
HUNGER

Dichtungen

EIN UNTERNEHMEN DER HUNGER-GRUPPE

Product Information



Your Partner for Complete Solutions

The Hunger DFE Concept

Decades of experience and continuous development have led to the creation by the firm Hunger DFE of a complete range of sealing and bearing elements. In several fields of application the knowledge gained from practical experience has been translated into modern sealing concepts which offer not only many advantages, but have proved their worth on millions of occasions.

Ever greater demands are placed on modern sealing elements in terms of their sealing capability and service life. Rod seals in particular have to fulfil the requirements of environmental protection with the lowest possible leakage rate.

Besides the leakage rate, the positioning accuracy of the cylinder also plays a significant role in the design of a modern hydraulic seal. Properties such as stick-slip-free running have become standard today. Modern sealing and bearing elements can guarantee this smooth, quiet movement even at lowest speeds.

TDI Rod Seal

In order to meet these requirements, the "TDI" rod seal (see illustration 1) was developed. One of the outstanding features of this patented seal is its high sealing capacity. Minimum leakage rates and a long service life have been harmonised to produce smooth cylinder operation over several million strokes. This seal consists of the two components, the elastic body and the slide ring:

- In the standard material design the elastic body consists of highly wear-resistant polyurethane (PUR). In the TDI sealing system this fulfils two tasks. On the one hand its geometry forms an elastic sealing lip as a primary seal. On the other hand it acts as an elastic pre-stressing element for the second sealing component, the integrated slide ring.
- The slide ring consists of a wear-resistant and low-friction PTFE bronze compound. Due to its shape this forms a secondary sealing edge. Any seepage oil that has passed the primary lip is held back by the secondary sealing edge, and during the return stroke of the rod is forced under the primary lip back to the oil chamber.

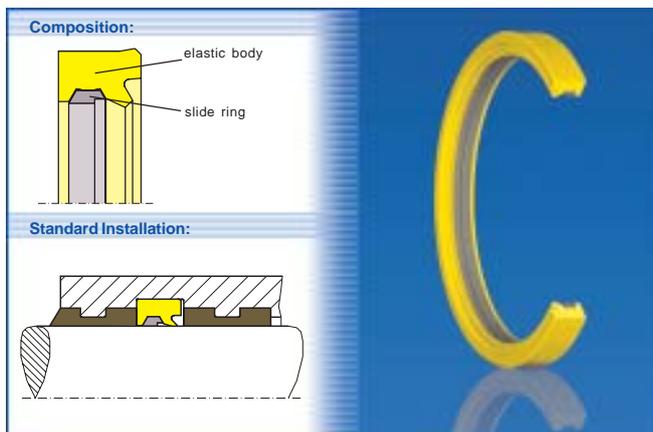


Illustration 1: TDI

The TDI offers the following advantages:

- full functionality in an unpressurised state due to the pretension of the sealing lips
- long service life of the sealing system
- permanent stick-slip-free running.

The operating temperature is between -35 and +100°C. Through the use of special rubbers it is possible to modify the TDI for use between -60 and +200°C and resistance to almost all types of media.

GD1000K Piston Seal

In contrast to the rod seal, the piston seal's qualities are well hidden. The GD1000K (see illustration 2), which is also patented, is suitable even for exceptional stresses. For the standard seal, temperatures of -45 to +120°C are permitted. When modified it may be used for temperatures of between -60 and +200°C, as well as at high pressures or running speeds. It is therefore a sealing element that can be used for all hydraulic and pneumatic applications.

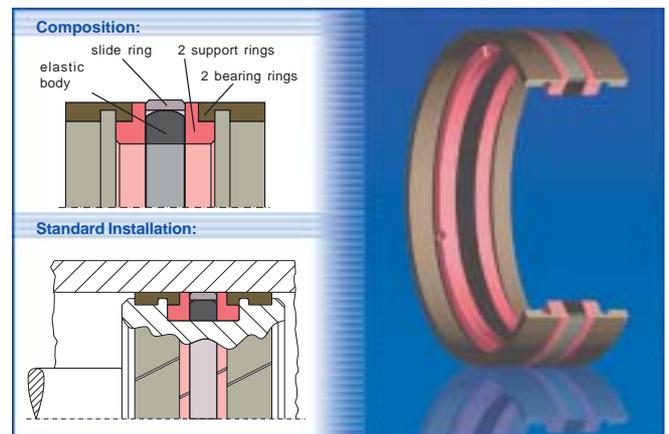


Illustration 2: GD 1000 K

The standard version of the GD1000K consists of the following:

- a rectangular, elastic body of modified NBR,
- a slide ring made of abrasion-proof and low-friction PTFE bronze compound as the actual sealing ring,
- two lateral support rings made of modified polyurethane (PUR) which protect against gap extrusion, and
- two bearing rings made of pressure-proof and low-wearing POM-PTFE bronze compound.

