0400	-	PTGC
Radial Height (mm) W x 10						
T-dimension (Standard, mm)						
Bore-Ø (mm) D_N x 10						
Quality Index (Standard)						
Material Code (Standard)						

For material code see page 139

Table 69: Preferred series for static applications, rectangular Back-up Ring Types BV (uncut) and BH (cut), External sealing, material PTFE – Metric

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.25$	$b_3 +0.25$			$r \pm 0.2$	OD x W x T		
mm									
D_N H8	d_3 h9	$b_2 +0.25$	$b_3 +0.25$	$r \pm 0.2$	OD x W x T	Uncut (BV)	Cut (BH)	No.	$d_1 \times d_2$
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
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

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.25$	$b_3 +0.25$			Uncut (BV)	Cut (BH)		
D_N H8	d_3 h9			$r \pm 0.2$	OD x W x T				$d_1 \times d_2$
mm									
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	ORAR0022	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
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	ORAR0034	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



Bore Ø	Groove Ø	Groove width		Radius r ±0.2	Back-up Ring dimension OD x W x T	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂	
		b ₂ +0.25	b ₃ +0.25			Uncut (BV)	Cut (BH)			
mm										
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	
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 available on request.

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

**Table 70: Preferred series for static applications, rectangular Back-up Ring
Types BV (uncut) and BH (cut), External sealing, material PTFE – Inch**

Bore ∅ D _N H8	Groove ∅ d ₃ h9	Groove width		Radius r ±0.008	Back-up Ring dimension OD x W x T	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010			Uncut (BV)	Cut (BH)		
inch									
0.236	0.134	0.150	0.205	0.010	0.236 x 0.051 x 0.055	BV1300060	BH1300060	ORAR00006	0.114 x 0.070
0.236	0.150	0.118	0.157	0.010	0.236 x 0.043 x 0.039	BV1100060	BH1100060	OR1500350	0.138 x 0.059
0.315	0.228	0.118	0.157	0.010	0.315 x 0.043 x 0.039	BV1100080	BH1100080	OR1500550	0.217 x 0.059
0.394	0.307	0.118	0.157	0.010	0.394 x 0.043 x 0.039	BV1100100	BH1100100	OR1500750	0.295 x 0.059
0.472	0.354	0.161	0.217	0.010	0.472 x 0.059 x 0.055	BV1500120	BH1500120	OR2000850	0.335 x 0.079
0.472	0.370	0.150	0.205	0.010	0.472 x 0.051 x 0.055	BV1300120	BH1300120	ORAR00012	0.364 x 0.070
0.551	0.433	0.161	0.217	0.010	0.551 x 0.059 x 0.055	BV1500140	BH1500140	OR2001000	0.394 x 0.079
0.551	0.449	0.150	0.205	0.010	0.551 x 0.051 x 0.055	BV1300140	BH1300140	ORAR00013	0.426 x 0.070
0.591	0.472	0.161	0.217	0.010	0.591 x 0.059 x 0.055	BV1500150	BH1500150	OR2001100	0.433 x 0.079
0.591	0.488	0.150	0.205	0.010	0.591 x 0.051 x 0.055	BV1300150	BH1300150	ORAR00014	0.489 x 0.070
0.630	0.512	0.161	0.217	0.010	0.630 x 0.059 x 0.055	BV1500160	BH1500160	OR2001200	0.472 x 0.079
0.630	0.528	0.150	0.205	0.010	0.630 x 0.051 x 0.055	BV1300160	BH1300160	ORAR00015	0.551 x 0.070
0.709	0.591	0.161	0.217	0.010	0.709 x 0.059 x 0.055	BV1500180	BH1500180	OR2001400	0.551 x 0.079
0.709	0.606	0.150	0.205	0.010	0.709 x 0.051 x 0.055	BV1300180	BH1300180	ORAR00016	0.614 x 0.070
0.787	0.669	0.161	0.217	0.010	0.787 x 0.059 x 0.055	BV1500200	BH1500200	OR2001600	0.630 x 0.079
0.787	0.685	0.150	0.205	0.010	0.787 x 0.051 x 0.055	BV1300200	BH1300200	ORAR00017	0.676 x 0.070
0.866	0.748	0.161	0.217	0.010	0.866 x 0.059 x 0.055	BV1500220	BH1500220	OR2001600	0.630 x 0.079
0.866	0.764	0.150	0.205	0.010	0.866 x 0.051 x 0.055	BV1300220	BH1300220	ORAR00018	0.739 x 0.070
0.984	0.866	0.161	0.217	0.010	0.984 x 0.059 x 0.055	BV1500250	BH1500250	OR2002100	0.827 x 0.079
0.984	0.882	0.150	0.205	0.010	0.984 x 0.051 x 0.055	BV1300250	BH1300250	ORAR00020	0.864 x 0.070
1.102	0.921	0.213	0.268	0.010	1.102 x 0.091 x 0.055	BV2300280	BH2300280	OR3002200	0.866 x 0.118
1.102	0.945	0.197	0.252	0.010	1.102 x 0.079 x 0.055	BV2000280	BH2000280	ORAR00119	0.924 x 0.103
1.181	1.000	0.213	0.268	0.010	1.181 x 0.091 x 0.055	BV2300300	BH2300300	OR3002400	0.945 x 0.079
1.181	1.024	0.197	0.252	0.010	1.102 x 0.079 x 0.055	BV2000280	BH2000280	ORAR00119	0.924 x 0.103
1.260	1.079	0.213	0.268	0.010	1.260 x 0.091 x 0.055	BV2300320	BH2300320	OR3002600	1.024 x 0.118
1.260	1.102	0.197	0.252	0.010	1.260 x 0.079 x 0.055	BV2000320	BH2000320	ORAR00121	1.049 x 0.103
1.378	1.197	0.213	0.268	0.010	1.378 x 0.091 x 0.055	BV2300350	BH2300350	OR3002900	1.154 x 0.118
1.378	1.220	0.197	0.252	0.010	1.378 x 0.079 x 0.055	BV2000350	BH2000350	ORAR00123	1.174 x 0.103
1.575	1.394	0.213	0.268	0.010	1.575 x 0.091 x 0.055	BV2300400	BH2300400	OR3003400	1.339 x 0.118
1.575	1.417	0.197	0.252	0.010	1.575 x 0.079 x 0.055	BV2000400	BH2000400	ORAR00126	1.362 x 0.103
1.654	1.472	0.213	0.268	0.010	1.654 x 0.091 x 0.055	BV2300420	BH2300420	OR3003600	1.417 x 0.118
1.654	1.496	0.197	0.252	0.010	1.654 x 0.079 x 0.055	BV2000420	BH2000420	ORAR00127	1.424 x 0.103
1.772	1.575	0.213	0.268	0.010	1.772 x 0.091 x 0.055	BV2300450	BH2300450	OR3003900	1.535 x 0.118
1.772	1.614	0.197	0.252	0.010	1.772 x 0.079 x 0.055	BV2000450	BH2000450	ORAR00129	1.549 x 0.103
1.890	1.646	0.272	0.339	0.010	1.890 x 0.122 x 0.067	BV3100480	BH3100480	OR4004000	1.575 x 0.157
1.890	1.677	0.244	0.299	0.010	1.890 x 0.106 x 0.055	BV2700480	BH2700480	ORAR00223	1.609 x 0.139
1.969	1.724	0.272	0.339	0.010	1.969 x 0.122 x 0.067	BV3100500	BH3100500	OR4004200	1.654 x 0.157
1.969	1.756	0.244	0.299	0.010	1.969 x 0.106 x 0.055	BV2700500	BH2700500	ORAR00224	1.734 x 0.139
2.047	1.803	0.272	0.339	0.010	2.047 x 0.122 x 0.067	BV3100520	BH3100520	OR4004400	1.732 x 0.157
2.047	1.835	0.244	0.299	0.010	2.047 x 0.106 x 0.055	BV2700520	BH2700520	ORAR00224	1.734 x 0.139



Bore ∅	Groove ∅	Groove width		Radius r	Back-up Ring dimension OD x W x T	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010			Uncut (BV)	Cut (BH)		
D _N H8	d ₃ h9			±0.008					
inch									
2.165	1.921	0.272	0.339	0.010	2.165 x 0.122 x 0.067	BV3100550	BH3100550	OR4004700	1.850 x 0.157
2.165	1.953	0.244	0.299	0.010	2.165 x 0.106 x 0.055	BV2700550	BH2700550	ORAR00225	1.859 x 0.139
2.362	2.118	0.272	0.339	0.010	2.362 x 0.122 x 0.067	BV3100600	BH3100600	OR4005200	2.047 x 0.157
2.362	2.150	0.244	0.299	0.010	2.362 x 0.106 x 0.055	BV2700600	BH2700600	ORAR00227	2.109 x 0.139
2.480	2.236	0.272	0.339	0.010	2.480 x 0.122 x 0.067	BV3100630	BH3100630	OR4005500	2.165 x 0.157
2.480	2.268	0.244	0.299	0.010	2.480 x 0.106 x 0.055	BV2700630	BH2700630	ORAR00228	2.234 x 0.139
2.559	2.315	0.272	0.339	0.010	2.559 x 0.122 x 0.067	BV3100650	BH3100650	OR4005700	2.244 x 0.157
2.559	2.346	0.244	0.299	0.010	2.559 x 0.106 x 0.055	BV2700650	BH2700650	ORAR00228	2.234 x 0.139
2.756	2.512	0.272	0.339	0.010	2.756 x 0.122 x 0.067	BV3100700	BH3100700	OR4006200	2.441 x 0.157
2.756	2.543	0.244	0.299	0.010	2.756 x 0.106 x 0.055	BV2700700	BH2700700	ORAR00230	2.484 x 0.139
2.953	2.709	0.272	0.339	0.010	2.953 x 0.122 x 0.067	BV3100750	BH3100750	OR4006700	2.638 x 0.157
2.953	2.740	0.244	0.299	0.010	2.953 x 0.106 x 0.055	BV2700750	BH2700750	ORAR00231	2.609 x 0.139
3.150	2.906	0.272	0.339	0.010	3.150 x 0.122 x 0.067	BV3100800	BH3100800	OR4007200	2.835 x 0.157
3.150	2.937	0.244	0.299	0.010	3.150 x 0.106 x 0.055	BV2700800	BH2700800	ORAR00233	2.859 x 0.139
3.346	3.102	0.272	0.339	0.010	3.346 x 0.122 x 0.067	BV3100850	BH3100850	OR4007700	3.031 x 0.157
3.346	3.134	0.244	0.299	0.010	3.346 x 0.106 x 0.055	BV2700850	BH2700850	ORAR00235	3.109 x 0.139
3.543	3.205	0.354	0.429	0.010	3.543 x 0.169 x 0.067	BV4300900	BH4300900	ORAR00338	3.100 x 0.210
3.543	3.228	0.327	0.394	0.010	3.543 x 0.157 x 0.067	BV4000900	BH4000900	OR5008000	3.150 x 0.197
3.740	3.402	0.354	0.429	0.010	3.740 x 0.169 x 0.067	BV4300950	BH4300950	ORAR00340	3.350 x 0.210
3.740	3.425	0.327	0.394	0.010	3.740 x 0.157 x 0.067	BV4000950	BH4000950	OR5008000	3.150 x 0.197
3.937	3.598	0.354	0.429	0.010	3.937 x 0.169 x 0.067	BV4301000	BH4301000	ORAR00342	3.600 x 0.210
3.937	3.622	0.327	0.394	0.010	3.937 x 0.157 x 0.067	BV4001000	BH4001000	OR5009000	3.543 x 0.197
4.134	3.795	0.354	0.429	0.010	4.134 x 0.169 x 0.067	BV4301050	BH4301050	ORAR00343	3.725 x 0.210
4.134	3.819	0.327	0.394	0.010	4.134 x 0.157 x 0.067	BV4001050	BH4001050	OR5009500	3.740 x 0.197
4.331	3.992	0.354	0.429	0.010	4.331 x 0.169 x 0.067	BV4301100	BH4301100	ORAR00345	3.975 x 0.210
4.331	4.016	0.327	0.394	0.010	4.331 x 0.157 x 0.067	BV4001100	BH4001100	OR5010000	3.937 x 0.197
4.528	4.189	0.354	0.429	0.010	4.528 x 0.169 x 0.067	BV4301150	BH4301150	ORAR00346	4.100 x 0.210
4.528	4.213	0.327	0.394	0.010	4.528 x 0.157 x 0.067	BV4001150	BH4001150	OR5010500	4.134 x 0.197
4.724	4.386	0.354	0.429	0.010	4.724 x 0.169 x 0.067	BV4301200	BH4301200	ORAR00348	4.350 x 0.210
4.724	4.409	0.327	0.394	0.010	4.724 x 0.157 x 0.067	BV4001200	BH4001200	OR5011000	4.331 x 0.197
4.921	4.583	0.354	0.429	0.010	4.921 x 0.169 x 0.067	BV4301250	BH4301250	ORAR00349	4.475 x 0.210
4.921	4.606	0.327	0.394	0.010	4.921 x 0.157 x 0.067	BV4001250	BH4001250	OR5011500	4.528 x 0.197
5.118	4.780	0.354	0.429	0.010	5.118 x 0.169 x 0.067	BV4301300	BH4301300	ORAR00351	4.725 x 0.210
5.118	4.803	0.327	0.394	0.010	5.118 x 0.157 x 0.067	BV4001300	BH4001300	OR5012000	4.724 x 0.197
5.315	4.858	0.484	0.594	0.010	5.315 x 0.228 x 0.098	BV5801350	BH5801350	ORAR00427	4.725 x 0.275
5.512	5.055	0.484	0.594	0.010	5.512 x 0.228 x 0.098	BV5801400	BH5801400	ORAR00429	4.975 x 0.275
5.906	5.449	0.484	0.594	0.010	5.906 x 0.228 x 0.098	BV5801500	BH5801500	ORAR00432	5.350 x 0.275
6.299	5.843	0.484	0.594	0.010	6.299 x 0.228 x 0.098	BV5801600	BH5801600	ORAR00435	5.725 x 0.275
6.693	6.236	0.484	0.594	0.010	6.693 x 0.228 x 0.098	BV5801700	BH5801700	ORAR00438	6.225 x 0.275
7.087	6.630	0.484	0.594	0.010	7.087 x 0.228 x 0.098	BV5801800	BH5801800	ORAR00439	6.475 x 0.275



Bore Ø	Groove Ø	Groove width		Radius r	Back-up Ring dimension	TSS Part No.		O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010			Uncut (BV)	Cut (BH)		
D _N H8	d ₃ h9			±0.008	OD x W x T				d ₁ x d ₂
inch									
7.480	7.024	0.484	0.594	0.010	7.480 x 0.228 x 0.098	BV5801900	BH5801900	ORAR00441	6.975 x 0.275
7.874	7.417	0.484	0.594	0.010	7.874 x 0.228 x 0.098	BV5802000	BH5802000	ORAR00442	7.225 x 0.275
8.268	7.811	0.484	0.594	0.010	8.268 x 0.228 x 0.098	BV5802100	BH5802100	ORAR00444	7.725 x 0.275
8.661	8.205	0.484	0.594	0.010	8.661 x 0.228 x 0.098	BV5802200	BH5802200	ORAR00445	7.975 x 0.275
9.055	8.598	0.484	0.594	0.010	9.055 x 0.228 x 0.098	BV5802300	BH5802300	ORAR00446	8.475 x 0.275
9.449	8.992	0.484	0.594	0.010	9.449 x 0.228 x 0.098	BV5802400	BH5802400	ORAR00447	8.975 x 0.275
9.843	9.386	0.484	0.594	0.010	9.843 x 0.228 x 0.098	BV5802500	BH5802500	ORAR00448	9.475 x 0.275
11.024	10.567	0.484	0.594	0.010	11.024 x 0.228 x 0.098	BV5802800	BH5802800	ORAR00450	10.475 x 0.275
11.811	11.354	0.484	0.594	0.010	11.811 x 0.228 x 0.098	BV5803000	BH5803000	ORAR00451	10.975 x 0.275
12.598	12.142	0.484	0.594	0.010	12.598 x 0.228 x 0.098	BV5803200	BH5803200	ORAR00453	11.975 x 0.275
13.780	13.323	0.484	0.594	0.010	13.780 x 0.228 x 0.098	BV5803500	-	ORAR00455	12.975 x 0.275
15.748	15.291	0.484	0.594	0.010	15.748 x 0.228 x 0.098	BV5804000	-	ORAR00459	14.975 x 0.275
16.535	16.079	0.484	0.594	0.010	16.535 x 0.228 x 0.098	BV5804200	-	ORAR00461	15.955 x 0.275
17.717	17.260	0.484	0.594	0.010	17.717 x 0.228 x 0.098	BV5804500	-	ORAR00463	16.955 x 0.275
18.898	18.441	0.484	0.594	0.010	18.898 x 0.228 x 0.098	BV5804800	-	ORAR00465	17.955 x 0.275
19.685	19.228	0.484	0.594	0.010	19.685 x 0.228 x 0.098	BV5805000	-	ORAR00467	18.955 x 0.275

Further sizes available on request.

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



H.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).

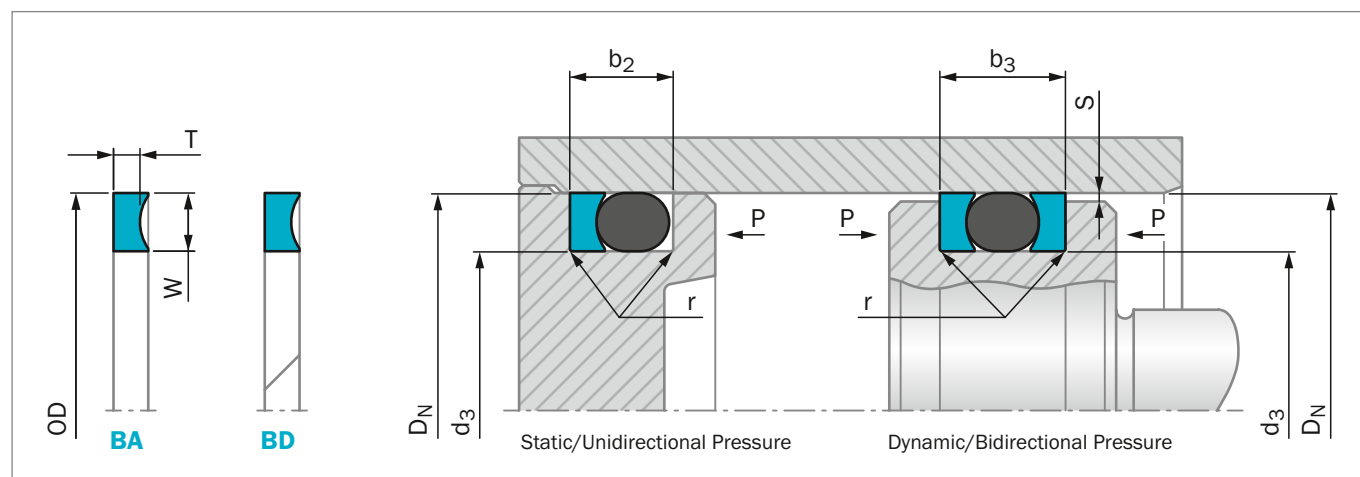


Figure 57: Installation drawing external sealing, concave Back-up Ring types

Table 71: Installation dimensions for concave Back-up Ring types, uncut and cut, External sealing, material PTFE – Metric

O-Ring Cross-Section-Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₃ h ₉		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.25	b ₃ +0.25	r ±0.2
mm								
1.50	1.25	1.10	1.00	D _N - 2.5	D _N - 2.2	3.00	4.00	0.25
1.60	1.30	1.20	1.00	D _N - 2.6	D _N - 2.4	3.10	4.10	0.25
1.78	1.45	1.30	1.40	D _N - 2.9	D _N - 2.6	3.80	5.20	0.25
1.80	1.45	1.30	1.40	D _N - 2.9	D _N - 2.6	3.80	5.20	0.25
2.00	1.65	1.50	1.40	D _N - 3.3	D _N - 3.0	4.10	5.50	0.25
2.40	2.05	1.80	1.40	D _N - 4.1	D _N - 3.6	4.60	6.00	0.25
2.50	2.15	1.90	1.40	D _N - 4.3	D _N - 3.8	4.70	6.10	0.25
2.62	2.25	2.00	1.40	D _N - 4.5	D _N - 4.0	5.00	6.40	0.25
2.65	2.25	2.00	1.40	D _N - 4.5	D _N - 4.0	5.00	6.40	0.25
3.00	2.60	2.30	1.40	D _N - 5.2	D _N - 4.6	5.40	6.80	0.25
3.53	3.10	2.70	1.40	D _N - 6.2	D _N - 5.4	6.20	7.60	0.25
3.55	3.10	2.70	1.40	D _N - 6.2	D _N - 5.4	6.20	7.60	0.25
4.00	3.50	3.10	1.70	D _N - 7.0	D _N - 6.2	6.90	8.60	0.25
5.00	4.40	4.00	1.70	D _N - 8.8	D _N - 8.0	8.30	10.00	0.25
5.30	4.70	4.30	1.70	D _N - 9.4	D _N - 8.6	9.00	10.90	0.25
5.33	4.70	4.30	1.70	D _N - 9.4	D _N - 8.6	9.00	10.90	0.25
5.70	5.00	4.60	1.70	D _N - 10.0	D _N - 9.2	9.00	11.00	0.25
6.00	5.30	4.90	1.70	D _N - 10.6	D _N - 9.8	9.30	11.20	0.25
6.99	6.10	5.80	2.50	D _N - 12.2	D _N - 11.6	12.30	15.10	0.25
8.00	7.10	6.70	2.50	D _N - 14.2	D _N - 13.4	12.60	15.40	0.25
8.40	7.50	7.10	2.50	D _N - 15.0	D _N - 14.2	12.80	15.60	0.25



Table 72: Installation dimensions for concave Back-up Ring types, uncut and cut, External sealing , material PTFE – Inch

O-Ring Cross-Section-Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₃ h9		Groove width		Radius r
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.010	b ₃ +0.010	r ±0.008
inch								
0.059	0.049	0.043	0.039	D _N - 0.098	D _N - 0.087	0.118	0.157	0.010
0.063	0.051	0.047	0.039	D _N - 0.102	D _N - 0.094	0.122	0.161	0.010
0.070	0.057	0.051	0.055	D _N - 0.114	D _N - 0.102	0.150	0.205	0.010
0.071	0.057	0.051	0.055	D _N - 0.130	D _N - 0.102	0.150	0.205	0.010
0.079	0.065	0.059	0.055	D _N - 0.130	D _N - 0.118	0.161	0.217	0.010
0.094	0.081	0.071	0.055	D _N - 0.161	D _N - 0.142	0.181	0.236	0.010
0.098	0.085	0.075	0.055	D _N - 0.169	D _N - 0.150	0.185	0.240	0.010
0.103	0.089	0.079	0.055	D _N - 0.177	D _N - 0.157	0.197	0.252	0.010
0.104	0.089	0.079	0.055	D _N - 0.177	D _N - 0.157	0.197	0.252	0.010
0.118	0.102	0.091	0.055	D _N - 0.205	D _N - 0.181	0.213	0.268	0.010
0.139	0.122	0.106	0.055	D _N - 0.244	D _N - 0.213	0.244	0.299	0.010
0.140	0.122	0.106	0.055	D _N - 0.244	D _N - 0.213	0.244	0.299	0.010
0.157	0.138	0.122	0.067	D _N - 0.276	D _N - 0.244	0.272	0.339	0.010
0.197	0.173	0.157	0.067	D _N - 0.346	D _N - 0.315	0.327	0.394	0.010
0.209	0.185	0.169	0.067	D _N - 0.370	D _N - 0.339	0.354	0.429	0.010
0.210	0.185	0.169	0.067	D _N - 0.370	D _N - 0.339	0.354	0.429	0.010
0.224	0.197	0.181	0.067	D _N - 0.394	D _N - 0.362	0.354	0.433	0.010
0.236	0.209	0.193	0.067	D _N - 0.417	D _N - 0.386	0.366	0.441	0.010
0.275	0.240	0.228	0.098	D _N - 0.480	D _N - 0.457	0.484	0.594	0.010
0.315	0.280	0.264	0.098	D _N - 0.559	D _N - 0.528	0.496	0.606	0.010
0.331	0.295	0.280	0.098	D _N - 0.591	D _N - 0.559	0.504	0.614	0.010

ORDERING EXAMPLE

Back-up Ring:	Concave, type BD (cut) for O-Ring seal
Application:	Static, external sealing
Bore diameter:	D _N = 40.00 mm (1.575 inch)
O-Ring Cross-Section:	d ₂ = 2.62 mm (0.103 inch)
Back-up Ring material:	PTFE, bronze filled (40%)

For material code see page 139

TSS Article No. **BD 20 0 0400 - PTB4**

Back-Up Ring (Cut) ———— BD

Radial Height (mm) W x 10 ———— 20

T-dimension (Standard, mm) ———— 0

Bore-Ø (mm) D_N x 10 ———— 0400

Quality Index (Standard) ———— -

Material Code (Standard) ———— PTB4



**Table 73: Preferred series for static applications, concave Back-up Ring
Type BD (cut), External sealing, material PTFE – Metric**

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 + 0.25$	$b_3 + 0.25$					
D_N H8	d_3 h9							
mm								
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
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



Bore ∅	Groove ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Bore ∅	Groove ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.25$	$b_3 +0.25$					
mm								
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 available on request.

