

AUTOMOTIVE | AEROSPACE | FOOD & BEVERAGE | FLUID TECHNOLOGIES | MOBILE MACHINERY

# FRANCEJOINT

SEALING SYSTEMS



**QUAD'RINGS**  
X'RINGS





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SEALING SYSTEMS

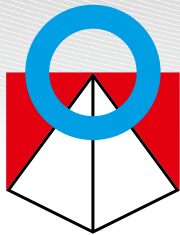
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## ○ X'RINGS

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**Site n°1:** Compression Molding – Injection Molding  
– Water Jet Cutting – Finition – Quality Control – Logistics

**Site N°2:** Administrative Area – Research & Development – Machining – Tooling



**FRANCEJOINT**  
SEALING SYSTEMS

Since 1981, FRANCE JOINT – SEALING SYSTEMS has been designing, manufacturing and distributing seals and precision rubber parts for its customers for whom quality is a determining factor.

**Faced with tough competition among the big decision-makers of the industrial world, FRANCE JOINT has responded with innovation, research and development, experience in Best-Cost manufacturing, and a consistently high level of quality, thanks to certificates ISO 9001, IATF 16949, EN/AS 9100 and ISO 14001.**

Today, FRANCE JOINT is working in close collaboration with its customers, meeting challenges head on with success. Automotive, Aeronautics, Mobile hydraulics, Beverages & Foods, Fluid engineering industries... every solution emerges from a uniquely individual partnership, constantly fostered and renewed.

Our prime objective, based on unrivalled quality, is to find the most suitable solutions for ensuring that

you will stand out in what has become an extremely competitive domain. Our position of excellence has led us since the birth of our company to acquire the tools necessary to anticipate and prevent risks and maximize our service; the ultimate objective being of course to help you keep ahead of developments in this more and more technological market.



AUTOMOTIVE



AERONAUTICS



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FLUID ENGINEERING



MOBILE HYDRAULICS



Compression molding



Injection molding



Machining / Tooling



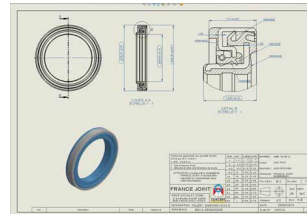
Logistics / Packaging

## RESEARCH & DEVELOPMENT

Innovation, reliability, safety, minimization of risk: your expectations are our daily concern. To get from the idea to the finished product demands firm managerial control over a wide range of projects in addition to expertise in manufacturing.

FRANCE JOINT's contributors, who are as much inventors as technicians, get the best of fully automated, state-of-the-art technology that takes them from drawing-board to prototype and finally to assembly line. From writing specifications to putting on a major technical event through designing (3D Solidwrks software) and testing for validation and compliance, FRANCE JOINT engineering works hand in hand with you to find the best solutions guaranteeing the level of expected performance.

More than 1000 compounds integrating elastomers, PTFE materials, Polyurethane, or even thermoplastics, as many solutions vis-a-vis the new most complex requirements which will put you in pole position today so that we can all be winners tomorrow. FRANCE JOINT puts in place qualifications in order to examine the behavior of its seals according to various parameters intervening on frictions, pressures, temperatures, speeds, strokes, leakages...

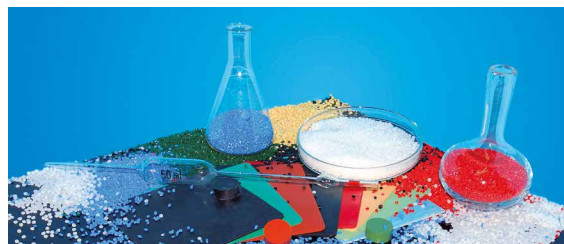


## QUALITY IN OUR CONCERNS

Several certificates obtained, ISO 9001, IATF 16949, EN/AS 9100 and ISO 14001, testify to the quality department's commitment to constant progress at every level of the company, at all stages of the realization, particularly where continual improvement is what has made FRANCE JOINT the name it is today.

Ambitious with customer satisfaction a priority, FRANCE JOINT has thus obtained the most powerful methods (PPAP, AMDEC, value analysis, Audits, MRP, 8D analysis, SPC, R&R ...) in order to optimize simultaneously the capacity of machines and processes, operational manpower performances, organizational methods, and finally, product and financial results.

FRANCE JOINT guarantees the best technology and pursues its daily objectives of a "Zero defects" production, through physico chemical controls (rheometer, spectrometer, durometer...), through dimensional and final aspects (unit controlling equipment, 3D camera ...). This is because the search for competitiveness is as important as the search for continuous improvement.



3D test device





## X'RINGS

### 1. Description

X'Rings are four-lobed double-acting seals used in static and dynamic applications. Usually made from EPDM, FKM, NBR, VMQ and other types of materials, they provide a better sealing and lower friction than conventional O'Rings.

### 2. Materials

#### 2.1 RUBBERS

The table below provides an overview of the different rubber families.

| ABBREVIATION<br>ISO 1629<br>ASTM 1418 | FRANCE JOINT<br>CODE | CHEMICAL NAME                                           |
|---------------------------------------|----------------------|---------------------------------------------------------|
| ACM                                   | B                    | Polyacrylate                                            |
| AEM                                   | V                    | Ethylene acrylate rubber                                |
| EPDM                                  | C                    | Ethylene Propylene Diene Monomer rubber                 |
| FFKM                                  | FF                   | Perfluorinated rubber                                   |
| FKM                                   | G                    | Fluorinated rubber                                      |
| FVMQ                                  | FS                   | Fluorosilicone rubber                                   |
| HNBR                                  | HK                   | Hydrogenated Nitrile Butadiene rubber                   |
| NBR                                   | K                    | Nitrile Butadiene rubber                                |
| NR                                    | N                    | Natural rubber                                          |
| PVMQ                                  | PS                   | Silicone rubber: Polysiloxane – Phenyl – Vinyl – Methyl |
| VMQ                                   | F                    | Silicone rubber: Polysiloxane – Vinyl – Methyl          |

## ● **ACM** (Polyacrylate)

Polymers containing ethyl acrylate (or butyl acrylate) have a small amount of monomer, which is necessary for cross-linking; ACM is a material with better heat resistance than NBR. It is often used for automatic gearboxes.

### Chemical resistance

Mineral oils (motor oils, gear box oils, ATF oils)  
Atmospheric and ozone agents

### Compatibility issue

Glycol-based brake fluids (Dot 3 & 4)  
Aromatic and chlorinated hydrocarbons  
Water and steam  
Acids, alkalis and amines

### Temperature range

-25°C / +150°C (short-term peak at +160°C)  
-35°C / +150°C with particular ACMs

## ● **AEM** (ethylene acrylate rubber)

As a methyl acrylate and ethylene copolymer, AEM is considered to be better resistant to heat than ACM. Its characteristics make it an intermediary between the ACM and FKM.

### Resistance to chemicals

Cooling fluids  
Aggressive mineral oils  
Atmospheric agents  
Water

### Compatibility issue

Aromatic solvents  
Strong acids  
Brake fluids  
Gearbox oils  
ATF oils

### Temperature range

-40°C/+150°C

## ● **EPDM** (Ethylene Propylene Diene Monomer rubber)

As an Ethylene Propylene Diene Monomer copolymer, EPDM is commonly used for hot water taps, cooling systems, brake systems, dishwashers and washing machines.

### Chemical resistance

Hot water and steam up to +150°C  
Glycol-based brake fluids (Dot 3 & 4) and silicone-based brake fluids (Dot 5)  
Organic and inorganic acids  
Cleaning agents, sodium and potassium alkalis  
Hydraulic fluids (HFD-R)  
Silicone oils and greases  
Polar solvents (alcohols, ketones and esters)  
Atmospheric and ozone agents

### Compatibility issue

Mineral oils and greases  
Hydrocarbons  
Low impermeability to gas

### Temperature range

-45°C / +150°C (short-term peak at +175°C)

## FFKM (perfluorinated rubber)

FFKM has the best resistance to high temperatures and an excellent chemical inertia. This FKM-based rubber is very often used for high-temperature hydraulic and pneumatic systems, industrial valves, injection/fuel systems, motor seals and high-vacuum systems.

### Resistance to chemicals

Aliphatic and aromatic hydrocarbons  
Polar solvents (ketones, esters and ethers)  
Organic and inorganic acids  
Water and steam  
High-vacuum system

### Compatibility issue

Coolants (R11, R12, R13, R113, R114, etc.)  
PFPE

### Temperature range

-15°C/+320°C

## FKM (fluorinated rubber)

Depending on their structure and fluorine content, fluoroelastomers can vary in terms of chemical resistance and resistance to cold. This FKM-based rubber is very often used for high-temperature hydraulics and pneumatics, for industrial valves, injection/fuel systems, motor seals and high-vacuum systems.

### Resistance to chemicals

Mineral oils and greases, ASTM n°1, IRM 902 and IRM 903 oils.  
Fire-resistant liquids (HFD)  
Silicone oils and greases  
Mineral and vegetable oils and greases  
Aliphatic hydrocarbons (propane, butane, petroleum)  
Aromatic hydrocarbons (benzene, toluene)  
Chlorinated hydrocarbons (trichlorethylene)  
Fuel (including high alcohol content)  
Atmospheric and ozone agents

### Compatibility issue

Glycol-based brake fluids  
Ammonia gas  
Organic acids with a low molecular weight (formic and acetic acids)

### Temperature range

-20°C / +200°C (short-term peak at +230°C)  
-40°C / +200°C with particular FKMs

## FVMQ (fluorosilicone rubber)

The FVMQ has mechanical and physical properties that are very similar to those of VMQ. However, the FVMQ offers better resistance to fuels and mineral oils. However, resistance to hot air is not as good as that of VMQ.

### Resistance to chemicals

Aromatic mineral oils (IRM 903 oil)  
Fuels  
Aromatic hydrocarbons with low molecular weights (benzene, toluene)

### Temperature range

-70°C/+175°C

## ● **HNBR** (Hydrogenated Nitrile Butadiene Rubber)

This HNBR-based elastomer is obtained through selective hydrogenation of the NBR's butadiene groups. It is commonly used for power-assisted steering and for air conditioning.

### Chemical resistance

Aliphatic hydrocarbons  
Mineral and vegetable oils and greases  
Fire-resistant fluids (HFA, HFB and HFC)  
Diluted acids, saline solutions and bases for operation at an average temperature  
Water and steam up to +150°C  
Atmospheric and ozone agents

### Compatibility issue

Chlorinated hydrocarbons  
Polar solvents (ketones, esters and ethers)  
Strong acids

### Temperature range

-30°C / +150°C (short-term peak at +160°C)  
-40°C / +150°C with particular HNBRs

## ● **NBR** (Nitrile Butadiene Rubber)

Nitrile rubber (NBR) is the general term for acrylonitrile-butadiene copolymer. The ACN content can vary between 18% and 50%. While the acrylonitrile content is important, the resistance to oil and fuel is more so. Conversely, the elasticity and compression set are not as good. The NBR has good mechanical properties and good wear resistance. However, its resistance to atmospheric agents and the ozone is relatively low.

### Resistance to chemicals

Aliphatic hydrocarbons (propane, butane, petroleum, diesel fuel)  
Mineral oils and greases  
Fire-resistant fluids (HFA, HFB and HFC)  
Diluted acids, low-temperature alkaline and saline solutions  
Water (up to +100°C max)

### Compatibility issue

Fuels with high aromatic content  
Aromatic hydrocarbons (benzene)  
Chlorinated hydrocarbons (trichlorethylene)  
Polar solvents (ketone, acetone, acetic acid, ethylene-ester)  
Strong acids  
Glycol-based brake fluids  
Atmospheric and ozone agents

### Temperature range

-30°C / +100°C (short-term peak at +120°C)  
-40°C / +100°C with particular NBRs

## ● **VMQ** (silicone rubber: Methyl Vinyl Polysiloxane)

This FVMQ-based rubber is very often used in fuel systems.

### Chemical resistance

Animal and vegetable oils and greases  
Water for operation at an average temperature  
Diluted saline solutions  
Atmospheric and ozone agents

### Compatibility issue

Superheated steam up to +120°C  
Chlorinated hydrocarbons with a low molecular weight (trichlorethylene)  
Aromatic hydrocarbons (benzene, toluene)  
Atmospheric and ozone agents

### Temperature range

-60°C / +200°C (short-term peak at +230°C)

## 2.2 CHEMICAL COMPATIBILITY

A "Chemical compatibility guide" catalogue can be downloaded from our website: [www.francejoint.com](http://www.francejoint.com)

You can also use our online "**Chemical compatibility**" tool free of charge.