The GD1000K offers numerous advantages:

- The bearing rings positioned on the support rings prevent any metal to metal contact between the piston and the cylinder tube, while also guaranteeing exact guidance.
- The piston seal fulfils the requirements for a high level of sealing as well as for stick-slip-free smooth running movement.
- Due to its structure it does not require any covered installation space, thus simplifying the design of the piston.
- Its combined bearing and sealing function in conjunction with its very narrow overall width provide structural advantages for the double-acting cylinder.

FA / FI / FAI Bearing Elements

The bearing rings (see illustration 3) represent the bearing and guiding surface between the moving parts of the hydraulic cylinder. These prevent metal to metal contact while at the same time ensuring a high degree of pressure resistance. The bearing rings consist of a highly wear-resistant, low-friction polyoxymethylene (POM) modified with bronze and PTFE. They are grooved for easy assembly and can be inserted using their patented U-shaped profile without metal chamfering. This makes it possible to fully screen the sliding surfaces from one another. Furthermore, due to their almost constant friction magnitude over the entire permitted speed range, they contribute to the stick-slip-free operation of the cylinder.

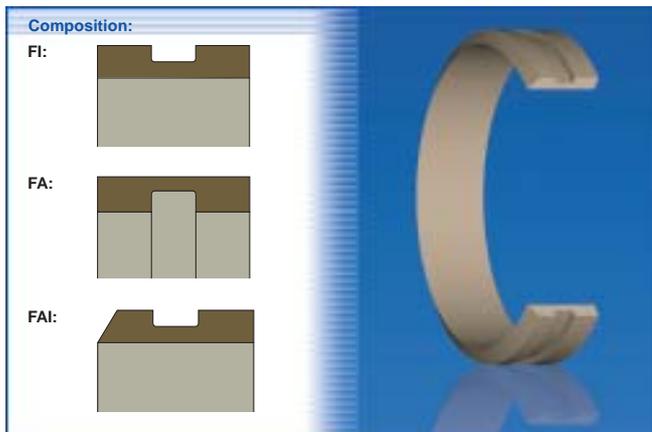


Illustration 3: FI / FA / FAI

OBVD Static Seal

One seal that has been specially developed for static sealing purposes fits into the existing O-ring installation spaces while preventing the undesired gap extrusion of the O-rings.

The composite O-ring back ring seal "OBVD" (see illustration 4) is an 80° Shore A hard NBR O ring with a cold welded and therefore permanently connected back ring made of 95° Shore A hard polyurethane (PUR) which is highly resistant to gap extrusion.

The OBVD can be inserted into the existing O-ring installation spaces without the need to make any structural changes. The standard insertion spaces of the O-rings are also sufficient for the OBVD in the case of new designs. The geometry of the polyurethane back ring supports the sealing function and, in contrast to hard back rings, does not have any sharp edges, thus preventing any peeling of the O-ring.

The one-part OBVD also has the advantage of simple installation and reduced storage.

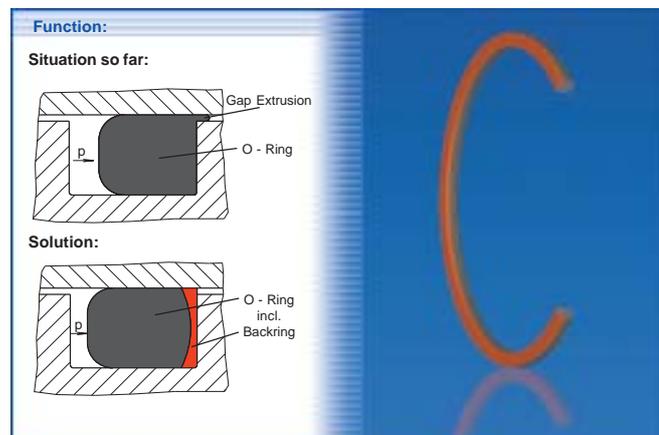


Illustration 4: OBVD

Modern Aspects

When selecting a design element, several aspects have to be considered:

Besides its basic function, it should be possible to combine the element with guide mechanisms and seals to form a sealing system.

The complexity of the design should be kept as low as possible.

The sealing and bearing elements play a decisive role in the serviceable life of the hydraulic cylinder.

That is why quality, sealing capability, guide functions and service life are the most important factors when selecting the sealing and guide elements.

Modern Materials for Bearing Elements

Since the foundation of Hunger DFE GmbH the company has been constantly involved in the development and processing of high-quality thermoplastics for the manufacture of the products.

Material Selection

The target of making a material ready for series production which was not only able to fulfil the bearing function but was also better in terms of its properties than the polyoxymethylene (POM) predestined for this task resulted in the creation of the POM-PTFE bronze compound that is enriched with PTFE and bronze particles.

This material and the optimised geometry of the bearing elements open up numerous opportunities for improving cylinder design.

