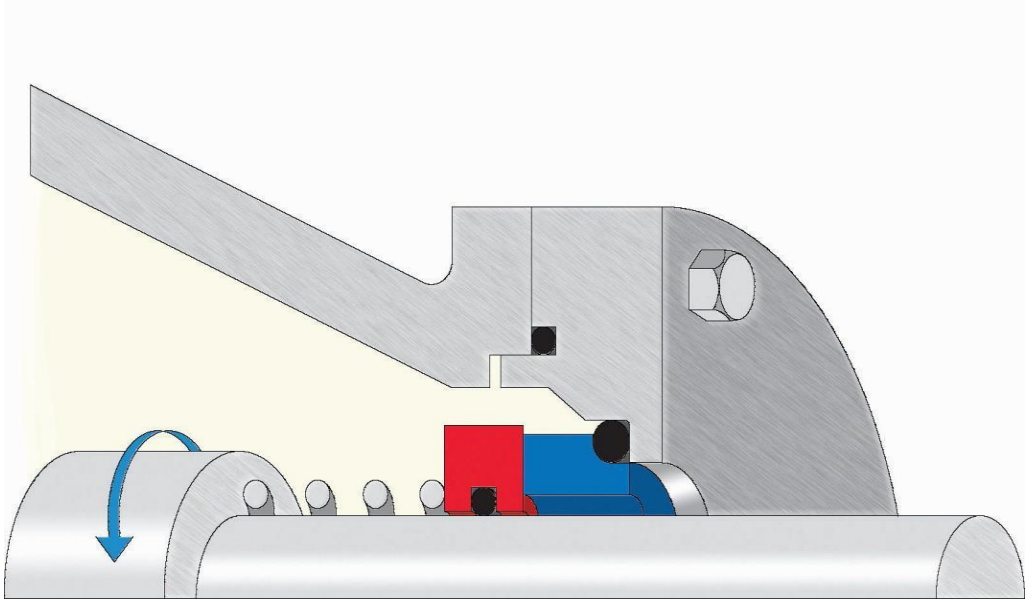
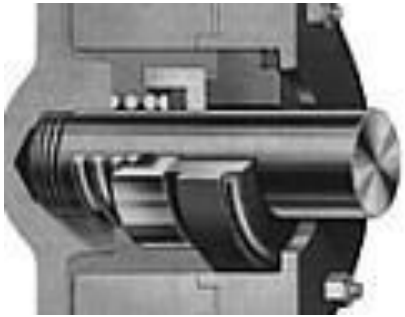
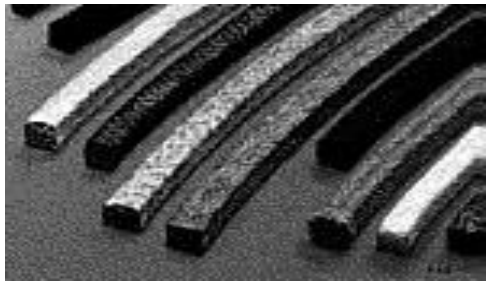
DYNAMIC SEALS



SEAL

- Seals are used to form a barrier between two spaces.
- A device that closes a gap between two surfaces or makes a joint fluid tight.
- Fluid may be gas or liquid





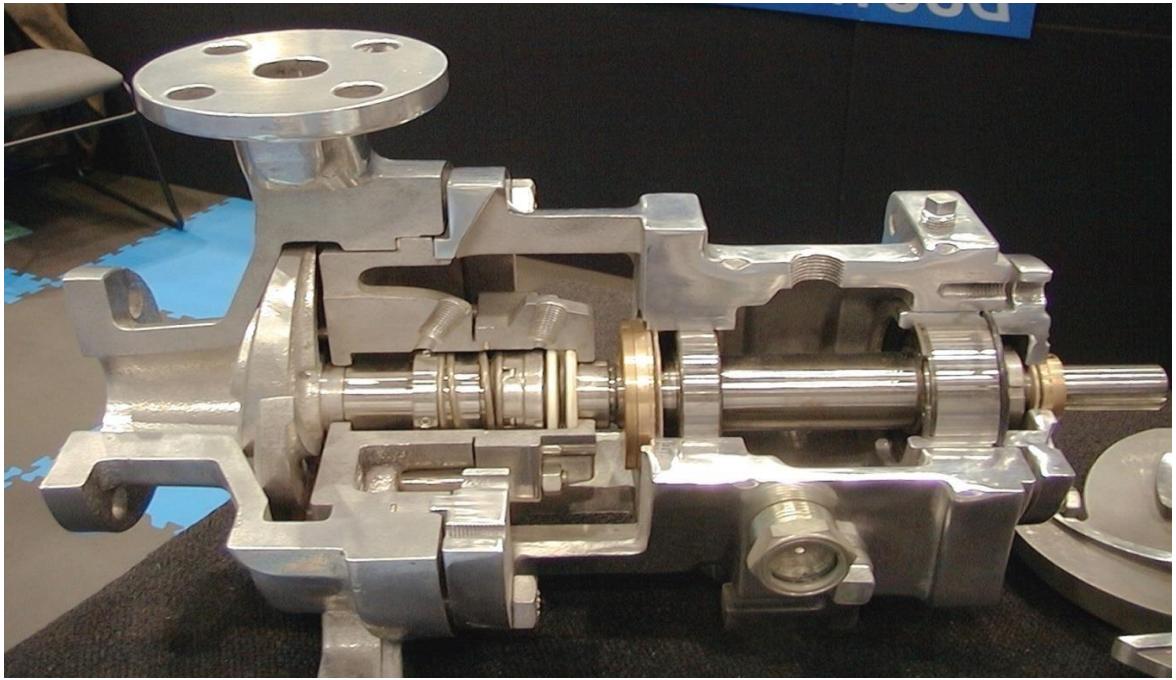
NEED FOR SEALS

- Seal is a device for closing a gap or making a joint fluid tight (liquid or gas)

NEED

- ✓ To minimize leakage
- ✓ To prevent toxic fluids escaping to atmosphere
- ✓ To reduce power loss

DYNAMIC SEAL



DYNAMIC SEALS

TYPES OF SEALS

1) Static Seals 2) Dynamic Seals

STATIC SEALS:

- In this type of seal, sealing takes place between the surfaces which do not move relative to one another.

Example: Gaskets in pipe flange connections, cylinder covers. Etc.

Static seals may be metallic, semi- metallic or non-metallic.

Types: 1=Gaskets 2- O-ring

DYNAMIC SEAL

1-Dynamic seals

- When there is relative movement between the sealing faces it is called dynamic seal.

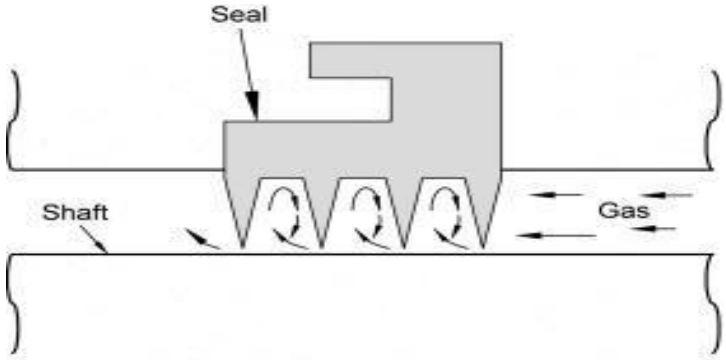
2- Contact seal

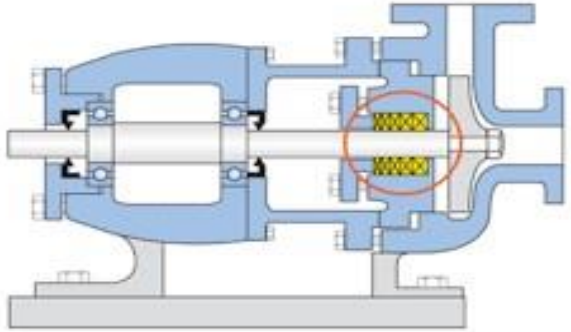
- Seals bear against its mating surfaces under positive pressure. e.g.: gland packing, Mechanical Seal.

