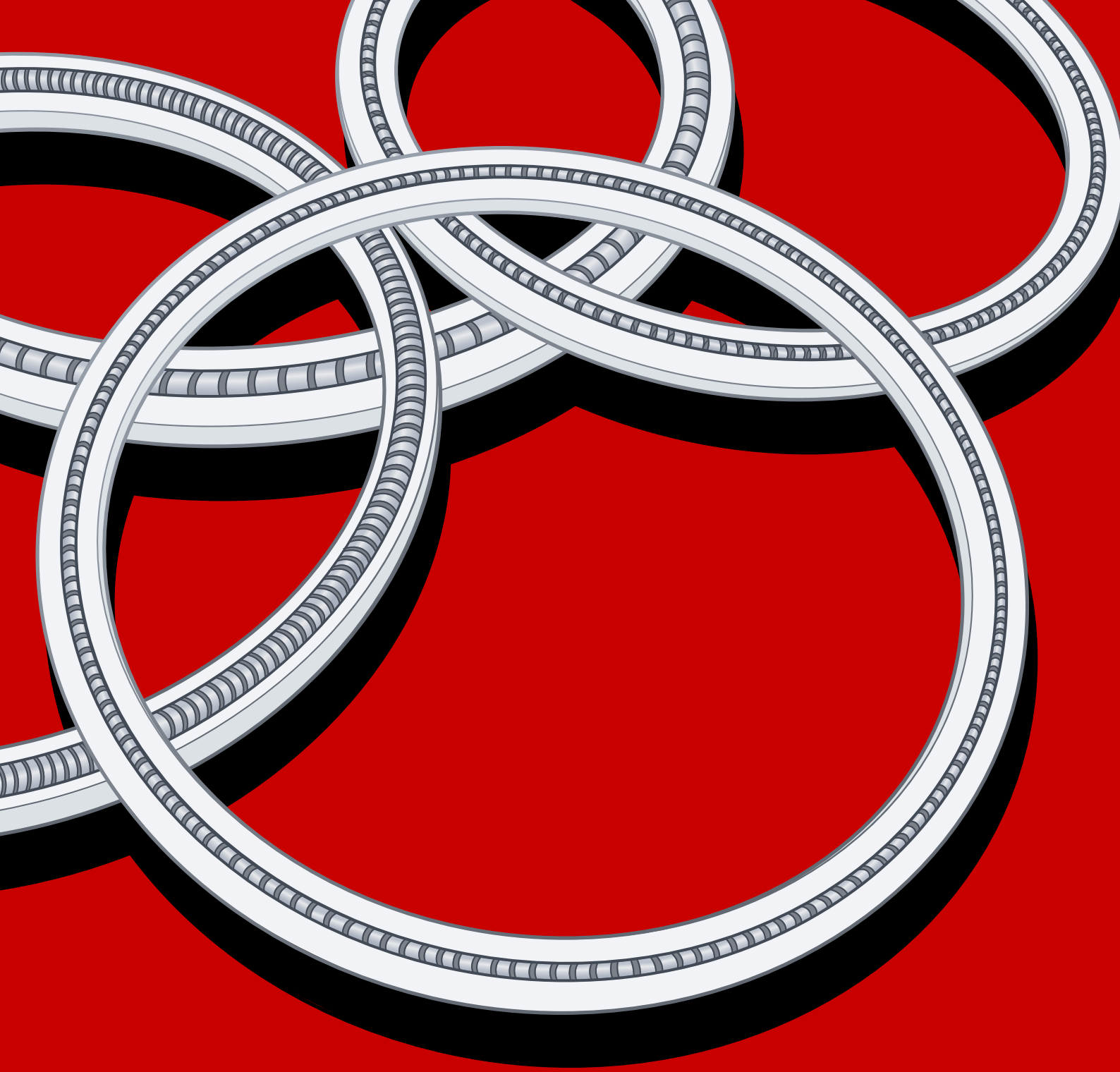
Haagensen
Sealing Solutions

THERMOPLASTIC SEALING SOLUTIONS

With a focus on high-performance applications, Haagensen provides thermoplastic seals that excel in harsh environments, delivering long-lasting and precise sealing solutions

www.haagensenseals.com



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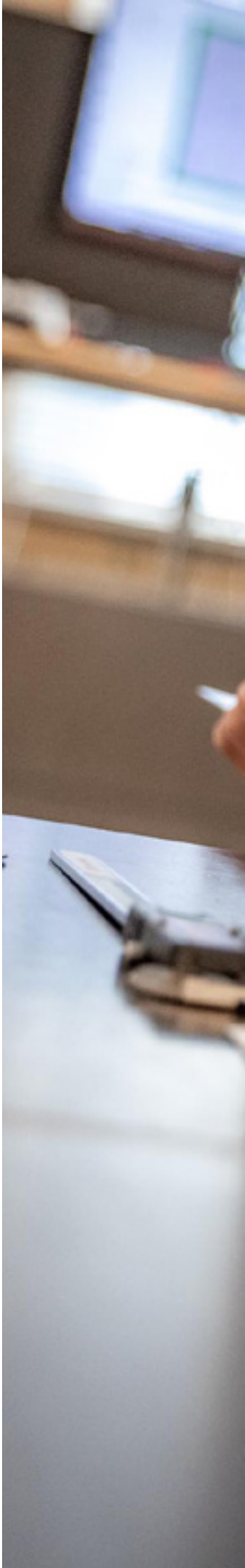
Haagensen
Sealing Solutions

1 ABOUT US

Welcome to Haagensen. Dive into our history and gain insight into our values and business philosophy. Learn more about the products, services, and industries we serve, and how we have built strong relationships over the years.



Our work & history

Haagensen is a specialized company in sealing systems and technical articles, dedicated to providing high-quality solutions to a wide range of different industries.

Founded in 1921 in Riga, Latvia, by Gunnar Haagensen, we initially started with the production of wooden bodies for the Ford Model A. In 1940, due to World War II, we relocated to Denmark and shifted our focus to seals and sealing elements, which have been our core competence ever since.

Today, we are located in Allerød, Zealand, where our headquarters house administration, production, and warehousing. As a long-standing family-owned business, now run by the fourth generation, Lasse Haagensen, we have built a reputation for quality and reliability. We offer a wide range of standard solutions from stock as well as custom solutions, supported by our skilled staff who provide advice and technical support.

With our ISO 9001 certification and a strong commitment to quality management, we continue to deliver innovative and reliable solutions that meet the most stringent industry requirements.

Exactly as you need

We live in a world where your company's ability to produce efficiently is crucial. Where your business depends on plants running, machines operating, and motors turning. Constantly and at full capacity.

Optimal uptime and minimal downtime are key. This requires attention to the big picture and focus on every individual part. Even a small component failure can have a significant impact on your company's competitiveness.

Customer focused since 1921

When Gunnar Haagensen founded the company in 1921, he put the customer at the center. Four generations later, this is still our driving force. We ensure that the right components and expertise are always within reach.

For more than 80 years, we have specialized in sealing solutions for the industry. We develop, produce, and supply dynamic and static sealing solutions to, among others, essential pharmaceutical companies, leading food producers, and everything in between.

Thousands of sealing solutions in stock – as standard

With nearly a century behind us, we know which solutions last – both for your challenges and in the long run. More often than not, we have your sealing solution on the shelf – among our thousands of standard solutions. We can pick it immediately and deliver exactly when you need it.

We understand that when time is critical for you, there is no time to waste. It's easy to do business with us. Data sheets and certificates are always available, and we understand that fast service is crucial. Downtime is costly. Every minute counts. That's why we are ready to move quickly and go the extra mile when needed. Otherwise, we keep both feet on the ground and are easy to talk to.

Safety with simulations

When a standard solution isn't the answer, we develop a custom solution for your specific application. With state-of-the-art technology, we have the ability to simulate flows and test solutions in practice before moving on to production. This eliminates uncertainty and provides peace of mind.

It makes us the partner you can rely on when you need effective sealing solutions that precisely meet your needs.

Sincerely,
Lasse Haagensen, CEO

Our products & services

Sealing solutions and advice tailored to the challenges of your industry

At Haagensen, we offer a comprehensive range of standard and custom-produced sealing solutions in elastomers, thermoplastic materials,and metals. We also provide kit production, where we assemblecomplete sets of sealing solutions tailored to our customers' needs. Thisallows our customers to receive all necessary components in a singledelivery, simplifying their logistics and saving time.

When standard solutions don't meet the need, Haagensen developscustom sealing solutions. Our engineers and technical specialists workclosely with customers to develop solutions that meet even the strictestrequirements. We also offer advanced quality control of materials, durability,and dimensions with our in-house measuring equipment, ensuringthat all solutions meet the highest standards. To the right is a selection ofour certifications.

EC 1935:2004

FDA

ADI free

USP

NORSOK M710

A3 18-03

REACH COMPLIANCE

RoHS

Elastomers
We offer a wide range of sealing solutions in both standard and specialized synthetic rubber types, selected for each specific application.

Thermoplastics
When applications require handling extreme temperatures, aggressive chemicals, or high friction, thermoplastic seals are ideal. They are designed to withstand these condi-tions and ensure reliable performance in demanding environments.

Metal solutions
When extreme pressures and temperatures rule out other materials, we offer metallic solutions that ensure reliability and durability under the most demanding conditions.

Kits
Haagensen offers custom kits containing all relevant sealing solutions for your needs, simplifying handling and increasing efficiency in the assembly process

Development, simulation, and testing
When a standard seal is not sufficient, our engineers offer expertise in consulting and developing custom solutions for your specific needs.

Quality control
We offer inspection and control of components according to applicable industrial standards and can assist with trouble-shooting and identification of components using our in-house measuring equipment.

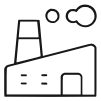
Industries we serve

Sealing solutions for industries worldwide, both locally and globally

At Haagensen, we offer advanced sealing solutions that meet the unique challenges of a wide range of industrial sectors. Whether it's preventing liquid or gas leaks, protecting equipment from corrosion, or maintaining process safety, we deliver sealing systems that can withstand even the most demanding process flows – both standard and custom-made. Our expertise covers everything from oil and gas to the food industry, where our technical knowledge and innovative approach ensure solutions that guarantee high reliability and performance. Haagensen is your partner when it comes to ensuring that your processes run smoothly and efficiently.

Oil and gas

Our solutions in durable materials ensure reliability and longevity in aggressive downhole environments, where extreme conditions demand maximum chemical resistance.

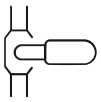


Food and pharma

With a focus on documentation and traceability, we deliver solutions that comply with regulatory requirements and support hygienic production.

Machine construction

A focus on competitive prices and delivery reliability makes us the ideal partner for stable production that effectively meets your operational requirements.



Valves and pumps

Effective leakage control and low friction make our solutions ideal for maximizing operational reliability and minimizing energy loss in valves and pumps.

Maritime

With a focus on high performance and long lifespan, we deliver solutions that meet the need for reliability and safeguard against downtime at sea.

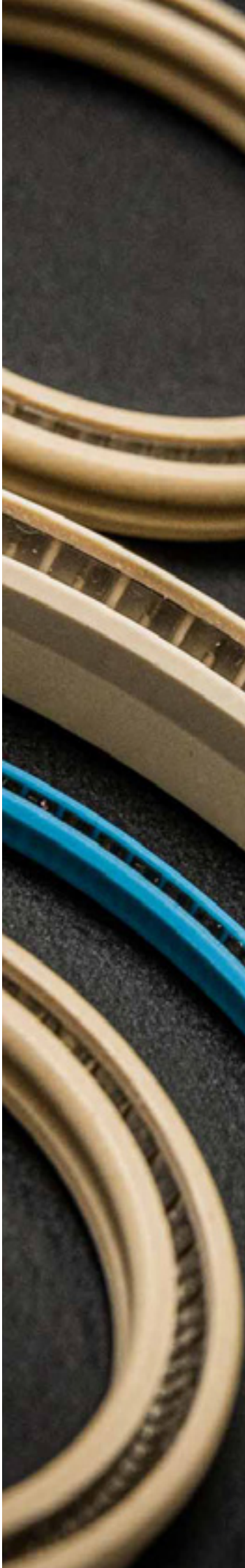
Renewable energy

Longevity and durability are at the core of our sealing solutions, minimizing the need for maintenance and maximizing operational efficiency.

Haagensen
Sealing Solutions

2 INTRODUCTION

When applications require high chemical and thermal resistance, thermoplastic seals are the solution. Explore our range of seal types, materials, and their applications.



Material Overview

Thermoplastic materials

Thermoplastic materials are a group of polymers that become soft and moldable when heated and harden when cooled. Thermoplastics are lightweight, have high impact strength, and can be reused multiple times without significant degradation of their mechanical properties.

Mechanically, thermoplastic materials are known for their toughness and flexibility, making them resistant to repeated load. They typically have good resistance to wear and deformation, which is essential in items such as seals. Thermally, they have a high heat resistance making them suitable for use in environments with large temperature fluctuations. Chemically, thermoplastic materials are often resistant to corrosion, acids, bases, and solvents, making them ideal for aggressive environments.

Common examples of thermoplastic materials include PTFE, PEEK, and UHMW-PE. Each of these materials has unique properties and areas of application. PTFE is known for its excellent chemical resistance and low friction coefficient, making it ideal for seals in chemical environments. PEEK is remarkable for its strength and heat resistance and is often used in high-tech applications such as aerospace and medical equipment. UHMW-PE is a very wear-resistant polymer with high impact strength, making it suitable for applications where mechanical wear is a challenge.

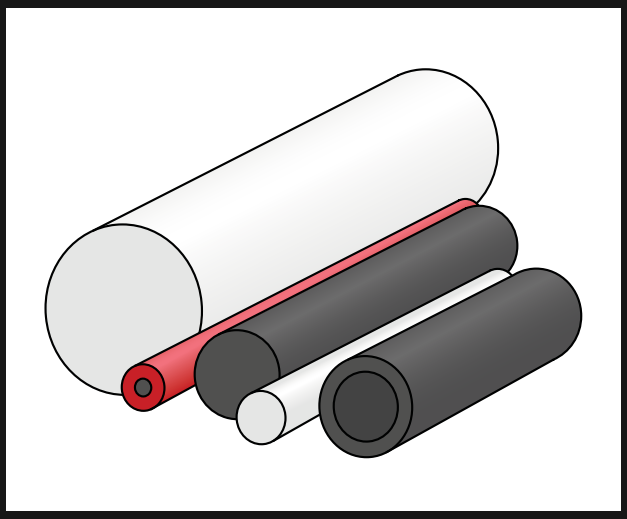


Figure 1: Thermoplastic tubes and cylinders for seal production.

Production

Production of thermoplastic seals typically involves machining them from tubes of the selected thermoplastic material. This method ensures the seals achieve precise dimensions and tolerances to meet stringent application requirements. Machined parts can be produced in both small and large series without the need for expensive molding tools, making it a flexible and cost-effective solution. This method also enables customized solutions where precision and adaptation to specific applications are critical, regardless of production volume.

Advantages of thermoplastic materials

The versatility of thermoplastic materials, combined with their excellent mechanical, thermal, and chemical properties, makes them a top choice in many industries, including medical, chemical processing, and hydraulics. Their ability to withstand various forms of stress without losing structural integrity makes them especially valuable in critical applications where reliability is paramount. Moreover, thermoplastic materials can be adapted to a wide range of environments and requirements, providing engineers with flexibility in material selection for specific applications.

In hydraulic systems, thermoplastic materials are particularly useful due to their resistance to high pressure and aggressive fluids. They are often used in seals and gaskets, where wear resistance and chemical resistance ensure long-lasting performance. In medical equipment, their biocompatibility and ability to be sterilized are significant advantages. In chemical process industries, their resistance to chemicals and high temperatures offers protection. These properties, along with their lightweight and wear resistance, make thermoplastics a preferred solution in demanding environments

Thermoplastics Seals

Application of thermoplastic seals

Thermoplastic seals are an especially attractive choice in situations where the unique properties of thermoplastic materials can be fully utilized. Thermoplastic materials, such as PTFE, PEEK, and UHMW-PE, have a combination of characteristics that make them particularly suitable for applications where standard elastomeric seals, such as O-rings and X-rings, may not meet the necessary requirements.

While elastomeric seals, typically made from rubber or other soft polymers, excel in flexibility and the ability to seal under moderate conditions, they can have limitations in terms of chemical resistance, temperature tolerance, and mechanical strength. This is where thermoplastic seals come into play. These seals offer superior resistance to aggressive chemicals, extreme temperatures, and high mechanical loads, making them ideal for demanding environments where elastomeric seals may quickly degrade or fail.

Moreover, thermoplastic materials often have a low coefficient of friction, making them suitable for applications with moving parts where minimal wear and maximum durability are essential. This provides long-term reliability in applications where the seals are exposed to constant movement or friction.

In short, when an application requires a seal that must withstand extreme conditions or aggressive environments, thermoplastic seals are often the preferred choice. Their ability to deliver high performance where elastomeric seals may not be sufficient makes them an indispensable solution in many industrial applications.

Basic sealing principles

Thermoplastic seals are specifically designed to maintain an effective and durable seal under even the most demanding conditions. They achieve this through the combination of a thermoplastic sealing element with an activating component, such as a spring or an O-ring, as shown in figure 2. This combination ensures that the seal can effectively adapt to varying pressures, temperatures, and environmental conditions, all while maintaining a stable and reliable seal throughout its operational life.

The spring or O-ring plays a central role in the sealing system by providing the initial activation of the sealing element. This activating component presses the thermoplastic sealing element against the sealing surface, ensuring tight contact from the start. When the sealing system is pressurized, the medium in the application flows into the seal's groove and adds its pressure to the seal. This creates an overpressure that works together with the spring or O-ring, ensuring that there is greater pressure on the seal than in the system itself. This combined pressure prevents leakage by maintaining an effective seal against the sealing surface.

This method makes thermoplastic seals particularly effective in dynamic and demanding applications where stability and reliability are critical. With this combination of activation mechanism and media pressure influence, the seal operates optimally under both static and dynamic conditions.

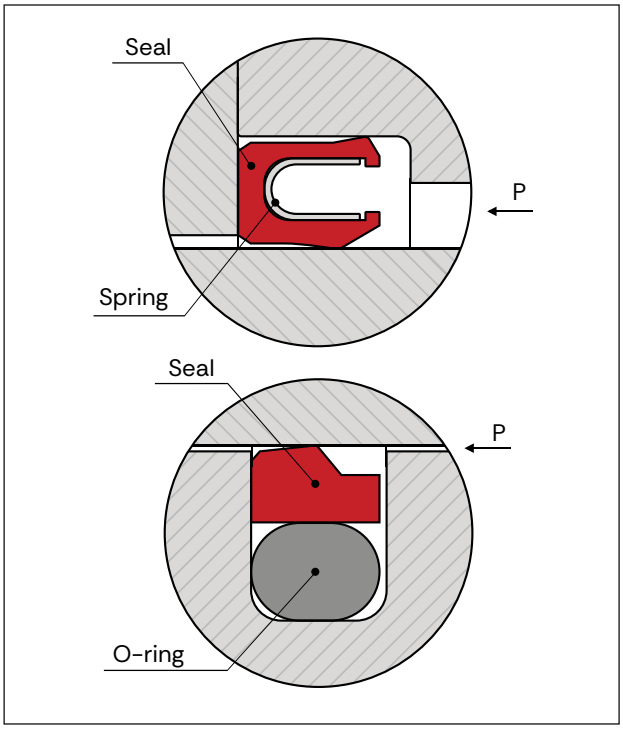


Figure 2: Components of thermoplastic seals.

O-ring activated seals

O-ring activated seals are radial sealing elements consisting of a thermoplastic sealing element combined with an elastomeric activating element, typically an O-ring. This combination provides a strong and flexible seal capable of handling the demanding conditions often found in industrial pneumatic and hydraulic applications. In these environments, where moving parts and varying pressures are the norm, O-ring activated seals offer a reliable solution. The thermoplastic sealing element faces the dynamic side of the application, thus constantly exposed to movement, while the O-ring ensures sealing at low pressure and compensates for wear and thickness reduction of the thermoplastic due to cold flow.

When O-ring activated seals are mounted in their grooves, the O-ring is compressed, resulting in the thermoplastic sealing element being pressed against the opposite sealing surface. This creates an initial sealing effect, ensuring a tight seal even at low system pressure. As system pressure increases, the O-ring and the sealing element are further activated by the present medium, as shown in figure 3. This leads to increased contact pressure against the opposite sealing surface, enhancing the seal's efficiency and preventing leakage, even under high-pressure.

A wide variety of profiles are available for both piston and rod applications, allowing the seal to be adapted to a wide range of uses. The thermoplastic sealing elements are typically made from PTFE and other high-performance thermoplastic materials. These materials are known for their ability to reduce friction and resist wear, extending the seal's lifespan and ensuring consistent performance. The elastomeric activating element, which can be supplied in materials such as NBR and FKM, provides additional flexibility by allowing adaptation to different chemical environments and temperature requirements.

While the thermoplastic sealing element delivers superior performance in many applications, it is important to note that the overall chemical resistance largely depends on the chosen elastomer material in the O-ring. This makes the selection of the O-ring material critical to the seal's overall performance and lifespan in the application. By choosing the right material, optimal sealing performance and maintained functionality can be ensured, even in the most challenging environments.

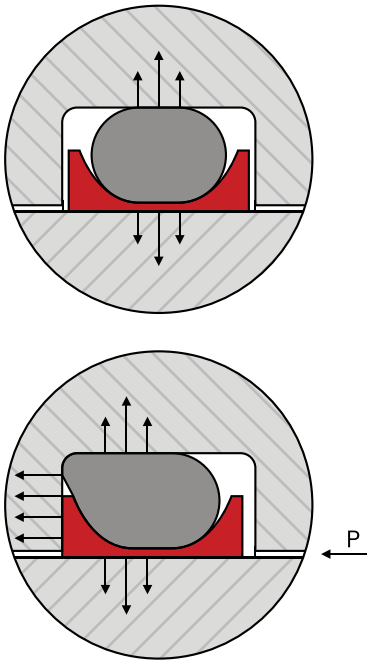


Figure 3: Illustration of an O-ring activated seal. At the top, the O-ring alone activates the seal. At the bottom, the seal is activated by both the O-ring and system pressure, resulting in increased contact pressure.

Spring-energized seals

Spring-energized seals are used in applications with particularly high demands, such as where operating parameters do not allow the use of seals containing elastomer components. This is especially true in environments with extremely high temperatures or strong chemicals, where elastomers would degrade or lose their effectiveness.

Spring-energized thermoplastic seals combine a durable thermoplastic jacket with an internal metallic spring, creating a seal that can withstand even the most demanding operating conditions without compromising the integrity of the seal. The elastic spring ensures reliable sealing even at low pressures, compensating for thickness reduction in the thermoplastic jacket due to cold flow, wear, and thermal contraction. The design of the spring allows the system pressure of the application to complement the spring force, increasing the contact pressure against the sealing surface and significantly reducing the risk of leakage, as shown in figure 4. This dual activation by the spring and system pressure provides an enhanced sealing effect, which is essential in applications where constant and reliable sealing is required.

The thermoplastic jacket is typically made of PTFE-based materials or other high-performance polymers, known for their low friction and excellent chemical resistance. Materials with special additives can also be used to improve wear resistance or high-temperature tolerance. PTFE's inherent properties make it less susceptible to issues such as explosive decompression and stick-slip, which is advantageous in applications where these conditions may occur and pose a risk to the seal's function.

The spring used in spring-energized seals is available in various corrosion-resistant metal alloys, including stainless steel, Elgiloy®, Hastelloy®, and other high-performance materials. Different types of springs are also available and are selected based on the specific seal or the application's requirements. The spring provides a constant force that presses the sealing lips against the sealing surface, ensuring a tight seal, even with cyclical temperature changes. Unlike elastomeric materials that may take on permanent compression or become too soft or hard with temperature changes, the spring remains effective under varying conditions, ensuring long-lasting and reliable sealing.