The improved characteristics of the compound essentially result from the positive values of its individual components:

- POM is a classical material for high-strength bearings and accurate guide mechanisms. Even the basic material stands out not only due to its low coefficient of friction and minimum wear, but also high thermal and chemical resistance.
- PTFE is the plastic with the lowest level of friction against steel. Its dynamic and static coefficients are practically the same and allow stick-slip-free running even at the lowest speeds.
- Bronze increases the pressure resistance of the material and reduces the tendency to creep to a minimum.

Not only the combination of these materials, but rather the correct ratio in which the components were mixed produced a material which opened up new possibilities because of its capabilities and broad range of applications.

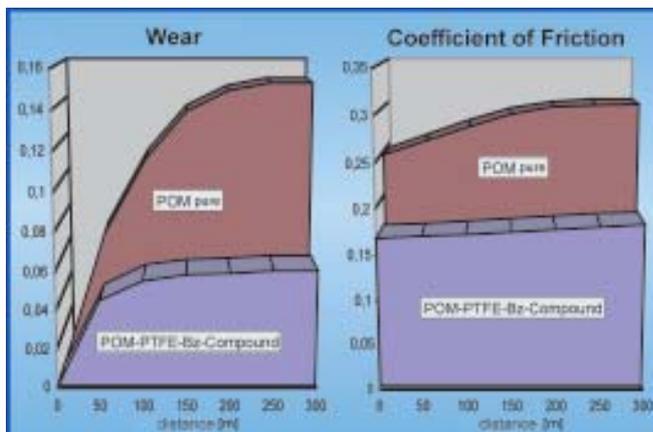


Diagram 1 and 2: Wear and Coefficient of friction

Laboratory Tests

An independent testing institute was commissioned to directly compare the new material with traditional ones. It was shown that the excellent properties of the POM were even further improved by the compounding.

The coefficient of friction of the compound is markedly lower than that of the starting material (see diagram 2). The main effect of this is the reduced wear on the guide mechanisms and sliding surface (see diagram 1).

The mechanical loss factor of the compound is higher, resulting in improved damping characteristics and a higher level of recovery after mechanical deformation.

The dynamic modulus of elasticity is lower than for the pure POM (see diagram 3). However, this is still within the range which is required for practical applications. After completion of the trials it was possible to get even closer to the modulus of elasticity using a new type of compounding process.

The positive properties of the material compound have been confirmed by all types of practical applications. Maintenance-free and reliable hydraulic components in production lines, casting plant, dams or in mobile hydraulics take advantage of these properties on a permanent basis.

Note:

The values stated here refer only to the samples used in these trials and do not represent a guaranteed property.

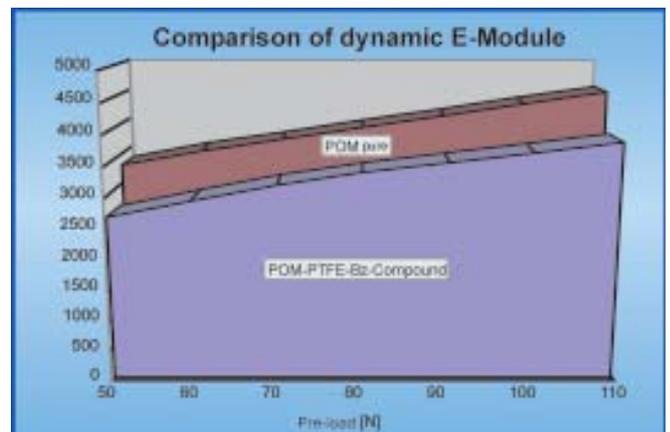


Diagram 3: Comparison of the dynamic modulus of elasticity

Hydraulic panorama lifts such as those to be found in shopping centres and furniture houses provide not only an insight into the multitude of items on sale, but also a direct insight into the technology of the lift.



"Wet" cylinder rods caused by leaking seals are therefore absolutely taboo!

What is required is a maximum sealing effect and reliability with a minimum of friction and stick-slip-free movement.

Particularly during the soft start on the way down after the lift has stopped at a floor, and again when coming to a stop at another floor, there must be no "jolting".

Passengers in the lift would be made to feel uneasy or even placed in danger.

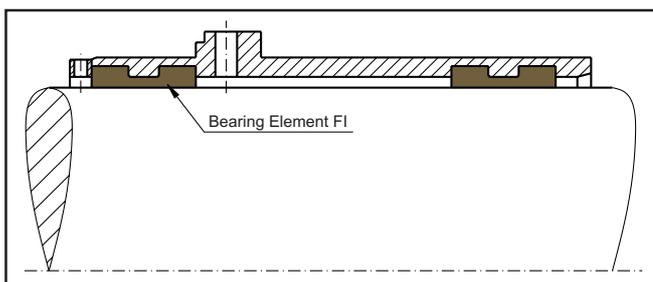


Illustration 1: Bearing elements of the damping bush

Here the sealing and bearing elements are required to ensure that the desired properties remain constant from the very beginning while the lift is travelling up and down.