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



**Table 74: Preferred series for static applications, concave Back-up Ring
Type BD (cut), External sealing, material PTFE – Inch**

Bore Ø	Groove Ø	Groove width		Radius r ±0.008	Back-up Ring dimension OD x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
D _N H8	d ₃ h9							
inch								
0.236	0.134	0.150	0.205	0.010	0.24 x 0.05 x 0.06	BD1300060	ORAR00006	0.114 x 0.070
0.236	0.150	0.118	0.157	0.010	0.24 x 0.04 x 0.04	BD1100060	OR1500350	0.138 x 0.059
0.315	0.228	0.118	0.157	0.010	0.31 x 0.04 x 0.04	BD1100080	OR1500550	0.217 x 0.059
0.394	0.307	0.118	0.157	0.010	0.39 x 0.04 x 0.04	BD1100100	OR1500750	0.295 x 0.059
0.472	0.354	0.161	0.217	0.010	0.47 x 0.06 x 0.06	BD1500120	OR2000850	0.335 x 0.079
0.472	0.370	0.150	0.205	0.010	0.47 x 0.05 x 0.06	BD1300120	ORAR00012	0.364 x 0.070
0.551	0.433	0.161	0.217	0.010	0.55 x 0.06 x 0.06	BD1500140	OR2001000	0.394 x 0.079
0.551	0.449	0.150	0.205	0.010	0.55 x 0.05 x 0.06	BD1300140	ORAR00013	0.426 x 0.070
0.591	0.472	0.161	0.217	0.010	0.59 x 0.06 x 0.06	BD1500150	OR2001100	0.433 x 0.079
0.591	0.488	0.150	0.205	0.010	0.59 x 0.05 x 0.06	BD1300150	ORAR00014	0.489 x 0.070
0.630	0.512	0.161	0.217	0.010	0.63 x 0.06 x 0.06	BD1500160	OR2001200	0.472 x 0.079
0.630	0.528	0.150	0.205	0.010	0.63 x 0.05 x 0.06	BD1300160	ORAR00015	0.551 x 0.070
0.709	0.591	0.161	0.217	0.010	0.71 x 0.06 x 0.06	BD1500180	OR2001400	0.551 x 0.079
0.709	0.606	0.150	0.205	0.010	0.71 x 0.05 x 0.06	BD1300180	ORAR00016	0.614 x 0.070
0.787	0.669	0.161	0.217	0.010	0.79 x 0.06 x 0.06	BD1500200	OR2001600	0.630 x 0.079
0.787	0.685	0.150	0.205	0.010	0.79 x 0.05 x 0.06	BD1300200	ORAR00017	0.676 x 0.070
0.866	0.748	0.161	0.217	0.010	0.87 x 0.06 x 0.06	BD1500220	OR2001600	0.630 x 0.079
0.866	0.764	0.150	0.205	0.010	0.87 x 0.05 x 0.06	BD1300220	ORAR00018	0.739 x 0.070
0.984	0.866	0.161	0.217	0.010	0.98 x 0.06 x 0.06	BD1500250	OR2002100	0.827 x 0.079
0.984	0.882	0.150	0.205	0.010	0.98 x 0.05 x 0.06	BD1300250	ORAR00020	0.864 x 0.070
1.102	0.921	0.213	0.268	0.010	1.10 x 0.09 x 0.06	BD2300280	OR3002200	0.866 x 0.118
1.102	0.945	0.197	0.252	0.010	1.10 x 0.08 x 0.06	BD2000280	ORAR00119	0.924 x 0.103
1.181	1.000	0.213	0.268	0.010	1.18 x 0.09 x 0.06	BD2300300	OR3002400	0.945 x 0.079
1.181	1.024	0.197	0.252	0.010	1.18 x 0.08 x 0.06	BD2000300	ORAR00120	0.987 x 0.103
1.260	1.079	0.213	0.268	0.010	1.26 x 0.09 x 0.06	BD2300320	OR3002600	1.024 x 0.118
1.260	1.102	0.197	0.252	0.010	1.26 x 0.08 x 0.06	BD2000320	ORAR00121	1.049 x 0.103
1.378	1.197	0.213	0.268	0.010	1.38 x 0.09 x 0.06	BD2300350	OR3002900	1.154 x 0.118
1.378	1.220	0.197	0.252	0.010	1.38 x 0.08 x 0.06	BD2000350	ORAR00123	1.174 x 0.103
1.575	1.394	0.213	0.268	0.010	1.57 x 0.09 x 0.06	BD2300400	OR3003400	1.339 x 0.118
1.575	1.417	0.197	0.252	0.010	1.57 x 0.08 x 0.06	BD2000400	ORAR00126	1.362 x 0.103
1.654	1.472	0.213	0.268	0.010	1.65 x 0.09 x 0.06	BD2300420	OR3003600	1.417 x 0.118
1.654	1.496	0.197	0.252	0.010	1.65 x 0.08 x 0.06	BD2000420	ORAR00127	1.424 x 0.103
1.772	1.575	0.213	0.268	0.010	1.77 x 0.09 x 0.06	BD2300450	OR3003900	1.535 x 0.118
1.772	1.614	0.197	0.252	0.010	1.77 x 0.08 x 0.06	BD2000450	ORAR00129	1.549 x 0.103
1.890	1.646	0.272	0.339	0.010	1.89 x 0.12 x 0.07	BD3100480	OR4004000	1.575 x 0.157
1.890	1.677	0.244	0.299	0.010	1.89 x 0.11 x 0.06	BD2700480	ORAR00223	1.609 x 0.139
1.969	1.724	0.272	0.339	0.010	1.97 x 0.12 x 0.07	BD3100500	OR4004200	1.654 x 0.157
1.969	1.756	0.244	0.299	0.010	1.97 x 0.11 x 0.06	BD2700500	ORAR00224	1.734 x 0.139
2.047	1.803	0.272	0.339	0.010	2.05 x 0.12 x 0.07	BD3100520	OR4004400	1.732 x 0.157
2.047	1.835	0.244	0.299	0.010	2.05 x 0.11 x 0.06	BD2700520	ORAR00224	1.734 x 0.139



Bore Ø	Groove Ø	Groove width		Radius r ±0.008	Back-up Ring dimension OD x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
D _N H8	d ₃ h9							
inch								
2.165	1.921	0.272	0.339	0.010	2.17 x 0.12 x 0.07	BD3100550	OR4004700	1.850 x 0.157
2.165	1.953	0.244	0.299	0.010	2.17 x 0.11 x 0.06	BD2700550	ORAR00225	1.859 x 0.139
2.362	2.118	0.272	0.339	0.010	2.36 x 0.12 x 0.07	BD3100600	OR4005200	2.047 x 0.157
2.362	2.150	0.244	0.299	0.010	2.36 x 0.11 x 0.06	BD2700600	ORAR00227	2.109 x 0.139
2.480	2.236	0.272	0.339	0.010	2.48 x 0.12 x 0.07	BD3100630	OR4005500	2.165 x 0.157
2.480	2.268	0.244	0.299	0.010	2.48 x 0.11 x 0.06	BD2700630	ORAR00228	2.234 x 0.139
2.559	2.315	0.272	0.339	0.010	2.56 x 0.12 x 0.07	BD3100650	OR4005700	2.244 x 0.157
2.559	2.346	0.244	0.299	0.010	2.56 x 0.11 x 0.06	BD2700650	ORAR00228	2.234 x 0.139
2.756	2.512	0.272	0.339	0.010	2.76 x 0.12 x 0.07	BD3100700	OR4006200	2.441 x 0.157
2.756	2.543	0.244	0.299	0.010	2.76 x 0.11 x 0.06	BD2700700	ORAR00230	2.484 x 0.139
2.953	2.709	0.272	0.339	0.010	2.95 x 0.12 x 0.07	BD3100750	OR4006700	2.638 x 0.157
2.953	2.740	0.244	0.299	0.010	2.95 x 0.11 x 0.06	BD2700750	ORAR00231	2.609 x 0.139
3.150	2.906	0.272	0.339	0.010	3.15 x 0.12 x 0.07	BD3100800	OR4007200	2.835 x 0.157
3.150	2.937	0.244	0.299	0.010	3.15 x 0.11 x 0.06	BD2700800	ORAR00233	2.859 x 0.139
3.346	3.102	0.272	0.339	0.010	3.35 x 0.12 x 0.07	BD3100850	OR4007700	3.031 x 0.157
3.346	3.134	0.205	0.299	0.010	3.35 x 0.11 x 0.06	BD2700850	ORAR00235	3.109 x 0.139
3.543	3.205	0.354	0.429	0.010	3.54 x 0.17 x 0.07	BD4300900	ORAR00338	3.100 x 0.210
3.543	3.228	0.327	0.394	0.010	3.54 x 0.16 x 0.07	BD4000900	OR5008000	3.150 x 0.197
3.740	3.402	0.354	0.429	0.010	3.74 x 0.17 x 0.07	BD4300950	ORAR00340	3.350 x 0.210
3.740	3.425	0.327	0.394	0.010	3.74 x 0.16 x 0.07	BD4000950	OR5008000	3.150 x 0.197
3.937	3.598	0.354	0.429	0.010	3.94 x 0.17 x 0.07	BD4301000	ORAR00342	3.600 x 0.210
3.937	3.622	0.327	0.394	0.010	3.94 x 0.16 x 0.07	BD4001000	OR5009000	3.543 x 0.197
4.134	3.795	0.354	0.429	0.010	4.13 x 0.17 x 0.07	BD4301050	ORAR00343	3.725 x 0.210
4.134	3.819	0.327	0.394	0.010	4.13 x 0.16 x 0.07	BD4001050	OR5009500	3.740 x 0.197
4.331	3.992	0.354	0.429	0.010	4.33 x 0.17 x 0.07	BD4301100	ORAR00345	3.975 x 0.210
4.331	4.016	0.327	0.394	0.010	4.33 x 0.16 x 0.07	BD4001100	OR5010000	3.937 x 0.197
4.528	4.189	0.354	0.429	0.010	4.53 x 0.17 x 0.07	BD4301150	ORAR00346	4.100 x 0.210
4.528	4.213	0.327	0.394	0.010	4.53 x 0.16 x 0.07	BD4001150	OR5010500	4.134 x 0.197
4.724	4.386	0.354	0.429	0.010	4.72 x 0.17 x 0.07	BD4301200	ORAR00348	4.350 x 0.210
4.724	4.409	0.327	0.394	0.010	4.72 x 0.16 x 0.07	BD4001200	OR5011000	4.331 x 0.197
4.921	4.583	0.354	0.429	0.010	4.92 x 0.17 x 0.07	BD4301250	ORAR00349	4.475 x 0.210
4.921	4.606	0.327	0.394	0.010	4.92 x 0.16 x 0.07	BD4001250	OR5011500	4.528 x 0.197
5.118	4.780	0.354	0.429	0.010	5.12 x 0.17 x 0.07	BD4301300	ORAR00351	4.725 x 0.210
5.118	4.803	0.327	0.394	0.010	5.12 x 0.16 x 0.07	BD4001300	OR5012000	4.724 x 0.197
5.315	4.858	0.484	0.594	0.010	5.31 x 0.23 x 0.10	BD5801350	ORAR00427	4.725 x 0.275
5.512	5.055	0.484	0.594	0.010	5.51 x 0.23 x 0.10	BD5801400	ORAR00429	4.975 x 0.275
5.906	5.449	0.484	0.594	0.010	5.91 x 0.23 x 0.10	BD5801500	ORAR00432	5.350 x 0.275
6.299	5.843	0.484	0.594	0.010	6.30 x 0.23 x 0.10	BD5801600	ORAR00435	5.725 x 0.275
6.693	6.236	0.484	0.594	0.010	6.69 x 0.23 x 0.10	BD5801700	ORAR00438	6.225 x 0.275
7.087	6.630	0.484	0.594	0.010	7.09 x 0.23 x 0.10	BD5801800	ORAR00439	6.475 x 0.275



Bore Ø	Groove Ø	Groove width		Radius r ±0.008	Back-up Ring dimension OD x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
inch								
7.480	7.024	0.484	0.594	0.010	7.48 x 0.23 x 0.10	BD5801900	ORAR00441	6.975 x 0.275
7.874	7.417	0.484	0.594	0.010	7.87 x 0.23 x 0.10	BD5802000	ORAR00442	7.225 x 0.275
8.268	7.811	0.484	0.594	0.010	8.27 x 0.23 x 0.10	BD5802100	ORAR00444	7.725 x 0.275
8.661	8.205	0.484	0.594	0.010	8.66 x 0.23 x 0.10	BD5802200	ORAR00445	7.975 x 0.275
9.055	8.598	0.484	0.594	0.010	9.06 x 0.23 x 0.10	BD5802300	ORAR00446	8.475 x 0.275
9.449	8.992	0.484	0.594	0.010	9.45 x 0.23 x 0.10	BD5802400	ORAR00447	8.975 x 0.275
9.843	9.386	0.484	0.594	0.010	9.84 x 0.23 x 0.10	BD5802500	ORAR00448	9.475 x 0.275
11.024	10.567	0.484	0.594	0.010	11.02 x 0.23 x 0.10	BD5802800	ORAR00450	10.475 x 0.275
11.811	11.354	0.484	0.594	0.010	11.81 x 0.23 x 0.10	BD5803000	ORAR00451	10.975 x 0.275
12.598	12.142	0.484	0.594	0.010	12.60 x 0.23 x 0.10	BD5803200	ORAR00453	11.975 x 0.275
13.780	13.323	0.484	0.594	0.010	13.78 x 0.23 x 0.10	BD5803500	ORAR00455	12.975 x 0.275
15.748	15.291	0.484	0.594	0.010	15.75 x 0.23 x 0.10	BD5804000	ORAR00459	14.975 x 0.275
16.535	16.079	0.484	0.594	0.010	16.54 x 0.23 x 0.10	BD5804200	ORAR00461	15.955 x 0.275
17.717	17.260	0.484	0.594	0.010	17.72 x 0.23 x 0.10	BD5804500	ORAR00463	16.955 x 0.275
18.898	18.441	0.484	0.594	0.010	18.90 x 0.23 x 0.10	BD5804800	ORAR00465	17.955 x 0.275
19.685	19.228	0.484	0.594	0.010	19.69 x 0.23 x 0.10	BD5805000	ORAR00467	18.955 x 0.275

Further sizes available on request.

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



H.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

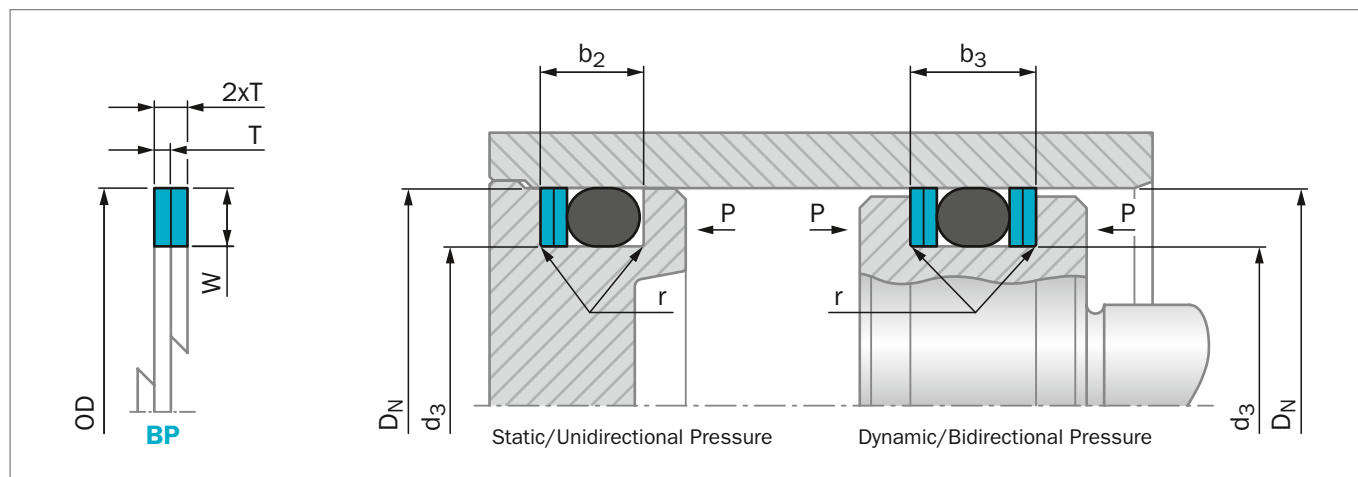


Figure 58: Installation drawing external sealing, spiral Back-up Ring type

Table 75: Installation dimensions for the spiral Back-up Ring type, External sealing, material PTFE – Metric

O-Ring Cross-Section-Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₃ h9		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.25	b ₃ +0.25	r ±0.2
mm								
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
6.99	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



Table 76: Installation dimensions for the spiral Back-up Ring type, External sealing, material PTFE – Inch

O-Ring Cross-Section-Ø d ₂	Back-up Ring Cross-Section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₃ h9		Groove width		Radius r
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.010	b ₃ +0.010	r ±0.008
inch								
0.059	0.049	0.043	0.020	D _N - 0.098	D _N - 0.087	0.118	0.157	0.010
0.063	0.051	0.047	0.020	D _N - 0.102	D _N - 0.094	0.122	0.161	0.010
0.070	0.057	0.051	0.028	D _N - 0.114	D _N - 0.102	0.150	0.205	0.010
0.071	0.057	0.051	0.028	D _N - 0.114	D _N - 0.102	0.150	0.205	0.010
0.079	0.065	0.059	0.028	D _N - 0.130	D _N - 0.118	0.161	0.217	0.010
0.094	0.081	0.071	0.028	D _N - 0.161	D _N - 0.142	0.181	0.236	0.010
0.098	0.085	0.075	0.028	D _N - 0.169	D _N - 0.150	0.185	0.240	0.010
0.103	0.089	0.079	0.028	D _N - 0.177	D _N - 0.157	0.197	0.252	0.010
0.104	0.089	0.079	0.028	D _N - 0.177	D _N - 0.157	0.197	0.252	0.010
0.118	0.102	0.091	0.028	D _N - 0.205	D _N - 0.181	0.213	0.268	0.010
0.139	0.122	0.106	0.028	D _N - 0.244	D _N - 0.213	0.244	0.299	0.010
0.140	0.122	0.106	0.028	D _N - 0.244	D _N - 0.213	0.244	0.299	0.010
0.157	0.138	0.122	0.033	D _N - 0.276	D _N - 0.244	0.272	0.339	0.010
0.197	0.173	0.157	0.033	D _N - 0.346	D _N - 0.315	0.327	0.394	0.010
0.209	0.185	0.169	0.033	D _N - 0.370	D _N - 0.339	0.354	0.429	0.010
0.210	0.185	0.169	0.033	D _N - 0.370	D _N - 0.339	0.354	0.429	0.010
0.224	0.197	0.181	0.033	D _N - 0.394	D _N - 0.362	0.354	0.433	0.010
0.236	0.209	0.193	0.033	D _N - 0.417	D _N - 0.386	0.366	0.441	0.010
0.275	0.240	0.228	0.049	D _N - 0.480	D _N - 0.457	0.484	0.594	0.010
0.315	0.280	0.264	0.049	D _N - 0.559	D _N - 0.528	0.496	0.606	0.010
0.331	0.295	0.280	0.049	D _N - 0.591	D _N - 0.559	0.504	0.614	0.010

ORDERING EXAMPLE

Back-up Ring:	Type BP (spiral) for O-Ring seal
Application:	Dynamic, external sealing
Bore diameter:	D _N = 120.00 mm (4.724 inch)
Groove diameter:	d ₃ = 111.20 mm (4.378 inch)
O-Ring Cross-Section:	d ₂ = 5.00 mm (0.197 inch)
Back-up Ring material:	PTFE, virgin

TSS Article No. **BP 44 0 1112 - PT00**

Back-Up Ring (Spiral) — BP
 Radial Height (mm) W x 10 — 44
 T-dimension (Standard, mm) — 0
 Groove-Ø (mm) d₃ x 10 — 1112
 Quality Index (Standard) —
 Material Code (Standard) — PT00

For material code see page 139



**Table 77: Preferred series for dynamic application, spiral Back-up Ring
Type BP, External sealing, material PTFE – Metric**

Bore Ø	Groove Ø	Groove width		Radi- us	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.25$	$b_3 +0.25$					
mm								
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
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	32.0 x 2.60 x 0.70	BP2600268	OR3002600	26.00 x 3.00
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



Bore Ø	Groove Ø	Groove width		Radi- us	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Bore Ø	Groove Ø	Groove width		Radi- us	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.25$	$b_3 +0.25$					
mm								
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
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 available on request.

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



**Table 78: Preferred series for dynamic application, spiral Back-up Ring
Type BP, External sealing, material PTFE – Inch**

Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
D _N H8	d ₃ h9							
inch								
0.236	0.122	0.150	0.205	0.010	0.236 x 0.057 x 0.028	BP14H00031	ORAR00006	0.114 x 0.070
0.236	0.138	0.118	0.157	0.010	0.236 x 0.049 x 0.020	BP12H00035	OR1500300	0.118 x 0.059
0.315	0.201	0.150	0.205	0.010	0.315 x 0.057 x 0.028	BP14H00051	ORAR00008	0.176 x 0.070
0.315	0.217	0.118	0.157	0.010	0.315 x 0.049 x 0.020	BP12H00055	OR1500500	0.197 x 0.059
0.394	0.280	0.150	0.205	0.010	0.394 x 0.057 x 0.028	BP14H00071	ORAR00011	0.301 x 0.070
0.394	0.295	0.118	0.157	0.010	0.394 x 0.057 x 0.020	BP12H00075	OR1500700	0.276 x 0.059
0.472	0.343	0.161	0.217	0.010	0.472 x 0.065 x 0.028	BP16H00087	OR2000800	0.315 x 0.079
0.472	0.358	0.150	0.205	0.010	0.472 x 0.057 x 0.028	BP14H00091	ORAR00012	0.364 x 0.070
0.551	0.421	0.161	0.217	0.010	0.551 x 0.065 x 0.028	BP16H00107	OR2001000	0.394 x 0.079
0.551	0.437	0.150	0.205	0.010	0.551 x 0.057 x 0.028	BP14H00111	ORAR00013	0.426 x 0.070
0.591	0.461	0.161	0.217	0.010	0.591 x 0.065 x 0.028	BP16H00117	OR2001100	0.433 x 0.079
0.591	0.476	0.150	0.205	0.010	0.591 x 0.057 x 0.028	BP14H00121	ORAR00014	0.489 x 0.070
0.630	0.500	0.161	0.217	0.010	0.630 x 0.065 x 0.028	BP16H00127	OR2001200	0.472 x 0.079
0.630	0.516	0.150	0.205	0.010	0.630 x 0.057 x 0.028	BP14H00131	ORAR00015	0.551 x 0.070
0.709	0.579	0.161	0.217	0.010	0.709 x 0.065 x 0.028	BP16H00147	OR2001400	0.551 x 0.079
0.709	0.594	0.150	0.205	0.010	0.709 x 0.057 x 0.028	BP14H00151	ORAR00016	0.614 x 0.070
0.787	0.657	0.161	0.217	0.010	0.787 x 0.065 x 0.028	BP16H00167	OR2001600	0.630 x 0.079
0.787	0.673	0.150	0.205	0.010	0.787 x 0.057 x 0.028	BP14H00171	ORAR00017	0.676 x 0.070
0.866	0.736	0.161	0.217	0.010	0.866 x 0.065 x 0.028	BP16H00187	OR2001800	0.709 x 0.079
0.866	0.752	0.150	0.205	0.010	0.866 x 0.057 x 0.028	BP14H00191	ORAR00018	0.739 x 0.070
0.984	0.854	0.161	0.217	0.010	0.984 x 0.065 x 0.028	BP16H00217	OR2002100	0.827 x 0.079
0.984	0.870	0.150	0.205	0.010	0.984 x 0.057 x 0.028	BP14H00221	ORAR00020	0.864 x 0.070
1.102	0.898	0.213	0.268	0.010	1.102 x 0.102 x 0.028	BP2600228	OR3002200	0.866 x 0.118
1.102	0.925	0.197	0.252	0.010	1.102 x 0.089 x 0.028	BP22H00235	ORAR00119	0.924 x 0.103
1.181	0.976	0.213	0.268	0.010	1.181 x 0.102 x 0.028	BP2600248	OR3002400	0.945 x 0.118
1.181	1.004	0.197	0.252	0.010	1.181 x 0.089 x 0.028	BP22H00255	ORAR00120	0.987 x 0.103
1.260	1.055	0.213	0.268	0.010	1.260 x 0.102 x 0.028	BP2600268	OR3002600	1.024 x 0.118
1.378	1.173	0.213	0.268	0.010	1.378 x 0.102 x 0.028	BP2600298	OR3002900	1.142 x 0.118
1.378	1.201	0.197	0.252	0.010	1.378 x 0.089 x 0.028	BP22H00305	ORAR00123	1.174 x 0.103
1.575	1.370	0.213	0.268	0.010	1.575 x 0.102 x 0.028	BP2600348	OR3003400	1.339 x 0.118
1.575	1.398	0.197	0.252	0.010	1.575 x 0.089 x 0.028	BP22H00355	ORAR00126	1.362 x 0.103
1.654	1.449	0.213	0.268	0.010	1.654 x 0.102 x 0.028	BP2600368	OR3003600	1.417 x 0.118
1.654	1.476	0.197	0.252	0.010	1.654 x 0.089 x 0.028	BP22H00375	ORAR00127	1.424 x 0.103
1.772	1.567	0.213	0.268	0.010	1.772 x 0.102 x 0.028	BP2600398	OR3003900	1.535 x 0.118
1.772	1.594	0.197	0.252	0.010	1.772 x 0.089 x 0.028	BP22H00405	ORAR00129	1.549 x 0.103
1.890	1.614	0.272	0.339	0.010	1.890 x 0.138 x 0.033	BP3500410	OR4004000	1.575 x 0.157
1.890	1.646	0.244	0.299	0.010	1.890 x 0.122 x 0.028	BP31D0418	ORAR00223	1.609 x 0.139
1.969	1.693	0.272	0.339	0.010	1.969 x 0.138 x 0.033	BP3500430	OR4004200	1.654 x 0.157
1.969	1.724	0.244	0.299	0.010	1.969 x 0.122 x 0.028	BP31D0438	ORAR00224	1.734 x 0.139
2.047	1.772	0.272	0.339	0.010	2.047 x 0.138 x 0.033	BP3500450	OR4004400	1.732 x 0.157