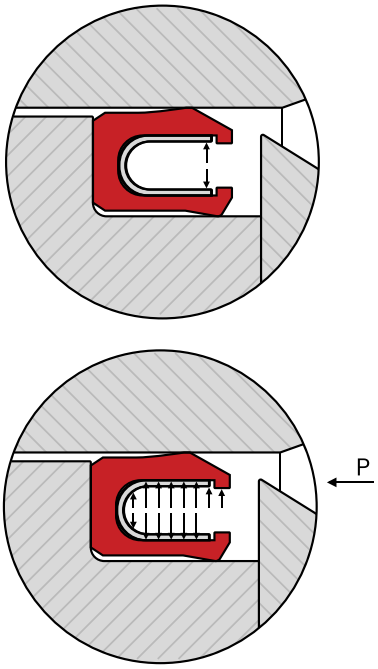


Figure 4: Illustration of a spring-energized seal. At the top, the spring alone ensures the sealing effect. At the bottom, the seal is reinforced by both the spring and system pressure, which increases the contact pressure.

Application types

Thermoplastic seals are highly versatile and can be used in many different applications, depending on their type. They can function as rotary, reciprocating, and static seals, as shown in figure 5, each with its own specific areas of use and associated requirements.

Rotary seals

In rotary applications, where the seal is in contact with a rotating shaft, thermoplastic seals are an excellent choice. They are typically used in pumps, motors, and gearboxes, where they prevent the leakage of liquids or gases. Compared to a pure elastomer solution, thermoplastic seals offer better friction properties and significantly higher wear resistance during dynamic use.

Reciprocating seals

Thermoplastic seals are also well-suited for reciprocating applications, where the seal is exposed to back-and-forth movements, as seen in hydraulic cylinders, piston compressors, and linear actuators. In these cases, thermoplastic seals result in significantly improved friction and wear resistance compared to elastomer-based solutions.

Static seals

Thermoplastic seals are also used as static seals, where their primary function is to prevent leakage between two surfaces that do not move relative to each other. This is typical in flanges, pipe connections, and enclosures in chemical plants, the oil and gas industry, and food production.

Housings and grooves

When identifying the specific type of seal that best suits a given application, it is crucial to consider where the seal will be used – whether in a flange, a cylinder, or a piston – as this influences both the seal's configuration and the design of the corresponding groove in which the seal will be mounted.

Cylinder

Cylinders are often used in dynamic applications that require a seal capable of handling motion, either rotary or reciprocating. Thermoplastic seals in cylinders are typically installed in a groove along the inner wall of the cylinder, allowing for a tight fit and effective sealing against the moving piston rod or rotating shaft.

Piston

Pistons are characterized by their movement within a cylinder, which means that the seal must withstand pressure from both sides, depending on the direction of movement. The sealing element is typically mounted in a groove in the piston, which is dimensioned to ensure a good fit and optimal sealing against the cylinder walls.

Flange

Flanges are typically used in static applications where the seal must withstand high pressure and temperatures without moving. The seal is usually installed in a groove in the flange, which is designed to securely hold the sealing element in place while ensuring an effective seal against the medium.

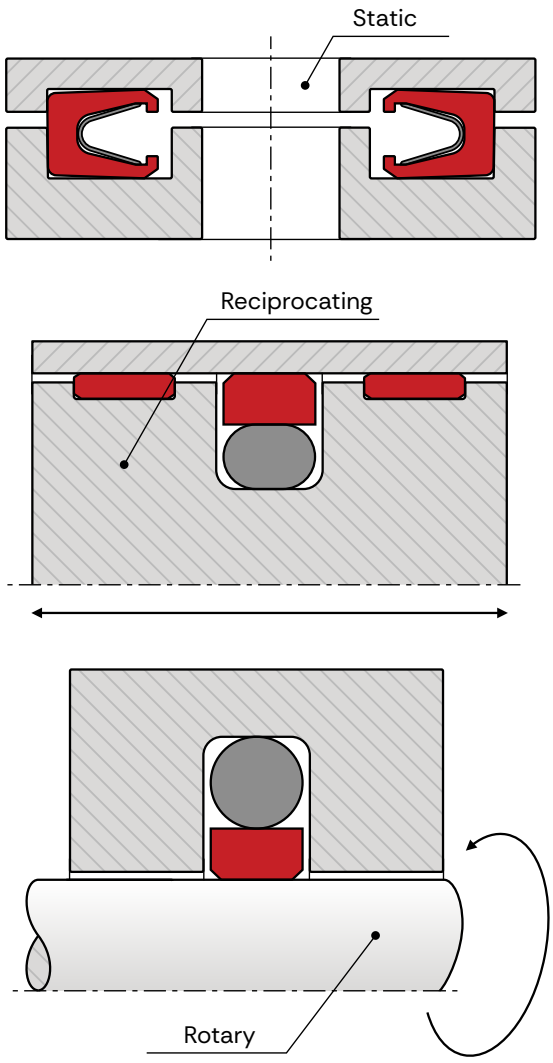


Figure 5: Illustration of static, rotary, and reciprocating seal applications.

Seal working principles

It is important to understand the difference between single-acting and double-acting seals, as this difference affects both the seal's performance and installation. The choice of seal type should be based on the application's pressure direction, and correct installation orientation is critical for single-acting seals, as errors can compromise the seals sealing capability.

Single acting seals

A single acting seal is designed to withstand pressure from only one side, as shown in figure 6. The seal is only effective when correctly installed, so the pressure comes from the side it is designed to resist. Incorrect installation can lead to leakage and reduced efficiency, highlighting the importance of careful installation and proper seal selection. These seals are typically used in applications where the pressure is clearly defined, such as in hydraulic systems where the pressure only comes from one side.

Double acting seals

Unlike single acting seals, double acting seals are designed to withstand pressure from both sides, as shown in figure 6. This makes them particularly suitable for applications where the pressure may vary in direction, or where sealing is required against pressure from both the inside and outside. Double acting seals are more versatile and can, in many cases, reduce the risk of installation errors, as they do not require a specific installation direction to function properly

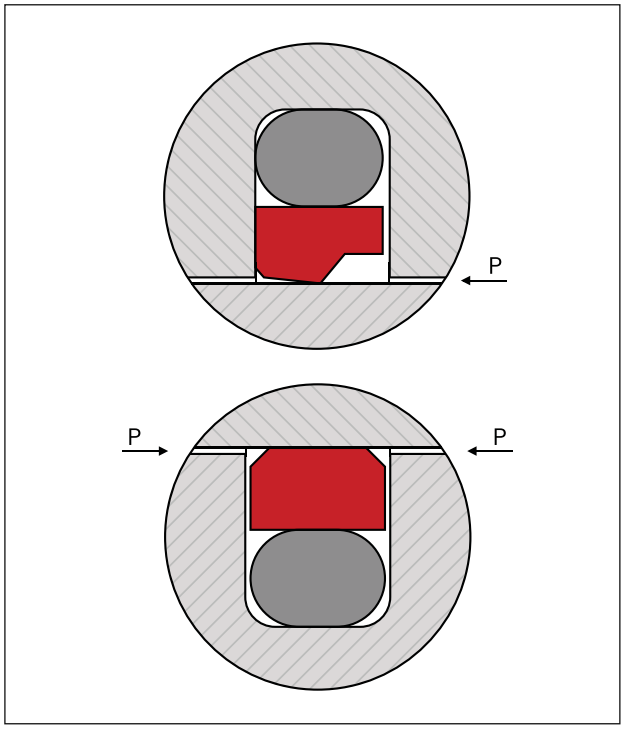


Figure 6: Single acting vs. double acting seal.

Notches

A 'notch' in the context of thermoplastic seals is a cut that runs across the thickness of the sealing element and acts as a passageway for the medium in the application, as shown in figure 7. The purpose of a notch is to ensure quick pressure equalization and activation of the seal during sudden changes in pressure or direction of movement. By adding notches on both sides of the seal, it can respond more quickly to pressure changes, improving its ability to maintain sealing capability under demanding operating conditions. Smaller seals often have two notches per side, while larger seals may have four or more notches per side, depending on the seal's application.

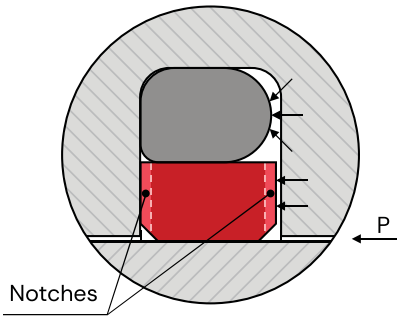


Figure 7: Double acting seal with notches on both sides.

Preload

Preload is an important factor in the design of rod and piston seals, where the sealing element is deliberately manufactured slightly smaller on the inner diameter and larger on the outer diameter, depending on the application. This sizing ensures that the seal always maintains contact with the opposing sealing surface, even with production tolerances in both the sealing element and surrounding components. The preload creates an initial sealing effect in combination with the activation force from an O-ring or spring.

Preload ensures constant contact pressure between the sealing element and the sealing surface, even before the system is pressurized. When the system is pressurized, the preload prevents the medium from passing the seal and causing leakage. Instead the medium is forced behind the sealing element, further activating the seal.

Without proper preload, there is a risk that the medium will flow underneath the seal and force it to the bottom of the groove, potentially causing leakage.

Series and versions of seals

When it comes to reciprocating and rotary thermoplastic seals, the cross-sectional size is often related to the seal's inner diameter. For many types of seals, these cross-sections are divided into series, typically classified as 0-series, 100-series, 200-series, 300-series, etc., depending on the type and application of the seal. The 0-series represents the smallest cross-section, with the series number increasing as diameters and cross-sections grow larger, as shown in figure 8.

For example, a standard 0-series for a typical single-acting reciprocating piston seal covers seals with a diameter from 8 to 16.9 mm. For seals with a diameter between 17 and 26.9 mm, a 100-series is typically used. This system ensures that smaller diameters are assigned a correspondingly smaller cross-section, as they often operate under less demanding conditions and therefore require a smaller seal. Smaller shafts tend to have less axial play, making it unnecessary to size the seal to compensate for large movements. Additionally, smaller shafts typically have tighter production tolerances measured in millimeters, meaning a smaller seal can be used since fewer millimeter deviations need to be compensated for due to these tolerances.

In addition to the standard series, there are also light and heavy versions. A light version represents a single step down in series size, meaning a seal with a smaller cross-section than the standard for the corresponding diameter can be used. For example, a seal that would normally require a 200-series might use a 100-series in a milder application. This results in space savings and can also be more cost-effective, as smaller cross-section seals is often cheaper.

Conversely, a heavy version represents a single step up in series size. This is chosen when operating conditions are more demanding, and a seal with a larger cross-section than the standard is needed. For instance, an application that would normally require a 200-series might instead use a 300-series to handle higher pressures or more challenging environments. This gives the seal increased wear resistance and durability under such demanding conditions.

The choice between standard, light, and heavy depends on the specific application requirements, and it is crucial to select the correct series and cross-sectional size to ensure optimal performance, longevity, and cost-effectiveness. See figure 8 for illustration.

Standard and custom-designed seals

Our catalog of thermoplastic seals includes a wide range of standard solutions, based on standardized seal designs and groove dimensions. This ensures consistent and predictable performance, allowing you to select the standard seal that best meets the application's requirements. In cases where a standard solution is not sufficient, we offer custom-designed sealing solutions. Haagensen's engineers are ready to develop customer-specific seals that meet special requirements for applications requiring unique solutions. This ensures optimal sealing, regardless of the complexity of the given application.

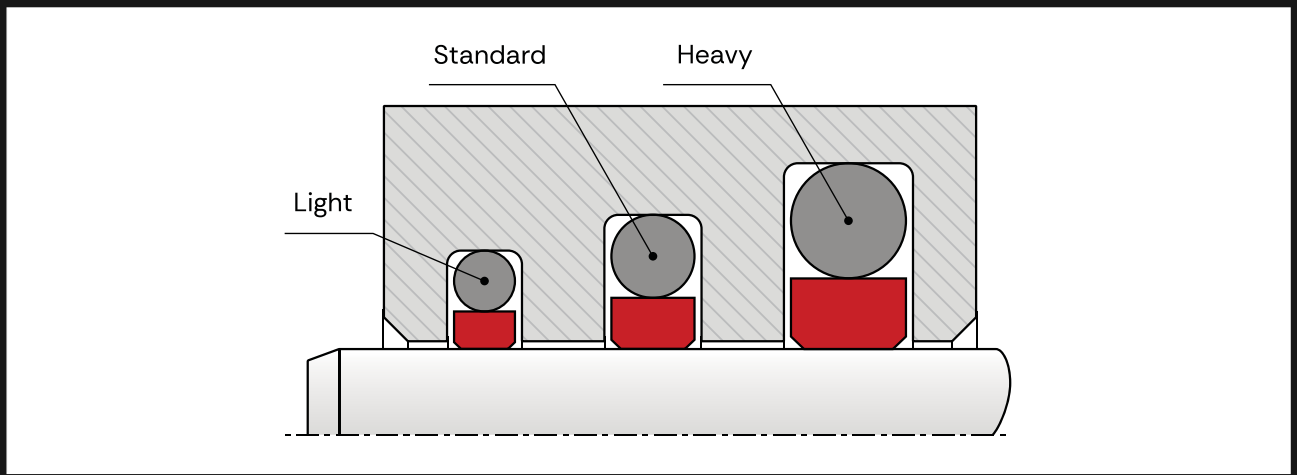


Figure 8: Different versions of a seal for the same shaft. Shown here are the light, standard, and heavy versions.

Overview of seal types

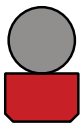
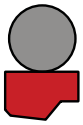
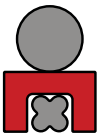
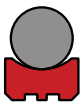
Seal		Version & working principle						Technical data			
Type	Page	Designation	Light	Standard	Heavy	Single act.	Double act.	Available diameter mm	Temp. °C	Speed m/s	Pressure MPa max.
Rod seals											
	28	HaaGlide R10	•	•	•		•	3 to 1000	NBR −27 to +100 FKM −10 to +200	15	60
	30	HaaStep R16	•	•	•	•		3 to 1000	NBR −27 to +100 FKM −10 to +200	15	60
	32	HaaCap R22		•			•	4 to 650	NBR −27 to +100 FKM −10 to +200	15	35
	34	HaaQuad R24		•			•	19 to 800	NBR −27 to +100 FKM −10 to +200	2	30
	36	HaaRoto R28		•			•	6 to 1000	NBR −27 to +100 FKM −10 to +200	1	20
	38	HaaSC Dynamic R32		•		•		3 to 1000	−200 to +260	15	40
	40	HaaSH Static R34		•		•		12 to 1000	−200 to +260	15	40

Table 1: Overview of seal types. Values under technical data depend on material selection, installation, and application.

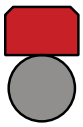
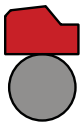
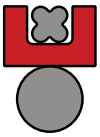
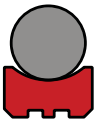
Seal		Version & working principle						Technical data			
Type	Page	Designation	Light	Standard	Heavy	Single act.	Double act.	Available diameter mm	Temp. °C	Speed m/s	Pressure MPa max.
Piston seals											
	44	HaaGlide P11	•	•	•		•	8 to 1000	NBR -27 to +100 FKM -10 to +200	15	60
	46	HaaStep P17	•	•	•	•		8 to 1000	NBR -27 to +100 FKM -10 to +200	15	60
	48	HaaCap P23		•			•	8 to 650	NBR -27 to +100 FKM -10 to +200	15	35
	50	HaaQuad P25		•			•	15 to 800	NBR -27 to +100 FKM -10 to +200	2	35
	52	HaaRoto P29		•			•	8 to 1000	NBR -27 to +100 FKM -10 to +200	1	20
	54	HaaSC Dynamic P33		•		•		6 to 1000	-200 to +260	15	40
	56	HaaSH Static P35		•		•		14 to 1000	-200 to +260	15	40
Scrapers											
	60	HaaScraper Light W96		•		•		6 to 1000	NBR -27 to +110 FKM -10 to +200	15	
	62	HaaScraper Heavy W98		•		•		20 to 1000	NBR -27 to +110 FKM -10 to +200	2	

Table 1: Continued from the previous page.

Seal		Version & working principle					Technical data			
Type	Page	Designation	Light	Standard	Heavy	Single act.	Double act.	Available diameter mm	Temp °C	Speed m/s	Pressure MPa max.
Wear rings											
	66	HaaWear Rod		•			•	8 to 1000	-30 to +90	15	5 N/mm² projected area
	68	HaaWear Piston		•			•	8 to 1000	-30 to +90	15	5 N/mm² projected area

Table 1: Continued from the previous page.

Thermoplastic materials

Material selection for sealing elements

Haagensen offers a wide range of PTFE materials and other polymers for the production of thermoplastic sealing elements. This allows us to meet your material needs across a variety of environmental and operational conditions.

In Table 2, you will find a selection of our most popular materials for thermoplastic seals. You can choose from materials that match the application's requirements and operating temperature.

Compound No.	Basic material	Description	Color	Temp °C	EC 1935:2004	No 10/2011	FDA 177.1550	Application
Haa15	PTFE	Virgin PTFE	White	-200 o +260				Ideal for static applications where a tight seal is required. Suitable for vacuum applications due to low gas permeability. Effective in cryogenic conditions, maintaining performance at very low temperatures.
Haa17	PTFE	PTFE + pigment	Turquoise	-200 to +260				Resembles virgin PTFE, but with improved creep resistance and wear strength.
Haa19	M. PTFE	Modified PTFE	White	-200 to +260				Resembles virgin PTFE, but with lower gas permeability and better resistance to extrusion. Suitable for applications with slow and infrequent movements. Also ideal for cryogenic conditions.
Haa23	PTFE	PTFE + glass + MoS_2 + pigment	Light grey	-200 to +260				The material has excellent wear resistance due to the built-in lubrication with MoS_2. It is suitable for high-pressure extrusion and rotary applications with high pressure and speed. Should only be used on hard counter surfaces due to its abrasive properties.
Haa27	PTFE	PTFE + glass	Light grey	-200 to +260				Improved resistance to both wear and extrusion. Should only be used on very hard counter surfaces due to the material's abrasive properties.
Haa29	PTFE	PTFE + carbon	Black	-200 to +260				Carbon improve creep resistance, increase flexural strength, and enhance hardness. The material has low thermal expansion and better electrical conductivity.
Haa31	PTFE	PTFE + carbon + graphite	Black	-200 to +260				This material is a versatile choice, often used in rotary applications. It performs exceptionally well in systems without lubrication, making it suitable for applications where lubricants are not possible or can only be used to a limited extent.

Table 2: Overview of thermoplastic materials.

Compound No.	Basic material	Description	Color	Temp °C	EC 1935:2004	No 10/2011	FDA 177.1550	Application
Haa37	PTFE	PTFE + bronze	Brown	-200 to +260				This high-filled material has excellent wear resistance and withstands high temperatures and pressure, making it ideal for high-speed applications. However, the chemical incompatibility of the filler may limit its use.
Haa41	PTFE	PTFE + ekonol	Beige	-200 to +260				This material is suitable for softer counter surfaces in dynamic applications and as a static seal at high temperatures. It offers excellent wear resistance with minimal abrasion but is not suitable for steam applications.
Haa45	POM-C	Virgin POM-C	Natur / Black	-40 to +100				The material is suitable for applications requiring high strength and dimensional stability. It has low friction, good wear resistance, and resists chemicals. Ideal for components under repeated movements, but not suitable for high temperatures.
Haa47	PUR	Virgin PUR	Natur / Black	-60 to +60				The material is suitable for applications requiring high wear resistance, flexibility, and impact resistance. It has good elastic properties and is ideal for components under constant movement, but is less suitable for use at high temperatures.
Haa49	UHMW-PE	Virgin UHMW-PE	White	-200 to +80				The material is known for its exceptional wear resistance and durability but has limited tolerance to both high temperatures and certain chemicals. It is best suited for applications with repetitive or very slow movements.
Haa51	PEEK natur	PEEK natur	Beige	-50 to +250				PEEK is a strong and durable material with excellent resistance to high temperatures and chemicals. It is well-suited for applications requiring high mechanical strength under demanding thermal and chemical conditions.
Haa90	PTFE	Food approved Virgin PTFE	White	-200 to +260	•	•	•	Ideal for static applications where a tight seal is required. Suitable for vacuum applications due to low gas permeability. Effective in cryogenic conditions, maintaining performance at very low temperatures.
Haa92	PTFE	Food approved PTFE + ekonol	Beige	-200 to +260	•	•	•	This material is suitable for softer counter surfaces in dynamic applications and as a static seal at high temperatures. It offers excellent wear resistance with minimal abrasion but is not suitable for steam applications.
Haa94	PEEK natur	Food approved PEEK natur	Beige	-50 to +250	•	•		PEEK is a strong and durable material with excellent resistance to high temperatures and chemicals. It is well-suited for applications requiring high mechanical strength under demanding thermal and chemical conditions.

Tabel 2: Continued from the previous page.

Rubber & spring materials

Material selection for activating elements

In addition to choosing the thermoplastic material for a sealing solution, selecting the right material for the seal's activating element is crucial. If the solution is activated by an O-ring, an appropriate elastomer must be selected based on the application's operating conditions, such as temperature, media, and pressure. The elastomer's resistance to these factors is vital for the system's performance and longevity.

When the seal is activated by a spring, it is important to choose a suitable alloy that can withstand the temperature and media. In Table 3, you will find a selection of our most commonly used materials for activating elements in thermoplastic seals. For guidance on special applications, our engineers are ready to provide advice and ensure the best solution for your situation.

Code	Type	Description	Application
B	Elastomer	NBR 70 ShA	NBR 70 ShA is a versatile elastomer with good resistance to oil, fuels, and wear. It is often used in seals, with temperatures up to 100°C.
R	Elastomer	NBR 90 ShA	NBR 90 ShA has the same properties as NBR 70 ShA but with higher hardness, making it suitable for applications with higher pressure.
F	Elastomer	FKM 75 ShA	FKM 75 ShA has excellent resistance to high temperatures and aggressive media. It is often used in applications where both thermal and chemical stability are critical.
K	Elastomer	FKM 90 ShA	FKM 90 ShA has the same properties as FKM 75 ShA but with higher hardness, making it suitable for applications with higher pressure.
S	Spring	Stainless steel AISI 301/302	301/302 stainless steel is suitable up to 315°C. In corrosive environments, it should be used below 200°C. It is a standard material for cantilevers and is cost-effective.
O	Spring	Stainless steel AISI 316/316L	316/316L stainless steel has increased corrosion resistance due to its higher nickel and molybdenum content. It is ideal for applications in food production and marine environments.
H	Spring	Hastelloy C-276	Hastelloy C-276 is known for its high resistance to a wide range of chemicals, including highly corrosive and oxidizing environments. It is used when corrosion resistance is critical.
E	Spring	Elgiloy 2.4711	Elgiloy 2.4711 offers excellent corrosion resistance, high strength, and flexibility. It is used in demanding applications where resistance to both chemicals and mechanical stress is required.

Table 3: Overview of available materials for activating elements.

Spring design

Selecting the right type of spring

The choice of spring for a spring-activated thermoplastic seal depends on the specific application and the requirements placed on the seal. The design of the springs plays a crucial role in the seal's performance, as different spring designs have unique advantages and are best suited for specific applications. Therefore, it is important to choose a sealing solution with the right spring to ensure optimal performance under the given operating conditions. Additionally, considering factors such as temperature variations, chemical exposure, and the mechanical stress the seal will face, can further enhance the effectiveness and durability of the seal.

Helical spring

The spiral-shaped helical spring is made from a flat metal strip wound into a spiral, as shown in figure 9. This spring design is primarily suited for static applications due to its high unit load. It can also be used in slow or infrequently rotating applications, as well as in dynamic, reciprocating movements where effective sealing is a top priority.

A helical spring distributes the load evenly over each coil, and the small gaps between the coils ensure a nearly constant load, reducing the risk of leakage. The tight spiral shape and high unit load make the spring ideal for vacuum and cryogenic applications, or when the pressure is too low to activate the seal otherwise.

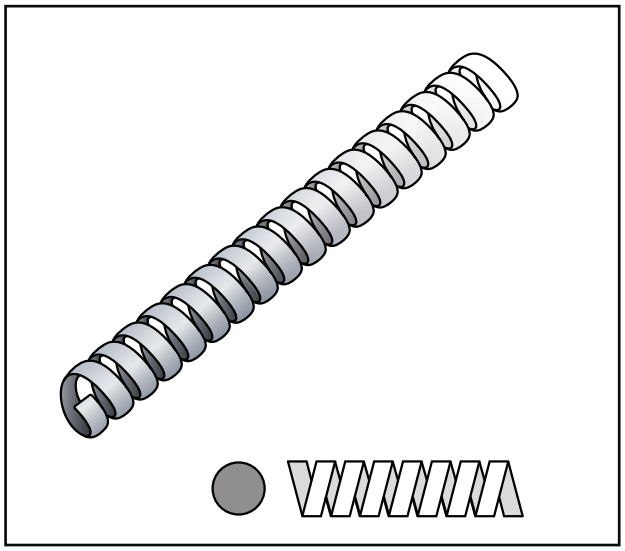


Figure 9: Illustration of a helical spring.