3-Clearance seal

- Which operates with positive clearance. e.g. Labyrinth seal.

Dynamic seals





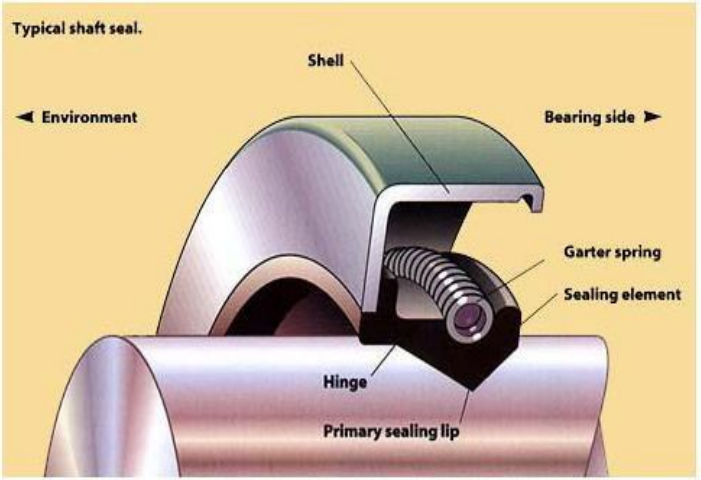
DYNAMIC SEAL

- O-RINGS
- LIP OIL SEALS
- PACKING
- MECHANICAL SEALS
- BEARING SEALS

LIP OIL SEAL

A shaft seal is a barrier with four functions.

- ✓ It retains lubricants or liquids
- ✓ It excludes contaminants
- ✓ It separates fluids
- ✓ It confines pressure.



MECHANICAL SEAL

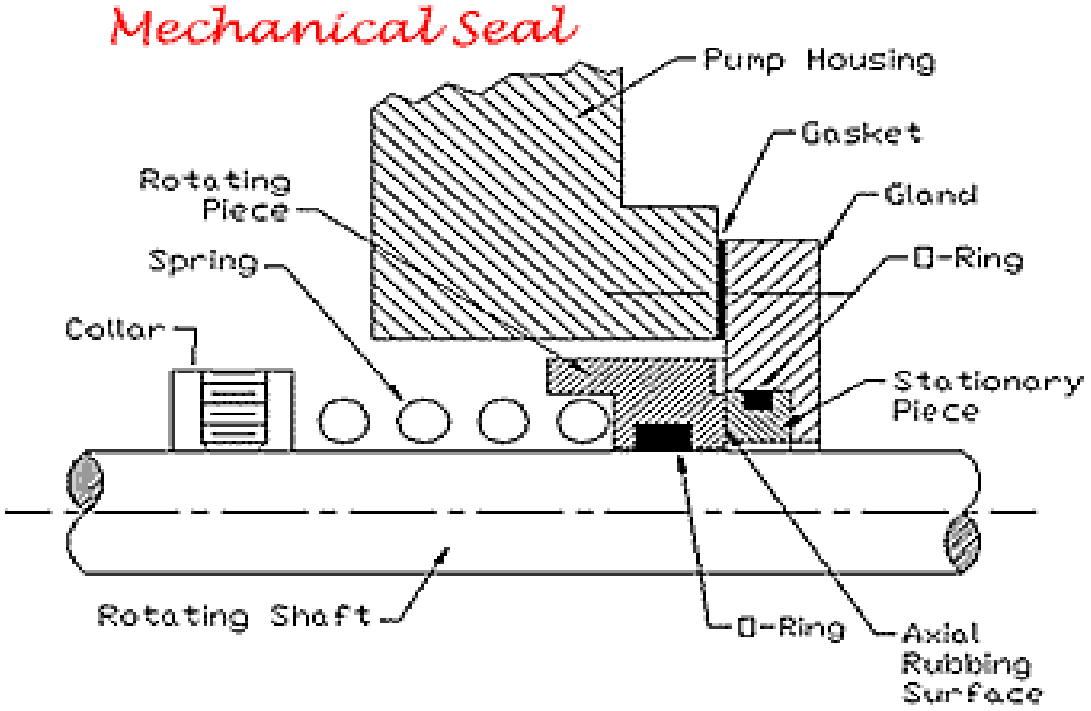
INTRODUCTION

- A mechanical seal is a sealing device which forms a running seal between rotating and stationary parts.
- These seals are commonly used in centrifugal pumps. The operating life of the mechanical seal strongly depends on its assembly and installation.
- Centrifugal and rotary positive displacement pumps require controlling of the pumped fluids through the stuffing box.

MECHANICAL SEAL

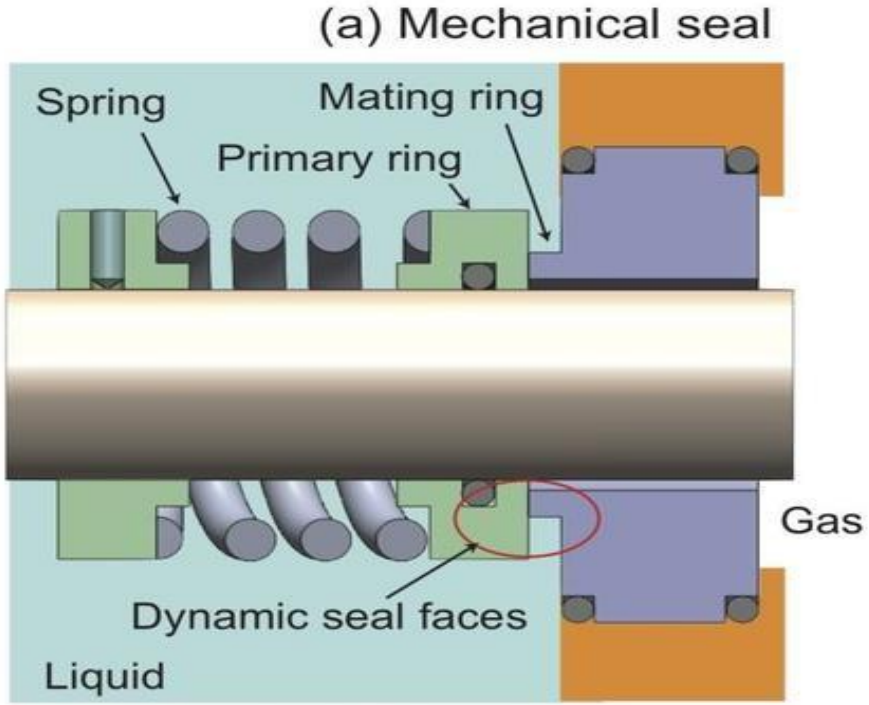
- It consists primarily of a rotary seal face with a driving mechanism which rotates at the same speed as the pump shaft, a stationary seal face which mates with the rotary.
- Stationary seal faces the mechanical seal assembly uses
- O-rings, v -rings, wedges.