Bore Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.010$	$b_3 +0.010$					
$D_N H8$	$d_3 h9$							
inch								
2.047	1.803	0.244	0.299	0.010	2.047 x 0.122 x 0.028	BP31D0458	ORAR00224	1.734 x 0.139
2.165	1.890	0.272	0.339	0.010	2.165 x 0.138 x 0.033	BP3500480	OR4004700	1.850 x 0.157
2.165	1.921	0.244	0.299	0.010	2.165 x 0.122 x 0.028	BP31D0488	ORAR00225	1.859 x 0.139
2.362	2.087	0.272	0.339	0.010	2.362 x 0.138 x 0.033	BP3500530	OR4005200	2.047 x 0.157
2.362	2.118	0.244	0.299	0.010	2.362 x 0.122 x 0.028	BP31D0538	ORAR00227	2.109 x 0.139
2.480	2.205	0.272	0.339	0.010	2.480 x 0.138 x 0.033	BP3500560	OR4005500	2.165 x 0.157
2.480	2.236	0.244	0.299	0.010	2.480 x 0.122 x 0.028	BP31D0568	ORAR00228	2.234 x 0.139
2.559	2.283	0.272	0.339	0.010	2.559 x 0.138 x 0.033	BP3500580	OR4005700	2.244 x 0.157
2.559	2.315	0.244	0.299	0.010	2.559 x 0.122 x 0.028	BP31D0588	ORAR00228	2.234 x 0.139
2.756	2.480	0.272	0.339	0.010	2.756 x 0.138 x 0.033	BP3500630	OR4006200	2.441 x 0.157
2.756	2.512	0.244	0.299	0.010	2.756 x 0.122 x 0.028	BP31D0638	ORAR00230	2.484 x 0.139
2.953	2.677	0.272	0.339	0.010	2.953 x 0.138 x 0.033	BP3500680	OR4006700	2.638 x 0.157
2.953	2.709	0.244	0.299	0.010	2.953 x 0.122 x 0.028	BP31D0688	ORAR00231	2.609 x 0.139
3.150	2.874	0.272	0.339	0.010	3.150 x 0.138 x 0.033	BP3500730	OR4007200	2.835 x 0.157
3.150	2.906	0.244	0.299	0.010	3.150 x 0.122 x 0.028	BP31D0738	ORAR00233	2.859 x 0.139
3.346	3.071	0.272	0.339	0.010	3.346 x 0.138 x 0.033	BP3500780	OR4007700	3.031 x 0.157
3.346	3.102	0.244	0.299	0.010	3.346 x 0.122 x 0.028	BP31D0788	ORAR00235	3.109 x 0.139
3.543	3.173	0.354	0.429	0.010	3.543 x 0.185 x 0.033	BP4700806	ORAR00338	3.100 x 0.210
3.543	3.197	0.327	0.394	0.010	3.543 x 0.173 x 0.033	BP4400812	OR5008000	3.150 x 0.197
3.740	3.370	0.354	0.429	0.010	3.740 x 0.185 x 0.033	BP4700856	ORAR00340	3.350 x 0.210
3.740	3.394	0.327	0.394	0.010	3.740 x 0.173 x 0.033	BP4400862	OR5008500	3.346 x 0.197
3.937	3.567	0.354	0.429	0.010	3.937 x 0.185 x 0.033	BP4700906	ORAR00342	3.600 x 0.210
3.937	3.591	0.327	0.394	0.010	3.937 x 0.173 x 0.033	BP4400912	OR5009000	3.543 x 0.197
4.134	3.764	0.354	0.429	0.010	4.134 x 0.185 x 0.033	BP4700956	ORAR00343	3.725 x 0.210
4.134	3.787	0.327	0.394	0.010	4.134 x 0.173 x 0.033	BP4400962	OR5009500	3.740 x 0.197
4.331	3.961	0.354	0.429	0.010	4.331 x 0.185 x 0.033	BP4701006	ORAR00345	3.975 x 0.210
4.331	3.984	0.327	0.394	0.010	4.331 x 0.173 x 0.033	BP4401012	OR5010000	3.937 x 0.197
4.528	4.157	0.354	0.429	0.010	4.528 x 0.185 x 0.033	BP4701056	ORAR00346	4.100 x 0.210
4.528	4.181	0.327	0.394	0.010	4.528 x 0.173 x 0.033	BP4401062	OR5010500	4.134 x 0.197
4.724	4.354	0.354	0.429	0.010	4.724 x 0.185 x 0.033	BP4701106	ORAR00348	4.350 x 0.210
4.724	4.378	0.327	0.394	0.010	4.724 x 0.173 x 0.033	BP4401112	OR5011000	4.331 x 0.197
4.921	4.551	0.35	0.429	0.010	4.921 x 0.185 x 0.033	BP4701156	ORAR00349	4.475 x 0.210
4.921	4.575	0.327	0.394	0.010	4.921 x 0.173 x 0.033	BP4401162	OR5011500	4.528 x 0.197
5.118	4.748	0.354	0.429	0.010	5.118 x 0.185 x 0.033	BP4701206	ORAR00351	4.725 x 0.210
5.118	4.772	0.327	0.394	0.010	5.118 x 0.173 x 0.033	BP4401212	OR5012000	4.724 x 0.197
5.315	4.835	0.484	0.594	0.010	5.315 x 0.240 x 0.049	BP6101228	ORAR00427	4.725 x 0.275
5.512	5.031	0.484	0.594	0.010	5.512 x 0.240 x 0.049	BP6101278	ORAR00429	4.975 x 0.275
5.906	5.425	0.484	0.594	0.010	5.906 x 0.240 x 0.049	BP6101378	ORAR00432	5.350 x 0.275
6.299	5.819	0.484	0.594	0.010	6.299 x 0.240 x 0.049	BP6101478	ORAR00435	5.725 x 0.275
6.693	6.213	0.484	0.594	0.010	6.693 x 0.240 x 0.049	BP6101578	ORAR00438	6.225 x 0.275



Bore ∅	Groove ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 +0.010$	$b_3 +0.010$					
inch								
7.087	6.606	0.484	0.594	0.010	7.087 x 0.240 x 0.049	BP6101678	ORAR00439	6.475 x 0.275
7.480	7.000	0.484	0.594	0.010	7.480 x 0.240 x 0.049	BP6101778	ORAR00441	6.975 x 0.275
7.874	7.394	0.484	0.594	0.010	7.874 x 0.240 x 0.049	BP6101878	ORAR00442	7.225 x 0.275
8.268	7.787	0.484	0.594	0.010	8.268 x 0.240 x 0.049	BP6101978	ORAR00444	7.725 x 0.275
8.661	8.181	0.484	0.594	0.010	8.661 x 0.240 x 0.049	BP6102078	ORAR00445	7.975 x 0.275
9.055	8.575	0.484	0.594	0.010	9.055 x 0.240 x 0.049	BP6102178	ORAR00446	8.475 x 0.275
9.449	8.969	0.484	0.594	0.010	9.449 x 0.240 x 0.049	BP6102278	ORAR00447	8.975 x 0.275
9.843	9.362	0.484	0.594	0.010	9.843 x 0.240 x 0.049	BP6102378	ORAR00448	9.475 x 0.275
11.024	10.543	0.484	0.594	0.010	11.024 x 0.240 x 0.049	BP6102678	ORAR00450	10.475 x 0.275
11.811	11.331	0.484	0.594	0.010	11.811 x 0.240 x 0.049	BP6102878	ORAR00451	10.975 x 0.275
12.598	12.118	0.484	0.594	0.010	12.598 x 0.240 x 0.049	BP6103078	ORAR00453	11.975 x 0.275
13.780	13.299	0.484	0.594	0.010	13.780 x 0.240 x 0.049	BP6103378	ORAR00455	12.975 x 0.275
15.748	15.268	0.484	0.594	0.010	15.748 x 0.240 x 0.049	BP6103878	ORAR00459	14.975 x 0.275
16.535	16.055	0.484	0.594	0.010	16.535 x 0.240 x 0.049	BP6104078	ORAR00461	15.955 x 0.275
17.717	17.236	0.484	0.594	0.010	17.717 x 0.240 x 0.049	BP6104378	ORAR00463	16.955 x 0.275
18.898	18.417	0.484	0.594	0.010	18.898 x 0.240 x 0.049	BP6104678	ORAR00465	17.955 x 0.275
19.685	19.205	0.484	0.594	0.010	19.685 x 0.240 x 0.049	BP6104878	ORAR00467	18.955 x 0.275

Further sizes available on request.

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



■ H.2 Internal Sealing (Rod), Static and Dynamic Applications

H.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).

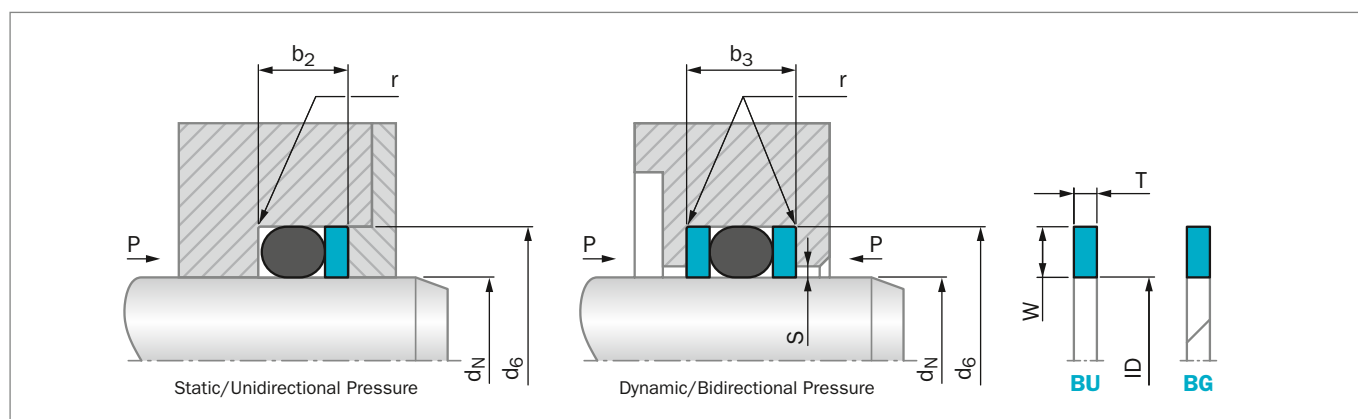


Figure 59: Installation drawing internal sealing, rectangular Back-up Ring types

Table 79: Installation dimensions for rectangular Back-up Ring types, uncut and cut, Internal sealing, material PTFE – Metric

O-Ring Cross-Section Ø d ₂	Back-up Ring Cross section			Groove dimensions				
	Radial height W		Thickness	Groove diameter d ₆ H9		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.25	b ₃ +0.25	r ±0.2
mm								
1.50	1.25	1.10	1.00	d _N + 2.5	d _N + 2.2	3.00	4.00	0.25
1.60	1.30	1.20	1.00	d _N + 2.6	d _N + 2.4	3.10	4.10	0.25
1.78	1.45	1.30	1.40	d _N + 2.9	d _N + 2.6	3.80	5.20	0.25
1.80	1.45	1.30	1.40	d _N + 2.9	d _N + 2.6	3.80	5.20	0.25
2.00	1.65	1.50	1.40	d _N + 3.3	d _N + 3.0	4.10	5.50	0.25
2.40	2.05	1.80	1.40	d _N + 4.1	d _N + 3.6	4.60	6.00	0.25
2.50	2.15	1.90	1.40	d _N + 4.3	d _N + 3.8	4.70	6.10	0.25
2.62	2.25	2.00	1.40	d _N + 4.5	d _N + 4.0	5.00	6.40	0.25
2.65	2.25	2.00	1.40	d _N + 4.5	d _N + 4.0	5.00	6.40	0.25
3.00	2.60	2.30	1.40	d _N + 5.2	d _N + 4.6	5.40	6.80	0.25
3.53	3.10	2.70	1.40	d _N + 6.2	d _N + 5.4	6.20	7.60	0.25
3.55	3.10	2.70	1.40	d _N + 6.2	d _N + 5.4	6.20	7.60	0.25
4.00	3.50	3.10	1.70	d _N + 7.0	d _N + 6.2	6.90	8.60	0.25
5.00	4.40	4.00	1.70	d _N + 8.8	d _N + 8.0	8.30	10.00	0.25
5.30	4.70	4.30	1.70	d _N + 9.4	d _N + 8.6	9.00	10.90	0.25
5.33	4.70	4.30	1.70	d _N + 9.4	d _N + 8.6	9.00	10.9	0.25
5.70	5.00	4.60	1.70	d _N + 10.0	d _N + 9.2	9.00	11.00	0.25
6.00	5.30	4.90	1.70	d _N + 10.6	d _N + 9.8	9.30	11.20	0.25
6.99	6.10	5.80	2.50	d _N + 12.2	d _N + 11.6	12.30	15.10	0.25
8.00	7.10	6.70	2.50	d _N + 14.2	d _N + 13.4	12.60	15.40	0.25
8.40	7.50	7.10	2.50	d _N + 15.0	d _N + 14.2	12.80	15.60	0.25



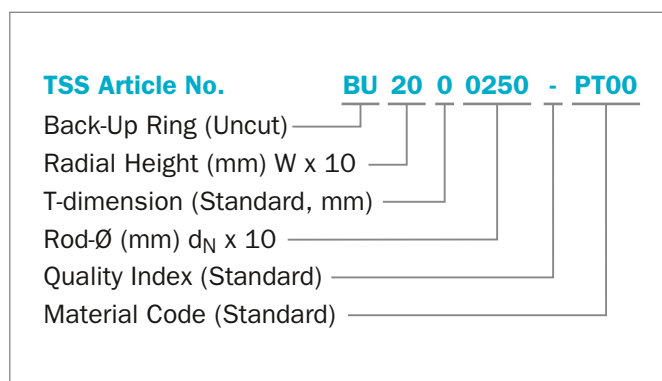
Table 80: Installation dimensions for rectangular Back-up Ring types, uncut and cut, Internal sealing, material PTFE – Inch

O-Ring Cross-Section Ø d ₂	Back-up Ring Cross section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₆ H9		Groove width		Radius r
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.010	b ₃ +0.010	r ±0.008
inch								
0.059	0.049	0.043	0.039	d _N + 0.098	d _N + 0.087	0.118	0.157	0.010
0.063	0.051	0.047	0.039	d _N + 0.102	d _N + 0.094	0.122	0.161	0.010
0.070	0.057	0.051	0.055	d _N + 0.114	d _N + 0.102	0.150	0.205	0.010
0.071	0.057	0.051	0.055	d _N + 0.114	d _N + 0.102	0.150	0.205	0.010
0.079	0.065	0.059	0.055	d _N + 0.130	d _N + 0.118	0.161	0.217	0.010
0.094	0.081	0.071	0.055	d _N + 0.161	d _N + 0.142	0.181	0.236	0.010
0.098	0.085	0.075	0.055	d _N + 0.169	d _N + 0.150	0.185	0.240	0.010
0.103	0.089	0.079	0.055	d _N + 0.177	d _N + 0.157	0.197	0.252	0.010
0.104	0.089	0.079	0.055	d _N + 0.177	d _N + 0.157	0.197	0.252	0.010
0.118	0.102	0.091	0.055	d _N + 0.205	d _N + 0.181	0.213	0.268	0.010
0.139	0.122	0.106	0.055	d _N + 0.244	d _N + 0.213	0.244	0.299	0.010
0.140	0.122	0.106	0.055	d _N + 0.244	d _N + 0.213	0.244	0.299	0.010
0.157	0.138	0.122	0.067	d _N + 0.276	d _N + 0.244	0.272	0.339	0.010
0.197	0.173	0.157	0.067	d _N + 0.346	d _N + 0.315	0.327	0.394	0.010
0.209	0.185	0.169	0.067	d _N + 0.370	d _N + 0.339	0.354	0.429	0.010
0.210	0.185	0.169	0.067	d _N + 0.370	d _N + 0.339	0.354	0.429	0.010
0.224	0.197	0.181	0.067	d _N + 0.394	d _N + 0.362	0.354	0.433	0.010
0.236	0.209	0.193	0.067	d _N + 0.417	d _N + 0.386	0.366	0.441	0.010
0.275	0.240	0.228	0.098	d _N + 0.480	d _N + 0.457	0.484	0.594	0.010
0.315	0.280	0.264	0.098	d _N + 0.559	d _N + 0.528	0.496	0.606	0.010
0.331	0.295	0.280	0.098	d _N + 0.591	d _N + 0.559	0.504	0.614	0.010

ORDERING EXAMPLE

Back-up Ring:	Type BU (uncut) for O-Ring seal
Application:	Static, external sealing
Rod diameter:	d _N = 25.00 mm (0.984 inch)
O-Ring cross section:	d ₂ = 2.62 mm (0.103 inch)
Back-up Ring material:	PTFE, virgin

For material code see page 139





**Table 81: Preferred series for static application, rectangular Back-up Ring
Type BU (uncut), Internal sealing, material PTFE – Metric**

Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
4.0	6.20	3.00	4.00	0.25	4.0 x 1.1 x 1.4	BU11L0040	OR1500400	4.00 x 1.50
4.0	6.60	3.80	5.20	0.25	4.0 x 1.3 x 1.4	BU1300040	ORAR00007	3.68 x 1.78
5.0	7.20	3.00	4.00	0.25	5.0 x 1.1 x 1.4	BU1100050	OR1500500	5.00 x 1.50
5.0	7.60	3.80	5.20	0.25	5.0 x 1.3 x 1.4	BU1300050	ORAR00008	4.47 x 1.78
6.0	8.20	3.00	4.00	0.25	6.0 x 1.1 x 1.4	BU1100060	OR1500600	6.00 x 1.50
6.0	8.60	3.80	5.20	0.25	6.0 x 1.3 x 1.4	BU1300060	ORAR00010	6.07 x 1.78
8.0	10.60	3.80	5.20	0.25	8.0 x 1.3 x 1.4	BU1300080	ORAR00011	7.65 x 1.78
8.0	11.00	4.10	5.50	0.25	8.0 x 1.5 x 1.4	BU1500080	OR2000800	8.00 x 2.00
10.0	12.60	3.80	5.20	0.25	10.0 x 1.3 x 1.4	BU1300100	ORAR00013	10.82 x 1.78
10.0	13.00	4.10	5.50	0.25	10.0 x 1.5 x 1.4	BU1500100	OR2001000	10.00 x 2.00
12.0	14.60	3.80	5.20	0.25	12.0 x 1.3 x 1.4	BU1300120	ORAR00014	12.42 x 1.78
12.0	15.00	4.10	5.50	0.25	12.0 x 1.5 x 1.4	BU1500120	OR2001200	12.00 x 2.00
14.0	16.60	3.80	5.20	0.25	14.0 x 1.3 x 1.4	BU1300140	ORAR00015	14.00 x 1.78
14.0	17.00	4.10	5.50	0.25	14.0 x 1.5 x 1.4	BU1500140	OR2001400	14.00 x 2.00
15.0	17.60	3.80	5.20	0.25	15.0 x 1.3 x 1.4	BU1300150	ORAR00016	15.60 x 1.78
15.0	18.00	4.10	5.50	0.25	15.0 x 1.5 x 1.4	BU1500150	OR2001500	15.00 x 2.00
16.0	18.60	3.80	5.20	0.25	16.0 x 1.3 x 1.4	BU1300160	ORAR00016	15.60 x 1.78
16.0	19.00	4.10	5.50	0.25	16.0 x 1.5 x 1.4	BU1500160	OR2001600	16.00 x 2.00
18.0	20.60	3.80	5.20	0.25	18.0 x 1.3 x 1.4	BU1300180	ORAR00018	18.77 x 1.78
18.0	21.00	4.10	5.50	0.25	18.0 x 1.5 x 1.4	BU1500180	OR2001800	18.00 x 2.00
20.0	22.60	3.80	5.20	0.25	20.0 x 1.3 x 1.4	BU1300200	ORAR00019	20.35 x 1.78
20.0	23.00	4.10	5.50	0.25	20.0 x 1.5 x 1.4	BU1500200	OR2002000	20.00 x 2.00
22.0	26.00	5.00	6.40	0.25	22.0 x 2.0 x 1.4	BU2000220	ORAR00118	21.89 x 2.62
22.0	26.60	5.40	6.80	0.25	22.0 x 2.3 x 1.4	BU2300220	OR3002200	22.00 x 3.00
25.0	29.00	5.00	6.40	0.25	25.0 x 2.0 x 1.4	BU2000250	ORAR00120	25.07 x 2.62
25.0	29.60	5.40	6.80	0.25	25.0 x 2.3 x 1.4	BU2300250	OR3002500	25.00 x 3.00
28.0	32.00	5.00	6.40	0.25	28.0 x 2.0 x 1.4	BU2000280	ORAR00122	28.24 x 2.62
28.0	32.60	5.40	6.80	0.25	28.0 x 2.3 x 1.4	BU2300280	OR3002800	28.00 x 2.00
30.0	34.00	5.00	6.40	0.25	30.0 x 2.0 x 1.4	BU2000300	ORAR00123	29.83 x 2.62
30.0	34.60	5.40	6.80	0.25	30.0 x 2.3 x 1.4	BU2300300	OR3003000	30.00 x 3.00
32.0	36.00	5.00	6.40	0.25	32.0 x 2.0 x 1.4	BU2000320	ORAR00125	31.42 x 2.62
32.0	36.60	5.40	6.80	0.25	32.0 x 2.3 x 1.4	BU2300320	OR3003200	32.00 x 3.00
35.0	39.00	5.00	6.40	0.25	35.0 x 2.0 x 1.4	BU2000350	ORAR00126	34.59 x 2.62
35.0	39.60	5.40	6.80	0.25	35.0 x 2.3 x 1.4	BU2300350	OR3003500	35.00 x 3.00
36.0	40.00	5.00	6.40	0.25	36.0 x 2.0 x 1.4	BU2000360	ORAR00127	36.17 x 2.62
36.0	40.60	5.40	6.80	0.25	36.0 x 2.3 x 1.4	BU2300360	OR3003600	36.00 x 3.00
40.0	45.40	6.20	7.60	0.25	40.0 x 2.7 x 1.4	BU2700400	ORAR00223	40.87 x 3.53
40.0	46.10	6.90	8.60	0.25	40.0 x 3.1 x 1.7	BU3100400	OR4004000	40.00 x 4.00
42.0	47.40	6.20	7.60	0.25	42.0 x 2.7 x 1.4	BU2700420	ORAR00223	40.87 x 3.53
42.0	48.20	6.90	8.60	0.25	42.0 x 3.1 x 1.7	BU3100420	OR4004200	42.00 x 4.00



Rod Ø d _N f7	Groove Ø d ₆ H9	Groove width		Radius r ±0.2	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.25	b ₃ +0.25					
mm								
45.0	50.40	6.20	7.60	0.25	45.0 x 2.7 x 1.4	BU2700450	ORAR00224	44.04 x 3.53
45.0	51.20	6.90	8.60	0.25	45.0 x 3.1 x 1.7	BU3100450	OR4004500	45.00 x 4.00
48.0	53.40	6.20	7.60	0.25	48.0 x 2.7 x 1.4	BU2700480	ORAR00225	47.22 x 3.53
48.0	54.20	6.90	8.60	0.25	48.0 x 3.1 x 1.7	BU3100480	OR4004800	48.00 x 4.00
50.0	55.40	6.20	7.60	0.25	50.0 x 2.7 x 1.4	BU2700500	ORAR00226	50.39 x 3.53
50.0	56.20	6.90	8.60	0.25	50.0 x 3.1 x 1.7	BU3100500	OR4005000	50.00 x 4.00
52.0	57.40	6.20	7.60	0.25	52.0 x 2.7 x 1.4	BU2700520	ORAR00226	50.39 x 3.53
52.0	58.20	6.90	8.60	0.25	52.0 x 3.1 x 1.7	BU3100520	OR4005200	52.00 x 4.00
55.0	60.40	6.20	7.60	0.25	55.0 x 2.7 x 1.4	BU2700550	ORAR00227	53.57 x 3.53
55.0	61.20	6.90	8.60	0.25	55.0 x 3.1 x 1.7	BU3100550	OR4005500	55.00 x 4.00
56.0	61.40	6.20	7.60	0.25	56.0 x 2.7 x 1.4	BU2700560	ORAR00228	56.74 x 3.53
56.0	62.20	6.90	8.60	0.25	56.0 x 3.1 x 1.7	BU3100560	OR4005600	56.00 x 4.00
60.0	65.40	6.20	7.60	0.25	60.0 x 2.7 x 1.4	BU2700600	ORAR00229	59.92 x 3.53
60.0	66.20	6.90	8.60	0.25	60.0 x 3.1 x 1.7	BU3100600	OR4006000	60.00 x 4.00
63.0	68.40	6.20	7.60	0.25	63.0 x 2.7 x 1.4	BU2700630	ORAR00230	63.09 x 3.53
63.0	69.20	6.90	8.60	0.25	63.0 x 3.1 x 1.7	BU3100630	OR4006300	60.00 x 4.00
65.0	70.40	6.20	7.60	0.25	65.0 x 2.7 x 1.4	BU2700650	ORAR00231	66.27 x 3.53
65.0	71.20	6.90	8.60	0.25	65.0 x 3.1 x 1.7	BU3100650	OR4006500	65.40 x 4.00
70.0	75.40	6.20	7.60	0.25	70.0 x 2.7 x 1.4	BU2700700	ORAR00232	69.44 x 3.53
70.0	76.20	6.90	8.60	0.25	70.0 x 3.1 x 1.7	BU3100700	OR4007000	70.00 x 4.00
75.00	80.40	6.20	7.60	0.25	75.0 x 2.7 x 1.4	BU2700750	ORAR00234	75.79 x 3.53
75.00	81.20	6.90	8.60	0.25	75.0 x 3.1 x 1.7	BU3100750	OR4007500	75.00 x 4.00
80.00	88.00	8.30	10.00	0.25	80.0 x 4.0 x 1.7	BU4000800	OR5008000	80.00 x 5.00
80.00	93.60	9.00	10.90	0.25	80.0 x 4.3 x 1.7	BU4300800	ORAR00339	81.92 x 5.33
85.00	88.60	9.00	10.90	0.25	85.0 x 4.0 x 1.7	BU4000850	OR5008500	85.00 x 5.00
85.00	93.00	8.30	10.00	0.25	85.0 x 4.3 x 1.7	BU4300850	ORAR00340	85.09 x 5.33
90.00	98.00	8.30	10.00	0.25	90.0 x 4.0 x 1.7	BU4000900	OR5009000	90.00 x 5.00
90.00	98.60	9.00	10.90	0.25	90.0 x 4.3 x 1.7	BU4300900	ORAR00342	91.44 x 5.33
95.00	103.00	8.30	10.00	0.25	95.0 x 4.0 x 1.7	BU4000950	OR5009500	95.00 x 5.00
95.00	103.60	9.00	10.90	0.25	95.0 x 4.3 x 1.7	BU4300950	ORAR00343	94.62 x 5.33
100.00	108.00	8.30	10.00	0.25	100.0 x 4.0 x 1.7	BU4001000	OR5010000	100.00 x 5.00
100.00	108.60	9.00	10.90	0.25	100.0 x 4.3 x 1.7	BU4301000	ORAR00345	100.97 x 5.33
105.00	113.00	8.30	10.00	0.25	105.0 x 4.0 x 1.7	BU4001050	OR5010500	105.00 x 5.00
105.00	113.60	9.00	10.90	0.25	105.0 x 4.3 x 1.7	BU4301050	ORAR00346	104.14 x 5.33
110.00	118.00	8.30	10.00	0.25	110.0 x 4.0 x 1.7	BU4001100	OR5011000	110.00 x 5.00
110.00	118.60	9.00	10.90	0.25	110.0 x 4.3 x 1.7	BU4301100	ORAR00348	110.49 x 5.33
115.00	123.00	8.30	10.00	0.25	115.0 x 4.0 x 1.7	BU4001150	OR5011500	115.00 x 5.00
115.00	123.60	9.00	10.90	0.25	115.0 x 4.3 x 1.7	BU4301150	ORAR00349	113.67 x 5.33
120.00	128.00	8.30	10.00	0.25	120.0 x 4.0 x 1.7	BU4001200	OR5012000	120.00 x 5.00
120.00	128.60	9.00	10.90	0.25	120.0 x 4.3 x 1.7	BU4301200	ORAR00351	120.02 x 5.33
125.00	133.00	8.30	10.00	0.25	125.0 x 4.0 x 1.7	BU4001250	OR5012500	125.00 x 5.00
125.00	133.60	9.00	10.90	0.25	125.0 x 4.3 x 1.7	BU4301250	ORAR00353	126.37 x 5.33



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
d _N f7	d ₆ H9	mm						
130.00	138.00	8.30	10.00	0.25	130.0 x 4.0 x 1.7	BU4001300	ORAR013000	130.00 x 5.00
130.00	138.60	9.00	10.90	0.25	130.0 x 4.3 x 1.7	BU4301300	ORAR00354	129.54 x 5.33
135.00	146.60	12.30	15.10	0.25	135.0 x 5.8 x 2.5	BU5801350	ORAR00432	135.89 x 6.99
140.00	151.60	12.30	15.10	0.25	140.0 x 5.8 x 2.5	BU5801400	ORAR00433	139.07 x 6.99
150.00	161.60	12.30	15.10	0.25	150.0 x 5.8 x 2.5	BU5801500	ORAR00437	151.77 x 6.99
160.00	171.60	12.30	15.10	0.25	160.0 x 5.8 x 2.5	BU5801600	ORAR00438	158.12 x 6.99
170.00	181.60	12.30	15.10	0.25	170.0 x 5.8 x 2.5	BU5801700	ORAR00440	170.82 x 6.99
180.00	191.60	12.30	15.10	0.25	180.0 x 5.8 x 2.5	BU5801800	ORAR00442	183.52 x 6.99
190.00	201.60	12.30	15.10	0.25	190.0 x 5.8 x 2.5	BU5801900	ORAR00443	189.87 x 6.99
200.00	211.60	12.30	15.10	0.25	200.0 x 5.8 x 2.5	BU5802000	ORAR00445	202.57 x 6.99
210.00	221.60	12.30	15.10	0.25	210.0 x 5.8 x 2.5	BU5802100	ORAR00446	215.27 x 6.99
220.00	231.60	12.30	15.10	0.25	220.0 x 5.8 x 2.5	BU5802200	ORAR00446	215.27 x 6.99
230.00	241.60	12.30	15.10	0.25	230.0 x 5.8 x 2.5	BU5802300	ORAR00447	227.97 x 6.99
240.00	251.60	12.30	15.10	0.25	240.0 x 5.8 x 2.5	BU5802400	ORAR00448	240.67 x 6.99
250.00	261.60	12.30	15.10	0.25	250.0 x 5.8 x 2.5	BU5802500	ORAR00449	253.37 x 6.99
280.00	291.60	12.30	15.10	0.25	280.0 x 5.8 x 2.5	BU5802800	ORAR00451	278.77 x 6.99
300.00	311.60	12.30	15.10	0.25	300.0 x 5.8 x 2.5	BU5803000	ORAR00453	304.17 x 6.99
320.00	331.60	12.30	15.10	0.25	320.0 x 5.8 x 2.5	BU5803200	ORAR00454	316.87 x 6.99
350.00	361.60	12.30	15.10	0.25	350.0 x 5.8 x 2.5	BU5803500	ORAR00457	354.97 x 6.99
360.00	371.60	12.30	15.10	0.25	360.0 x 5.8 x 2.5	BU5803600	ORAR00457	354.97 x 6.99
400.00	411.60	12.30	15.10	0.25	400.0 x 5.8 x 2.5	BU5804000	ORAR00461	405.26 x 6.99

Further sizes available on request.

