

# OPERATING MANUAL

## BT-BURGMANN MECHANICAL SEALS

***AR/AR3 – RN/RN3/RN6 – FN/FN3 – FH/FHC/FH6 – PN/PNL – PNT – A2 – A3  
RN.NU/RN3.NU/RN6.NU – RN.NB/RN3.NB – FN.NU – C5.KU/C56.KU– C5.KB/C56.KB***

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To ensure optimum seal performance and to avoid any inconvenience or malfunction, please carefully READ and OBSERVE the following operating instructions.

In the event of any doubt, please contact BT-BURGMANN.

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## 1) SAFETY

Any person being involved in assembly, disassembly, start-up, operation and maintenance of the BT-BURGMANN mechanical seals must have read and understood this operating manual and in particular the safety notes.

We recommend the user to have this confirmed in writing.

BT-BURGMANN mechanical seals are manufactured on a high quality level (the Company has attained the quality system certification UNI-EN 9001) and they keep a high working reliability.

Yet, if the mechanical seals are not operated within their intended purpose or handled inexpertly by untrained personnel, they may cause risks.

The user has to check what effects a failure of the mechanical seal might have and what safety measures have to be taken to prevent personal injury or damage to the environment.

The pump has to be put up in such a way that seal leakage can be led off and disposed properly and that any personal injury caused by spurting product in the event of a seal failure is avoided.

BT-BURGMANN mechanical seals must be operated, maintained or repaired by authorised, trained and instructed personnel only.

In principle, any work to be done on the mechanical seal is permitted when the seal is neither operating nor pressurized.

The responsibilities for the respective jobs to be done have to be determined clearly and observed in order to prevent unclear competencies from the point of safety.

Apart from the notes given in this manual the general regulations for worker's protection and those for the prevention of accidents have to be observed.

Unauthorised modifications or alterations which affect the operational safety of the mechanical seal are not permitted.

## 2) MANUFACTURER

BT TENUTE MECCANICHE ROTANTI S.p.A.

Via Leonardo da Vinci n.9

36057 Arcugnano – Vicenza (Italia)

## 3) DISTRIBUTOR

BT-BURGMANN S.p.A.

Via A. Meucci n.58

36057 Arcugnano – Vicenza (Italia)

## 4) DECLARATION

Within the meaning of the EC-directive on "MACHINERY", the manufacturer declares that the product here described does not function independently, but is intended to be incorporated into or assembled with machinery.

## 5) OPERATING LIMITS

The operating limits for each model of mechanical seal are indicated in the BT-BURGMANN catalogue.

Shaft diameter	$d_1$ [mm]
Pressure to be sealed	$p_{max}$ [bar]
Temperature of medium	$t$ [°C]
Sliding speed	$v$ [m/s]

Model of seal	Diameter $d_1$	Pressure $p_{max}$ (*)	Temperature $t$ (**)	Speed $v$ (*)
<b>AR-AR3</b>	6 ÷ 60	6	-20 ÷ +140	10
<b>RN-RN3-RN6</b>	8 ÷ 110	10	-70 ÷ +200	20
<b>FN-FN3</b>	10 ÷ 40	10	-20 ÷ +180	20
<b>FH-FHC-FH6</b>	10 ÷ 100	10	-70 ÷ +200	20
<b>PN-PNL</b>	8 ÷ 40	12	-20 ÷ +120	10
<b>PNT</b>	1/2" ÷ 3/4"	12	-20 ÷ +120	10
<b>A2</b>	1/2" ÷ 3/4"	4	-20 ÷ +140	10
<b>A3</b>	14 ÷ 16	12	-20 ÷ +140	10
<b>RN.NU-RN3.NU-RN6.NU</b>	10 ÷ 100	10	-70 ÷ +200	20
<b>RN.NB-RN3.NB</b>	10 ÷ 100	50	-70 ÷ +200	20
<b>C5.KU-C56.KU</b>	20 ÷ 100	10	-70 ÷ +200	20
<b>C5.KB-C56.KB</b>	20 ÷ 100	50	-70 ÷ +200	20
<b>FN.NU</b>	10 ÷ 35	10	-20 ÷ +180	20

(\*) The operating limits vary according to the materials of the sliding parts and directly depend on the PV factor.