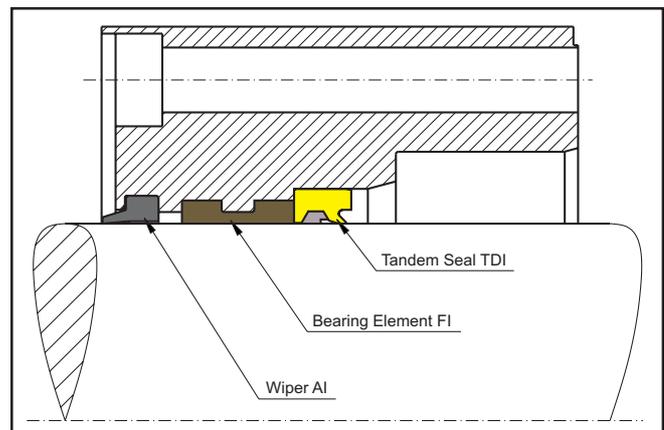
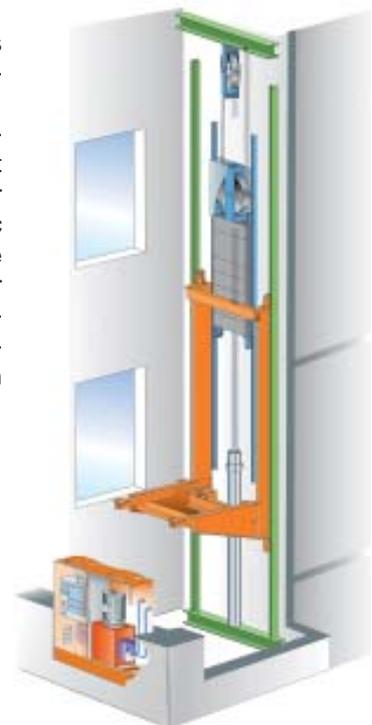


Illustration 2: Seals and bearing elements of the guiding head

A number of lift manufacturers therefore use HUNGER products with which the requirements of easy running and absence of leaks are easily fulfilled under all operating conditions (pressure, speed, temperature, etc.).

An interesting insight is provided by open steel-glass constructions. And there, visible to everyone, laterally placed lift cylinders (plungers or multistage telescopic cylinders) confirm the reliability of the Hunger system solutions consisting of sealing and bearing elements that are in use there.



Forestry Machines

The ratio of modern timber harvesting machines used for the thinning out or large-scale felling of trees is constantly increasing. Harvesting machines are used all over the world, from Indonesia to Siberia, and in the most difficult of terrains.



For the transport of the timber to paved roadways forwarders are used which can transport up to 14 tonnes of material. These are equipped with a telescopic crane which can grip tree trunks from a distance of 10 m.

Highest Demands

One of the world's leading manufacturers of forestry machines is the Finnish company Ponsse. The timber companies expect their machines to be fast and highly productive during the harvesting process. In order to be able to fulfil these requirements Ponsse demands the highest levels of quality from their suppliers. After extensive testing - and due to the outstanding quality shown by practical experience - for approximately the last five years the hydraulic cylinders have been equipped almost exclusively with HUNGER sealing and bearing elements. Depending on the type of machine, 10 to 20 hydraulic cylinders of varying diameter and construction (supporting cylinders, telescopic cylinders, steering cylinders...) are used, making it possible to carry out lifting, lowering, tensioning and swivelling operations. With this considerable number of cylinders per vehicle and the high standards required, it becomes clear that also the wearing parts, such as the sealing and bearing elements, are of particular significance.

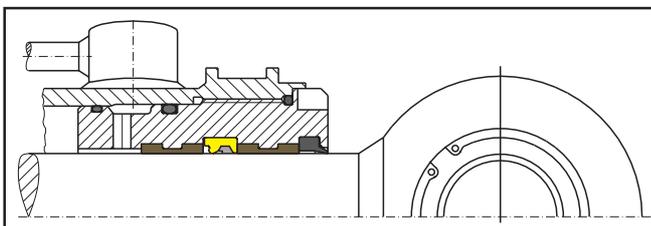


Illustration 1: Mounting arrangement of the cylinder rod

Tailor-Made Sealing Systems

The decisive factor in the service life of a sealing system is harmonisation of the components used, taking into account all operating parameters and structural aspects.

The sealing systems have been adapted to the respective demands placed on the cylinders. For example, in the case of the harvesting aggregate a rapidly assembled sealing and guide system was developed. With this, the tree trunks are cut into lengths, disbranched and deposited on the vehicle for removal in less than a minute.

In order to fulfil the requirements of a rapid assembly sealing and guide system without having to forfeit any of the sealing effect, the TDI tandem seal was chosen as the rod seal in conjunction with the FI bearing element.

Environmental Protection

Besides the absence of leaks, a further important environmental aspect is fulfilled by the possible use of environmentally friendly hydraulic fluids. The use of rapidly degradable hydraulic media is frequently demanded both by customers and strict regional environment legislation. For all the sealing types used the materials can be adapted to the environmentally friendly hydraulic fluids approved by Ponsse.