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

**Table 82: Preferred series for static application, rectangular Back-up Ring Type BU (uncut), Internal sealing, material PTFE – Inch**

Rod Ø	Groove Ø	Groove width		Radius r ±0.008	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
inch								
0.157	0.244	0.118	0.157	0.010	0.157 x 0.043 x 0.055	BU11L0040	OR1500400	0.157 x 0.059
0.157	0.260	0.150	0.205	0.010	0.157 x 0.051 x 0.055	BU1300040	ORAR00007	0.145 x 0.070
0.197	0.283	0.118	0.157	0.010	0.197 x 0.043 x 0.055	BU1100050	OR1500500	0.197 x 0.059
0.197	0.299	0.150	0.205	0.010	0.197 x 0.051 x 0.055	BU1300050	ORAR00008	0.176 x 0.070
0.236	0.323	0.118	0.157	0.010	0.236 x 0.043 x 0.055	BU1100060	OR1500600	0.236 x 0.059
0.236	0.339	0.150	0.205	0.010	0.236 x 0.051 x 0.055	BU1300060	ORAR00010	0.239 x 0.070
0.315	0.417	0.150	0.205	0.010	0.315 x 0.051 x 0.055	BU1300080	ORAR00011	0.301 x 0.070
0.315	0.433	0.161	0.217	0.010	0.315 x 0.059 x 0.055	BU1500080	OR2000800	0.315 x 0.079
0.394	0.496	0.150	0.205	0.010	0.394 x 0.051 x 0.055	BU1300100	ORAR00013	0.426 x 0.070
0.394	0.512	0.161	0.217	0.010	0.394 x 0.059 x 0.055	BU1500100	OR2001000	0.394 x 0.079
0.472	0.575	0.150	0.205	0.010	0.472 x 0.051 x 0.055	BU1300120	ORAR00014	0.489 x 0.070
0.472	0.591	0.161	0.217	0.010	0.472 x 0.059 x 0.055	BU1500120	OR2001200	0.472 x 0.079
0.551	0.654	0.150	0.205	0.010	0.551 x 0.051 x 0.055	BU1300140	ORAR00015	0.551 x 0.070
0.551	0.669	0.161	0.217	0.010	0.551 x 0.059 x 0.055	BU1500140	OR2001400	0.551 x 0.079
0.591	0.693	0.150	0.205	0.010	0.591 x 0.051 x 0.055	BU1300150	ORAR00016	0.614 x 0.070
0.591	0.709	0.161	0.217	0.010	0.591 x 0.059 x 0.055	BU1500150	OR2001500	0.591 x 0.079
0.630	0.732	0.150	0.205	0.010	0.630 x 0.051 x 0.055	BU1300160	ORAR00016	0.614 x 0.070
0.630	0.748	0.161	0.217	0.010	0.630 x 0.059 x 0.055	BU1500160	OR2001600	0.630 x 0.079
0.709	0.811	0.150	0.205	0.010	0.709 x 0.051 x 0.055	BU1300180	ORAR00018	0.739 x 0.070
0.709	0.827	0.161	0.217	0.010	0.709 x 0.059 x 0.055	BU1500180	OR2001800	0.709 x 0.079
0.787	0.890	0.150	0.205	0.010	0.787 x 0.051 x 0.055	BU1300200	ORAR00019	0.801 x 0.070
0.787	0.906	0.161	0.217	0.010	0.787 x 0.059 x 0.055	BU1500200	OR2002000	0.787 x 0.079
0.866	1.024	0.197	0.252	0.010	0.866 x 0.079 x 0.055	BU2000220	ORAR00118	0.862 x 0.103
0.866	1.047	0.213	0.268	0.010	0.866 x 0.091 x 0.055	BU2300220	OR3002200	0.866 x 0.118
0.984	1.142	0.197	0.252	0.010	0.984 x 0.079 x 0.055	BU2000250	ORAR00120	0.987 x 0.103
0.984	1.165	0.213	0.268	0.010	0.984 x 0.091 x 0.055	BU2300250	OR3002500	0.984 x 0.118
1.102	1.260	0.197	0.252	0.010	1.102 x 0.079 x 0.055	BU2000280	ORAR00122	1.112 x 0.103
1.102	1.283	0.213	0.268	0.010	1.102 x 0.091 x 0.055	BU2300280	OR3002800	1.102 x 0.079
1.181	1.339	0.197	0.252	0.010	1.181 x 0.079 x 0.055	BU2000300	ORAR00123	1.174 x 0.103
1.181	1.362	0.213	0.268	0.010	1.181 x 0.091 x 0.055	BU2300300	OR3003000	1.181 x 0.118
1.260	1.417	0.197	0.252	0.010	1.260 x 0.079 x 0.055	BU2000320	ORAR00125	1.237 x 0.103
1.260	1.441	0.213	0.268	0.010	1.260 x 0.091 x 0.055	BU2300320	OR3003200	1.260 x 0.118
1.378	1.535	0.197	0.252	0.010	1.378 x 0.079 x 0.055	BU2000350	ORAR00126	1.362 x 0.103
1.378	1.559	0.213	0.268	0.010	1.378 x 0.091 x 0.055	BU2300350	OR3003500	1.378 x 0.118
1.417	1.575	0.197	0.252	0.010	1.417 x 0.079 x 0.055	BU2000360	ORAR00127	1.424 x 0.103
1.417	1.598	0.213	0.268	0.010	1.417 x 0.091 x 0.055	BU2300360	OR3003600	1.417 x 0.118
1.575	1.787	0.244	0.299	0.010	1.575 x 0.106 x 0.055	BU2700400	ORAR00223	1.609 x 0.139
1.575	1.815	0.272	0.339	0.010	1.575 x 0.122 x 0.067	BU3100400	OR4004000	1.575 x 0.157
1.654	1.866	0.244	0.299	0.010	1.654 x 0.106 x 0.055	BU2700420	ORAR00223	1.609 x 0.139
1.654	1.898	0.272	0.339	0.010	1.654 x 0.122 x 0.067	BU3100420	OR4004200	1.654 x 0.157



Rod Ø	Groove Ø	Groove width		Radius r ±0.008	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
d _N f7	d ₆ H9							
inch								
1.772	1.984	0.244	0.299	0.010	1.772 x 0.106 x 0.055	BU2700450	ORAR00224	1.734 x 0.139
1.772	2.016	0.272	0.339	0.010	1.772 x 0.122 x 0.067	BU3100450	OR4004500	1.772 x 0.157
1.890	2.102	0.244	0.299	0.010	1.890 x 0.106 x 0.055	BU2700480	ORAR00225	1.859 x 0.139
1.890	2.134	0.272	0.339	0.010	1.890 x 0.122 x 0.067	BU3100480	OR4004800	1.890 x 0.157
1.969	2.181	0.244	0.299	0.010	1.969 x 0.106 x 0.055	BU2700500	ORAR00226	1.984 x 0.139
1.969	2.213	0.272	0.339	0.010	1.969 x 0.122 x 0.067	BU3100500	OR4005000	1.969 x 0.157
2.047	2.260	0.244	0.299	0.010	2.047 x 0.106 x 0.055	BU2700520	ORAR00226	1.984 x 0.139
2.047	2.291	0.272	0.339	0.010	2.047 x 0.122 x 0.067	BU3100520	OR4005200	2.047 x 0.157
2.165	2.378	0.244	0.299	0.010	2.165 x 0.106 x 0.055	BU2700550	ORAR00227	2.109 x 0.139
2.165	2.409	0.272	0.339	0.010	2.165 x 0.122 x 0.067	BU3100550	OR4005500	2.165 x 0.157
2.205	2.417	0.244	0.299	0.010	2.205 x 0.106 x 0.055	BU2700560	ORAR00228	2.234 x 0.139
2.205	2.449	0.272	0.339	0.010	2.205 x 0.122 x 0.067	BU3100560	OR4005600	2.205 x 0.157
2.362	2.575	0.244	0.299	0.010	2.362 x 0.106 x 0.055	BU2700600	ORAR00229	2.359 x 0.139
2.362	2.606	0.272	0.339	0.010	2.362 x 0.122 x 0.067	BU3100600	OR4006000	2.362 x 0.157
2.480	2.693	0.244	0.299	0.010	2.480 x 0.106 x 0.055	BU2700630	ORAR00230	2.484 x 0.139
2.480	2.724	0.272	0.339	0.010	2.480 x 0.122 x 0.067	BU3100630	OR4006300	2.362 x 0.157
2.559	2.772	0.244	0.299	0.010	2.559 x 0.106 x 0.055	BU2700650	ORAR00231	2.609 x 0.139
2.559	2.803	0.272	0.339	0.010	2.559 x 0.122 x 0.067	BU3100650	OR4006500	2.575 x 0.157
2.756	2.969	0.244	0.299	0.010	2.756 x 0.106 x 0.055	BU2700700	ORAR00232	2.734 x 0.139
2.756	3.000	0.272	0.339	0.010	2.756 x 0.122 x 0.067	BU3100700	OR4007000	2.756 x 0.157
2.953	3.165	0.244	0.299	0.010	2.953 x 0.106 x 0.055	BU2700750	ORAR00234	2.984 x 0.139
2.953	3.197	0.272	0.339	0.010	2.953 x 0.122 x 0.067	BU3100750	OR4007500	2.953 x 0.157
3.150	3.465	0.327	0.394	0.010	3.150 x 0.157 x 0.067	BU4000800	OR5008000	3.150 x 0.197
3.150	3.685	0.354	0.429	0.010	3.150 x 0.169 x 0.067	BU4300800	ORAR00339	3.225 x 0.210
3.346	3.488	0.354	0.429	0.010	3.346 x 0.157 x 0.067	BU4000850	OR5008500	3.346 x 0.197
3.346	3.661	0.327	0.394	0.010	3.346 x 0.169 x 0.067	BU4300850	ORAR00340	3.350 x 0.210
3.543	3.858	0.327	0.394	0.010	3.543 x 0.157 x 0.067	BU4000900	OR5009000	3.543 x 0.197
3.543	3.882	0.354	0.429	0.010	3.543 x 0.169 x 0.067	BU4300900	ORAR00342	3.600 x 0.210
3.740	4.055	0.327	0.394	0.010	3.740 x 0.157 x 0.067	BU4000950	OR5009500	3.740 x 0.197
3.740	4.079	0.354	0.429	0.010	3.740 x 0.169 x 0.067	BU4300950	ORAR00343	3.725 x 0.210
3.937	4.252	0.327	0.394	0.010	3.937 x 0.157 x 0.067	BU4001000	OR5010000	3.937 x 0.197
3.937	4.276	0.354	0.429	0.010	3.937 x 0.169 x 0.067	BU4301000	ORAR00345	3.975 x 0.210
4.134	4.449	0.327	0.394	0.010	4.134 x 0.157 x 0.067	BU4001050	OR5010500	4.134 x 0.197
4.134	4.472	0.354	0.429	0.010	4.134 x 0.169 x 0.067	BU4301050	ORAR00346	4.100 x 0.210
4.331	4.646	0.327	0.394	0.010	4.331 x 0.157 x 0.067	BU4001100	OR5011000	4.331 x 0.197
4.331	4.669	0.354	0.429	0.010	4.331 x 0.169 x 0.067	BU4301100	ORAR00348	4.350 x 0.210
4.528	4.843	0.327	0.394	0.010	4.528 x 0.157 x 0.067	BU4001150	OR5011500	4.528 x 0.197
4.528	4.866	0.354	0.429	0.010	4.528 x 0.169 x 0.067	BU4301150	ORAR00349	4.475 x 0.210
4.724	5.039	0.327	0.394	0.010	4.724 x 0.157 x 0.067	BU4001200	OR5012000	4.724 x 0.197
4.724	5.063	0.354	0.429	0.010	4.724 x 0.169 x 0.067	BU4301200	ORAR00351	4.725 x 0.210



Rod ∅	Groove ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
4.921	5.236	0.327	0.394	0.010	4.921 x 0.157 x 0.067	BU4001250	OR5012500	4.921 x 0.197
4.921	5.260	0.354	0.429	0.010	4.921 x 0.169 x 0.067	BU4301250	ORAR00353	4.975 x 0.210
5.118	5.433	0.327	0.394	0.010	5.118 x 0.157 x 0.067	BU4001300	OR5013000	5.118 x 0.197
5.118	5.457	0.354	0.429	0.010	5.118 x 0.169 x 0.067	BU4301300	ORAR00354	5.100 x 0.210
5.315	5.772	0.484	0.594	0.010	5.315 x 0.228 x 0.098	BU5801350	ORAR00432	5.350 x 0.275
5.512	5.969	0.484	0.594	0.010	5.512 x 0.228 x 0.098	BU5801400	ORAR00433	5.475 x 0.275
5.906	6.362	0.484	0.594	0.010	5.906 x 0.228 x 0.098	BU5801500	ORAR00437	5.975 x 0.275
6.299	6.756	0.484	0.594	0.010	6.299 x 0.228 x 0.098	BU5801600	ORAR00438	6.225 x 0.275
6.693	7.150	0.484	0.594	0.010	6.693 x 0.228 x 0.098	BU5801700	ORAR00440	6.725 x 0.275
7.087	7.543	0.484	0.594	0.010	7.087 x 0.228 x 0.098	BU5801800	ORAR00442	7.225 x 0.275
7.480	7.937	0.484	0.594	0.010	7.480 x 0.228 x 0.098	BU5801900	ORAR00443	7.475 x 0.275
7.874	8.331	0.484	0.594	0.010	7.874 x 0.228 x 0.098	BU5802000	ORAR00445	7.975 x 0.275
8.268	8.724	0.484	0.594	0.010	8.268 x 0.228 x 0.098	BU5802100	ORAR00446	8.475 x 0.275
8.661	9.118	0.484	0.594	0.010	8.661 x 0.228 x 0.098	BU5802200	ORAR00446	8.475 x 0.275
9.055	9.512	0.484	0.594	0.010	9.055 x 0.228 x 0.098	BU5802300	ORAR00447	8.975 x 0.275
9.449	9.906	0.484	0.594	0.010	9.449 x 0.228 x 0.098	BU5802400	ORAR00448	9.475 x 0.275
9.843	10.299	0.484	0.594	0.010	9.843 x 0.228 x 0.098	BU5802500	ORAR00449	9.975 x 0.275
11.024	11.480	0.484	0.594	0.010	11.024 x 0.228 x 0.098	BU5802800	ORAR00451	10.975 x 0.275
11.811	12.268	0.484	0.594	0.010	11.811 x 0.228 x 0.098	BU5803000	ORAR00453	11.975 x 0.275
12.598	13.055	0.484	0.594	0.010	12.598 x 0.228 x 0.098	BU5803200	ORAR00454	12.475 x 0.275
13.780	14.236	0.484	0.594	0.010	13.780 x 0.228 x 0.098	BU5803500	ORAR00457	13.975 x 0.275
14.173	14.630	0.484	0.594	0.010	14.173 x 0.228 x 0.098	BU5803600	ORAR00457	13.975 x 0.275
15.748	16.205	0.484	0.594	0.010	15.748 x 0.228 x 0.098	BU5804000	ORAR00461	15.955 x 0.275

Further sizes available on request.

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



H.2.2 CONCAVE BACK-UP RING TYPES, UN CUT (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).

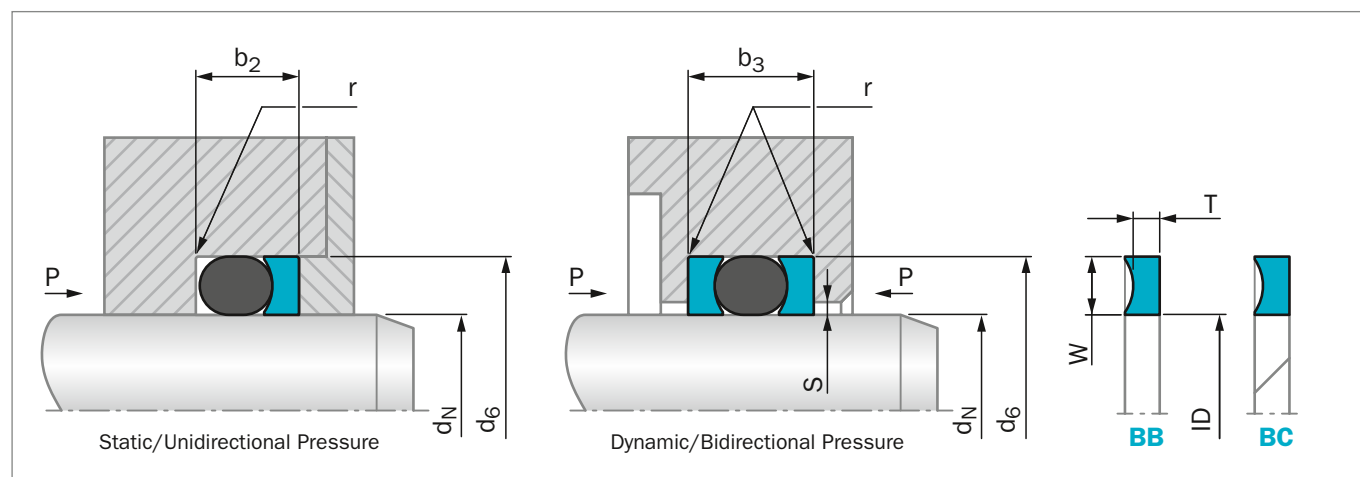


Figure 60: Installation drawing internal sealing, concave Back-up Ring types

Table 83: Installation dimensions for concave Back-up Ring types, uncut and cut, Internal sealing, material PTFE – Metric

O-Ring Cross- Section-Ø d_2	Back-up Ring Cross section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d_6 H9		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	$b_2 + 0.25$	$b_3 + 0.25$	$r \pm 0.2$
mm								
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
6.99	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



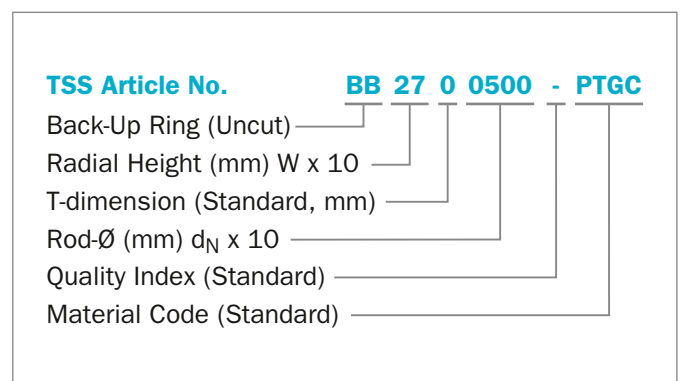
Table 84: Installation dimensions for concave Back-up Ring types, uncut and cut, Internal sealing, material PTFE – Inch

O-Ring Cross-Section-Ø d ₂	Back-up Ring Cross section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₆ H9		Groove width		Radius r
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.010	b ₃ +0.010	r ±0.008
inch								
0.059	0.049	0.043	0.039	d _N + 0.098	d _N + 0.087	0.118	0.157	0.010
0.063	0.051	0.047	0.039	d _N + 0.102	d _N + 0.094	0.122	0.161	0.010
0.070	0.057	0.051	0.055	d _N + 0.114	d _N + 0.102	0.150	0.205	0.010
0.071	0.057	0.051	0.055	d _N + 0.114	d _N + 0.102	0.150	0.205	0.010
0.079	0.065	0.059	0.055	d _N + 0.130	d _N + 0.118	0.161	0.217	0.010
0.094	0.081	0.071	0.055	d _N + 0.161	d _N + 0.142	0.181	0.236	0.010
0.098	0.085	0.075	0.055	d _N + 0.169	d _N + 0.150	0.185	0.240	0.010
0.103	0.089	0.079	0.055	d _N + 0.177	d _N + 0.157	0.197	0.252	0.010
0.104	0.089	0.079	0.055	d _N + 0.177	d _N + 0.157	0.197	0.252	0.010
0.118	0.102	0.091	0.055	d _N + 0.205	d _N + 0.181	0.213	0.268	0.010
0.139	0.122	0.106	0.055	d _N + 0.244	d _N + 0.213	0.244	0.299	0.010
0.140	0.122	0.106	0.055	d _N + 0.244	d _N + 0.213	0.244	0.299	0.010
0.157	0.138	0.122	0.067	d _N + 0.276	d _N + 0.244	0.272	0.339	0.010
0.197	0.173	0.157	0.067	d _N + 0.346	d _N + 0.315	0.327	0.394	0.010
0.209	0.185	0.169	0.067	d _N + 0.370	d _N + 0.339	0.354	0.429	0.010
0.210	0.185	0.169	0.067	d _N + 0.370	d _N + 0.339	0.354	0.429	0.010
0.224	0.197	0.181	0.067	d _N + 0.394	d _N + 0.362	0.354	0.433	0.010
0.236	0.209	0.193	0.067	d _N + 0.417	d _N + 0.386	0.366	0.441	0.010
0.275	0.240	0.228	0.098	d _N + 0.480	d _N + 0.457	0.484	0.594	0.010
0.315	0.280	0.264	0.098	d _N + 0.559	d _N + 0.528	0.496	0.606	0.010
0.331	0.295	0.280	0.098	d _N + 0.591	d _N + 0.559	0.504	0.614	0.010

ORDERING EXAMPLE

Back-up Ring:	Concave, type BB (uncut) for O-Ring seal
Application:	Static, external sealing
Rod diameter:	d _N = 50.00 mm (1.969 inch)
O-Ring cross section:	d ₂ = 3.53 mm (0.139 inch)
Back-up Ring material:	PTFE, glassfiber filled (25%)

For material code see page 139





**Table 85: Preferred series for static application, concave Back-up Ring
Type BB (uncut), Internal sealing, material PTFE – Metric**

Rod Ø	Groove Ø	Groove width		Radius r ±0.2	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.25	b ₃ +0.25					
mm								
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	ORA2001200	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
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



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Rod Ø	Groove Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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 available on request.

