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MECHANICAL SEALS

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All types of pumps require a seal, and a mechanical seal is just one way to seal a pump. The purpose of any seal is to prevent whatever the pump is pumping from leaking out between the part of the pump that is stationary and the part of the pump that turns.

Before the widespread adoption of mechanical seals in industrial manufacturing, it was typical to use graphite packing to plug leaks in a pump. It is actually still used today in a lot of pumps. However, packing can't handle friction as well as a mechanical seal. Water must be constantly flushed over the packing to keep it from overheating, and even then, it has to be replaced frequently since it wears down so quickly. Engineers realized that a more efficient solution was needed to prevent their pumps from leaking.

The intent of this manual is to provide you with a basic understanding of mechanical seal technology and how maintenance can have a positive impact on the life of mechanically sealed equipment.

Each time a seal fails, it involves every department. There are labor costs, potential downtime, loss of production, and seal bearing costs as well. The average cost of an ANSI pump seal failure is between $1,500 and $2,500. The average cost for an API pump seal failure is between $3,500 and $4,500. These costs do not reflect loss of production.

Plant units that can operate with extended (MTPM) Mean Time Between Planned Maintenance schedules are more profitable and can compete more effectively in their markets.

This manual will be one more step towards that goal.

Table of Contents

Terms & Definitions

Hydraulics

The study of fluid at rest or in motion. Fluids include both liquids and gases. We concern ourselves only with liquids.

Density

Sometimes referred to as specific weight. The weight per unit volume of a substance. The density of water is 62.4 lbm/ft3 at 14.7 PSIA at 60°F (15.6°C)

Specific Gravity

The ratio of its density to that of some standard substance. for liquids the standard is water at 14.7 PSIA and 60°F (15.6°C). Water has a specific gravity of 1.0

Pressure

Pressure is the force exerted per unit area. If pressure is applied to the surface of a liquid, the pressure is transmitted undiminished in all directions. Pressure is expressed in pounds per sq. inch or kPa.

Atmospheric Pressure

The force exerted on a unit area by the weight of the atmosphere. Atmospheric pressure at sea level is 14.7 psi (1 bar = 100kPa = 14.504 psi

Absolute Pressure

The sum of gauge pressure and atmospheric pressure. The absolute pressure of the atmosphere at sea level is 14.7 PSIA - 0 psi gauge.

Vacuum

Used to express pressure below atmospheric. Frequently expressed in inches of mercury. Atmospheric pressure at sea level is 29.92 in. Hg you are operating in a vacuum. (1 psi = 2.04 in. Hg)

Vapor Pressure

The pressure at which a liquid will flash into a vapor at a given temperature. At 60°F (15.6°C) water has a vapor pressure of 0.258 PSIG. At 212°F (100°C) water has a vapor pressure of 14.1 PSIG. Every liquid has its own unique vapor pressure curve where the vapor pressure is plotted vs. temperature.

Terms & Definitions

PUMP PRESSURES

Suction Pressure

The actual pressure at the pump suction as measured on a gauge.

Head

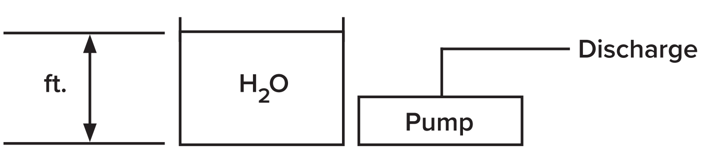
Head is a term for expressing pressure. Commonly used to represent the vertical height in feet of a static column of liquid. Also considered as the amount of work necessary to move a liquid from its original position to the required delivery position.

Pressure can be converted to head by the equation:

$$\text{Head, ft.} = \frac{2.31 \text{ x pressure, PSI}}{\text{sp. gr.}}$$

Head can be converted to pressure by the equation:

$$\text{Pressure, psi.} = \frac{\text{Head, ft. x sp. gr.}}{2.31}$$



Discharge Pressure

The actual pressure at the pump discharge connection as measured on a gauge. It is equal to the pump suction pressure plus total head developed by the pump.

Stuffing Box Pressure

The pressure acting on the stuffing box which must be sealed. It is a function of pump **Impeller design.**

IMPELLER DESIGN & STUFFING BOX PRESSURE

Open Style - Back Pump Out Vanes

Suction + 25% differential = stuffing box pressure

eg)	Discharge Pressure (psig)	100
	Suction Pressure (psig)	20
	Differential Pressure (psig) (100-20)	80

Stuffing Box equals 20 + 0.25 (80) = 40psig

Closed Style with Balance Holes

Suction + 10% differential = stuffing box pressure

eg)	Discharge Pressure (psig)	100
	Suction Pressure (psig)	20
	Differential Pressure (psig) (100-20)	80

Stuffing Box equals 20 + 0.10(80) = 28psig

Single Stage - Split Case Horizontal

Suction pressure = stuffing box pressure

NET POSITIVE SUCTION HEAD - NPSH

The amount of energy in the liquid at the pump centerline must be defined to have meaning of either NPSH available or NPSH required

NPSH Available

Characteristic of the system and is defined as the energy which is in the liquid at the suction connection of the pump over and above that energy in the liquid due to its vapor pressure.