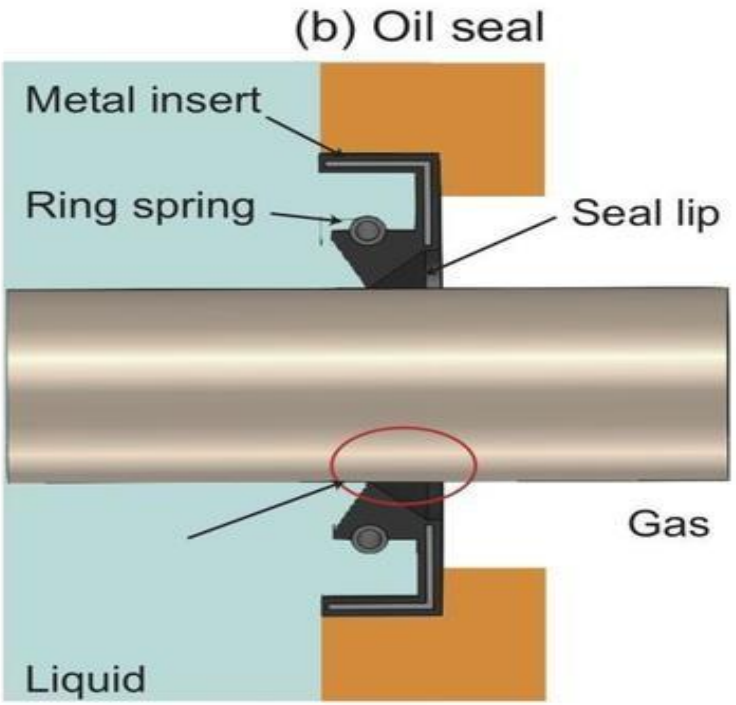
MECHANICAL SEALCOMPONENTS



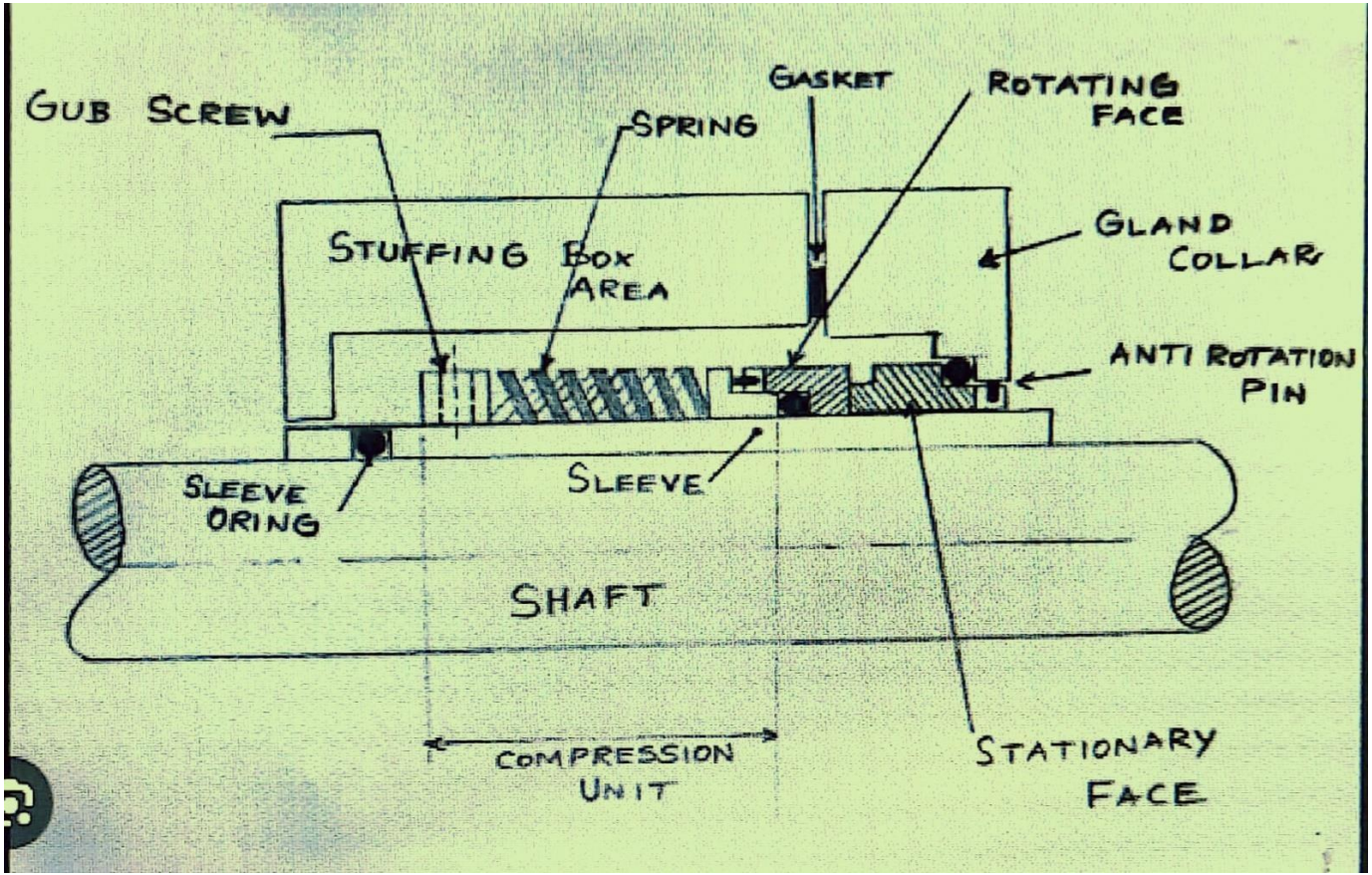
- ✓ Gap in between seal faces, resulting leakage

