

PTFE Backup Rings & Anti-Extrusion Rings

Prevent extrusion and extend seal life in high-pressure static and dynamic applications

Overview

Backup rings-also referred to as anti-extrusion rings-are precision-engineered, washer-like sealing accessories installed on the low-pressure side of an O-ring groove. Their fundamental role is to block the diametral clearance gap into which the elastomer O-ring would otherwise extrude under pressure, a failure mechanism responsible for the majority of premature O-ring degradation in high-pressure hydraulic and pneumatic systems. Manufactured primarily from polytetrafluoroethylene (PTFE) and its filled variants, backup rings represent a mature, cost-effective engineering solution for extending seal service life from mere hundreds to tens of thousands of pressure cycles.

The operational principle of a backup ring is elegantly simple yet critically important. When system pressure acts upon an O-ring seated in a gland, the elastomer material experiences a hydrostatic force that drives it toward the low-pressure side of the groove. If a clearance gap exists between the mating metal surfaces-typically 0.10 to 0.15 mm in standard industrial assemblies-the O-ring material flows into this gap. With each pressure cycle, this extrusion progresses incrementally, leading to a phenomenon known as nibbling or shredding, where small fragments of elastomer are sheared off by the sharp edges of the clearance gap. Over time, this progressive material loss reduces the O-ring cross-section, diminishes sealing force, and ultimately results in catastrophic seal failure. A properly dimensioned backup ring occupies this clearance gap, providing a zero-clearance barrier that prevents the O-ring from entering the extrusion zone.

Engineering guidelines for backup ring deployment are well established in fluid power design handbooks and sealing industry standards. For dynamic (reciprocating) service involving standard NBR 70 Shore A O-rings with typical diametral clearances, a single backup ring is recommended at pressures exceeding 100 bar (1,450 psi). In static (non-moving) applications, the threshold extends to approximately 150 bar (2,175 psi) before a single backup ring becomes necessary. For pressures above 150 bar in dynamic service or above 200 bar in static service-or in any application where pressure direction alternates-dual backup rings, one installed on each side of the O-ring, provide bidirectional extrusion protection. These thresholds assume standard groove geometries manufactured to AS568 or ISO 3601 tolerances. It is important to note that larger clearance gaps, lower O-ring hardness, elevated operating temperatures, and aggressive pressure spikes all reduce these pressure thresholds, often necessitating backup rings at significantly lower nominal pressures.

Material selection for backup rings is governed by the specific demands of the application environment. Virgin PTFE offers universal chemical compatibility, an exceptionally low coefficient of friction (0.05-0.10), and an extraordinarily broad temperature range spanning from cryogenic conditions at -200 C to elevated temperatures of +260 C. This makes virgin PTFE the material of choice for chemical processing, food and pharmaceutical applications, and any service where contamination must be eliminated. Glass-filled PTFE, containing 15-25% glass fiber by weight, addresses the primary weakness of virgin PTFE-cold flow and creep under sustained compressive loads. The glass reinforcement increases compressive strength, reduces dimensional deformation under load, and improves wear resistance in dynamic reciprocating service, making it the standard choice for general industrial hydraulics operating in the 150-350 bar range. For the most demanding applications, bronze-filled PTFE with 40-60% bronze content delivers the highest compressive strength and excellent thermal conductivity, enabling superior heat dissipation and dimensional stability at extreme pressures exceeding 350 bar in heavy-duty hydraulic systems.

Backup rings are manufactured in three primary configurations to accommodate varying installation constraints and pressure requirements. Spiral-cut backup rings feature a continuous helical cut that allows the ring to be elastically stretched over a piston or collapsed onto a rod without requiring full gland disassembly. This installation flexibility makes spiral-cut rings indispensable for field maintenance, retrofit applications, and equipment where groove access is limited. Solid (uncut) backup rings provide the maximum possible extrusion resistance because the continuous circumferential geometry eliminates any potential leakage path through the backup ring itself. However, solid rings

require the gland assembly to be fully disassembled for installation, restricting their use to new equipment designs and the highest-pressure static seals where structural integrity is paramount. Scarf-cut or contoured backup rings employ a single diagonal cut at approximately 45 degrees, striking an optimal balance between installation convenience and sealing performance. The scarf cut allows the ring to be opened slightly for installation while maintaining significantly better gap closure than a spiral cut, making scarf-cut rings the preferred choice for production assembly lines and general industrial hydraulics in the 150-300 bar pressure range.