These two tools enable you to measure the behaviour of our materials that come into contact with the majority of existing fluids. The data displayed is the result of rigorous testing at the ambient temperature and takes previous publications into consideration. Test results are not fully representative because of the specific features of your application. The tests performed actually do not consider additives and impurities that may exist under actual conditions of use, nor the potential elevation of temperatures. Other parameters can also alter the behaviour of our materials, such as the hardness, persistence, abrasion, etc. We therefore recommend performing your own tests to verify the compatibility of our materials depending on your specific application. Our technical team can provide you with any additional information.

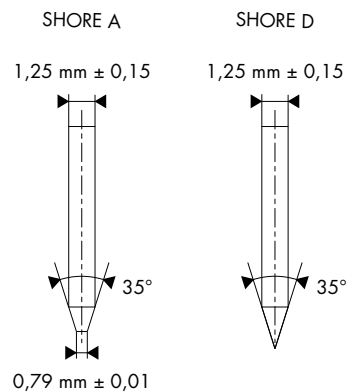
## 2.3 PHYSICAL PROPERTIES

### a. Hardness

Hardness is the major feature that defines resilient materials. The hardness test is carried out using testing devices that display the results as Shore A, Shore D or in IRHD. The majority of X'Rings are Shore A  $\pm 5$  tested (IRHD for specific cases). The test must be carried out at  $23^{\circ}\text{C} \pm 2$ , at the earliest 16 hours after the last vulcanisation on specimen that have not been subjected to mechanical stress in the meantime. Test conditions must be included in the test report.

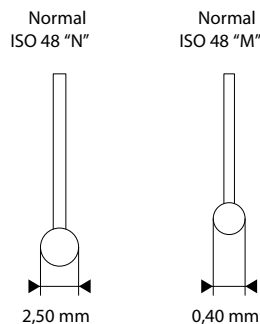
#### In Shore A / Shore D

- Test on specimen only
- Min. thickness: 6.00 mm
- Min. diameter: 30.00 mm
- Duration of entry: 3 seconds
- Standards applied:  
ISO 868 / ISO 7619 / ASTM D 2240



#### In IRHD DIDC

- Tests on specimen and finished parts
- Thickness of 1.50 to 2.50 mm with operating mode "M"
- Thickness of 8.00 to 10.00 mm with operating mode "N"
- Duration of entry: 30 seconds
- Standards applied:  
ISO 48 / ASTM 1414 / ASTM 1415



### b. Compression Set (CS)

The Compression Set (CS) is a method that measures the ability of rubbers to maintain their elastic properties at specific temperatures following prolonged compression under consistent deformation, in line with standards ISO 815 / ASTM D 395.

#### THE CS IS MEASURED AS FOLLOWS:

$$CS \% = \frac{(e0 - e2)}{(e0 - e1)} \times 100$$

#### WHERE:

- e0: initial thickness of the X'Ring
- e1: thickness under compression with specified conditions (temperature, fluid, duration, deformation rate)
- e2: thickness after tension release

### IMPORTANT

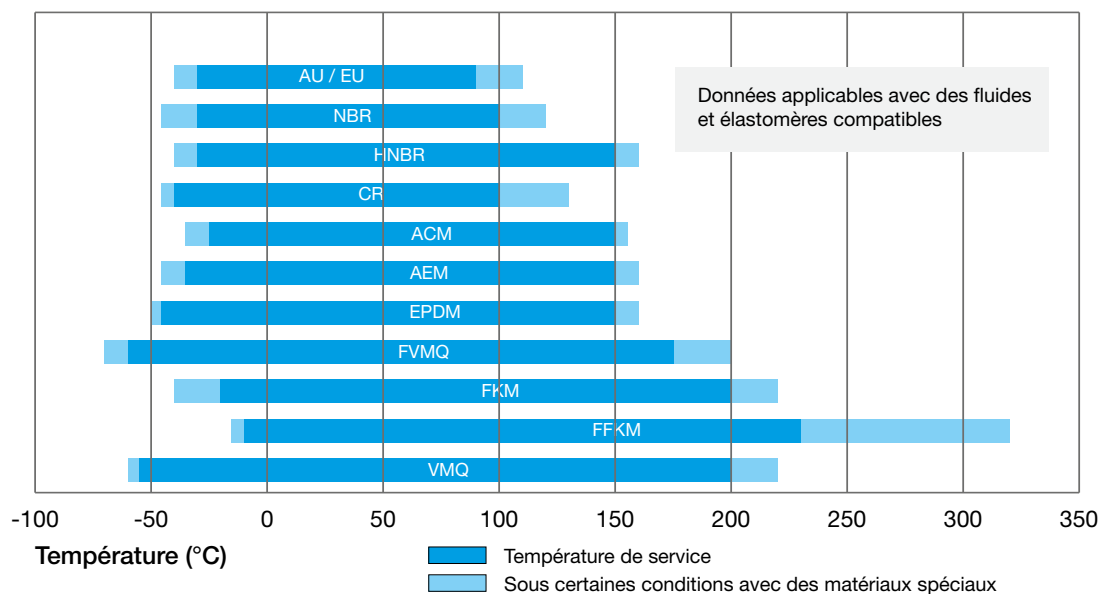
e2 = e0; the material has perfect elasticity  
 e2 = e1; the material has a complete permanent plastic deformation  
 The lower the CS, the better the rubber's elasticity.

### c. Tensile strength, elongation at break, modulus of elasticity 100% to 300%

Usually expressed in MPa for tensile strength and the modulus of elasticity and in % for the elongation at break, the values are obtained according to ISO 37 / ASTM D 412. Once placed between the jaws of the measuring device, the specimen is stretched at a constant speed (approximately 500 mm/min) until it breaks completely. This test characterises the physical properties of rubbers and allows us to understand their limits in terms of resistance to stress, stretching when the seals are stretch-fitted and resistance to extrusion.

### d. Temperature resistance

The temperature strongly influences the physical properties of materials. The graph below sets out the temperature limits for each material. However, we can provide custom-made compounds depending on your needs (e.g. NBR or FKM capable of withstanding temperatures of -40°C)



### e. Volume change

Chemical resistance is a decisive criteria when it comes to selecting an appropriate material. That's why it is essential to be aware of the liquids or gases used in the application, as this will affect the operation of the material as well as the service temperature.

Moreover, hardening or softening, loss of stiffness or elasticity, loss of tension, deformation relaxation and changes in volume through swelling or shrinkage can be ascertained using the volume change test, in line with standards ISO 1817 / ASTM D 471.

These tests are carried out either in the actual application environment or using standardised liquid tests (ASTM no. 1, IRM 902 and IRM 903 oils, ASTM fuels A to C).

## 3. Operating principle

### 3.1 ELONGATION E% – COMPRESSION C%

For the outer radial sealing (piston sealing), the X'Ring is stretch-fitted and must therefore be stretched on its groove. The X'Ring elongation values are applied depending on the inside diameter  $\varnothing d1$ :

- 6% if  $\varnothing d1 > 50.00$  mm
- 8% if  $\varnothing d1 \leq 50.00$  mm

For the inner radial sealing (rod sealing), the X'Ring is stretch-fitted and must therefore be compressed on its groove. The X'Ring compression rate must be less than 3%, whatever the type of application.

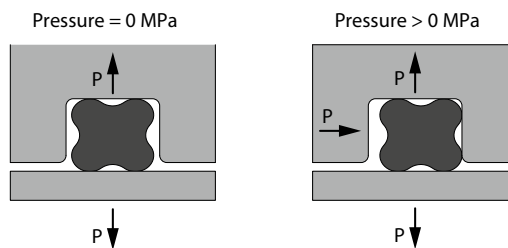
If the maximum elongation or compression values are exceeded, X'Ring thickness  $\varnothing d2$  of the ring will drop too much (stretching) or will rise too much (compression), which will affect the life span of the system.

### 3.2 TIGHTNESS S%

The tightening is a determining element to guarantee optimal sealing. It is obtained by suitably sizing the groove that receives the X'Ring. The resulting initial compression results in an elastic reaction in the X'Ring on the areas to be made watertight and, in this way, creates automatic sealing, even if the fluid is not pressurised.

The tightening rates that should not be exceeded depend on the type of application:

- In static sealing: 8% to 25%
- In dynamic sealing: 6% to 18%



## 4. Tolerances applied to X'Rings

### 4.1 TOLERANCES ON THE INSIDE DIAMETER $\varnothing d1$ FOR X'RINGS

The tolerances on the inside diameters  $\varnothing d1$  set out in the table below relate to standard ISO 3601-1:2008 and are applicable to X'Rings.

THE FORMULA BELOW PROVIDES THE TOLERANCES TO BE APPLIED ON THE INSIDE DIAMETER  $\varnothing d1$  OF THE X'RING.

$$\text{Tolerance on } \varnothing d1 = \pm [(d1^{0.95} \times 0.009) + 0.11]$$

| Inside diameter<br>Ød1 | Tolerances |
|------------------------|------------|
| 0.74 < Ød1 ≤ 1.78      | ± 0.12     |
| 1.78 < Ød1 ≤ 3.00      | ± 0.13     |
| 3.00 < Ød1 ≤ 4.20      | ± 0.14     |
| 4.20 < Ød1 ≤ 5.50      | ± 0.15     |
| 5.50 < Ød1 ≤ 6.75      | ± 0.16     |
| 6.75 < Ød1 ≤ 8.10      | ± 0.17     |
| 8.10 < Ød1 ≤ 9.50      | ± 0.18     |
| 9.50 < Ød1 ≤ 10.69     | ± 0.19     |
| 10.69 < Ød1 ≤ 12.00    | ± 0.20     |
| 12.00 < Ød1 ≤ 13.30    | ± 0.21     |
| 13.30 < Ød1 ≤ 14.80    | ± 0.22     |
| 14.80 < Ød1 ≤ 16.00    | ± 0.23     |
| 16.00 < Ød1 ≤ 17.30    | ± 0.24     |
| 17.30 < Ød1 ≤ 18.72    | ± 0.25     |
| 18.72 < Ød1 ≤ 20.22    | ± 0.26     |
| 20.22 < Ød1 ≤ 21.50    | ± 0.27     |
| 21.50 < Ød1 ≤ 23.00    | ± 0.28     |
| 23.00 < Ød1 ≤ 24.20    | ± 0.29     |
| 24.20 < Ød1 ≤ 25.50    | ± 0.30     |
| 25.50 < Ød1 ≤ 27.00    | ± 0.31     |
| 27.00 < Ød1 ≤ 28.24    | ± 0.32     |
| 28.24 < Ød1 ≤ 29.70    | ± 0.33     |
| 29.70 < Ød1 ≤ 31.12    | ± 0.34     |
| 31.12 < Ød1 ≤ 32.50    | ± 0.35     |
| 32.50 < Ød1 ≤ 34.00    | ± 0.36     |
| 34.00 < Ød1 ≤ 35.20    | ± 0.37     |
| 35.20 < Ød1 ≤ 37.00    | ± 0.38     |
| 37.00 < Ød1 ≤ 38.00    | ± 0.39     |
| 38.00 < Ød1 ≤ 39.40    | ± 0.40     |
| 39.40 < Ød1 ≤ 40.87    | ± 0.41     |
| 40.87 < Ød1 ≤ 42.30    | ± 0.42     |
| 42.30 < Ød1 ≤ 43.70    | ± 0.43     |
| 43.70 < Ød1 ≤ 45.30    | ± 0.44     |
| 45.30 < Ød1 ≤ 46.99    | ± 0.45     |
| 46.99 < Ød1 ≤ 48.00    | ± 0.46     |
| 48.00 < Ød1 ≤ 49.30    | ± 0.47     |
| 49.30 < Ød1 ≤ 50.80    | ± 0.48     |
| 50.80 < Ød1 ≤ 52.30    | ± 0.49     |
| 52.30 < Ød1 ≤ 53.57    | ± 0.50     |
| 53.57 < Ød1 ≤ 55.00    | ± 0.51     |
| 55.00 < Ød1 ≤ 56.52    | ± 0.52     |
| 56.52 < Ød1 ≤ 58.00    | ± 0.53     |
| 58.00 < Ød1 ≤ 59.30    | ± 0.54     |
| 59.30 < Ød1 ≤ 61.00    | ± 0.55     |
| 61.00 < Ød1 ≤ 62.30    | ± 0.56     |
| 62.30 < Ød1 ≤ 64.00    | ± 0.57     |
| 64.00 < Ød1 ≤ 65.10    | ± 0.58     |
| 65.10 < Ød1 ≤ 66.60    | ± 0.59     |
| 66.60 < Ød1 ≤ 67.95    | ± 0.60     |
| 67.95 < Ød1 ≤ 69.40    | ± 0.61     |
| 69.40 < Ød1 ≤ 71.00    | ± 0.62     |
| 71.00 < Ød1 ≤ 72.39    | ± 0.63     |
| 72.39 < Ød1 ≤ 74.00    | ± 0.64     |
| 74.00 < Ød1 ≤ 75.57    | ± 0.65     |
| 75.57 < Ød1 ≤ 77.00    | ± 0.66     |
| 77.00 < Ød1 ≤ 78.50    | ± 0.67     |
| 78.50 < Ød1 ≤ 79.60    | ± 0.68     |
| 79.60 < Ød1 ≤ 81.00    | ± 0.69     |
| 81.00 < Ød1 ≤ 82.50    | ± 0.70     |
| 82.50 < Ød1 ≤ 84.00    | ± 0.71     |
| 84.00 < Ød1 ≤ 86.00    | ± 0.72     |
| 86.00 < Ød1 ≤ 87.00    | ± 0.73     |
| 87.00 < Ød1 ≤ 88.49    | ± 0.74     |
| 88.49 < Ød1 ≤ 90.00    | ± 0.75     |
| 90.00 < Ød1 ≤ 91.44    | ± 0.76     |
| 91.44 < Ød1 ≤ 93.00    | ± 0.77     |
| 93.00 < Ød1 ≤ 94.30    | ± 0.78     |
| 94.30 < Ød1 ≤ 96.00    | ± 0.79     |
| 96.00 < Ød1 ≤ 97.50    | ± 0.80     |
| 97.50 < Ød1 ≤ 99.00    | ± 0.81     |
| 99.00 < Ød1 ≤ 100.50   | ± 0.82     |
| 100.50 < Ød1 ≤ 101.60  | ± 0.83     |