Terms & Definitions

NPSH Required

Characteristic of the pump. The energy required to overcome friction losses from the pump suction opening to the impeller vanes. Determined by test or calculation and varies with pump design, size, and opening conditions.

Note: The available NPSH must always be equal to or greater than the required NPSH for the pump

Cavitation

If the energy and the suction line fall below the liquid vapor pressure, vapor is formed in the liquid stream.
The vapor bubbles or cavities collapse when they reach regions of high pressure on their way through the pump.

The effects of the cavitation are noise and vibration caused by the collapse of the vapor bubbles as they reach the high pressure side of the pump. If operated under cavitating conditions for sufficient length of time, the following may occur:

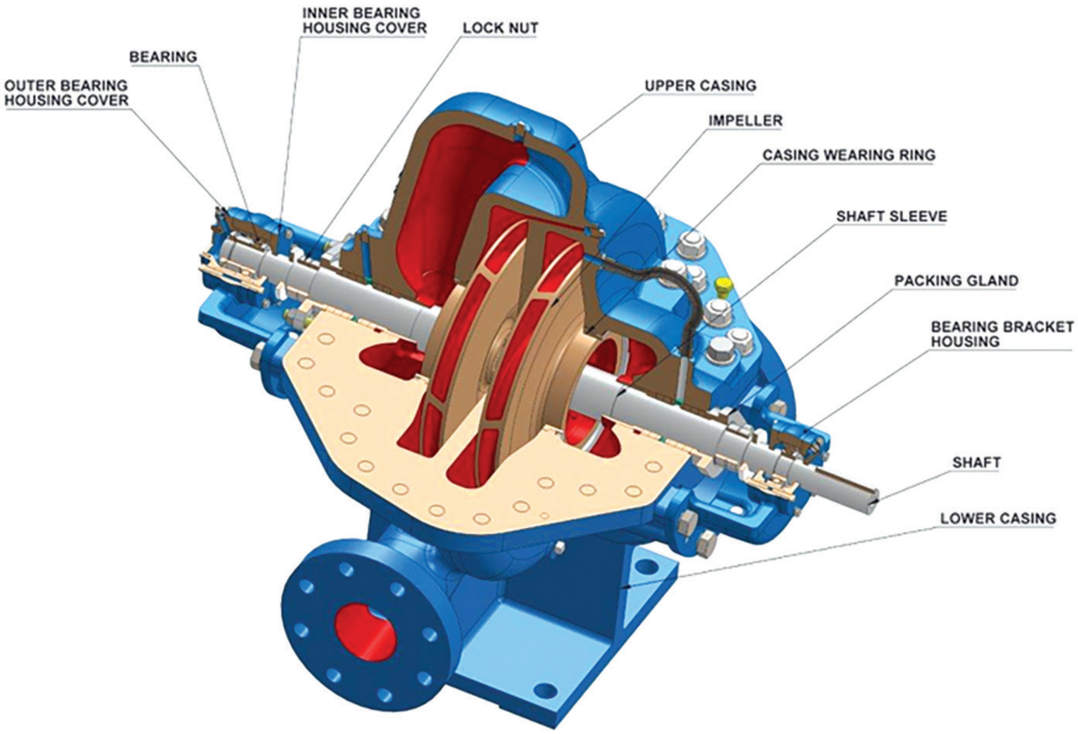
- Impeller vane pitting
- Bearing failure
- Shaft breakage and other fatigue failures in the

Serious damage to mechanical seals:

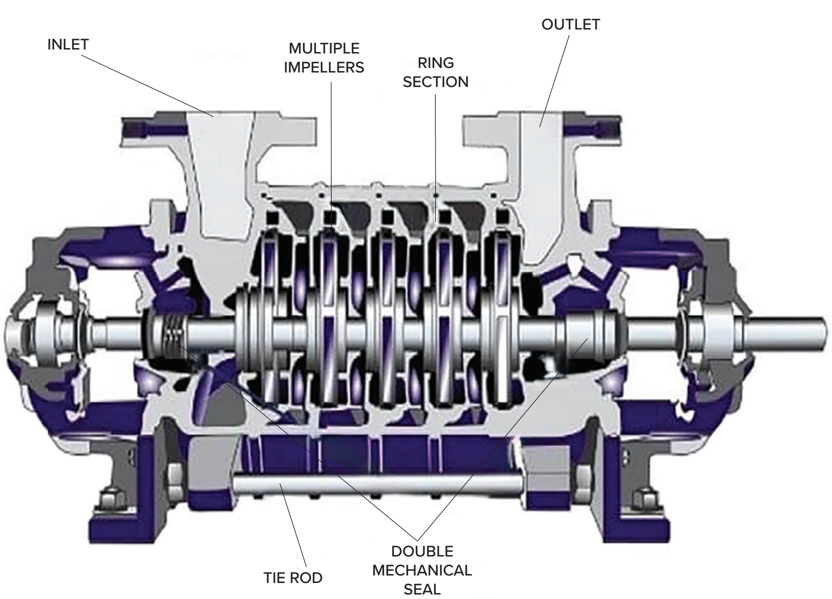
- Worn pins and pin slots
- Broken springs
- Shaft fretting
- Chipping of carbon faces, etc.

Pump Types

1. Single stage horizontal split case pump is a single-stage, non-self-priming, between-bearing centrifugal volute pump. Its axially split design allows easy removal of the top casing and access to the pump components (bearings, wear rings, impeller, and shaft seal) without disturbing the motor or pipe work.



2. The multistage pump is a type of centrifugal pump that pressurizes the fluid in multiple stages (two or more stages). Because this pump uses more than one stage, it is known as a multistage pump.



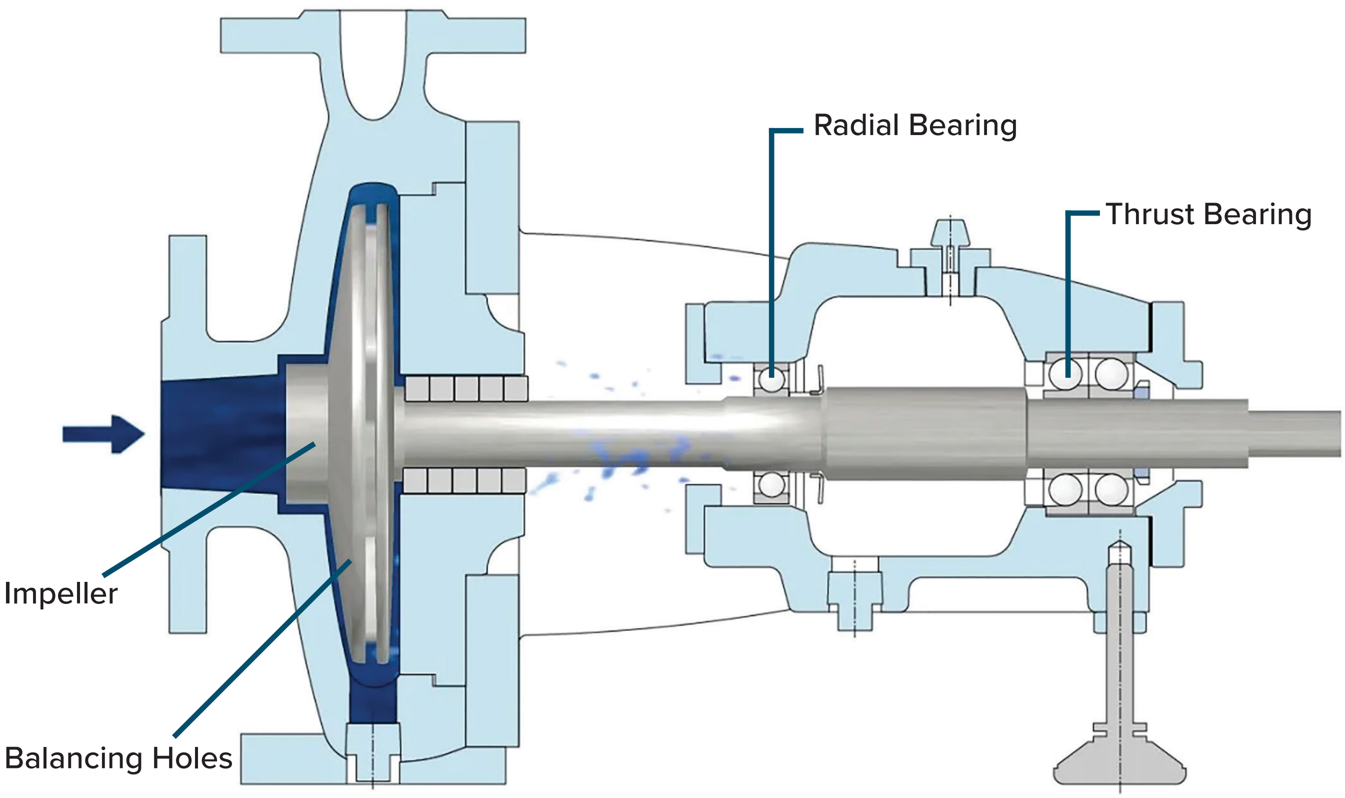
Pump Types

3. A vertical in-line circulation pump is a type of centrifugal pump with a vertically oriented shaft. Unlike end suction pumps that require a change of direction, these pumps have their suction and discharge connections in line with each other.