However, helical springs have limited deformation ability, making them less suitable for applications with large groove tolerances, eccentricity, or misalignment.

Recommended applications helical:

- Static seals for rods, pistons, and flanges
- Vacuum and cryogenic applications
- Slow rotating or reciprocating applications

Cantilever spring

A cantilever spring is made from a flat metal strip shaped in a twisted pattern and bent into a round 'V' shape, as shown in figure 10. This spring is particularly well-suited for dynamic applications involving rotating or reciprocating movements. It can also be used in static situations where greater deformation is required due to wide groove tolerances.

The spring's unique geometry, with individual tabs separated by small gaps, provides some flexibility, making it suitable for both radial and face seals.

Recommended applications cantilever:

- Rotating shafts
- Reciprocating rod and piston seals
- Applications with large tolerances

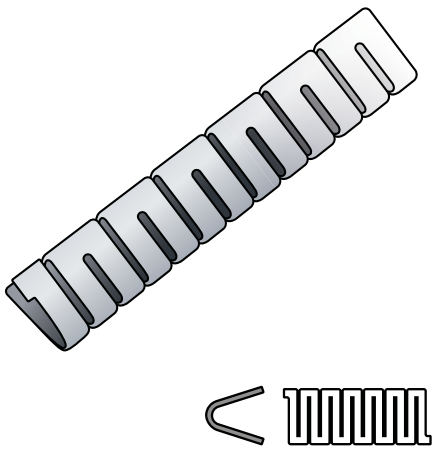


Figure 10: Illustration of a cantilever spring.

Haagensen
Sealing Solutions

3 ROD SEALS

Rod seals ensure reliable sealing around shafts in reciprocating or rotating movements. They prevent the leakage of fluids and gas, making them ideal for both hydraulic and pneumatic systems. Explore our range of rod seals and their applications.

Hardware & mounting

Guiding chamfers

To avoid potential damage to the rod seal during installation, it is essential to incorporate a 15° lead-in chamfer along with rounded edges on the piston rods, as illustrated in figure 11. This chamfer ensures that the seal is gently guided into place without risk of deformation or damage, allowing sufficient clearance for the seal assembly to sit freely after calibration. In cases where design limitations prevent the inclusion of such chamfers, the use of a specialized installation tool is strongly recommended to ensure safe and effective installation.

The minimum required length for the lead-in chamfer (L_{min}) depends on the specific profile size of the seal, as indicated in the accompanying tables. For HaaCap seals, an L value of at least 2.5% of the rod diameter is advised to provide adequate lead-in length, particularly crucial for larger diameter rods. Ensuring the correct chamfer angle and length minimizes the risk of misalignment during installation and enhances the overall lifespan and reliability of the seal assembly.

O-ring energized seals

Groove width G	Chamfer lenght L_{MIN}
2,2	2,5
3,2	3,0
4,2	3,5
6,3	5,0
8,1	6,5
9,5	7,5

Tabel 4: Chamfer lenghts for O-ring energized rod seals.

HaaCap seals

O-ring cross section	Chamfer*lenght L_{MIN}
1,78	2,5
2,62	3,0
3,53	3,5
5,33	5,0
6,99	6,5
8,40	7,5

Tabel 5: Chamfer lenghts for O-ring energized HaaCap rod seals.

** Not less than 2,5% of the rod diameter*

Spring energized seals

Groove width G	Chamfer lenght L_{MIN}
2,4	4,5
3,6	5,0
4,8	5,0
7,1	7,5
9,5	12,0

Tabel 6: Chamfer lenghts for spring energized rod seals.

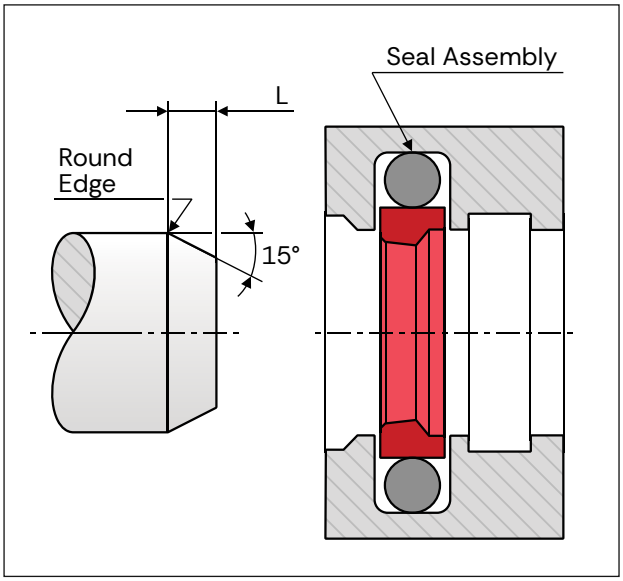


Figure 11: Guiding chamfers

Surface roughness

Achieving an adequate surface finish of the seal groove is crucial for ensuring effective sealing and extending seal life, particularly in dynamic applications where movement can increase wear on the seal. When surface roughness is excessive, it can create leakage paths that compromise the seal's integrity and accelerate wear on the material. For seals made from PTFE, the material's high durability and low friction properties allow it to glide smoothly over surface irregularities, reducing abrasion and enhancing long-term performance.

To maximize seal effectiveness and lifespan, the specific surface roughness guidelines outlined in table 7 should be adhered to. These recommendations help maintain the optimal contact between the seal and mating surface, which is especially important in applications with frequent or continuous movement. In dynamic environments, surfaces with greater roughness levels are prone to higher wear rates, potentially reducing the overall longevity of the seal and affecting its ability to perform under stress.

Surface roughness R_a (µm)		
Media	**Dynamic use**	**Static use**
Cryogenics	0,1 to 0,2	0,1 to 0,2
Freon Hydrogen Helium	0,1 to 0,2	0,2 to 0,4
Air Nitrogen Natural gas Fuel	0,2 to 0,4	0,4 to 0,8
Water Hydraulic oil Crude oil	0,2 to 0,4	0,4 to 1,6

Tabel 7: Surface roughness depending on media.

In dynamic reciprocating applications, relying solely on a maximum R_a value is insufficient for fully assessing the suitability of a surface finish, as this value alone does not account for the complete texture of the surface. Surfaces with different textural patterns can share similar R_a values, yet exhibit vastly different impacts on sealing performance and resistance to abrasion.

Therefore, for optimal performance, table 8 provides a recommended combination of surface roughness parameters, for an example with a R_a of 0,2 max, in order to achieve the most desirable plateau profile. This plateau structure offers smoother contact with the seal in dynamic reciprocating applications, reducing the risk of premature wear and ensuring a more consistent sealing function over time.

Advised surface roughness dynamic use (µm)		
Average roughness	R_a	0,2 max
Average peek-to-peak height	R_z	1,2 max
Maxiumum peek height	R_p	0,2 max
Bearing ratio (%)	t_p	60% min. with a reference line located at 0,25 Rz if Rz>1 0,5 Rz if Rz<1

Tabel 8: Roughness parameters for dynamic rod seals.

Seal groove spacing

When installing tandem seal arrangements or double-acting scraper seals in combination with rod seals that incorporate back-pumping featuresl, we suggest the following setup:

- The distance between seal grooves and/or the scraper seal groove (S) should be at least equal to the groove depth Y.
- An oil reservoir should be included to capture the returning oil, as illustrated in figure 12.

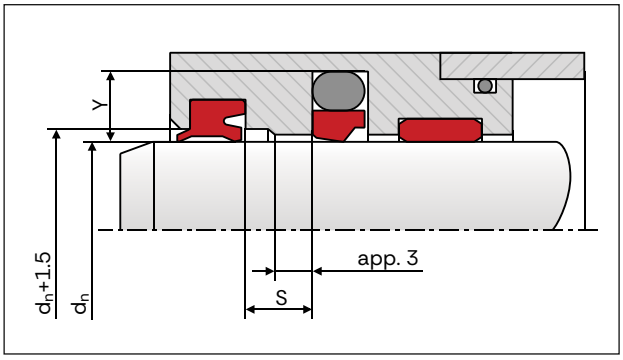


Figure 12: Seal groove spacing.

Installation instructions

Proper seal installation is critical to ensuring optimal performance, durability, and leak prevention in the final assembly. Following the steps below precisely ensures that the seal is correctly positioned, secure, and ready to withstand operational demands.

- Ensure the piston rod has a suitable lead-in chamfer; if not, a calibration mandrel should be used as shown in figure 17.
- Deburr or round off any sharp edges, and cover the tips of screw threads to prevent damage.
- Clear away any machining residue or other foreign particles, and thoroughly clean all components.
- Applying grease or oil can ease seal installation; however, ensure compatibility between the seal material and the chosen lubricant. Only use grease without solid additives.
- Avoid using tools with sharp edges that could damage the seal.

Installation in split grooves

Installing seals in split grooves is straightforward. The order of installation should match the configuration of the seal, ensuring that individual seal elements remain untwisted as shown in figure 13. During final assembly (inserting the piston rod into the seal), O-ring or spring-energized seals should be calibrated. The piston rod, if it has an extended lead-in chamfer, can serve this purpose. Otherwise, a calibration mandrel should be employed.

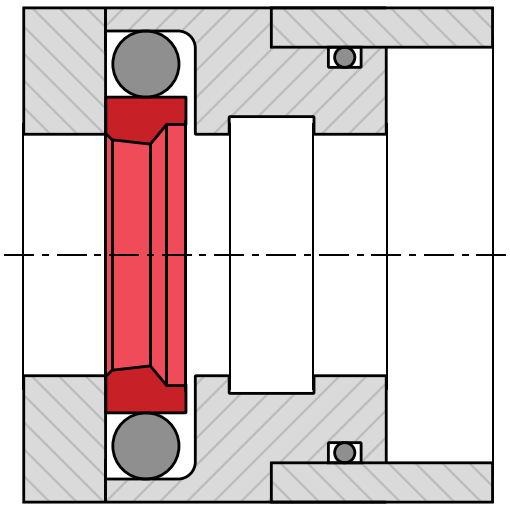


Figure 13: Installation in split groove.

Installation in closed grooves

To install O-ring activated seals in closed grooves, follow the instructions detailed below. For seals made of polyurethane, using dedicated installation tools is advised. If no installation tools are available, use the same sequence as for O-ring activated seals:

- Insert the O-Ring into the groove (not required for U-Cup seals).
- Compress the seal into a kidney shape, avoiding sharp bends (see figure 15). When folding a rod seal with notches, be cautious to avoid bending at the notches to prevent overstretching or damaging the seal material.
- Position the compressed seal ring within the groove, pressing it against the O-Ring and reshaping it into a complete ring (see figure 16).
- Finally, size the seal ring with a mandrel that has a 15° chamfer, extending over at least twice the minimum lead-in chamfer length Z_{min} (see table 4).

The calibration mandrel should be made from a polymer material, such as polyamide, which provides excellent sliding characteristics and a smooth and high-quality surface finish. This is essential to prevent any scratching, tearing, or deformation of the seals during the calibration process. A polymer-based mandrel minimizes friction, allowing the seal to move into its position without excessive resistance or risk of abrasion. If a calibration mandrel is not available, the piston rod itself can serve this purpose, as long as it has a lead-in chamfer that is sufficiently long.

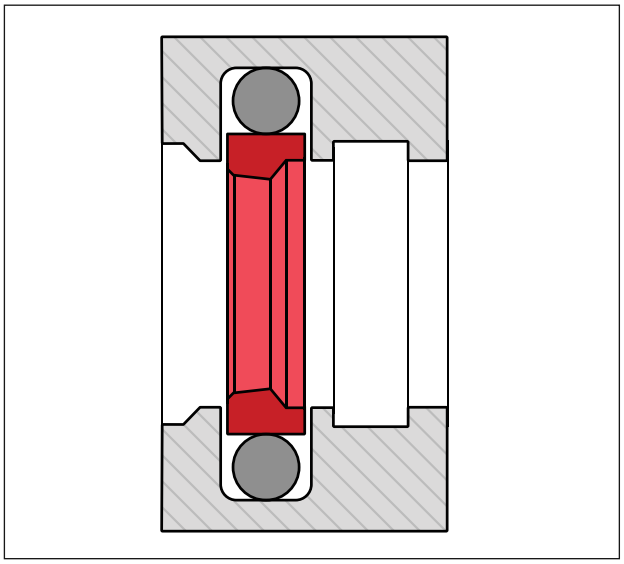


Figure 14: Installation in closed groove.

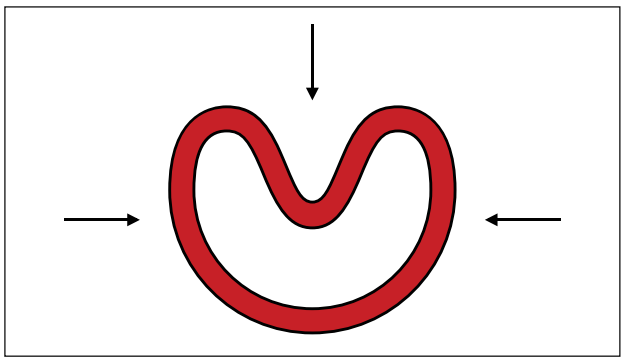


Figure 15: Deformation of the seal ring into kidney-shape.

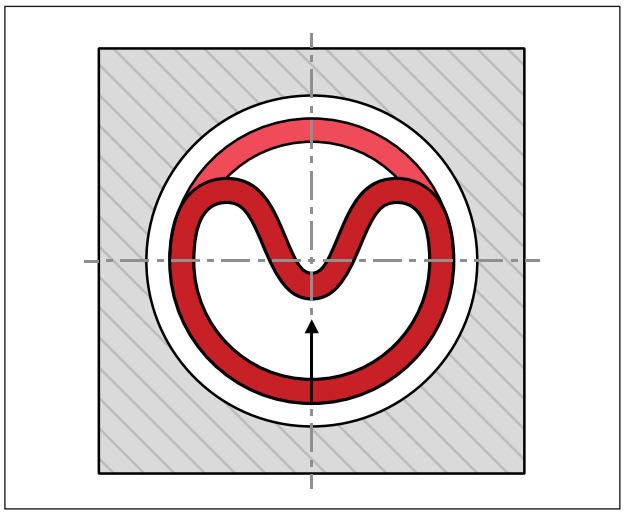


Figure 16: Insertion of the seal ring into the closed groove

Installation of HaaQuad rod seal

To install HaaQuad rod seals, follow the standard procedure for installation in either split or closed grooves. However, a key distinction with HaaQuad seals is that the Quad-ring component should not be placed in the seal groove until the thermoplastic sealing element has been fully calibrated and securely positioned within its designated groove. This step ensures that the thermoplastic seal is correctly aligned and seated before any additional components are introduced, which is crucial for maintaining the integrity of the seal.

When installing the Quad-ring within the thermoplastic seal, take extra care to verify that it is not twisted or misaligned. A twisted Quad-ring can create uneven pressure points and distort the sealing surface, leading to potential leaks and premature seal failure. Ensuring a smooth, untwisted Quad-ring placement is essential for effective sealing performance, especially under dynamic conditions where fluctuating pressures may exacerbate any misalignment or weaknesses.

Proper installation of the Quad-ring and thermoplastic element enhances the seal's performance and longevity, especially in applications where the seal may be subjected to high pressures or repetitive movements.

Following these guidelines will reduce the risk of seal degradation, leakage, or mechanical failure, thus ensuring that the HaaQuad rod seal functions reliably throughout its operational life.

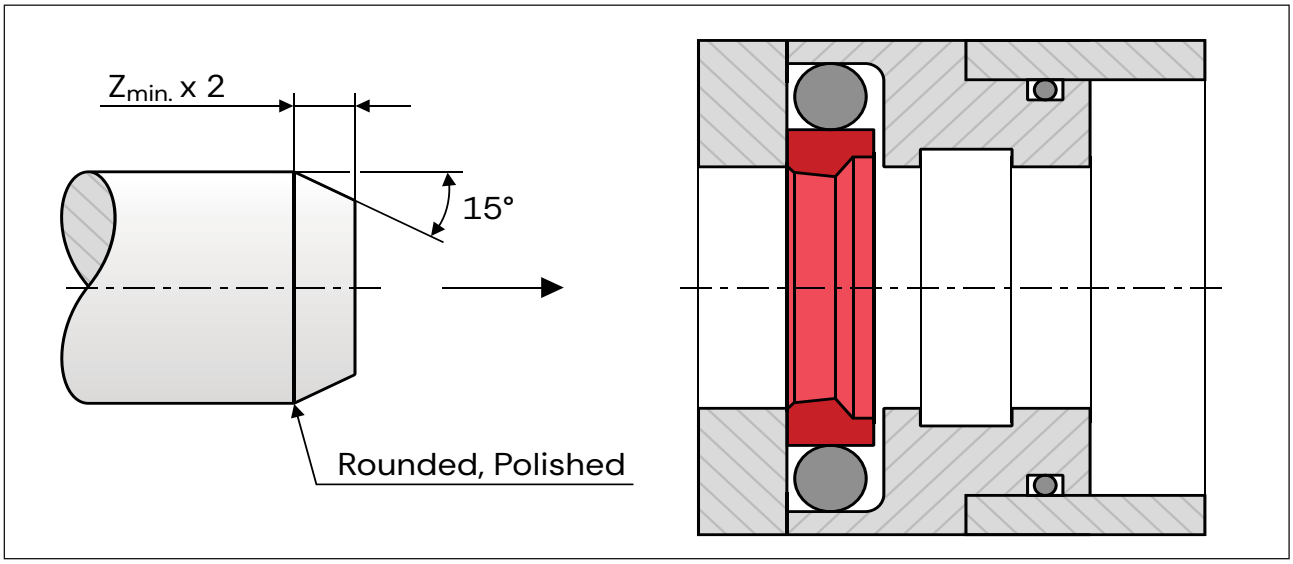


Figure 17: Calibration of the seal once it is installed.

Installation of HaaCap rod seal

Proper seal installation is critical to ensuring optimal performance, durability, and leak prevention in the final assembly. Following the steps below precisely ensures that the seal is correctly positioned, secure, and ready to withstand operational demands.

- Begin by placing the O-ring into the groove to provide the initial support for the HaaCap seal.
- Compress the HaaCap seal into a kidney shape, taking care to avoid sharp bends that could stress the material (see figure 18). For rod seals with notches, ensure that the seal is not bent at the notched areas, as this may lead to overstretching or damage to the seal material.
- Insert the compressed seal ring into the groove, pressing it gently against the O-ring in the indicated direction by hand (see figure 19). For diameters smaller than 30 mm, the use of an insertion tube is recommended to ease the process and minimize the risk of damaging the seal (see figure 20).
- Lastly, size the seal ring using a calibration mandrel (see figure 21), which should have a chamfer angle of 15° over a minimum length of twice the lead-in chamfer length Z_{min}, as specified in table 5. This chamfer facilitates the correct positioning of the seal without causing deformation or wear.

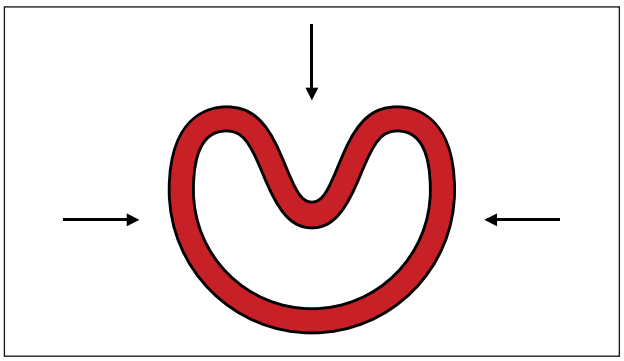


Figure 18: Deformation of the seal ring into kidney-shape.

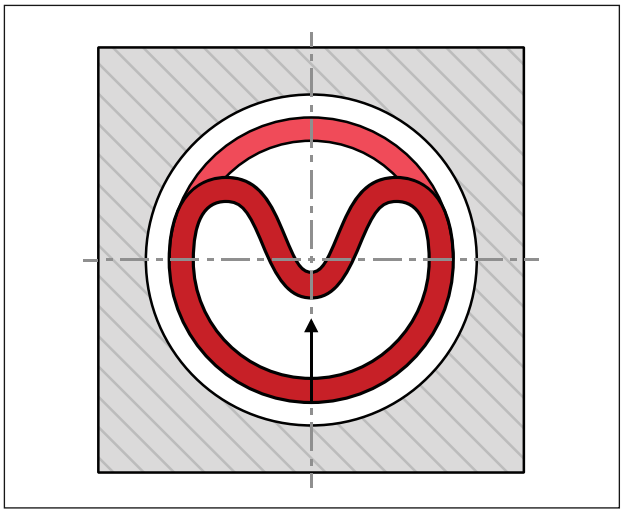


Figure 19: Insertion of the seal ring into the closed groove

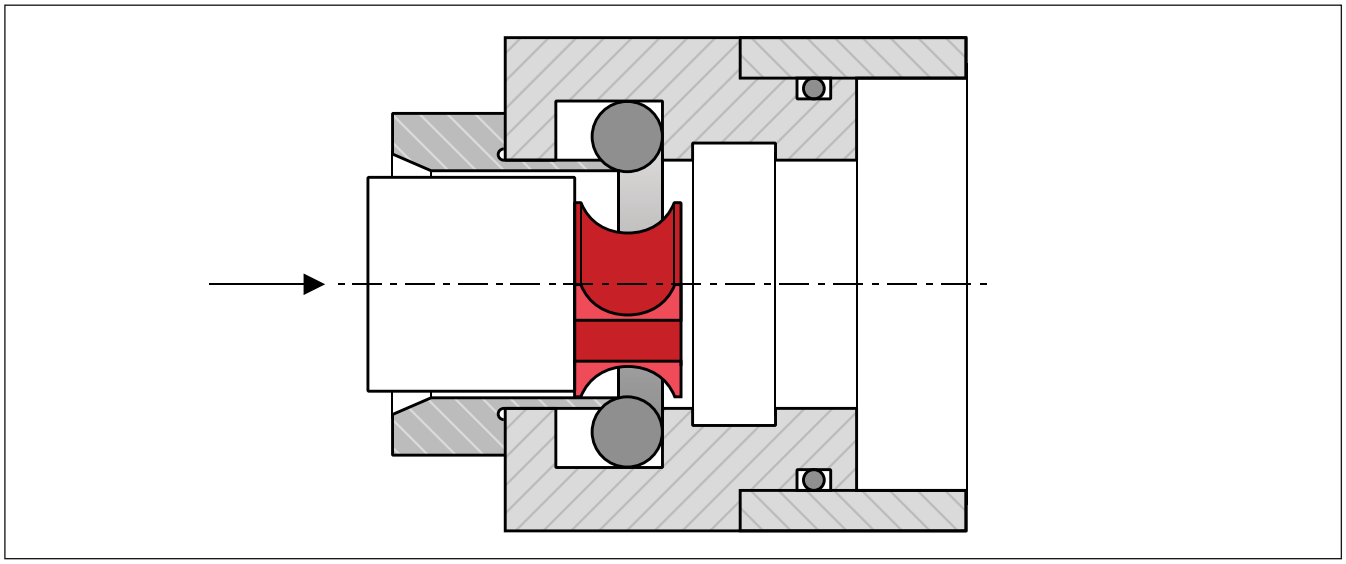


Figure 20: Installation of a HaaCap seal with an insertion tube.

Installation of spring energized seals

Spring energized seals are ideally suited for installation in split grooves, as this configuration allows for straightforward placement without excessive stress on the seal material. Installing these seals in split grooves ensures that the spring element remains properly aligned and reduces the risk of misalignment or damage during assembly.

In certain cases, installation in half-open grooves is also feasible, provided a snap fitting technique is used, as illustrated in figure 22 and specified in table 9. When installing in half-open grooves, extra care should be taken to ensure that the seal seats securely without twisting or deformation, as improper alignment can compromise sealing effectiveness.