| Inside diameter<br>Ød1 | Tolerances |
|------------------------|------------|
| 101.60 < Ød1 ≤ 103.00  | ± 0.84     |
| 103.00 < Ød1 ≤ 104.50  | ± 0.85     |
| 104.50 < Ød1 ≤ 106.00  | ± 0.86     |
| 106.00 < Ød1 ≤ 107.54  | ± 0.87     |
| 107.54 < Ød1 ≤ 109.00  | ± 0.88     |
| 109.00 < Ød1 ≤ 110.49  | ± 0.89     |
| 110.49 < Ød1 ≤ 112.00  | ± 0.90     |
| 112.00 < Ød1 ≤ 113.67  | ± 0.91     |
| 113.67 < Ød1 ≤ 115.00  | ± 0.92     |
| 115.00 < Ød1 ≤ 116.84  | ± 0.93     |
| 116.84 < Ød1 ≤ 118.00  | ± 0.94     |
| 118.00 < Ød1 ≤ 119.30  | ± 0.95     |
| 119.30 < Ød1 ≤ 121.00  | ± 0.96     |
| 121.00 < Ød1 ≤ 123.00  | ± 0.97     |
| 123.00 < Ød1 ≤ 123.83  | ± 0.98     |
| 123.83 < Ød1 ≤ 126.00  | ± 0.99     |
| 126.00 < Ød1 ≤ 126.72  | ± 1.00     |
| 126.72 < Ød1 ≤ 129.00  | ± 1.01     |
| 129.00 < Ød1 ≤ 129.77  | ± 1.02     |
| 129.77 < Ød1 ≤ 131.50  | ± 1.03     |
| 131.50 < Ød1 ≤ 132.72  | ± 1.04     |
| 132.72 < Ød1 ≤ 134.30  | ± 1.05     |
| 134.30 < Ød1 ≤ 135.76  | ± 1.06     |
| 135.76 < Ød1 ≤ 138.00  | ± 1.07     |
| 138.00 < Ød1 ≤ 138.94  | ± 1.08     |
| 138.94 < Ød1 ≤ 140.50  | ± 1.09     |
| 140.50 < Ød1 ≤ 142.00  | ± 1.10     |
| 142.00 < Ød1 ≤ 144.00  | ± 1.11     |
| 144.00 < Ød1 ≤ 145.00  | ± 1.12     |
| 145.00 < Ød1 ≤ 147.00  | ± 1.13     |
| 147.00 < Ød1 ≤ 148.00  | ± 1.14     |
| 148.00 < Ød1 ≤ 149.23  | ± 1.15     |
| 149.23 < Ød1 ≤ 151.00  | ± 1.16     |
| 151.00 < Ød1 ≤ 152.50  | ± 1.17     |
| 152.50 < Ød1 ≤ 154.00  | ± 1.18     |
| 154.00 < Ød1 ≤ 155.50  | ± 1.19     |
| 155.50 < Ød1 ≤ 157.00  | ± 1.20     |
| 157.00 < Ød1 ≤ 158.34  | ± 1.21     |
| 158.34 < Ød1 ≤ 160.00  | ± 1.22     |
| 160.00 < Ød1 ≤ 161.30  | ± 1.23     |
| 161.30 < Ød1 ≤ 163.00  | ± 1.24     |
| 163.00 < Ød1 ≤ 164.30  | ± 1.25     |
| 164.30 < Ød1 ≤ 166.00  | ± 1.26     |
| 166.00 < Ød1 ≤ 167.50  | ± 1.27     |
| 167.50 < Ød1 ≤ 169.00  | ± 1.28     |
| 169.00 < Ød1 ≤ 170.69  | ± 1.29     |
| 170.69 < Ød1 ≤ 172.00  | ± 1.30     |
| 172.00 < Ød1 ≤ 173.87  | ± 1.31     |
| 173.87 < Ød1 ≤ 175.00  | ± 1.32     |
| 175.00 < Ød1 ≤ 177.00  | ± 1.33     |
| 177.00 < Ød1 ≤ 178.00  | ± 1.34     |
| 178.00 < Ød1 ≤ 179.50  | ± 1.35     |
| 179.50 < Ød1 ≤ 181.00  | ± 1.36     |
| 181.00 < Ød1 ≤ 182.50  | ± 1.37     |
| 182.50 < Ød1 ≤ 184.00  | ± 1.38     |
| 184.00 < Ød1 ≤ 186.00  | ± 1.39     |
| 186.00 < Ød1 ≤ 187.00  | ± 1.40     |
| 187.00 < Ød1 ≤ 189.00  | ± 1.41     |
| 189.00 < Ød1 ≤ 190.00  | ± 1.42     |
| 190.00 < Ød1 ≤ 192.00  | ± 1.43     |
| 192.00 < Ød1 ≤ 193.00  | ± 1.44     |
| 193.00 < Ød1 ≤ 195.00  | ± 1.45     |
| 195.00 < Ød1 ≤ 196.22  | ± 1.46     |
| 196.22 < Ød1 ≤ 198.00  | ± 1.47     |
| 198.00 < Ød1 ≤ 199.10  | ± 1.48     |
| 199.10 < Ød1 ≤ 201.00  | ± 1.49     |
| 201.00 < Ød1 ≤ 202.57  | ± 1.50     |
| 202.57 < Ød1 ≤ 204.00  | ± 1.51     |
| 204.00 < Ød1 ≤ 206.00  | ± 1.52     |
| 206.00 < Ød1 ≤ 207.00  | ± 1.53     |
| 207.00 < Ød1 ≤ 208.50  | ± 1.54     |
| 208.50 < Ød1 ≤ 210.00  | ± 1.55     |

| Inside diameter<br>Ød1 | Tolerances |
|------------------------|------------|
| 210.00 < Ød1 ≤ 212.00  | ± 1.56     |
| 212.00 < Ød1 ≤ 213.00  | ± 1.57     |
| 213.00 < Ød1 ≤ 214.50  | ± 1.58     |
| 214.50 < Ød1 ≤ 216.00  | ± 1.59     |
| 216.00 < Ød1 ≤ 218.00  | ± 1.60     |
| 218.00 < Ød1 ≤ 219.00  | ± 1.61     |
| 219.00 < Ød1 ≤ 221.00  | ± 1.62     |
| 221.00 < Ød1 ≤ 222.00  | ± 1.63     |
| 222.00 < Ød1 ≤ 224.00  | ± 1.64     |
| 224.00 < Ød1 ≤ 226.00  | ± 1.65     |
| 226.00 < Ød1 ≤ 227.00  | ± 1.66     |
| 227.00 < Ød1 ≤ 228.19  | ± 1.67     |
| 228.19 < Ød1 ≤ 230.00  | ± 1.68     |
| 230.00 < Ød1 ≤ 232.00  | ± 1.69     |
| 232.00 < Ød1 ≤ 233.00  | ± 1.70     |
| 233.00 < Ød1 ≤ 234.32  | ± 1.71     |
| 234.32 < Ød1 ≤ 236.00  | ± 1.72     |
| 236.00 < Ød1 ≤ 237.50  | ± 1.73     |
| 237.50 < Ød1 ≤ 239.00  | ± 1.74     |
| 239.00 < Ød1 ≤ 240.67  | ± 1.75     |
| 240.67 < Ød1 ≤ 242.00  | ± 1.76     |
| 242.00 < Ød1 ≤ 244.00  | ± 1.77     |
| 244.00 < Ød1 ≤ 246.00  | ± 1.78     |
| 246.00 < Ød1 ≤ 247.00  | ± 1.79     |
| 247.00 < Ød1 ≤ 249.00  | ± 1.80     |
| 249.00 < Ød1 ≤ 250.00  | ± 1.81     |
| 250.00 < Ød1 ≤ 252.00  | ± 1.82     |
| 252.00 < Ød1 ≤ 253.00  | ± 1.83     |
| 253.00 < Ød1 ≤ 254.50  | ± 1.84     |
| 254.50 < Ød1 ≤ 256.00  | ± 1.85     |
| 256.00 < Ød1 ≤ 258.00  | ± 1.86     |
| 258.00 < Ød1 ≤ 259.00  | ± 1.87     |
| 259.00 < Ød1 ≤ 261.00  | ± 1.88     |
| 261.00 < Ød1 ≤ 263.00  | ± 1.89     |
| 263.00 < Ød1 ≤ 264.00  | ± 1.90     |
| 264.00 < Ød1 ≤ 266.00  | ± 1.91     |
| 266.00 < Ød1 ≤ 267.00  | ± 1.92     |
| 267.00 < Ød1 ≤ 269.00  | ± 1.93     |
| 269.00 < Ød1 ≤ 270.00  | ± 1.94     |
| 270.00 < Ød1 ≤ 272.00  | ± 1.95     |
| 272.00 < Ød1 ≤ 273.00  | ± 1.96     |
| 273.00 < Ød1 ≤ 274.50  | ± 1.97     |
| 274.50 < Ød1 ≤ 276.00  | ± 1.98     |
| 276.00 < Ød1 ≤ 278.00  | ± 1.99     |
| 278.00 < Ød1 ≤ 279.30  | ± 2.00     |
| 279.30 < Ød1 ≤ 281.00  | ± 2.01     |
| 281.00 < Ød1 ≤ 283.00  | ± 2.02     |
| 283.00 < Ød1 ≤ 284.00  | ± 2.03     |
| 284.00 < Ød1 ≤ 286.00  | ± 2.04     |
| 286.00 < Ød1 ≤ 287.00  | ± 2.05     |
| 287.00 < Ød1 ≤ 289.00  | ± 2.06     |
| 289.00 < Ød1 ≤ 290.00  | ± 2.07     |
| 290.00 < Ød1 ≤ 291.47  | ± 2.08     |
| 291.47 < Ød1 ≤ 293.00  | ± 2.09     |
| 293.00 < Ød1 ≤ 295.00  | ± 2.10     |
| 295.00 < Ød1 ≤ 297.00  | ± 2.11     |
| 297.00 < Ød1 ≤ 297.80  | ± 2.12     |
| 297.80 < Ød1 ≤ 299.30  | ± 2.13     |
| 299.30 < Ød1 ≤ 301.00  | ± 2.14     |
| 301.00 < Ød1 ≤ 303.00  | ± 2.15     |
| 303.00 < Ød1 ≤ 304.00  | ± 2.16     |
| 304.00 < Ød1 ≤ 306.00  | ± 2.17     |
| 306.00 < Ød1 ≤ 307.00  | ± 2.18     |
| 307.00 < Ød1 ≤ 309.00  | ± 2.19     |
| 309.00 < Ød1 ≤ 310.50  | ± 2.20     |
| 310.50 < Ød1 ≤ 312.00  | ± 2.21     |
| 312.00 < Ød1 ≤ 314.00  | ± 2.22     |
| 314.00 < Ød1 ≤ 315.00  | ± 2.23     |
| 315.00 < Ød1 ≤ 316.87  | ± 2.24     |
| 316.87 < Ød1 ≤ 318.00  | ± 2.25     |
| 318.00 < Ød1 ≤ 319.50  | ± 2.26     |
| 319.50 < Ød1 ≤ 321.50  | ± 2.27     |