4. Turbine (Deep well type) - Deep-well turbine pumps are used to pump groundwater. They consist of a housing or bowl, impellers, and a shaft, all of which are installed in the well. Impeller types include closed and semi-open impellers.

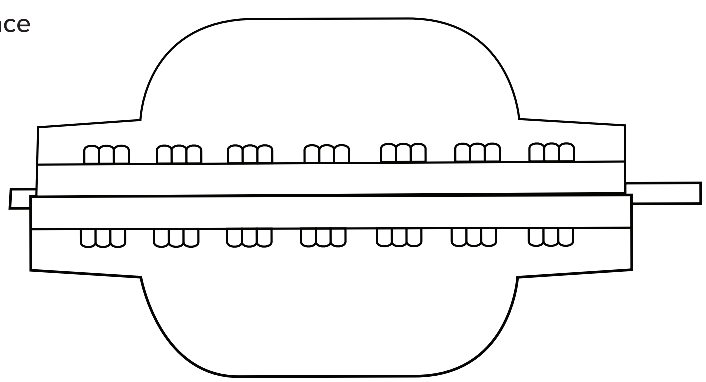
Pump Types

5. Back pull out, ANSI standard - Back pull-out design refers to a centrifugal pump, design type which meets refineries' requirements for rapid dismantling and re-assembly and is therefore often used for process pumps The advantage of this design is that the rotating assembly including bearings and shaft seals can be pulled out of the pump casing once the motor has been decoupled and the connection flange unscrewed. This means that internal components can be inspected and replaced without having to remove the casing from the piping



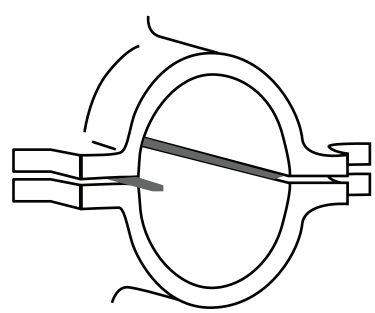
Split, Horizontal Pumps Have Special Problems

Stuffing box face
is not aligned



You must machine it smooth or the
stationary will cock and the gasket will leak

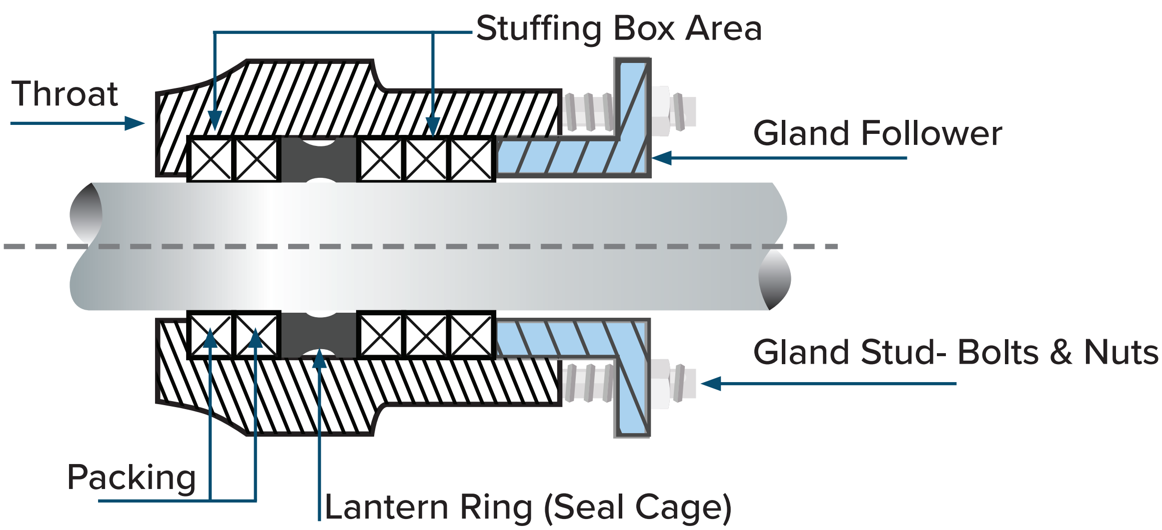
Gasket must be flush with the stuffing box
face - extend it through and trim it smooth



If the gasket does not extend flush with the
face the seal will leak through the gap.

