MECHANICAL SEALS FOR
Oil & Gas | Refinery | Petrochemical | Chemical | Power
Fertiliser | Pharmaceutical | Paper | Aerospace | Marine

sealmaticindia.com
About the Company

Sealmatic designs and manufactures mechanical seals and associated products mainly for the oil & gas, chemical, pharmaceutical, pulp & paper, power, mining and many more industrial applications. Sealmatic can help relieve stress and reduce the life cycle costs associated with the most important aspects of plant operation. Sealmatic has a longstanding tradition of providing mechanical seals and sealing services that are trusted by the industry.

Sealing Technology

With a wide range of products and services, Sealmatic has solutions for every sealing requirement – such as Pusher Seals, Standard Cartridge Seals, Elastomer Bellows Seals, Metal Bellows Seals, Engineered Seals, Split Seals, Gas-Lubricated Seals and many more. Each and every Sealmatic seal is the result of numerous steps involving extensive engineering and thus processing the same in various production steps. Our engineers at Sealmatic work with discipline and passion to maintain high standards in their respective fields. With the use of 3D modelling we ensure optimum performance of application specific seals. Sealmatic has engineered high-performance products that reliably withstand extreme environments, challenging applications and evolving legislation. No matter how strict the specification or how unique the application, we have the solutions to offer. Extremely complicated seal faces for Dry Gas Seals are manufactured under a controlled environment, deploying sophisticated machines to produce intricate profiles on the seal face.

Continuous Research & Training

To maintain our position at the forefront of technological innovation, we continuously test our new designs in real-world environments, simulated by our state-of-the-art test rigs. Sealmatic provides a wide range of training courses that cover the correct procedures for installing, operating and maintaining mechanical seals. With a combination of hands on as well as theoretical training, our employees learn about safety, performance, reliability of energy services and industrial process plants including trouble shooting and problem solving, enabling them to become experts in their fields. With the deep knowledge of over 70 subjects and intricate designs, we have built a legacy to carry forward the vision of our company.

Global Sales & Service

Our aim at Sealmatic is to ensure utmost satisfaction of our customers, where we ensure international quality and close proximity. And because our partners are globally located, we can be present in person anytime, offering engineering services whenever needed. Our customers are spread across all the continents and we are very proud to state that we have 100% retention rate, we have a satisfied base of over 1000 customers across the globe.

Environmental, Health & Safety

Sealmatic’s management and employees take active participation in establishing and supporting Environmental, Health and Safety (EHS) policy and procedures. By maintaining compliance with applicable EHS laws and regulations, Sealmatic strives to ensure the health, safety, and welfare of its employees and others affected by its business operations.
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Sealmatic is continuously improving and upgrading their products with respect to quality and application and therefore any changes made to the catalogue may be made without any notice.
Industrial Applications

Onshore

To be able to cope with sand, water and gases found in crude oil, pumping systems for mineral oil require heavy duty pumps with reliable engineered mechanical seals that feature durable sliding faces with good emergency running characteristics. Often it is necessary to seal pressures in excess of 100 bar and sliding velocities of over 60 m/s. The ideal seal face combination for such conditions have proven to be high-strength carbons running against silicon carbide.

Typical Applications
- Crude Oil Pump
- Pipeline Pump
- Water Injection Pump

Quarrying & Coal Mining

The cutter heads on quarrying and mining machines are fed with water, not only for cooling purposes but also for settling the dust and extinguishing any sparks produced by the cutting tools. Mechanical Seals perform the dual function of a rotary joint and a seal for the cutter and roller heads. Sealing systems used on these equipment are exposed to abrasive and chemically aggressive media. In some applications, high temperature and pressure make conditions even more challenging. Despite the harsh operating environment, users expect high reliability to avoid costly downtime.

Typical Applications
- Cutter Head Seal
- Mining Machine
- Roller Head Seal
- Rotary Joint For Carbide Cutter

Offshore

Adverse environmental conditions, high rotational speed and pressure levels as well as corrosive media constituents place demanding requirements on sealing technology used in the offshore production and subsequent conveyance of oil and gas. Not only that but in many cases highly abrasive mixtures of crude oil, water, gas and sand cause a high degree of wear. SEALmatic has proven itself with its heavy-duty mechanical seals with innovative and tailor made seal components with high-strength seal faces, guaranteeing longer service life even in highly stressed pumps.

Typical Applications
- Main Oil Export Pump
- Multiphase Pump
- Water Injection Pump

Coal Gasification

There were times, particularly during the oil-crisis years, when coal gasification centered on the process of hydrogenation, e.g. to produce motor fuels. Nowadays the driving force behind its further development is the generation of electricity by combination-type power stations with integrated coal gasification. Here the main objectives are to lower CO2 emissions, to raise fuel efficiency and to stretch existing resources.

Typical Applications
- Coal Feed Screw

Compressors

High speed machines whose trouble free availability constitutes a major precondition for many process engineering operations. Key criteria for the selection and design of compressors are the working medium, the compression ratio, the volume flow, the number of intermediate inputs & outputs and the design of the shaft seal which assumes critical importance.

Typical Applications
- Ammonia Compressor
- CO Compressor
- Oven Gas Compressor
- Ethylene Compressor
- Flash Turbine
- Screw Compressor

Chemical & Petrochemical

The materials used in the chemical/petrochemical industry need to be capable of coping with the large array of media, many of them explosive or toxic and others which could become when mixed. An increased awareness of environmental risks calls for a maximum reliability and operational safety, especially from sealing systems. Against this background, the sealing systems used in applications involving what are in many cases explosive, toxic or aggressive media have to ensure optimum tightness. On the other hand they should also help optimize processes and thus be of advantage where the economic aspects are concerned as well. From non-critical sealing points – for which standard solutions are deployed – right through to highly complex system solutions required where particularly difficult operating conditions are concerned.