(\*\*) The temperature is in terms of the elastomers used in the seal

Operation under several limit values should be avoided. Higher loads (pressure, temperature, speed) can increase wear or lead to damage of sliding faces or elastomers. This could result in a shorter life and in the risk of a sudden seal failure endangering men and environment.

Operation under conditions lying outside the operating limits is not suggested.

Should the seal be operated under different conditions than those indicated, consultation with the BT-BURGMANN technical department is recommended.

## 6) WORKING CONDITIONS

The mechanical seal should be constantly wetted by liquid medium. It is absolutely to avoid a dry running of the seal.

The medium to be sealed should not damage the mechanical seal neither chemically (corrosion, embrittlement) nor physically (erosion, abrasion).

The seal are also usable as multiple mechanical seals in tandem arrangement together with a quench supply or as double mechanical seals together with a barrier fluid system.

In case of double opposite mechanical seal assembly, we recommend to use a barrier fluid suitable with the circulating product, at a pressure of 1,5 ÷ 2 bar higher than the fluid to be sealed.

## 7) MATERIALS

The following table is showing the limit running temperatures for conventional OR (elastomers and non-elastomers):

<i>Elastomers</i>		<i>Temperature</i>	<i>Notes</i>
<b>Nitrile rubber</b>	<b>P</b>	- 20 ÷ + 90°C	
<b>Chloroprene rubber</b>	<b>C</b>	- 30 ÷ + 120°C	
<b>Ethilenpropilene</b>	<b>E</b>	- 40 ÷ + 140°C	not resistant to mineral oil and grease
<b>Silicon</b>	<b>S</b>	- 50 ÷ + 200°C	
<b>Viton°</b>	<b>V</b>	- 20 ÷ + 200°C	in hot water at max 120°C
<b>Buthile rubber</b>	<b>B</b>	- 40 ÷ + 140°C	not resistant to mineral oil and grease
<b>Kalrez°</b>	<b>X</b>	+ 270°C	possible swelling in fluoride solvents
<b>Teflon°</b>	<b>T</b>	- 200 ÷ + 250°C	

The following table is showing the materials used to realise the different components of mechanical seal.

### MATERIALS OF THE SLIDING FACES

#### *SYNTHETIC CARBONS*

- A** Antimony impregnated carbon
- B** Resin impregnated carbon
- B1** Resin agglomerate carbon
- B2** Impregnated resin hard carbon (machined carbon)
- B3** Non impregnated resin carbon
- B4** Impregnated resin soft carbon

#### *PLASTIC MATERIALS*

- Y** PTFE glass reinforced (25%)
- Y1** PTFE graphite reinforced
- Y2** PTFE fiberglass reinforced (15%)

#### *CARBIDES*

- U** Antiacid tungsten carbide (insert)
- U1** Antiacid tungsten carbide (integral)
- Q1** Integral silicon carbide
- Q2** Porous silicon carbide
- Q6** Reduced sticktion silicon carbide

#### *CERAMICI MATERIALS*

- V** Allumin oxyde 99,5%
- V1** Allumin oxyde 96-98%
- X** Steatite

#### *METALLIC MATERIALS*

- E** Cr steel (AISI 420)
- F** Cr-Ni steel (AISI 304)
- F1** Cr-Ni steel (AISI 431)
- G** Cr-Ni-Mo steel (AISI 316)
- S** Cr-Mo cast-iron
- S1** Ni-Cr cast-iron

### MATERIALS OF THE SECONDARY SEALS

#### *ELASTOMERS*

- P** Nitrile rubber (NBR)
- P1** Nitrile rubber NBR 80±5 IRHD
- P2** Nitrile rubber NBR WRC approved
- P4** Hydrogenated nitrile rubber (HNBR) Therban
- P5** Nitrile rubber NBR antiozone
- N** Chloroprene rubber (CR)
- B** Butyle rubber (IIR)
- E** Etilen propilene rubber (EPDM)
- E2** EPDM rubber WRC approved
- E3** Peroxyde EPDM rubber
- S** Silicon rubber (Si)
- V** Viton Fluoroelastomers
- V1** Viton Fluoroelastomers green pigmented
- M** Single PTFE coated Viton
- M1** Double PTFE coated Viton
- X** Kalrez