| Inside diameter<br>Ød1 | Tolerances | Inside diameter<br>Ød1 | Tolerances | Inside diameter<br>Ød1 | Tolerances |
|------------------------|------------|------------------------|------------|------------------------|------------|
| 321.50 < Ød1 ≤ 323.00  | ± 2.28     | 405.00 < Ød1 ≤ 406.00  | ± 2.81     | 489.00 < Ød1 ≤ 490.00  | ± 3.34     |
| 323.00 < Ød1 ≤ 325.00  | ± 2.29     | 406.00 < Ød1 ≤ 408.00  | ± 2.82     | 490.00 < Ød1 ≤ 492.00  | ± 3.35     |
| 325.00 < Ød1 ≤ 326.00  | ± 2.30     | 408.00 < Ød1 ≤ 409.00  | ± 2.83     | 492.00 < Ød1 ≤ 494.00  | ± 3.36     |
| 326.00 < Ød1 ≤ 328.00  | ± 2.31     | 409.00 < Ød1 ≤ 411.00  | ± 2.84     | 494.00 < Ød1 ≤ 495.00  | ± 3.37     |
| 328.00 < Ød1 ≤ 329.00  | ± 2.32     | 411.00 < Ød1 ≤ 413.00  | ± 2.85     | 495.00 < Ød1 ≤ 497.00  | ± 3.38     |
| 329.00 < Ød1 ≤ 331.00  | ± 2.33     | 413.00 < Ød1 ≤ 414.00  | ± 2.86     | 497.00 < Ød1 ≤ 498.00  | ± 3.39     |
| 331.00 < Ød1 ≤ 332.00  | ± 2.34     | 414.00 < Ød1 ≤ 416.00  | ± 2.87     | 498.00 < Ød1 ≤ 500.00  | ± 3.40     |
| 332.00 < Ød1 ≤ 334.00  | ± 2.35     | 416.00 < Ød1 ≤ 417.00  | ± 2.88     | 500.00 < Ød1 ≤ 504.00  | ± 3.41     |
| 334.00 < Ød1 ≤ 335.90  | ± 2.36     | 417.00 < Ød1 ≤ 419.00  | ± 2.89     | 504.00 < Ød1 ≤ 505.00  | ± 3.43     |
| 335.90 < Ød1 ≤ 337.00  | ± 2.37     | 419.00 < Ød1 ≤ 421.00  | ± 2.90     | 505.00 < Ød1 ≤ 506.81  | ± 3.44     |
| 337.00 < Ød1 ≤ 339.00  | ± 2.38     | 421.00 < Ød1 ≤ 422.00  | ± 2.91     | 506.81 < Ød1 ≤ 508.00  | ± 3.45     |
| 339.00 < Ød1 ≤ 340.00  | ± 2.39     | 422.00 < Ød1 ≤ 424.00  | ± 2.92     | 508.00 < Ød1 ≤ 510.00  | ± 3.46     |
| 340.00 < Ød1 ≤ 342.00  | ± 2.40     | 424.00 < Ød1 ≤ 425.00  | ± 2.93     | 510.00 < Ød1 ≤ 515.00  | ± 3.47     |
| 342.00 < Ød1 ≤ 343.00  | ± 2.41     | 425.00 < Ød1 ≤ 427.00  | ± 2.94     | 515.00 < Ød1 ≤ 516.00  | ± 3.50     |
| 343.00 < Ød1 ≤ 345.00  | ± 2.42     | 427.00 < Ød1 ≤ 428.00  | ± 2.95     | 516.00 < Ød1 ≤ 523.00  | ± 3.51     |
| 345.00 < Ød1 ≤ 347.00  | ± 2.43     | 428.00 < Ød1 ≤ 430.00  | ± 2.96     | 523.00 < Ød1 ≤ 524.50  | ± 3.55     |
| 347.00 < Ød1 ≤ 348.00  | ± 2.44     | 430.00 < Ød1 ≤ 432.00  | ± 2.97     | 524.50 < Ød1 ≤ 530.00  | ± 3.56     |
| 348.00 < Ød1 ≤ 350.00  | ± 2.45     | 432.00 < Ød1 ≤ 433.00  | ± 2.98     | 530.00 < Ød1 ≤ 532.21  | ± 3.60     |
| 350.00 < Ød1 ≤ 351.00  | ± 2.46     | 433.00 < Ød1 ≤ 435.00  | ± 2.99     | 532.21 < Ød1 ≤ 538.00  | ± 3.61     |
| 351.00 < Ød1 ≤ 353.00  | ± 2.47     | 435.00 < Ød1 ≤ 436.00  | ± 3.00     | 538.00 < Ød1 ≤ 540.00  | ± 3.65     |
| 353.00 < Ød1 ≤ 354.00  | ± 2.48     | 436.00 < Ød1 ≤ 438.00  | ± 3.01     | 540.00 < Ød1 ≤ 544.00  | ± 3.66     |
| 354.00 < Ød1 ≤ 356.00  | ± 2.49     | 438.00 < Ød1 ≤ 439.30  | ± 3.02     | 544.00 < Ød1 ≤ 545.00  | ± 3.68     |
| 356.00 < Ød1 ≤ 358.00  | ± 2.50     | 439.30 < Ød1 ≤ 441.00  | ± 3.03     | 545.00 < Ød1 ≤ 549.00  | ± 3.69     |
| 358.00 < Ød1 ≤ 359.00  | ± 2.51     | 441.00 < Ød1 ≤ 443.00  | ± 3.04     | 549.00 < Ød1 ≤ 552.00  | ± 3.71     |
| 359.00 < Ød1 ≤ 361.00  | ± 2.52     | 443.00 < Ød1 ≤ 444.00  | ± 3.05     | 552.00 < Ød1 ≤ 553.00  | ± 3.73     |
| 361.00 < Ød1 ≤ 362.00  | ± 2.53     | 444.00 < Ød1 ≤ 446.00  | ± 3.06     | 553.00 < Ød1 ≤ 555.00  | ± 3.74     |
| 362.00 < Ød1 ≤ 364.00  | ± 2.54     | 446.00 < Ød1 ≤ 447.00  | ± 3.07     | 555.00 < Ød1 ≤ 557.61  | ± 3.75     |
| 364.00 < Ød1 ≤ 365.00  | ± 2.55     | 447.00 < Ød1 ≤ 449.00  | ± 3.08     | 557.61 < Ød1 ≤ 560.00  | ± 3.77     |
| 365.00 < Ød1 ≤ 367.00  | ± 2.56     | 449.00 < Ød1 ≤ 451.00  | ± 3.09     | 560.00 < Ød1 ≤ 569.00  | ± 3.78     |
| 367.00 < Ød1 ≤ 369.00  | ± 2.57     | 451.00 < Ød1 ≤ 452.00  | ± 3.10     | 569.00 < Ød1 ≤ 570.00  | ± 3.84     |
| 369.00 < Ød1 ≤ 370.00  | ± 2.58     | 452.00 < Ød1 ≤ 454.00  | ± 3.11     | 570.00 < Ød1 ≤ 575.00  | ± 3.85     |
| 370.00 < Ød1 ≤ 372.00  | ± 2.59     | 454.00 < Ød1 ≤ 455.00  | ± 3.12     | 575.00 < Ød1 ≤ 579.00  | ± 3.88     |
| 372.00 < Ød1 ≤ 373.00  | ± 2.60     | 455.00 < Ød1 ≤ 457.00  | ± 3.13     | 579.00 < Ød1 ≤ 580.00  | ± 3.90     |
| 373.00 < Ød1 ≤ 374.50  | ± 2.61     | 457.00 < Ød1 ≤ 459.00  | ± 3.14     | 580.00 < Ød1 ≤ 582.68  | ± 3.91     |
| 374.50 < Ød1 ≤ 376.00  | ± 2.62     | 459.00 < Ød1 ≤ 460.00  | ± 3.15     | 582.68 < Ød1 ≤ 590.00  | ± 3.92     |
| 376.00 < Ød1 ≤ 378.00  | ± 2.63     | 460.00 < Ød1 ≤ 462.00  | ± 3.16     | 590.00 < Ød1 ≤ 596.27  | ± 3.97     |
| 378.00 < Ød1 ≤ 379.30  | ± 2.64     | 462.00 < Ød1 ≤ 463.00  | ± 3.17     | 596.27 < Ød1 ≤ 600.00  | ± 4.01     |
| 379.30 < Ød1 ≤ 381.00  | ± 2.65     | 463.00 < Ød1 ≤ 465.00  | ± 3.18     | 600.00 < Ød1 ≤ 608.00  | ± 4.03     |
| 381.00 < Ød1 ≤ 383.00  | ± 2.66     | 465.00 < Ød1 ≤ 467.00  | ± 3.19     | 608.00 < Ød1 ≤ 615.00  | ± 4.08     |
| 383.00 < Ød1 ≤ 384.00  | ± 2.67     | 467.00 < Ød1 ≤ 468.00  | ± 3.20     | 615.00 < Ød1 ≤ 623.00  | ± 4.12     |
| 384.00 < Ød1 ≤ 386.00  | ± 2.68     | 468.00 < Ød1 ≤ 470.00  | ± 3.21     | 623.00 < Ød1 ≤ 630.00  | ± 4.17     |
| 386.00 < Ød1 ≤ 387.00  | ± 2.69     | 470.00 < Ød1 ≤ 471.00  | ± 3.22     | 630.00 < Ød1 ≤ 633.48  | ± 4.22     |
| 387.00 < Ød1 ≤ 389.00  | ± 2.70     | 471.00 < Ød1 ≤ 473.00  | ± 3.23     | 633.48 < Ød1 ≤ 640.00  | ± 4.24     |
| 389.00 < Ød1 ≤ 391.00  | ± 2.71     | 473.00 < Ød1 ≤ 475.00  | ± 3.24     | 640.00 < Ød1 ≤ 647.07  | ± 4.28     |
| 391.00 < Ød1 ≤ 392.00  | ± 2.72     | 475.00 < Ød1 ≤ 476.00  | ± 3.25     | 647.07 < Ød1 ≤ 650.00  | ± 4.32     |
| 392.00 < Ød1 ≤ 394.00  | ± 2.73     | 476.00 < Ød1 ≤ 478.00  | ± 3.26     | 650.00 < Ød1 ≤ 658.88  | ± 4.34     |
| 394.00 < Ød1 ≤ 395.00  | ± 2.74     | 478.00 < Ød1 ≤ 479.00  | ± 3.27     | 658.88 < Ød1 ≤ 670.00  | ± 4.40     |
| 395.00 < Ød1 ≤ 397.00  | ± 2.75     | 479.00 < Ød1 ≤ 481.00  | ± 3.28     | 670.00 < Ød1 ≤ 683.00  | ± 4.47     |
| 397.00 < Ød1 ≤ 398.00  | ± 2.76     | 481.00 < Ød1 ≤ 482.00  | ± 3.29     | 683.00 < Ød1 ≤ 732.50  | ± 4.55     |
| 398.00 < Ød1 ≤ 400.00  | ± 2.77     | 482.00 < Ød1 ≤ 484.00  | ± 3.30     | 732.50 < Ød1 ≤ 782.00  | ± 4.85     |
| 400.00 < Ød1 ≤ 402.00  | ± 2.78     | 484.00 < Ød1 ≤ 486.00  | ± 3.31     | 782.00 < Ød1 ≤ 836.50  | ± 5.15     |
| 402.00 < Ød1 ≤ 403.00  | ± 2.79     | 486.00 < Ød1 ≤ 487.00  | ± 3.32     | 836.50 < Ød1 ≤ 940.50  | ± 5.49     |
| 403.00 < Ød1 ≤ 405.00  | ± 2.80     | 487.00 < Ød1 ≤ 489.00  | ± 3.33     | 940.50 < Ød1 ≤ 1044.00 | ± 6.12     |

## 4.2 TOLERANCES ON SECTION Ød2 FOR X'RINGS

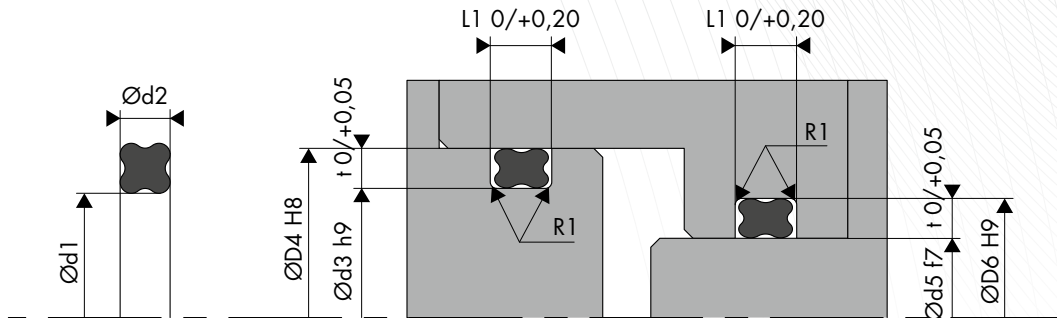
The tolerances on X'Rings thickness Ød2 set out in the table below relate to standard ISO 3601-1:2008 and are applicable to X'Rings.