Typical Applications
- Agitator Bead Mill
- Chemical Pump
- Eccentric Screw Pump
- Gear Pump
- Glass Lined Reactor
- Thin Film Evaporator
- Centrifuge
- Chemical Reactor
The processing of crude oil in refineries is a complex and multi-stage process in which crude oil is transformed into refined, high-quality end products or feed materials for petrochemical industry. Sealing technology for such diverse applications have to meet challenges in various respects; risk of insufficient lubrication and dry running, media with a diversity of physical properties, high and low temperature ranges and the handling of hazardous substances and all other conditions which need to be controlled with absolute reliability. With a comprehensive range of API-compliant quality seals and supply systems, Sealmatic is playing a key role towards ensuring the reliability and safety of refinery processes.

### Typical Applications
- Discharge Pump
- Gas Oil Pump
- GLP Delivery Pump
- Quench Oil Pump
- Residual Oil Pump

### Power
Sealing systems featuring maximum operational reliability, convenient maintenance and low leakage rates with necessary environmental protective measures are standard requirements in modern power stations. The product range includes mechanical seals and supply systems for auxiliary and secondary pumps, boiler circulation pumps and feedwater pumps as well as mechanical seals and carbon floating ring seals for turbines, compressors and fans.

### Typical Applications
- Boiler Circulating Pump
- Feed Pump
- Flue Gas Desulphurisation
- Residue Evacuation Pump
- Condensate Pump

### Pulp & Paper
Wood is the most important raw material for the pulp and paper industry. It is either digested to chemical pulp in digesters or reduced to mechanical pulp in grinders or refiners. The pulp produced this way is then graded, bleached and washed and conveyed to the paper machine. There it passes through the various stages such as head box, wire part, press section, drying section and reeling section.

### Typical Applications
- Pressure Grinder
- Pulp Pump
- Digesting & Bleaching Pump
- Deinking Pump

### Hot water
Hot water is conveyed by pumps for a variety of purposes in thermal energy generating systems, district heating systems, home heating systems and so on. The suitability of a mechanical seal for such applications depends on many different parameters, e.g. pressure to be sealed, temperature at the seal, sliding velocity, power consumption, water quality (pH-value, O2-dose, conductivity, operating mode), water additives such as corrosion inhibitors etc.

### Typical Applications
- Agglomerator
- Spherical Dryer
- Eccentric Pump
- Sterile Pump
- Centrifugal Pump
- Filter Dryer
- Food Pump

### Sugar
Sugar campaigns are over in a relatively short time. For optimum economy and ecology it is all the more important, therefore to have a reliable sealing systems. In the past it was normal for juice pumps to be equipped with double seals to cope with the tendency to crystalization and carbonation. Today the use of single seals is possible in most of the cases due to availability of modern materials and new seal compartment geometries.

### Typical Applications
- Flume Water Pump
- Juice Circulating Pump
- Worm Agitator
- Mash Pump

### Pharmaceutical
In addition to meeting technical requirements a seal has to display many other characteristics in connection with cleanliness, health and general legislation. These include for example materials which are compatible with food, smooth and abrasion-proof surfaces which are easy to clean, complete units which can be sterilized and cleaned without having to be dismantled (SIP/CIP). Sealmatic mechanical seals have been used for such demanding applications with great success in sterile processes. Our range of mechanical seals includes a broad spectrum of high-quality, specifically optimized sealing solutions ranging from standard solutions to specialized system solutions for nearly any application in the pharmaceutical industry.

### Typical Applications
- Agglomerator
- Spherical Dryer
- Eccentric Pump
- Sterile Pump
- Centrifugal Pump
- Filter Dryer
- Food Pump
Agitator Seals Accessories

Optional Extras

Additional Options

Types Of Drive

Code System For DIN Seals

Shut-Down Seal (Vessel Containment)

STD1

If an STD is employed, it is possible to change seals with the vessel loaded and under pressure (shaft must be stationary!) This seal is only used if the product does not harden or congeal during the shut down period. It cannot be used if PTFE is required or for sterile operation (fermenting vessels). Can be installed in all aspects. Fitting dimensions in accordance with DIN 28138 Part 1 are possible.

Chemical industry

Pharmaceutical industry

Agitators

Marine

Typical Industrial Applications

Screwed Connections

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Designation and position in accordance with DIN 28138 T3.

A = Buffer fluid resp. quench IN
B = Buffer fluid resp. quench OUT
C = Drainage
D = Leakage drain G1/8"
E = Coolant IN G3/8"
F = Coolant OUT G3/8"
G = Grease point

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N.B.: The code system published in DIN 28138 Part 3 can also be used to describe and order DIN agitator seals.
**Sealmatic Product Locator For Mechanical Seals**

### Category

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</table>

#### Mechanical Seal

**Seal Type A**

- **Rotating**: CTXAPI-SN, CTXAPI-DN, GSPH-Ta, CTXAPI-DN, GSPH-KD
- **Stationary**: CTXAPI-DN, GSPH-KD

**Seal Types**

- **Seal Type A**
  - Rotating: B750VN, B750VK, B750VK-GSPH, GSPH-Ta, B750VK-D
  - Stationary: GSPH-Ta, GSPH-KD

- **Seal Type B**
  - Rotating: UFL850, UFL850-Ta, UFL850-Ta, UFL850-D
  - Stationary: UFL850-Ta, UFL850-D