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



**Table 86: Preferred series for static application, concave Back-up Ring
Type BB (uncut), Internal sealing, material PTFE – Inch**

Rod Ø	Groove Ø	Groove width		Radius r	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
d _N f7	d ₆ H9			±0.008				
inch								
0.157	0.244	0.118	0.157	0.010	0.157 x 0.043 x 0.055	BB1100040	OR1500400	0.157 x 0.059
0.157	0.260	0.150	0.205	0.010	0.157 x 0.051 x 0.055	BB1300040	ORAR00007	0.145 x 0.070
0.197	0.283	0.118	0.157	0.010	0.197 x 0.043 x 0.055	BB1100050	OR1500500	0.197 x 0.059
0.197	0.299	0.150	0.205	0.010	0.197 x 0.051 x 0.055	BB1300050	ORAR00008	0.176 x 0.070
0.236	0.323	0.118	0.157	0.010	0.236 x 0.043 x 0.055	BB1100060	OR1500600	0.236 x 0.059
0.236	0.339	0.150	0.205	0.010	0.236 x 0.091 x 0.055	BB1300060	ORAR00010	0.239 x 0.070
0.315	0.417	0.150	0.205	0.010	0.315 x 0.051 x 0.055	BB1300080	ORAR00011	0.301 x 0.070
0.315	0.433	0.161	0.217	0.010	0.315 x 0.059 x 0.055	BB1500080	OR2000800	0.315 x 0.079
0.394	0.496	0.150	0.205	0.010	0.394 x 0.051 x 0.055	BB1300100	ORAR00013	0.426 x 0.070
0.394	0.512	0.161	0.217	0.010	0.394 x 0.059 x 0.055	BB1500100	OR2001000	0.394 x 0.079
0.472	0.575	0.150	0.205	0.010	0.472 x 0.051 x 0.055	BB1300120	ORAR00014	0.489 x 0.070
0.472	0.591	0.161	0.217	0.010	0.472 x 0.059 x 0.055	BB1500120	OR2001200	0.472 x 0.079
0.551	0.654	0.150	0.205	0.010	0.551 x 0.051 x 0.055	BB1300140	ORAR00015	0.551 x 0.070
0.551	0.669	0.161	0.217	0.010	0.551 x 0.059 x 0.055	BB1500140	OR2001400	0.551 x 0.079
0.591	0.693	0.150	0.205	0.010	0.591 x 0.051 x 0.055	BB1300150	ORAR00016	0.614 x 0.070
0.591	0.709	0.161	0.217	0.010	0.591 x 0.059 x 0.055	BB1500150	OR2001500	0.591 x 0.079
0.630	0.732	0.150	0.205	0.010	0.630 x 0.051 x 0.055	BB1300160	ORAR00016	0.614 x 0.070
0.630	0.748	0.161	0.217	0.010	0.630 x 0.059 x 0.055	BB1500160	OR2001600	0.630 x 0.079
0.709	0.811	0.150	0.205	0.010	0.709 x 0.051 x 0.055	BB1300180	ORAR00018	0.739 x 0.070
0.709	0.827	0.161	0.217	0.010	0.709 x 0.059 x 0.055	BB1500180	OR2001800	0.709 x 0.079
0.787	0.890	0.150	0.205	0.010	0.787 x 0.051 x 0.055	BB1300200	ORAR00019	0.801 x 0.070
0.787	0.906	0.161	0.217	0.010	0.787 x 0.059 x 0.055	BB1500200	OR2002000	0.787 x 0.079
0.866	1.024	0.197	0.252	0.010	0.866 x 0.079 x 0.055	BB2000220	ORAR00118	0.862 x 0.103
0.866	1.047	0.213	0.268	0.010	0.866 x 0.091 x 0.055	BB2300220	OR3002200	0.866 x 0.118
0.984	1.142	0.197	0.252	0.010	0.984 x 0.079 x 0.055	BB2000250	ORAR00120	0.987 x 0.103
0.984	1.165	0.213	0.268	0.010	0.984 x 0.091 x 0.055	BB2300250	OR3002500	0.984 x 0.118
1.102	1.260	0.197	0.252	0.010	1.102 x 0.079 x 0.055	BB2000280	ORAR00122	1.112 x 0.103
1.102	1.283	0.213	0.268	0.010	1.102 x 0.091 x 0.055	BB2300280	OR3002800	1.102 x 0.079
1.181	1.339	0.197	0.252	0.010	1.181 x 0.079 x 0.055	BB2000300	ORAR00123	1.174 x 0.103
1.181	1.362	0.213	0.268	0.010	1.181 x 0.091 x 0.055	BB2300300	OR3003000	1.181 x 0.118
1.260	1.417	0.197	0.252	0.010	1.260 x 0.079 x 0.055	BB2000320	ORAR00125	1.237 x 0.103
1.260	1.441	0.213	0.268	0.010	1.260 x 0.091 x 0.055	BB2300320	OR3003200	1.260 x 0.118
1.378	1.535	0.197	0.252	0.010	1.378 x 0.079 x 0.055	BB2000350	ORAR00126	1.362 x 0.103
1.378	1.559	0.213	0.268	0.010	1.378 x 0.091 x 0.055	BB2300350	OR3003500	1.378 x 0.118
1.417	1.575	0.197	0.252	0.010	1.417 x 0.079 x 0.055	BB2000360	ORAR00127	1.424 x 0.103
1.417	1.598	0.213	0.268	0.010	1.417 x 0.091 x 0.055	BB2300360	OR3003600	1.417 x 0.118
1.575	1.787	0.244	0.299	0.010	1.575 x 0.106 x 0.055	BB2700400	ORAR00223	1.609 x 0.139
1.575	1.819	0.272	0.339	0.010	1.575 x 0.122 x 0.067	BB3100400	OR4004000	1.575 x 0.157
1.654	1.866	0.244	0.299	0.010	1.654 x 0.106 x 0.055	BB2700420	ORAR00223	1.609 x 0.139
1.654	1.898	0.272	0.339	0.010	1.654 x 0.122 x 0.067	BB3100420	OR4004200	1.654 x 0.157



Rod Ø	Groove Ø	Groove width		Radius r	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
d _N f7	d ₆ H9			±0.008				
inch								
1.772	1.984	0.244	0.299	0.010	1.772 x 0.106 x 0.055	BB2700450	ORAR00224	1.734 x 0.139
1.772	2.016	0.272	0.339	0.010	1.772 x 0.122 x 0.067	BB3100450	OR4004500	1.772 x 0.157
1.890	2.102	0.244	0.299	0.010	1.890 x 0.106 x 0.055	BB2700480	ORAR00225	1.859 x 0.139
1.890	2.134	0.272	0.339	0.010	1.890 x 0.122 x 0.067	BB3100480	OR4004800	1.890 x 0.157
1.969	2.181	0.244	0.299	0.010	1.969 x 0.106 x 0.055	BB2700500	ORAR00226	1.984 x 0.139
1.969	2.213	0.272	0.339	0.010	1.969 x 0.122 x 0.067	BB3100500	OR4005000	1.969 x 0.157
2.047	2.260	0.244	0.299	0.010	2.047 x 0.106 x 0.055	BB2700520	ORAR00226	1.984 x 0.139
2.047	2.291	0.272	0.339	0.010	2.047 x 0.122 x 0.067	BB3100520	OR4005200	2.047 x 0.157
2.165	2.378	0.244	0.299	0.010	2.165 x 0.106 x 0.055	BB2700550	ORAR00227	2.109 x 0.139
2.165	2.409	0.272	0.339	0.010	2.165 x 0.122 x 0.067	BB3100550	OR4005500	2.165 x 0.157
2.205	2.417	0.244	0.299	0.010	2.205 x 0.106 x 0.055	BB2700560	ORAR00228	2.234 x 0.139
2.205	2.449	0.272	0.339	0.010	2.205 x 0.122 x 0.067	BB3100560	OR4005600	2.205 x 0.157
2.362	2.575	0.244	0.299	0.010	2.362 x 0.106 x 0.055	BB2700600	ORAR00229	2.359 x 0.139
2.362	2.606	0.272	0.339	0.010	2.362 x 0.122 x 0.067	BB3100600	OR4006000	2.362 x 0.157
2.480	2.693	0.244	0.299	0.010	2.480 x 0.106 x 0.055	BB2700630	ORAR00230	2.484 x 0.139
2.480	2.724	0.272	0.339	0.010	2.480 x 0.122 x 0.067	BB3100630	OR4006300	2.362 x 0.157
2.559	2.772	0.244	0.299	0.010	2.559 x 0.106 x 0.055	BB2700650	ORAR00231	2.609 x 0.139
2.559	2.803	0.272	0.339	0.010	2.559 x 0.122 x 0.067	BB3100650	OR4006500	2.575 x 0.157
2.756	2.969	0.244	0.299	0.010	2.756 x 0.106 x 0.055	BB2700700	ORAR00232	2.734 x 0.139
2.756	3.000	0.272	0.339	0.010	2.756 x 0.122 x 0.067	BB3100700	OR4007000	2.756 x 0.157
2.953	3.165	0.244	0.299	0.010	2.953 x 0.106 x 0.055	BB2700750	ORAR00234	2.984 x 0.139
2.953	3.197	0.272	0.339	0.010	2.953 x 0.122 x 0.067	BB3100750	OR4007500	2.953 x 0.157
3.150	3.465	0.327	0.394	0.010	3.150 x 0.157 x 0.067	BB4000800	OR5008000	3.150 x 0.197
3.150	3.488	0.354	0.429	0.010	3.150 x 0.169 x 0.067	BB4300800	ORAR00339	3.225 x 0.210
3.346	3.661	0.327	0.394	0.010	3.346 x 0.157 x 0.067	BB4000850	OR5008500	3.346 x 0.197
3.346	3.685	0.354	0.429	0.010	3.346 x 0.169 x 0.067	BB4300850	ORAR00340	3.350 x 0.210
3.543	3.858	0.327	0.394	0.010	3.543 x 0.157 x 0.067	BB4000900	OR5009000	3.543 x 0.197
3.543	3.882	0.354	0.429	0.010	3.543 x 0.169 x 0.067	BB4300900	ORAR00342	3.600 x 0.210
3.740	4.055	0.327	0.394	0.010	3.740 x 0.157 x 0.067	BB4000950	OR5009500	3.740 x 0.197
3.740	4.079	0.354	0.429	0.010	3.740 x 0.169 x 0.067	BB4300950	ORAR00343	3.725 x 0.210
3.937	4.252	0.327	0.394	0.010	3.937 x 0.157 x 0.067	BB4001000	OR5010000	3.937 x 0.197
3.937	4.276	0.354	0.429	0.010	3.937 x 0.169 x 0.067	BB4301000	ORAR00345	3.975 x 0.210
4.134	4.449	0.327	0.394	0.010	4.134 x 0.157 x 0.067	BB4001050	OR5010500	4.134 x 0.197
4.134	4.472	0.354	0.429	0.010	4.134 x 0.169 x 0.067	BB4301050	ORAR00346	4.100 x 0.210
4.331	4.646	0.327	0.394	0.010	4.331 x 0.157 x 0.067	BB4001100	OR5011000	4.331 x 0.197
4.331	4.669	0.354	0.429	0.010	4.331 x 0.169 x 0.067	BB4301100	ORAR00348	4.350 x 0.210
4.528	4.843	0.327	0.394	0.010	4.528 x 0.157 x 0.067	BB4001150	OR5011500	4.528 x 0.197
4.528	4.866	0.354	0.429	0.010	4.528 x 0.169 x 0.067	BB4301150	ORAR00349	4.475 x 0.210
4.724	5.039	0.327	0.394	0.010	4.724 x 0.157 x 0.067	BB4001200	OR5012000	4.724 x 0.197
4.724	5.063	0.354	0.429	0.010	4.724 x 0.169 x 0.067	BB4301200	ORAR00351	4.725 x 0.210



Rod ∅	Groove ∅	Groove width		Radius r	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
d _N f7	d ₆ H9			±0.008				
inch								
4.921	5.236	0.327	0.394	0.010	4.921 x 0.157 x 0.067	BB4001250	OR5012500	4.921 x 0.197
4.921	5.260	0.354	0.429	0.010	4.921 x 0.169 x 0.067	BB4301250	ORAR00353	4.975 x 0.210
5.118	5.433	0.327	0.394	0.010	5.118 x 0.157 x 0.067	BB4001300	OR5013000	5.118 x 0.197
5.118	5.457	0.354	0.429	0.010	5.118 x 0.169 x 0.067	BB4301300	ORAR00354	5.100 x 0.210
5.315	5.772	0.484	0.594	0.010	5.315 x 0.228 x 0.098	BB5801350	ORAR00432	5.350 x 0.275
5.512	5.969	0.484	0.594	0.010	5.512 x 0.228 x 0.098	BB5801400	ORAR00433	5.475 x 0.275
5.906	6.362	0.484	0.594	0.010	5.906 x 0.228 x 0.098	BB5801500	ORAR00437	5.975 x 0.275
6.299	6.756	0.484	0.594	0.010	6.299 x 0.228 x 0.098	BB5801600	ORAR00438	6.225 x 0.275
6.693	7.150	0.484	0.594	0.010	6.693 x 0.228 x 0.098	BB5801700	ORAR00440	6.725 x 0.275
7.087	7.543	0.484	0.594	0.010	7.087 x 0.228 x 0.098	BB5801800	ORAR00442	7.225 x 0.275
7.480	7.937	0.484	0.594	0.010	7.480 x 0.228 x 0.098	BB5801900	ORAR00443	7.475 x 0.275
7.874	8.331	0.484	0.594	0.010	7.874 x 0.228 x 0.098	BB5802000	ORAR00445	7.975 x 0.275
8.268	8.724	0.484	0.594	0.010	8.268 x 0.228 x 0.098	BB5802100	ORAR00446	8.475 x 0.275
8.661	9.118	0.484	0.594	0.010	8.661 x 0.228 x 0.098	BB5802200	ORAR00446	8.475 x 0.275
9.055	9.512	0.484	0.594	0.010	9.055 x 0.228 x 0.098	BB5802300	ORAR00447	8.975 x 0.275
9.449	9.906	0.484	0.594	0.010	9.449 x 0.228 x 0.098	BB5802400	ORAR00448	9.475 x 0.275
9.843	10.299	0.484	0.594	0.010	9.843 x 0.228 x 0.098	BB5802500	ORAR00449	9.975 x 0.275
11.024	11.480	0.484	0.594	0.010	11.024 x 0.228 x 0.098	BB5802800	ORAR00451	10.975 x 0.275
11.811	12.268	0.484	0.594	0.010	11.811 x 0.228 x 0.098	BB5803000	ORAR00453	11.975 x 0.275
12.598	13.055	0.484	0.594	0.010	12.598 x 0.228 x 0.098	BB5803200	ORAR00454	12.475 x 0.275
13.780	14.236	0.484	0.594	0.010	13.780 x 0.228 x 0.098	BB5803500	ORAR00457	13.975 x 0.275
14.173	14.630	0.484	0.594	0.010	14.173 x 0.228 x 0.098	BB5803600	ORAR00457	13.975 x 0.275
15.748	16.205	0.484	0.594	0.010	15.748 x 0.228 x 0.098	BB5804000	ORAR00461	15.955 x 0.275

Further sizes available on request.

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



H.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

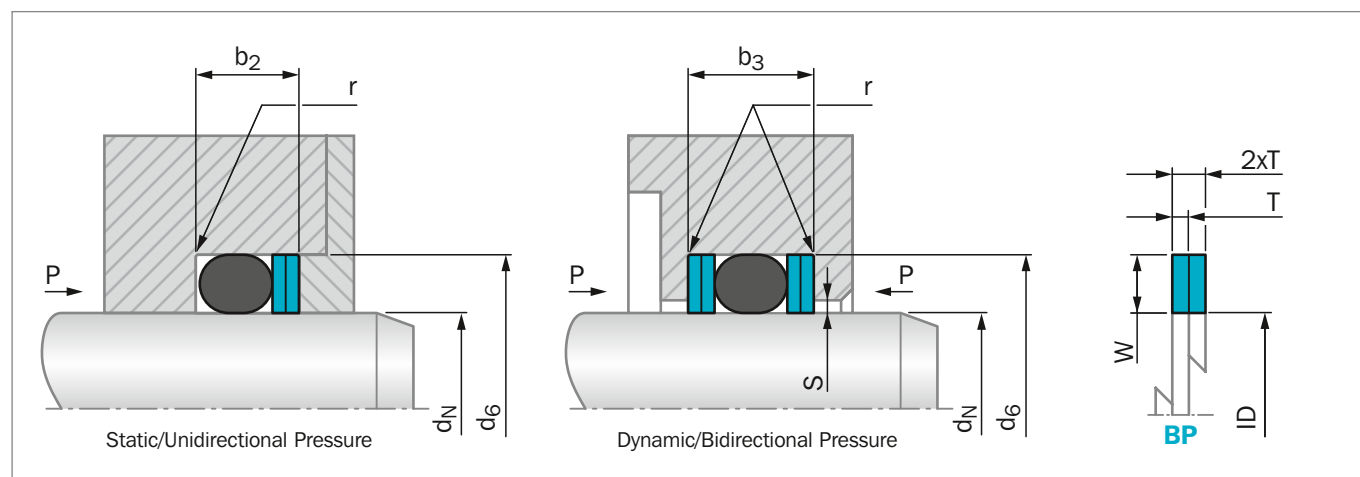


Figure 61: Installation drawing internal sealing, spiral Back-up Ring type

Table 87: Installation dimensions for the spiral Back-up Ring type, Internal sealing, material PTFE – Metric

O-Ring Cross- Section-Ø d ₂	Back-up Ring Cross section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₆ H9		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.25	b ₃ +0.25	r ±0.2
mm								
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

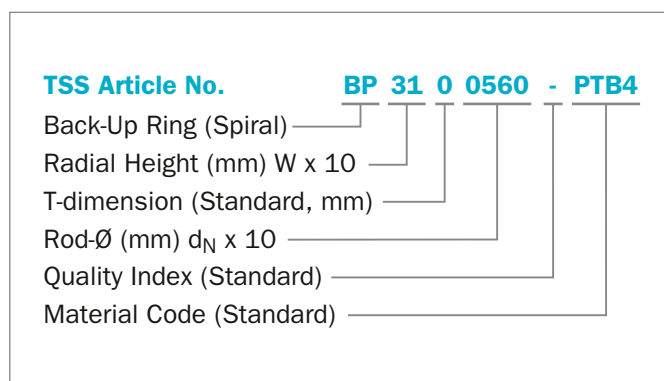


Table 88: Installation dimensions for the spiral Back-up Ring type, Internal sealing, material PTFE – Inch

O-Ring Cross-Section-Ø d ₂	Back-up Ring Cross section			Groove dimensions				
	Radial height W		Thickness T	Groove diameter d ₆ H9		Groove width		Radius
	Dynamic	Static	T	Dynamic	Static	b ₂ +0.010	b ₃ +0.010	r ±0.008
inch								
0.059	0.049	0.043	0.020	d _N + 0.098	d _N + 0.087	0.118	0.157	0.010
0.063	0.051	0.047	0.020	d _N + 0.102	d _N + 0.094	0.122	0.161	0.010
0.070	0.057	0.051	0.028	d _N + 0.114	d _N + 0.102	0.150	0.205	0.010
0.071	0.057	0.051	0.028	d _N + 0.114	d _N + 0.102	0.150	0.205	0.010
0.079	0.065	0.059	0.028	d _N + 0.130	d _N + 0.118	0.161	0.217	0.010
0.094	0.081	0.071	0.028	d _N + 0.161	d _N + 0.142	0.181	0.236	0.010
0.098	0.085	0.075	0.028	d _N + 0.169	d _N + 0.150	0.185	0.240	0.010
0.103	0.089	0.079	0.028	d _N + 0.177	d _N + 0.157	0.197	0.252	0.010
0.104	0.089	0.079	0.028	d _N + 0.177	d _N + 0.157	0.197	0.252	0.010
0.118	0.102	0.091	0.028	d _N + 0.205	d _N + 0.181	0.213	0.268	0.010
0.139	0.122	0.106	0.028	d _N + 0.244	d _N + 0.213	0.244	0.299	0.010
0.140	0.122	0.106	0.028	d _N + 0.244	d _N + 0.213	0.244	0.299	0.010
0.157	0.138	0.122	0.033	d _N + 0.276	d _N + 0.244	0.272	0.339	0.010
0.197	0.173	0.157	0.033	d _N + 0.346	d _N + 0.315	0.327	0.394	0.010
0.209	0.185	0.169	0.033	d _N + 0.370	d _N + 0.339	0.354	0.429	0.010
0.210	0.185	0.169	0.033	d _N + 0.370	d _N + 0.339	0.354	0.429	0.010
0.224	0.197	0.181	0.033	d _N + 0.394	d _N + 0.362	0.354	0.433	0.010
0.236	0.209	0.193	0.033	d _N + 0.417	d _N + 0.386	0.366	0.441	0.010
0.276	0.240	0.228	0.049	d _N + 0.480	d _N + 0.457	0.484	0.594	0.010
0.315	0.280	0.264	0.049	d _N + 0.559	d _N + 0.528	0.496	0.606	0.010
0.331	0.295	0.280	0.049	d _N + 0.591	d _N + 0.559	0.504	0.614	0.010

ORDERING EXAMPLE

Back-up Ring:	Type BP (spiral) for O-Ring seal
Application:	Dynamic, internal sealing
Rod diameter:	d _N = 56.00 mm (2.205 inch)
O-Ring cross section:	d ₂ = 3.53 mm (0.139 inch)
Back-up Ring material:	PTFE, bronze-filled (40%)



For material code see page 139



**Table 89: Preferred series for dynamic application, spiral Back-up Ring
Type BP, Internal sealing, material PTFE – Metric**

Rod Ø	Groove Ø	Groove width		Radius r ±0.2	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.25	b ₃ +0.25					
mm								
4.00	6.50	3.00	4.00	0.25	4.0 x 1.25 x 0.50	BP12H00040	OR1500400	4.00 x 1.50
4.00	6.90	3.80	5.20	0.25	4.0 x 1.45 x 0.70	BP14H00040	ORAR00007	3.68 x 1.78
5.00	7.50	3.00	4.00	0.25	5.0 x 1.25 x 0.50	BP12H00050	OR1500500	5.00 x 1.50
5.00	7.90	3.80	5.20	0.25	5.0 x 1.45 x 0.70	BP14H00050	ORAR00008	4.47x 1.78
6.00	8.50	3.00	4.00	0.25	6.0 x 1.25 x 0.50	BP12H00060	OR1500600	6.00 x 1.50
6.00	8.90	3.80	5.20	0.25	6.0 x 1.45 x 0.70	BP14H00060	ORAR00010	6.07 x 1.78
8.00	10.90	3.80	5.20	0.25	8.0 x 1.45 x 0.70	BP14H00080	ORAR00011	7.65 x 1.78
8.00	11.30	4.10	5.50	0.25	8.0 x 1.65 x 0.70	BP16H00080	OR2000800	8.00 x 2.00
10.00	12.90	3.80	5.20	0.25	10.0 x 1.45 x 0.70	BP14H00100	ORAR00013	10.82 x 1.78
10.00	13.30	4.10	5.50	0.25	10.0 x 1.65 x 0.70	BP16H00100	OR2001000	10.00 x 2.00
12.00	14.90	3.80	5.20	0.25	12.0 x 1.45 x 0.70	BP14H00120	ORAR00014	12.42 x 1.78
12.00	15.30	4.10	5.50	0.25	12.0 x 1.65 x 0.70	BP16H00120	OR2001200	12.00 x 2.00
14.00	16.90	3.80	5.20	0.25	14.0 x 1.45 x 0.70	BP14H00140	ORAR00015	14.00 x 1.78
14.00	17.30	4.10	5.50	0.25	14.0 x 1.65 x 0.70	BP16H00140	OR2001400	14.00 x 2.00
15.00	17.90	3.80	5.20	0.25	15.0 x 1.45 x 0.70	BP14H00150	ORAR00016	15.60 x 1.78
15.00	18.30	4.10	5.50	0.25	15.0 x 1.65 x 0.70	BP16H00150	OR2001500	15.00 x 2.00
16.00	18.90	3.80	5.20	0.25	16.0 x 1.45 x 0.70	BP14H00160	ORAR00016	15.60 x 1.78
16.00	19.30	4.10	5.50	0.25	16.0 x 1.65 x 0.70	BP16H00160	OR2001600	16.00 x 2.00
18.00	20.90	3.80	5.20	0.25	18.0 x 1.45 x 0.70	BP14H00180	ORAR00018	18.77 x 1.78
18.00	21.30	4.10	5.50	0.25	18.0 x 1.65 x 0.70	BP16H00180	OR2001800	18.00 x 2.00
20.00	22.90	3.80	5.20	0.25	20.0 x 1.45 x 0.70	BP14H00200	ORAR00019	20.35 x 1.78
20.00	23.30	4.10	5.50	0.25	20.0 x 1.65 x 0.70	BP16H00200	OR2002000	20.00 x 2.00
22.00	26.50	5.00	6.40	0.25	22.0 x 2.25 x 0.70	BP22H00220	ORAR00118	21.89 x 2.62
22.00	27.20	5.40	6.80	0.25	22.0 x 2.60 x 0.70	BP2600220	OR3002200	22.00 x 3.00
25.00	29.50	5.00	6.40	0.25	25.0 x 2.25 x 0.70	BP22H00250	ORAR00120	25.07 x 2.62
25.00	30.20	5.40	6.80	0.25	25.0 x 2.60 x 0.70	BP2600250	OR3002500	25.00 x 3.00
28.00	32.50	5.00	6.40	0.25	28.0 x 2.25 x 0.70	BP22H00280	ORAR00122	28.24 x 2.62
28.00	33.20	5.40	6.80	0.25	28.0 x 2.60 x 0.70	BP2600280	OR3002800	28.00 x 3.00
30.00	34.50	5.00	6.40	0.25	30.0 x 2.25 x 0.70	BP22H00300	ORAR00123	29.83 x 2.62
30.00	35.20	5.40	6.80	0.25	30.0 x 2.60 x 0.70	BP2600300	OR3003000	30.00 x 3.00
32.00	36.50	5.00	6.40	0.25	32.0 x 2.25 x 0.70	BP22H00320	ORAR00125	31.42 x 2.62
32.00	37.20	5.40	6.80	0.25	32.0 x 2.60 x 0.70	BP2600320	OR3003200	32.00 x 3.00
35.00	39.50	5.00	6.40	0.25	35.0 x 2.25 x 0.70	BP22H00350	ORAR00126	24.59 x 2.62
35.00	40.20	5.40	6.80	0.25	35.0 x 2.60 x 0.70	BP2600350	OR3003500	35.00 x 3.00
36.00	40.50	5.00	6.40	0.25	36.0 x 2.25 x 0.70	BP22H00360	ORAR00127	36.17 x 2.62
36.00	41.20	5.40	6.80	0.25	36.0 x 2.60 x 0.70	BP2600360	OR3003600	36.00 x 3.00
40.00	46.20	6.20	7.60	0.25	40.0 x 3.10 x 0.70	BP31D0400	ORAR00223	40.87 x 3.53
40.00	47.00	6.90	8.60	0.25	40.0 x 3.50 x 0.85	BP3500400	OR4004000	40.00 x 4.00
42.00	48.20	6.20	7.60	0.25	42.0 x 3.10 x 0.70	BP31D0420	ORAR00223	40.87 x 3.53
42.00	49.00	6.90	8.60	0.25	42.0 x 3.50 x 0.70	BP35D0420	OR4004200	42.00 x 2.00