Our manufacturing capabilities encompass all standard backup ring sizes matching AS568 and ISO 3601 O-ring cross-sections, including cross-sections of 1.78 mm, 2.62 mm, 3.53 mm, 5.33 mm, and 6.99 mm for AS568 series, and 1.50 mm, 2.00 mm, 2.50 mm, 3.00 mm, 4.00 mm, 5.00 mm, and 7.00 mm for ISO 3601 metric series. Custom dimensions are manufactured directly from raw PTFE stock without tooling fees, enabling rapid prototyping and economical production of non-standard sizes. All backup rings are produced under ISO 9001 certified quality management systems, with dimensional tolerances held to +/-0.05 mm for standard sizes and material certificates of conformance available on request. Lead time for standard sizes is 7-15 business days; custom sizes typically ship within 10-20 business days depending on quantity and material specification.

Types

or installation without full gland disassembly. The spiral creates a slight overlap, maintaining the closed gap needed for extrusion prevention. Ideal for field service and re
high-pressure fluid to bypass the backup ring. Requires the gland to be fully open for installation. Best for new machine designs and the highest-pressure static seals whe
Easier to install than solid rings while providing better extrusion resistance than spiral cuts. The preferred style for production assembly lines where glands must be opene

Advantages

housands of cycles in documented field applications. This reduction in seal replacement frequency directly translates to lower maintenance costs, reduced equipment do
nts. This makes PTFE backup rings the only viable extrusion protection solution in chemical processing, pharmaceutical manufacturing, and semiconductor fabrication wh
ed alongside an O-ring in a reciprocating seal assembly, a PTFE backup ring adds negligible frictional drag to the system. This preserves actuator efficiency, reduces hea
arge due to manufacturing tolerances, to ultra-high-pressure hydraulic presses exceeding 700 bar, backup rings provide an engineering pathway to reliable sealing witho
versized inside diameters, and special thickness profiles-can be produced economically in quantities as low as one piece. This eliminates the typical \$2,000-\$15,000 mol
Spiral-cut rings enable field installation without gland disassembly; scarf-cut rings balance installation speed with structural integrity for production lines; and solid rings de

Materials

	Best For
ance, lowest friction coefficient (0.05-0.10), -200 C to +260 C operating range, no contamination risk	Chemical processing, food and pharmaceutical, cry
ngth, reduced cold flow, improved creep resistance under sustained load, better wear resistance in dynamic service	High-pressure hydraulics (150-350 bar), reciprocati
ngth, excellent thermal conductivity for heat dissipation, superior extrusion resistance at extreme pressures	Heavy-duty hydraulics >350 bar, high-temperature

Sizing

Backup rings are sized by the O-ring cross-section (CS) and inside diameter they pair with. We supply rings matching all standard AS568 and ISO 3601 cross-sections. Backup ring width is typically 80-100% of the O-ring cross-section diameter.

Available Size Ranges

Series	Coverage
AS568	1.78 mm, 2.62 mm, 3.53 mm, 5.33 mm, 6.99 mm
ISO 3601 / Metric	1.50 mm, 2.00 mm, 2.50 mm, 3.00 mm, 4.00 mm, 5.00 mm, 7.00 mm
Custom	Any non-standard CS and ID manufactured to drawing

FAQ

Do I need one or two backup rings?

For static seals at pressures up to 150 bar (2,175 psi), a single backup ring on the low-pressure side is usually sufficient. For dynamic (reciprocating) seals above 100 bar, or static seals above 150 bar, use one backup ring on the low-pressure side. For dynamic seals above 150 bar, or applications where pressure alternates direction, use two backup rings-one on each side of the O-ring-to prevent extrusion in both pressure directions.

Can backup rings be used with dynamic seals?

Yes. Backup rings are commonly used in reciprocating hydraulic cylinders, particularly for rod seals and piston seals above 100 bar. For dynamic service, spiral-cut or scarf-cut PTFE backup rings are preferred over solid rings to accommodate installation. PTFE's low friction coefficient (0.05-0.10) means backup rings add minimal friction to the dynamic seal assembly.

What is the difference between a backup ring and a wear ring?