#### *NON ELASTOMERS*

- T** PTFE
- T1** reinforced PTFE

### SPRINGS AND CONSTRUCTION MATERIALS

- D** Carbon steel
- F** Cr-Ni steel (AISI 304)
- F1** Cr-Ni steel (AISI 431)
- G** Cr-Ni-Mo steel (AISI 316)
- M** Hastelloy B
- M1** Hastelloy C

▪ **BT-AR / BT-AR3**

Rotary ring: A, B, B2, B3, Q1, U, Y, Y2  
Stationary ring: X, V, V1, Q1, Q2, E, F1, G  
Elastomers: P, P2, P4, P5, E, E2, V, V1  
Spring: F, G

▪ **BT-RN / BT-RN3 / BT-RN.NU / BT-RN3.NU / BT-RN6.NU / BT-RN.NB / BT-RN3.NB**

Rotary ring: F1, G, U  
Stationary ring: A, B, B2, U, U1  
Elastomers: P, E, V, T  
Spring: G

▪ **BT-PN / BT-PNL / BT-PNT**

Rotary ring: A, B, B2, B3, Q1  
Stationary ring: X, V, V1, Q1, Q2  
Elastomers: P, P2, E, E2, E3, V  
Spring: F, G

▪ **BT-FN / BT-FN3 / BT-FN.NU**

Rotary ring: A, B, X, V, V1, Q1, U1  
Stationary ring: A, B, X, V, V1, Q1, U1  
Elastomers: P, E, V, T  
Spring: G

▪ **BT-FH / BT-FHC / BT-FH6**

Rotary ring: A, B, X, V, Q1, U1  
Stationary ring: A, B, X, V, Q1, U1  
Elastomers: P, E, V, T  
Spring: G

▪ **BT-A2**

Rotary ring: B, B3  
Stationary ring: X, V, V1, Q1  
Elastomers: P  
Spring: F, G

▪ **BT-A3**

Rotary ring: B, Q1  
Stationary ring: X, V, V1, Q1, Q2  
Elastomers: P, E, V  
Spring: G

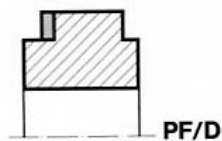
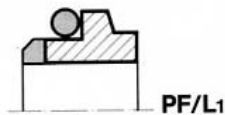
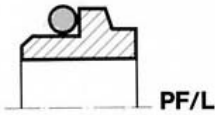
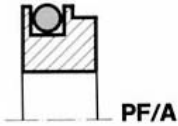
▪ **BT-C5.KU / BT-C56.KU / BT-C5.KB / BT-C56.KB**

Rotary ring: B2, Y, Q1  
Stationary ring: V, Q1, U, U1  
Elastomers: P, E, V, T  
Spring: G

## 8) STATIONARY SEATS

Hereafter the most important stationary seats produced.

Dimensions of the stationary seats may be according to EN 12756 or not.



## 9) EMISSIONS (LEAKAGE)

A mechanical seal is a dynamic seal that cannot be free of leakage due to physical and technical reasons.

Seal design, manufacture tolerances, operating conditions, running quality of the machine, etc. mainly define the leakage value. In fact, compared to other dynamic sealing systems, there is few leakage.

A possibly increased leakage during start-up will decrease to a normal quantity after the running-in period of the sliding faces.

The leakage can be liquid or gaseous, depending on the aggressiveness of the medium to be sealed.

Medium may splash out if the seal fails.

Personal injury may be prevented by the user providing for splash protection and wearing safety goggles.

Care has to be taken by the user for proper disposal of the leakage.

Leakage of mechanical seal at outboard side has to be drained and disposed properly.

Components which may get in contact with the leakage have to be corrosion-resistant or have to be adequately protected.

## 10) TRANSPORT

If not specified differently by contract the BT-BURGMANN standard packing is used which is suitable for dry transport by truck, train or plane.

The warning signs and notes on the packing must be observed.

Notes for income inspection:

- Check packaging for visible damage
- Open packaging carefully. Do not damage or lose parts supplied.
- Check if consignment is complete (delivery note).
- Inform the supplier immediately if parts are damaged or missing.

## 11) STORAGE

These instructions apply to all BT-BURGMANN mechanical seals which have been supplied and stored in their undamaged original packaging as well as to seals which have been installed in a component of a plant (e.g. pump, compressor, agitator, etc.), but have not yet been put into operation.

A preservation of the BT-BURGMANN mechanical seals is not necessary.

Do not use anticorrosives.