MECHANICAL SEALCOMPONENTS

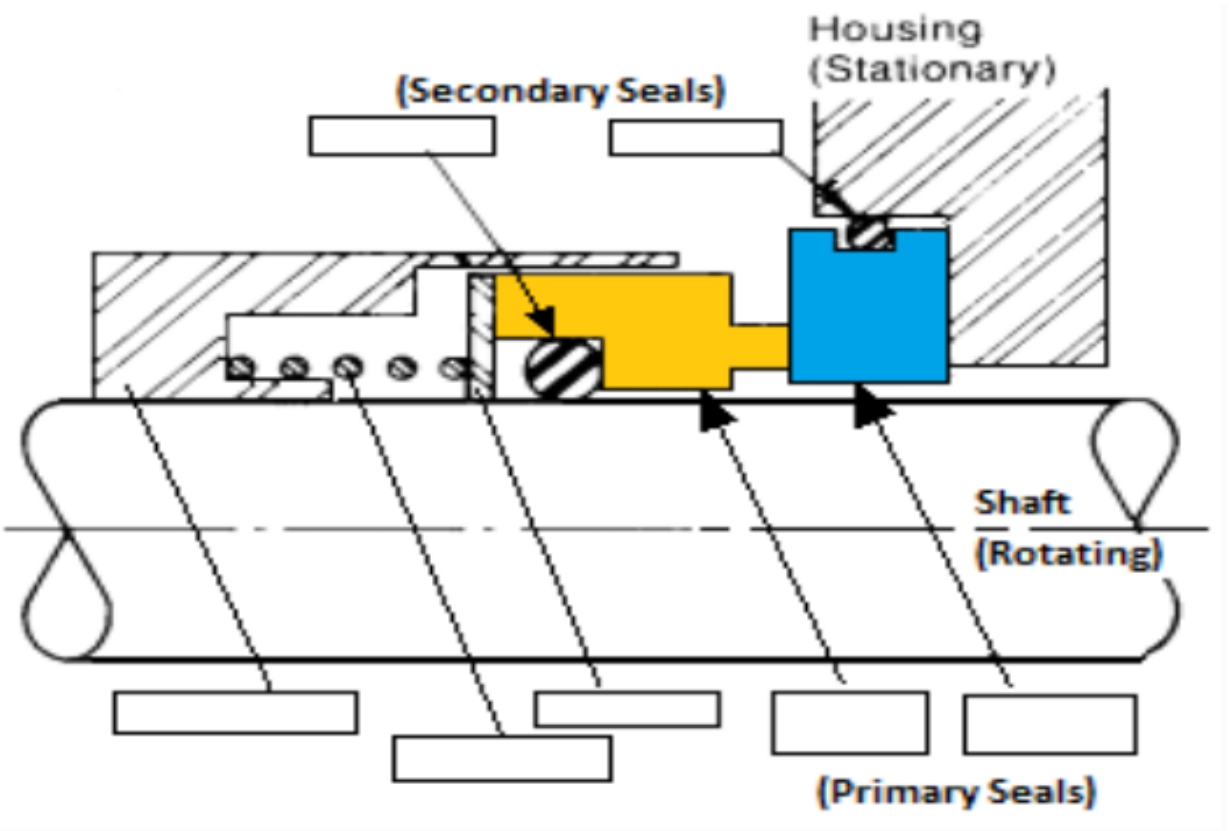




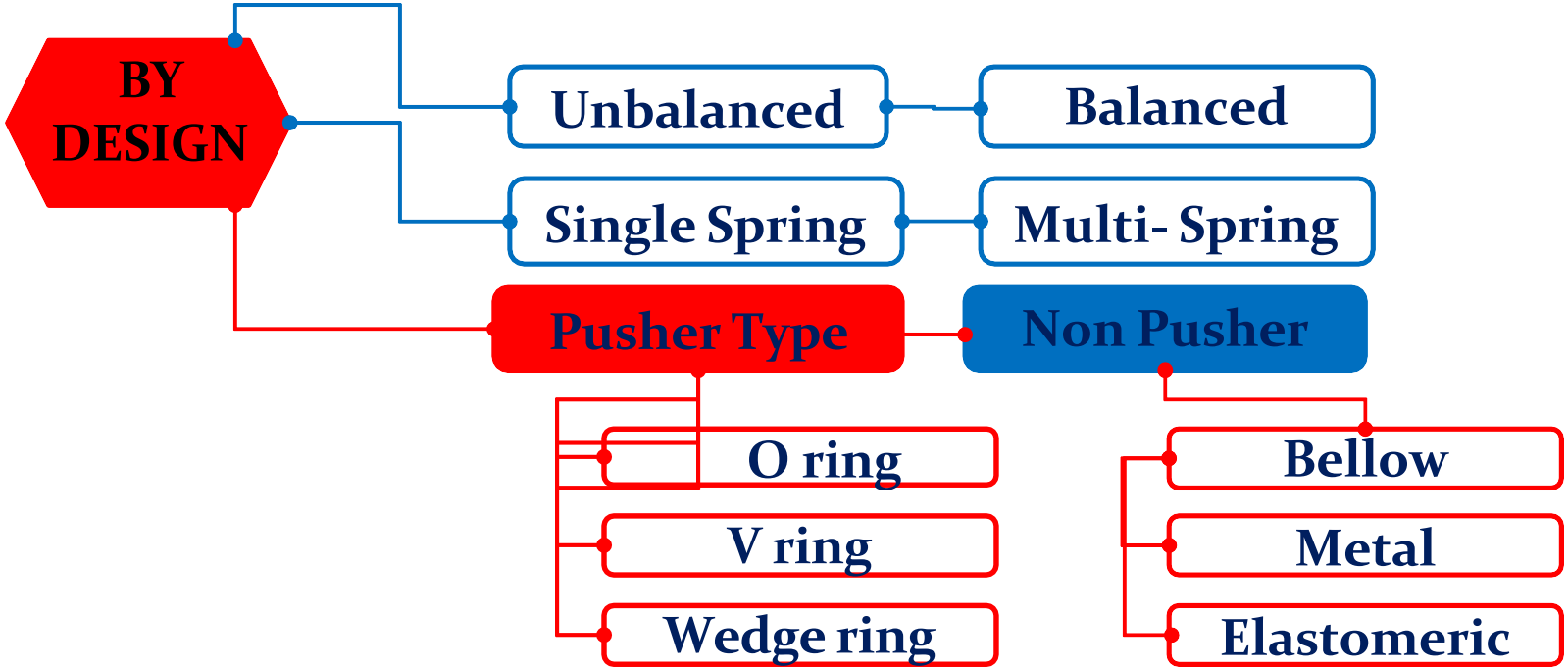
MECHANICAL SEALCOMPONENTS



MECHANICAL SEALCOMPONENTS



CLASSIFICATION



TYPES OF MECHANICAL SEAL

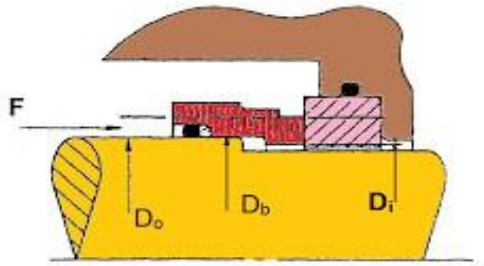
- **DIFFERENT TYPES OF MECHANICAL SEALS FOR CENTRIFUGAL PUMPS**

1) Balanced seals
2) Unbalanced seals
3) Single spring
4) Multi spring
5) Pusher seals
6) Non-pusher seals
7) Cartridge seals

TYPES OF MECHANICAL SEAL

1-Balanced seals

- Balanced seals reduce the seal ring area on which the hydraulic pressure of the liquid in the pump (Pp) acts.
- All mechanical seals are hydraulically balanced to control the opening and closing forces on the seals rings.(faces)
- Balanced mechanical seals are particularly suited to higher operating pressures

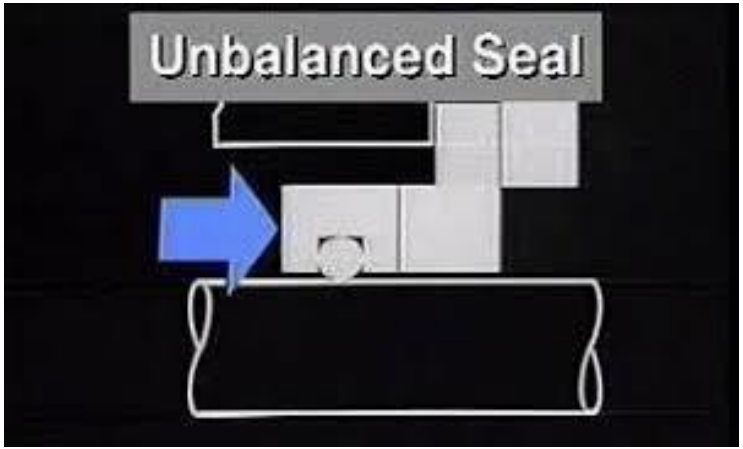


BALANCED SEAL

TYPES OF MECHANICAL SEAL

2-Un-Balanced seals

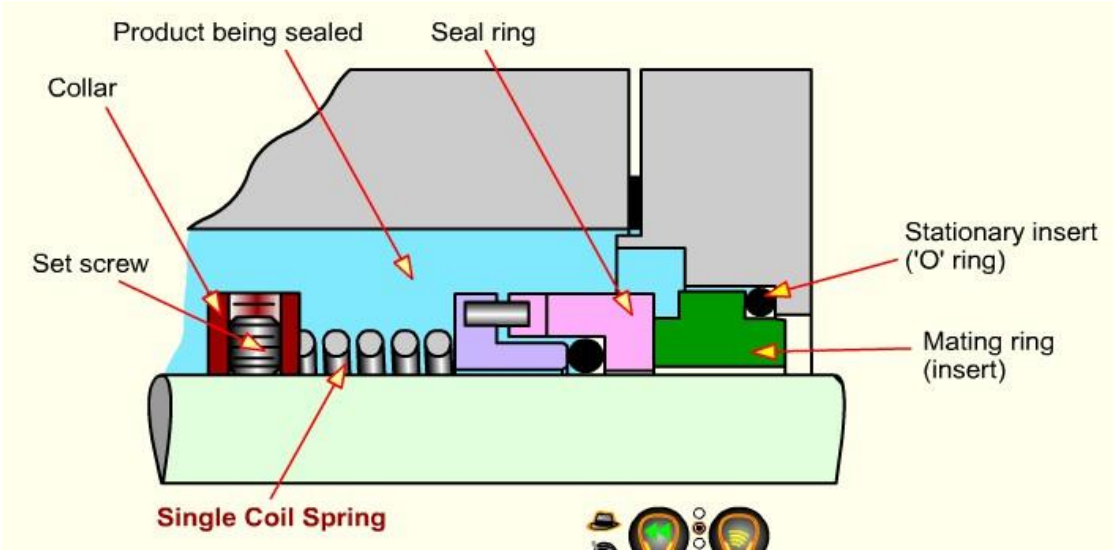
- Unbalanced seals are not recommended for high pressure.
- They are suitable for use in lower pressure and temperature applications and can handle a range of fluids.

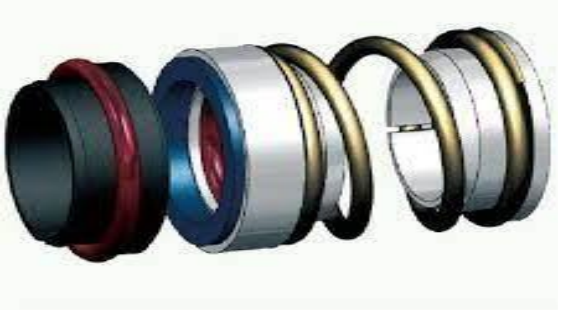


TYPES OF MECHANICAL SEAL

3-Single spring seal

- Single Spring seals are used for Viscous, Abrasive, Solidifying & Non-Corrosive Slurry.