Groove width G	X_{min}	$d_{N\,min}$	Chamfer lenght L_{MIN}	C_{min}
2,4	0,4	20,0	4,5	0,70
3,6	0,6	30,0	5,0	1,10
4,8	0,7	35,0	5,0	1,25
7,1	0,8	40,0	7,5	1,40
9,5	0,9	45,0	12,0	1,60

Tabel 9: Half-open groove specifications.

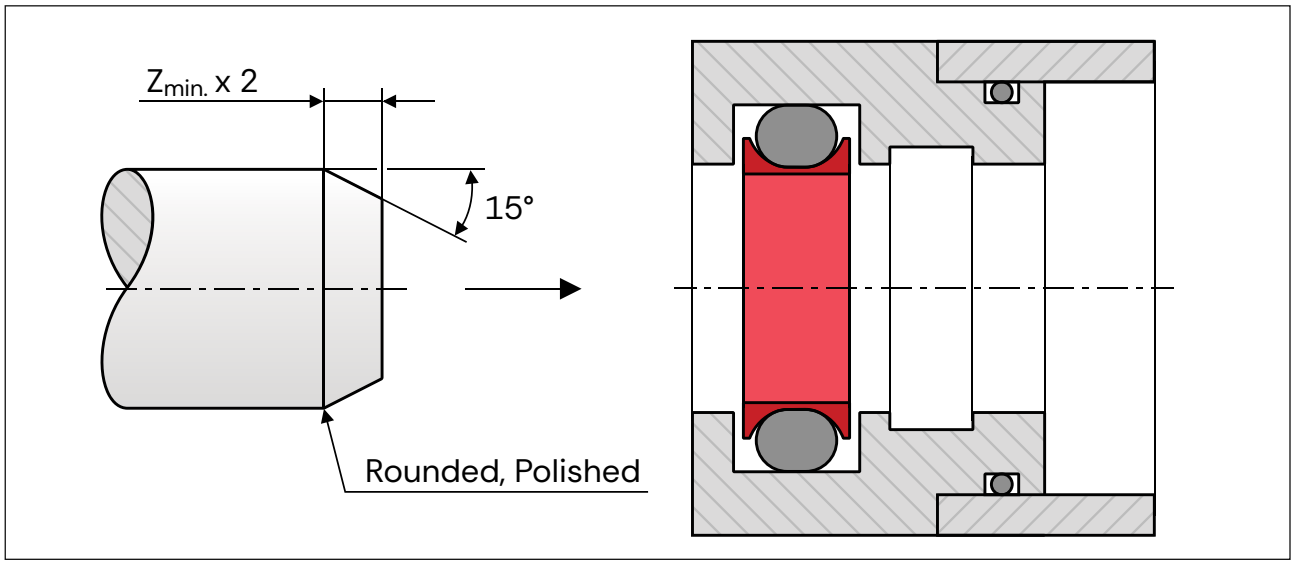


Figure 21: Calibration of a HaaCap seal once installed.

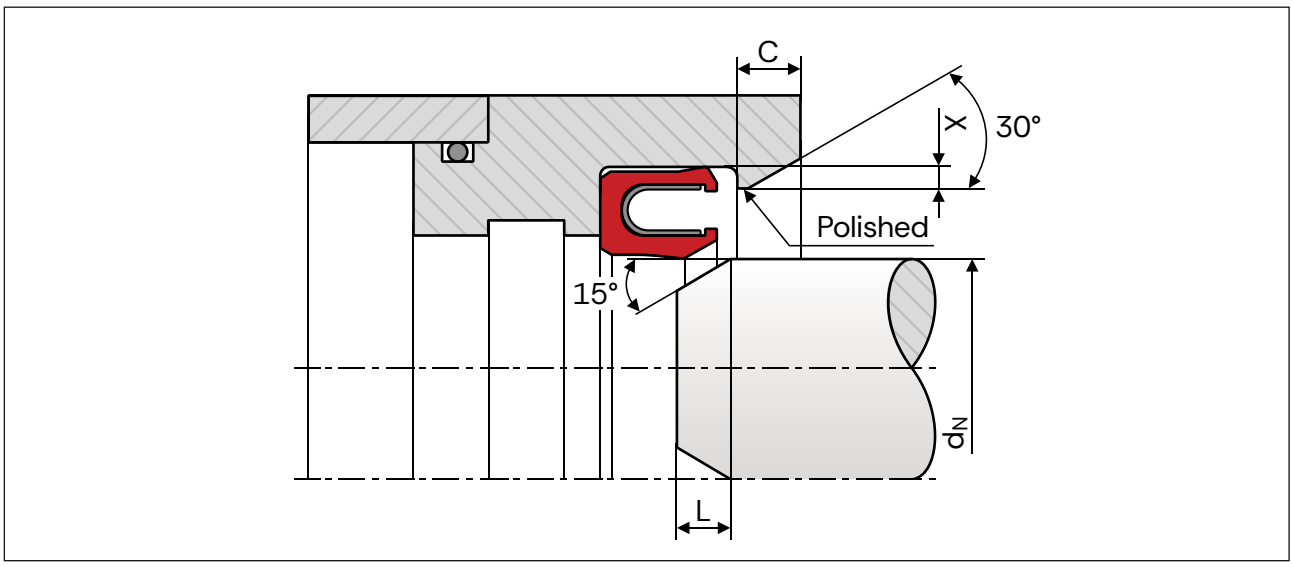


Figure 22: Installation of a spring energized seal in a half-open groove.

HaaGlide R10

Description

HaaGlide R10 is a reliable and efficient low-friction seal, suited for double-acting applications in both high- and low-pressure systems. Its compact design makes it ideal for small groove dimensions, ensuring excellent dimensional stability and high resistance to extrusion.

HaaGlide R10 can also be supplied with notches for pressure activation, even during rapid pressure changes. The combination of low-friction properties and the ability to handle changing pressure makes it a great choice for demanding environments, where reliable sealing and long service life are crucial.

Advantages

- Excellent wear resistance
- Can also be used for single-acting applications
- High resistance to extrusion
- Good sealing capability under small installation conditions
- No stick-slip
- Can be used for small grooves
- Minimal start-up and dynamic friction ensures smooth movement, even at low speeds
- Suitable for most hydraulic fluids and compatible with a wide range of modern hardware materials and surface treatments, depending on the material used

Application examples

- Jacks
- Brake boosters
- Hydraulic motors
- Servo cylinders
- Valves for hydraulic and pneumatic circuits
- Valve stems
- Presses
- Machine tools
- Injection molding machines

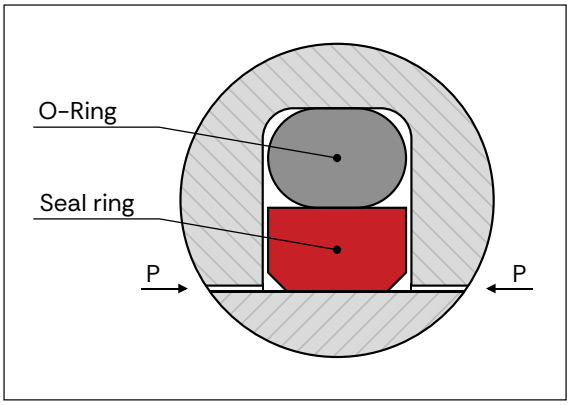


Figure 23: HaaGlide R10

Working conditions

Speed:	15 m/s
Pressure:	60 MPa
Action:	Double acting
Activation:	O-ring
Standard:	ISO 7425-2
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø3 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

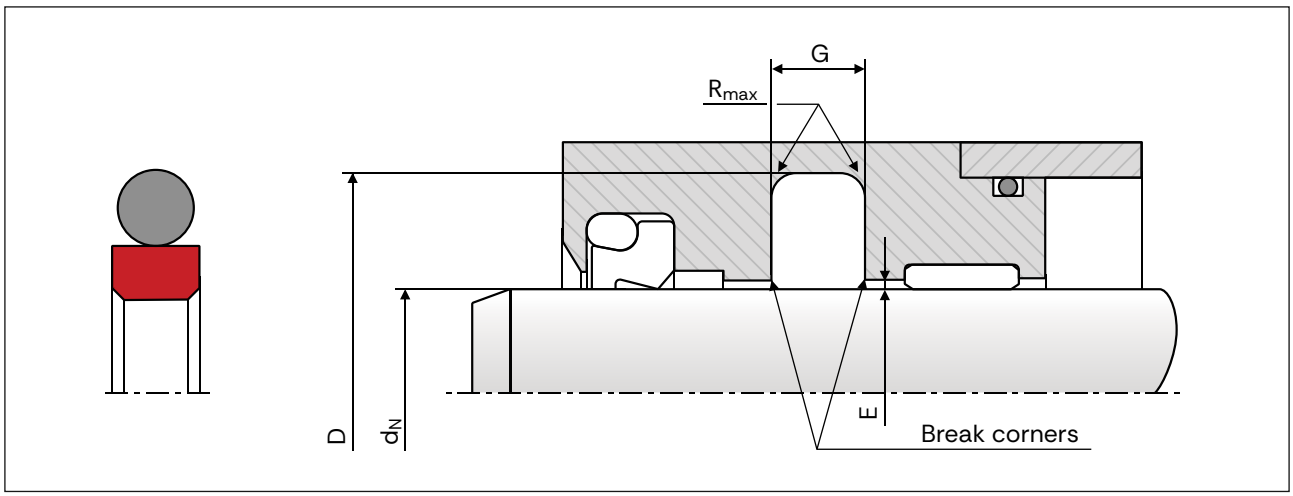


Figure 24: Assembly drawing for HaaGlide R10.

R10	D H9	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9			Max radial gab E			O-ring
				Light	Standard	Heavy	10 MPa	20 MPa	40 MPa	Cross section
00	d_N + 4,9	2,2	0,4	8 - 18,9	3 - 7,9	-	0,30	0,20	0,15	1,78
01	d_N + 7,3	3,2	0,6	19 - 37,9	8 - 18,9	-	0,40	0,25	0,15	2,62
02	d_N + 10,7	4,2	1,0	38 - 199,9	19 - 37,9	8 - 18,9	0,40	0,25	0,20	3,53
03	d_N + 15,1	6,3	1,3	200 - 255,9	38 - 199,9	19 - 37,9	0,50	0,30	0,20	5,33
04	d_N + 20,5	8,1	1,8	256 - 649,9	200 - 255,9	38 - 199,9	0,60	0,35	0,25	6,99
05	d_N + 24,0	8,1	1,8	650 - 999,9	256 - 649,9	200 - 255,9	0,60	0,36	0,25	6,99
06	d_N + 27,3	9,5	2,5	-	650 - 999,9	256 - 649,9	0,70	0,50	0,30	8,40

Tabel 10: Recommended standard installation dimensions for HaaGlide R10. For pressures above 40 MPa, use diameter tolerances H7/f7 (bore/rod) or contact Haagensen A/S for advice.

Order example

HaaGlide R10 standard for a Ø40 mm rod

Article number:	R1003	0400	37	B	N
Series					
Rod d_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaStep R16

Description

HaaStep R16 is a robust and reliable seal, designed to ensure optimal sealing and fluid control in hydraulic systems. Its unique design creates a high contact pressure gradient on the high-pressure side and a lower gradient on the low-pressure side, minimizing fluid accumulation on the rod during the outstroke. This allows the remaining fluid film on the rod to be drawn back into the system during the return stroke, reducing fluid loss and increasing efficiency.

HaaStep R16 is an ideal choice for applications where fluid control is crucial during both the outward and return strokes.

Advantages

- High static and dynamic sealing efficiency
- No stick-slip
- High wear resistance, high operational reliability
- Can be used for small grooves
- Low friction, high efficiency
- Good energy efficiency due to low friction
- Simple installation without deformation of the seal's edge
- Suitable for most hydraulic fluids and compatible with a wide range of modern hardware materials and surface treatments, depending on the material used

Application examples

- Servo cylinders
- Shock absorbers
- Automotive industry
- Wind turbines
- Presses
- Injection molding machines
- Standard cylinders
- Mining
- Mobile hydraulic systems

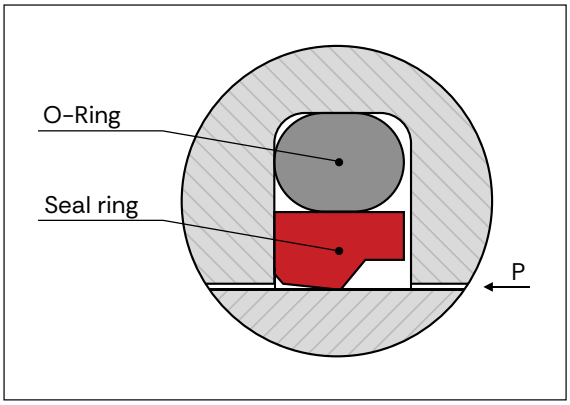


Figure 25: HaaStep R16.

Working conditions

Speed:	15 m/s
Pressure:	60 MPa
Action:	Single acting
Activation:	O-ring
Standard:	ISO 7425-2
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø3 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

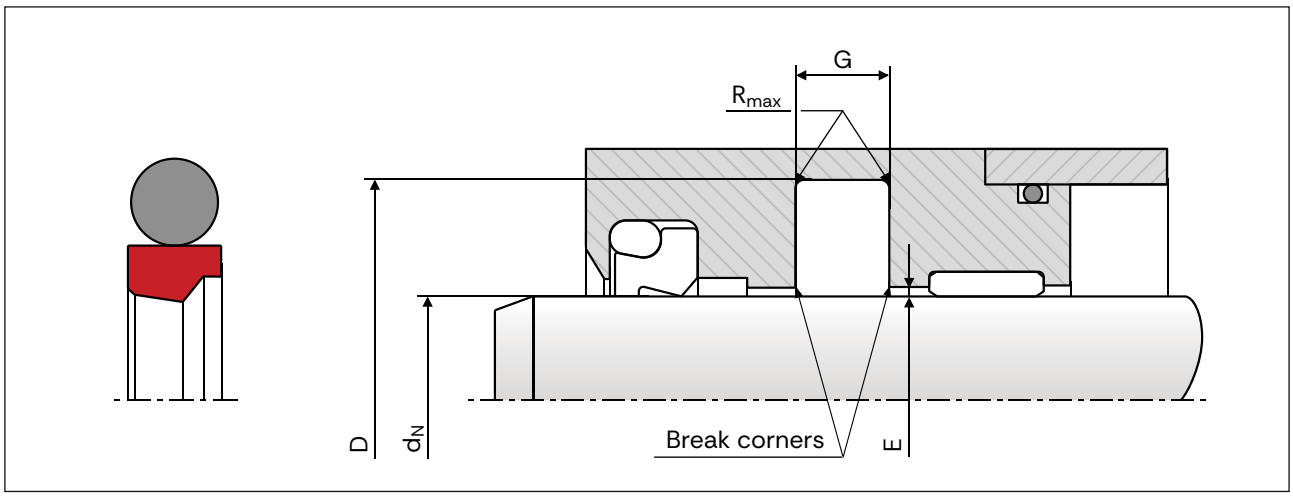


Figure 26: Assembly drawing for HaaStep R16.

R16	D H9	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9			Max radial gab E			O-ring
				Light	Standard	Heavy	10 MPa	20 MPa	40 MPa	Cross section
00	d_N + 4,9	2,2	0,4	8 - 18,9	3 - 7,9	-	0,30	0,20	0,15	1,78
01	d_N + 7,3	3,2	0,6	19 - 37,9	8 - 18,9	-	0,40	0,25	0,15	2,62
02	d_N + 10,7	4,2	1,0	38 - 199,9	19 - 37,9	8 - 18,9	0,40	0,25	0,20	3,53
03	d_N + 15,1	6,3	1,3	200 - 255,9	38 - 199,9	19 - 37,9	0,50	0,30	0,20	5,33
04	d_N + 20,5	8,1	1,8	256 - 649,9	200 - 255,9	38 - 199,9	0,60	0,35	0,25	6,99
05	d_N + 24,0	8,1	1,8	650 - 999,9	256 - 649,9	200 - 255,9	0,60	0,36	0,25	6,99
06	d_N + 27,3	9,5	2,5	-	650 - 999,9	256 - 649,9	0,70	0,50	0,30	8,40

Tabel 11: Recommended standard installation dimensions for HaaStep R16. For pressures above 40 MPa, use diameter tolerances H7/f7 (bore/rod) or contact Haagensen A/S for advice.

Order example

HaaStep R16 standard for a Ø40 mm rod

Article number:	**R1603**	**0400**	**37**	**B**	**N**
Series					
Rod d_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaCap R22

Description

HaaCap R22 is an O-ring activated seal that enhances the O-ring's performance in terms of wear, friction, and stick-slip effect. It consists of an O-ring and a thermoplastic jacket, which reduces contact between the O-ring and moving surfaces. This makes HaaCap R22 ideal for reciprocating applications, as the jacket is activated by the O-ring and prevents stick-slip.

HaaCap R22 can be installed in standard O-ring grooves and retains dimensional stability even under varying pressure. For applications with rapid pressure changes, it can be supplied with radial notches, which help activate the O-ring and ensure optimal sealing.

Advantages

- Low friction without stick-slip
- Can be used in existing O-ring grooves
- Can be used for small grooves
- High resistance to extrusion
- High wear resistance

Application examples

- Valves
- Mobile hydraulic systems
- Chemical process equipment

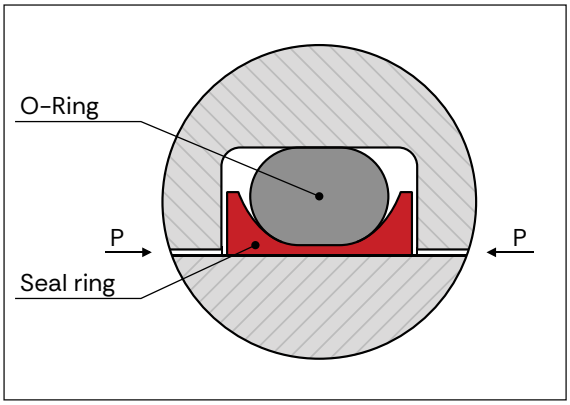


Figure 27: HaaCap R22.

Working conditions

Speed:	15 m/s
Pressure:	35 MPa
Action:	Double acting
Activation:	O-ring
Standard:	AS4716D
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø4 to Ø650
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

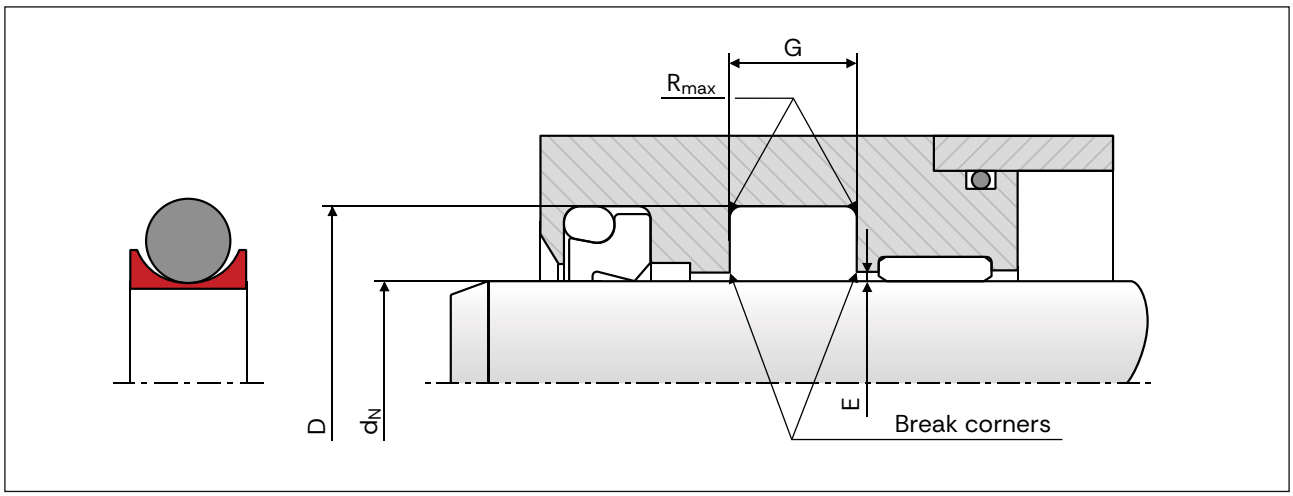


Figure 28: Assembly drawing for HaaCap R22.

R22	D H9	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	Max radial gab E				O-ring
				Standard	2 MPa	10 MPa	20 MPa	40 MPa	Cross Section
00	d_N + 2,9	2,4	0,4	4 - 9,9	0,10	0,10	0,08	0,05	1,78
01	d_N + 4,5	3,6	0,4	10 - 19,9	0,15	0,15	0,10	0,07	2,62
02	d_N + 6,2	4,8	0,6	20 - 39,9	0,25	0,20	0,15	0,08	3,53
03	d_N + 9,4	7,1	0,8	40 - 119,9	0,35	0,25	0,20	0,10	5,33
04	d_N + 12,2	9,5	0,8	120 - 649,9	0,50	0,30	0,25	0,15	6,99

Tabel 12: Recommended standard installation dimensions for HaaCap R22.

Order example

HaaCap R22 standard for a Ø40 mm rod

Article number:	R2203	0400	37	B	N
Series					
Rod d_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaQuad R24

Description

HaaQuad R24 is a double-acting seal that consists of an O-ring, a Quad-ring, and a thermoplastic sealing element. The O-ring acts as the activating element, ensuring both initial contact pressure and sustained dimensional stability, even under changing operating conditions.

By combining the thermoplastic sealing element with a Quad-ring, the advantages of the low-friction material are achieved along with the excellent sealing effect of the elastomeric element. This optimizes leakage control while minimizing friction for extended lifespan and increased reliability.

Advantages

- High static and dynamic sealing efficiency
- High resistance to extrusion
- Low friction, high efficiency
- Can be used for small grooves
- No stick-slip
- High operational stability
- Effective sealing in applications requiring separation of media, e.g., liquid/gas
- Utilizes the advantages of combining thermoplastic low-friction materials and an elastomeric Quad-ring

Application examples

- Mobile hydraulic systems
- Presses
- Injection molding machines
- Standard cylinders
- Servo cylinders

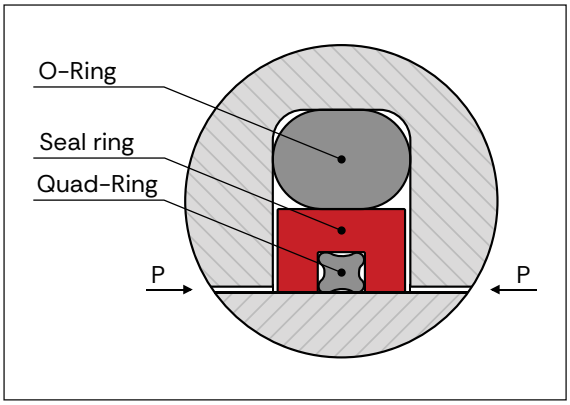


Figure 29: HaaCap R24.

Working conditions

Speed:	15 m/s
Pressure:	35 MPa
Action:	Double acting
Activation:	O-ring
Standard:	AS4716D
Temperature:	NBR: -27 to +100 °C FKM: -10 to +200 °C
Diameter:	Ø4 to Ø650
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

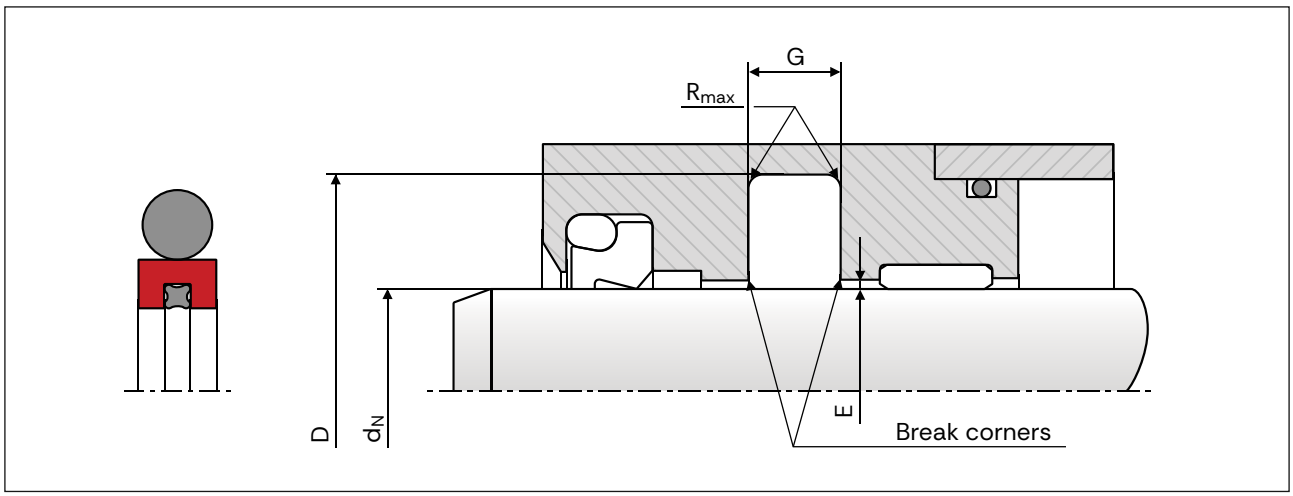


Figure 30: Assembly drawing for HaaCap R24.