Rod ∅	Groove ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
45.00	51.20	6.20	7.60	0.25	45.0 x 3.10 x 0.70	BP31D0450	ORAR00224	44.04 x 3.53
45.00	52.00	6.90	8.60	0.25	45.0 x 3.50 x 0.85	BP3500450	OR4004500	45.00 x 4.00
48.00	54.20	6.20	7.60	0.25	48.0 x 3.10 x 0.70	BP31D0480	ORAR00225	47.22 x 3.53
48.00	55.00	6.90	8.60	0.25	48.0 x 3.50 x 0.85	BP3500480	OR4004800	48.00 x 4.00
50.00	56.20	6.20	7.60	0.25	50.0 x 3.10 x 0.70	BP31D0500	ORAR00226	50.39 x 3.53
50.00	57.00	6.90	8.60	0.25	50.0 x 3.50 x 0.85	BP3500500	OR4005000	50.00 x 4.00
52.00	58.20	6.20	7.60	0.25	52.0 x 3.10 x 0.70	BP31D0520	ORAR00226	50.39 x 3.53
52.00	59.00	6.90	8.60	0.25	52.0 x 3.50 x 0.85	BP3500520	OR4005200	52.00 x 4.00
55.00	61.20	6.20	7.60	0.25	55.0 x 3.10 x 0.70	BP31D0550	ORAR00227	53.57 x 3.53
55.00	62.00	6.90	8.60	0.25	55.0 x 3.50 x 0.85	BP3500550	OR4005500	55.00 x 4.00
56.00	62.20	6.20	7.60	0.25	56.0 x 3.10 x 0.70	BP31D0560	ORAR00228	56.74 x 3.53
56.00	63.00	6.90	8.60	0.25	56.0 x 3.50 x 0.85	BP3500560	OR4005600	56.00 x 4.00
60.00	66.20	6.20	7.60	0.25	60.0 x 3.10 x 0.70	BP31D0600	ORAR00229	59.92 x 3.53
60.00	97.00	6.90	8.60	0.25	60.0 x 3.50 x 0.85	BP3500600	OR4006000	60.00 x 4.00
63.00	69.20	6.20	7.60	0.25	63.0 x 3.10 x 0.70	BP31D0630	ORAR00230	63.09 x 3.53
63.00	70.00	6.90	8.60	0.25	63.0 x 3.50 x 0.85	BP3500630	OR4006300	63.00 x 4.00
65.00	71.20	6.20	7.60	0.25	65.0 x 3.10 x 0.70	BP31D0650	ORAR00231	66.27 x 3.53
65.00	72.00	6.90	8.60	0.25	65.0 x 3.50 x 0.85	BP3500650	OR4006500	65.00 x 4.00
70.00	76.20	6.20	7.60	0.25	70.0 x 3.10 x 0.70	BP31D0700	ORAR00232	69.44 x 3.53
70.00	77.00	6.90	8.60	0.25	70.0 x 3.50 x 0.85	BP3500700	OR4007000	70.00 x 4.00
75.00	81.20	6.20	7.60	0.25	75.0 x 3.1 x 0.7	BP31D0750	ORAR00234	75.79 x 3.53
75.00	82.00	6.90	8.60	0.25	75.0 x 3.5 x 0.9	BP3500750	OR4007500	75.00 x 4.00
80.00	88.80	8.30	10.00	0.25	80.0 x 4.4 x 0.9	BP4400800	OR5008000	80.00 x 5.00
80.00	89.40	9.00	10.90	0.25	80.0 x 4.7 x 0.9	BP4700800	ORAR00339	81.92 x 5.33
85.00	93.80	8.30	10.00	0.25	85.0 x 4.4 x 0.9	BP4400850	OR5008500	85.00 x 5.00
80.00	89.40	9.00	10.90	0.25	80.0 x 4.7 x 0.9	BP4700850	ORAR00340	85.09 x 5.33
90.00	98.80	8.30	10.00	0.25	90.0 x 4.4 x 0.9	BP4400900	OR5009000	90.00 x 5.00
90.00	99.40	9.00	10.90	0.25	90.0 x 4.7 x 0.9	BP4700900	ORAR00342	91.44 x 5.33
95.00	103.80	8.30	10.00	0.25	95.0 x 4.4 x 0.9	BP4400950	OR5009500	95.00 x 5.00
95.00	104.40	9.00	10.90	0.25	95.0 x 4.7 x 0.9	BP4700950	ORAR00343	94.62 x 5.33
100.00	108.80	8.30	10.00	0.25	100.0 x 4.4 x 0.9	BP4401000	OR5010000	100.00 x 5.00
100.00	109.40	9.00	10.90	0.25	100.0 x 4.7 x 0.9	BP4701000	ORAR00345	100.97 x 5.33
105.00	113.80	8.30	10.00	0.25	105.0 x 4.4 x 0.9	BP4401050	OR5010500	105.00 x 5.00
105.00	114.40	9.00	10.90	0.25	105.0 x 4.7 x 0.9	BP4701050	ORAR00346	104.14 x 5.33
110.00	118.80	8.30	10.00	0.25	110.0 x 4.4 x 0.9	BP4401100	OR5011000	110.00 x 5.00
110.00	119.40	9.00	10.90	0.25	110.0 x 4.7 x 0.9	BP4701100	ORAR00348	110.49 x 5.33
115.00	123.80	8.30	10.00	0.25	115.0 x 4.4 x 0.9	BP4401150	OR5011500	115.00 x 5.00
115.00	124.40	9.00	10.90	0.25	115.0 x 4.7 x 0.9	BP4701150	ORAR00349	113.67 x 5.33
120.00	128.80	8.30	10.00	0.25	120.0 x 4.4 x 0.9	BP4401200	OR5012000	120.00 x 5.00
120.00	129.40	9.00	10.90	0.25	120.0 x 4.7 x 0.9	BP4701200	ORAR00351	120.02 x 5.33
125.00	133.80	8.30	10.00	0.25	125.0 x 4.4 x 0.9	BP4401250	OR5012500	125.00 x 5.00
125.00	134.40	9.00	10.90	0.25	125.0 x 4.7 x 0.9	BP4701250	ORAR00353	126.37 x 5.33



Rod ∅	Groove ∅	Groove width		Radius r ±0.2	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.25	b ₃ +0.25					
mm								
130.00	138.80	8.30	10.00	0.25	130.0 x 4.4 x 0.9	BP4401300	OR5013000	130.00 x 5.00
130.00	139.40	9.00	10.90	0.25	130.0 x 4.7 x 0.9	BP4701300	ORAR00354	129.54 x 5.33
135.00	147.20	12.30	15.10	0.25	135.0 x 6.1 x 1.3	BP6101350	ORAR00432	135.89 x 6.99
140.00	152.20	12.30	15.10	0.25	140.0 x 6.1 x 1.3	BP6101400	ORAR00433	139.07 x 6.99
150.00	162.20	12.30	15.10	0.25	150.0 x 6.1 x 1.3	BP6101500	ORAR00437	151.77 x 6.99
160.00	172.20	12.30	15.10	0.25	160.0 x 6.1 x 1.3	BP6101600	ORAR00438	158.12 x 6.99
170.00	182.20	12.30	15.10	0.25	170.0 x 6.1 x 1.3	BP6101700	ORAR00440	170.82 x 6.99
180.00	192.20	12.30	15.10	0.25	180.0 x 6.1 x 1.3	BP6101800	ORAR00442	183.52 x 6.99
190.00	202.20	12.30	15.10	0.25	190.0 x 6.1 x 1.3	BP6101900	ORAR00443	189.87 x 6.99
200.00	212.20	12.30	15.10	0.25	200.0 x 6.1 x 1.3	BP6102000	ORAR00445	202.57 x 6.99
210.00	222.20	12.30	15.10	0.25	210.0 x 6.1 x 1.3	BP6102100	ORAR00446	215.27 x 6.99
220.00	232.20	12.30	15.10	0.25	220.0 x 6.1 x 1.3	BP6102200	ORAR00446	215.27 x 6.99
230.00	242.20	12.30	15.10	0.25	230.0 x 6.1 x 1.3	BP6102300	ORAR00447	227.97 x 6.99
240.00	252.20	12.30	15.10	0.25	240.0 x 6.1 x 1.3	BP6102400	ORAR00448	240.67 x 6.99
250.00	262.20	12.30	15.10	0.25	250.0 x 6.1 x 1.3	BP6102500	ORAR00449	253.37 x 6.99
280.00	292.20	12.30	15.10	0.25	280.0 x 6.1 x 1.3	BP6102800	ORAR00451	278.77 x 6.99
300.00	312.20	12.30	15.10	0.25	300.0 x 6.1 x 1.3	BP6103000	ORAR00453	304.17 x 6.99
320.00	332.20	12.30	15.10	0.25	320.0 x 6.1 x 1.3	BP6103200	ORAR00454	316.87 x 6.99
350.00	362.20	12.30	15.10	0.25	350.0 x 6.1 x 1.3	BP6103500	ORAR00457	354.97 x 6.99
360.00	372.20	12.30	15.10	0.25	360.0 x 6.1 x 1.3	BP6103600	ORAR00457	354.97 x 6.99
400.00	412.20	12.30	15.10	0.25	400.0 x 6.1 x 1.3	BP6104000	ORAR00461	405.26 x 6.99

Further sizes available on request.

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



**Table 90: Preferred series for dynamic application, spiral Back-up Ring
Type BP, Internal sealing, material PTFE – Inch**

Rod Ø d _N f7	Groove Ø d ₆ H9	Groove width		Radius r ±0.008	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
inch								
0.157	0.256	0.118	0.157	0.010	0.157 x 0.049 x 0.020	BP12H00040	OR1500400	0.157 x 0.059
0.157	0.272	0.150	0.205	0.010	0.157 x 0.057 x 0.028	BP14H00040	ORAR00007	0.145 x 0.070
0.197	0.295	0.118	0.157	0.010	0.197 x 0.049 x 0.020	BP12H00050	OR1500500	0.197 x 0.059
0.197	0.311	0.150	0.205	0.010	0.197 x 0.057 x 0.028	BP14H00050	ORAR00008	0.176 x 0.070
0.236	0.335	0.118	0.157	0.010	0.236 x 0.049 x 0.020	BP12H00060	OR1500600	0.236 x 0.059
0.236	0.350	0.150	0.205	0.010	0.236 x 0.057 x 0.028	BP14H00060	ORAR00010	0.239 x 0.070
0.315	0.429	0.150	0.205	0.010	0.315 x 0.057 x 0.028	BP14H00080	ORAR00011	0.301 x 0.070
0.315	0.445	0.161	0.217	0.010	0.315 x 0.065 x 0.028	BP16H00080	OR2000800	0.315 x 0.079
0.394	0.508	0.150	0.205	0.010	0.394 x 0.057 x 0.028	BP14H00100	ORAR00013	0.426 x 0.070
0.394	0.524	0.161	0.217	0.010	0.394 x 0.065 x 0.028	BP16H00100	OR2001000	0.394 x 0.079
0.472	0.587	0.150	0.205	0.010	0.472 x 0.057 x 0.028	BP14H00120	ORAR00014	0.489 x 0.070
0.472	0.602	0.161	0.217	0.010	0.472 x 0.065 x 0.028	BP16H00120	OR2001200	0.472 x 0.079
0.551	0.665	0.150	0.205	0.010	0.551 x 0.057 x 0.028	BP14H00140	ORAR00015	0.551 x 0.070
0.551	0.681	0.161	0.217	0.010	0.551 x 0.065 x 0.028	BP16H00140	OR2001400	0.551 x 0.079
0.591	0.705	0.150	0.205	0.010	0.591 x 0.057 x 0.028	BP14H00150	ORAR00016	0.614 x 0.070
0.591	0.720	0.161	0.217	0.010	0.591 x 0.065 x 0.028	BP16H00150	OR2001500	0.591 x 0.079
0.630	0.744	0.150	0.205	0.010	0.630 x 0.057 x 0.028	BP14H00160	ORAR00016	0.614 x 0.070
0.630	0.760	0.161	0.217	0.010	0.630 x 0.065 x 0.028	BP16H00160	OR2001600	0.630 x 0.079
0.709	0.823	0.150	0.205	0.010	0.709 x 0.057 x 0.028	BP14H00180	ORAR00018	0.739 x 0.070
0.709	0.839	0.161	0.217	0.010	0.709 x 0.065 x 0.028	BP16H00180	OR2001800	0.709 x 0.079
0.787	0.902	0.150	0.205	0.010	0.787 x 0.057 x 0.028	BP14H00200	ORAR00019	0.801 x 0.070
0.787	0.917	0.161	0.217	0.010	0.787 x 0.065 x 0.028	BP16H00200	OR2002000	0.787 x 0.079
0.866	1.043	0.197	0.252	0.010	0.866 x 0.089 x 0.028	BP22H00220	ORAR00118	0.862 x 0.103
0.866	1.071	0.213	0.268	0.010	0.866 x 0.102 x 0.028	BP2600220	OR3002200	0.866 x 0.118
0.984	1.161	0.197	0.252	0.010	0.984 x 0.089 x 0.028	BP22H00250	ORAR00120	0.987 x 0.103
0.984	1.189	0.213	0.268	0.010	0.984 x 0.102 x 0.028	BP2600250	OR3002500	0.984 x 0.118
1.102	1.280	0.197	0.252	0.010	1.102 x 0.089 x 0.028	BP22H00280	ORAR00122	1.112 x 0.103
1.102	1.307	0.213	0.268	0.010	1.102 x 0.102 x 0.028	BP2600280	OR3002800	1.102 x 0.118
1.181	1.358	0.197	0.252	0.010	1.181 x 0.089 x 0.028	BP22H00300	ORAR00123	1.174 x 0.103
1.181	1.386	0.213	0.268	0.010	1.181 x 0.102 x 0.028	BP2600300	OR3003000	1.181 x 0.118
1.260	1.437	0.197	0.252	0.010	1.260 x 0.089 x 0.028	BP22H00320	ORAR00125	1.237 x 0.103
1.260	1.465	0.213	0.268	0.010	1.260 x 0.102 x 0.028	BP2600320	OR3003200	1.260 x 0.118
1.378	1.555	0.197	0.252	0.010	1.378 x 0.089 x 0.028	BP22H00350	ORAR00126	0.968 x 0.103
1.378	1.583	0.213	0.268	0.010	1.378 x 0.102 x 0.028	BP2600350	OR3003500	1.378 x 0.118
1.417	1.594	0.197	0.252	0.010	1.417 x 0.089 x 0.028	BP22H00360	ORAR00127	1.424 x 0.103
1.417	1.622	0.213	0.268	0.010	1.378 x 0.102 x 0.028	BP2600350	OR3003500	1.378 x 0.118
1.575	1.819	0.244	0.299	0.010	1.575 x 0.122 x 0.028	BP31D0400	ORAR00223	1.609 x 0.139
1.575	1.850	0.272	0.339	0.010	1.575 x 0.138 x 0.033	BP3500400	OR4004000	1.575 x 0.157
1.654	1.898	0.244	0.299	0.010	1.654 x 0.122 x 0.028	BP31D0420	ORAR00223	1.609 x 0.139
1.654	1.929	0.272	0.339	0.010	1.654 x 0.138 x 0.028	BP35D0420	OR4004200	1.654 x 0.079



Rod Ø	Groove Ø	Groove width		Radius r	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
d _N f7	d ₆ H9			±0.008				
inch								
1.772	2.016	0.244	0.299	0.010	1.772 x 0.122 x 0.028	BP31D0450	ORAR00224	1.734 x 0.139
1.772	2.047	0.272	0.339	0.010	1.772 x 0.138 x 0.033	BP3500450	OR4004500	1.772 x 0.157
1.890	2.134	0.244	0.299	0.010	1.890 x 0.122 x 0.028	BP31D0480	ORAR00225	1.859 x 0.139
1.890	2.165	0.272	0.339	0.010	1.890 x 0.138 x 0.033	BP3500480	OR4004800	1.890 x 0.157
1.969	2.213	0.244	0.299	0.010	1.969 x 0.122 x 0.028	BP31D0500	ORAR00226	1.984 x 0.139
1.969	2.244	0.272	0.339	0.010	1.969 x 0.138 x 0.033	BP3500500	OR4005000	1.969 x 0.157
2.047	2.291	0.244	0.299	0.010	2.047 x 0.122 x 0.028	BP31D0520	ORAR00226	1.984 x 0.139
2.047	2.323	0.272	0.339	0.010	2.047 x 0.138 x 0.033	BP3500520	OR4005200	2.047 x 0.157
2.165	2.409	0.244	0.299	0.010	2.165 x 0.122 x 0.028	BP31D0550	ORAR00227	2.109 x 0.139
2.165	2.441	0.272	0.339	0.010	2.165 x 0.138 x 0.033	BP3500550	OR4005500	2.165 x 0.157
2.205	2.449	0.244	0.299	0.010	2.205 x 0.122 x 0.028	BP31D0560	ORAR00228	2.234 x 0.139
2.205	2.480	0.272	0.339	0.010	2.205 x 0.138 x 0.033	BP3500560	OR4005600	2.205 x 0.157
2.362	2.606	0.244	0.299	0.010	2.362 x 0.122 x 0.028	BP31D0600	ORAR00229	2.359 x 0.139
2.362	3.819	0.272	0.339	0.010	2.362 x 0.138 x 0.033	BP3500600	OR4006000	2.362 x 0.157
2.480	2.724	0.244	0.299	0.010	2.480 x 0.122 x 0.028	BP31D0630	ORAR00230	2.484 x 0.139
2.480	2.756	0.272	0.339	0.010	2.480 x 0.138 x 0.033	BP3500630	OR4006300	2.480 x 0.157
2.559	2.803	0.244	0.299	0.010	2.559 x 0.122 x 0.028	BP31D0650	ORAR00231	2.609 x 0.139
2.559	2.835	0.272	0.339	0.010	2.559 x 0.138 x 0.033	BP3500650	OR4006500	2.559 x 0.157
2.756	3.000	0.244	0.299	0.010	2.756 x 0.122 x 0.028	BP31D0700	ORAR00232	2.734 x 0.139
2.756	3.031	0.272	0.339	0.010	2.756 x 0.138 x 0.033	BP3500700	OR4007000	2.756 x 0.157
2.953	3.197	0.244	0.299	0.010	2.953 x 0.122 x 0.028	BP31D0750	ORAR00234	2.984 x 0.139
3.150	3.496	0.327	0.394	0.010	3.150 x 0.173 x 0.033	BP4400800	OR5008000	3.150 x 0.197
2.953	3.197	0.244	0.299	0.010	2.953 x 0.122 x 0.028	BP31D0750	ORAR00234	2.984 x 0.139
2.953	3.228	0.272	0.339	0.010	2.953 x 0.138 x 0.033	BP3500750	OR4007500	2.953 x 0.157
3.150	3.496	0.327	0.394	0.010	3.150 x 0.173 x 0.033	BP4400800	OR5008000	3.150 x 0.197
3.150	3.520	0.354	0.429	0.010	3.150 x 0.185 x 0.033	BP4700800	ORAR00339	3.225 x 0.210
3.346	3.693	0.327	0.394	0.010	3.346 x 0.173 x 0.033	BP4400850	OR5008500	3.346 x 0.197
3.346	3.717	0.354	0.429	0.010	3.346 x 0.185 x 0.033	BP4700850	ORAR00340	3.350 x 0.210
3.543	3.890	0.327	0.394	0.010	3.543 x 0.173 x 0.033	BP4400900	OR5009000	3.543 x 0.197
3.543	3.913	0.354	0.429	0.010	3.543 x 0.185 x 0.033	BP4700900	ORAR00342	3.600 x 0.210
3.740	4.087	0.327	0.394	0.010	3.740 x 0.173 x 0.033	BP4400950	OR5009500	3.740 x 0.197
3.740	4.110	0.354	0.429	0.010	3.740 x 0.185 x 0.033	BP4700950	ORAR00343	3.725 x 0.210
3.937	4.283	0.327	0.394	0.010	3.937 x 0.173 x 0.033	BP4401000	OR5010000	3.937 x 0.197
3.937	4.307	0.354	0.429	0.010	3.937 x 0.185 x 0.033	BP4701000	ORAR00345	3.975 x 0.210
4.134	4.480	0.327	0.394	0.010	4.134 x 0.173 x 0.033	BP4401050	OR5010500	4.134 x 0.197
4.134	4.504	0.354	0.429	0.010	4.134 x 0.185 x 0.033	BP4701050	ORAR00346	4.100 x 0.210
4.331	4.677	0.327	0.394	0.010	4.331 x 0.173 x 0.033	BP4401100	OR5011000	4.331 x 0.197
4.331	4.701	0.354	0.429	0.010	4.331 x 0.185 x 0.033	BP4701100	ORAR00348	4.350 x 0.210
4.528	4.874	0.327	0.394	0.010	4.528 x 0.173 x 0.033	BP4401150	OR5011500	4.528 x 0.197
4.528	4.898	0.354	0.429	0.010	4.528 x 0.185 x 0.033	BP4701150	ORAR00349	4.475 x 0.210



Rod ∅ d _N f7	Groove ∅ d ₆ H9	Groove width		Radius r ±0.008	Back-up Ring dimension ID x W x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
inch								
4.724	5.071	0.327	0.394	0.010	4.724 x 0.173 x 0.033	BP4401200	OR5012000	4.724 x 0.197
4.724	5.094	0.354	0.429	0.010	4.724 x 0.185 x 0.033	BP4701200	ORAR00351	4.725 x 0.210
4.921	5.268	0.327	0.394	0.010	4.921 x 0.173 x 0.033	BP4401250	OR5012500	4.921 x 0.197
4.921	5.291	0.354	0.429	0.010	4.921 x 0.185 x 0.033	BP4701250	ORAR00353	4.975 x 0.210
5.118	5.465	0.327	0.394	0.010	5.118 x 0.173 x 0.033	BP4401300	OR5013000	5.118 x 0.197
5.118	5.488	0.354	0.429	0.010	5.118 x 0.185 x 0.033	BP4701300	ORAR00354	5.100 x 0.210
5.315	5.795	0.484	0.594	0.010	5.315 x 0.240 x 0.049	BP6101350	ORAR00432	5.350 x 0.275
5.512	5.992	0.484	0.594	0.010	5.512 x 0.240 x 0.049	BP6101400	ORAR00433	5.475 x 0.275
5.906	6.386	0.484	0.594	0.010	5.906 x 0.240 x 0.049	BP6101500	ORAR00437	5.975 x 0.275
6.299	6.780	0.484	0.594	0.010	6.299 x 0.240 x 0.049	BP6101600	ORAR00438	6.225 x 0.275
6.693	7.173	0.484	0.594	0.010	6.693 x 0.240 x 0.049	BP6101700	ORAR00440	6.725 x 0.275
7.087	7.567	0.484	0.594	0.010	7.087 x 0.240 x 0.049	BP6101800	ORAR00442	7.225 x 0.275
7.480	7.961	0.484	0.594	0.010	7.480 x 0.240 x 0.049	BP6101900	ORAR00443	7.475 x 0.275
7.874	8.354	0.484	0.594	0.010	7.874 x 0.240 x 0.049	BP6102000	ORAR00445	7.975 x 0.275
8.268	8.748	0.484	0.594	0.010	8.268 x 0.240 x 0.049	BP6102100	ORAR00446	8.475 x 0.275
8.661	9.142	0.484	0.594	0.010	8.661 x 0.240 x 0.049	BP6102200	ORAR00446	8.475 x 0.275
9.055	9.535	0.484	0.594	0.010	9.055 x 0.240 x 0.049	BP6102300	ORAR00447	8.975 x 0.275
9.449	9.929	0.484	0.594	0.010	9.449 x 0.240 x 0.049	BP6102400	ORAR00448	9.475 x 0.275
9.843	10.323	0.484	0.594	0.010	9.843 x 0.240 x 0.049	BP6102500	ORAR00449	9.975 x 0.275
11.024	11.504	0.484	0.594	0.010	11.024 x 0.240 x 0.049	BP6102800	ORAR00451	10.975 x 0.275
11.811	12.291	0.484	0.594	0.010	11.811 x 0.240 x 0.049	BP6103000	ORAR00453	11.975 x 0.275
12.598	13.079	0.484	0.594	0.010	12.598 x 0.240 x 0.049	BP6103200	ORAR00454	12.475 x 0.275
13.780	14.260	0.484	0.594	0.010	13.780 x 0.240 x 0.049	BP6103500	ORAR00457	13.975 x 0.275
14.173	14.654	0.484	0.594	0.010	14.173 x 0.240 x 0.049	BP6103600	ORAR00457	13.975 x 0.275
15.748	16.228	0.484	0.594	0.010	15.748 x 0.240 x 0.049	BP6104000	ORAR00461	15.955 x 0.275

Further sizes available on request.

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



■ H.3 External (Piston) and Internal (Rod) Sealing, Static Applications only

H.3.1 CONCAVE BACK-UP RING TYPE (BB), MATERIAL NBR AND FKM FOR O-RINGS IN ACCORDANCE WITH 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.

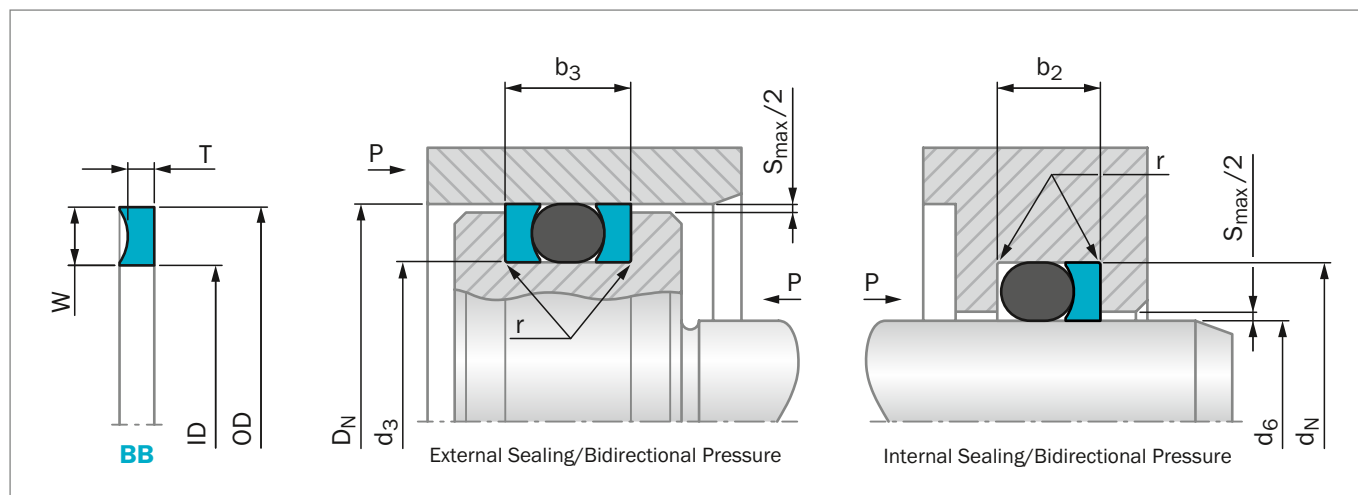


Figure 62: Installation drawing internal and external sealing, concave Back-up Ring type BB

Table 91: Installation dimensions for the concave Back-up Ring Type BB, External and Internal Sealing, material NBR and FKM – Metric

O-Ring Cross-Section-Ø in accordance with ISO 3601-1 AS 568	Size code (dash-no.) ISO 3601-1 AS 568	Back-up Ring Cross section		Groove dimensions					Radial clearance
		Radial height	Thickness	Groove diameter		Groove width		Radius	
				external	internal	b ₂ +0.25	b ₃ +0.25		
d ₂		W	T	d ₃ -0.1	d ₆ +0.1	b ₂ +0.25	b ₃ +0.25	r ±0.2	S max.
mm									
1.78	004 to 050	1.35	1.14	D _N - 2.9	d _N + 2.9	3.60	5.00	0.25	0.06
2.62	102 to 178	2.18	1.14	D _N - 4.5	d _N + 4.5	4.50	5.90	0.25	0.06
3.53	201 to 284	3.00	1.02	D _N - 6.2	d _N + 6.2	5.60	7.00	0.25	0.08
5.33	309 to 395	4.65	1.52	D _N - 9.4	d _N + 9.4	7.90	9.60	0.25	0.08
6.33	425 to 475	5.99	2.44	D _N - 12.2	d _N + 12.2	10.70	13.20	0.25	0.10



Table 92: Installation dimensions for the concave Back-up Ring Type BB, External and Internal sealing, material NBR and FKM – Inch

O-Ring Cross-Section-Ø in accordance with ISO 3601-1 AS 568	Size code (dash-no.) ISO 3601-1 AS 568	Back-up Ring Cross section		Groove dimensions					Radial clearance S max.
		Radial height W	Thick-ness T	Groove diameter		Groove width	Radius r ±0.008		
				external d ₃ -0.004	internal d ₆ +0.004				
d ₂		W	T	d ₃ -0.004	d ₆ +0.004	b ₂ +0.010	b ₃ +0.010	r ±0.008	S max.
inch									
0.070	004 to 050	0.053	0.045	D _N - 0.114	d _N + 0.114	0.142	004 to 050	0.010	0.002
0.103	102 to 178	0.086	0.045	D _N - 0.177	d _N + 0.177	0.177	102 to 178	0.010	0.002
0.139	201 to 284	0.118	0.040	D _N - 0.244	d _N + 0.244	0.220	201 to 284	0.010	0.003
0.210	309 to 395	0.183	0.060	D _N - 0.370	d _N + 0.370	0.311	309 to 395	0.010	0.003
0.249	425 to 475	0.236	0.096	D _N - 0.480	d _N + 0.480	0.421	425 to 475	0.010	0.004

