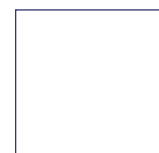


Cartridge seals as a standardisation solution for slurry applications.

*Methods, requirements and typical applications.*





The recovery of raw materials and the subsequent conditioning of the ores and minerals is often associated with abrasive and corrosive media with an extremely high solids content (slurries), sometimes combined with high temperatures and pressures.

This creates a particularly stringent and robust requirement profile for the machines, pumps and seal systems applied.

The operator's external environment is increasingly subject to more stringent environmental protection conditions and the need to minimise or even totally eliminate power and water consumption.

This leads to requirements to increase system availability and productivity, which resulted in a progressive development process in the field of seal technology.

Asa Seal has played a successful part in this process. Today, Asa Seal offers a broad range of technical-ly mature, proven and cost-effective seal and supply systems.

The cartridge versions of the HR and Cartex® mechanical seal series, in particular, have been successfully used in many different slurry applications.



### Application methods

The processes with the most stringent requirements due to the solids content of the media can be divided into dredging, tailing and metal refining from the viewpoint of the seal technology.



Submersible dredge pump (Damen)

### Dredging

Dredging means the dredging of silty waters (rivers, lakes, waterways and harbours), transporting sands containing raw materials from beaches (beach mining) or the drainage of settlement basins in the mining industry.

A supply unit is generally fitted on a boat-like float and supplies a pivoting or rise-and-fall suction pipe. The suction pipe has a rotating cutter head that detaches the sediments to be pumped from the river, lake or sea-bed. These sediments are then pumped to the surface by a powerful intake pump and transported to collecting boats or to the shore via pressure pumps.

### Process conditions

- Pressure at the seal: Vacuum ... 6 bar
- Solids content up to approx. 70 %
- Solids sizes from a few  $\mu\text{m}$  to 50 mm (20 mm in the seal chamber)
- Temperatures up to approx. 30 °C
- Single seal with quench

seals from the HR series operated with quench have proven suitable for this application. They are particularly ideal for conditions that change suddenly (water hammer) due to clogging of the suction pipe



# slurry applications ...

... proven and reliable, even under the hardest conditions



## Tailings

Tailings means the pumping and storage of excavated material. This excavated material occurs in the first stage of the mining process, when the lower quality rock fractions are separated from the more highly concentrated fractions.

The excavated material can be piled up to form rubble walls. These are used to dam up settlement basins in mining operations.

It also includes pumping solids-containing media over long distances or tall obstacles (e.g. heaps of excavated material).

### Process conditions

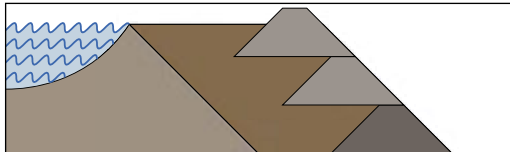
- High pressures up to 45 bar
- Solids content up to 40 %
- Solids sizes from a few  $\mu\text{m}$  to 10 mm
- Single and double seal

Mechanical seals from the Cartex series are used for medium solids contents up to 40 % and pressures up to 25 bar.

Only HR double seals are used in pressure booster stations for pressures up to 45 bar when there are also solids in the medium.

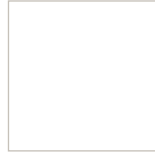


Pressure booster station (Warman)



Typical construction of a Tailings Dam





### Metal refining

Chemically pure raw materials and metals such as copper, nickel, zinc, etc. are normally generated and produced in a three-stage process: Extraction, concentration and refining.

The process of copper recovery is described here by way of example:

Ore is mined in surface or underground mines and crushed to a transportable material size.

Once the unusable rock fractions have been separated out, the ore is milled and concentrated by flotation (with water and chemicals) until a copper content of up to 35 % is obtained.

The smelting method depends on the type of ore. Sulphidic (containing sulphur) ores (84 % of worldwide production) are generally worked by flash smelting, while oxidic (containing oxygen) ores are worked using the solvent extraction method.

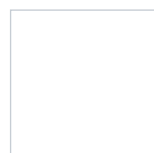
This is followed by fire refining; in the first stage, further impurities are removed from the liquid copper by blowing in air. The metal is then cast to form plate copper, from which the purest copper can be obtained by electrolysis.

Although the pumping and sealing conditions in extraction and concentration are similar to those already described under dredging and tailing, the refining stage is dominated by high chemical stresses and high temperatures.