| X'Ring thickness<br>Ød2 | Tolerances | X'Ring thickness<br>Ød2 | Tolerances |
|-------------------------|------------|-------------------------|------------|
| 1.02                    | ± 0.08     | 2.62                    | ± 0.09     |
| 1.27                    | ± 0.08     | 3.53                    | ± 0.10     |
| 1.52                    | ± 0.08     | 5.33                    | ± 0.13     |
| 1.78                    | ± 0.08     | 6.99                    | ± 0.15     |

## 5. Static sealing

### 5.1 INSTALLATION DIMENSIONS - RECTANGULAR GROOVE WITH RADIAL DEFORMATION

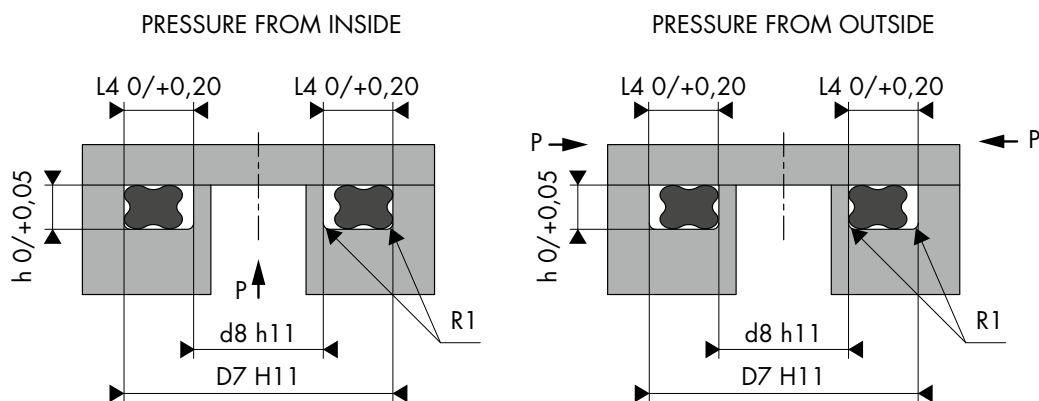
The X'Ring used in static applications must be fitted in a rectangular groove with a depth and width defined according to the X'Ring ring section, in line with the table below.



| X'Ring thickness<br>Ød2 | Groove depth<br>t 0/+0.05 | Groove width<br>L1 0/+0.20 | Groove radius<br>R1 | Radial extrusion gap<br>F/2 |
|-------------------------|---------------------------|----------------------------|---------------------|-----------------------------|
| 1.02                    | 0.75                      | 1.20                       | 0.10                | 0.03                        |
| 1.27                    | 0.90                      | 1.40                       | 0.10                | 0.03                        |
| 1.52                    | 1.15                      | 1.70                       | 0.20                | 0.04                        |
| 1.78                    | 1.40                      | 2.00                       | 0.20                | 0.05                        |
| 2.62                    | 2.25                      | 3.00                       | 0.30                | 0.08                        |
| 3.53                    | 3.10                      | 4.00                       | 0.40                | 0.08                        |
| 5.33                    | 4.75                      | 6.00                       | 0.40                | 0.10                        |
| 6.99                    | 6.20                      | 8.00                       | 0.60                | 0.10                        |

### 5.2 INSTALLATION DIMENSIONS - RECTANGULAR GROOVE WITH AXIAL DEFORMATION

The X'Ring ensures the sealing of flanges or covers that are subject to axial deformation. The groove dimensions are determined according to the X'Ring thickness.

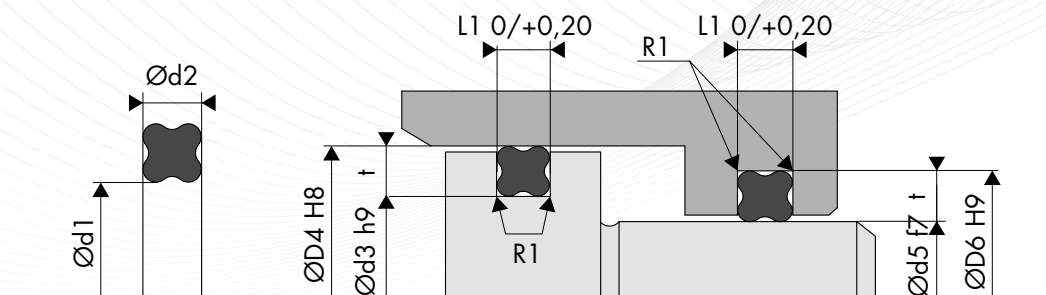


| X'Ring thickness<br>Ød2 | Groove depth<br>h 0/+0.05 | Groove width<br>L4 0/+0.20 | Groove radius<br>R1 | Radial extrusion gap<br>F/2 |
|-------------------------|---------------------------|----------------------------|---------------------|-----------------------------|
| 1.02                    | 0.75                      | 1.20                       | 0.10                | 0.03                        |
| 1.27                    | 0.90                      | 1.40                       | 0.10                | 0.03                        |
| 1.52                    | 1.15                      | 1.70                       | 0.20                | 0.04                        |
| 1.78                    | 1.40                      | 2.00                       | 0.20                | 0.05                        |
| 2.62                    | 2.25                      | 3.00                       | 0.30                | 0.08                        |
| 3.53                    | 3.10                      | 4.00                       | 0.40                | 0.08                        |
| 5.33                    | 4.75                      | 6.00                       | 0.40                | 0.10                        |
| 6.99                    | 6.20                      | 8.00                       | 0.60                | 0.10                        |

## 6. Dynamic sealing

### 6.1 INSTALLATION DIMENSIONS - HYDRAULIC WITH AXIAL MOVEMENTS - RECTANGULAR GROOVE WITH RADIAL DEFORMATION

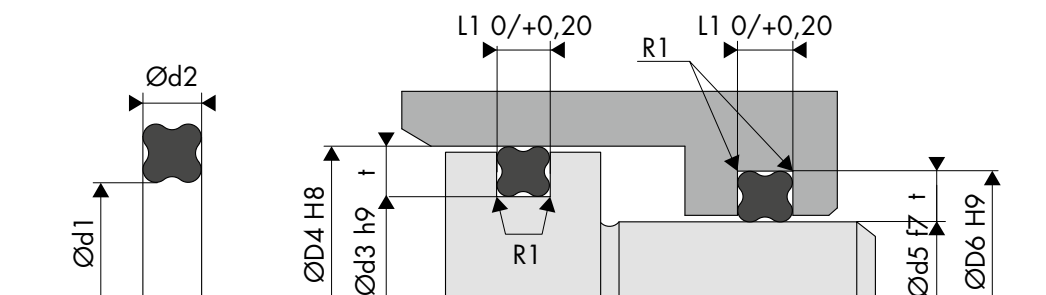
The X'Ring used in dynamic linear applications must be fitted in a rectangular groove with a depth and width defined according to the X'Ring thickness, in line with the table below.



| X'Ring thickness<br>Ød2 | Groove depth<br>t 0/+0.05 | Groove width<br>L1 0/+0.20 | Groove radius<br>R1 | Radial extrusion gap<br>F/2 |
|-------------------------|---------------------------|----------------------------|---------------------|-----------------------------|
| 1.02                    | 0.80                      | 1.20                       | 0.10                | 0.03                        |
| 1.27                    | 1.00                      | 1.40                       | 0.10                | 0.03                        |
| 1.52                    | 1.25                      | 1.70                       | 0.20                | 0.04                        |
| 1.78                    | 1.50                      | 2.00                       | 0.20                | 0.05                        |
| 2.62                    | 2.30                      | 3.00                       | 0.30                | 0.08                        |
| 3.53                    | 3.20                      | 4.00                       | 0.40                | 0.08                        |
| 5.33                    | 4.90                      | 6.00                       | 0.40                | 0.10                        |
| 6.99                    | 6.40                      | 8.00                       | 0.60                | 0.10                        |

### 6.2 INSTALLATION DIMENSIONS - HYDRAULIC WITH ROTATING MOVEMENTS - RECTANGULAR GROOVE WITH RADIAL DEFORMATION

The X'Ring used in dynamic rotating applications must be fitted in a rectangular groove with a depth and width defined according to the X'Ring thickness, in line with the table below.



| X'Ring thickness<br>Ød2 | Groove depth<br>t 0/+0.05 | Groove width<br>L1 0/+0.20 | Groove radius<br>R1 | Radial extrusion gap<br>F/2 |
|-------------------------|---------------------------|----------------------------|---------------------|-----------------------------|
| 1.02                    | 0.80                      | 1.20                       | 0.10                | 0.03                        |
| 1.27                    | 1.00                      | 1.40                       | 0.10                | 0.03                        |
| 1.52                    | 1.25                      | 1.70                       | 0.20                | 0.04                        |
| 1.78                    | 1.50                      | 2.00                       | 0.20                | 0.05                        |
| 2.62                    | 2.30                      | 3.00                       | 0.30                | 0.08                        |
| 3.53                    | 3.20                      | 4.00                       | 0.40                | 0.08                        |
| 5.33                    | 4.90                      | 6.00                       | 0.40                | 0.10                        |
| 6.99                    | 6.40                      | 8.00                       | 0.60                | 0.10                        |

## 7. Chamfers and radius

Given that the X'Rings are fitted pre-tightened, the chamfer lengths and rounded cutting edges must fit with the table below.

| X'Ring thickness<br>Ød2 | Radius<br>R1 | Max radius<br>R2 | Chamfer<br>C |      |
|-------------------------|--------------|------------------|--------------|------|
|                         |              |                  | 15°          | 20°  |
| 1.02                    | 0.10         | 0.20             | 2.00         | 1.50 |
| 1.27                    | 0.10         | 0.20             | 2.00         | 1.50 |
| 1.52                    | 0.20         | 0.20             | 2.50         | 2.00 |
| 1.78                    | 0.20         | 0.20             | 2.50         | 2.00 |
| 2.62                    | 0.30         | 0.20             | 3.00         | 2.50 |
| 3.53                    | 0.40         | 0.20             | 3.50         | 3.00 |
| 5.33                    | 0.40         | 0.20             | 4.00         | 3.50 |
| 6.99                    | 0.60         | 0.20             | 5.00         | 4.00 |

## 8. Surface roughness

We recommend using steel or non-porous cast iron to make the tubes and rods. For dynamic applications, brass, untreated stainless steel and aluminium are not as hard and are therefore not recommended, as they would be subjected to a lot of wear.

The sealing must be of a high quality due to the roughness. The surface roughness of grooves improves during alternating pressures.

| Type of application     | Type of surface                     | Ra µm | Rz µm | Rmax µm |
|-------------------------|-------------------------------------|-------|-------|---------|
| <b>Radial - Static</b>  | <b>Under non-pulsating pressure</b> |       |       |         |
|                         | Mating surface (rod and cylinder)   | 1.6   | 6.3   | 10.0    |
|                         | Groove diameter and groove flanks   | 1.6   | 6.3   | 10.0    |
|                         | <b>Under pulsating pressure</b>     |       |       |         |
|                         | Mating surface (rod and cylinder)   | 0.8   | 3.2   | 5.0     |
|                         | Groove diameter and groove flanks   | 1.6   | 6.3   | 10.0    |
| <b>Radial - Dynamic</b> | Mating surface (rod and cylinder)   | 0.4   | 1.6   | 2.5     |
|                         | Groove diameter and groove flanks   | 0.8   | 3.2   | 5.0     |
| <b>Axial - Static</b>   | Clamping surface                    | 1.6   | 6.3   | 10.0    |
|                         | Groove flanks                       | 1.6   | 6.3   | 10.0    |