- **Seal Type C**
  - Rotating: UFLWTB00, UFLWTB00-Ta, UFLWTB00-Ta, UFLWTB00-D
  - Stationary: UFLWTB00-Ta, UFLWTB00-D

### API 682 4th Edition Code

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<th>Mechanical Seal</th>
<th>Design Options</th>
<th>Size</th>
<th>Plans</th>
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Seal designation: 22A-PI/FN-050-02/52
Double PTFE-encapsulated O-rings of the type used in SEALMATIC mechanical seals combine the elasticity of the core materials (synthetic rubber) with the chemical and thermal resistance of the PTFE. The material PTFE features good chemical and thermal resistance, but it also displays a high degree of rigidity, a low coefficient of thermal conductivity, an unfavourable expansion characteristic (see graph) and a tendency to cold flow.

The assembly position of double PTFE-encapsulated elastomers is critical. Care must be taken to ensure that the joint on the outer jacket faces against the assembly direction, as otherwise there is a risk of the jacket opening and being pulled off.

Bending of the jacket must be avoided at all costs to prevent leaks. Slip TTV O-rings onto tubes for safe storage.

Screw locking
If no special provision is made for locking screw thread, use set screw with a suitable adhesive (e.g. Loctite®) after removing any grease.

Conical springs
When a conical spring is used for driving the seal (e.g. in standard types U200 and U300), the mechanical seal becomes dependent on the direction of rotation. Looking toward the sliding face of the rotating parts of the seal, shafts rotating in clockwise direction require right-hand springs and shafts rotating in anti-clockwise direction require left-hand springs. Mounting the conical spring is easier if you twist it onto the shaft with a screwing action in the same direction as the spring coiling. This screwing action will cause the spring to open. For brief reversals of the direction of rotation we recommend seal type "S30".

Shaft torque must be transmitted uniformly to the shaft sleeve and/or rotating parts under all operating conditions. Depending on the seal design it is necessary to make allowance for centrifugal and axial forces and in some cases to observe special installation instructions. Incorrect fitting can cause, for example, jamming and de-formation of the seal.

Types of drive

For a seal to function properly, the shaft torque must be transmitted uniformly to the shaft sleeve and/or rotating parts under all operating conditions. Depending on the seal design it is necessary to make allowance for centrifugal and axial forces and in some cases to observe special installation instructions. Incorrect fitting can cause, for example, jamming and de-formation of the seal.

Technical Information

**Conversion table**

The following conversion table shows the kinematic viscosity \( \nu \) in terms of conventional units of measurement at the same temperature.

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<th>SU sec</th>
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Conventional units of measurement:

- \( °E \) = degrees Engler
- \( R \) = Redwood Seconds I and II
- \( SU \) = Saybolt Universal seconds

* according to Ubbelohde mm²/s = cSt
### Circulation

For single seals it is generally advisable to install a circulation pipe from the discharge nozzle of the pump to the seal chamber. A pipe size G1/4 is normally sufficient. There should be a close fitting neck bush between the pump casing and the seal chamber.

### Flushing

Flushing systems are installed in accordance with DIN ISO 5199, Appendix E, Plan No. 08a or API 610, Appendix D, Plan 32. A clean and mostly cold external medium is injected into the stuffing box in the area of the sliding faces via orifice (throttle) into the medium to be sealed. Flushing is used either to lower the temperature or to prevent deposits forming in the area of the mechanical seal. Again it is recommended that a close fitting neck bush is employed.

### Quench

Quench is the term commonly used in sealing engineering for an arrangement that applies a pressureless external medium (fluid, vapour, gas) to a mechanical seal’s faces on the atmosphere side. A quench is used on the one hand when a single mechanical seal does not function at all or only within certain limits without auxiliary measures or when a double mechanical seal with pressurized buffer medium is unnecessary. When an integral stationary seat stop is fitted, the quench pressure should not exceed 1 bar. A quench performs at least one of the duties described below.

- Fluid quench
  - Absorption or removal of leakage by the quench medium
  - Monitoring of the mechanical seal’s leakage rate by periodic measurement of the level of the quench medium in the circulation vessel or thermosiphon vessel
  - Lubrication and cooling of the stand-by mechanical seal
- Exclusion of air: For media which react with atmospheric oxygen the quenching medium stops the leakage making contact with the atmosphere
- Protection against dry running: For applications subject to brief, periods of vacuum and operation of pumps without pumping liquid (submersible pumps) the quenching medium prevents dry running of the mechanical seal
- Stabilization of the lubrication film: For operation under vacuum and/or sealing pressures close to the vapour pressure, the quenching medium stabilizes the lubrication film
- Cooling or heating of the outboard side of the mechanical seal.

### Steam quench

- Heating: For media with a high melting point the vapour quench prevents the leakage from solidifying in that area of the mechanical seal critical for its proper functioning
- Exclusion of air
- Removal of leakage

### Gas quench

- Icing protection: With operating temperatures <0 °C (cryogenic mechanical seals), the injection of nitrogen or dry air into the seal housing prevents the mechanical seal parts on the atmosphere side from icing up
- Exclusion of air
- Removal of leakage

### Sealing the quench medium

- Outboard mini-gland – the preferred choice for steam, not so much for liquids
- Lip seals – the preferred choice for oils and water
- Mechanical seals – the preferred choice for all circulating quench fluids

In some cases, for mechanical seals to function correctly the conditions in which they operate must be altered. This depends on the seal type, the duty conditions including environmental protection, and the type of equipment into which the seals are fitted.