The harvester fells, measures, disbranches and cuts the trees into lengths within a few seconds for further processing of the trunks.

Washing Robot

Tedious and time-consuming washing by hand is no longer required. Today the washing brush is rotated by the robot.

The airline Deutsche Lufthansa AG successfully uses a real "master cleaner" for almost the entire Boeing and Airbus family at Frankfurt and Munich Airports. By the use of state-of-the-art technology, this sensitive washing robot makes it possible to save time and money when washing the aircraft. Computer controlled and regulated with extreme accuracy, the washing brush is pressed gently against the body of the aircraft. The frictional resistance of the brush elements regulates the telescopic movement of the robot arm. This is of course assisted by the sealing systems of the hydraulic cylinders that are installed, so that the 33 metre-high, 5-armed mast slides safely and reliably with the washing brush over the surfaces of the aircraft.

Sealing Concept

Besides the leak and stick-slip-free rod sealing concept, consisting of the AI wiper, TDI rod seal and FI bearing rings, the GD 1000 K piston seal also has a decisive role to play.

The double-acting GD 1000K compact piston seal is composed of two bearing rings, two support rings, an elastomer section and a PTFE compound slide ring. Through its stick-slip-free movement this seal also ensures the exact positionability of the arm, holding it exactly on the sensitive skin of the aircraft with its outstanding sealing effect. Its plastic bearing rings fully exclude metal to metal contact on the inside of the hydraulic cylinder, thus enabling a low wearing and inexpensive cylinder design.

In order to guarantee reliability, which is absolutely essential in the area of the static seals, a composite element consisting of an O-ring with back ring is used.

This so-called OBVD (O-ring back ring composite seal) can be easily installed in standard installation spaces for

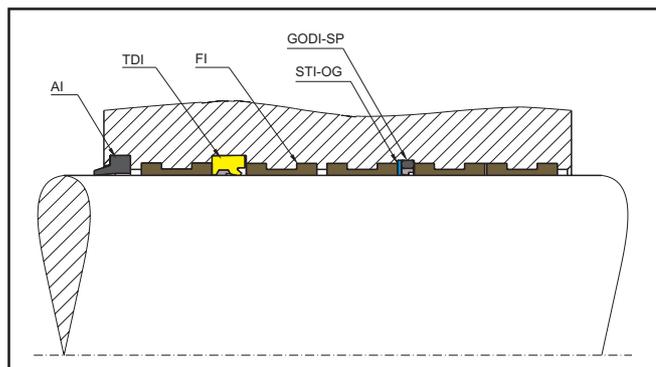


Illustration 1: Mounting arrangement of the rod seal



Illustration: Company Putzmeister

O-rings in accordance with DIN 3771, but is protected by the back ring against undesired gap extrusion.

Therefore, in this application the sealing and bearing elements used ensure that during the 2-3 hour washing of the aircraft, only the "gentle wash" is switched on.

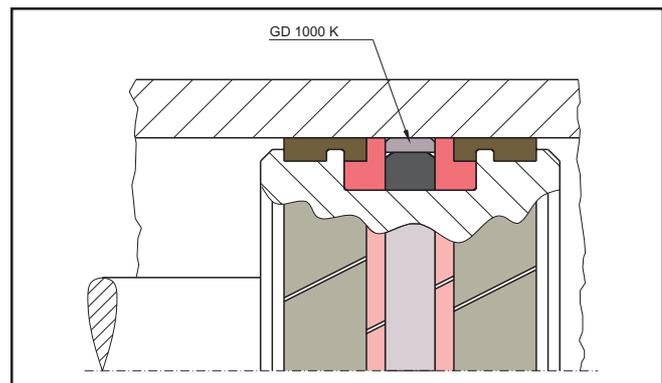


Illustration 2: Mounting arrangement of the piston seal

Construction Machines

Construction machines lift, hold, transport and move large loads. Behind the scenes there is usually a sophisticated hydraulic system at work which has to fulfil a number of requirements.



For the seal manufacturer these requirements are specifically defined: a long service life, a high level of operating safety, short-term availability, replacability with products of the competitors and easy installation, as the repair of the machine often has to be carried out on site using simple equipment.

Fields of Application

The fields of application for seals are as numerous as their various types. For example, many construction machines have supporting cylinders which give the basic device the required stability. Here the seals are subjected not so much to wear and tear than to high static sealing requirements. Due to the technical principle used, lip seals made of thermoplastics or elastomers are recommended here which have sharp-edged sealing lips and which keep the pressure constant over a long time. Illustration 1 shows an example of the structure of a supporting cylinder combined with seals and bearing elements which permit maximum lateral forces without contact of the metal sliding "partners". Complemented by a robust wiping element which carefully removes any dirt when the support is drawn in, the system is able to fulfil all requirements.