ORDERING EXAMPLE

Back-up Ring:	Concave type BB (uncut) for O-Ring seal
Application:	Static, external sealing
Bore diameter:	D _N = 38.00 mm (1.496 inch)
O-Ring cross section:	d ₂ = 1.78 mm (0.070 inch)
Back-up Ring material:	N962N (NBR 90 Shore A)

For material code see page 139

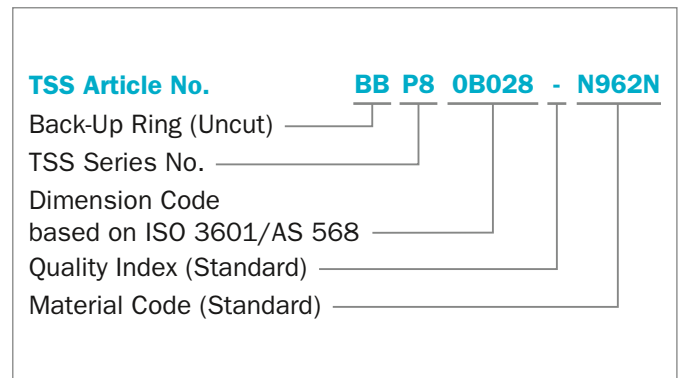


Table 93: Preferred series for static application, concave Back-up Ring, based on ISO 3601-1 O-Ring series, Type BB (uncut), Internal sealing, material NBR and FKM – Metric

Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
d _N f7	D _N H9	b ₂ +0.25	b ₃ +0.25	r ±0.2	ID x OD x T			d ₁ x d ₂
mm								
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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
22.0	27.00	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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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	481.46 x 5.33
508.0	518.0	7.9	9.6	0.25	508.15 x 517.45 x 1.52	BBP80B389	ORAR00389	506.86 x 5.33
533.0	543.0	7.9	9.6	0.25	533.55 x 542.85 x 1.52	BBP80B390	ORAR00390	532.26 x 5.33
559.0	568.0	7.9	9.6	0.25	558.95 x 568.25 x 1.52	BBP80B391	ORAR00391	557.66 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



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.25	b ₃ +0.25					
mm								
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
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



Table 94: Preferred series for static application, concave Back-up Ring, based on ISO 3601-1 O-Ring series, Type BB (uncut), Internal sealing, material NBR and FKM – Inch

Rod Ø	Bore Ø	Groove width		Radius r ±0.008	Back-up Ring dimension ID x OD x T	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension d ₁ x d ₂
		b ₂ +0.010	b ₃ +0.010					
inch								
0.079	0.205	0.142	0.197	0.010	0.096 x 0.202 x 0.045	BBP80B004	ORAR00004	0.070 x 0.070
0.098	0.236	0.142	0.197	0.010	0.128 x 0.234 x 0.045	BBP80B005	ORAR00005	0.101 x 0.070
0.118	0.256	0.142	0.197	0.010	0.140 x 0.246 x 0.045	BBP80B006	ORAR00006	0.114 x 0.070
0.157	0.276	0.142	0.197	0.010	0.187 x 0.277 x 0.045	BBP80B007	ORAR00007	0.145 x 0.070
0.197	0.315	0.142	0.197	0.010	0.202 x 0.308 x 0.045	BBP80B008	ORAR00008	0.176 x 0.070
0.217	0.354	0.142	0.197	0.010	0.234 x 0.340 x 0.045	BBP80B009	ORAR00009	0.208 x 0.070
0.256	0.394	0.142	0.197	0.010	0.265 x 0.371 x 0.045	BBP80B010	ORAR00010	0.239 x 0.070
0.315	0.433	0.142	0.197	0.010	0.327 x 0.433 x 0.045	BBP80B011	ORAR00011	0.301 x 0.070
0.374	0.512	0.142	0.197	0.010	0.390 x 0.496 x 0.045	BBP80B012	ORAR00012	0.364 x 0.070
0.433	0.551	0.142	0.197	0.010	0.455 x 0.561 x 0.045	BBP80B013	ORAR00013	0.426 x 0.070
0.512	0.630	0.142	0.197	0.010	0.518 x 0.624 x 0.045	BBP80B014	ORAR00014	0.489 x 0.070
0.551	0.669	0.142	0.197	0.010	0.580 x 0.686 x 0.045	BBP80B015	ORAR00015	0.551 x 0.070
0.630	0.748	0.142	0.197	0.010	0.643 x 0.749 x 0.045	BBP80B016	ORAR00016	0.614 x 0.070
0.669	0.827	0.142	0.197	0.010	0.705 x 0.811 x 0.045	BBP80B017	ORAR00017	0.676 x 0.070
0.748	0.866	0.142	0.197	0.010	0.768 x 0.874 x 0.045	BBP80B018	ORAR00018	0.739 x 0.070
0.787	0.945	0.142	0.197	0.010	0.830 x 0.936 x 0.045	BBP80B019	ORAR00019	0.801 x 0.070
0.866	0.984	0.142	0.197	0.010	0.893 x 0.999 x 0.045	BBP80B020	ORAR00020	0.864 x 0.070
0.945	1.063	0.142	0.197	0.010	0.955 x 1.061 x 0.045	BBP80B021	ORAR00021	0.926 x 0.070
0.984	1.142	0.142	0.197	0.010	1.018 x 1.124 x 0.045	BBP80B022	ORAR00022	0.989 x 0.070
1.063	1.181	0.142	0.197	0.010	1.080 x 1.186 x 0.045	BBP80B023	ORAR00023	1.051 x 0.070
1.142	1.260	0.142	0.197	0.010	1.143 x 1.249 x 0.045	BBP80B024	ORAR00024	1.114 x 0.070
1.181	1.299	0.142	0.197	0.010	1.205 x 1.311 x 0.045	BBP80B025	ORAR00025	1.176 x 0.070
1.260	1.378	0.142	0.197	0.010	1.268 x 1.374 x 0.045	BBP80B026	ORAR00026	1.239 x 0.070
1.299	1.437	0.142	0.197	0.010	1.330 x 1.436 x 0.045	BBP80B027	ORAR00027	1.301 x 0.070
1.378	1.496	0.142	0.197	0.010	1.393 x 1.499 x 0.045	BBP80B028	ORAR00028	1.364 x 0.070
1.496	1.614	0.142	0.197	0.010	1.518 x 1.624 x 0.045	BBP80B029	ORAR00029	1.489 x 0.070
1.614	1.752	0.142	0.197	0.010	1.643 x 1.749 x 0.045	BBP80B030	ORAR00030	1.614 x 0.070
1.752	1.890	0.142	0.197	0.010	1.768 x 1.874 x 0.045	BBP80B031	ORAR00031	1.739 x 0.070
1.890	2.008	0.142	0.197	0.010	1.893 x 1.999 x 0.045	BBP80B032	ORAR00032	1.864 x 0.070
2.008	2.126	0.142	0.197	0.010	2.018 x 2.124 x 0.045	BBP80B033	ORAR00033	1.989 x 0.070
2.126	2.244	0.142	0.197	0.010	2.147 x 2.249 x 0.045	BBP80B034	ORAR00034	2.114 x 0.070
2.244	2.362	0.142	0.197	0.010	2.268 x 2.374 x 0.045	BBP80B035	ORAR00035	2.239 x 0.070
2.362	2.500	0.142	0.197	0.010	2.393 x 2.499 x 0.045	BBP80B036	ORAR00036	2.364 x 0.070
2.480	2.638	0.142	0.197	0.010	2.518 x 2.624 x 0.045	BBP80B037	ORAR00037	2.489 x 0.070
2.638	2.756	0.142	0.197	0.010	2.643 x 2.749 x 0.045	BBP80B038	ORAR00038	2.614 x 0.070
2.756	2.874	0.142	0.197	0.010	2.768 x 2.874 x 0.045	BBP80B039	ORAR00039	2.739 x 0.070
2.874	2.992	0.142	0.197	0.010	2.893 x 2.999 x 0.045	BBP80B040	ORAR00040	2.864 x 0.070
2.992	3.150	0.142	0.197	0.010	3.018 x 3.124 x 0.045	BBP80B041	ORAR00041	2.989 x 0.070
3.268	3.386	0.142	0.197	0.010	3.268 x 3.374 x 0.045	BBP80B042	ORAR00042	3.239 x 0.070
3.504	3.622	0.142	0.197	0.010	3.518 x 3.624 x 0.045	BBP80B043	ORAR00043	3.489 x 0.070



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
3.740	3.898	0.142	0.197	0.010	3.768 x 3.874 x 0.045	BBP80B044	ORAR00044	3.739 x 0.070
4.016	4.134	0.142	0.197	0.010	4.018 x 4.124 x 0.045	BBP80B045	ORAR00045	3.989 x 0.070
4.252	4.370	0.142	0.197	0.010	4.268 x 4.374 x 0.045	BBP80B046	ORAR00046	4.239 x 0.070
4.488	4.646	0.142	0.197	0.010	4.518 x 4.624 x 0.045	BBP80B047	ORAR00047	4.489 x 0.070
4.764	4.882	0.142	0.197	0.010	4.768 x 4.874 x 0.045	BBP80B048	ORAR00048	4.739 x 0.070
5.000	5.118	0.142	0.197	0.010	5.018 x 5.124 x 0.045	BBP80B049	ORAR00049	4.989 x 0.070
5.236	5.394	0.142	0.197	0.010	5.268 x 5.374 x 0.045	BBP80B050	ORAR00050	5.239 x 0.070
0.063	0.248	0.177	0.232	0.010	0.077 x 0.249 x 0.045	BBP80B102	ORAR00102	0.049 x 0.103
0.098	0.276	0.177	0.232	0.010	0.109 x 0.281 x 0.045	BBP80B103	ORAR00103	0.081 x 0.103
0.118	0.315	0.177	0.232	0.010	0.140 x 0.312 x 0.045	BBP80B104	ORAR00104	0.112 x 0.103
0.157	0.354	0.177	0.232	0.010	0.171 x 0.343 x 0.045	BBP80B105	ORAR00105	0.143 x 0.103
0.197	0.374	0.177	0.232	0.010	0.202 x 0.374 x 0.045	BBP80B106	ORAR00106	0.174 x 0.103
0.217	0.394	0.177	0.232	0.010	0.234 x 0.406 x 0.045	BBP80B107	ORAR00107	0.206 x 0.103
0.256	0.433	0.177	0.232	0.010	0.265 x 0.437 x 0.045	BBP80B108	ORAR00108	0.237 x 0.103
0.315	0.512	0.177	0.232	0.010	0.327 x 0.499 x 0.045	BBP80B109	ORAR00109	0.299 x 0.103
0.374	0.551	0.177	0.232	0.010	0.390 x 0.562 x 0.045	BBP80B110	ORAR00110	0.362 x 0.103
0.433	0.630	0.177	0.232	0.010	0.452 x 0.624 x 0.045	BBP80B111	ORAR00111	0.424 x 0.103
0.512	0.669	0.177	0.232	0.010	0.515 x 0.687 x 0.045	BBP80B112	ORAR00112	0.487 x 0.103
0.551	0.748	0.177	0.232	0.010	0.577 x 0.749 x 0.045	BBP80B113	ORAR00113	0.549 x 0.103
0.630	0.827	0.177	0.232	0.010	0.640 x 0.812 x 0.045	BBP80B114	ORAR00114	0.612 x 0.103
0.669	0.866	0.177	0.232	0.010	0.702 x 0.874 x 0.045	BBP80B115	ORAR00115	0.674 x 0.103
0.748	0.945	0.177	0.232	0.010	0.765 x 0.937 x 0.045	BBP80B116	ORAR00116	0.737 x 0.103
0.787	0.984	0.177	0.232	0.010	0.831 x 1.003 x 0.045	BBP80B117	ORAR00117	0.799 x 0.103
0.866	1.063	0.177	0.232	0.010	0.893 x 1.065 x 0.045	BBP80B118	ORAR00118	0.862 x 0.103
0.945	1.142	0.177	0.232	0.010	0.956 x 1.128 x 0.045	BBP80B119	ORAR00119	0.924 x 0.103
0.984	1.181	0.177	0.232	0.010	1.018 x 1.190 x 0.045	BBP80B120	ORAR00120	0.987 x 0.103
1.063	1.260	0.177	0.232	0.010	1.081 x 1.253 x 0.045	BBP80B121	ORAR00121	1.049 x 0.103
1.142	1.299	0.177	0.232	0.010	1.143 x 1.315 x 0.045	BBP80B122	ORAR00122	1.112 x 0.103
1.181	1.378	0.177	0.232	0.010	1.206 x 1.378 x 0.045	BBP80B123	ORAR00123	1.174 x 0.103
1.260	1.437	0.177	0.232	0.010	1.268 x 1.440 x 0.045	BBP80B124	ORAR00124	1.237 x 0.103
1.299	1.496	0.177	0.232	0.010	1.331 x 1.503 x 0.045	BBP80B125	ORAR00125	1.299 x 0.103
1.378	1.575	0.177	0.232	0.010	1.393 x 1.565 x 0.045	BBP80B126	ORAR00126	1.362 x 0.103
1.437	1.614	0.177	0.232	0.010	1.456 x 1.628 x 0.045	BBP80B127	ORAR00127	1.424 x 0.103
1.496	1.693	0.177	0.232	0.010	1.518 x 1.690 x 0.045	BBP80B128	ORAR00128	1.487 x 0.103
1.575	1.752	0.177	0.232	0.010	1.581 x 1.753 x 0.045	BBP80B129	ORAR00129	1.549 x 0.103
1.614	1.811	0.177	0.232	0.010	1.643 x 1.815 x 0.045	BBP80B130	ORAR00130	1.612 x 0.103
1.693	1.890	0.177	0.232	0.010	1.706 x 1.878 x 0.045	BBP80B131	ORAR00131	1.674 x 0.103
1.752	1.969	0.177	0.232	0.010	1.768 x 1.940 x 0.045	BBP80B132	ORAR00132	1.737 x 0.103
1.811	2.008	0.177	0.232	0.010	1.831 x 2.003 x 0.045	BBP80B133	ORAR00133	1.799 x 0.103
1.890	2.047	0.177	0.232	0.010	1.893 x 2.065 x 0.045	BBP80B134	ORAR00134	1.862 x 0.103
1.929	2.126	0.177	0.232	0.010	1.963 x 2.128 x 0.045	BBP80B135	ORAR00135	1.925 x 0.103
2.008	2.185	0.177	0.232	0.010	2.018 x 2.190 x 0.045	BBP80B136	ORAR00136	1.987 x 0.103



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
2.047	2.244	0.177	0.232	0.010	2.081 x 2.253 x 0.045	BBP80B137	ORAR00137	2.050 x 0.103
2.126	2.283	0.177	0.232	0.010	2.143 x 2.315 x 0.045	BBP80B138	ORAR00138	2.112 x 0.103
2.165	2.362	0.177	0.232	0.010	2.206 x 2.378 x 0.045	BBP80B139	ORAR00139	2.175 x 0.103
2.244	2.441	0.177	0.232	0.010	2.268 x 2.440 x 0.045	BBP80B140	ORAR00140	2.237 x 0.103
2.323	2.500	0.177	0.232	0.010	2.331 x 2.503 x 0.045	BBP80B141	ORAR00141	2.300 x 0.103
2.362	2.559	0.177	0.232	0.010	2.393 x 2.565 x 0.045	BBP80B142	ORAR00142	2.362 x 0.103
2.441	2.638	0.177	0.232	0.010	2.456 x 2.628 x 0.045	BBP80B143	ORAR00143	2.425 x 0.103
2.480	2.677	0.177	0.232	0.010	2.518 x 2.690 x 0.045	BBP80B144	ORAR00144	2.487 x 0.103
2.559	2.756	0.177	0.232	0.010	2.581 x 2.753 x 0.045	BBP80B145	ORAR00145	2.550 x 0.103
2.638	2.795	0.177	0.232	0.010	2.643 x 2.815 x 0.045	BBP80B146	ORAR00146	2.612 x 0.103
2.677	2.874	0.177	0.232	0.010	2.706 x 2.878 x 0.045	BBP80B147	ORAR00147	2.675 x 0.103
2.756	2.953	0.177	0.232	0.010	2.768 x 2.940 x 0.045	BBP80B148	ORAR00148	2.737 x 0.103
2.795	2.992	0.177	0.232	0.010	2.831 x 3.003 x 0.045	BBP80B149	ORAR00149	2.800 x 0.103
2.874	3.071	0.177	0.232	0.010	2.893 x 3.065 x 0.045	BBP80B150	ORAR00150	2.862 x 0.103
2.992	3.189	0.177	0.232	0.010	3.018 x 3.190 x 0.045	BBP80B151	ORAR00151	2.987 x 0.103
3.268	3.425	0.177	0.232	0.010	3.268 x 3.440 x 0.045	BBP80B152	ORAR00152	3.237 x 0.103
3.504	3.701	0.177	0.232	0.010	3.518 x 3.690 x 0.045	BBP80B153	ORAR00153	3.487 x 0.103
3.740	3.937	0.177	0.232	0.010	3.768 x 3.937 x 0.045	BBP80B154	ORAR00154	3.737 x 0.103
4.016	4.173	0.177	0.232	0.010	4.018 x 4.190 x 0.045	BBP80B155	ORAR00155	3.987 x 0.103
4.252	4.449	0.177	0.232	0.010	4.268 x 4.440 x 0.045	BBP80B156	ORAR00156	4.237 x 0.103
4.488	4.685	0.177	0.232	0.010	4.518 x 4.690 x 0.045	BBP80B157	ORAR00157	4.487 x 0.103
4.764	4.921	0.177	0.232	0.010	4.768 x 4.940 x 0.045	BBP80B158	ORAR00158	4.737 x 0.103
5.000	5.197	0.177	0.232	0.010	5.018 x 5.190 x 0.045	BBP80B159	ORAR00159	4.987 x 0.103
5.236	5.433	0.177	0.232	0.010	5.268 x 5.440 x 0.045	BBP80B160	ORAR00160	5.237 x 0.103
5.512	5.669	0.177	0.232	0.010	5.518 x 5.690 x 0.045	BBP80B161	ORAR00161	5.487 x 0.103
5.748	5.945	0.177	0.232	0.010	5.768 x 5.940 x 0.045	BBP80B162	ORAR00162	5.737 x 0.103
5.984	6.181	0.177	0.232	0.010	6.018 x 6.190 x 0.045	BBP80B163	ORAR00163	5.987 x 0.103
6.260	6.457	0.177	0.232	0.010	6.268 x 6.440 x 0.045	BBP80B164	ORAR00164	6.237 x 0.103
6.496	6.693	0.177	0.232	0.010	6.518 x 6.690 x 0.045	BBP80B165	ORAR00165	6.487 x 0.103
6.772	6.929	0.177	0.232	0.010	6.768 x 6.940 x 0.045	BBP80B166	ORAR00166	6.737 x 0.103
7.008	7.205	0.177	0.232	0.010	7.018 x 7.189 x 0.045	BBP80B167	ORAR00167	6.987 x 0.103
7.244	7.441	0.177	0.232	0.010	7.268 x 7.440 x 0.045	BBP80B168	ORAR00168	7.237 x 0.103
7.480	7.677	0.177	0.232	0.010	7.518 x 7.690 x 0.045	BBP80B169	ORAR00169	7.487 x 0.103
7.756	7.953	0.177	0.232	0.010	7.768 x 7.940 x 0.045	BBP80B170	ORAR00170	7.737 x 0.103
7.992	8.189	0.177	0.232	0.010	8.018 x 8.190 x 0.045	BBP80B171	ORAR00171	7.987 x 0.103
8.268	8.425	0.177	0.232	0.010	8.268 x 8.440 x 0.045	BBP80B172	ORAR00172	8.237 x 0.103
8.504	8.701	0.177	0.232	0.010	8.518 x 8.690 x 0.045	BBP80B173	ORAR00173	8.487 x 0.103
8.740	8.937	0.177	0.232	0.010	8.768 x 8.940 x 0.045	BBP80B174	ORAR00174	8.737 x 0.103
9.016	9.173	0.177	0.232	0.010	9.018 x 9.190 x 0.045	BBP80B175	ORAR00175	8.987 x 0.103
9.252	9.449	0.177	0.232	0.010	9.268 x 9.440 x 0.045	BBP80B176	ORAR00176	9.237 x 0.103
9.488	9.685	0.177	0.232	0.010	9.518 x 9.690 x 0.045	BBP80B177	ORAR00177	9.487 x 0.103
9.764	9.921	0.177	0.232	0.010	9.768 x 9.940 x 0.045	BBP80B178	ORAR00178	9.737 x 0.103



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
0.197	0.433	0.220	0.276	0.010	0.202 x 0.438 x 0.040	BBP80B201	ORAR00201	0.171 x 0.139
0.256	0.512	0.220	0.276	0.010	0.265 x 0.501 x 0.040	BBP80B202	ORAR00202	0.234 x 0.139
0.315	0.551	0.220	0.276	0.010	0.327 x 0.563 x 0.040	BBP80B203	ORAR00203	0.296 x 0.139
0.374	0.630	0.220	0.276	0.010	0.390 x 0.626 x 0.040	BBP80B204	ORAR00204	0.359 x 0.139
0.433	0.669	0.220	0.276	0.010	0.455 x 0.691 x 0.040	BBP80B205	ORAR00205	0.421 x 0.139
0.512	0.748	0.220	0.276	0.010	0.518 x 0.754 x 0.040	BBP80B206	ORAR00206	0.484 x 0.139
0.551	0.827	0.220	0.276	0.010	0.580 x 0.816 x 0.040	BBP80B207	ORAR00207	0.546 x 0.139
0.630	0.866	0.220	0.276	0.010	0.643 x 0.879 x 0.040	BBP80B208	ORAR00208	0.609 x 0.139
0.669	0.945	0.220	0.276	0.010	0.705 x 0.941 x 0.040	BBP80B209	ORAR00209	0.671 x 0.139
0.748	0.984	0.220	0.276	0.010	0.766 x 1.002 x 0.040	BBP80B210	ORAR00210	0.734 x 0.139
0.787	1.063	0.220	0.276	0.010	0.828 x 1.064 x 0.040	BBP80B211	ORAR00211	0.796 x 0.139
0.866	1.142	0.220	0.276	0.010	0.891 x 1.127 x 0.040	BBP80B212	ORAR00212	0.859 x 0.139
0.945	1.181	0.220	0.276	0.010	0.953 x 1.189 x 0.040	BBP80B213	ORAR00213	0.921 x 0.139
0.984	1.260	0.220	0.276	0.010	1.016 x 1.252 x 0.040	BBP80B214	ORAR00214	0.984 x 0.139
1.063	1.299	0.220	0.276	0.010	1.078 x 1.314 x 0.040	BBP80B215	ORAR00215	1.046 x 0.139
1.142	1.378	0.220	0.276	0.010	1.141 x 1.377 x 0.040	BBP80B216	ORAR00216	1.109 x 0.139
1.181	1.437	0.220	0.276	0.010	1.203 x 1.439 x 0.040	BBP80B217	ORAR00217	1.171 x 0.139
1.260	1.496	0.220	0.276	0.010	1.266 x 1.502 x 0.040	BBP80B218	ORAR00218	1.234 x 0.139
1.299	1.575	0.220	0.276	0.010	1.334 x 1.570 x 0.040	BBP80B219	ORAR00219	1.296 x 0.139
1.378	1.614	0.220	0.276	0.010	1.398 x 1.634 x 0.040	BBP80B220	ORAR00220	1.359 x 0.139
1.417	1.693	0.220	0.276	0.010	1.459 x 1.695 x 0.040	BBP80B221	ORAR00221	1.421 x 0.139
1.496	1.752	0.220	0.276	0.010	1.522 x 1.758 x 0.040	BBP80B222	ORAR00222	1.484 x 0.139
1.614	1.890	0.220	0.276	0.010	1.647 x 1.883 x 0.040	BBP80B223	ORAR00223	1.609 x 0.139
1.752	2.008	0.220	0.276	0.010	1.772 x 2.008 x 0.040	BBP80B224	ORAR00224	1.734 x 0.139
1.890	2.126	0.220	0.276	0.010	1.897 x 2.133 x 0.040	BBP80B225	ORAR00225	1.859 x 0.139
2.008	2.244	0.220	0.276	0.010	2.022 x 2.258 x 0.040	BBP80B226	ORAR00226	1.984 x 0.139
2.126	2.362	0.220	0.276	0.010	2.147 x 2.383 x 0.040	BBP80B227	ORAR00227	2.109 x 0.139
2.244	2.500	0.220	0.276	0.010	2.272 x 2.508 x 0.040	BBP80B228	ORAR00228	2.234 x 0.139
2.362	2.638	0.220	0.276	0.010	2.397 x 2.712 x 0.040	BBP80B229	ORAR00229	2.359 x 0.139
2.500	2.756	0.220	0.276	0.010	2.522 x 2.758 x 0.040	BBP80B230	ORAR00230	2.484 x 0.139
2.638	2.874	0.220	0.276	0.010	2.631 x 2.867 x 0.040	BBP80B231	ORAR00231	2.609 x 0.139
2.756	2.992	0.220	0.276	0.010	2.756 x 2.992 x 0.040	BBP80B232	ORAR00232	2.734 x 0.139
2.874	3.110	0.220	0.276	0.010	2.881 x 3.117 x 0.040	BBP80B233	ORAR00233	2.859 x 0.139
2.992	3.268	0.220	0.276	0.010	3.006 x 3.242 x 0.040	BBP80B234	ORAR00234	2.984 x 0.139
3.130	3.386	0.220	0.276	0.010	3.131 x 3.367 x 0.040	BBP80B235	ORAR00235	3.109 x 0.139
3.268	3.504	0.220	0.276	0.010	3.256 x 3.492 x 0.040	BBP80B236	ORAR00236	3.234 x 0.139
3.386	3.622	0.220	0.276	0.010	3.381 x 3.617 x 0.040	BBP80B237	ORAR00237	3.359 x 0.139
3.543	3.740	0.220	0.276	0.010	3.506 x 3.742 x 0.040	BBP80B238	ORAR00238	3.484 x 0.139
3.622	3.858	0.220	0.276	0.010	3.631 x 3.867 x 0.040	BBP80B239	ORAR00239	3.609 x 0.139
3.740	4.016	0.220	0.276	0.010	3.756 x 3.992 x 0.040	BBP80B240	ORAR00240	3.734 x 0.139
3.858	4.134	0.220	0.276	0.010	3.881 x 4.117 x 0.040	BBP80B241	ORAR00241	3.859 x 0.139
4.016	4.252	0.220	0.276	0.010	4.006 x 4.242 x 0.040	BBP80B242	ORAR00242	3.984 x 0.139