### Barrier medium

The barrier medium fulfills two functions - it dissipates the heat generated by the seal and it prevents the product from penetrating the sealing gap to any appreciable degree. Any liquid and any gas can be chosen as barrier medium, with due consideration to the corrosion resistance of the parts it comes into contact with and to its compatibility with the process medium and surroundings. The barrier medium does not contain any solids. It is particularly important that liquid barrier media do not tend to precipitate and that they have a high boiling point, a high specific thermal capacity and good thermal conductivity. Clean, demineralised water satisfies these requirements to a high degree.

Hydraulic oil is often used in buffer fluid units and water in closed barrier fluid circuits. To prevent damage to the TS and sealing system, due allowance must be made for the co-efficient of volumetric expansion of the barrier fluids used.

### Barrier systems

To guarantee the correct working of double mechanical seals, the barrier inter-space (between the product side and the atmosphere side of the mechanical seal) must be completely filled with clean barrier medium.

Before starting up double mechanical seals it is vital, therefore, to ensure a sufficient rate of circulation of the barrier fluid. The barrier fluid pressure should lie 10 % or at least 2...3 bar above the maximum pressure to be sealed. The flow rate must be controlled to ensure that the temperature of the barrier medium at the outlet lies below approximately 60 °C and that it does not exceed boiling point under any circumstances. The maximum acceptable inlet/outlet temperature differential is 15 K. The barrier fluid outlet lies at the highest point of the stuffing box for automatic venting of any vapour. In view of the basic conditions of operation, a barrier system must perform the following functions:

- Build-up pressure in the barrier interspace
- Compensation of leakage
- Circulation of the barrier medium
- Cooling of the barrier medium
- Cooling of the seal

Barrier fluid systems for liquid-lubricated mechanical seals break down into two basic categories:

- **Open circuit**: A circuit in which both the circulation and the pressurization take place through a single barrier fluid system. After each circuit the barrier fluid is relieved and collected in a pressureless tank.
- **Closed circuit**: In this type of circuit all the components are kept under the same pressure. Pressure is applied by means of nitrogen or the process medium pressure or via a refill system. Pressure loss in the circuit must be taken into account when drawing up the design.
Clean pumping media

Plan 01
Internal circulation from the pump case to the seal.

Plan 02
Dead end seal chamber with no circulation. Stuffing box cooling and a neck bushing are necessary, unless otherwise specified.

Plan 03
Circulation between the seal chamber and the pump created by the design of the seal chamber. (eg. taper bore)

Plan 11
Circulation from the pump discharge, through an orifice to the seal.

Plan 12
Circulation from the pump discharge, through a strainer and an orifice to the seal.

Plan 13
Circulation from the seal chamber, through an orifice and back to pump suction.

Plan 14
Circulation from pump discharge through orifice to seal chamber and through orifice back to pump suction. (Combination of Plan 11+13).

Plan 21
Circulation from the pump discharge, through an orifice and a cooler to the seal.

Plan 22
Circulation from the pump discharge, through a strainer, an orifice and a cooler to the seal.

Plan 23
Circulation by means of a pumping ring from the seal, through a cooler and back to the seal.

Contaminated and special pumping media

Plan 31
Circulation from the pump discharge through a cyclone separator.

Plan 32
Injection of clean fluid into the seal chamber from an external source.

Plan 41
Circulation from the pump case through a cyclone separator, and clean fluid through a cooler to the seal.

Buffer/barrier medium between seals

Plan 51
External fluid reservoir, pressureless, thermosiphon or forced circulation as required.

Plan 53A
Circulation with thermosiphon system, pressurized. Forced circulation by pumping ring or circulation pump.

Plan 53B
Circulation with bladder accumulator and cooler, pressurized. Forced circulation by pumping ring or circulation pump.

Plan 54
Circulation of clean fluid from an external system.

Plan 55
External source to provide a clean unpressurized buffer fluid to a dual unpressurized seal.

Plan 71
Tapped connections for purchaser’s use. Typically this plan is used when the purchaser may use buffer gas in the future.

Plan 72
Externally supplied buffer gas for arrangement 2 seals. Buffer gas may be used alone to dilute seal leakage or in conjunction with Plan 75 or 76 to help sweep leakage into a closed collection system. Pressure of buffer gas is lower than process side pressure of inner seal.

Plan 74
Externally supplied barrier gas for arrangement 3 seals. Barrier gas is maintained at a pressure greater than a seal chamber pressure.

Plan 75
Containment seal chamber leakage collection system for condensing or mixed phase leakage on arrangement 2 seals. This plan is used when pumped fluid condenses at ambient temperature.

Plan 76
Containment seal chamber drain for non-condensing leakage on arrangement 2 seals. This plan is used if the pumped fluid does not condense at ambient temperature.

Plan for atmospheric side

-contaminant and special pumping media

Plan 51
External fluid reservoir, pressureless, thermosiphon or forced circulation as required.

Plan 53A
Circulation with thermosiphon system, pressurized. Forced circulation by pumping ring or circulation pump.

Plan 53B
Circulation with bladder accumulator and cooler, pressurized. Forced circulation by pumping ring or circulation pump.

Plan 55
External source to provide a clean unpressurized buffer fluid to a dual unpressurized seal.

Plan 71
Tapped connections for purchaser’s use. Typically this plan is used when the purchaser may use buffer gas in the future.

Plan 72
Externally supplied buffer gas for arrangement 2 seals. Buffer gas may be used alone to dilute seal leakage or in conjunction with Plan 75 or 76 to help sweep leakage into a closed collection system. Pressure of buffer gas is lower than process side pressure of inner seal.