Sliding materials and elastomers are subject to material-specific and time based alterations (distortion, ageing) which might reduce the full efficiency of the seals.

This may be avoided by observing the storage instruction.

Damages caused by improper storage may not be claimed on the BT-BURGMANN company with reference to their warranty.

Store the mechanical seals in their original packing, lying on a flat surface.

Conveniences for storing of mechanical seals:

- constantly tempered (relative air humidity below 65%; temperature between 15°C and 25°C)
- dusty-free
- moderately ventilated

Protect the seal from:

- direct exposure to heat (sun, heating)
- ultraviolet light (arc welding, halogen or fluorescent lamps, sunlight)
- risk of embrittlement of elastomeric materials

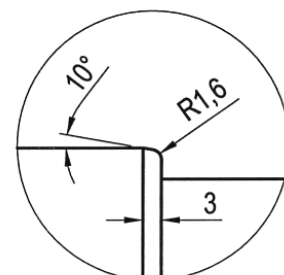
Check the mechanical seal:

- after a storage period of approximately 2-3 years
- in case of a damage of the packing
- after a shock on the mechanical seal (e.g. by dropping the packed seal)

## 12) PRELIMINARIES TO ASSEMBLY

Check at the machine:

- All connecting surfaces free from burrs and sharp edges
- Radiused transitions
- Chamfered edges (it is preferable a cone of 2mm x 30° or in accordance with EN 12756, according to the following figure):

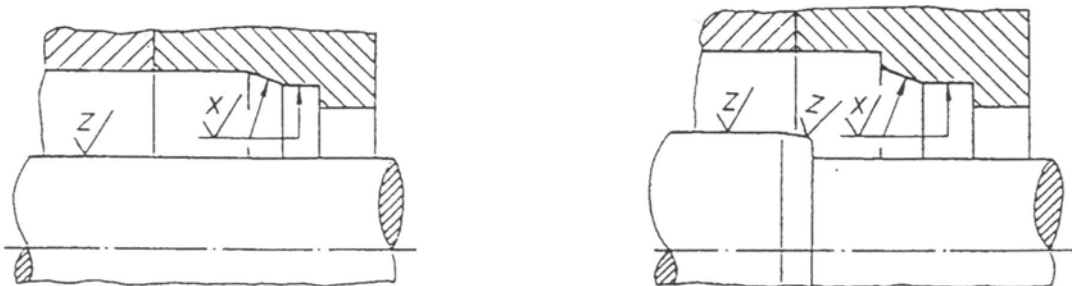


- Ensure that quotes and tolerances of the shaft diameters and seats are strictly observed (refer to BT catalogue or to BT-BURGMANN technical dept. specific drawings).
- Provide a shoulder or stop device for the seal driver to take up the axial forces
- To fit at the assembly quote our BT-PN and BT-PNL mechanical seals, with back ring, in case of lock with seeger ring, it is suggested to insert a 2-3 mm spacer ring (e.g. a washer) between the seeger and the back ring to avoid a deformation of the back ring itself.

Shaft and seat finishing :

- for bellows seals (BT series AR, PN, PNL, PNT and A3) shaft finishing must have Ra from 0,6 µm to 1 µm
- for o-ring mechanical seals (BT series RN, FN, FH and C5) shaft finishing must have Ra from 0,4 µm to 0,6 µm
- for PTFE wedge mechanical seals (BT series RN6, FH6 and C56) shaft finishing must have Ra ≤ 0,2 µm
- the seat surface must have Ra ≤ 2,5 µm in case of stationary seats with elastomers, and Ra ≤ 1,6 µm in case of stationary seats with PTFE.

Secondary seal material	$\sqrt{x} =$	$\sqrt{z} =$
Elastomers	Ra 2,5	Ra 0,8
Non-elastomers or optional use of elastomers and non-elastomers	Ra 1,6	Ra 0,20



Check at the machine:

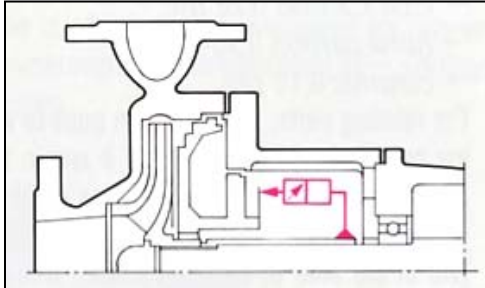
- damage of connecting surfaces to the mechanical seals
- matching dimensions, rectangularity and concentricity to the shaft axis
- concentricity accuracy of the shaft, according to ISO 5199:
  - diameters up to 50 mm: max 0,05 mm
  - diameters 50 ÷ 100 mm: max 0,08 mm
  - diameters exceeding 100 mm: max 0,1 mm