## 9. Dimensions

| Part number | Standard | Inside diameter Ød1 | X'Ring thickness Ød2 |
|-------------|----------|---------------------|----------------------|
| 001.QR001   | 001      | 2.90                | 1.78                 |
| 001.QR002   | 002      | 3.68                | 1.78                 |
| 001.QR003   | 003      | 4.47                | 1.78                 |
| 001.QR03A   | 03A      | 4.62                | 1.78                 |
| 001.QR004   | 004      | 5.28                | 1.78                 |
| 001.QR04A   | 04A      | 5.70                | 1.78                 |
| 001.QR005   | 005      | 6.07                | 1.78                 |
| 001.QR05A   | 05A      | 6.65                | 1.78                 |
| 001.QR006   | 006      | 7.65                | 1.78                 |
| 001.QR06A   | 06A      | 8.70                | 1.78                 |
| 001.QR007   | 007      | 9.25                | 1.78                 |
| 001.QR07A   | 07A      | 9.70                | 1.78                 |
| 001.QR113   | 113      | 10.82               | 1.78                 |
| 001.QR114   | 114      | 12.42               | 1.78                 |
| 001.QR115   | 115      | 14.00               | 1.78                 |
| 001.QR116   | 116      | 15.60               | 1.78                 |
| 001.QR117   | 117      | 17.17               | 1.78                 |
| 001.QR118   | 118      | 18.77               | 1.78                 |
| 001.QR119   | 119      | 20.35               | 1.78                 |
| 001.QR120   | 120      | 21.95               | 1.78                 |
| 001.QR121   | 121      | 23.52               | 1.78                 |
| 001.QR122   | 122      | 25.12               | 1.78                 |
| 001.QR123   | 123      | 26.70               | 1.78                 |
| 001.QR124   | 124      | 28.30               | 1.78                 |
| 001.QR125   | 125      | 29.87               | 1.78                 |
| 001.QR137   | 137      | 63.22               | 1.78                 |
| 001.QR008   | 008      | 9.19                | 2.62                 |
| 001.QR08A   | 08A      | 9.80                | 2.62                 |
| 001.QR009   | 009      | 10.77               | 2.62                 |
| 001.QR09A   | 09A      | 11.70               | 2.62                 |
| 001.QR010   | 010      | 12.37               | 2.62                 |
| 001.QR10A   | 10A      | 12.80               | 2.62                 |
| 001.QR10B   | 10B      | 13.70               | 2.62                 |
| 001.QR011   | 011      | 13.94               | 2.62                 |
| 001.QR11A   | 11A      | 14.70               | 2.62                 |
| 001.QR012   | 012      | 15.54               | 2.62                 |
| 001.QR013   | 013      | 17.12               | 2.62                 |
| 001.QR13A   | 13A      | 17.75               | 2.62                 |
| 001.QR014   | 014      | 18.72               | 2.62                 |
| 001.QR14A   | 14A      | 19.60               | 2.62                 |
| 001.QR217   | 217      | 20.30               | 2.62                 |
| 001.QR218   | 218      | 21.89               | 2.62                 |
| 001.QR219   | 219      | 23.47               | 2.62                 |
| 001.QR220   | 220      | 25.07               | 2.62                 |
| 001.QR221   | 221      | 26.64               | 2.62                 |
| 001.QR222   | 222      | 28.24               | 2.62                 |
| 001.QR223   | 223      | 29.82               | 2.62                 |
| 001.QR224   | 224      | 31.42               | 2.62                 |
| 001.QR225   | 225      | 32.99               | 2.62                 |
| 001.QR226   | 226      | 34.60               | 2.62                 |
| 001.QR227   | 227      | 36.17               | 2.62                 |
| 001.QR228   | 228      | 37.77               | 2.62                 |
| 001.QR229   | 229      | 39.34               | 2.62                 |
| 001.QR230   | 230      | 40.94               | 2.62                 |
| 001.QR231   | 231      | 42.52               | 2.62                 |
| 001.QR261   | 261      | 139.37              | 2.62                 |
| 001.QR015   | 015      | 18.64               | 3.53                 |
| 001.QR016   | 016      | 20.22               | 3.53                 |

| Part number | Standard | Inside diameter Ød1 | X'Ring thickness Ød2 |
|-------------|----------|---------------------|----------------------|
| 001.QR16A   | 16A      | 20.90               | 3.53                 |
| 001.QR017   | 017      | 21.82               | 3.53                 |
| 001.QR018   | 018      | 23.39               | 3.53                 |
| 001.QR18A   | 18A      | 23.99               | 3.53                 |
| 001.QR019   | 019      | 24.99               | 3.53                 |
| 001.QR19A   | 19A      | 25.90               | 3.53                 |
| 001.QR020   | 020      | 26.57               | 3.53                 |
| 001.QR20A   | 20A      | 27.57               | 3.53                 |
| 001.QR021   | 021      | 28.17               | 3.53                 |
| 001.QR022   | 022      | 29.74               | 3.53                 |
| 001.QR023   | 023      | 31.34               | 3.53                 |
| 001.QR23A   | 23A      | 32.04               | 3.53                 |
| 001.QR024   | 024      | 32.92               | 3.53                 |
| 001.QR24A   | 24A      | 33.80               | 3.53                 |
| 001.QR025   | 025      | 34.52               | 3.53                 |
| 001.QR026   | 026      | 36.09               | 3.53                 |
| 001.QR027   | 027      | 37.69               | 3.53                 |
| 001.QR323   | 323      | 40.87               | 3.53                 |
| 001.QR324   | 324      | 44.05               | 3.53                 |
| 001.QR325   | 325      | 47.22               | 3.53                 |
| 001.QR326   | 326      | 50.39               | 3.53                 |
| 001.QR327   | 327      | 53.57               | 3.53                 |
| 001.QR328   | 328      | 56.75               | 3.53                 |
| 001.QR329   | 329      | 59.92               | 3.53                 |
| 001.QR330   | 330      | 63.09               | 3.53                 |
| 001.QR331   | 331      | 66.27               | 3.53                 |
| 001.QR332   | 332      | 69.44               | 3.53                 |
| 001.QR333   | 333      | 72.62               | 3.53                 |
| 001.QR334   | 334      | 75.80               | 3.53                 |
| 001.QR335   | 335      | 78.97               | 3.53                 |
| 001.QR336   | 336      | 82.15               | 3.53                 |
| 001.QR337   | 337      | 85.32               | 3.53                 |
| 001.QR338   | 338      | 88.49               | 3.53                 |
| 001.QR339   | 339      | 91.67               | 3.53                 |
| 001.QR340   | 340      | 94.84               | 3.53                 |
| 001.QR341   | 341      | 98.02               | 3.53                 |
| 001.QR342   | 342      | 101.20              | 3.53                 |
| 001.QR348   | 348      | 120.25              | 3.53                 |
| 001.QR363   | 363      | 183.74              | 3.53                 |
| 001.QR028   | 028      | 37.47               | 5.33                 |
| 001.QR28A   | 28A      | 39.64               | 5.33                 |
| 001.QR029   | 029      | 40.64               | 5.33                 |
| 001.QR29A   | 29A      | 41.80               | 5.33                 |
| 001.QR030   | 030      | 43.82               | 5.33                 |
| 001.QR30A   | 30A      | 45.04               | 5.33                 |
| 001.QR30B   | 30B      | 45.84               | 5.33                 |
| 001.QR031   | 031      | 46.99               | 5.33                 |
| 001.QR31A   | 31A      | 47.80               | 5.33                 |
| 001.QR032   | 032      | 50.17               | 5.33                 |
| 001.QR32A   | 32A      | 52.00               | 5.33                 |
| 001.QR033   | 033      | 53.34               | 5.33                 |
| 001.QR33A   | 33A      | 54.50               | 5.33                 |
| 001.QR034   | 034      | 56.52               | 5.33                 |
| 001.QR34A   | 34A      | 57.52               | 5.33                 |
| 001.QR035   | 035      | 59.69               | 5.33                 |
| 001.QR35A   | 35A      | 61.54               | 5.33                 |
| 001.QR036   | 036      | 62.87               | 5.33                 |
| 001.QR36A   | 36A      | 64.59               | 5.33                 |

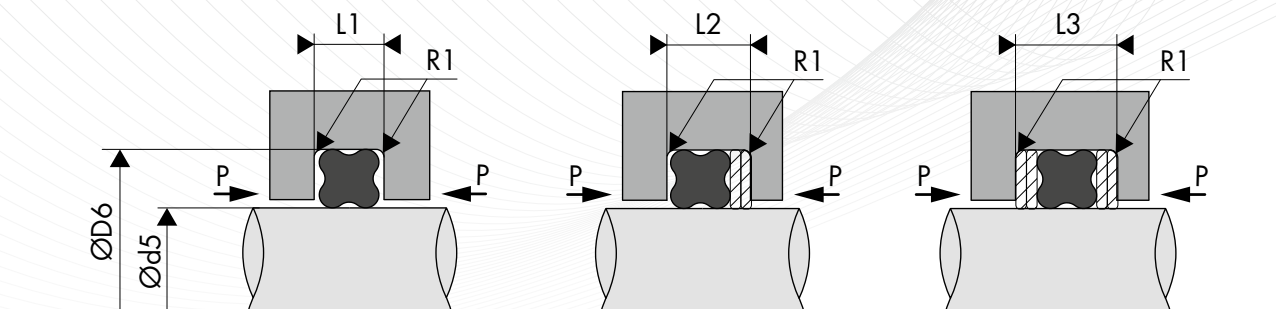
| Part number | Standard | Inside diameter<br>Ød1 | X'Ring thickness<br>Ød2 |
|-------------|----------|------------------------|-------------------------|
| 001.QR037   | 037      | 66.04                  | 5.33                    |
| 001.QR37A   | 37A      | 67.64                  | 5.33                    |
| 001.QR038   | 038      | 69.22                  | 5.33                    |
| 001.QR38A   | 38A      | 70.64                  | 5.33                    |
| 001.QR039   | 039      | 72.39                  | 5.33                    |
| 001.QR39A   | 39A      | 73.84                  | 5.33                    |
| 001.QR040   | 040      | 75.57                  | 5.33                    |
| 001.QR041   | 041      | 78.74                  | 5.33                    |
| 001.QR41A   | 41A      | 80.09                  | 5.33                    |
| 001.QR042   | 042      | 81.92                  | 5.33                    |
| 001.QR42A   | 42A      | 83.39                  | 5.33                    |
| 001.QR043   | 043      | 85.09                  | 5.33                    |
| 001.QR43A   | 43A      | 86.64                  | 5.33                    |
| 001.QR044   | 044      | 88.27                  | 5.33                    |
| 001.QR44A   | 44A      | 89.59                  | 5.33                    |
| 001.QR045   | 045      | 91.44                  | 5.33                    |
| 001.QR046   | 046      | 94.62                  | 5.33                    |
| 001.QR047   | 047      | 97.99                  | 5.33                    |
| 001.QR048   | 048      | 100.97                 | 5.33                    |
| 001.QR48A   | 48A      | 102.34                 | 5.33                    |
| 001.QR049   | 049      | 104.14                 | 5.33                    |
| 001.QR49A   | 49A      | 105.80                 | 5.33                    |
| 001.QR050   | 050      | 107.32                 | 5.33                    |
| 001.QR051   | 051      | 110.49                 | 5.33                    |
| 001.QR052   | 052      | 113.67                 | 5.33                    |
| 001.QR088   | 088      | 113.67                 | 6.99                    |
| 001.QR52A   | 52A      | 115.84                 | 6.99                    |
| 001.QR053   | 053      | 116.84                 | 6.99                    |
| 001.QR054   | 054      | 120.02                 | 6.99                    |
| 001.QR055   | 055      | 123.19                 | 6.99                    |
| 001.QR056   | 056      | 126.37                 | 6.99                    |
| 001.QR057   | 057      | 129.54                 | 6.99                    |
| 001.QR058   | 058      | 132.72                 | 6.99                    |
| 001.QR059   | 059      | 135.89                 | 6.99                    |
| 001.QR060   | 060      | 139.07                 | 6.99                    |
| 001.QR061   | 061      | 142.24                 | 6.99                    |
| 001.QR062   | 062      | 145.42                 | 6.99                    |
| 001.QR063   | 063      | 148.59                 | 6.99                    |
| 001.QR064   | 064      | 151.77                 | 6.99                    |
| 001.QR64A   | 64A      | 155.02                 | 6.99                    |
| 001.QR065   | 065      | 158.12                 | 6.99                    |
| 001.QR65A   | 65A      | 161.02                 | 6.99                    |
| 001.QR066   | 066      | 164.47                 | 6.99                    |
| 001.QR66A   | 66A      | 167.02                 | 6.99                    |
| 001.QR067   | 067      | 170.82                 | 6.99                    |
| 001.QR67A   | 67A      | 173.52                 | 6.99                    |