#### Process conditions

- Solids content > 40 %
- Highly corrosion and erosion-resistant materials across the entire pH range
- Temperatures up to approx. 180 °C
- Single and double seals with buffer system

type HR seals are particularly robust, which makes them very flexible. They are ideal for this applications since components that come into contact with the product can be made from ceramic materials where high solids fractions are combined with high chemical stresses.



# Seal applications



## Advantages of cartridge seals

Cartex and HR mechanical seals fulfil at least the following requirements:

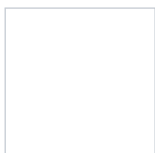
- Reliable and safe sealing of media containing the highest solids contents
- Resistant to erosion and corrosion from the most abrasive and/or corrosive media
- Materials can be optimally adapted to the application for the longest possible service life
- Media that may be detrimental to the health or present other hazards can be sealed in an environmentally friendly and operationally safe manner
- Seals can be standardised for optimum storage and improved system availability
- Reduced water consumption and thus lower operating costs compared to the many pumps that are still sealed with packings today



## Choice of seal according to solids content

Max. solids content % by weight	Max. grain size mm*)	Seal type	Method of use to API	Pump stuffing box
7 %	1	Cartex-SNO	<b>Plan 2</b> , Dead-end without circulation	Open stuffing box space
7 %	1	Cartex-SN	<b>Plan 11</b> , Circulation from the pump case to the seal	Open stuffing box space
15 %	1	Cartex-QN	<b>Plan 62</b> , External fluid quench <b>Plan 11</b> , Circulation from the pump case to the seal	Open stuffing box space
15 %	1	Cartex-DN	<b>Plan 52</b> , External fluid quench, unpressurised;	Open stuffing box space
25 %	1	Cartex-SN	<b>Plan 32</b> , Injection of clean fluid into the seal chamber from an external source	Cylindrical stuffing box space with throttle on product side
25 %	1	Cartex-QN	<b>Plan 32 + plan 62</b> , Injection of clean fluid into the seal chamber from an external source + external fluid quench	Cylindrical stuffing box space with throttle on product side
40 %	1	Cartex-DN	<b>Plan 53</b> , External fluid reservoir, pressurised	Open stuffing box space
50 %	10	HR321	<b>Plan 02</b> , Dead-end without circulation	Open stuffing box space
50 %	10	HR222	<b>Plan 62</b> , External fluid quench	Open stuffing box space
50 %	10	HRKS-D	<b>Plan 52</b> , External fluid quench	Open stuffing box space
> 50 %	10	HRKS-D	<b>Plan 53</b> , External fluid reservoir, pressurised	Open stuffing box space

\*) in the seal chamber



# Light and Medium Duty

Cartex® mechanical seals as complete, preassembled units are suitable for use with media with a solids content of up to 40 %. They are balanced, independent of the direction of rotation and equipped with all the necessary connections for the most common operating modes. Also suitable for ANSI stuffing boxes.

## Operating limits

$d_1 = 25 \dots 100 \text{ mm } 1,000'' \dots 4,000''$   
 $t = -40 \text{ }^\circ\text{C} \dots 220 \text{ }^\circ\text{C} \text{ } -40 \text{ }^\circ\text{F} \dots 428 \text{ }^\circ\text{F}$   
 $p_1 = 16 \text{ bar } 232 \text{ PSI}$   
 (Cartex-SN, -SNO, -QN)  
 20 bar 290 PSI (Cartex-DN)  
 $v_g = 10 \text{ (15) m/s } 32 \text{ (49) ft/s}$

Axial displacement  
 $\pm 1.0 \text{ mm } > d_1 = 75 \pm 1.5 \text{ mm}$

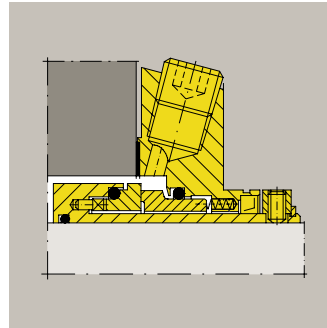
## Materials

(Short designation to EN 12756)

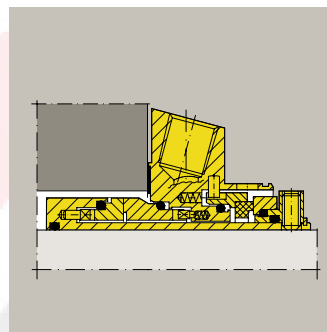
Seal face: Q1, B, U1  
 Seat: Q1  
 Components: G, M  
 Springs: M  
 O-Rings: V, E, K, U1, HNBR  
 Radial seal: P, T3  
 Throttle ring: T12