Packing or Seals

Mechanical Packings



MECHANICAL PACKING MUST LEAK!

Leakage Rates

ONE DRIP PER SECOND	1 Minute loss	=	1/2 oz (2.9 centiliters)	1 Week loss	=	8 Gal (30.28 L)
	1 Hour loss	=	1/2 oz (17.74 centiliters)	1 Month loss	=	34 Gal (128.69 L)
	1 Day loss	=	1 Gal & 1 Pt. (4.26 L)			
TWO DRIP PER SECOND	1 Minute loss	=	1/3 oz (8.9 centiliters)	1 Week loss	=	26 Gal (58.41 L)
	1 Hour loss	=	20oz (59.14 centiliters)	1 Month loss	=	100 Gal (378.5 L)
	1 Day loss	=	3-2/3 Gal (13.88 L)			
DROPS BREAKING TO STREAM	1 Minute loss	=	2 oz (5.91 centiliters)	1 Week loss	=	175 Gal (662.38 L)
	1 Hour loss	=	1 Gal (3.79 L)	1 Month loss	=	700 Gal (2,649.5 L)
	1 Day loss	=	24 Gal (90.84 L)			
1/16” (1.6mm) STREAM	1 Minute loss	=	7-1/2 oz (22.17 centiliters)	1 Week loss	=	575 Gal (2,176.38 L)
	1 Hour loss	=	3-1/2 Gal (13.25 L)	1 Month loss	=	2,500 Gal (9,462.5 L)
	1 Day loss	=	64 Gal (317.91 L)			
1/8” (3.2mm) STREAM	1 Minute loss	=	23 oz (68.01 centiliters)	1 Week loss	=	1,800 Gal (6,813 L)
	1 Hour loss	=	11 Gal (41.64 L)	1 Month loss	=	7,800 Gal (29,523 L)
	1 Day loss	=	250 Gal (984.10 L)			
3/16” (4.8mm) STREAM	1 Minute loss	=	39 oz (1.15 L)	1 Week loss	=	3,000 Gal (11,355.5 L)
	1 Hour loss	=	18 Gal (68.13 L)	1 Month loss	=	12,750 Gal (48,258.75 L)
	1 Day loss	=	425 Gal (1,608.62 L)			
1/4” (6.2mm) STREAM	1 Minute loss	=	83 oz (2.45 L)	1 Week loss	=	6,500 Gal (24,602.5 L)
	1 Hour loss	=	39 Gal (147.62 L)	1 Month loss	=	27,750 Gal (105,033.75 L)
	1 Day loss	=	925 Gal (3,501.13 L)			

Packing vs Mechanical Seals

The argument for packing usually centers around 4 statements:

You don't have to take the pump apart to change packing.
A: Actually, the pump must be taken apart to change sleeves and bearings. Sleeve replacement is a normal part of repacking a pump. The size of the sleeve replacement and hard coating markets are evidence of how to be dismantled more than a seal pump. Frequently, removal of old baked-in packing requires pump dismantling.

In an emergency you can always add packing.
A: If additional reliability is needed, install a double or tandem seal.

Packing is cheaper.
A: Packing is cheaper if the packing alone is the only consideration.

Packing is less complicated.
A: Packing is less complicated only to an inexperienced person. Teaching an apprentice how to inspect a stuffing box and shaft, cut packing, install it so as to align the lantern ring, tamp it in place, and adjust it properly so as to keep leakage to a minimum and not generate excessive heat, can become very involved.

Knowledge of new technology can seem at first complicated. Once understood, it becomes a valued solution

Comparative power requirements between packing and mechanical seals

Packing:
Test establish an average power requirement of Kw per hour of operation.

Mechanical Seal
Precise calculations establish a power requirement of .33Kw per hour of operation.

$\frac{2Kw}{0.33}$ = **6:1 Power Requirement Ration**

Example is based on a typical ANSI pump with a 1-3/4" shaft size, shaft speed of 3,600RPM and a 50 PSIG stuffing box.

Power consumption association with the use of mechanical packings

It is accepted by the manufacturers of rotating equipment that in medium size electric motors approximately 10% of the horsepower is used to rotate the shaft against the frictional force created by the packing squeezed against the shaft. If we assume the following, an exact cost per year can be determined.

Calculations on using a 30HP motor, are as follows:
a) In theory 1 HP equals .746 Kw. However, in discussions with electrical power companies, taking into consideration the line losses in the motor itself, it can safely be said that in practice 1 HP = 1Kw

Packing vs **Mechanical Seals**

b) 30 HP equals 30 Kw, 10% for the packing friction equals 3 Kw. Every hour the packing friction would consume 3 Kw/hr. 1 Kw/hr costs on the average 8 cents. A year consists of 8,760 hours.