A backup ring (anti-extrusion ring) prevents O-ring extrusion through the diametral clearance gap under pressure. It sits in the same groove as the O-ring and directly contacts it. A wear ring (or guide ring) is a separate, wider component installed in its own groove that prevents metal-to-metal contact and absorbs radial side loads from piston weight or eccentric forces. Wear rings do not prevent O-ring extrusion. Both are often used together in high-performance hydraulic cylinders.

At what pressure do I need backup rings?

The pressure threshold depends on diametral clearance gap, O-ring hardness, and whether the service is static or dynamic. General guidelines: for standard NBR 70 Shore A with 0.10-0.15 mm clearance gap-backup ring required above 100 bar in dynamic service and above 150 bar in static service. For 90 Shore A PU or NBR-backup ring threshold extends to 200-350 bar. Larger clearance gaps (manufacturing tolerance or wear) lower these thresholds significantly. Always check the O-ring manufacturer's pressure-clearance extrusion chart for your specific groove tolerances.

Which backup ring material should I choose?

Virgin PTFE is the correct choice for chemical, food, and pharmaceutical applications-universal chemical resistance and FDA compliance with no risk of contamination. Glass-filled PTFE (15-25% glass) is the standard for general hydraulic service-better compressive strength and reduced cold flow under sustained pressure, with acceptable chemical resistance for mineral oil systems. Bronze-filled PTFE offers the highest compressive strength and thermal conductivity for extreme pressures (>350 bar) and heavy-duty industrial equipment. Avoid bronze-filled PTFE in food, pharmaceutical, or chemical processing-bronze filler is not chemically inert.

Do backup rings affect O-ring groove dimensions?

Yes. Adding a backup ring requires a wider groove than a standard O-ring groove. The groove width must accommodate both the O-ring cross-section and the backup ring width (typically 70-85% of O-ring CS). Groove depth remains the same as the standard O-ring groove-the backup ring sits beside the O-ring, not beneath it. When retrofitting backup rings to existing grooves, verify that the existing groove width is sufficient, or that the groove can be widened. Parker Hannifin O-Ring Handbook (ORD 5700) and ISO 3601-2 provide groove dimension tables for O-ring plus backup ring combinations.

Do you supply backup rings for specific O-ring sizes?

Yes. We match any O-ring size across AS568 and ISO 3601 standards. Provide the O-ring cross-section (CS) and gland bore or rod diameter (ID), and we confirm the correct backup ring dimensions. Custom sizes with non-standard CS or ID are manufactured without additional tooling fees for standard PTFE profiles. Specify virgin, glass-filled, or bronze-filled PTFE when ordering.

What is the shelf life of PTFE backup rings?

PTFE backup rings have an effectively unlimited shelf life when stored properly. Unlike elastomer O-rings, PTFE does not undergo oxidative degradation, ozone attack, or compression set during storage. Store backup rings in a clean, dry environment away from sharp objects that could damage the precision-machined edges. For filled PTFE variants (glass or bronze), avoid prolonged exposure to moisture that could promote surface oxidation of the filler particles, though this is primarily a cosmetic concern and does not affect functional performance.

Can backup rings be reused during maintenance?

PTFE backup rings can be reused if they are inspected and found to be undamaged, with no scoring, cracking, or permanent deformation of the cross-section. However, because PTFE is relatively soft and can develop deformation under sustained pressure, best practice in critical applications is to replace backup rings whenever the O-ring is replaced. The cost of a backup ring is typically 10-20% of the O-ring cost, making replacement economical insurance against seal failure. For non-critical maintenance applications where budget constraints are tight, inspect the backup ring carefully under magnification and reuse only if the sealing surface is smooth and the cut edges are intact.

What is the lead time and MOQ for custom backup rings?

Standard AS568 and ISO 3601 backup rings in virgin PTFE typically ship within 7-15 business days with an MOQ of 1 piece. Glass-filled and bronze-filled variants require 10-20 business days due to material availability. Custom dimensions are manufactured directly from PTFE stock without tooling fees, with lead times of 10-20 business days depending on quantity and complexity. For urgent requirements, emergency production can be arranged with 3-5 business day turnaround for standard materials, subject to current production schedule availability. Contact our engineering team with your groove dimensions, pressure requirements, and material specification for a formal quotation and delivery commitment.