The next hydraulic station of the equipment could, for example, be the rotary actuator of a boom. In such cases toothed racks are mostly used to transmit a rotary movement to a pinion using hydraulic control. This task has to be performed as smoothly as possible, often using precise control methods; the sealing elements must therefore have a low coefficient of friction. The specific use of PTFE (polytetrafluoroethylene) and its compounds has brought many advantages in comparison to the some-

what "antiquated" sets of sleeves, especially when this involves elastomer lip seals with PTFE slide ring (tandem construction). These combine the sealing power of the lip seal with the excellent sliding properties of a slide ring seal. The moving arm or boom of the crane now has to be lifted and lowered. Here too, high standards are required of the system and rod seals. Primarily, both elements must provide high levels of sealing capability, as a sudden drop as a result of a leak from the piston would be even more fatal than oil leaking from the piston rod.

Collaboration

Many construction machine manufacturers collaborate intensively with the seal producer, and in the present case this resulted in the 6-part compact seal "GD 1000 K" (see illustration 2, page 7), where each element is allocated a specific task. The heart of this seal is a rectangular expander made of nitrile rubber which is rounded off to the cylinder tube and covered with a slide ring made of PTFE compound.

In order to resist high pressures for a prolonged period, this element also includes chamber rings made of high-strength TPE. The seal is rounded off by two U-shaped bearing elements consisting of PTFE-enriched POM, which are mounted by simply snapping on into place. In principle the same requirements are placed on the sealing elements with respect to the rod. Therefore only seals which are able to withstand high pressures can be used. With the lip seals which are mostly used, a back ring is inserted as extrusion protection for support over the entire area (illustration 2). For pressures over 360 bar this is recommended, while from 450 bar and up it is required. Nevertheless, with rod and piston seals it may be necessary to insert a back ring even at lower temperatures but greater gap sizes. These gap sizes need not be based only on manufacturing tolerances, as often the fits only become apparent once operation has started, for example through pipe enlargement (high internal pressures,

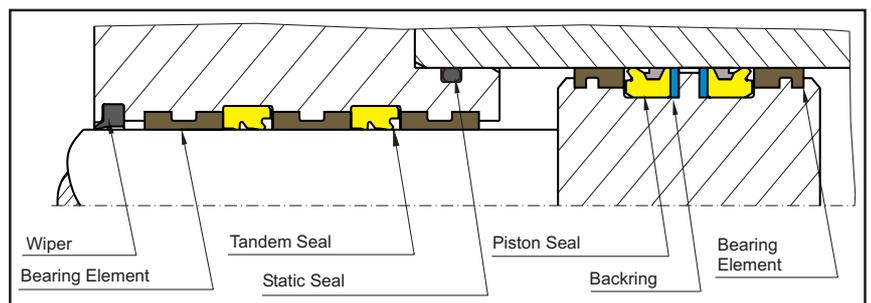


Illustration 1: Mounting arrangement of the cylinder



lightweight cylinders). Therefore you should consult the application engineer of your seal supplier for advice at an early stage. Even at the design phase it is then possible to exchange valuable experience or adopt complete installation proposals.

Often it is easier to seal tilting cylinders with a telescopic construction. These are mostly only single-acting and the return stroke is effected by the device's own weight. Here, tandem lip seals are the most suitable solution, where a compact sealing element can have several sealing lips arranged one behind the other (illustration 3).

Hydraulic Media

Particular attention must be given to the selection of sealing elements of increasing dimensions with respect to their compatibility with the hydraulic medium. Although in the past mineral oils were almost exclusively used in mobile

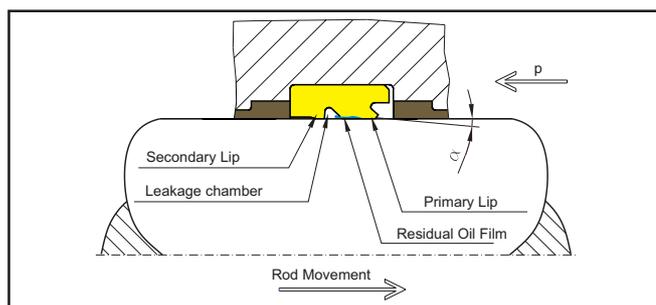


Illustration 3: The residual oil film is forced back via the leading edge angle α

hydraulics which were compatible with almost all widely used sealing materials, today more and more rapidly biodegradable media are used which even on the same basis have a different effect on the behaviour of the elastomers. The following fluids are the main ones on offer today:

- HETG fluids on a vegetable oil base
- HEPG fluids on a synthetic polyglycol base and
- HEES fluids consisting of synthetic carbonic acids.

The consequences of unsuitable material/medium pairing may be various types of damage. The sealing material may swell and become soft, shrink and become hard or even be dissolved. It is therefore essential for the seal manufacturer to carry out thorough compatibility trials using various biological media.