Plan 74
Externally supplied barrier gas for arrangement 3 seals. Barrier gas is maintained at a pressure greater than a seal chamber pressure.

Plan 75
Containment seal chamber leakage collection system for condensing or mixed phase leakage on arrangement 2 seals. This plan is used when pumped fluid condenses at ambient temperature.

Plan 76
Containment seal chamber drain for non-condensing leakage on arrangement 2 seals. This plan is used if the pumped fluid does not condense at ambient temperature.

Legend

- Cooler
- Cyclone separator
- Strainer
- Flow control valve
- Block valve
- Non return valve
- Orifice
- Drain
- Flush
- Flow indicator
- LBI Liquid buffer/barrier inlet
- LBO Liquid buffer/barrier outlet
- LI Level indicator
- LSH Level switch MAX
- LSL Level switch MIN
- PI Pressure indicator
- PS Pressure switch
- PSL Pressure switch MIN
- TI Temperature indicator
- Q Quench
For single mechanical seals there is a distinction drawn between standard (N) and short (K) types. For double mechanical seals (back-to-back) EN specifies the short type only.

### Single seal

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>standard type with ( t_{1N} )</td>
</tr>
<tr>
<td>K</td>
<td>short type with ( t_{1K} )</td>
</tr>
<tr>
<td>C</td>
<td>type C</td>
</tr>
</tbody>
</table>

- \( U = \) no shaft step
- \( B = \) with shaft step
- \( C = 0 \)

| Nominal diameters \( d_1 \) and \( d_4 \) of the mechanical seal |
| Sealed shaft sleeve diameters are always three-digit numbers |
| Beneath the stationary seal for types \( U \) and \( B \) |

### Double seal

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<td>U</td>
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</tr>
<tr>
<td>B</td>
<td>with shaft step</td>
</tr>
<tr>
<td>C</td>
<td>type C</td>
</tr>
</tbody>
</table>

- \( U = \) no shaft step \( \rightarrow \) on product side
- \( B = \) with shaft step \( \rightarrow \) on atmosphere side

| Nominal diameters \( d_1 \) and \( d_4 \) (always three-digit numbers) |

### Direction of rotation of the Mechanical Seal

- Type N and K
- \( \Delta \) is also the spring winding direction
- \( R = \) clockwise
- \( L = \) anti-clockwise
- \( S = \) independent of direction of rotation

#### Material

- Pinned stationary seat
  - 0 = no torsion lock, without anti-rotation pin
  - 1 = with torsion lock, with anti-rotation pin
  - 2 = for type C

---

### Symbols

- \( A \) Area of sliding face
- \( A_H \) Area hydraulically loaded by medium pressure
- \( b \) Width of sliding face
- \( c \) Specific heat capacity
- \( D \) Outer diameter of sliding face
- \( d \) Inner diameter of sliding face
- \( D_a \) Outer diameter of bellows
- \( D_H \) Hydraulic diameter
- \( D_I \) Inner diameter of bellows
- \( d_m \) Mean diameter of sliding face
- \( d_w \) Diameter of shaft
- \( f \) Coefficient of friction
- \( F_f \) Spring force
- \( h \) Gap width
- \( H \) Delivery head of pumping screw
- \( k \) Balance ratio
- \( k_k \) Pressure gradient factor
- \( n \) Speed
- \( P_1 \) Medium pressure
- \( P_2 \) Atmosphere pressure
- \( P_3 \) Buffer fluid pressure
- \( \Delta p \) \( P_1 - P_2 = P_3 \)
- \( P_f \) Spring pressure
- \( P_g \) Sliding pressure
- \( P_r \) Calculated load for the frictional force of the secondary seal
- \( P_V \) Turbulence loss through rotating parts
- \( V \) Delivery rate
- \( Q \) Mechanical seal leakage rate
- \( R_a \) Mean roughness index (calculated)
| \( t_{ij}, T \) Temperature of the medium to be sealed |
| \( \Delta T \) Rise in temperature of the medium to be sealed |
| \( t_s \) Temperature of the buffer medium |
| \( v_g \) Sliding velocity |
| \( \eta_1 \) Dynamic viscosity |
| \( \chi \) Load factor |
| \( \rho \) Density |
| \( \nu \) Kinematic viscosity |

---

### Technical Information

- \( S \) independent of direction of rotation
- \( R = \) clockwise
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### Notes

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Seal and Material Code to API 682/ISO 21049

1) O-ring seal
2) Metal bellows seal

The seal description was redefined in ISO 21048, Annex D. Contrary to the earlier arrangement, no details such as the face and O-ring materials used are included in the designation. Such details are now to be found only in the seal data sheet.

The following rule applies for seal codes with four or more digits.

1st digit Seal Category
Here a C is used followed by the corresponding category number 1, 2 or 3 to which the seal belongs.

2nd digit Arrangement
Here an A is used followed by the number 1, 2 or 3 according to the seal arrangement applied.

3rd digit Seal Type
Here the letter A, B or C is used according to the seal in question.

4th digit and other Supply System Plans
The cooling and/or flushing diagrams used are listed here one after the other without separating commas.

Example 1:
C1A1A11
Seal category 1
Seal arrangement 1 (single seal)
Seal type A (O-ring seal)
Product circulation according to Plan 11

Example 2:
C3A2B1152
Seal category 3
Seal arrangement 2 (double seal pressureless)
Seal type B (rotating metal bellows seal)
Product circulation according to Plan 11
Pressureless quench according to Plan 52

Unbalanced k > 1

Unlike an O-ring seal, the hydraulic diameter of a bellows seal is not a fixed geometric value. It is conditional on the absolute level of the pressure to be sealed and on the direction of pressurization (internal or external pressure).