## Technical benefits of Cartex®

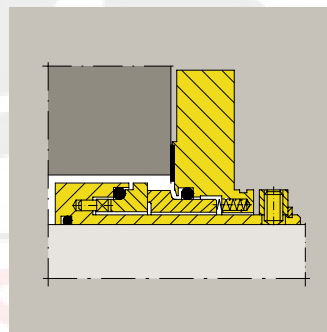
- Stationary seal concept
- Springs outside the medium
- No dynamic O-ring for the shaft sleeve
- Seal faces and seats are flexibly mounted for reliable adaptation of the sliding surface in the event of shaft deflection
- Surface contour on the product side is smooth and largely free of dead space
- Double pressure balanced (-DN)
- Integral circulating device (-DN) for optimum distribution and circulation of the buffer fluid



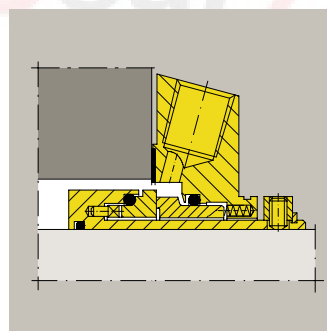
**Cartex-QN**  
 Single seal for operation with unpressurised fluid reservoir. Cover with supply connections for flush and quench.



**Cartex-DN**  
 Pressurised with buffer fluid ( $p_1 < p_3$ ), with venting hole. Also suitable for tandem operation ( $p_1 > p_3$ ) with buffer fluid in dead-end or circulating mode.



**Cartex-SNO**  
 Single seal without connections for dead-end operation.



**Cartex-SN**  
 Single seal with connection for flushing.



# Medium and Heavy Duty

Mechanical seals from the HR series are specially designed for use in media with high solids contents without external flushing or product circulation. The special design features include the rotating seat arranged directly on the pump impeller and the spring protective sleeve which has proven highly effective in practice.

## Operating limits

$d_N = 36 \dots 200 \text{ (400) mm}$   
 $1.4'' \dots 8'' \text{ (16'')}$   
 $t = -20 \text{ }^\circ\text{C} \dots 180 \text{ }^\circ\text{C} \text{ } 53 \text{ }^\circ\text{F} \dots 356 \text{ }^\circ\text{F}$   
 $p_1 = 16 \text{ (45) bar } 230 \text{ (652) PSI}$   
 (higher pressures available upon request)  
 $v_g = 10 \text{ (12 m/s) } 32 \text{ (39) ft/s}$   
 Axial displacement  $\pm 2 \text{ mm}$

## Materials

Seal face: Q1, Q2  
 Seat: Q1, Q2  
 Components: 1.4571, 1.4462 Duplex,  
 1.4501 Superduplex  
 Springs: Hastelloy®-C4 (2.4610)  
 O-Rings: V, E, K,

Other materials available upon request.

## Technical benefits

HR222 / HR321

- Stationary seal concept
- Open seal space
- Single seal, balanced, no dead spaces
- Sliding faces close to the impeller
- Solid seal faces for high temperature stability and erosion and corrosion resistance
- Protected springs away from the product and large axial movement
- Large gaps between components
- Elastically-mounted seat

:HRKS-D/F

- Double seal, suitable for pressure reversal
- Pumping screw (optional) for optimum distribution and circulation of the buffer fluid



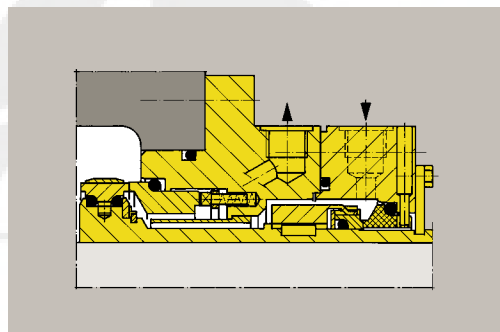
**HR2 ...**  
 Single seal, cartridge version, for use with quench.



**HR3 ...**  
 Single seal, cartridge version.



**HRK-D**  
 Double seal, cartridge version, for buffer pressure or quench operation, suitable for pressure reversal (does not open if the buffer pressure fails); can alternatively be used with pumping screw to increase the circulated volume.