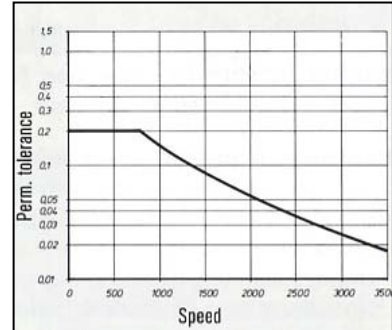
- Run-out: it is the axial oscillation of the seal (or the stationary) surface measured on a single complete shaft rotation.

The run-out tolerances depend on the shaft rotation speed.

Exceeding the above values, the seal life decreases and fluid emissions can occur.



*Run-out and tolerances*



### 13) UTILITIES & TOOLS

The following utilities and tools are suggested:

- Ethyl alcohol
- Water and detergent (water and soap solution at 2%)
- Pushers
- Mounting sleeves or cones

### 14) ASSEMBLY

The BT-BURGMANN mechanical seals are precision components requiring special care during assembly.

The seal should remain packed until the assembly, and operations done in dusty-free surroundings.

Cleanliness must be as well observed for the different pump components, as chips and blasting traces can damage irreparably the seal.

Should any seeger seats, locks for keys or sharp edged seats be present on the shaft, the use of pushers or mounting sleeves is required, thus avoiding to compromise the secondary seals integrity (cuts on bellows or o-rings).

For installation the assembly drawing of the mechanical seal (working length and the related dimensions) has to be on hand.

At this point:

- Unpack the seal and check seal face, seat and elastomer bellows for possible damages.
- Ensure that the sliding faces are perfectly clean from greases, oils and any dirty (possible leakage).
- Preferably mount the seal dry by means of pushers.

In case of difficult assembly, sprinkle the seat or the shaft with ethyl alcohol (or water + 2% detergent) ensuring the sliding faces remain dry and clean.

Oil or grease as assembly agent is absolutely to be avoided.

- For BT-BURGMANN bellow seals (serie BT-AR, BT-PN, BT-PNL, BT-PNT and BT-A3) push the rotating seal unit (bellow) with a slow clockwise turn onto the shaft until the bellow shoulder is settled on the shaft. For long pushing distances add liquid again.
- Do not use any lubricant.

Surfaces must be absolutely clean and dry.

- Never assembly the seal under the minimum assembly quote suggested by BT-BURGMANN catalogue, ensuring the seal is perfectly settled on its stop.

Do never force during installation.

Absolutely avoid the seal is having impacts or shocks.

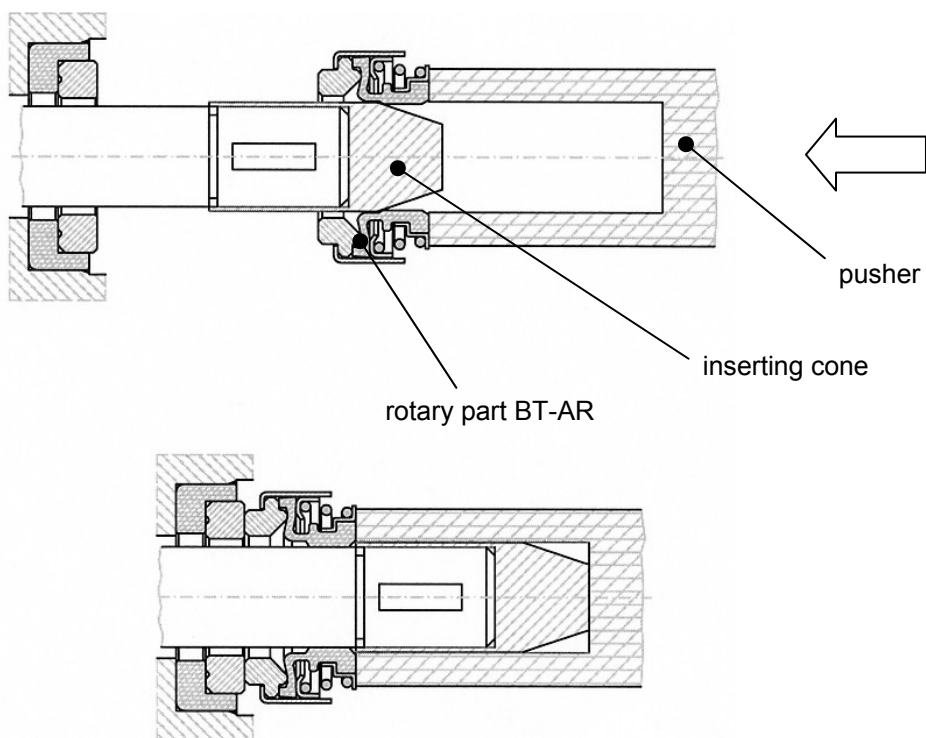
If by accident the seal drops to the ground, its integrity must be verified and the seal eventually replaced with a new one.