| Part number | Standard | Inside diameter<br>Ød1 | X'Ring thickness<br>Ød2 |
|-------------|----------|------------------------|-------------------------|
| 001.QR068   | 068      | 177.17                 | 6.99                    |
| 001.QR68A   | 68A      | 180.52                 | 6.99                    |
| 001.QR069   | 069      | 183.52                 | 6.99                    |
| 001.QR69A   | 69A      | 186.02                 | 6.99                    |
| 001.QR070   | 070      | 189.87                 | 6.99                    |
| 001.QR70A   | 70A      | 192.02                 | 6.99                    |
| 001.QR071   | 071      | 196.22                 | 6.99                    |
| 001.QR71A   | 71A      | 199.02                 | 6.99                    |
| 001.QR072   | 072      | 202.57                 | 6.99                    |
| 001.QR72A   | 72A      | 206.80                 | 6.99                    |
| 001.QR72B   | 72B      | 211.02                 | 6.99                    |
| 001.QR073   | 073      | 215.27                 | 6.99                    |
| 001.QR73A   | 73A      | 219.02                 | 6.99                    |
| 001.QR73B   | 73B      | 223.50                 | 6.99                    |
| 001.QR074   | 074      | 227.97                 | 6.99                    |
| 001.QR74A   | 74A      | 231.02                 | 6.99                    |
| 001.QR74B   | 74B      | 235.00                 | 6.99                    |
| 001.QR075   | 075      | 240.67                 | 6.99                    |
| 001.QR75A   | 75A      | 243.02                 | 6.99                    |
| 001.QR75B   | 75B      | 248.00                 | 6.99                    |
| 001.QR076   | 076      | 253.37                 | 6.99                    |
| 001.QR76A   | 76A      | 259.00                 | 6.99                    |
| 001.QR077   | 077      | 266.07                 | 6.99                    |
| 001.QR77A   | 77A      | 273.10                 | 6.99                    |
| 001.QR078   | 078      | 278.77                 | 6.99                    |
| 001.QR78A   | 78A      | 284.00                 | 6.99                    |
| 001.QR78B   | 78B      | 287.50                 | 6.99                    |
| 001.QR079   | 079      | 291.47                 | 6.99                    |
| 001.QR79A   | 79A      | 298.00                 | 6.99                    |
| 001.QR080   | 080      | 304.17                 | 6.99                    |
| 001.QR80A   | 80A      | 310.00                 | 6.99                    |
| 001.QR081   | 081      | 316.87                 | 6.99                    |
| 001.QR81A   | 81A      | 323.50                 | 6.99                    |
| 001.QR082   | 082      | 329.57                 | 6.99                    |
| 001.QR82A   | 82A      | 336.50                 | 6.99                    |
| 001.QR083   | 083      | 342.27                 | 6.99                    |
| 001.QR83A   | 83A      | 348.50                 | 6.99                    |
| 001.QR084   | 084      | 354.97                 | 6.99                    |
| 001.QR84A   | 84A      | 362.50                 | 6.99                    |
| 001.QR085   | 085      | 367.67                 | 6.99                    |
| 001.QR85A   | 85A      | 374.00                 | 6.99                    |
| 001.QR086   | 086      | 380.37                 | 6.99                    |
| 001.QR86A   | 86A      | 387.50                 | 6.99                    |
| 001.QR087   | 087      | 393.07                 | 6.99                    |
| 001.QR87A   | 87A      | 401.00                 | 6.99                    |

Other dimensions can be made, please ask us.

## 10. Preferential back-up ring dimensions

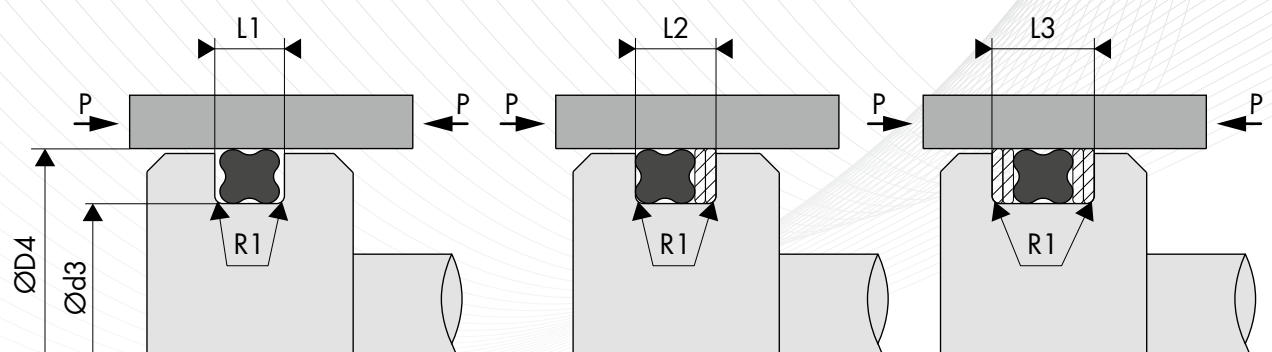
### 10.1 INNER SEALING - DYNAMIC APPLICATION (ALTERNATING) WITH BECA 012 ROD BACK-UP RING



| Part number | X'Ring dimensions | Rod diameter | Groove diameter | Groove width |            |            | Radius | Back-up ring                |
|-------------|-------------------|--------------|-----------------|--------------|------------|------------|--------|-----------------------------|
|             |                   | Ød5 f7       | ØD6 H9          | L1 0/+0.20   | L2 0/+0.20 | L3 0/+0.20 | R1     | Part number<br>BECA 012 Rod |
| 001.QR003   | 4.47 x 1.78       | 4.00         | 7.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.004007                  |
| 001.QR004   | 5.28 x 1.78       | 5.00         | 8.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.005008                  |
| 001.QR005   | 6.07 x 1.78       | 6.00         | 9.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.006009                  |
| 001.Q82178  | 8.20 x 1.78       | 8.00         | 11.00           | 2.00         | 3.40       | 4.80       | 0.20   | 012.008011                  |
| 001.Q10226  | 10.20 x 2.62      | 10.00        | 14.60           | 3.00         | 4.40       | 5.80       | 0.30   | 012.010146                  |
| 001.QR010   | 12.37 x 2.62      | 12.00        | 16.60           | 3.00         | 4.40       | 5.80       | 0.30   | 012.012166                  |
| 001.QR011   | 13.94 x 2.62      | 14.00        | 18.60           | 3.00         | 4.40       | 5.80       | 0.30   | 012.014186                  |
| 001.QR11A   | 14.70 x 2.62      | 15.00        | 19.60           | 3.00         | 4.40       | 5.80       | 0.30   | 012.015196                  |
| 001.Q16226  | 16.20 x 2.62      | 16.00        | 20.60           | 3.00         | 4.40       | 5.80       | 0.30   | 012.016206                  |
| 001.Q18235  | 18.20 x 3.53      | 18.00        | 24.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.018244                  |
| 001.QR016   | 20.22 x 3.53      | 20.00        | 26.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.020264                  |
| 001.QR017   | 21.82 x 3.53      | 22.00        | 28.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.022284                  |
| 001.QR019   | 24.99 x 3.53      | 25.00        | 31.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.025314                  |
| 001.QR021   | 28.17 x 3.53      | 28.00        | 34.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.028344                  |
| 001.QR022   | 29.74 x 3.53      | 30.00        | 36.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.030364                  |
| 001.QR023   | 31.34 x 3.53      | 32.00        | 38.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.032384                  |
| 001.QR025   | 34.52 x 3.53      | 35.00        | 41.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.035414                  |
| 001.QR026   | 36.09 x 3.53      | 36.00        | 42.40           | 4.00         | 5.40       | 6.80       | 0.40   | 012.036424                  |
| 001.QR029   | 40.64 x 5.33      | 40.00        | 49.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.040498                  |
| 001.QR029   | 40.64 x 5.33      | 42.00        | 51.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.042518                  |
| 001.Q45253  | 45.20 x 5.33      | 45.00        | 54.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.045548                  |
| 001.QR031   | 46.99 x 5.33      | 48.00        | 57.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.048578                  |
| 001.QR032   | 50.17 x 5.33      | 50.00        | 59.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.050598                  |
| 001.QR032   | 50.17 x 5.33      | 52.00        | 61.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.052618                  |
| 001.QR033   | 53.34 x 5.33      | 55.00        | 64.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.055648                  |
| 001.QR034   | 56.52 x 5.33      | 56.00        | 65.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.056658                  |
| 001.QR035   | 59.69 x 5.33      | 60.00        | 69.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.060698                  |
| 001.QR036   | 62.87 x 5.33      | 63.00        | 72.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.063728                  |
| 001.QR037   | 66.04 x 5.33      | 65.00        | 74.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.065748                  |
| 001.QR038   | 69.22 x 5.33      | 70.00        | 79.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.070798                  |

| Part number | X'Ring dimensions | Rod diameter | Groove diameter | Groove width |            |            | Radius | Back-up ring                |
|-------------|-------------------|--------------|-----------------|--------------|------------|------------|--------|-----------------------------|
|             |                   | Ød5 f7       | ØD6 H9          | L1 0/+0.20   | L2 0/+0.20 | L3 0/+0.20 | R1     | Part number<br>BECA 012 Rod |
| 001.QR040   | 75.57 x 5.33      | 75.00        | 84.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.075848                  |
| 001.QR041   | 78.74 x 5.33      | 80.00        | 89.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.080898                  |
| 001.QR043   | 85.09 x 5.33      | 85.00        | 94.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.085948                  |
| 001.QR045   | 91.44 x 5.33      | 90.00        | 99.80           | 6.00         | 7.70       | 9.40       | 0.40   | 012.090998                  |
| 001.QR048   | 100.97 x 5.33     | 100.00       | 109.80          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1001098                 |
| 001.QR049   | 104.14 x 5.33     | 105.00       | 114.80          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1051148                 |
| 001.QR051   | 110.49 x 5.33     | 110.00       | 119.80          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1101198                 |
| 001.QR053   | 116.84 x 6.99     | 115.00       | 127.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1151278                 |
| 001.QR054   | 120.02 x 6.99     | 120.00       | 132.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1201328                 |
| 001.QR056   | 126.37 x 6.99     | 125.00       | 137.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1251378                 |
| 001.QR057   | 129.54 x 6.99     | 130.00       | 142.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1301428                 |
| 001.QR059   | 135.89 x 6.99     | 135.00       | 147.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1351478                 |
| 001.QR060   | 139.07 x 6.99     | 140.00       | 152.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1401528                 |
| 001.QR063   | 148.59 x 6.99     | 150.00       | 162.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1501628                 |
| 001.Q16056  | 160.50 x 6.99     | 160.00       | 172.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1601728                 |
| 001.QR067   | 170.82 x 6.99     | 170.00       | 182.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1701828                 |
| 001.QR068   | 177.17 x 6.99     | 180.00       | 192.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1801928                 |
| 001.QR070   | 189.87 x 6.99     | 190.00       | 202.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1902028                 |
| 001.QR072   | 202.57 x 6.99     | 200.00       | 212.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2002128                 |
| 001.QR073   | 215.27 x 6.99     | 210.00       | 222.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2102228                 |
| 001.QR073   | 215.27 x 6.99     | 220.00       | 232.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2202328                 |
| 001.QR074   | 227.97 x 6.99     | 230.00       | 242.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2302428                 |
| 001.QR075   | 240.67 x 6.99     | 240.00       | 252.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2402528                 |
| 001.QR076   | 253.37 x 6.99     | 250.00       | 262.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2502628                 |
| 001.QR078   | 278.77 x 6.99     | 280.00       | 292.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2802928                 |
| 001.QR080   | 304.17 x 6.99     | 300.00       | 312.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3003128                 |
| 001.QR081   | 316.87 x 6.99     | 320.00       | 332.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3203328                 |
| 001.QR084   | 354.97 x 6.99     | 350.00       | 362.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3503628                 |
| 001.QR084   | 354.97 x 6.99     | 360.00       | 372.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3603728                 |
| 001.Q40526  | 405.26 x 6.99     | 400.00       | 412.80          | 8.00         | 10.50      | 13.00      | 0.60   | 012.4004128                 |

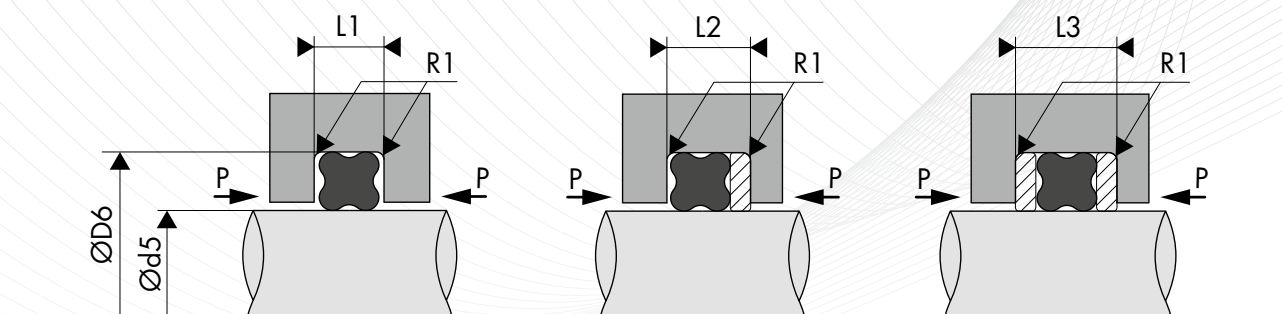
## 10.2 OUTER SEALING - DYNAMIC APPLICATION (ALTERNATING) WITH BECA 012 PISTON BACK-UP RING