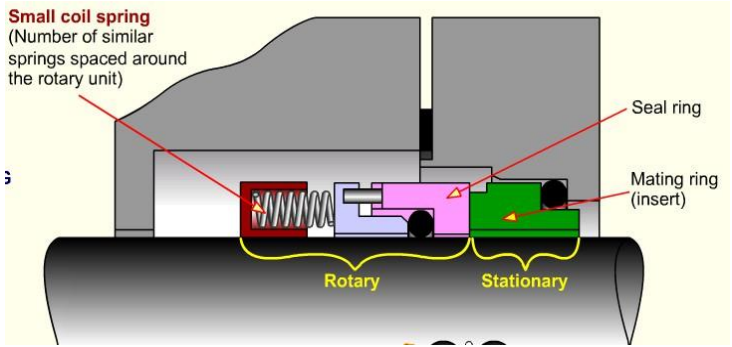




TYPES OF MECHANICAL SEAL

4-Multi spring seal

- Multi-spring seals are widely used for various clean media applications.
- Multi-Spring seals design has many springs put uniform force over the faces hence increase its life.



TYPES OF MECHANICAL SEAL

3-Pusher seals

- Pusher seals utilize one or multiple springs to maintain seal closing forces.
- The springs can be in the rotating or stationary element of the mechanical seal.
- Pusher wedge ring and O-ring acts as the secondary seal which moves axially to compensate for seal wear.
- Pusher type seals can provide sealing at very high pressures

TYPES OF MECHANICAL SEAL

4-Non-Pusher seals

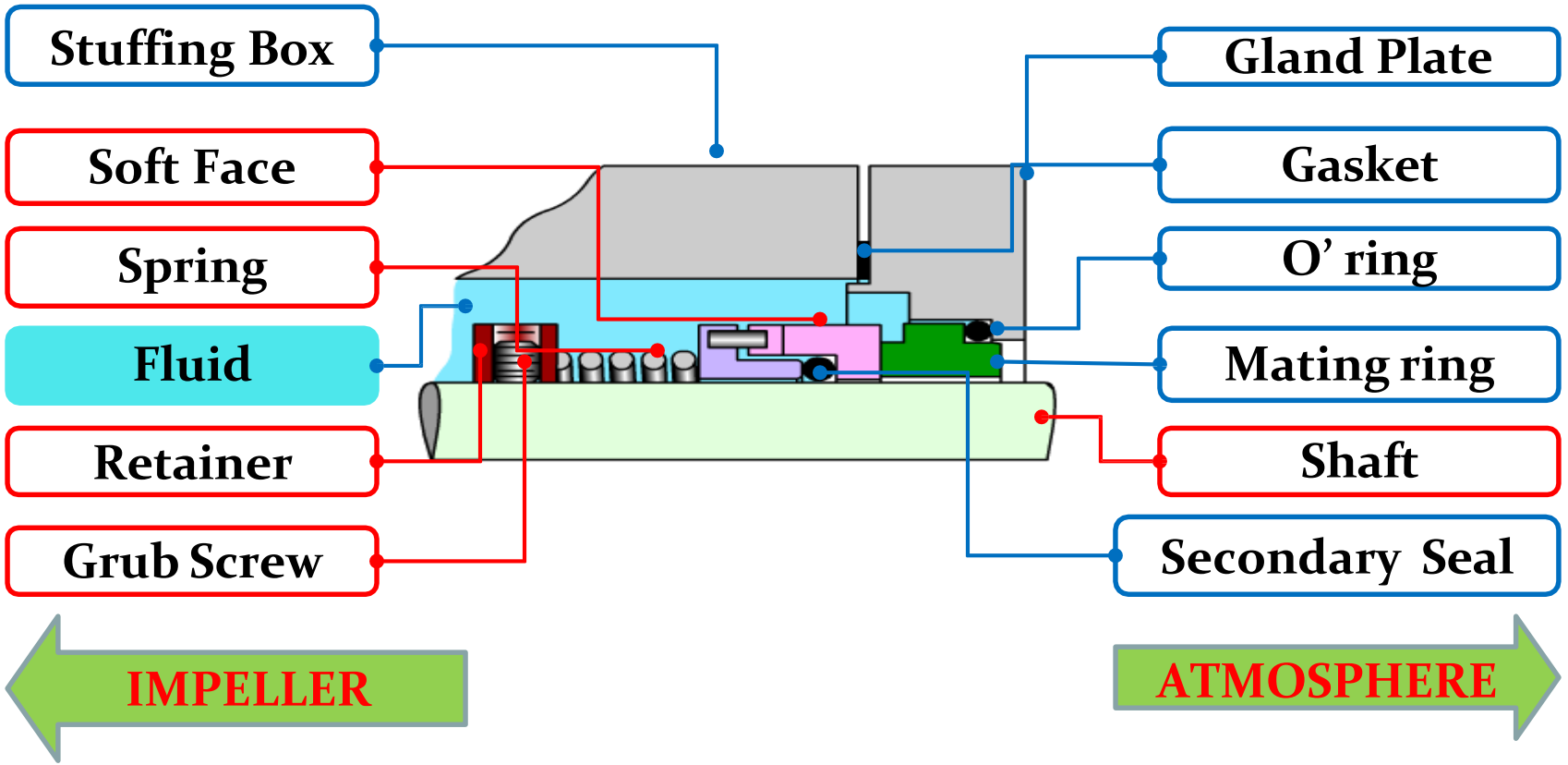
- Non-pusher seals utilize a metal or elastomeric bellows to maintain seal closing forces.
- These seals are ideally suited to dirty and high temperature applications.
- Bellows seals are limited to medium/lower pressure applications.

TYPES OF MECHANICAL SEAL

5-Cartridge seals

- A cartridge mechanical seal is a completely enclosed seal system with preassembled components
- Cartridge seals are designed for rapid installation on and removal from pump shafts.

MECHANICAL SEAL COMPONENTS



MECHANICAL SEAL COMPONENTS

1. Rotary seal face
2. Stationary seal face
3. Springs
4. Retainer
5. Sealing /flushing media
6. O- rings

✓ Mechanical seals are used to stop leakage through pump shaft.

✓ The location of Mechanical seal is in stuffing box of pump.

BASIC PARTS AND THEIR FUNCTIONS

Retainer

- Rotating seal ring is fixed in the retainer.
- Setscrews or grub screws are used to fasten the retainer with the shaft or sleeve.

Notches:

- The indentations on the retainer and the sealing ring called notches.
- The retainer rotates with the shaft, and ring rotates with the retainer.
- Driving mechanisms other than notches can be used.
- For example, Keys, set screws etc.