**Never put EPDM elastomers in contact with mineral oil or greases.**

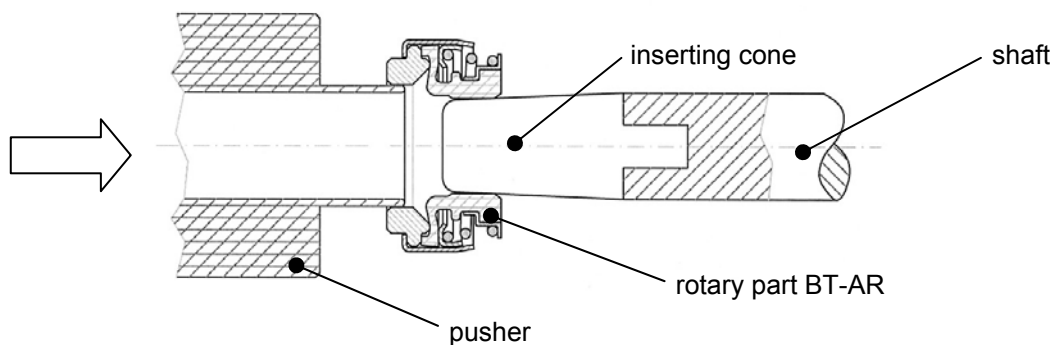
Any problem or anomaly, please contact our technical department for the opportune explanations and informations.

Following the above instructions helps to avoid damages to the sealing system and subsequent leakage.

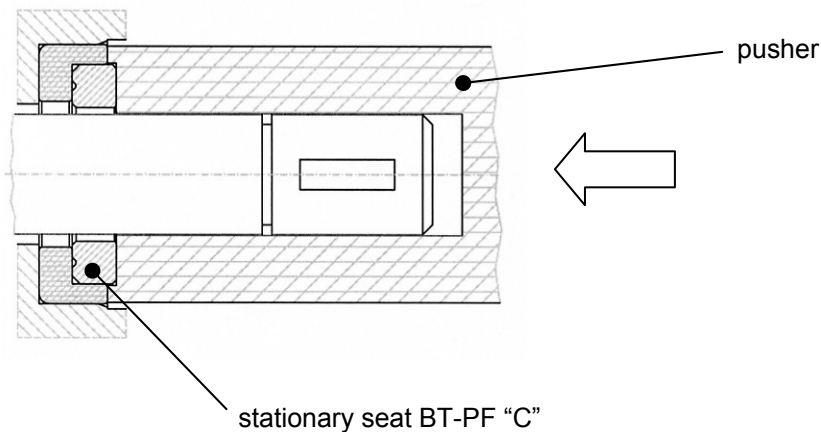
- *Example of assembly of a BT-AR seal (straight assembly)*



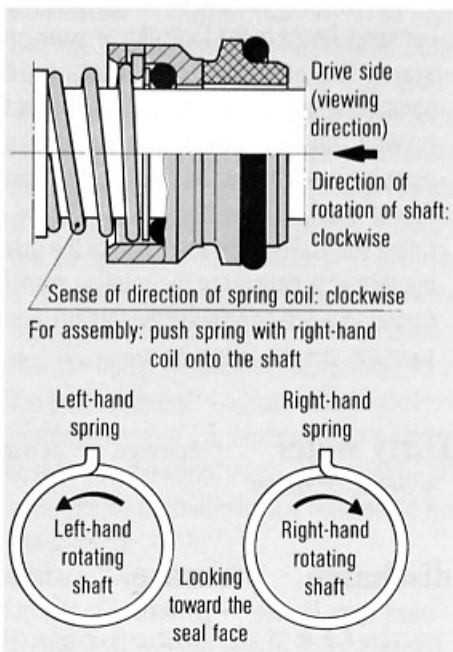
- *Example of assembly of a BT-AR seal (reverse assembly)*