Annual cost in energy using packing in one stuffing box

3 Kw/hr x 8 cents x 8,760hrs = $2,102.40/year

A balanced mechanical seal requires only 1/6 the electrical consumption that packing requires.

Annual cost in energy to operate a seal

1/2 Kw/hr x 8 cents x 8,760hrs = $350.40/year

Therefore, the savings obtained by operating a mechanical seal would be $2,102.40 - $350.40 = $1,752/year. The savings would cover the cost of an excellent cartridge seal. All other advantages would be a bonus.

Comparative leakage rates between packing and mechanical seals

Packing:

Average 25 drops/minute | 1,500 drops/hour

36,000 drops/day

Mechanical Seal

Average 0.030 drops/minute | 1.88 drops/hour

45 drops/day

$$\frac{\textbf{25 drops/min x 60min/hr x 24hrs/day}}{\textbf{45}} = \textbf{800}$$

Extra costs of Mechanical Packings

- Fluid Loss
- Sleeve repair or replacement
- Bearing Replacement
- Maintenance
- Down Time
- Housekeeping
- Environmental
- Energy Consumption

Mechanical Seal - Material

A mechanically loaded device consisting of rotating and stationary members, having lapped faces operating in close proximity under hydraulic load, used to minimize leakage between rotating shaft and stationary housing.

Construction materials of a mechanical seal

Metal Parts

316SS, Alloy 20, Monel®, Hastelloy-B®, Hastelloy-C®, Titanium, Inconel®

Wearing Faces

Carbon Family (Carbon Graphite Resin Impregnated, Carbon Graphite Metal Filled), Glass Filled Teflon, Silicon Carbide, Tunsten Carbide

Secondary Sealing Parts

Elastomers (Buna N, FKM, EPDM, Neoprene, Aflas®, etc), Perfluoroelastomers - FFKM (Kalrez®, Chemraz®, Parofluor®), Teflon® (Virgin, Glass Filled, Carbon Filled), Garfoil®, Asbestos Substitute

Hard Faces

Ceramic (Aluminum Oxide, Chrome Oxide), Niresist (Cast Iron, Some Nickle), 17-4PH Stainless, Tungsten Carbide, Silicon Carbide.

Material Compound	Chemical PH Range	Min. Temp. Limit		Max. Temp. Limit	
		˚F	˚C	˚F	˚C
FKM (Fluoroelastomer)	1-10	0	-18	400	204
EPDM	3-12	-40	-40	300	149
EPDM - Geothermal in hot water or steam	3-12	-40	-40	400	204
BUNA N (Nitrile)	3-10	-40	-40	225	107
NEOPRENE	3-10	-40	-40	225	107
AFLAS®	1-14	32	0	400	204
CHEMRAZ(505)®	1-14	0	-18	400	204
CHEMRAZ(615)®	1-14	0	-18	600	315
KALREZ(1050LF)®	1-14	0	-18	500	260
KALREZ(4079)®	1-14	0	-18	600	315
PAROFLUOR(8545)®	1-14	0	-18	550	273
PTFE (Encapsulated Fluoroelastomer)	1-14	-40	-40	350	177
TEFLON®	1-14	-350	-210	500	260
GYLON®	1-14	-350	-210	500	260
GRAFOIL	1-14	-450	-268	800	427
NASB	1-14	-40	-40	700	357

Note: These limits are only guidelines and may vary with specific applications. Material limits are based on pure compounds and do not include the limitations of mounting or various grades of compounds available

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Mechanical Seal - Material

Tungsten Carbide

	Nickle Bound Tungsten Carbide	Cobalt Bound Tungsten Carbide
Composition	Tungsten carbide is used with 6% **nickle binder** matrix, which serves as the "glue" to hold the hard carbide particles together.	Tungsten carbide is used with 6% **cobalt binder** matrix, which serves as the "glue" to hold the hard carbide particles together.
Abrasion Resistance	Excellent	Excellent
Repairability	Excellent, 0.062" from original length	Excellent, 0.062" from original length
Fragility	Superior to Silicon Carbide & Ceramic	Superior to Silicon Carbide & Ceramic
Chemical Resistance	Good	Fair

Note: Others are available but, these two are the dominant ones used in mechanical seals.