R24	D H9	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	Max radial gab E			O-ring	Q-ring
				Standard	10 MPa	20 MPa	40 MPa	Cross section	Cross section
02	d_N + 10,7	4,2	1,0	19 - 37,9	0,25	0,15	0,10	3,53	1,78
03	d_N + 15,1	6,3	1,3	38 - 199,9	0,30	0,20	0,15	5,33	1,78
04	d_N + 20,5	8,1	1,8	200 - 255,9	0,30	0,20	0,15	6,99	2,62
03	d_N + 24,0	8,1	1,8	256 - 649,9	0,30	0,20	0,15	6,99	2,62
04	d_N + 27,3	9,5	2,5	650 - 799,9	0,45	0,30	0,25	8,4	3,53

Tabel 13: Standard anbefalinger for spormål til HaaQuad R24.

Order example

HaaQuad R24 standard for a Ø40 mm rod

Article number:	R2403	0400	37	B	N
Series					
Rod d_N x 10					
Material (Seal)					
Material (Elastomer)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaRoto R28

Description

HaaRoto R28 is a rotary seal consisting of a thermoplastic jacket that reduces friction and wear on the rotating surface, as well as an elastomeric O-ring that activates the seal and ensures effective sealing on the static side. The compressed O-ring provides sealing at low pressures. The material properties of the thermoplastic jacket ensure that the system is free from stick-slip effects.

HaaRoto R28 is double-acting, meaning it operates effectively regardless of pressure direction. The seal guarantees reliable sealing between the rotating surface and the seal jacket.

Advantages

- Low friction without stick-slip
- Excellent dimensional stability
- Can be used for small grooves
- High resistance to extrusion
- High wear resistance

Application examples

- Swivel joints
- Pump seals
- Motor shaft seals
- Gearboxes
- Water and wastewater treatment

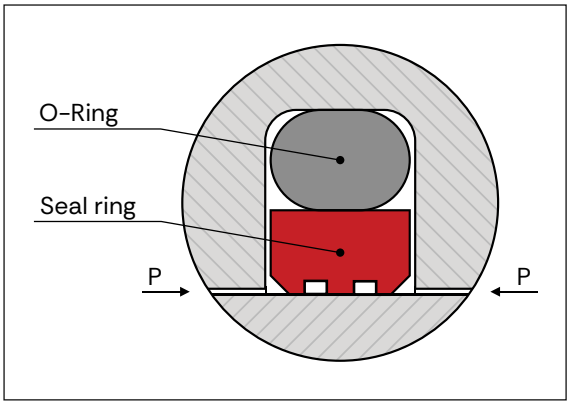


Figure 31: HaaRoto R28.

Working conditions

Speed:	1 m/s
Pressure:	20 MPa
Action:	Double acting
Activation:	O-ring
Standard:	ISO 7425-2
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø6 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

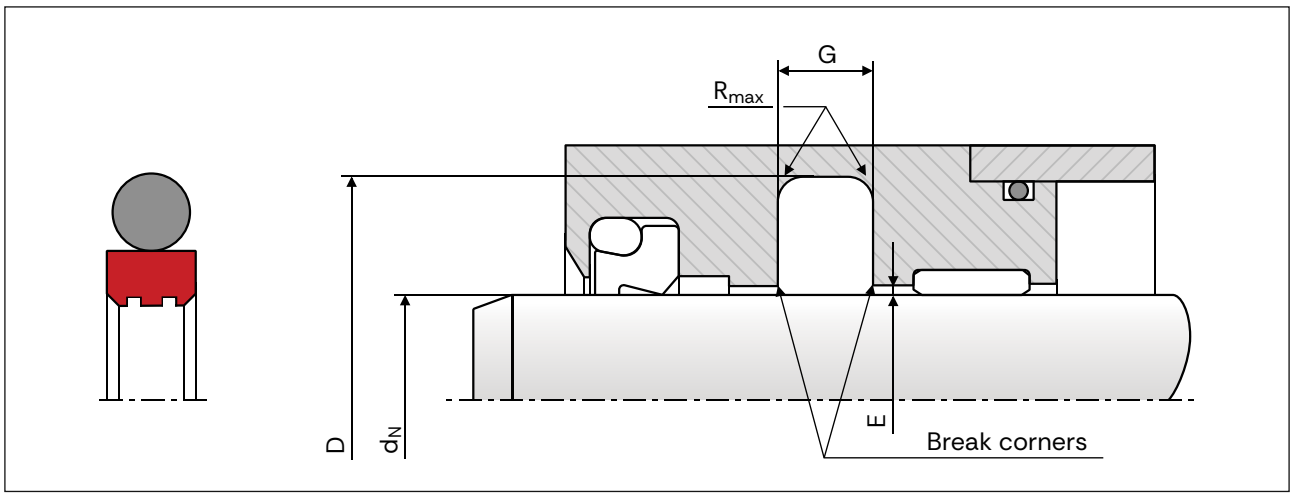


Figure 32: Assembly drawing for HaaRoto R28.

R28	D H9	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	Max radial gab E		O-ring
				Standard	10 MPa	20 MPa	Cross Section
00	d_N + 4,9	2,2	0,4	6 - 24,9	0,15	0,10	1,78
01	d_N + 7,3	3,2	0,6	25 - 59,9	0,20	0,15	2,62
02	d_N + 10,7	4,2	1,0	60 - 132,9	0,25	0,20	3,53
03	d_N + 15,1	6,3	1,3	133 -329,9	0,30	0,25	5,33
04	d_N + 20,5	8,1	1,8	330 - 654,9	0,35	0,25	6,99
05	d_N + 27,3	9,5	2,5	655 - 999,9	0,45	0,30	8,40

Tabel 14: Recommended standard installation dimensions for HaaRoto R28.

Order example

HaaRoto R28 standard for a Ø40 mm rod

Article number:	R2801	0400	37	B	N
Series					
Rod d_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaSC Dynamic R32

Description

HaaSC Dynamic R32 is designed to deliver high sealing efficiency in dynamic applications. The seal consists of a thermoplastic jacket, activated by a V-shaped cantilever spring made of stainless steel or other high-performance alloys. The spring ensures both good spring force and high flexibility, so the seal maintains its elasticity and sealing effect.

HaaSC Dynamic R32 is also available in a Hi-Clean version, where the spring cavity is filled with EC 1935:2004 compliant silicone to ensure an easy-to-clean seal. This makes it ideal for applications with high hygiene requirements.

Advantages

- Excellent dimensional stability
- Low friction without stick-slip
- High chemical resistance
- High thermal resistance
- High wear resistance and reliability
- No aging over time
- Available in Hi-Clean version

Application examples

- Process machines
- Filling machines
- Spindles
- Pneumatics
- Hydraulics
- Chemical machinery
- Food machinery

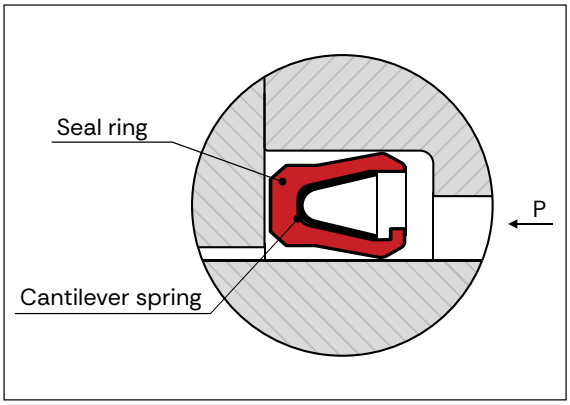


Figure 33: HaaSC Dynamic R32.

Working conditions

Speed:	15 m/s
Pressure:	40 MPa
Action:	Single acting
Activation:	Spring
Standard:	AS4716D
Temperature:	-60 to +260 °C
Diameter:	Ø3 to Ø1000
Notches:	No

Seal performance depends on operating conditions and must be verified through real-world testing.

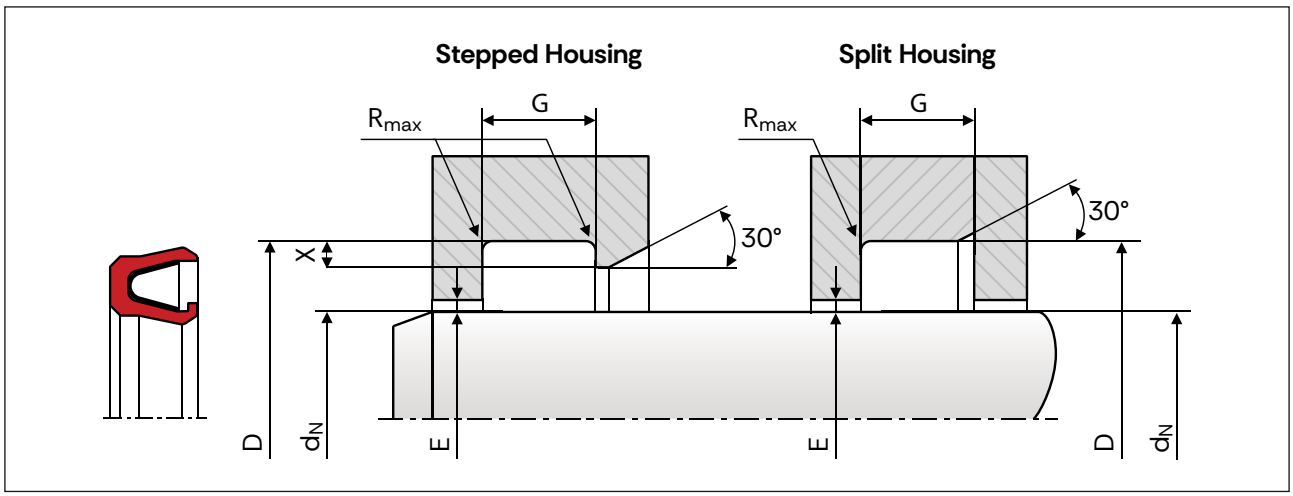


Figure 34: Assembly drawing for HaaSC Dynamic R32.

R32	D H9	G $^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	Max radial gab E				X
				Standard	2 MPa	10 MPa	20 MPa	40 MPa	Min.
00	d_N + 2,9	2,4	0,4	3 - 9,9	0,20	0,10	0,08	0,05	0,4
01	d_N + 4,5	3,6	0,4	10 - 19,9	0,25	0,15	0,10	0,07	0,6
02	d_N + 6,2	4,8	0,6	20 - 39,9	0,35	0,20	0,15	0,08	0,7
03	d_N + 9,4	7,1	0,8	40 - 119,9	0,50	0,25	0,20	0,10	0,8
04	d_N + 12,2	9,5	0,8	120 - 999,9	0,60	0,30	0,25	0,12	0,9

Tabel 15: Recommended standard installation dimensions for HaaSC Dynamic R32.

Order example

HaaSC Dynamic R32 standard for a Ø40 mm rod

Article number:	**R3203**	**0400**	**37**	**S**	**C**
Series					
Rod d_2 x 10					
Material (Seal)					
Material (Spring)					
Hi-Clean					

See pages 22 to 24 for an overview of material options for the sealing element and the spring. If silicone is required in the spring cavity for hygienic use, add 'C' at the end of the article number when ordering.

HaaSH Static R34

Description

HaaSH Static R34 consists of a thermoplastic sealing element, activated by a helical spring made of stainless steel or another high-performance alloy. The helical spring provides optimal spring force and ensures a stable and reliable seal.

HaaSH Static R34 is typically used in static applications, including as a flange seal, and is designed to deliver high sealing efficiency even at extreme temperatures, such as in cryogenic applications. The design of the seal ensures long-lasting elasticity and performance, even under harsh operating conditions and high demands for chemical resistance.

Advantages

- Excellent dimensional stability
- Low friction without stick-slip
- High chemical resistance
- High thermal resistance
- High wear resistance and reliability
- No aging over time

Application examples

- Process machines
- Filling machines
- Spindles
- Pneumatics
- Hydraulics
- Chemical machinery
- Food processing machines
- Ovens

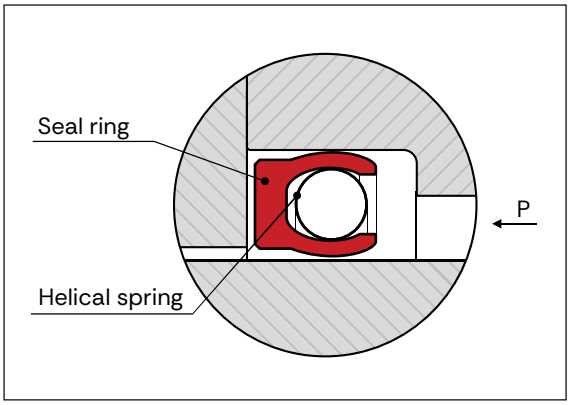


Figure 35: HaaSH Static R34.

Working conditions

Speed:	1 m/s
Pressure:	40 MPa
Action:	Single acting
Activation:	Spring
Standard:	AS4716D
Temperature:	-60 to +260 °C
Diameter:	Ø12 to Ø1000
Notches:	No

Seal performance depends on operating conditions and must be verified through real-world testing.

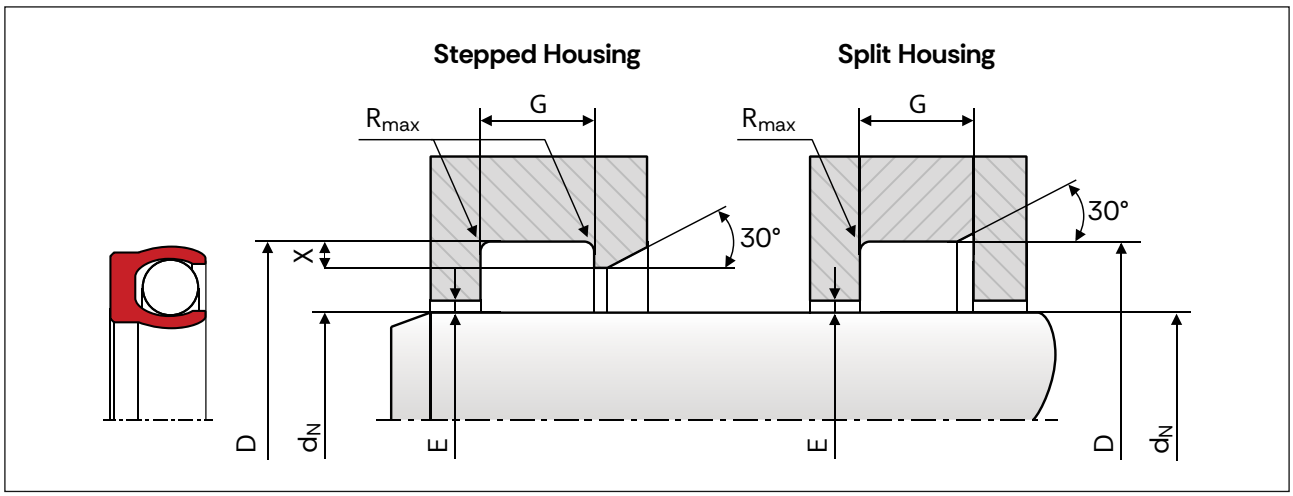


Figure 36: Assembly drawing for HaaSH Static R34.

R34	D H9	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	Max radial gab E				X
				Standard	2 MPa	10 MPa	20 MPa	40 MPa	Min.
01	d_N + 4,5	3,6	0,4	12 - 19,9	0,25	0,15	0,10	0,07	0,7
02	d_N + 6,2	4,8	0,6	20 - 39,9	0,35	0,20	0,15	0,08	1,0
03	d_N + 9,4	7,1	0,8	40 - 119,9	0,50	0,25	0,20	0,10	1,5
04	d_N + 12,2	9,5	0,8	120 - 999,9	0,60	0,30	0,25	0,12	1,9

Tabel 16: Recommended standard installation dimensions for HaaSH Static R34.

Order example

HaaSH Static R34 standard for a Ø40 mm rod

Article number:	**R3403**	**0400**	**37**	**S**
Series				
Rod d_2 x 10				
Material (Seal)				
Material (Spring)				

See pages 22 to 24 for an overview of material options for the sealing element and the spring.

Haagensen
Sealing Solutions

4 PISTON SEALS

Our piston seals ensure sealing between the piston and cylinder, preventing pressure loss in hydraulic and pneumatic systems. With high resistance to pressure and friction, they extend the system's lifespan. Explore our range of piston seals and their applications.

Hardware & mounting

Guiding chamfers

To prevent potential damage to the piston seal during installation, it is crucial to incorporate a 15° lead-in chamfer with smoothly rounded edges on the cylinder barrel, as illustrated in figure 37. This chamfer allows the seal to be carefully guided into place, minimizing risk of deformation or stress on the seal material and ensuring a secure fit. If design constraints do not permit these chamfers, the use of a specialized installation tool is highly recommended to facilitate safe and accurate installation.

The minimum required length for the lead-in chamfer (L_{min}) depends on the specific profile size of the seal, as indicated in the accompanying tables. For HaaCap seals, an L value of at least 2.5% of the rod diameter is advised to provide adequate lead-in length, particularly crucial for larger diameter pistions. Ensuring the correct chamfer angle and length minimizes the risk of misalignment during installation and enhances the overall lifespan and reliability of the seal assembly.

O-ring energized seals

Groove width G	Chamfer lenght L_{MIN}
2,2	2,5
3,2	3,0
4,2	3,5
6,3	5,0
8,1	6,5
9,5	7,5

Tabel 17: Chamfer lenghts for O-ring energized piston seals.

HaaCap seals

O-ring cross section	Chamfer*lenght L_{MIN}
1,78	2,5
2,62	3,0
3,53	3,5
5,33	5,0
6,99	6,5
8,40	7,5

Table 18: Chamfer lengths for HaaCap O-ring piston seals.

** Not less than 2,5% of the rod diameter*

Spring energized seals

Groove width G	Chamfer lenght L_{MIN}
2,4	4,5
3,6	5,0
4,8	5,0
7,1	7,5
9,5	12,0

Tabel 19: Chamfer lenghts for spring energized piston seals.

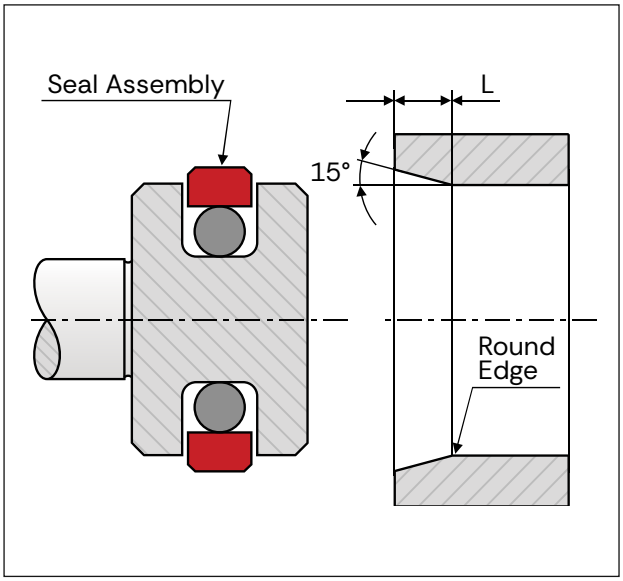


Figure 37: Guiding chamfers

Surface roughness

Achieving an adequate surface finish of the seal groove is crucial for ensuring effective sealing and extending seal life, particularly in dynamic applications where movement can increase wear on the seal. When surface roughness is excessive, it can create leakage paths that compromise the seal's integrity and accelerate wear on the material. For seals made from PTFE, the material's high durability and low friction properties allow it to glide smoothly over surface irregularities, reducing abrasion and enhancing long-term performance.

To maximize seal effectiveness and lifespan, the specific surface roughness guidelines outlined in table 20 should be adhered to. These recommendations help maintain the optimal contact between the seal and mating surface, which is especially important in applications with frequent or continuous movement. In dynamic environments, surfaces with greater roughness levels are prone to higher wear rates, potentially reducing the overall longevity of the seal and affecting its ability to perform under stress.

Surface roughness R_a (µm)		
Media	**Dynamic use**	**Static use**
Cryogenics	0,1 to 0,2	0,1 to 0,2
Freon Hydrogen Helium	0,1 to 0,2	0,2 to 0,4
Air Nitrogen Natural gas Fuel	0,2 to 0,4	0,4 to 0,8
Water Hydraulic oil Crude oil	0,2 to 0,4	0,4 to 1,6

Tabel 20: Surface roughness depending on media.

In dynamic reciprocating applications, relying solely on a maximum R_a value is insufficient for fully assessing the suitability of a surface finish, as this value alone does not account for the complete texture of the surface. Surfaces with different textural patterns can share similar R_a values, yet exhibit vastly different impacts on sealing performance and resistance to abrasion.

Therefore, for optimal performance, table 21 provides a recommended combination of surface roughness parameters, for an example with a R_a of 0,2 max, in order to achieve the most desirable plateau profile. This plateau structure offers smoother contact with the seal in dynamic reciprocating applications, reducing the risk of premature wear and ensuring a more consistent sealing function over time.

Advised surface roughness dynamic use (µm)		
Average roughness	R_a	0,2 max
Average peek-to-peak height	R_z	1,2 max
Maxiumum peek height	R_p	0,2 max
Bearing ratio (%)	t_p	60% min. with a reference line located at 0,25 Rz if Rz>1 0,5 Rz if Rz<1

Tabel 21: Roughness parameters for dynamic piston seals.

Installation instructions

To achieve optimal performance and longevity from piston seals, it is essential to follow proper installation procedures. Careful adherence to the steps below ensures that the seal is securely and correctly placed, ready to handle operational pressures.

- Confirm that the cylinder tube includes a lead-in chamfer; if this is not possible, use a calibration sleeve as shown in figure 38.
- Deburr or round off any sharp edges, and cover the tips of screw threads to prevent damage.
- Clear away any machining residue or other foreign particles, and thoroughly clean all components.
- Applying grease or oil can ease seal installation; however, ensure compatibility between the seal material and the chosen lubricant. Only use grease without solid additives.
- Avoid using tools with sharp edges that could damage the seal.

Installation in split grooves

Installing seals in split grooves is straightforward. The installation sequence should align with the seal's design, ensuring each seal element remains properly aligned without twisting, as shown in figure 39. During final assembly, where the piston is inserted into the cylinder, elastomeric or spring-energized seals require calibration. If the cylinder barrel has an extended lead-in chamfer, it can serve this purpose; otherwise, a calibration sleeve is recommended.

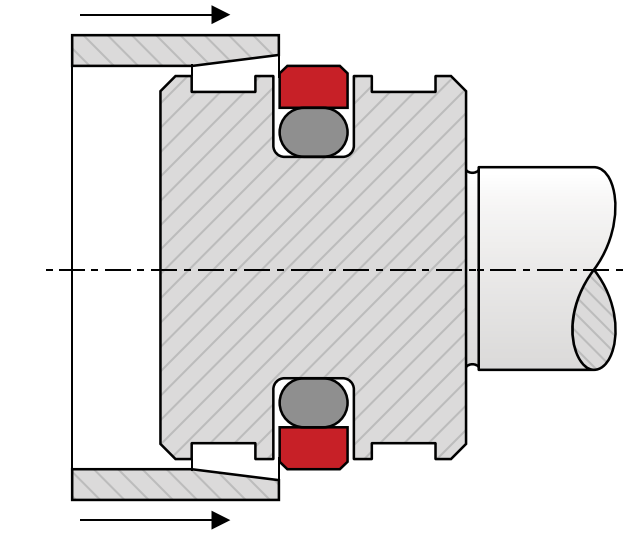


Figure 38: Use of calibration sleeve after installation.