Retainer and notches

Retainer and notches

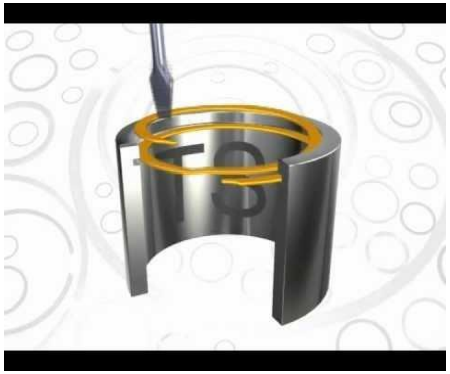
Retainer and notches

BASIC PARTS AND THEIR FUNCTIONS

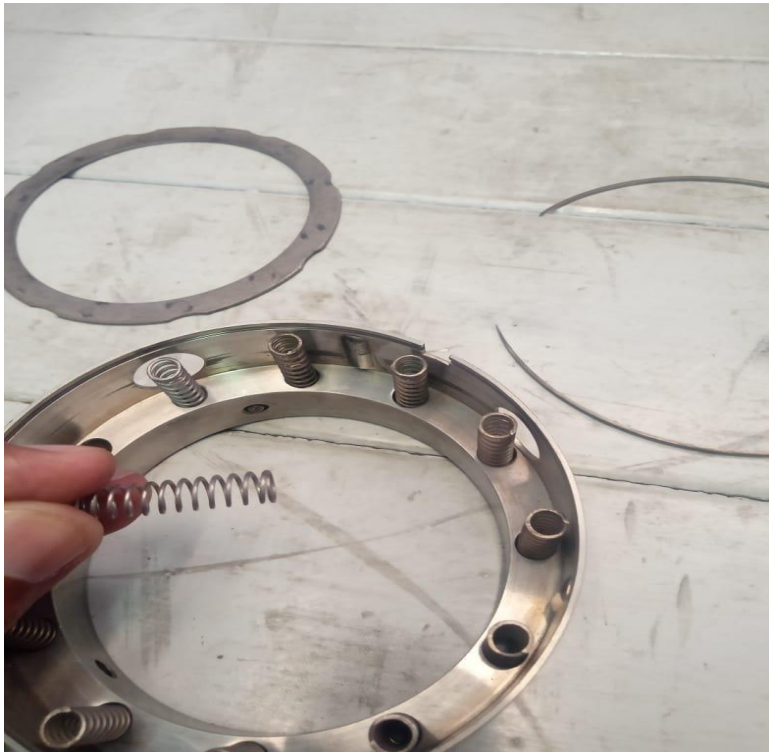
Compression spring

- Spring in mechanical seal provides closing force to balanced face.
- Spring provides the force to keep the faces of both the sealing rings together.
- It compensates for the wear of the rubbing faces.
- Single or multiple springs can be used.

Compression spring



Compression spring



BASIC PARTS AND THEIR FUNCTIONS

Compression ring (Thrust ring)

- Compression ring is simply a metal ring that distributes the force of spring evenly on sealing face.

Lock ring

- It keeps the rotating seal ring in the retainer

Thrust ring

FLUID FILM

- If the mechanical seal faces rotated against each other without some form of lubrication they would wear out (and the seal would fail) due to face friction and the resultant heat generated.
- So, lubrication is required which for simplicity, is supplied by the product media.
- This is known as fluid film and maintaining its stability is of prime importance if the seal is to provide satisfactory and reliable service.

MECHANICAL SEAL SEALIMG POINTS

1- Face to face sealing

- Rotary and stationary faces contact

2- Stationary face (seat) sealing

- Sealing by O-ring

3- Rotary face sealing

- Rotary face sealing by O-ring ,wedge ,u cup

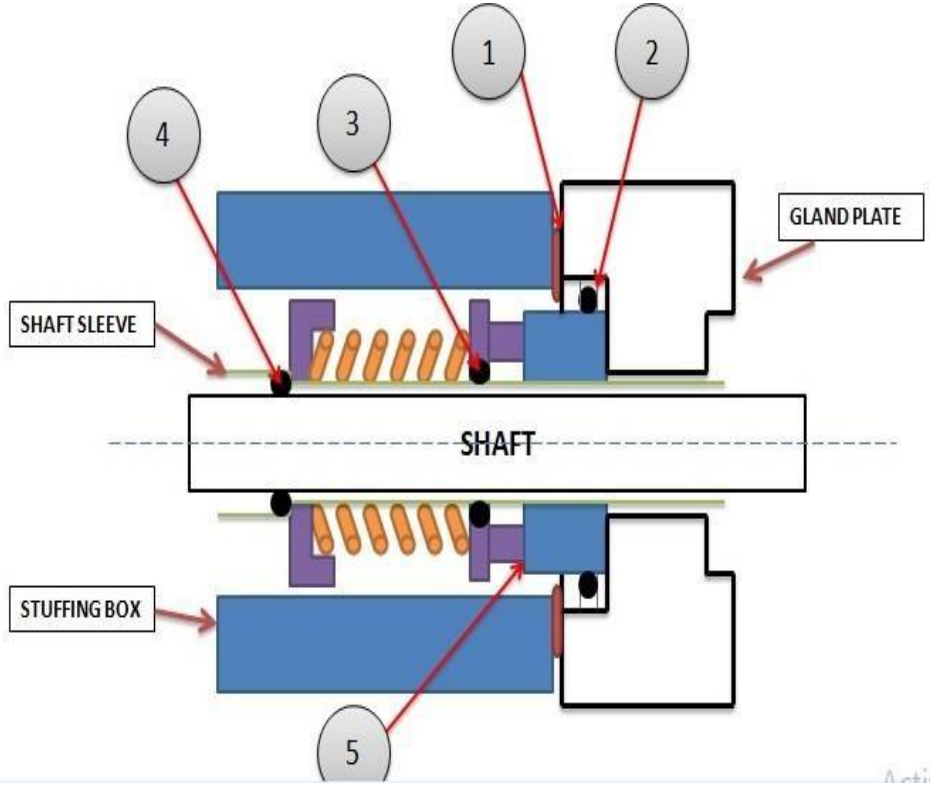
4- Along the shaft and sleeve sealing

- Along the shaft and sleeve sealing by O-ring and Teflon ring

5- Gland plate to pump housing sealing

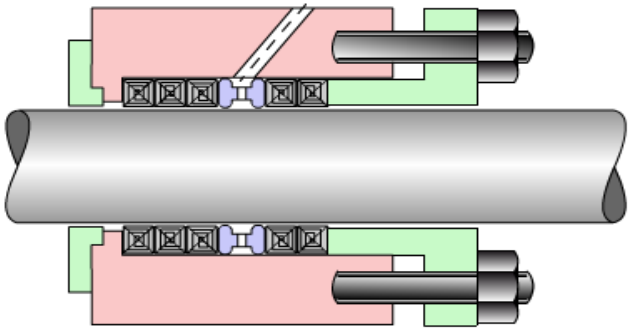
- Gland plate to pump housing sealing by O-ring and gasket.

MECHANICAL SEAL SEALIMG POINTS

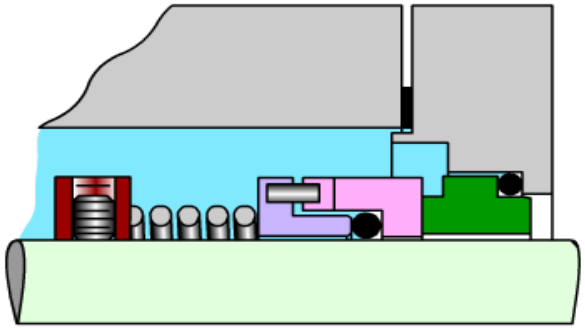


Packing vs. Mechanical Seals

COMPRESSION PACKING



MECHANICAL SEAL



LEAKAGE RATE

- Average 90 drops /min : Average 05 drops /min
- Average 3153 liters/year : Average 2.9liters/year

This sows a leakage ratio of packing to seals of: 1080:1

Materials for Primary Ring & Mating Ring

Common Primary Ring Materials

1) Carbon Graphite
2) Silicon Carbide
3) Tungsten Carbide

Common Mating Ring Materials

1- Ceramic
2- Silicon Carbide
3-Tungsten Carbide

O-RINGS MATERIALS

Most commonly used elastomers are:

1- VITON : Sp. Gr. = 1.85 (Temp. Range: -100F to +4000F)

2- BUNA-N : Sp. Gr. = 1.20 (Temp. Range: -400F to +2250F)

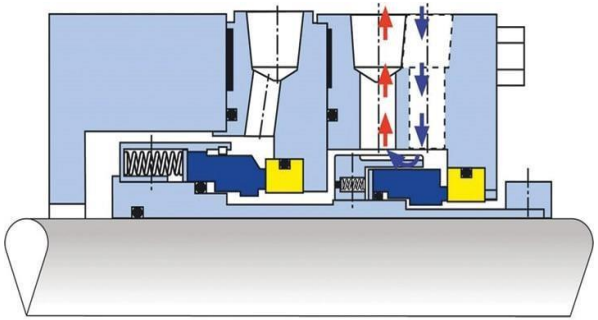
3- PTFE : Sp. Gr. =2.10 (Temp. Range: -4500F to +5000F)

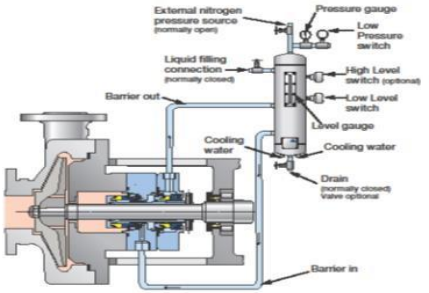
4- E.P. : Sp. Gr. =0.86 (Temp. Range: -500F to +3000F)

5- KALREZ : Sp. Gr. =2.01 (Temp. Range: -400F to +5500F)

Double Mechanical seal

- A double mechanical seal consists of two seals arranged in a series.
- Primary seal" keeps the product contained within the pump housing.
- Secondary seal" prevents the flush liquid from leaking into the atmosphere.
- A pumping ring in the seal circulates the buffer fluid





Assembly and Installation of Mechanical seal

Introduction

- A mechanical seal is a sealing device which forms a running seal between rotating and stationary parts.
- These seals are commonly used in centrifugal pumps.
- The operating life of the mechanical seal strongly depends on its assembly and installation.