Silicon Carbide

	Reaction Bonded Silicon Carbide	Cobalt Bound Tungsten Carbide
Composition	Solid fine grain homogeneous silicon carbide. **8-12% free silicon.** No free carbon. Impervious structure requiring no impregnant	Solid homogeneous silicon carbide. **No free silicon.** No free carbon. Impervious structure requiring no impregnant
Abrasion Resistance	Excellent	Excellent
Repairability	Excellent, 0.062" from original length	Excellent, 0.062" from original length
Fragility	Similar to Ceramic	Similar to Ceramic
Chemical Resistance	Good	Excellent

The following list represents major chemicals to avoid when using REACTION BONDED SiC.
Note: This is not a complete list
Sodium Hydroxide, Potassium Hydroxide, HF Acid, Caustic Potash (Aqueous), Caustic Soda (Aqueous)
Under certain conditions:
Nitric Acid, Green Sulfate Liquor, Calcium Hydroxide

Mechanical Seal - Material

Frequently used seal face materials and their PV limitations

Sliding Materials		PV Limit lbs/in² ft.min	Comments
Primary Ring	**Mating Ring**		
Carbon Graphite	Ni-Resist	100,000	Better thermal shock resistance than ceramic.
	Ceramic (99% AL_2O_3)	100,000	Poor thermal shock resistance. Better corrosion resistance than Ni-resist
	Tungsten (6% Ni)	500,000	Ni binder for better corrosion resistance.
	Siliconized Carbon	500,000	Good wear resistance. Thin layer of Siliconized Carbon makes relapping questionable.
	Silicon Carbide (solid)	500,000	Better corrosion resistance than tungsten carbide.
Carbon Graphite		50,000	Low PV
Ceramic		10,000	Good service on sealing certain acid applications.
Tungsten Carbide		120,000	PV is up to 185,000 with two grades that have different binders.
Silicon Carbide		500,000	Excellent abrasion resistance, good corrosion resistance, moderate thermal shock resistance.

PV= (Pressure)(Velocity)

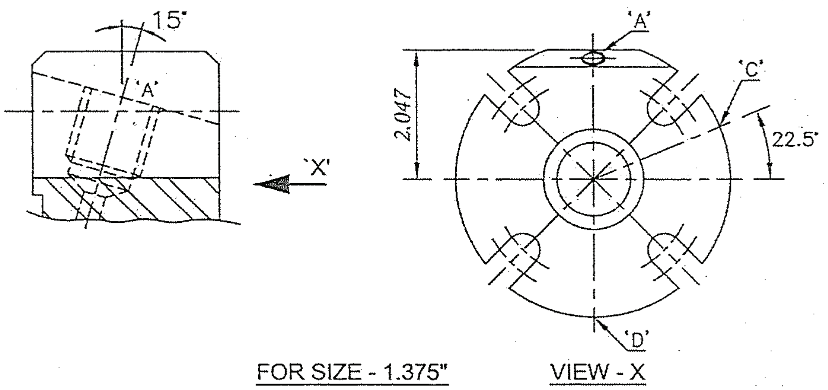
NOTE: Beyond PV limit, seals will experience severe wear.

Mechanical Seal - Material

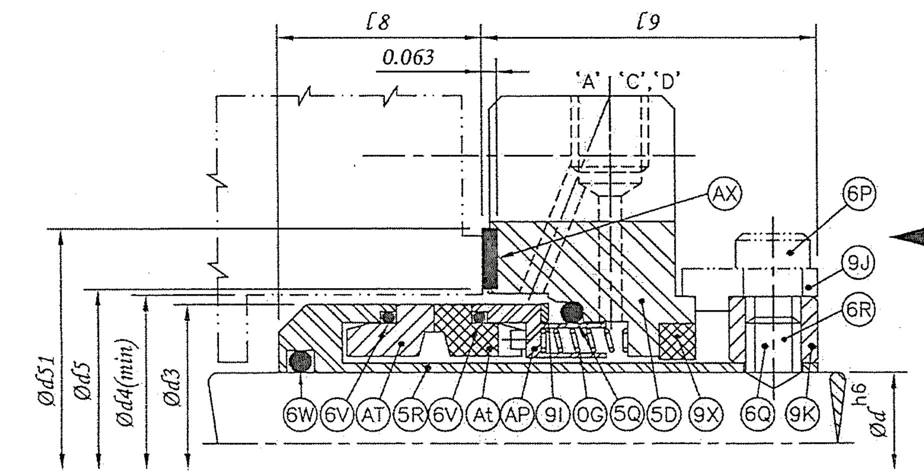
Temperature Limits of Seal Face Material