Balance ratio

The balance ratio is a non-dimensional factor of the mechanical seal and is defined as:

\[ k = \frac{A_{hl}}{A} \]

In practice k values are selected between 0.65 and 1.2. With a lower k value, the safety against thermal overload will increase, but the mechanical seal may also lift off more easily.

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Seal Locking to EN 12756

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Seal type B (rotating metal bellows seal)
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Seal arrangement 2 (double seal pressureless)
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Seal arrangement 1 (single seal)
Seal type A (O-ring seal)
Product circulation according to Plan 11

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C3A2B1152
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Seal arrangement 2 (double seal pressureless)
Seal type B (rotating metal bellows seal)
Product circulation according to Plan 11
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Technical Information

Load factor $\chi$

The balance ratio is just a non-dimensional factor used to assess a mechanical seal. A second one is the load factor $\chi$.

$$\chi = k + \frac{p_i + p_o}{\Delta p}$$

The balance ratio and the load factor are practically identical when the pressure differentials to be sealed are large. The friction at the dynamic secondary seals $p_o$ is usually disregarded in the calculation.

Sliding pressure $p_s$

The term "sliding pressure" is understood to be the surface pressure on the two sealing faces which remains after subtracting all those forces that act on the seal face and which are balanced by hydraulic pressures. The sliding pressure is conditional on the pressure differential to be sealed, the balance ratio, the pressure conditions inside the sealing gap i.e. gap between the seal faces (pressure gradient factor) and the spring pressure. The pressure gradient factor $k$, can assume values between 0 and 1, depending on the geometry of the two sealing faces. For sealing gap geometries which converge in leakage direction - $V$-gap for externally pressurized seals - the value of $k$ is $> 0.5$, while for sealing gap geometries which diverge in leakage direction - $A$-gap for externally pressurized seals - the value of $k < 0.5$. For simplified calculations the value of $k$ is generally taken to be 0.5. Under unfavourable conditions the sliding pressure can become negative, causing the sealing faces to open resulting in excessive leakage.

$$p_s = \Delta p (k - k_i) + p_i$$

Coefficient of friction $f$

The coefficient of friction $f$ is conditional on the materials that are in contact, the medium being sealed, the sliding velocity and the design-related conditions of contact between the sliding faces.

For general considerations and calculations, a coefficient of friction of between 0.05 and 0.08 can be applied as a good approximation. As can be seen in the graph, a lower value is obtained under improved conditions of lubrication, e.g. due to partial build-up of hydrodynamic pressure in the sealing gap. On the other hand, when a mechanical seal is run under purely hydrodynamic conditions of operation, the coefficient of friction will rise as the speed increases - similar to hydrodynamic bearings.

Gap width $h$

Seals with contacting faces

In contact seals with a theoretically parallel sealing gap, the distance between the two sealing faces is conditional on the roughness of the surfaces. Numerous measurements taken in the laboratory and in practice with due allowance for external factors indicate that a mean gap width of less than 1 mm can be used as a basis for calculating the normal degree of leakage.

Seals with non-contacting faces

Hydrostatically or hydrodynamically balanced, non-contacting mechanical seals adjust automatically to a defined gap width during operation. The width of the gap depends mainly on the shape of the gap in radial as well as circumferential direction, on the operating conditions and on the medium.

Surface roughness

Microfinished sliding faces made of various materials display the following average, arithmetic mean roughness values ($R_q$):

- Tungsten carbide: $0.01 \mu m$
- Nickel-bonded silicon carbide (SiC): $0.04 \mu m$
- Special cast Cr-steel: $0.15 \mu m$
- Carbon graphite: $0.10 \mu m$
- Aluminum oxide: $0.15 \mu m$
- C-SiC-Si/C-SiC: $0.15 \mu m$

The lower the roughness value, the higher the percentage bearing area and hence the higher load capacity of a mechanical seal.

Turbulence losses $P_t$

The turbulence-related consumption of power is not significant until the circumferential speed reaches 30 m/s. It must be given due consideration particularly with special seals.

Power consumption

The total power consumption of a mechanical seal is calculated from:

- The power consumed by the sliding faces.
- The power consumption due to turbulence consumption of the rotating parts.

Heat transfer

The total power consumption of a mechanical seal has to be dissipated into the medium or the buffer fluid by means of appropriate measures in order to stop the seal from overheating. The necessary fluid flow rate for removal of the power losses is calculated by

$$V = \frac{P_w + P_v}{\Delta T - c - \rho}$$

Under certain conditions of installation or operation heat may pass from the product to the sealing compartment and will need to be taken into account when calculating the circulation rate.

Example calculation:

- $P_w = 420 W$ (1 W = 1 J/s)
- $\Delta T = 10 K$
- Fluid: Water;
- $c = 4200 J/(kg\cdot K)$
- $\rho = 1 kg/dm^3$
- $V = 420 \cdot \frac{W}{kg\cdot K} \cdot dm^3$
- $10K - 420Ws - 1kg$
- $= 0.01 l/s = 0.6 l/min$

---

Heat transfer diagram

---

Surface roughness diagram

---

Power consumption diagram

---

Heat transfer diagram
To fit a seal you will need its installation and operating instructions with the correct drawing. Before starting, check the dimensions, the maximum acceptable deviations and the geometrical tolerances of the machine.

**Edges and shoulders**
All edges and shoulders onto or into which the mechanical seal is pushed during installation must be chamfered, deburred and rounded off to less than $30^\circ \times 2\, \text{mm}$.