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
4.134	4.370	0.220	0.276	0.010	4.131 x 4.367 x 0.040	BBP80B243	ORAR00243	4.109 x 0.139
4.252	4.488	0.220	0.276	0.010	4.256 x 4.492 x 0.040	BBP80B244	ORAR00244	4.234 x 0.139
4.370	4.646	0.220	0.276	0.010	4.381 x 4.617 x 0.040	BBP80B245	ORAR00245	4.359 x 0.139
4.488	4.764	0.220	0.276	0.010	4.506 x 4.742 x 0.040	BBP80B246	ORAR00246	4.484 x 0.139
4.646	4.882	0.220	0.276	0.010	4.631 x 4.867 x 0.040	BBP80B247	ORAR00247	4.609 x 0.139
4.764	5.000	0.220	0.276	0.010	4.768 x 5.004 x 0.040	BBP80B248	ORAR00248	4.734 x 0.139
4.882	5.118	0.220	0.276	0.010	4.893 x 5.129 x 0.040	BBP80B249	ORAR00249	4.859 x 0.139
5.000	5.236	0.220	0.276	0.010	5.018 x 5.254 x 0.040	BBP80B250	ORAR00250	4.984 x 0.139
5.118	5.374	0.220	0.276	0.010	5.143 x 5.379 x 0.040	BBP80B251	ORAR00251	5.109 x 0.139
5.236	5.512	0.220	0.276	0.010	5.268 x 5.504 x 0.040	BBP80B252	ORAR00252	5.234 x 0.139
5.374	5.630	0.220	0.276	0.010	5.393 x 5.629 x 0.040	BBP80B253	ORAR00253	5.359 x 0.139
5.512	5.748	0.220	0.276	0.010	5.518 x 5.754 x 0.040	BBP80B254	ORAR00254	5.484 x 0.139
5.630	5.906	0.220	0.276	0.010	5.643 x 5.879 x 0.040	BBP80B255	ORAR00255	5.609 x 0.139
5.748	5.984	0.220	0.276	0.010	5.768 x 6.004 x 0.040	BBP80B256	ORAR00256	5.734 x 0.139
5.866	6.142	0.220	0.276	0.010	5.893 x 6.129 x 0.040	BBP80B257	ORAR00257	5.859 x 0.139
5.984	6.260	0.220	0.276	0.010	6.018 x 6.254 x 0.040	BBP80B258	ORAR00258	5.984 x 0.139
6.260	6.496	0.220	0.276	0.010	6.268 x 6.504 x 0.040	BBP80B259	ORAR00259	6.234 x 0.139
6.496	6.772	0.220	0.276	0.010	6.518 x 6.754 x 0.040	BBP80B260	ORAR00260	6.484 x 0.139
6.772	7.500	0.220	0.276	0.010	7.268 x 7.504 x 0.040	BBP80B263	ORAR00261	6.734 x 0.139
7.008	7.008	0.220	0.276	0.010	6.768 x 7.004 x 0.040	BBP80B261	ORAR00262	6.984 x 0.139
7.244	7.244	0.220	0.276	0.010	7.018 x 7.254 x 0.040	BBP80B262	ORAR00263	7.234 x 0.139
7.500	7.756	0.220	0.276	0.010	7.518 x 7.754 x 0.040	BBP80B264	ORAR00264	7.484 x 0.139
7.756	7.992	0.220	0.276	0.010	7.768 x 8.004 x 0.040	BBP80B265	ORAR00265	7.734 x 0.139
7.992	8.268	0.220	0.276	0.010	8.018 x 8.254 x 0.040	BBP80B266	ORAR00266	7.984 x 0.139
8.268	8.500	0.220	0.276	0.010	8.268 x 8.504 x 0.040	BBP80B267	ORAR00267	8.234 x 0.139
8.500	8.752	0.220	0.276	0.010	8.518 x 8.754 x 0.040	BBP80B268	ORAR00268	8.484 x 0.139
8.752	9.016	0.220	0.276	0.010	8.768 x 9.004 x 0.040	BBP80B269	ORAR00269	8.734 x 0.139
9.000	9.252	0.220	0.276	0.010	9.018 x 9.254 x 0.040	BBP80B270	ORAR00270	8.984 x 0.139
9.252	9.488	0.220	0.276	0.010	9.268 x 9.504 x 0.040	BBP80B271	ORAR00271	9.234 x 0.139
9.488	9.764	0.220	0.276	0.010	9.518 x 9.754 x 0.040	BBP80B272	ORAR00272	9.484 x 0.139
9.764	10.000	0.220	0.276	0.010	9.768 x 10.004 x 0.040	BBP80B273	ORAR00273	9.734 x 0.139
10.000	10.236	0.220	0.276	0.010	10.018 x 10.254 x 0.040	BBP80B274	ORAR00274	9.984 x 0.139
10.512	10.748	0.220	0.276	0.010	10.518 x 10.754 x 0.040	BBP80B275	ORAR00275	10.484 x 0.139
11.024	11.260	0.220	0.276	0.010	11.018 x 11.254 x 0.040	BBP80B276	ORAR00276	10.984 x 0.139
11.496	11.772	0.220	0.276	0.010	11.518 x 11.754 x 0.040	BBP80B277	ORAR00277	11.484 x 0.139
12.008	12.244	0.220	0.276	0.010	12.018 x 12.254 x 0.040	BBP80B278	ORAR00278	11.984 x 0.139
12.992	13.228	0.220	0.276	0.010	13.018 x 13.254 x 0.040	BBP80B279	ORAR00279	12.984 x 0.139
14.016	14.252	0.220	0.276	0.010	14.018 x 14.254 x 0.040	BBP80B280	ORAR00280	13.984 x 0.139
15.000	15.236	0.220	0.276	0.010	15.018 x 15.254 x 0.040	BBP80B281	ORAR00281	14.984 x 0.139
15.984	16.260	0.220	0.276	0.010	15.989 x 16.225 x 0.040	BBP80B282	ORAR00282	15.955 x 0.139
17.008	17.244	0.220	0.276	0.010	16.989 x 17.225 x 0.040	BBP80B283	ORAR00283	16.955 x 0.139
17.992	18.268	0.220	0.276	0.010	17.989 x 18.225 x 0.040	BBP80B284	ORAR00284	17.955 x 0.139



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
0.433	0.827	0.311	0.378	0.010	0.450 x 0.816 x 0.060	BBP80B309	ORAR00309	0.412 x 0.210
0.512	0.866	0.311	0.378	0.010	0.513 x 0.879 x 0.060	BBP80B310	ORAR00310	0.475 x 0.210
0.551	0.945	0.311	0.378	0.010	0.575 x 0.941 x 0.060	BBP80B311	ORAR00311	0.537 x 0.210
0.630	0.984	0.311	0.378	0.010	0.638 x 1.004 x 0.060	BBP80B312	ORAR00312	0.600 x 0.210
0.669	1.063	0.311	0.378	0.010	0.700 x 1.066 x 0.060	BBP80B313	ORAR00313	0.662 x 0.210
0.748	1.142	0.311	0.378	0.010	0.763 x 1.129 x 0.060	BBP80B314	ORAR00314	0.725 x 0.210
0.787	1.181	0.311	0.378	0.010	0.825 x 1.191 x 0.060	BBP80B315	ORAR00315	0.787 x 0.210
0.866	1.260	0.311	0.378	0.010	0.888 x 1.254 x 0.060	BBP80B316	ORAR00316	0.850 x 0.210
0.945	1.299	0.311	0.378	0.010	0.950 x 1.316 x 0.060	BBP80B317	ORAR00317	0.912 x 0.210
0.984	1.378	0.311	0.378	0.010	1.013 x 1.379 x 0.060	BBP80B318	ORAR00318	0.975 x 0.210
1.063	1.437	0.311	0.378	0.010	1.075 x 1.441 x 0.060	BBP80B319	ORAR00319	1.037 x 0.210
1.142	1.496	0.311	0.378	0.010	1.138 x 1.504 x 0.060	BBP80B320	ORAR00320	1.100 x 0.210
1.181	1.575	0.311	0.378	0.010	1.198 x 1.564 x 0.060	BBP80B321	ORAR00321	1.162 x 0.210
1.260	1.614	0.311	0.378	0.010	1.263 x 1.629 x 0.060	BBP80B322	ORAR00322	1.225 x 0.210
1.299	1.693	0.311	0.378	0.010	1.316 x 1.682 x 0.060	BBP80B323	ORAR00323	1.287 x 0.210
1.378	1.752	0.311	0.378	0.010	1.388 x 1.754 x 0.060	BBP80B324	ORAR00324	1.350 x 0.210
1.496	1.890	0.311	0.378	0.010	1.513 x 1.879 x 0.060	BBP80B325	ORAR00325	1.475 x 0.210
1.614	2.008	0.311	0.378	0.010	1.638 x 2.004 x 0.060	BBP80B326	ORAR00326	1.600 x 0.210
1.752	2.126	0.311	0.378	0.010	1.763 x 2.129 x 0.060	BBP80B327	ORAR00327	1.725 x 0.210
1.890	2.244	0.311	0.378	0.010	1.888 x 2.254 x 0.060	BBP80B328	ORAR00328	1.850 x 0.210
2.008	2.362	0.311	0.378	0.010	2.013 x 2.379 x 0.060	BBP80B329	ORAR00329	1.975 x 0.210
2.126	2.500	0.311	0.378	0.010	2.138 x 2.504 x 0.060	BBP80B330	ORAR00330	2.100 x 0.210
2.244	2.638	0.311	0.378	0.010	2.268 x 2.634 x 0.060	BBP80B331	ORAR00331	2.225 x 0.210
2.362	2.756	0.311	0.378	0.010	2.393 x 2.759 x 0.060	BBP80B332	ORAR00332	2.350 x 0.210
2.520	2.874	0.311	0.378	0.010	2.518 x 2.884 x 0.060	BBP80B333	ORAR00333	2.475 x 0.210
2.638	2.992	0.311	0.378	0.010	2.643 x 3.009 x 0.060	BBP80B334	ORAR00334	2.600 x 0.210
2.756	3.150	0.311	0.378	0.010	2.768 x 3.134 x 0.060	BBP80B335	ORAR00335	2.725 x 0.210
2.874	3.268	0.311	0.378	0.010	2.893 x 3.259 x 0.060	BBP80B336	ORAR00336	2.850 x 0.210
2.992	3.386	0.311	0.378	0.010	3.018 x 3.384 x 0.060	BBP80B337	ORAR00337	2.975 x 0.210
3.150	3.504	0.311	0.378	0.010	3.143 x 3.509 x 0.060	BBP80B338	ORAR00338	3.100 x 0.210
3.268	3.622	0.311	0.378	0.010	3.273 x 3.639 x 0.060	BBP80B339	ORAR00339	3.225 x 0.210
3.386	3.740	0.311	0.378	0.010	3.398 x 3.764 x 0.060	BBP80B340	ORAR00340	3.350 x 0.210
3.543	3.858	0.311	0.378	0.010	3.523 x 3.889 x 0.060	BBP80B341	ORAR00341	3.475 x 0.210
3.622	4.016	0.311	0.378	0.010	3.648 x 4.014 x 0.060	BBP80B342	ORAR00342	3.600 x 0.210
3.740	4.134	0.311	0.378	0.010	3.773 x 4.139 x 0.060	BBP80B343	ORAR00343	3.725 x 0.210
3.858	4.252	0.311	0.378	0.010	3.898 x 4.264 x 0.060	BBP80B344	ORAR00344	3.850 x 0.210
4.016	4.370	0.311	0.378	0.010	4.028 x 4.394 x 0.060	BBP80B345	ORAR00345	3.975 x 0.210
4.134	4.488	0.311	0.378	0.010	4.153 x 4.519 x 0.060	BBP80B346	ORAR00346	4.100 x 0.210
4.252	4.646	0.311	0.378	0.010	4.278 x 4.644 x 0.060	BBP80B347	ORAR00347	4.225 x 0.210
4.370	4.764	0.311	0.378	0.010	4.403 x 4.769 x 0.060	BBP80B348	ORAR00348	4.350 x 0.210
4.488	4.882	0.311	0.378	0.010	4.528 x 4.894 x 0.060	BBP80B349	ORAR00349	4.475 x 0.210
4.528	5.118	0.311	0.378	0.010	4.778 x 5.144 x 0.060	BBP80B351	ORAR00351	4.725 x 0.210



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
4.646	5.000	0.311	0.378	0.010	4.653 x 5.019 x 0.060	BBP80B350	ORAR00350	4.600 x 0.210
4.882	5.236	0.311	0.378	0.010	4.903 x 5.269 x 0.060	BBP80B352	ORAR00352	4.850 x 0.210
5.000	5.394	0.311	0.378	0.010	5.028 x 5.394 x 0.060	BBP80B353	ORAR00353	4.975 x 0.210
5.118	5.512	0.311	0.378	0.010	5.153 x 5.519 x 0.060	BBP80B354	ORAR00354	5.100 x 0.210
5.276	5.630	0.311	0.378	0.010	5.279 x 5.645 x 0.060	BBP80B355	ORAR00355	5.225 x 0.210
5.394	5.748	0.311	0.378	0.010	5.403 x 5.769 x 0.060	BBP80B356	ORAR00356	5.350 x 0.210
5.512	5.906	0.311	0.378	0.010	5.528 x 5.894 x 0.060	BBP80B357	ORAR00357	5.475 x 0.210
5.630	5.984	0.311	0.378	0.010	5.653 x 6.019 x 0.060	BBP80B358	ORAR00358	5.600 x 0.210
5.748	6.142	0.311	0.378	0.010	5.778 x 6.144 x 0.060	BBP80B359	ORAR00359	5.725 x 0.210
5.906	6.260	0.311	0.378	0.010	5.903 x 6.269 x 0.060	BBP80B360	ORAR00360	5.846 x 0.210
5.984	6.378	0.311	0.378	0.010	6.028 x 6.394 x 0.060	BBP80B361	ORAR00361	5.975 x 0.210
6.260	6.614	0.311	0.378	0.010	6.278 x 6.644 x 0.060	BBP80B362	ORAR00362	6.225 x 0.210
6.496	6.890	0.311	0.378	0.010	6.528 x 6.894 x 0.060	BBP80B363	ORAR00363	6.475 x 0.210
6.772	7.126	0.311	0.378	0.010	6.778 x 7.144 x 0.060	BBP80B364	ORAR00364	6.725 x 0.210
7.008	7.362	0.311	0.378	0.010	7.028 x 7.394 x 0.060	BBP80B365	ORAR00365	6.975 x 0.210
7.244	7.638	0.311	0.378	0.010	7.278 x 7.644 x 0.060	BBP80B366	ORAR00366	7.225 x 0.210
7.520	7.874	0.311	0.378	0.010	7.528 x 7.894 x 0.060	BBP80B367	ORAR00367	7.475 x 0.210
7.756	8.110	0.311	0.378	0.010	7.778 x 8.144 x 0.060	BBP80B368	ORAR00368	7.725 x 0.210
7.992	8.386	0.311	0.378	0.010	8.028 x 8.394 x 0.060	BBP80B369	ORAR00369	7.975 x 0.210
8.268	8.661	0.311	0.378	0.010	8.278 x 8.644 x 0.060	BBP80B370	ORAR00370	8.225 x 0.210
8.504	8.858	0.311	0.378	0.010	8.528 x 8.894 x 0.060	BBP80B371	ORAR00371	8.475 x 0.210
8.740	9.134	0.311	0.378	0.010	8.778 x 9.144 x 0.060	BBP80B372	ORAR00372	8.725 x 0.210
9.016	9.370	0.311	0.378	0.010	9.028 x 9.394 x 0.060	BBP80B373	ORAR00373	8.975 x 0.210
9.252	9.626	0.311	0.378	0.010	9.278 x 9.644 x 0.060	BBP80B374	ORAR00374	9.225 x 0.210
9.488	9.882	0.311	0.378	0.010	9.528 x 9.894 x 0.060	BBP80B375	ORAR00375	9.475 x 0.210
9.764	10.118	0.311	0.378	0.010	9.778 x 10.144 x 0.060	BBP80B376	ORAR00376	9.725 x 0.210
10.000	10.394	0.311	0.378	0.010	10.028 x 10.394 x 0.060	BBP80B377	ORAR00377	9.975 x 0.210
10.512	10.866	0.311	0.378	0.010	10.528 x 10.894 x 0.060	BBP80B378	ORAR00378	10.475 x 0.210
11.024	11.417	0.311	0.378	0.010	11.028 x 11.394 x 0.060	BBP80B379	ORAR00379	10.975 x 0.210
11.496	11.890	0.311	0.378	0.010	11.528 x 11.894 x 0.060	BBP80B380	ORAR00380	11.475 x 0.210
12.008	12.402	0.311	0.378	0.010	12.028 x 12.394 x 0.060	BBP80B381	ORAR00381	11.975 x 0.210
12.992	13.386	0.311	0.378	0.010	13.028 x 13.394 x 0.060	BBP80B382	ORAR00382	12.975 x 0.210
14.016	14.409	0.311	0.378	0.010	14.028 x 14.394 x 0.060	BBP80B383	ORAR00383	13.975 x 0.210
15.000	15.374	0.311	0.378	0.010	15.028 x 15.394 x 0.060	BBP80B384	ORAR00384	14.975 x 0.210
16.024	16.378	0.311	0.378	0.010	16.008 x 16.374 x 0.060	BBP80B385	ORAR00385	15.955 x 0.210
17.008	17.362	0.311	0.378	0.010	17.008 x 17.374 x 0.060	BBP80B386	ORAR00386	16.955 x 0.210
17.992	18.386	0.311	0.378	0.010	18.008 x 18.374 x 0.060	BBP80B387	ORAR00387	17.955 x 0.210
19.016	19.370	0.311	0.378	0.010	19.006 x 19.372 x 0.060	BBP80B388	ORAR00388	18.955 x 0.210
20.000	20.394	0.311	0.378	0.010	20.006 x 20.372 x 0.060	BBP80B389	ORAR00389	19.955 x 0.210
20.984	21.378	0.311	0.378	0.010	21.006 x 21.372 x 0.060	BBP80B390	ORAR00390	20.955 x 0.210
22.008	22.362	0.311	0.378	0.010	22.006 x 22.372 x 0.060	BBP80B391	ORAR00391	21.955 x 0.210
22.992	23.346	0.311	0.378	0.010	22.993 x 23.359 x 0.060	BBP80B392	ORAR00392	22.940 x 0.210



Rod ∅	Bore ∅	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		b ₂ +0.010	b ₃ +0.010					
inch								
24.016	24.370	0.311	0.378	0.010	23.993 x 24.359 x 0.060	BBP80B393	ORAR00393	23.940 x 0.210
25.000	25.354	0.311	0.378	0.010	24.993 x 25.359 x 0.060	BBP80B394	ORAR00394	24.940 x 0.210
25.984	26.378	0.311	0.378	0.010	25.993 x 26.359 x 0.060	BBP80B395	ORAR00395	25.940 x 0.210
4.488	5.039	0.421	0.520	0.010	4.551 x 5.023 x 0.096	BBP80B425	ORAR00425	4.475 x 0.275
4.646	5.157	0.421	0.520	0.010	4.676 x 5.148 x 0.096	BBP80B426	ORAR00426	4.600 x 0.275
4.764	5.276	0.421	0.520	0.010	4.801 x 5.273 x 0.096	BBP80B427	ORAR00427	4.725 x 0.275
4.882	5.394	0.421	0.520	0.010	4.929 x 5.401 x 0.096	BBP80B428	ORAR00428	4.850 x 0.275
5.000	5.512	0.421	0.520	0.010	5.051 x 5.523 x 0.096	BBP80B429	ORAR00429	4.975 x 0.275
5.118	5.630	0.421	0.520	0.010	5.176 x 5.648 x 0.096	BBP80B430	ORAR00430	5.100 x 0.275
5.276	5.787	0.421	0.520	0.010	5.301 x 5.773 x 0.096	BBP80B431	ORAR00431	5.225 x 0.275
5.394	5.906	0.421	0.520	0.010	5.426 x 5.898 x 0.096	BBP80B432	ORAR00432	5.350 x 0.275
5.512	5.984	0.421	0.520	0.010	5.551 x 6.023 x 0.096	BBP80B433	ORAR00433	5.475 x 0.275
5.630	6.142	0.421	0.520	0.010	5.676 x 6.148 x 0.096	BBP80B434	ORAR00434	5.600 x 0.275
5.394	5.906	0.421	0.520	0.010	5.426 x 5.898 x 0.096	BBP80B432	ORAR00432	5.350 x 0.275
5.512	5.984	0.421	0.520	0.010	5.551 x 6.023 x 0.096	BBP80B433	ORAR00433	5.475 x 0.275
6.024	6.496	0.421	0.520	0.010	6.051 x 6.523 x 0.096	BBP80B437	ORAR00437	5.975 x 0.275
6.260	6.772	0.421	0.520	0.010	6.274 x 6.746 x 0.096	BBP80B438	ORAR00438	6.225 x 0.275
6.496	7.008	0.421	0.520	0.010	6.524 x 6.996 x 0.096	BBP80B439	ORAR00439	6.475 x 0.275
6.772	7.244	0.421	0.520	0.010	6.774 x 7.246 x 0.096	BBP80B440	ORAR00440	6.725 x 0.275
7.008	7.500	0.421	0.520	0.010	7.024 x 7.496 x 0.096	BBP80B441	ORAR00441	6.975 x 0.275
7.283	7.756	0.421	0.520	0.010	7.274 x 7.746 x 0.096	BBP80B442	ORAR00442	7.225 x 0.275
7.480	7.992	0.421	0.520	0.010	7.524 x 7.996 x 0.096	BBP80B443	ORAR00443	7.475 x 0.275
7.756	8.268	0.421	0.520	0.010	7.774 x 8.246 x 0.096	BBP80B444	ORAR00444	7.725 x 0.275
7.992	8.504	0.421	0.520	0.010	8.024 x 8.496 x 0.096	BBP80B445	ORAR00445	7.975 x 0.275
8.504	9.016	0.421	0.520	0.010	8.524 x 8.996 x 0.096	BBP80B446	ORAR00446	8.475 x 0.275
9.016	9.488	0.421	0.520	0.010	9.024 x 9.496 x 0.096	BBP80B447	ORAR00447	8.975 x 0.275
9.488	10.000	0.421	0.520	0.010	9.524 x 9.996 x 0.096	BBP80B448	ORAR00448	9.475 x 0.275
10.000	10.512	0.421	0.520	0.010	10.024 x 10.496 x 0.096	BBP80B449	ORAR00449	9.975 x 0.275
10.512	11.024	0.421	0.520	0.010	10.524 x 10.996 x 0.096	BBP80B450	ORAR00450	10.475 x 0.275
11.024	11.496	0.421	0.520	0.010	11.024 x 11.496 x 0.096	BBP80B451	ORAR00451	10.975 x 0.275
11.496	12.008	0.421	0.520	0.010	11.524 x 11.996 x 0.096	BBP80B452	ORAR00452	11.475 x 0.275
12.008	8.583	0.421	0.520	0.010	12.024 x 12.496 x 0.096	BBP80B453	ORAR00453	11.975 x 0.275
12.520	12.992	0.421	0.520	0.010	12.524 x 12.996 x 0.096	BBP80B454	ORAR00454	12.475 x 0.275
12.992	13.504	0.421	0.520	0.010	13.024 x 13.496 x 0.096	BBP80B455	ORAR00455	12.975 x 0.275
13.504	14.016	0.421	0.520	0.010	13.524 x 13.996 x 0.096	BBP80B456	ORAR00456	13.483 x 0.275
14.016	14.488	0.421	0.520	0.010	14.024 x 14.216 x 0.096	BBP80B457	ORAR00457	13.975 x 0.275
14.488	15.000	0.421	0.520	0.010	14.524 x 14.996 x 0.096	BBP80B458	ORAR00458	14.475 x 0.275
15.000	15.512	0.421	0.520	0.010	15.024 x 15.493 x 0.096	BBP80B459	ORAR00459	14.975 x 0.275
15.512	15.984	0.421	0.520	0.010	15.524 x 15.996 x 0.096	BBP80B460	ORAR00460	15.475 x 0.275
16.024	16.496	0.421	0.520	0.010	16.004 x 16.476 x 0.096	BBP80B461	ORAR00461	15.955 x 0.275
16.535	17.008	0.421	0.520	0.010	16.504 x 16.976 x 0.096	BBP80B462	ORAR00462	16.455 x 0.275
17.008	17.500	0.421	0.520	0.010	17.004 x 17.476 x 0.096	BBP80B463	ORAR00463	16.955 x 0.275



Rod Ø	Bore Ø	Groove width		Radius	Back-up Ring dimension	TSS Part No.	O-Ring TSS Part No.	O-Ring dimension
		$b_2 + 0.010$	$b_3 + 0.010$					
inch								
17.520	17.992	0.421	0.520	0.010	17.504 x 17.976 x 0.096	BBP80B464	ORAR00464	17.455 x 0.275
18.031	18.504	0.421	0.520	0.010	18.004 x 18.476 x 0.096	BBP80B465	ORAR00465	17.955 x 0.275
18.504	19.016	0.421	0.520	0.010	18.504 x 18.976 x 0.096	BBP80B466	ORAR00466	18.455 x 0.275
19.016	19.488	0.421	0.520	0.010	19.004 x 19.476 x 0.096	BBP80B467	ORAR00467	18.952 x 0.275
19.488	20.000	0.421	0.520	0.010	19.504 x 19.976 x 0.096	BBP80B468	ORAR00468	19.455 x 0.275
20.000	20.512	0.421	0.520	0.010	20.004 x 20.476 x 0.096	BBP80B469	ORAR00469	19.955 x 0.275
20.984	21.496	0.421	0.520	0.010	21.004 x 21.488 x 0.096	BBP80B470	ORAR00470	20.955 x 0.275
22.008	22.520	0.421	0.520	0.010	22.004 x 22.476 x 0.096	BBP80B471	ORAR00471	21.955 x 0.275
22.992	23.504	0.421	0.520	0.010	23.004 x 23.476 x 0.096	BBP80B472	ORAR00472	22.940 x 0.275
24.016	24.488	0.421	0.520	0.010	24.004 x 24.476 x 0.096	BBP80B473	ORAR00473	23.940 x 0.275
25.000	25.512	0.421	0.520	0.010	25.004 x 25.476 x 0.096	BBP80B474	ORAR00474	24.940 x 0.275
25.984	26.496	0.421	0.520	0.010	26.004 x 26.476 x 0.096	BBP80B475	ORAR00475	25.940 x 0.275

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General Quality Criteria and Storage Guidelines

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■ I 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 including ISO 9001, IATF 16949, EN/AS 9100, ISO 13485, ISO 14001, OHSAS 18001 or ISO 29001 and meets the specific requirements of the quality management system.

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 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.

■ J 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), aluminium foil/paper/polyethylene laminate or other similar means of protection should be used to ensure protection from ingress of moisture.

Temperature

The preferred storage temperature for elastomer parts is +15 °C (+59 °F) and should not exceed +25 °C (+77 °F). 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 (+59 °F), 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 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 ultra-violet 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 it 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 95: 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, VMQ, 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 (77 °F) this will influence the storage time. Storage at 10 °C (50 °F) higher will reduce the storage time by about 50%. Storage at 10 °C (50 °F) 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.

Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

Trelleborg Sealing Solutions is a leading developer, manufacturer and supplier of precision seals, bearings and custom-molded polymer components. It focuses on meeting the most demanding needs of aerospace, automotive and general industrial customers with innovative solutions.

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