Installation in closed grooves without aids

For elastomer energized seals, it is recommended to use an installation tool. If installation must proceed without tools, please follow these guidelines:

- Refer to the instructions in the "Installation instructions" section, and note that installing elastomer seals in closed grooves requires expanding the seal ring over the piston.
- Begin by placing the O-ring in the groove, then expand the seal ring carefully over the piston (see figure 39. For PTFE seals, heating the material in oil, water, or with a hot air fan to approximately 80–100 °C can ease installation by temporarily expanding the seal.
- Avoid using tools with sharp edges when expanding seal rings to prevent damage.
- Perform a calibration of the seal ring using a separate calibration sleeve or by using the cylinder tube, provided it has lead-in chamfers equivalent to twice the values shown in table 17. Calibration will reduce the diameter of the seal and place it correctly in its groove (see figure 41).

The calibration sleeve should be made from a polymer material, such as polyamide, which provides excellent sliding characteristics and a smooth and high quality surface finish. This is essential to prevent any scratching, tearing, or deformation of the seals during calibration. A polymer-based mandrel minimizes friction, allowing the seal to move into its position without excessive resistance or risk of abrasion.

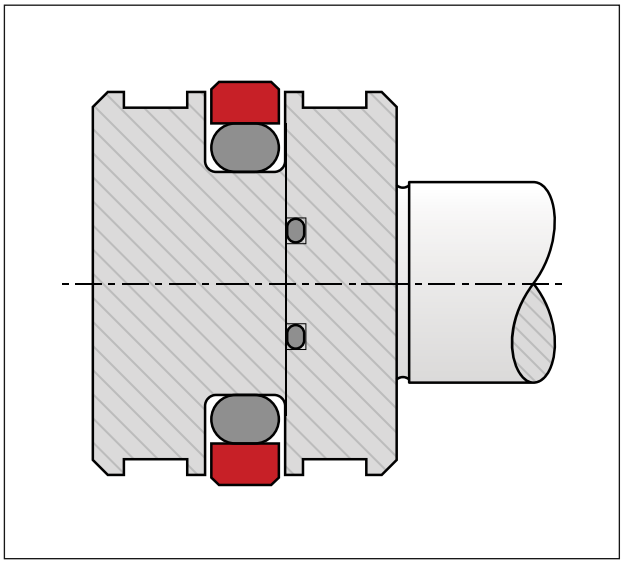


Figure 39: Installation in split groove.

Installation in closed grooves with aids

When installing elastomer energized seals in closed grooves, it is recommended to use a three-piece installation tool. This tool set includes:

- Installation cone
- Expanding pusher
- Calibration sleeve

Follow these guidelines to ensure a proper installation:

- Refer to the instructions in the "Installation instructions" section, and note that installing elastomer seals in closed grooves requires expanding the seal ring over the piston.

- Start by placing the O-ring into the groove, then carefully expand the seal ring over the installation cone (see figure 40). For PTFE seals, heating the material in oil, water, or with a hot air fan to approximately 80–100 °C can facilitate installation by temporarily expanding the seal.

- Avoid using tools with sharp edges when handling seal rings, as this can cause damage.

- Position the expanding pusher over the installation cone, using it to guide the sealing ring into the groove. This action will expand the seal ring over the piston and ease the installation process (see figure 41). Once the seal reaches the groove, it will snap into it.

- Finally, calibrate the seal ring by using a separate calibration sleeve or the cylinder tube of this has lead-in chamfers equivalent to twice the values shown in table 17. Calibration will ensure the seal ring is properly seated (see figure 38).

Haagensen offers three-piece installation tools specifically designed for the installation of elastomer energized seals. Please contact Haagensen if you are interested in more information or in placing an order.

Installation of HaaCap piston seal

Installation of HaaCap piston seals in closed grooves is feasible for bore diameters starting from 8 mm. For diameters under 50 mm, it is recommended to use an installation cone, as descriped the section for "Installation in closed grooves with aids" and shown in figure 42.

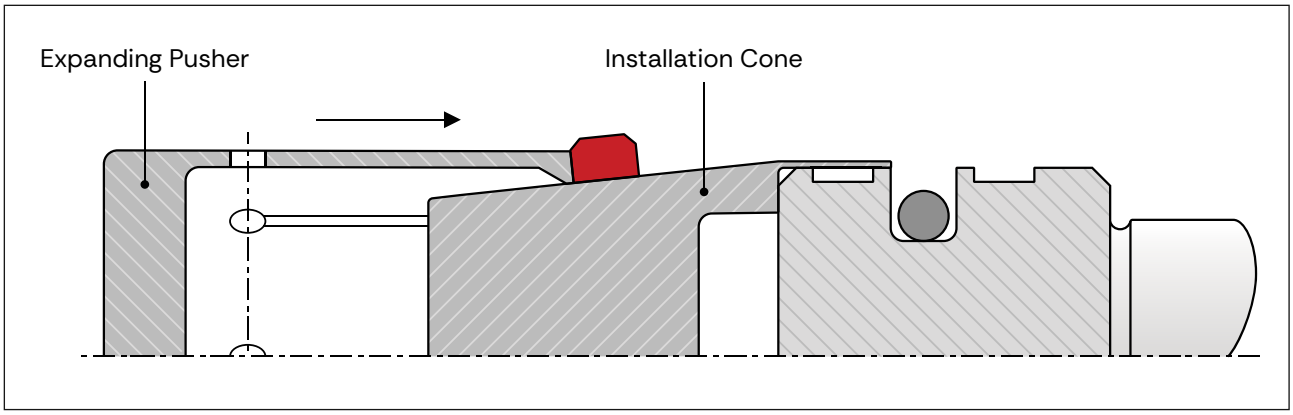


Figure 40: Expansion of a sealing ring over the installation cone.

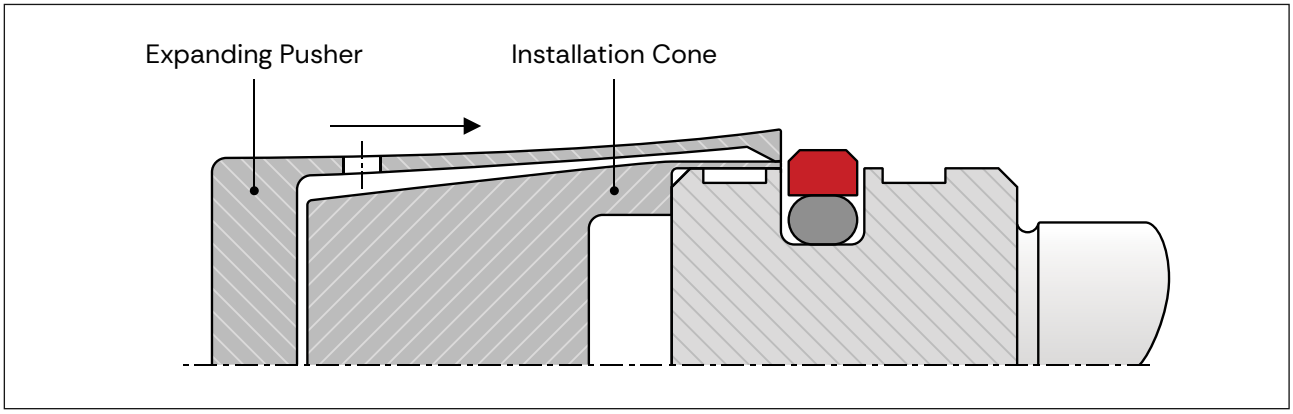


Figure 41: Installation of the sealing ring in the piston groove.

Installation of spring energized seals

Spring energized seals are ideally suited for installation in split grooves, as this configuration allows for straightforward placement without excessive stress on the seal material. Installing these seals in split grooves ensures that the spring element remains properly aligned and reduces the risk of misalignment or damage during assembly.

In certain cases, installation in half-open grooves is also feasible, provided a snap fitting technique is used, as illustrated in figure 43 and specified in table 22. When installing in half-open grooves, extra care should be taken to ensure that the seal seats securely without twisting or deformation, as improper alignment can compromise sealing effectiveness.

Groove width G	X_{min}	$D_{N\,min}$	Chamfer lenght L_{MIN}	C_{min}
2,4	0,4	11,0	4,5	0,70
3,6	0,6	17,5	5,0	1,10
4,8	0,7	20,0	5,0	1,25
7,1	0,8	28,0	7,5	1,40
9,5	0,9	45,0	12,0	1,60

Tabel 22: Half-open groove specifications.

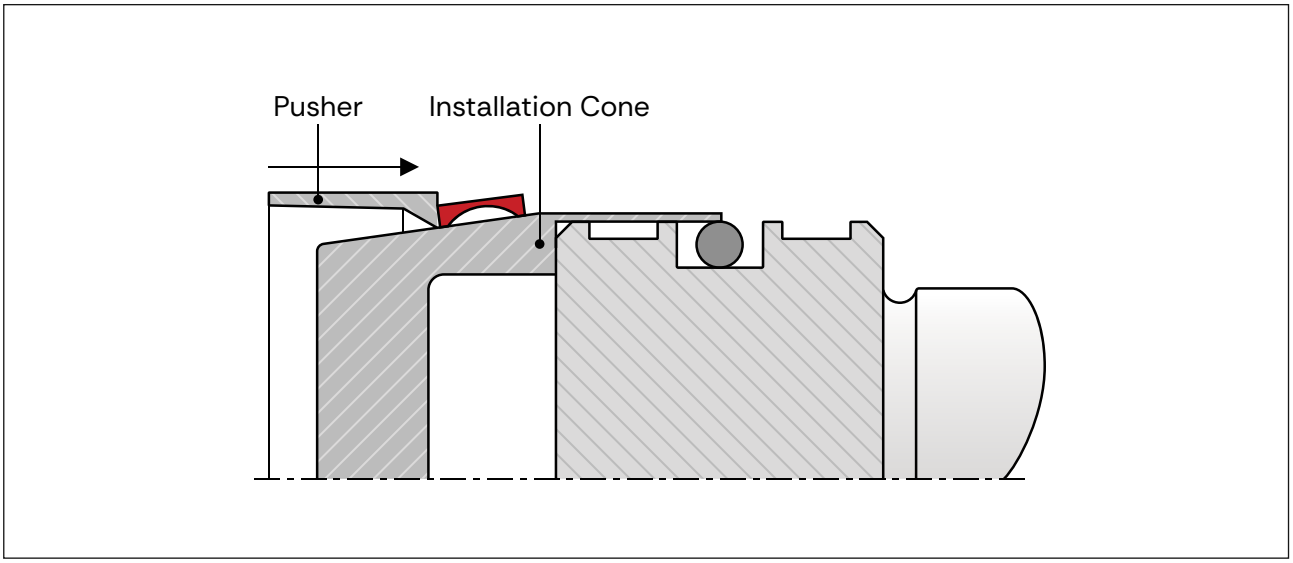


Figure 42: Calibration of a HaaCap seal once installed.

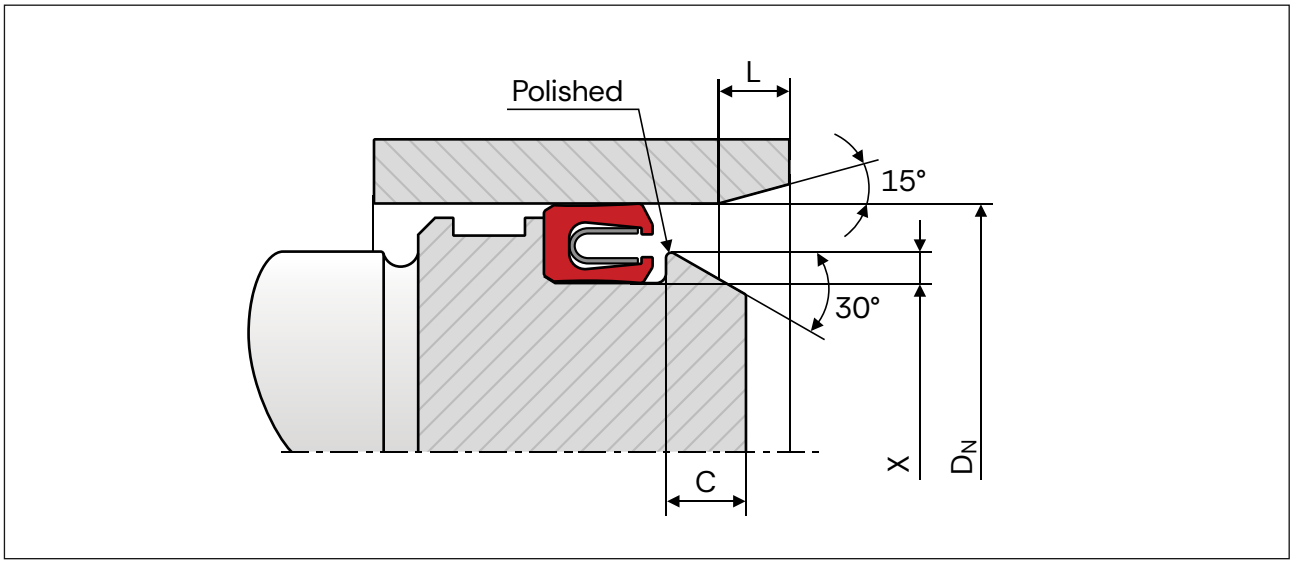


Figure 43: Installation of a spring energized seal in a half-open groove.

HaaGlide P11

Description

HaaGlide P11 is a reliable and efficient low-friction seal, suited for double-acting applications in both high- and low-pressure systems. Its compact design makes it ideal for small groove dimensions, ensuring excellent dimensional stability and high resistance to extrusion.

HaaGlide P11 can also be supplied with notches for pressure activation, even during rapid pressure changes. The combination of low-friction properties and the ability to handle changing pressure makes it a great choice for demanding environments, where reliable sealing and long service life are crucial.

Advantages

- Excellent wear resistance
- Can also be used for single-acting applications
- High resistance to extrusion
- Good sealing capability under small installation conditions
- No stick-slip
- Can be used for small grooves
- Minimal start-up and dynamic friction ensures smooth movement, even at low speeds
- Suitable for most hydraulic fluids and compatible with a wide range of modern hardware materials and surface treatments, depending on the material used

Application examples

- Jacks
- Brake boosters
- Hydraulic motors
- Servo cylinders
- Valves for hydraulic and pneumatic circuits
- Valve stems
- Presses
- Machine tools
- Injection molding machines

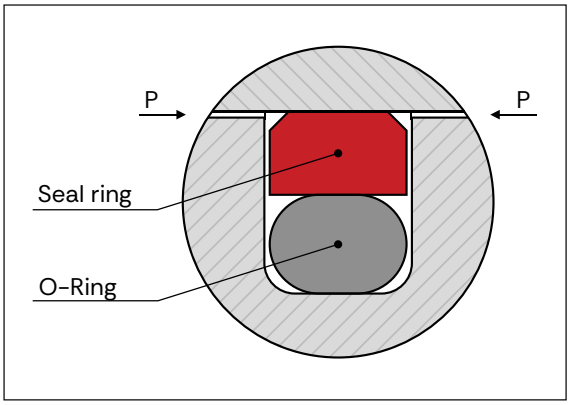


Figure 44: HaaGlide P11.

Working conditions

Speed:	15 m/s
Pressure:	60 MPa
Action:	Double acting
Activation:	O-ring
Standard:	ISO 7425-1
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø8 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

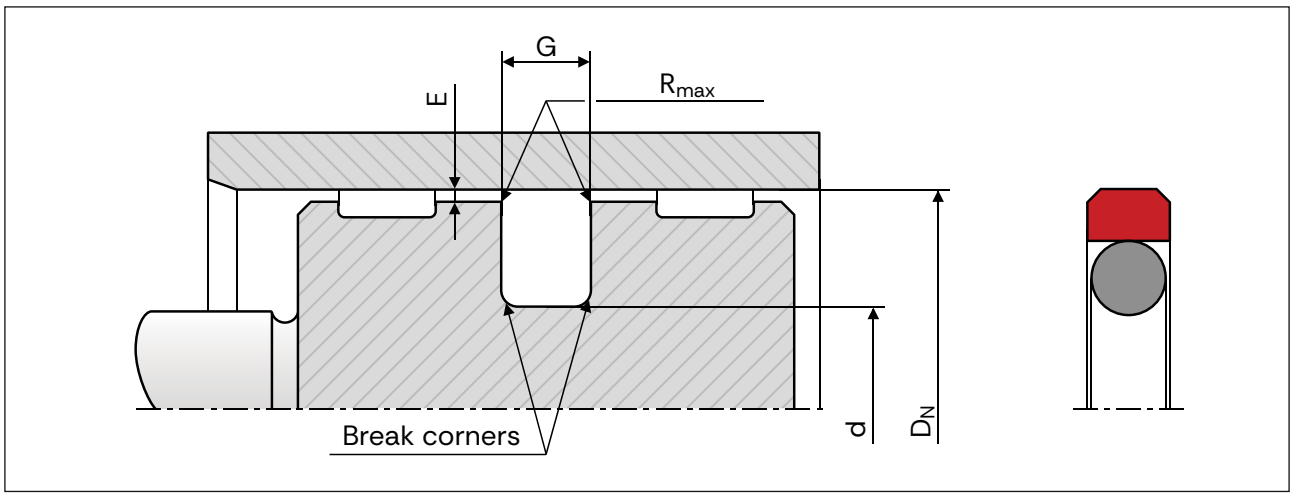


Figure 45: Assembly drawing for HaaGlide P11.

P11	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9			Max radial gab E			O-ring
				Light	Standard	Heavy	10 MPa	20 MPa	40 MPa	Cross section
00	D_N - 4,9	2,2	0,4	15- 39,9	8 - 14,9	-	0,30	0,20	0,15	1,78
01	D_N - 7,5	3,2	0,6	40 - 79,9	15- 39,9	-	0,40	0,25	0,15	2,62
02	D_N - 11,0	4,2	1,0	80 - 132,9	40 - 79,9	15 - 39,9	0,40	0,25	0,20	3,53
03	D_N - 15,5	6,3	1,3	133 - 329,9	80 - 132,9	40 - 79,9	0,50	0,30	0,20	5,33
04	D_N - 21,0	8,1	1,8	330 - 669,9	133 - 329,9	80 - 132,9	0,60	0,35	0,25	6,99
05	D_N - 24,5	8,1	1,8	670 - 999,9	330 - 669,9	133 - 329,9	0,60	0,36	0,25	6,99
06	D_N - 28,0	9,5	2,5	-	670 - 999,9	330 - 669,9	0,70	0,50	0,30	8,40

Tabel 23: Recommended standard installation dimensions for HaaGlide P11. For pressures above 40 MPa, use diameter tolerances H7/f7 (bore/rod) or contact Haagensen A/S for advice.

Order example

HaaGlide P11 standard for a Ø40 mm bore

Article number:	P1102	0400	37	B	N
Series					
Bore D_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaStep P17

Description

HaaStep P17 is a robust and reliable seal, designed to ensure optimal sealing and fluid control in hydraulic systems. Its unique design creates a high contact pressure gradient on the high-pressure side and a lower gradient on the low-pressure side, minimizing fluid accumulation on the bore during the outstroke. This allows the remaining fluid film on the bore to be drawn back into the system during the return stroke, reducing fluid loss and increasing efficiency.

HaaStep P17 is an ideal choice for applications where fluid control is crucial during both the outward and return strokes.

Advantages

- High static and dynamic sealing efficiency
- No stick-slip
- High wear resistance, high operational reliability
- Can be used for small grooves
- Low friction, high efficiency
- Good energy efficiency due to low friction
- Simple installation without deformation of the seal's edge
- Suitable for most hydraulic fluids and compatible with a wide range of modern hardware materials and surface treatments, depending on the material used

Application examples

- Servo cylinders
- Shock absorbers
- Automotive industry
- Wind turbines
- Presses
- Injection molding machines
- Standard cylinders
- Mining
- Mobile hydraulic systems

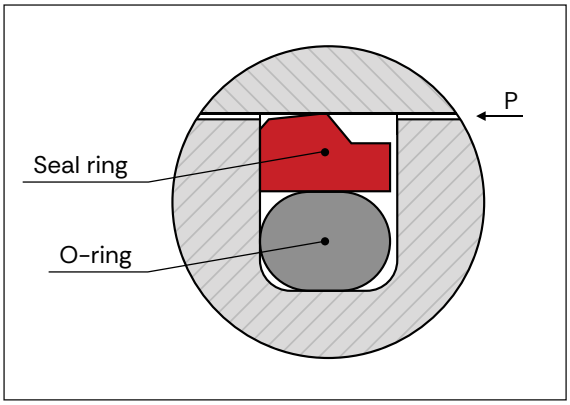


Figure 46: HaaStep P17

Working conditions

Speed:	15 m/s
Pressure:	60 MPa
Action:	Single acting
Activation:	O-ring
Standard:	ISO 7425-1
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø8 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

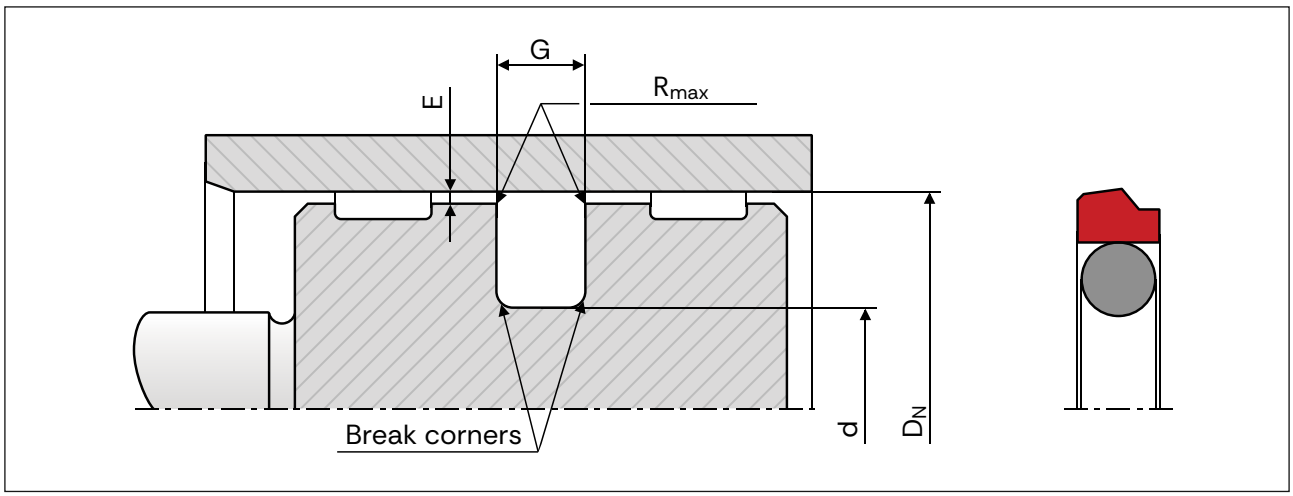


Figure 47: Assembly drawing for HaaStep P17.

P17	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9			Max radial gab E			O-ring
				Light	Standard	Heavy	10 MPa	20 MPa	40 MPa	Cross section
00	D_N - 4,9	2,2	0,4	17 - 26,9	8 - 16,9	-	0,30	0,20	0,15	1,78
01	D_N - 7,3	3,2	0,6	27 - 59,9	17 - 26,9	-	0,40	0,25	0,15	2,62
02	D_N - 10,7	4,2	1,0	60 - 199,9	27 - 59,9	17 - 26,9	0,50	0,30	0,20	3,53
03	D_N - 15,1	6,3	1,3	200 - 255,9	60 - 199,9	27 - 59,9	0,70	0,40	0,25	5,33
04	D_N - 20,5	8,1	1,8	256 - 669,9	200 - 255,9	60 - 199,9	0,80	0,60	0,35	6,99
05	D_N - 24,0	8,1	1,8	670 - 999,9	256 - 669,9	200 - 255,9	0,90	0,70	0,40	6,99
06	D_N - 27,3	9,5	2,5	-	670 - 999,9	256 - 669,9	1,00	0,80	0,60	8,40

Tabel 24: Recommended standard installation dimensions for HaaStep P17. For pressures above 40 MPa, use diameter tolerances H7/f7 (bore/rod) or contact Haagensen A/S for advice.