**Dimensional deviations**
Acceptable deviations for dimensions having no tolerance specification:
- ISO 2768 Part 1, fine/medium for linear and angular dimensions
- ISO 2768 Part 2, tolerance class K for general geometrical tolerances

**Shaft in accordance with ISO 5199**
In the area of the mechanical seal the shaft concentricity tolerance must not exceed $50\, \mu\text{m}$ for diameters $< 50$ mm, $50\, \mu\text{m}$-$80\, \mu\text{m}$ for diameters between 50 and 100 mm, and $110\, \mu\text{m}$ for diameters $> 100$ mm.

**Seal chamber bore**
For sliding velocities of $v_\text{s} < 25$ m/s the concentricity tolerance of the seal chamber in relation to the shaft should not exceed $0.2$ mm, and when pumping screws are used it should not exceed $0.1$ mm due to the effect of the pumping characteristic. If these values are exceeded please contact Sealmatic.

**Concentricity tolerance**
Absolute cleanliness and care are essential when fitting mechanical seals. Dirt and damage to sliding faces and O-rings jeopardize a seal's function. Any protective covering on the sliding faces must be removed without trace. Never put lubricant on the sliding faces - mount only in a completely dry, dust free and clean state. The accompanying installation instructions and the notes on the assembly drawings must be observed exactly.

**Fitting advice**
To reduce the friction on O-rings when mounting seals on a shaft or when inserting seal cartridges in their housing, apply a thin coating of silicon grease or oil to the shaft or housing (N.B.: this does not apply to elastomer bellows seals). Never allow EP rubber O-rings to come into contact with mineral oil or grease. When inserting stationary seats, be careful to apply even pressure and use only water or alcohol to reduce O-ring friction.

**Screw locking**
If no special provision is made for locking screw threads, use set screws with a suitable adhesive (e.g. Loctite®) after removing any grease.

**Venting**
To prevent damage to the sliding faces from dry running, the buffer space must be carefully vented after you have installed the seal. This is particularly important for those types of buffer/barrier fluid systems that do not vent themselves or are partially self venting (double seal with buffer/barrier fluid systems).

**Extrusion characteristics of elastomeric O-rings**
The extrusion resistance of elastomeric O-rings can be greatly enhanced by the use of support rings.

**Surface finish**
Finished surfaces according to EN12756

<table>
<thead>
<tr>
<th>Mean roughness index for secondary seal material</th>
<th>b</th>
<th>w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastomers</td>
<td>2.5 $\mu$m</td>
<td>0.8 $\mu$m</td>
</tr>
<tr>
<td>Non-elastomers or optional use of elastomers and non-elastomers</td>
<td>1.6 $\mu$m</td>
<td>0.2 $\mu$m</td>
</tr>
</tbody>
</table>

**Technical Information**

<table>
<thead>
<tr>
<th>Pressure differential (bar)</th>
<th>Total radial clearance in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>0.40</td>
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<tr>
<td>0.50</td>
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<tr>
<td>0.70</td>
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<td>0.80</td>
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<tr>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Mounting face**
Axial run-out depends on the speed. Permissible values are indicated by the graph.
## Stationary Seats General Table

<table>
<thead>
<tr>
<th>Seats</th>
<th>Types of Seals</th>
<th>Description/ materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Seal Type</strong></td>
<td><strong>Version</strong></td>
</tr>
<tr>
<td>G4</td>
<td>U320</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G6</td>
<td>U320N4</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G7</td>
<td>U320S8</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G9</td>
<td>U320N</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G9 to DIN 24960</td>
<td>U700N</td>
<td>Carbon Resin/Antimony Impregnated</td>
</tr>
<tr>
<td>G9 to DIN 24960</td>
<td>B700N</td>
<td>Carbon Resin/Antimony Impregnated</td>
</tr>
<tr>
<td>G9 to DIN 24960</td>
<td>U377GN</td>
<td>Shrunken in Tungsten Carbide/ Silicon Carbide</td>
</tr>
<tr>
<td>G9 to DIN 24960</td>
<td>U177GN</td>
<td>Shrunken in Tungsten Carbide/ Silicon Carbide</td>
</tr>
<tr>
<td>G12</td>
<td>U377G</td>
<td>Shrunken in Tungsten Carbide/ Silicon Carbide</td>
</tr>
<tr>
<td>G13</td>
<td>U300</td>
<td>solid Carbon Resin/Antimony Impregnated</td>
</tr>
<tr>
<td>G15</td>
<td>B721G15</td>
<td>Shrunken in Tungsten Carbide/ Silicon Carbide (cooled)</td>
</tr>
<tr>
<td>G16</td>
<td>BJ920N</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G18</td>
<td>U377GS8</td>
<td>Shrunken in Tungsten Carbide/ Silicon Carbide</td>
</tr>
<tr>
<td>G30</td>
<td>U300N4</td>
<td>solid Carbon Resin/Antimony Impregnated</td>
</tr>
<tr>
<td>G35</td>
<td>TB850</td>
<td>double-elastic mounted, solid Ceramic, Tungsten Carbide/ Silicon Carbide</td>
</tr>
<tr>
<td>G42</td>
<td>TB850</td>
<td>Ceramic, Tungsten Carbide/ Silicon Carbide</td>
</tr>
<tr>
<td>G50</td>
<td>UG943</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G55</td>
<td>UG943</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G60</td>
<td>UG100</td>
<td>solid Special Cast Chrome Steel, Ceramic, Silicon Carbide/Tungsten Carbide</td>
</tr>
<tr>
<td>G115</td>
<td>B750G115</td>
<td>solid Silicon Carbide/Tungsten Carbide (Cooled)</td>
</tr>
</tbody>
</table>