**HR2S ...**  
 Special seal for dredging. Suitable for vacuum and pressure reversal.



# Proven in practice:



## HRKS1 for seal-ing cutter heads and rinsing pumps for dredging

Sandstorms filled a 300 km long, open channel system in Namibia with large quantities of desert sand. This channel system is used to irrigate vast areas of agricultural land.

The Namibian government decided on the need to develop a mobile system that can remove the sand. It had to be extremely robust and have an autonomous power supply. A technical reliable and mobile solution was implemented by converting a dredger equipped with a hydraulically-driven suction and cutter head.

## Robust seal solution in constant use

The special feature with respect to sealing lay in the choice of a single seal; double or quench seals are normally used to seal high solids contents in the pumped medium as these ensure that the sliding surface on the product side is lubricated with clean medium.

In this case, however, the available hydraulic system of the dredger was used. The available oil pressure on the atmosphere side of the mechanical seal was limited to max. 6 bar, which lubricates the HR single seal and prevents the ingress of solids at the same time.

The dredger's hydraulic system continuously generates sufficient pressure, so the single mechanical seal used has been used now for over 10,000 hours with no maintenance or monitoring required.

## Operating conditions

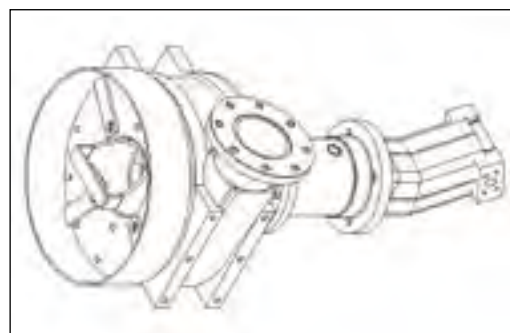
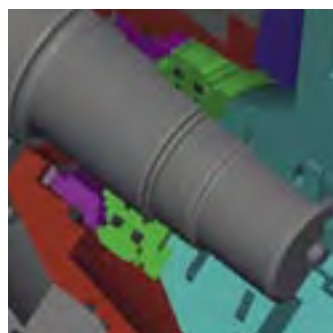
$d_N = 90 \text{ mm}$   
 $n = 1,700 \text{ min}^{-1}$   
 $p_1 = \text{vacuum} \dots 6 \text{ bar}$   
 $t = < 80 \text{ }^\circ\text{C}$

## Medium

Water with up to 50 % sand fractions  
Seal type HRKS1/90-G11-E1

## Materials

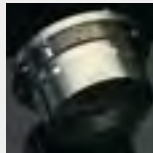
Seal face and seat: Buna 20 (Q2)  
Components: 1.4571  
O-Rings: Viton®



Illustrations: Courtesy of Maschinenbauk De Hollandse Ijszet



# seals in use



## HRS for sealing slurry pumps

Queensland Alumina (QAL) is the world's largest aluminium oxide producer and meets around 10 % of world-wide needs. Warman slurry pumps are used in production to pump aggressive media with a high solids content.

The service life of earlier seals was unacceptable for QAL. The company therefore set the task of developing a single seal with a minimum service life of 6 months. Complicated double seals with buffer system could not be used. The 6-month minimum service life was derived from the service life of the pump components in contact with the product up to the first maintenance.

## Service life exceeds expectations

The HR proved to be the optimum solution and exceeded expectations concerning service life six-fold

A flushing connection and a throttle with self-cleaning profile integrated into the cover were provided to aid lubrication of the sliding surfaces and keep out solids. The very small throttle gap means that purging water consumption can be limited to no more than 2 l/min.

This mode of operation achieved a service life of more than 3 years.

## Operating conditions

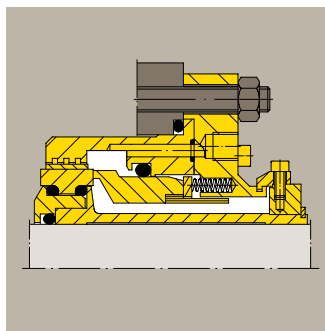
$d_N = 82.5 \text{ mm (3.250")}$   
 $n = 1,450 \text{ min}^{-1}$   
 $p_1 = 9 \text{ bar}$   
 $t = 70 \text{ }^\circ\text{C}$   
 $Sg = 1.4 \dots 1.5 \text{ g/cm}^3$

## Medium

Caustic hydrate with solids content > 40 %

## Face materials

Seal face and seat: Buka 22 (Q1)





### HRS as double and single seals in nickel and cobalt production

Minara Resources runs one of the largest nickel and cobalt mines in Australia. The company markets refined nickel and cobalt, plus enriched sulphides, all around the world. The system is located at Murin Murin, some 900 km North-East of Perth. The raw materials are extracted from the ore using sulphuric acid.