The task of a widely used mobile hydraulic application should also be carried out, as it is not always possible to connect subassemblies moving in opposite directions to one another by hydraulic tubes or pipes. By the use of rotary transmission leadthroughs or medium rotary distributors, pressure, lubricating, cooling or cleaning media are transported from the static to the moving subassem-

\varnothing -range	\varnothing gap 2s [mm] (with metallic chamfering)				
	Lip Seals rod / piston sealing			slide and O-Ring Seals with integrated chamfering rod / piston sealing	
	100 bar	with Backring		100 bar	450 bar
450 bar		Backring width			
0 - 56	0,6	0,8	1	0,7	0,5
60 - 115	0,7	1,2	2	0,8	0,6
120 - 300	0,8	1,2	2	1	0,8
> 300	1	2	3	1,6	1,4

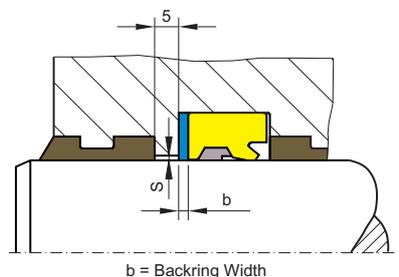


Illustration 2: Backring as extrusion protection as a function of pressure and gap

bly. Here it is not only necessary to avoid leakage to the exterior; the individual channels must be reliably separated from one another, as otherwise the penetration of water, for example, into the central lubrication channels may result in entire aggregates being destroyed before the damage is detected. This important task should be left to specially designed slide and O-ring seals. Their geometry is modified with respect to the axial seals to the extent that the movement has to be specifically placed on the dynamic sealing surface. Rotation of the slide ring on the expander is generally a cause of premature failure for rotary seals and often results from incorrect installation (overstretching). During initial assembly or employee training courses you should therefore take note of the installation instructions, recommendations concerning special installation greases or practical tips given by the application engineers of your seal supplier.

Scrap Presses

Punchings from bodywork manufacture of the automobile producers are transported by conveyor belt in the respective production shops through the factory to a central packing press.



Producing a great deal of noise, unshapely pieces of sheet metal punched out during production fall down to the lower storeys into the meter-long filler channel of the hydraulic press, where an initial hydraulic cylinder pushes them several meters into the pressing chamber. Here, the cylinders press the shapeless pieces of metal into a space-saving block, which is then transported away for recycling.

Similar equipment is found in the yards of the scrap car dealers.

Common to both applications are the high standards required of the sealing and bearing elements of the hydraulic cylinders, which have to work reliably at all times under the most difficult of conditions. In the past designers therefore often used rubber-tissue V-shaped seals, which were considered to be robust.

V-Packing Replacement

The continually increasing requirement for higher operating pressures in conjunction with faster speeds and higher levels of press utilisation can often not be fulfilled by these V-shaped seals (illustration 1).

In existing plant these inadequate seals have therefore been replaced by bushes equipped with state-of-the-art sealing systems (illustration 2).

This saves valuable time which would otherwise have to be used for corrective measures and modifications, with the packing presses becoming fully available again after only a short time.



Illustration 1: Worn-out V-Packing

In this system the metal guide bush, which is often responsible for damage to the piston rod of the cylinder, is replaced by a "more flexible" guide bush made of a high-performance thermoplastic. This plastic bush reduces the punctual pressing peaks and distributes the load evenly, so that the level of pressing is kept at a low level. Damage to the rod is therefore a thing of the past.

The modern sealing elements that are now incorporated have a high level of efficiency, allow maximum speeds and can be positioned exactly. Due to their ideal profile geometry and optimum material selection they show the lowest possible levels of friction, minimising wear and guaranteeing a long service life.

Hunger system solutions therefore make an important contribution towards guaranteeing plant availability as required by all users in the field of automobile manufacturing and recycling.

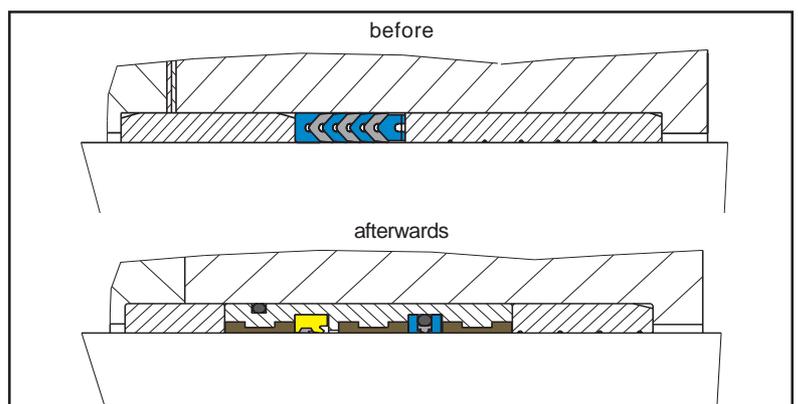


Illustration 2: Replacement of V-Packings by modern sealing systems

One example of how the functional properties of a hydraulic component can be optimised by the specific coordination of cylinder design and selection of the sealing elements is shown by the use of Hunger hydraulic cylinders with Hunger DFE sealing elements in casting cylinders. These ensure consistent casting quality in over 50 vertical casting plants worldwide.