- Default
- Optional
# Table of Materials

## Face Materials (Item 1/2)

<table>
<thead>
<tr>
<th>Synthetic Carbons</th>
<th>Metals</th>
<th>Carbides</th>
<th>Non-Elastomers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>G Pure graphite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T PTFE (Polytetrafluoroethylene)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T2 PTFE glass fiber reinforced</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T3 PTFE carbon reinforced</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T12 PTFE graphite-reinforced</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Carbon graphite antimony impregnated</td>
<td>E Cr-Steel</td>
<td>U = Tungsten carbides</td>
<td></td>
</tr>
<tr>
<td>B Carbon graphite resin impregnated, approved for foodstuffs</td>
<td>G CrNiMo-Steel</td>
<td>Q = Silicon carbides</td>
<td></td>
</tr>
<tr>
<td>B3 Carbon graphite resin impregnated</td>
<td>S Special cast CrMo-Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4 Electrographite resin impregnated</td>
<td></td>
<td>Q1 SiC, silicon carbide, sintered pressureless</td>
<td></td>
</tr>
<tr>
<td>B5 Carbon, resin bonded</td>
<td></td>
<td>Q12 SiC, silicon carbide, sintered pressureless(shrunken-in)</td>
<td></td>
</tr>
<tr>
<td>C Electrographite antimony impregnated</td>
<td></td>
<td>Q2 SiC-Si, reaction bonded</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q22 SiC-Si, reaction bonded(shrunken-in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q3 SiC-C-Si, carbon silicon imprinted</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q32 SiC-C-Si, carbon silicon imprinted</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q6 SiC-C, SiC, sintered pressureless with carbon</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q4 C-SiC, carbon surface silicatd</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q19 SiC-DLC-coated</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q15 SiC-Diamond face</td>
<td></td>
</tr>
</tbody>
</table>

Standards followed:
EN 12756
ISO 1629

## Metal Oxides (Ceramics)

| V Al-Oxide > 99% | X Steatite (Magnesia silicate) |

## Plastics

| Y1 PTFE, glass fiber reinforced | Y2 PTFE, carbon reinforced |

## Spring and Construction Mat. (Item 4/5)

| G 1.4571 CrNiMo Steel | M 2.4610 Hastelloy® C-4 Nickel-base alloy |

## Elastomers, not wrapped

| B Butyl rubber | D St C steel |
| E Ethylene propylene rubber | E 1.4122 Cr steel |
| K Perfluorocarbon rubber | F 1.4301 CrNi steel |
| N Chloroprene rubber | F 1.4308 CrNi cast steel |
| P Nitrile-butadiene rubber | F1 1.4313 Special cast CrNi steel |
| S Silicone rubber | G 1.4401 CrNiMo steel |
| V Fluorocarbon rubber | G 1.4404 CrNiMo steel |
| X HNBR | G 1.4571 CrMo steel |

## Elastomers, wrapped

| M1 FKM, double PTFE wrapped | M 1.4581 CrNiMo cast steel |
| M2 EPDM, double PTFE wrapped | M1 1.4462 CrNiMo steel-Duplex |
| M3 VMQ, double PTFE wrapped | M3 1.4460 CrNiMo steel-Duplex |
| M4 CR, double PTFE wrapped | M4 1.4410 CrNiMo steel superduplex |
| M5 FKM, FEP wrapped | M4 1.4501 CrNiMoCu steel - Superduplex |
| M7 FKM, double PTFE wrapped/PTFE solid | M3 1.4539 NiCrMo steel |

## Differing Materials

| U1 Perfluorocarbon rubber/PTFE | U 1.4501 CrNiMoCu steel - Superduplex |

## Construction Materials

<table>
<thead>
<tr>
<th>M = Nickel-base alloy</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 2.4610 Hastelloy® C-4</td>
</tr>
<tr>
<td>M1 2.4617 Hastelloy® B-2</td>
</tr>
<tr>
<td>M3 2.4660 Carpenter® 20Cb3</td>
</tr>
<tr>
<td>M4 2.4375 Mone® alloy K50</td>
</tr>
<tr>
<td>M5 2.4819 Hastelloy® C-276</td>
</tr>
<tr>
<td>M6 2.4668 Inconel® 718</td>
</tr>
</tbody>
</table>

## Other materials

<table>
<thead>
<tr>
<th>T Pure Titanium</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 1.4505 CrNiMoCuNb steel</td>
</tr>
<tr>
<td>T2 3.7035 Pure Titanium</td>
</tr>
<tr>
<td>T3 2.4856 Inconel® 625</td>
</tr>
<tr>
<td>T4 1.3917 Carpenter® 42</td>
</tr>
<tr>
<td>T5 1.4876 Inconel® 800</td>
</tr>
<tr>
<td>T6 - AM350</td>
</tr>
</tbody>
</table>

## Material code designation example

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seal face</td>
<td>Stat. face</td>
<td>Secondary Seals</td>
<td>Spring</td>
<td>Other parts</td>
<td></td>
</tr>
<tr>
<td>acc.to EN 12756</td>
<td>Q1</td>
<td>B</td>
<td>V</td>
<td>G</td>
<td>G</td>
</tr>
</tbody>
</table>

Example : Sealmatic U700N/d, Q1 B V G G
MECHANICAL SEALS FOR
Pumps | Compressors | Agitators | Rotary Applications
Seal Supply Systems | Components

sealmatic®

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