| Part number | X'Ring Dimensions | Bore diameter | Groove diameter | Groove width |            |            | Radius | Back-up ring                |
|-------------|-------------------|---------------|-----------------|--------------|------------|------------|--------|-----------------------------|
|             |                   | ØD4 H8        | Ød3 h9          | L1 0/+0.20   | L2 0/+0.20 | L3 0/+0.20 | R1     | Part number BECA 012 Piston |
| 001.257178  | 2.57 x 1.78       | 6.00          | 3.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.006003                  |
| 001.QR003   | 4.47 x 1.78       | 8.00          | 5.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.008005                  |
| 001.QR005   | 6.07 x 1.78       | 10.00         | 7.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.010007                  |
| 001.Q82178  | 8.20 x 1.78       | 12.00         | 9.00            | 2.00         | 3.40       | 4.80       | 0.20   | 012.012009                  |
| 001.QR050   | 10.82 x 1.78      | 14.00         | 11.00           | 2.00         | 3.40       | 4.80       | 0.20   | 012.014011                  |
| 001.Q10226  | 10.20 x 2.62      | 15.00         | 10.40           | 3.00         | 4.40       | 5.80       | 0.30   | 012.015104                  |
| 001.QR009   | 10.77 x 2.62      | 16.00         | 11.40           | 3.00         | 4.40       | 5.80       | 0.30   | 012.016114                  |
| 001.QR010   | 12.37 x 2.62      | 18.00         | 13.40           | 3.00         | 4.40       | 5.80       | 0.30   | 012.018134                  |
| 001.QR11A   | 14.70 x 2.62      | 20.00         | 15.40           | 3.00         | 4.40       | 5.80       | 0.30   | 012.020154                  |
| 001.Q16226  | 16.20 x 2.62      | 22.00         | 17.40           | 3.00         | 4.40       | 5.80       | 0.30   | 012.022174                  |
| 001.Q18235  | 18.20 x 3.53      | 25.00         | 18.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.025186                  |
| 001.QR017   | 21.82 x 3.53      | 28.00         | 21.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.028216                  |
| 001.QR018   | 23.39 x 3.53      | 30.00         | 23.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.030236                  |
| 001.QR019   | 24.99 x 3.53      | 32.00         | 25.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.032256                  |
| 001.QR021   | 28.17 x 3.53      | 35.00         | 28.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.035286                  |
| 001.QR024   | 32.92 x 3.53      | 40.00         | 33.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.040336                  |
| 001.QR025   | 34.52 x 3.53      | 42.00         | 35.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.042356                  |
| 001.QR027   | 37.69 x 3.53      | 45.00         | 38.60           | 4.00         | 5.40       | 6.80       | 0.40   | 012.045386                  |
| 001.QR028   | 37.47 x 5.33      | 48.00         | 38.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.048382                  |
| 001.Q39253  | 39.20 x 5.33      | 50.00         | 40.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.050402                  |
| 001.QR029   | 40.64 x 5.33      | 52.00         | 42.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.052422                  |
| 001.QR030   | 43.82 x 5.33      | 55.00         | 45.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.055452                  |
| 001.QR032   | 50.17 x 5.33      | 60.00         | 50.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.060502                  |
| 001.QR033   | 53.34 x 5.33      | 63.00         | 53.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.063532                  |
| 001.QR033   | 53.34 x 5.33      | 65.00         | 55.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.065552                  |
| 001.QR035   | 59.69 x 5.33      | 70.00         | 60.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.070602                  |
| 001.QR036   | 62.87 x 5.33      | 75.00         | 65.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.075652                  |
| 001.QR038   | 69.22 x 5.33      | 80.00         | 70.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.080702                  |
| 001.QR040   | 75.57 x 5.33      | 85.00         | 75.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.085752                  |
| 001.QR041   | 78.74 x 5.33      | 90.00         | 80.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.090802                  |
| 001.QR043   | 85.09 x 5.33      | 95.00         | 85.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.095852                  |

| Part number | X'Ring Dimensions | Bore diameter | Groove diameter | Groove width |            |            | Radius | Back-up ring                      |
|-------------|-------------------|---------------|-----------------|--------------|------------|------------|--------|-----------------------------------|
|             |                   | ØD4 H8        | Ød3 h9          | L1 0/+0.20   | L2 0/+0.20 | L3 0/+0.20 | R1     | Part number<br>BECA 012<br>Piston |
| 001.QR045   | 91.44 x 5.33      | 100.00        | 90.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.100902                        |
| 001.QR046   | 94.62 x 5.33      | 105.00        | 95.20           | 6.00         | 7.70       | 9.40       | 0.40   | 012.105952                        |
| 001.QR048   | 100.97 x 5.33     | 110.00        | 100.20          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1101002                       |
| 001.QR049   | 104.14 x 5.33     | 115.00        | 105.20          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1151052                       |
| 001.QR051   | 110.49 x 5.33     | 120.00        | 110.20          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1201102                       |
| 001.QR052   | 113.67 x 5.33     | 125.00        | 115.20          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1251152                       |
| 001.120533  | 120.02 x 5.33     | 130.00        | 120.20          | 6.00         | 7.70       | 9.40       | 0.40   | 012.1301202                       |
| 001.QR054   | 120.02 x 6.99     | 135.00        | 122.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1351222                       |
| 001.QR056   | 126.37 x 6.99     | 140.00        | 127.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1401272                       |
| 001.QR059   | 135.89 x 6.99     | 150.00        | 137.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1501372                       |
| 001.QR062   | 145.42 x 6.99     | 160.00        | 147.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1601472                       |
| 001.QR065   | 158.12 x 6.99     | 170.00        | 157.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1701572                       |
| 001.QR066   | 164.47 x 6.99     | 180.00        | 167.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1801672                       |
| 001.QR068   | 177.17 x 6.99     | 190.00        | 177.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.1901772                       |
| 001.QR069   | 183.52 x 6.99     | 200.00        | 187.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2001872                       |
| 001.QR071   | 196.22 x 6.99     | 210.00        | 197.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2101972                       |
| 001.QR072   | 202.57 x 6.99     | 220.00        | 207.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2202072                       |
| 001.QR073   | 215.27 x 6.99     | 230.00        | 217.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2302172                       |
| 001.QR074   | 227.97 x 6.99     | 240.00        | 227.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2402272                       |
| 001.QR074   | 227.97 x 6.99     | 250.00        | 237.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2502372                       |
| 001.QR077   | 266.07 x 6.99     | 280.00        | 267.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.2802672                       |
| 001.QR078   | 278.77 x 6.99     | 300.00        | 287.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3002872                       |
| 001.QR080   | 304.17 x 6.99     | 320.00        | 307.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3203072                       |
| 001.QR082   | 329.57 x 6.99     | 350.00        | 337.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.3503372                       |
| 001.QR086   | 380.37 x 6.99     | 400.00        | 387.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.4003872                       |
| 001.Q40526  | 405.26 x 6.99     | 420.00        | 407.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.4204072                       |
| 001.Q43066  | 430.66 x 6.99     | 450.00        | 437.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.4504372                       |
| 001.Q45606  | 456.06 x 6.99     | 480.00        | 467.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.4804672                       |
| 001.Q48146  | 481.46 x 6.99     | 500.00        | 487.20          | 8.00         | 10.50      | 13.00      | 0.60   | 012.5004872                       |

### 10.3 SHAFT SEALING - DYNAMIC APPLICATION (ROTATING) WITH UNCUT BECA 011 ROD BACK-UP RING



| Part number | X'Ring dimensions | Rod diameter | Groove diameter | Groove width |            |            | Radius | Back-up ring             |
|-------------|-------------------|--------------|-----------------|--------------|------------|------------|--------|--------------------------|
|             |                   | Ød5 f7       | ØD6 H9          | L1 0/+0.20   | L2 0/+0.20 | L3 0/+0.20 | R1     | Part number BECA 011 Rod |
| 001.QR003   | 4.47 x 1.78       | 4.00         | 7.20            | 2.00         | 3.20       | 4.40       | 0.20   | 011.004072               |
| 001.QR004   | 5.28 x 1.78       | 5.00         | 8.20            | 2.00         | 3.20       | 4.40       | 0.20   | 011.005082               |
| 001.Q82178  | 8.20 x 1.78       | 8.00         | 11.20           | 2.00         | 3.20       | 4.40       | 0.20   | 011.008112               |
| 001.Q10226  | 10.20 x 2.62      | 10.00        | 14.80           | 2.80         | 4.00       | 5.20       | 0.30   | 011.010148               |
| 001.QR010   | 12.37 x 2.62      | 12.00        | 16.80           | 2.80         | 4.00       | 5.20       | 0.30   | 011.012168               |
| 001.QR012   | 15.54 x 2.62      | 15.00        | 19.80           | 2.80         | 4.00       | 5.20       | 0.30   | 011.015198               |
| 001.QR013   | 17.12 x 2.62      | 16.00        | 20.80           | 2.80         | 4.00       | 5.20       | 0.30   | 011.016208               |
| 001.QR014   | 18.72 x 2.62      | 18.00        | 22.80           | 2.80         | 4.00       | 5.20       | 0.30   | 011.018228               |
| 001.QR016   | 20.22 x 3.53      | 20.00        | 26.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.020267               |
| 001.QR018   | 23.39 x 3.53      | 22.00        | 28.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.022287               |
| 001.QR020   | 26.57 x 3.53      | 25.00        | 31.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.025317               |
| 001.QR022   | 29.74 x 3.53      | 28.00        | 34.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.028347               |
| 001.QR023   | 31.34 x 3.53      | 30.00        | 36.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.030367               |
| 001.QR024   | 32.92 x 3.53      | 32.00        | 38.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.032387               |
| 001.QR026   | 36.09 x 3.53      | 35.00        | 41.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.035417               |
| 001.QR027   | 37.69 x 3.53      | 36.00        | 42.70           | 3.80         | 5.40       | 7.00       | 0.40   | 011.036427               |
| 001.QR029   | 40.64 x 5.33      | 40.00        | 49.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.040499               |
| 001.QR030   | 43.82 x 5.33      | 42.00        | 51.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.042519               |
| 001.QR031   | 46.99 x 5.33      | 45.00        | 54.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.045549               |
| 001.QR032   | 50.17 x 5.33      | 48.00        | 57.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.048579               |
| 001.QR032   | 50.17 x 5.33      | 48.00        | 57.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.048579               |
| 001.QR033   | 53.34 x 5.33      | 50.00        | 59.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.050599               |
| 001.QR033   | 53.34 x 5.33      | 52.00        | 61.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.052619               |
| 001.QR034   | 56.52 x 5.33      | 55.00        | 64.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.055649               |
| 001.QR034   | 56.52 x 5.33      | 56.00        | 65.00           | 6.00         | 8.00       | 10.00      | 0.40   | 011.05665                |
| 001.QR036   | 62.87 x 5.33      | 60.00        | 69.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.060699               |
| 001.QR037   | 66.04 x 5.33      | 63.00        | 72.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.063729               |
| 001.QR037   | 66.04 x 5.33      | 65.00        | 74.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.065749               |
| 001.QR039   | 72.39 x 5.33      | 70.00        | 79.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.070799               |
| 001.QR041   | 78.74 x 5.33      | 75.00        | 84.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.075849               |
| 001.QR042   | 81.92 x 5.33      | 80.00        | 89.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.080899               |
| 001.QR044   | 88.27 x 5.33      | 85.00        | 94.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.085949               |
| 001.QR046   | 94.62 x 5.33      | 90.00        | 99.90           | 6.00         | 8.00       | 10.00      | 0.40   | 011.090999               |

| Part number | X'Ring dimensions | Rod diameter | Groove diameter | Groove width |            |            | Radius | Back-up ring                |
|-------------|-------------------|--------------|-----------------|--------------|------------|------------|--------|-----------------------------|
|             |                   | Ød5 f7       | ØD6 H9          | L1 0/+0.20   | L2 0/+0.20 | L3 0/+0.20 | R1     | Part number<br>BECA 011 Rod |
| 001.QR047   | 97.99 x 5.33      | 95.00        | 104.90          | 6.00         | 8.00       | 10.00      | 0.40   | 011.0951049                 |
| 001.QR049   | 104.14 x 5.33     | 100.00       | 109.90          | 6.00         | 8.00       | 10.00      | 0.40   | 011.1001099                 |
| 001.QR051   | 110.49 x 5.33     | 105.00       | 114.90          | 6.00         | 8.00       | 10.00      | 0.40   | 011.1051149                 |
| 001.QR053   | 116.84 x 6.99     | 110.00       | 123.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1101233                 |
| 001.QR054   | 120.02 x 6.99     | 115.00       | 128.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1151283                 |
| 001.QR055   | 123.19 x 6.99     | 120.00       | 133.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1201333                 |
| 001.QR057   | 129.54 x 6.99     | 125.00       | 138.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1251383                 |
| 001.QR059   | 135.89 x 6.99     | 130.00       | 143.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1301433                 |
| 001.QR062   | 145.42 x 6.99     | 140.00       | 153.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1401533                 |
| 001.QR065   | 158.12 x 6.99     | 150.00       | 163.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1501633                 |
| 001.QR066   | 164.47 x 6.99     | 160.00       | 173.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1601733                 |
| 001.QR069   | 183.52 x 6.99     | 180.00       | 193.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.1801933                 |
| 001.QR072   | 202.57 x 6.99     | 200.00       | 213.30          | 7.70         | 10.20      | 12.70      | 0.60   | 011.2002133                 |

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