Order example

HaaStep P17 standard for a Ø40 mm bore

Article number:	P1702	0400	37	B	N
Series					
Bore N_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaCap P23

Description

HaaCap P23 is an O-ring activated seal that enhances the O-ring's performance in terms of wear, friction, and stick-slip effect. It consists of an O-ring and a thermoplastic jacket, which reduces contact between the O-ring and moving surfaces. This makes HaaCap P23 ideal for reciprocating applications, as the jacket is activated by the O-ring and prevents stick-slip.

HaaCap P23 can be installed in standard O-ring grooves and retains dimensional stability even under varying pressure. For applications with rapid pressure changes, it can be supplied with radial notches, which help activate the O-ring and ensure optimal sealing.

Advantages

- Low friction without stick-slip
- Can be used in existing O-ring grooves
- Can be used for small grooves
- High resistance to extrusion
- High wear resistance

Application examples

- Valves
- Mobile hydraulic systems
- Chemical process equipment

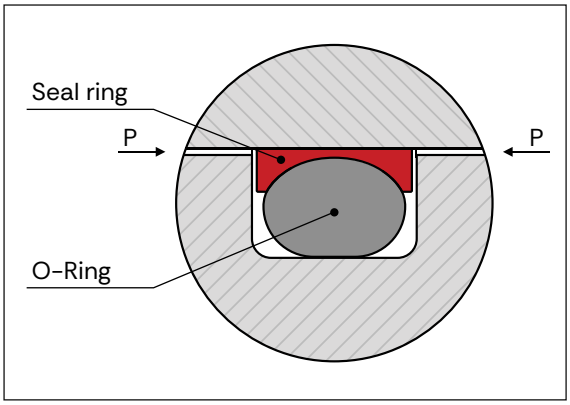


Figure 48: HaaCap P23.

Working conditions

Speed:	15 m/s
Pressure:	35 MPa
Action:	Double acting
Activation:	O-ring
Standard:	AS4716D
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø8 to Ø650
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

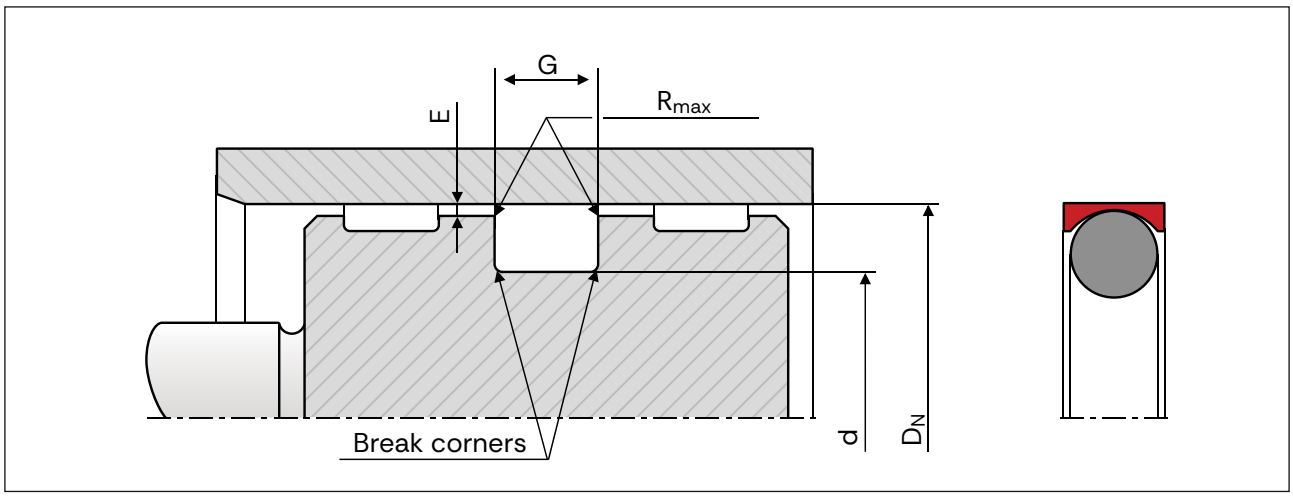


Figure 49: Assembly drawing for HaaCap P23.

P23	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9	Max radial gab E				O-ring
				Standard	2 MPa	10 MPa	20 MPa	40 MPa	Cross section
00	D_N - 2,9	2,4	0,4	8 - 13,9	0,10	0,10	0,08	0,05	1,78
01	D_N - 4,5	3,6	0,4	14 - 24,9	0,15	0,15	0,10	0,07	2,62
02	D_N - 6,2	4,8	0,6	25 - 45,9	0,25	0,20	0,15	0,08	3,53
03	D_N - 9,4	7,1	0,8	46 - 124,9	0,35	0,25	0,20	0,10	5,33
04	D_N - 12,2	9,5	0,8	125 - 649,9	0,50	0,30	0,25	0,15	6,99

Tabel 25: Recommended standard installation dimensions for HaaCap P23.

Order example

HaaCap P23 standard for a Ø40 mm bore

Article number:	P2302	0400	37	B	N
Series					
Bore D_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaQuad P25

Description

HaaQuad P25 is a double-acting seal that consists of an O-ring, a Quad-ring, and a thermoplastic sealing element. The O-ring acts as the activating element, ensuring both initial contact pressure and sustained dimensional stability, even under changing operating conditions.

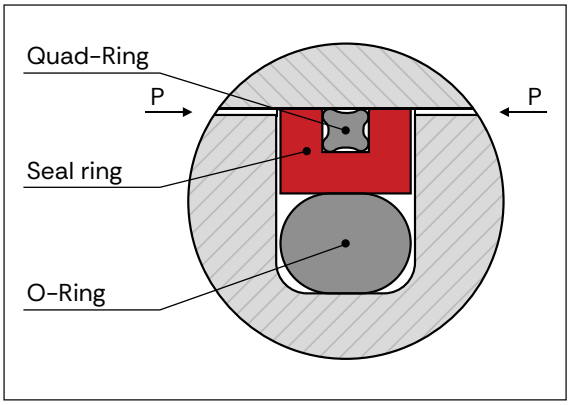
By combining the thermoplastic sealing element with a Quad-ring, the advantages of the low-friction material are achieved along with the excellent sealing effect of the elastomeric element. This optimizes leakage control while minimizing friction for extended lifespan and increased reliability.

Advantages

- High static and dynamic sealing efficiency
- High resistance to extrusion
- Low friction, high efficiency
- Can be used for small grooves
- No stick-slip
- High operational stability
- Effective sealing in applications requiring separation of media, e.g., liquid/gas
- Utilizes the advantages of combining thermoplastic low-friction materials and an elastomeric Quad-ring

Application examples

- Mobile hydraulic systems
- Presses
- Injection molding machines
- Standard cylinders
- Servo cylinders



Figur 50: HaaQuad P25.

Working conditions

Speed:	2 m/s
Pressure:	30 MPa
Action:	Double acting
Activation:	O-ring & Quad-ring
Standard:	ISO 7425-1
Temperature:	NBR: -27 to +100 °C FKM: -10 to +200 °C
Diameter:	Ø15 to Ø800
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

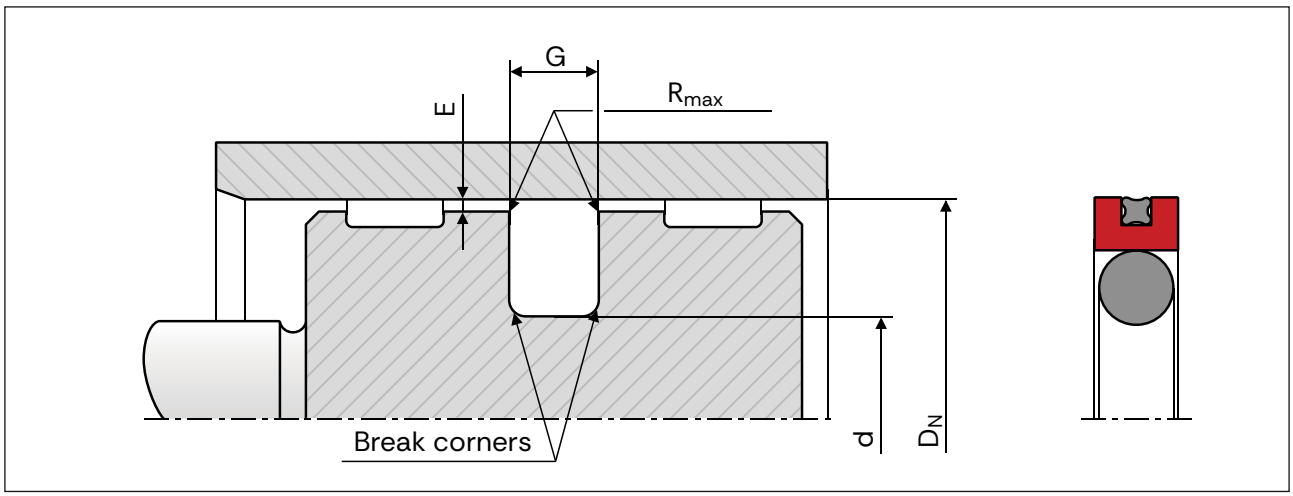


Figure 51: Assembly drawing for HaaQuad P25.

P25	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9	Max radial gab E			O-ring	Q-ring
				Standard	10 MPa	20 MPa	40 MPa	Cross section	Cross section
02	D_N - 11,0	4,2	1,0	15 - 39,9	0,25	0,15	0,10	3,53	1,78
03	D_N - 15,5	6,3	1,3	40 - 79,9	0,30	0,20	0,15	5,33	1,78
04	D_N - 21,0	8,1	1,8	80 - 132,9	0,30	0,20	0,15	6,99	2,62
03	D_N - 24,5	8,1	1,8	133 - 252,9	0,30	0,20	0,15	6,99	2,62
04	D_N - 28,0	9,5	2,5	253 - 799,9	0,45	0,30	0,25	8,4	3,53

Tabel 26: Recommended standard installation dimensions for HaaQuad P25.

Order example

HaaQuad P25 standard for a Ø40 mm bore

Article number:	**P2503**	**0400**	**37**	**B**	**N**
Series					
Bore D_N x 10					
Material (Seal)					
Material (Elastomer)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaRoto P29

Description

HaaRoto P29 is a rotary seal consisting of a thermo-plastic jacket that reduces friction and wear on the rotating surface, as well as an elastomeric O-ring that activates the seal and ensures effective sealing on the static side. The compressed O-ring provides sealing at low pressures. The material properties of the thermoplastic jacket ensure that the system is free from stick-slip effects.

HaaRoto P29 is double-acting, meaning it operates effectively regardless of pressure direction. The seal guarantees reliable sealing between the rotating surface and the seal jacket.

Advantages

- Low friction without stick-slip
- Excellent dimensional stability
- Can be used for small grooves
- High resistance to extrusion
- High wear resistance

Application examples

- Swivel joints
- Pump seals
- Motor shaft seals
- Gearboxes
- Water and wastewater treatment

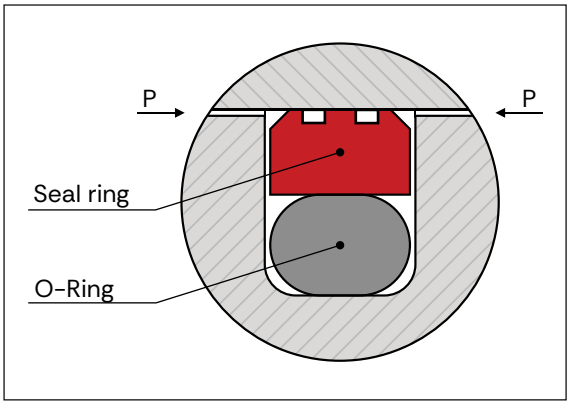


Figure 52: HaaRoto P29.

Working conditions

Speed:	1 m/s
Pressure:	20 MPa
Action:	Double acting
Activation:	O-ring
Standard:	ISO 7425-1
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø8 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

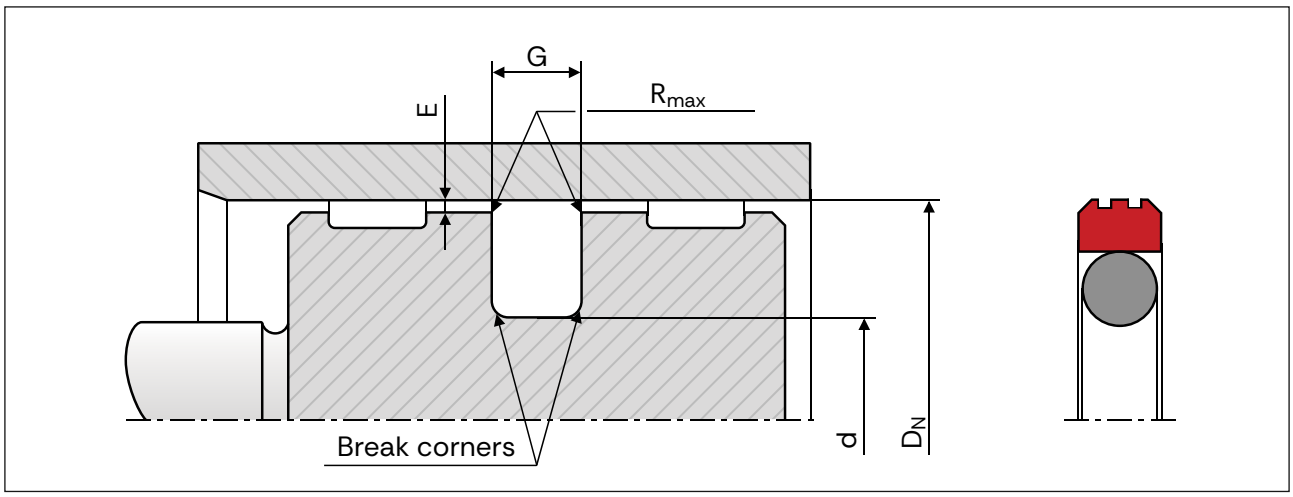


Figure 53: Assembly drawing for HaaRoto P29.

P29	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9	Max radial gab E		O-ring
				Standard	10 MPa	20 MPa	Cross section
00	D_N - 4,9	2,2	0,4	8 - 29,9	0,15	0,10	1,78
01	D_N - 7,5	3,2	0,6	30 - 69,9	0,20	0,15	2,62
02	D_N - 11,0	4,2	1,0	70 - 132,9	0,25	0,20	3,53
03	D_N - 15,5	6,3	1,3	133 - 329,9	0,30	0,25	5,33
04	D_N - 21,0	8,1	1,8	330 - 689,9	0,35	0,25	6,99
05	D_N - 28,0	9,5	2,5	690 - 999,9	0,45	0,30	8,40

Tabel 27: Recommended standard installation dimensions for HaaRoto P29.

Order example

HaaRoto P29 standard for a Ø40 mm bore

Article number:	**P2901**	**0400**	**37**	**B**	**N**
Series					
Bore D_N x 10					
Material (Seal)					
Material (O-ring)					
Notches					

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaSC Dynamic P33

Description

HaaSC Dynamic P33 is designed to deliver high sealing efficiency in dynamic applications. The seal consists of a thermoplastic jacket, activated by a V-shaped cantilever spring made of stainless steel or other high-performance alloys. The spring ensures both good spring force and high flexibility, so the seal maintains its elasticity and sealing effect.

HaaSC Dynamic P33 is also available in a Hi-Clean version, where the spring cavity is filled with EC 1935:2004 compliant silicone to ensure an easy-to-clean seal. This makes it ideal for applications with high hygiene requirements.

Advantages

- Excellent dimensional stability
- Low friction without stick-slip
- High chemical resistance
- High thermal resistance
- High wear resistance and reliability
- No aging over time
- Available in Hi-Clean version

Application examples

- Process machines
- Filling machines
- Spindles
- Pneumatics
- Hydraulics
- Chemical machinery
- Food machinery

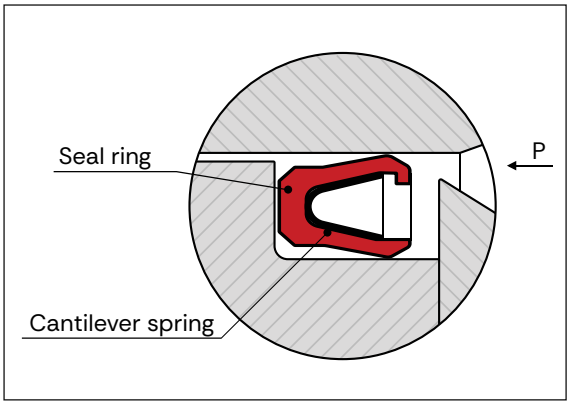


Figure 54: HaaSC Dynamic P33.

Working conditions

Speed:	15 m/s
Pressure:	40 MPa
Action:	Single acting
Activation:	Spring
Standard:	AS4716D
Temperature:	-60 to +260 °C
Diameter:	Ø6 to Ø1000
Notches:	No

Seal performance depends on operating conditions and must be verified through real-world testing.

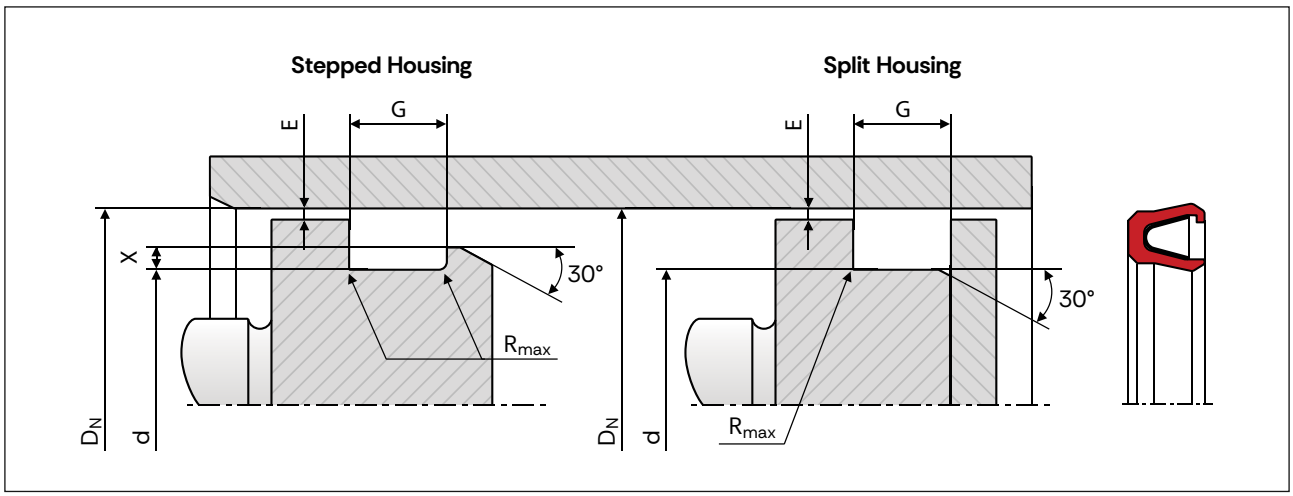


Figure 55: Assembly drawing for HaaSC Dynamic P33.

P33	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9	Max radial gab E				X
				Standard	2 MPa	10 MPa	20 MPa	40 MPa	Min.
00	D_N - 2,9	2,4	0,4	6 - 13,9	0,20	0,10	0,08	0,05	0,4
01	D_N - 4,5	3,6	0,4	14 -24,9	0,25	0,15	0,10	0,07	0,6
02	D_N - 6,2	4,8	0,6	25 - 45,9	0,35	0,20	0,15	0,08	0,7
03	D_N - 9,4	7,1	0,8	46 - 124,9	0,50	0,25	0,20	0,10	0,8
04	D_N - 12,2	9,5	0,8	125 - 999,9	0,60	0,30	0,25	0,12	0,9

Tabel 28: Recommended standard installation dimensions for HaaSC Dynamic P33.

Order example

HaaSC Dynamic P33 standard for a Ø40 mm bore

Article number:	P3302	0400	37	S	C
Series					
Bore D_N x 10					
Material (Seal)					
Material (Spring)					
Hi-Clean					

See pages 22 to 24 for an overview of material options for the sealing element and the spring. If silicone is required in the spring cavity for hygienic use, add 'C' at the end of the article number when ordering.

HaaSH Static P35

Description

HaaSH Static P35 consists of a thermoplastic sealing element, activated by a helical spring made of stainless steel or another high-performance alloy. The helical spring provides optimal spring force and ensures a stable and reliable seal.

HaaSH Static P35 is typically used in static applications, including as a flange seal, and is designed to deliver high sealing efficiency even at extreme temperatures, such as in cryogenic applications. The design of the seal ensures long-lasting elasticity and performance, even under harsh operating conditions and high demands for chemical resistance.

Advantages

- Excellent dimensional stability
- Low friction without stick-slip
- High chemical resistance
- High thermal resistance
- High wear resistance and reliability
- No aging over time

Application examples

- Process machines
- Filling machines
- Spindles
- Pneumatics
- Hydraulics
- Chemical machinery
- Food processing machines
- Ovens

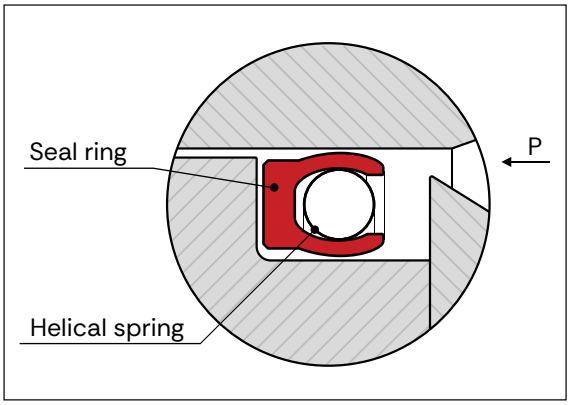


Figure 56: HaaSH Static P35.

Working conditions

Speed	1 m/s
Pressure:	40 MPa
Action:	Single acting
Activation:	Spring
Standard:	AS4716D
Temperature:	-60 to +260 °C
Diameter:	Ø14 to Ø1000
Notches:	No

Seal performance depends on operating conditions and must be verified through real-world testing.

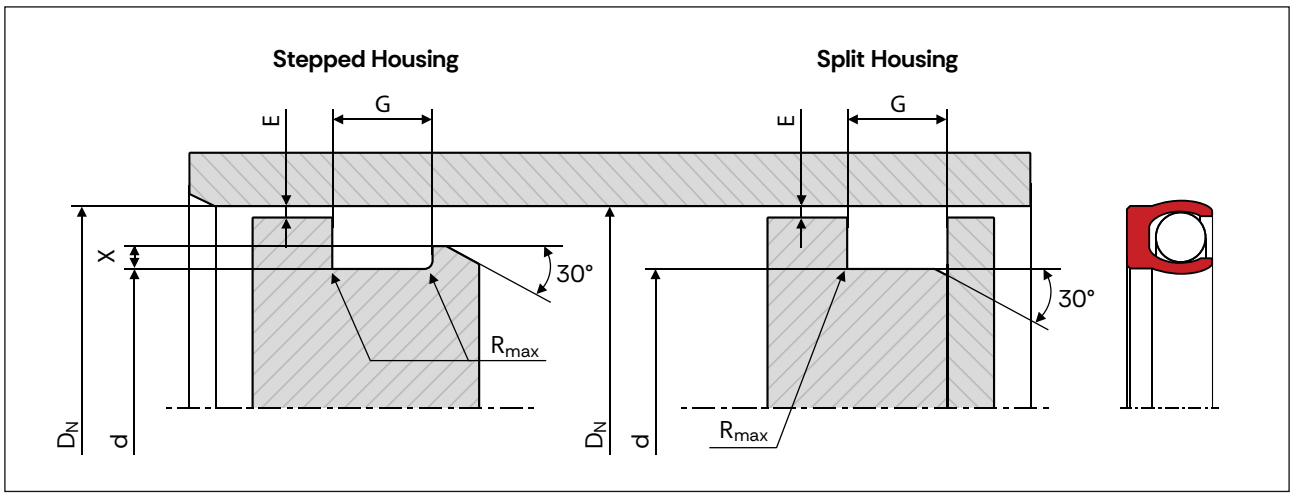


Figure 57: Assembly drawing for HaaSH Static P35.