Over 140 slurry pumps are applied and extremely high demands are placed on them. For these, in coordination with the pump manufacturer Warman, developed a special type HRS70 or HRS70-D mechanical seal specifically for this application. It is primarily applied as a double seal, and only rarely in a single arrangement. The basic type of this seal design has already been used successfully in large numbers in similar special applications.

#### Operating conditions

$p_1 = \dots 2.5 \text{ MPa}$   
 $t_1 = \dots 180 \text{ }^\circ\text{C}$   
 $n = \dots 2,800 \text{ min}^{-1}$   
 $\text{pH} = 1 \dots 2$   
 $S_g = 1.3 \text{ g/cm}^3$

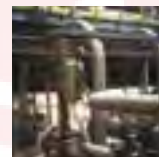
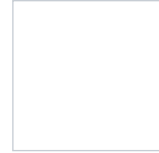
Most of these applications are based on dual mechanical seals. They are pressurised by a central buffer pressure system. Demineralized water is used as buffer medium.

#### References (extract)

Minara Resources  
 Australian Magnesium  
 Queensland Nickel  
 Queensland Alumina  
 Comalco  
 Weir Minerals (Warman)  
 HI-SMELT  
 Rio Tuba (Philippines)  
 Syncrude (Canada)  
 Western Mining  
 Sepon Copper (Laos)  
 Raventhorp Nickel  
 Goro Nickel New Caledonia

#### takes over service

All the Warman slurry pumps were equipped with mechanical seals, so it was entirely logical for Minara to conclude a service agreement with. This covers the maintenance, provision of spare parts and repair of the seals in these 140 pumps



# EBI in Profile

## Certifications

ISO 9001:2000

EN 9100

ISO 14001

OHSAS 18001

QHD  
Qualified Hygienic  
Design VDMA

DIN/EN 729-2  
HPO certified

KTA 1401  
Certified for  
Nuclear  
Power Plants

ISO TS 16949

WHG  
Fachbetrieb (§ 19)

Germanischer Lloyd  
Approvals

IHK  
Prüfungsbetrieb

Umweltpakt  
Bayern



(Plant I Wolftrathausen (D))



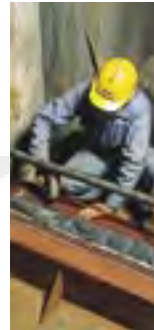
(Niigata (J))



(Plant II Eurasburg (D))

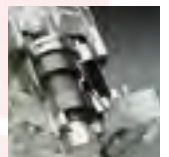


(Plant Judenburg (A))



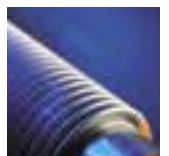
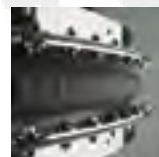
**EBI - An alliance with a great deal to offer our customers and partners** and the leading Japanese mechanical seal manufacturer Eagle Industry have laid the foundation for a global cooperation: an alliance with a pronounced understanding for quality and service as well as customer orientation

The basis of this arrangement is an intensive and trust-based cooperation that notably strengthens the global competitiveness of both partners and makes them one of the top suppliers of sealing technology on the world market. A worldwide presence, market-orientated products and high-quality services are further key factors of success. All this, together with the know-how and dedication of our employees, means that we have considerable potential to offer our customers.



## We are there when you need us

Customers want proximity, speed and solutions to their problems. Thanks to our worldwide presence, flexibility and specialist know-how we can face these challenges with quiet confidence. All over the world we offer our in-depth package of services – from the simple stuffing box packing to the complex high-tech seal, plus the backing of our "Total Seal Care" modular support offering, which allows each customer to put together exactly the right service package based on individual needs and requirements. Numerous service contracts and international agreements attest to the trust which top-name companies place in our expertise and confirm the quality of our services.



## Making our customers more successful

Our customers expect their machines to operate without problems. With this objective in mind, we are working to produce innovative, economically rational and easy-to-use seal solutions that help to fulfill the highest requirements in terms of environmental protection and safety. In doing so, it is our intention to increase our customers' efficiency and productivity and to put across our global profile as a reliable, competent partner for high quality and technological leadership. The technical knowledge, creativity, motivation and performance of our workforce makes a major contribution to achieving these objectives and making our customers more successful.