The Casting Cylinder System Solution

The casting process of aluminium bars is shown in illustration 1. Molten aluminium passes via channels from the casting furnace to a mould, in which several bars can be depicted at the same time. Initially the mould is closed at the bottom by the casting platform, which is mounted on the casting cylinder plunger. The casting platform is slowly lowered into the casting pit by drawing in the casting cylinder, while at the same time further molten aluminium is added from above. The bars "grow" so to speak from the bottom of the casting mould. In order to achieve perfect aluminium casting it is essential that the stroke of the casting cylinder is absolutely stick-slip-free. Any jerky movement or changes to the stroke speed result in the aluminium material losing its homogeneity.

For this reason Hunger DFE sealing and bearing elements that have been specially adapted for this application are used in the casting.

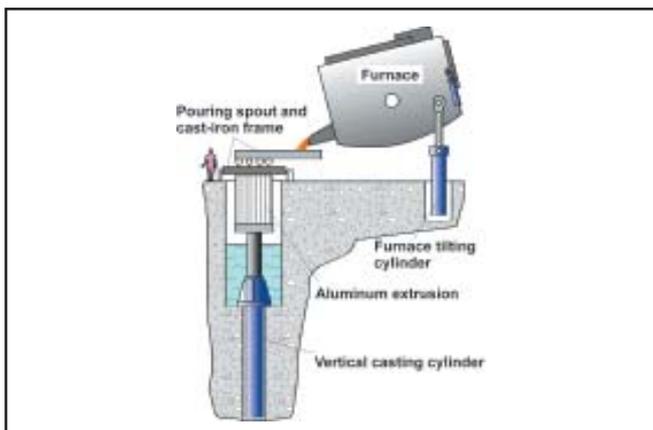


Illustration 1: Prinziple of a vertical casting plant

Intelligent Sealing System

The sealing and bearing elements play a decisive role in the friction and movement behaviour of the casting cylinder.

In addition to a primary sealing ring of type "TDI" or "DMD Tandem 2000", the cylinder sealing system contains a secondary seal. This uses a sealing ring of the externally adjustable sealing system of type EVD.

The sealing ring of the EVD has a pressure chamber which is integrated into the main body of the seal and is inserted into the installation space without any radial prestressing. If the primary seal is intact the sealing edge of the EVD does not have any function and is therefore not subject to any wear and tear. If after a long period a leak occurs as a result of wear or damage to the primary seal, the externally adjustable EVD sealing system can be activated and

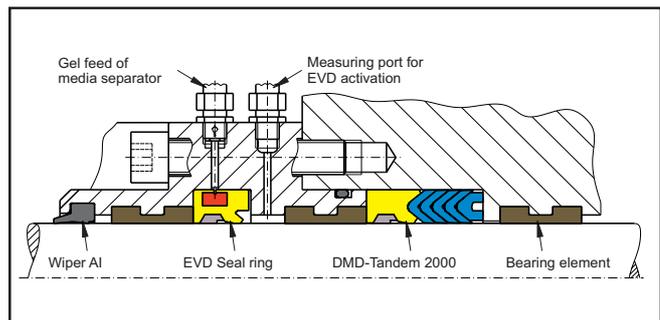


Illustration 2: Sealing system of a vertical casting cylinder with EVD

can then take over the full sealing function. To this purpose gel is pressed via an external pressure source into the pressure chamber of the EVD sealing ring, with the result that the sealing edge is pressed against the piston rod surface. The sealing function is therefore provided with a sealing edge that is not worn. There are several ways of building up pressure for the EVD, from manual delivery to an intelligent sealing system which offers automatic leak detection and activation of a pressure-regulated hydraulic unit. The intelligent sealing system is particularly useful for this application, as it is almost impossible for the operator of the plant to detect any external leakage of the plunger seal at an early stage. With the intelligent EVD the plant operator is informed of the activation of the EVD by means of a signal lamp and can include maintenance of the casting cylinder in the maintenance schedule of the casting plant in the long term. The function of the casting cylinder and therefore the entire casting plant is retained in full.

Rod Seals					
TDI	EVD	TDT	NDT	TDMI	GGDI
GGDI-SP	ZSDI	GODI	GDSI	GODI-SP	
Piston Seals					
GD 1000 K	GKD	GD 2000 P	TDA	TDMA	GGDA
ZSDA	GODA	GDSA	GODA-SP		
Rotary Seals					
RDI	RDA	RODI	RODA	RSI	WDI/WDA
Wipers					
AI	AI-D	AIST	A-EIS	A-EIS-S	AI-FF
Bearing Elements					
FI	FAI	FA	RFI	RFA	PFB
V-Packings			Complete Pistons		
DMD-Tandem 2000	DMD 3	DMD 9	KKP	KKH	
Static Seals					
OBVD	S90	POR	STI/STA	MCOR	UPOR

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