P35	d h9	$G^{+0,2}_{-0}$	R_{max}	Bore D_N H9	Max radial gab E				X
				Standard	2 MPa	10 MPa	20 MPa	40 MPa	Min.
01	D_N - 4,5	3,6	0,4	14 - 24,9	0,25	0,15	0,10	0,07	0,7
02	D_N - 6,2	4,8	0,6	25 - 45,9	0,35	0,20	0,15	0,08	1,0
03	D_N - 9,4	7,1	0,8	46 - 124,9	0,50	0,25	0,20	0,10	1,5
04	D_N - 12,2	9,5	0,8	125 - 999,9	0,60	0,30	0,25	0,12	1,9

Tabel 29: Recommended standard installation dimensions for HaaSH Static P35.

Order example

HaaSH Static P35 standard for a Ø40 mm bore

Article number: P3502 0400 37 S

- Series
- Bore D_N x 10
- Material (Seal)
- Material (Spring)

See pages 22 to 24 for an overview of material options for the sealing element and the spring.

Haagensen
Sealing Solutions

5 SCRAPERS

Our scrapers are installed in hydraulic cylinders and effectively remove dirt, foreign objects, moisture, and similar contaminants from piston rods during retraction. This protects the hydraulic fluid and prevents damage to wear rings, seals, and other components. Explore our range of scrapers.

HaaScraper Light W96

Description

HaaScraper Light W96 is a traditional double-acting scraper, activated by a single O-ring. It offers a long lifespan, low friction, and excellent wiper efficiency, and can withstand moderate back pressure. The scraper effectively removes dirt, foreign objects, moisture, and similar contaminants from piston rods during retraction, preventing system contamination.

The O-ring ensures constant contact pressure of the scraper's lip against the opposing surface and compensates for rod deflection, enhancing the scraper's efficiency under various operating conditions.

Advantages

- Excellent wiper efficiency
- Secondary sealing lip
- Excellent wear resistance
- Can be used for small grooves
- Can compensate for rod deflection

Application examples

- Mobile hydraulic systems
- Standard cylinders
- Injection molding machines
- Servo cylinders
- Presses
- Machine tools

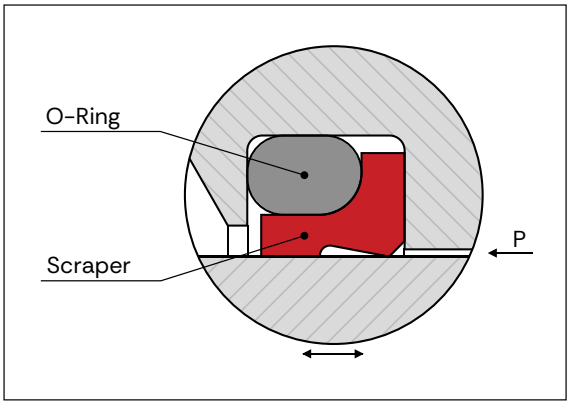


Figure 58: HaaScraper Light W96.

Working conditions

Speed:	15 m/s
Action:	Double acting
Activation:	O-ring
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø6 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

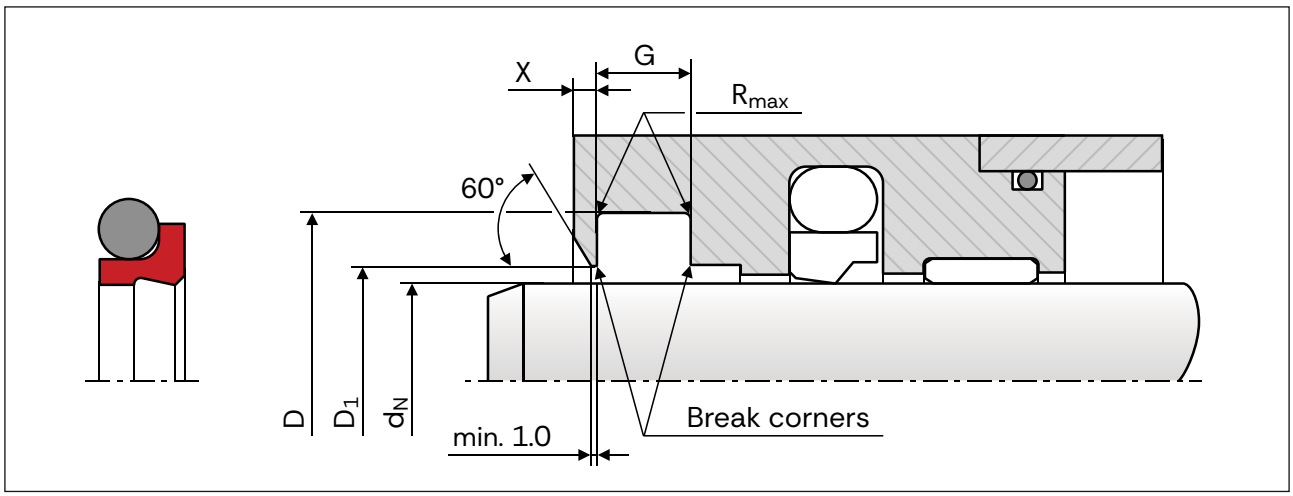


Figure 59: Assembly drawing for HaaScraper Light W96.

W96	D H9	D_1 H11	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	X	O-ring
					Standard	Min.	Cross section
00	d_N + 4,8	d_N + 1,5	3,8	0,4	6 - 11,9	2,0	1,78
01	d_N + 6,8	d_N + 1,5	5,0	0,8	12 - 64,9	2,0	2,62
02	d_N + 8,8	d_N + 1,5	6,0	1,0	65 - 250,9	3,0	3,53
03	d_N + 12,2	d_N + 2,0	8,4	1,5	251 - 420,9	4,0	5,33
04	d_N + 16,0	d_N + 2,0	11,0	1,5	421 - 650,9	4,0	6,99
05	d_N + 20,0	d_N + 2,5	14,0	2,0	651 - 999,9	5,0	8,40

Tabel 30: Recommended standard installation dimensions for HaaScraper Light W96.

Order example

HaaScraper Light W96 standard for a Ø40 mm rod

Article number: W9601 0400 37 B

- W9601 — Series
- 0400 — Rod d_N x 10
- 37 — Material (Scraper)
- B — Material (O-ring)

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

HaaScraper Heavy W98

Description

HaaScraper Heavy W98 is a heavy-duty version a traditional double-acting scraper, activated by a single O-ring. It offers a long lifespan, low friction, and excellent wiper efficiency, and can withstand moderate back pressure. The scraper effectively removes dirt, foreign objects, moisture, and similar contaminants from piston rods during retraction, preventing system contamination.

The O-ring ensures constant contact pressure of the scraper's lip against the opposing surface and compensates for rod deflection, enhancing the scraper's efficiency.

Advantages

- Excellent wiper efficiency
- Secondary sealing lip
- Excellent wear resistance
- Can be used for small grooves
- Can compensate for rod deflection

Application examples

- Mobile hydraulic systems
- Standard cylinders
- Injection molding machines
- Servo cylinders
- Presses
- Machine tools

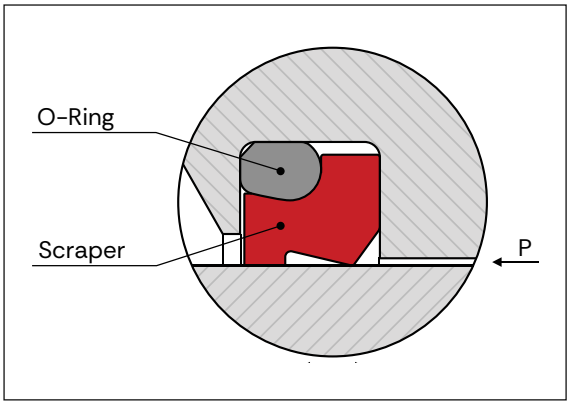


Figure 60: HaaScraper Heavy W98.

Working conditions

Speed:	2 m/s
Action:	Double acting
Activation:	O-ring
Temperature:	NBR O-ring: -27 to +100 °C FKM O-ring: -10 to +200 °C
Diameter:	Ø20 to Ø1000
Notches:	Can be added

The O-ring must be compatible with the operating temperature and the applied medium. The performance of the seal depends on the operating conditions and must be verified through real-world testing.

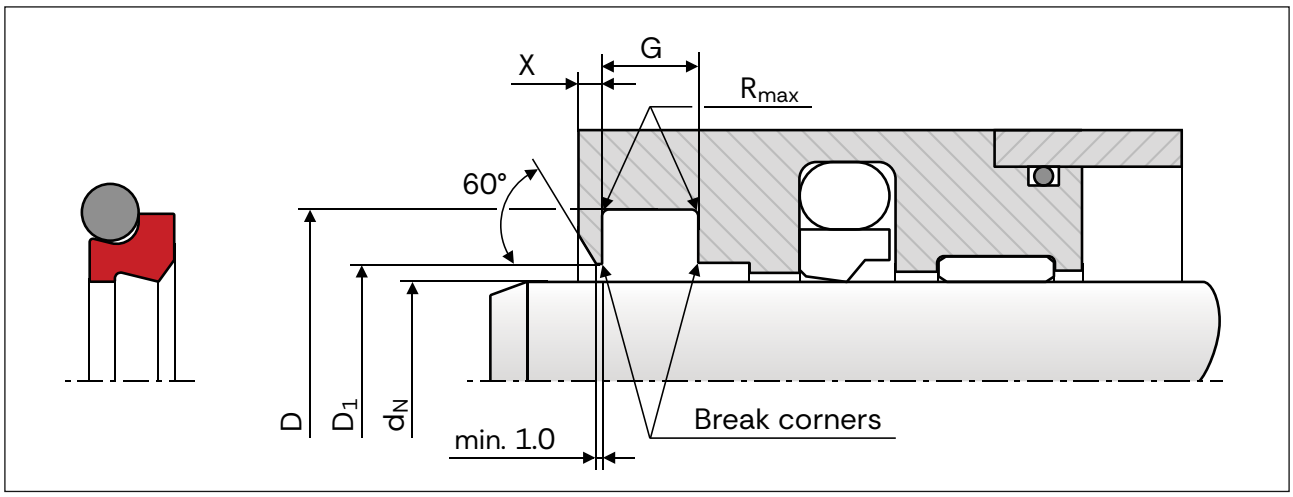


Figure 61: Assembly drawing for HaaScraper Heavy W98.

W98	D H9	D_1 H11	$G^{+0,2}_{-0}$	R_{max}	Rod d_N f8/h9	X	O-ring
					Standard	Min.	Cross section
00	d_N + 7,6	d_N + 1,5	4,2	0,4	19,9 - 39,9	3,0	2,62
01	d_N + 8,8	d_N + 1,5	6,3	0,8	40 - 69,9	3,0	2,62
02	d_N + 12,2	d_N + 2,0	8,1	1,0	70 - 139,9	4,0	3,53
03	d_N + 16,0	d_N + 2,5	9,5	1,5	140 - 399,9	5,0	5,33
04	d_N + 24,0	d_N + 2,5	14,0	1,5	400 - 649,9	8,0	6,99
05	d_N + 27,3	d_N + 2,5	16,0	2,0	650 - 999,9	10,0	8,40

Tabel 31: Recommended standard installation dimensions for HaaScraper Heavy W98.

Order example

HaaScraper Heavy W98 standard for a Ø40 mm rod

Article number: W9801 | 0400 | 37 | B

- W9801 – Series
- 0400 – Rod d_N x 10
- 37 – Material (Scraper)
- B – Material (O-ring)

See pages 22 to 24 for an overview of material options for the sealing element and the O-ring. If an O-ring is not required, it is omitted from the article number when ordering.

Haagensen
Sealing Solutions

6 WEAR RINGS

Our wear rings guides pistons and rods in hydraulic cylinders by absorbing lateral forces and preventing metallic contact. Wear rings made from thermoplastic materials offer significant advantages over traditional metallic guides, such as increased durability and lower friction. Explore our range of wear rings.

HaaWear Rod

Description

HaaWear rod wear rings are designed to guide rods in hydraulic cylinders by absorbing lateral forces and preventing metallic contact between moving parts. HaaWear rod protects seals and other components, extending the system's lifespan. HaaWear is supplied as a strip that forms into a ring in the groove during installation. When ordering rod wear rings, the length of the ring must therefore be calculated.

HaaWear rod is also available with a diamond pattern, ensuring even lubrication and stable performance. They are ideal for moderate side loads and provide reliable operation and high stability.

Advantages

- Low friction
- No stick-slip
- Vibration dampening
- Simple installation in closed grooves
- Protects against cold welding
- Available with diamond pattern

Application examples

- Mobile hydraulic systems
- Standard cylinders
- Injection molding machines
- Servo cylinders
- Presses
- Machine tools

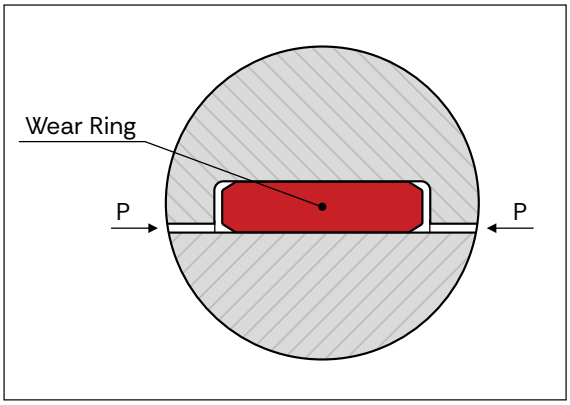


Figure 62: HaaWear rod.

Working conditions

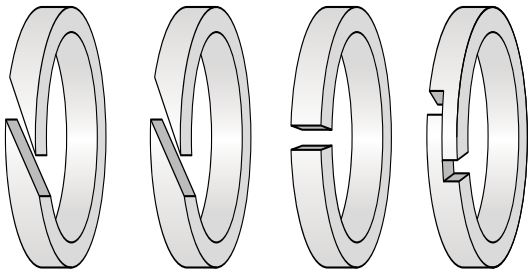
Speed:	15 m/s
Action:	Double acting
Temperature:	-30 to +90 °C
Diameter:	Ø8 to Ø1000
Load:	5 N/mm² projected area

Wear ring performance depends on operating conditions and must be verified through real-world testing.

Length calculation

Equation:	$3{,}11 \times (d_2 + W) - k = L$
Example:	3,11 x (40 + 1,55) - 0,5 = 128,7 (129)
Temperature:	+60 to +90 °C : k = 0,5
Temperature:	Above +90 °C : k = 2,0

Rounding is done to the nearest whole millimeter when calculating the strip length. The given formula is for calculating the length of strips for rods. Note that the formula for calculating the length for pistons is different.



Type 1 30° cut | Type 2 45° cut | Type 3 Straight cut | Type 4 Z cut

Figure 63: Types of cuts for HaaWear rod.

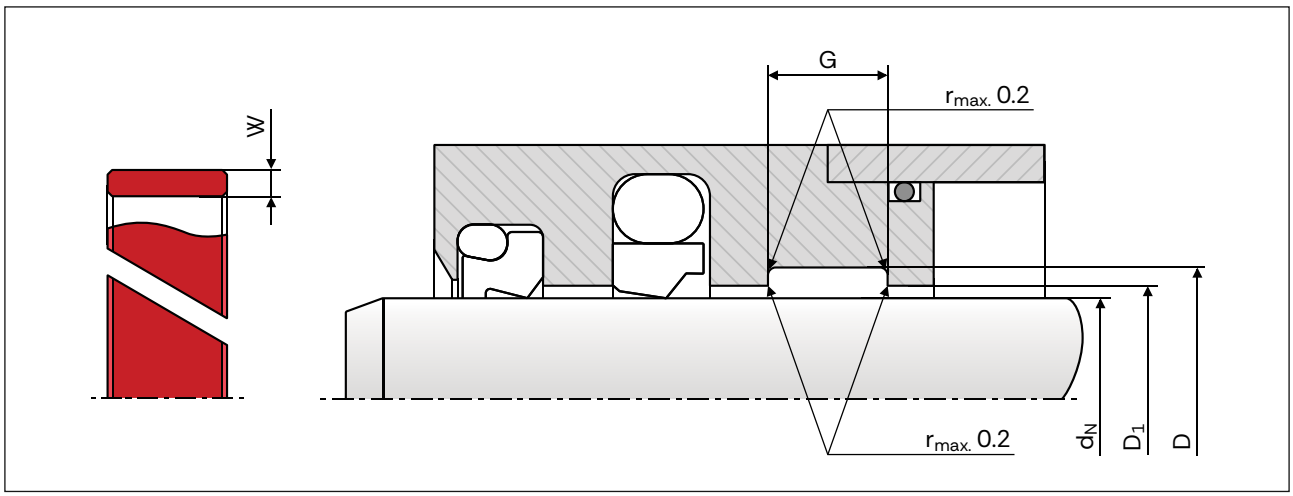


Figure 64: Assembly drawing for HaaWear rod.

SW	D H7	D_1 H9	G $^{+0,2}_{-0}$	Rod d_N f8/h9	W $^{+0,0}_{-0,05}$
				Standard	
155025	d_N + 3,1	d_N + 0,8	2,5	8 - 20,0	1,55
155040	d_N + 3,1	d_N + 0,8	4,0	10 - 50,0	1,55
250056	d_N + 5,0	d_N + 1,6	5,6	15 - 140,0	2,50
250097	d_N + 5,0	d_N + 1,6	9,7	20 - 220,0	2,50
250150	d_N + 5,0	d_N + 1,6	15,0	80 - 400,0	2,50
250250	d_N + 5,0	d_N + 1,6	25,0	200 - 2000,0	2,50
400250	d_N + 8,0	d_N + 2,0	25,0	280 - 2000,0	4,00

Tabel 32: Recommended standard installation dimensions for HaaWear rod.

Order example

HaaWear rod standard with 1,55 mm thickness for a 4,0 mm groove to a Ø40 mm rod

Article number:	SW155040	0129	37	D	2
Series					
Length calculation					
Material (Wear ring)					
Diamant					
Cut					

See pages 22 to 24 for an overview of material options for the wear ring. If a diamond pattern is not desired for the wear ring, it is omitted from the article number when ordering. See figure 63 for types of wear ring cut.

HaaWear Piston

Description

HaaWear piston wear rings are designed to guide pistons in hydraulic cylinders by absorbing lateral forces and preventing metallic contact between moving parts. HaaWear piston protects seals, extending the system's lifespan. HaaWear is supplied as a strip that forms into a ring in the groove during installation. When ordering piston wear rings, the length of the ring must therefore be calculated.

HaaWear piston is also available with a diamond pattern, ensuring even lubrication and stable performance. They are ideal for moderate side loads and provide reliable operation and high stability.

Advantages

- Low friction
- No stick-slip
- Vibration dampening
- Simple installation in closed grooves
- Protects against cold welding
- Available with diamond pattern

Application examples

- Mobile hydraulic systems
- Standard cylinders
- Injection molding machines
- Servo cylinders
- Presses
- Machine tools

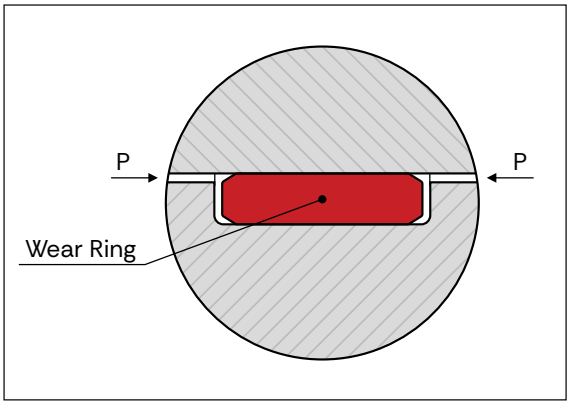


Figure 65: HaaWear piston.

Working conditions

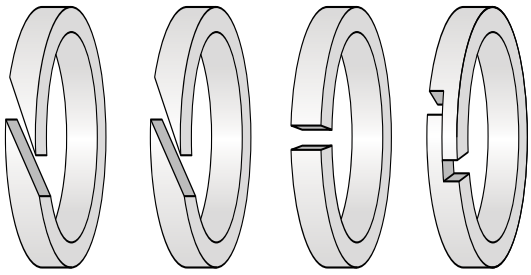
Speed:	15 m/s
Action:	Double acting
Temperature:	-30 to +90 °C
Diameter:	Ø8 to Ø1000
Load:	5 N/mm² projected area

Wear ring performance depends on operating conditions and must be verified through real-world testing.

Length calculation

Equation:	3,11 x (d_2 - W) - k = L
Example:	3,11 x (40 - 1,55) - 0,5 = 119,1 (119)
Temperature:	+60 to +90 °C : k = 0,5
Temperature:	Above +90 °C : k = 2,0

Rounding is done to the nearest whole millimeter when calculating the strip length. The given formula is for calculating the length of strips for pistons. Note that the formula for calculating the length for rods is different.



Type 1 30° cut | Type 2 45° cut | Type 3 Straight cut | Type 4 Z cut

Figure 66: Types of cuts for HaaWear piston.

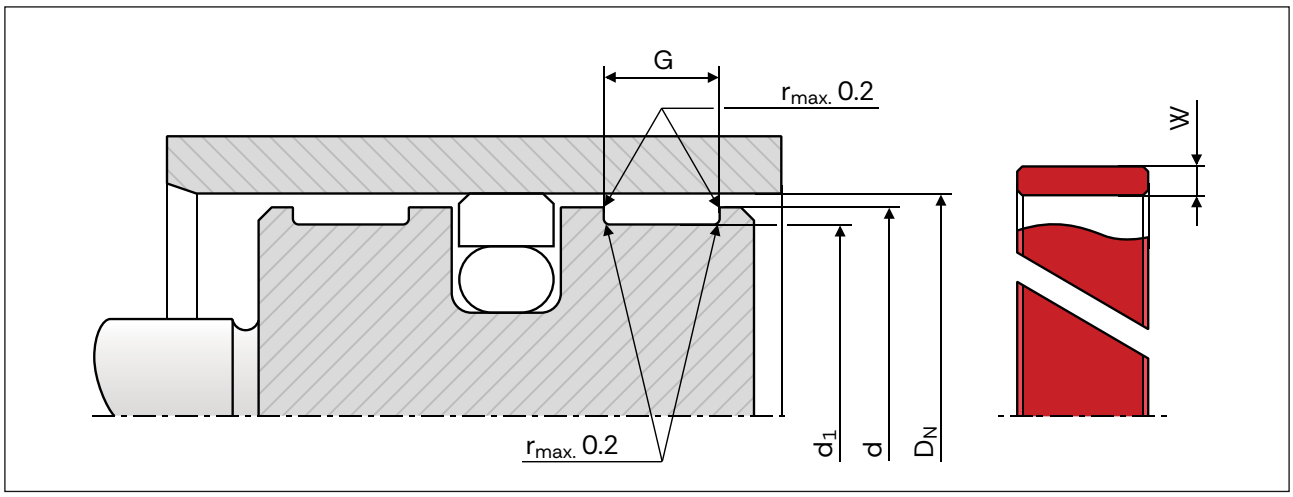


Figure 67: Assembly drawing for HaaWear piston.

SW	d_1 h7	d h9	G $^{+0,2}_{-0}$	Bore D_N H9	W $^{+0,0}_{-0,05}$
				Standard	
155025	D_N - 3,1	D_N - 0,8	2,5	8 - 20,0	1,55
155040	D_N - 3,1	D_N - 0,8	4,0	10 - 50,0	1,55
250056	D_N - 5,0	D_N - 1,6	5,6	16 - 140,0	2,50
250097	D_N - 5,0	D_N - 1,6	9,7	60 - 220,0	2,50
250150	D_N - 5,0	D_N - 1,6	15,0	130 - 400,0	2,50
250250	D_N - 5,0	D_N - 1,6	25,0	200 - 2000,0	2,50
400250	D_N - 8,0	D_N - 2,0	25,0	280 - 2000,0	4,00

Tabel 33: Recommended standard installation dimensions for HaaWear piston.

Order example

HaaWear piston standard with 1,55 mm thickness for a 4,0 mm groove to a Ø40 mm bore

Article number:	SW155040	0119	37	D	2
Series					
Length calculation					
Material (Wear ring)					
Diamant					
Cut					

See pages 22 to 24 for an overview of material options for the wear ring. If a diamond pattern is not desired for the wear ring, it is omitted from the article number when ordering. See figure 66 for types of wear ring cut.

Do you have questions about thermoplastic seals?

Contact Haagensen A/S for expert guidance. Our team is ready to assist with sealing solutions and technical inquiries, drawing on our extensive industry experience.

Contact us
Telefone: +45 48 17 65 00
E-mail: Sales@haagensenseals.com

www.haagensenseals.com

Haagensen
Sealing Solutions