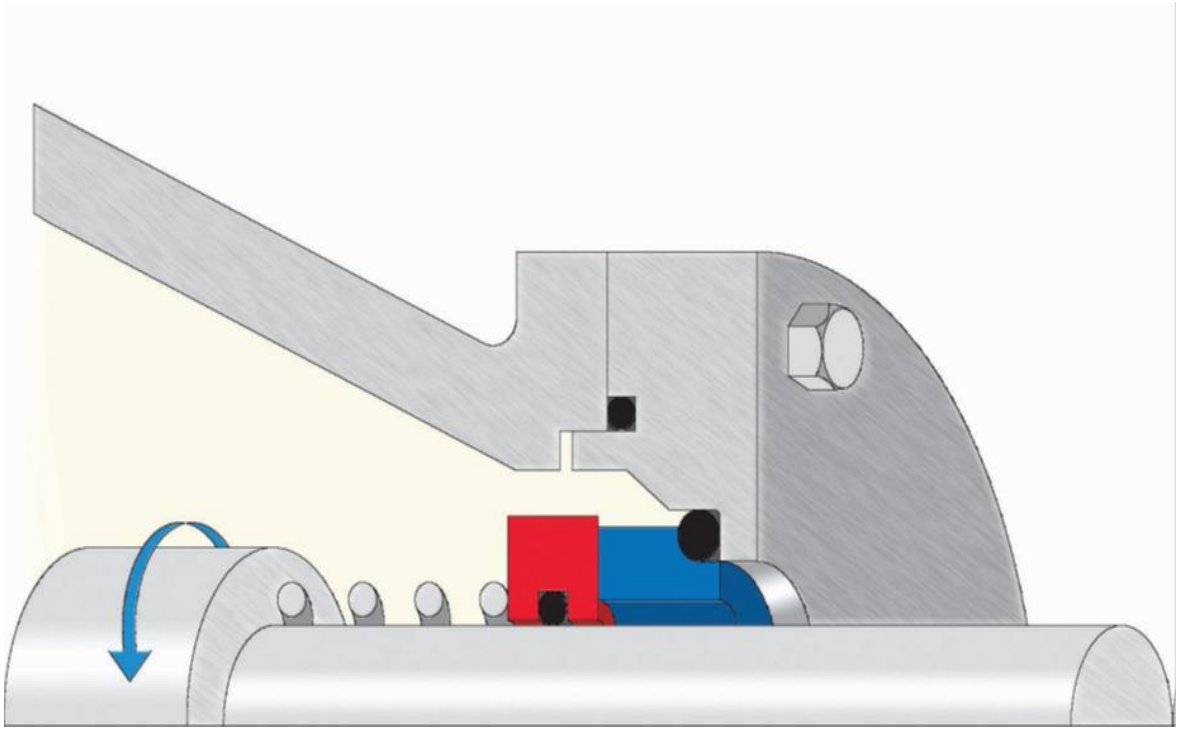
Tools Requirement

- Following tools/fixtures are used for assembly and installation of mechanical seals; applicable tools should be arranged and inspected before starting the assembly and installation job:

Tools Requirement

1) Micrometer
2) Vernier caliper
3) Dial Indicator
4) Bore gauge
5) Balanced face assembly fixture
6) Leveling plate
7) Appropriate size spanners for tightening/loosening of the stuffing box bolts

MECHANICAL SEAL



Requirement Balanced face assembly fixture

Balanced face assembly fixture

Material Requirement

Material Requirement

Following material is required for mechanical seal assembly and installation:

1. Emery paper
2. White Grease
3. Tissue Paper

Procedure

Checking and Preparing the Equipment

- Successful operation and life of mechanical seal is dependent on acceptable equipment dimensions, alignment and finishes.
- Before installation of the seal, the following measurements/checks should be made with respect to the seal housing and the shaft.

1) Shaft outside diameter
2) Shaft surface finish
3) Shaft axial float
4) Square ness of seal chamber face to shaft
5) Shaft runout
6) Shaft ovality

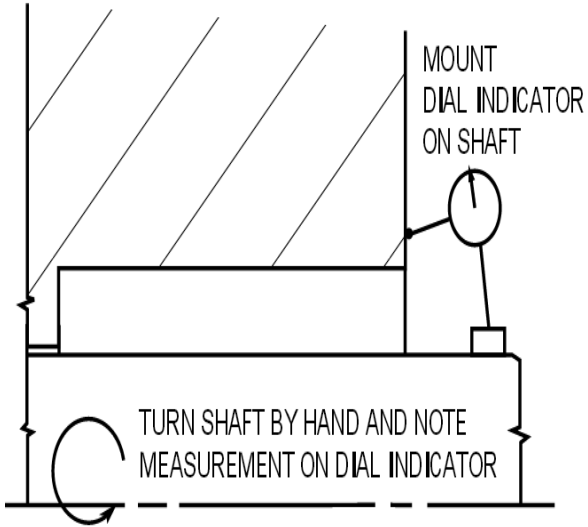
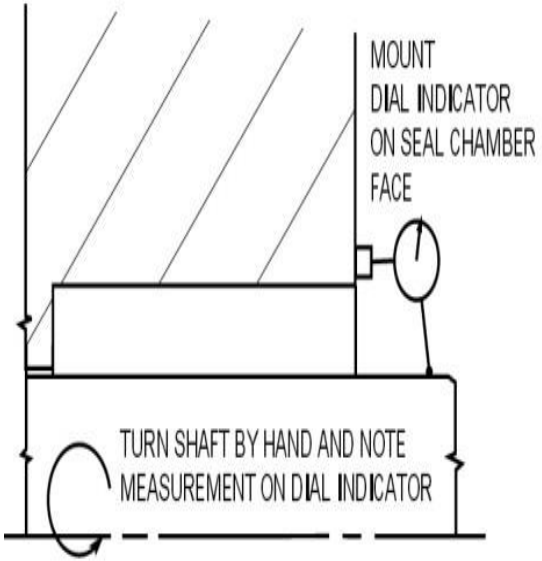


Figure 1:

- **Checking of Square ness of Seal Chamber with Shaft**

Figure II:

- **Checking Run-out of Shaft**



Balanced Face and Hard Face

Balanced Face and Hard Face

- For new balanced and hard faces, check the faces for any scratches/damage.
- Faces should be free from any mark. If reclaimed faces are to be used, condition of lapped faces and their thickness to be checked and compared with the new one

Balanced Face and Hard Face

SLEEVE

SHAFT SLEEVE

- Sleeve should be dimensionally checked before installation.
- Sleeve should be slide fit on the shaft.
- There should be no fretting marks on the sleeve at secondary seal (wedge, O-ring etc.) working location .
- Remove all sharp edges from the sleeve.

Shaft Sleeve

Wedge ,springs O-rings

Wedge

- Wedge should be checked by installing on the sleeve.
- Wedge should not be loose on the sleeve.
- The sealing edge of the wedge should be free from any cut mark.