- *Example of assembly of a stationary "C" shaped seat*



## 15) ROTATION HAND



The BT-BURGMANN mechanical seals serie AR, PN, PNL, PNT, A3 and C5 have independent rotation hand and could be assembled on machines having both clockwise or anticlockwise direction of shaft rotation.

The BT-BURGMANN mechanical seals serie RN, FN, and FH, driven by a conical spring, have dependent direction of rotation, therefore it must be ensured that, looking toward the seal face, the shaft direction of rotation and the winding direction of the conical spring (left-hand or right-hand thread) are matched to one another.

## 16) START UP

Flood pump and seal cavity (stuffing box) with medium and vent thoroughly.

Now the seal is ready for operation.

The mechanical seal has constantly to be wetted by the product in its liquid form, in particular when the pump is started or stopped.

The pump design has to be such as to take this necessity into consideration (e.g. heating of the product).

Never start the machine in dry conditions (dry running) to avoid irreparable damages of the sliding faces.

If the operation limit values and the instructions given in this manual are observed, a trouble-free operation of the mechanical seal can be expected.

## 17) WORKERS PROTECTION

BT-BURGMANN's mechanical seals are seldom used for sealing hazardous substances (chemical, medical substances, etc.). If that were the case, the valid regulations for handling hazardous substances have to be observed by all means.

Medium may splash out if the seal fails.

Personal injury may be prevented by the user, providing for splash protection and wearing safety goggles, etc., as well as care for proper disposal of the leakage.

## 18) TROUBLES

In case of failure due to high leakage the amount of leakage should be observed. Changes of the operating conditions have possibly to be recorded.

In case of hazardous substances leakage the mechanical seal must be shut down for reasons of safety.

A continuous, flowing leakage indicates that the seal is damaged and must be replaced.

## 19) MAINTENANCE

The correctly operated mechanical seal needs no maintenance. Wear parts, however, have to be replaced if necessary (e.g. in BT-C5).

An inspection of the mechanical seal should be carried out during a revision of the machine.

If the mechanical seal is disassembled during a revision of the plant it should be replaced by a new one.

## 20) REPAIR

Particularly in case of small size shafts, a repair of the seal is generally not cheaper than a new seal.

If repair has to be done on site, it should be carried out in a clean room, preferably by trained personnel.

Store a complete spare seal for a quick replacement.

## 21) REMOVAL

- Shut down the pump in duly procedure, let it cool down and depressurize it.
- Drain the pump if necessary.
- Secure the pump against inadvertent start.
- Observe the safety notes.

In principle, any work to be done on the mechanical seal is allowed only when the seal is neither operating nor pressurised.

We recommend to follow the regulations for preventing accidents valid in your Country.

If the seal have been in operation with hazardous substances the regulations for handling hazardous substances must be followed.

In case of doubt the necessary informations has to be obtained before starting repair.

The order of disassembly to remove the mechanical seal out of the pump depends on the design of the pump and has to be determined by the pump manufacturer.

The disassembly (removal) of the seal is carried out in the reverse sequence as described for assembly (set up).

## 22) DISPOSAL

Usually, the BT-BURGMANN mechanical seals can be easily disposed after a thorough cleaning.

- Metal parts (steels, non-ferrous heavy metal) divided into the different groups belongs to scrap metal waste.
- Secondary seals materials (elastomers, PTFE) belong to special waste. Some of them, divided into the different groups, can be recycled.

**Attention:** material containing fluorine (e.g. Viton o-rings, PTFE) must not be burnt.

- Ceramic materials (synthetic carbons ceramics, carbides) can be separated from their housing materials and disposed as common waste.

## 23) TECHNICAL ASSISTANCE AND INFORMATIONS

For informations or enquiries (technical informations, prices, orders, etc.) please contact us at the following address:

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