Springs

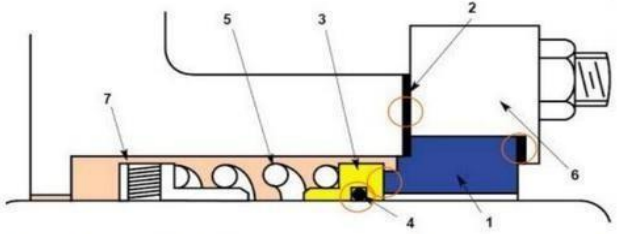
- Springs should be checked for any rubbing marks (For single spring only)

O-rings

- O-Rings should be inspected visually for cut marks or any other surface abnormality

Adapter Plate/Gland Plate

- O-Ring groove and seating surface of adapter should be checked and thoroughly clean.
- Any irregularities if any should be removed before assembly.



By way of example, a simple mechanical seal design has seven components

1. Stationary component; commonly referred to as "the seat"
2. Stationary component sealing member
3. Rotating component
4. Rotating component sealing member
5. Spring
6. Gland plate
7. Clamp ring

MECHANICAL SEAL

Thrust Ring

- Thrust ring bears the force of multiple springs installed in the retainer and transmits this force to the balanced face.

MECHANICAL SEAL

RETAINER

- Retainer should be checked for any ovelity.
- The notches of the retainer should be visually inspected and it should be ensured that thrust ring travels smoothly on the notches.
- Snap ring should be checked for proper fitting by installing into the retainer.

MECHANICAL SEAL

Installation of Mechanical Seal

- Use a suitable lubricant when fitting the seal.
- Do not use hydrocarbon-based liquids on ethylene propylene bellows and elastomers.
- Place the retainer in the fixture and install the spring and thrust ring.
- Install the secondary sealing element wedge or O-Ring in the balanced face and place the same on the thrust ring.
- Press the balanced face downwards using the fixture and lock the assembly with snap ring.
- Check the free movement of the balanced face in the retainer.

MECHANICAL SEAL

Installation of Mechanical Seal

- Install the retainer with balanced face assembly on the sleeve and lock the retainer with grub screws.
- Balanced face must be seated on the sleeve step.
- Install the Hard face O-Ring in the gland / adapter plate and then install the hard face.
- Alignment of hard face notch and anti-rotation pin in adapter plate to be ensured during assembly.

Note: Hard face should be pressed evenly to seat in the gland / adapter plate and avoid sudden jerks to the face during installation.

MECHANICAL SEAL

Installation of Mechanical Seal

- Remove any grease, dirt or other foreign material from faces.
- For single mechanical seal, install the gland plate on the casing cover.

- For double mechanical seal, install the process seal in the adapter plate and the second seal (buffer/barrier) in the gland plate.
- Install the adapter plate in the casing cover and then install the gland plate with the casing cover.

MECHANICAL SEAL

Checking Mechanical Seal Tension (Single Seal)

Adjustment of Mechanical Seal Tension

- Mechanical seal tension is kept within 3 to 5 mm range keeping in view the type of fluid, temperature and experience regarding seal life.

Mechanical seal tension can be reduced by:

1) Machining the sleeve step for retainer
2) Increasing the thickness of gland/adapter plate gasket
3) Increasing thickness of spacer at sleeve step (If provided)

Mechanical seal tension of single seal can be increased by:

1) Machining of sleeve inner step
2) Reducing the thickness of spacer at sleeve step (If provided)
3) Reducing the thickness of gland plate gasket

MECHANICAL SEAL

Final Assembly and Installation of Mechanical Seal

- After adjustment of the seal tension remove the casing cover and install the adapter plate / gland plate gaskets
- Casing cover is then re-installed and tightened.
- Install the sleeve O-Ring/gasket.
- Install the retainer assembly on the sleeve.
- Install the sleeve on the shaft.
- Install the impeller and then finally tightened it.

MECHANICAL SEAL

Safety Precautions

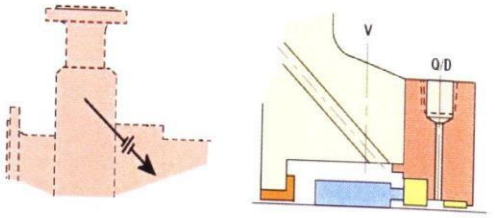
1) Don’t unpack the seal until ready to install
2) Wash hands
3) Avoid touching or handling lapped seal faces
4) Use clean tissue paper on workbench to prevent contamination
5) Don’t set the seal down on its face
6) Clean faces with soft tissue and approved solvent before installation.

API Flush Plan 01

- Integral(internal) recirculation from pump discharge to seal.
- Recommended for clean pump age only.

Used in

1) P-4106
2) P-4108
3) P-4109

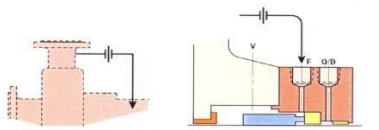


Integral (internal) recirculation from pump discharge to seal.
Recommended for clean pumpage only.

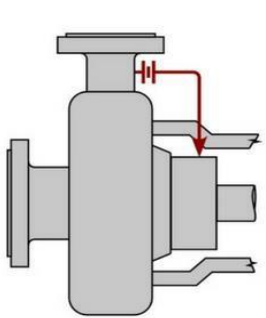
API Flush Plan 11

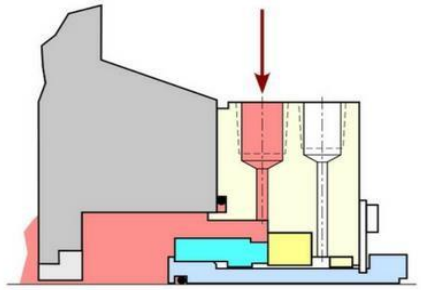
- Recirculation from pump discharge through a flow control orifice to the seal.
- Single Seal Flushing By - Pass from Discharge

Used in
P-4103, P-4105, P-4107



Recirculation from pump discharge through a flow control orifice to the seal.



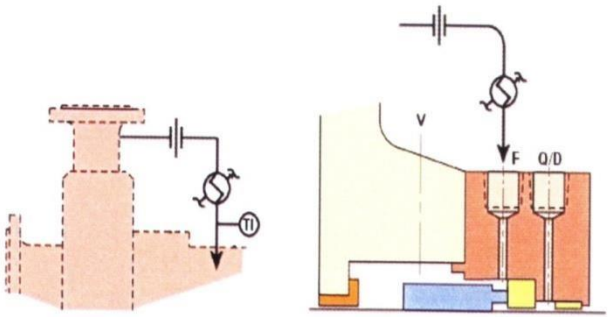


API Flush Plan 21

- Recirculation from pump discharge through a flow control orifice and cooler to the seal chamber.

- Used in

1) P-4110
2) P-4115



Recirculation from pump discharge through a flow control orifice and cooler to the seal chamber.

Operational and Maintenance Errors

- Operation error is the single most cause in seal failure in throughout industry today.
- Some are mentioned below :
- Dry running.
- Suction chocking.
- Foreign material.
- Material Incompatibility.
- Abnormal process parameters.
- Flushing Plan Off.

Operational and Maintenance Errors

Maintenance fitting errors are also affects the mechanical seal life.

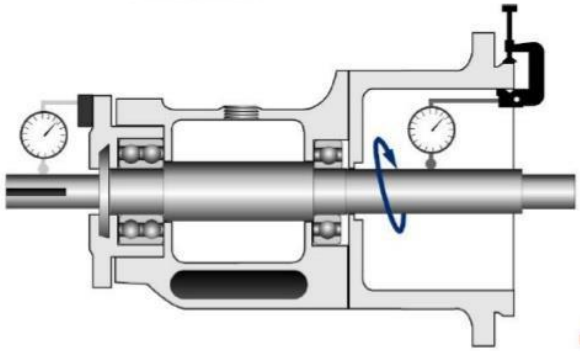
1) Misalignment < 0.05 mm.
2) Stuffing Box Concentricity or gland register <0.1 MM.
3) Shaft Run Out < 0.05 MM.
4) Stuffing Box To shaft Perpendicularity < 0.07 MM.
5) End Play (Hold b/w 0.02 MM – 0.1 MM)
6) Radial Deflection < 0.07 MM.
7) Failed Bearings.
8) Unavailability of Flushing Plan Required.
9) Stuffing Box Concentricity or gland register <0.1 MM.

Shaft Run Out

Shaft Run Out < 0.07 MM

Shaft Run-Out

Bent Shaft



0.05 MM