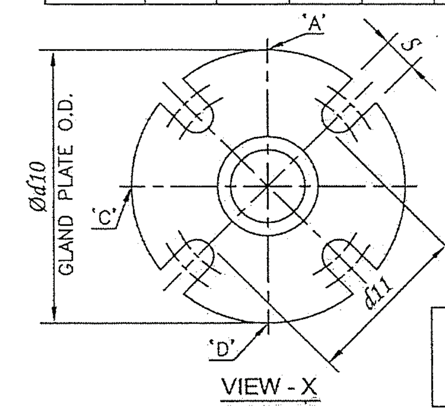
Material	Construction	Max. Temperature	
		˚F	˚C
Tungsten Carbide	Solid Tungsten Carbide Ring	750	400
Tungsten Carbide Pressed (SS)	Solid Tungsten Carbide Ring Mounted into 316SS Body	500	260
Tungsten Carbide Pressed (HC)	Solid Tungsten Carbide Ring Mounted into Alloy C-276 Body	500	260
Tungsten Carbide Pressed (17-4)	Solid Tungsten Carbide Ring Mounted into 17-4PH SS Body	700	370
Silicon Carbide	Solid Silicon Carbide Ring	800	427
Silicon Carbide Pressed (SS)	Silicon Carbide Ring Mounted into 316SS Body	200	93
Silicon Carbide Pressed (HC)	Silicon Carbide Ring Mounted into Alloy C-276 Body	250	120
Silicon Carbide Pressed (17-4)	Silicon Carbide Ring Mounted into 17-4PH SS Body	250	120
Silicon Carbide Pressed (A-42)	Silicon Carbide Ring Mounted into Alloy 42 Body	750	400
Silicon Carbide Pressed (A-42)	Silicon Carbide Ring Mounted into Alloy 42 Body	750	400
Ceramic	Solid Pure Ceramic Ring (Subject to fracture from thermal shock)	350	177
Bronze	Solid Leaded Bronze Ring	350	177
Glass Filled Teflon®	Solid Ring	160	70
Carbon #4	Carbon Graphite - Resin Filled Hardest Carbon for High Loads	500	260
Carbon #6	Carbon Graphite - Carbon Filled, No Resin Most Chemical Resistant for Acid Service	500	260
Carbon #9	Carbon Graphite - Resin Filled Standard Grade - Most Commonly Used	500	260
Carbon #10 & #12	Carbon Graphite - Antimony Filled Blister Resistant - Dry Running Capability (See Engineering)	700	370
Carbon #11	Carbon Graphite - Bronze Filled Blister Resistant - For Refinery Service	570	300

*NOTE: The following prints are for sizing mechanical seals based on shaft diameter



SEAL SIZE Ød	Ød3	Ød4	Ød5	Ød51	Ød10	Ød11	ℓ8	ℓ9	S
1.000	1.595	1.625	1.771	2.106	4.000	2.224	0.952	1.460	0.551
1.125	1.708	1.750	1.909	2.283	4.125	2.421	0.952	1.460	
1.250	1.865	2.000	2.037	2.362	4.250	2.500	0.952	1.460	
1.375	1.950	2.000	2.145	2.539	4.250	2.696	0.952	1.460	
1.500	2.172	2.250	2.368	2.736	5.000	2.815	0.952	1.460	
1.625	2.283	2.375	2.460	2.854	4.500	2.972	0.952	1.460	
1.750	2.401	2.500	2.578	2.992	5.000	3.062	0.952	1.460	
1.875	2.537	2.625	2.755	3.110	5.250	3.188	0.952	1.460	
2.000	2.670	2.750	2.834	3.267	5.500	3.307	0.952	1.460	
2.125	2.795	2.875	2.952	3.386	5.750	3.503	0.952	1.460	0.709
2.250	2.913	3.000	3.110	3.504	6.500	3.622	0.952	1.460	
2.375	3.037	3.125	3.228	3.700	6.500	3.818	0.952	1.460	
2.500	3.288	3.375	3.464	3.858	6.500	3.976	1.311	1.622	
2.625	3.410	3.500	3.543	3.937	7.000	4.055	1.311	1.622	
2.750	3.617	3.625	3.780	4.252	7.000	4.370	1.311	1.622	
2.875	3.685	3.750	3.905	4.377	7.500	4.614	1.311	1.772	





CONNECTION :- 'A' - FLUSH
'C' - VENT
'D' - DRAIN

FOLLOW THE INSTALLATION INSTRUCTIONS (OVERLEAF) WHILE INSTALLING THE SEAL

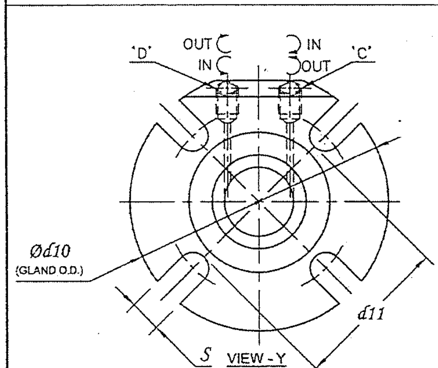
PT.NO.	DESCRIPTION	QTY.	MATERIAL	PT.NO.	DESCRIPTION	QTY.	MATERIAL
✓0G	SPRING		HAST—C	✓6V	'O' RING	2	
✓AT	ROTARY FACE—CS SHORT	1		✓6W	'O' RING	1	
✓At	ST. FACE—CS SHORT	1		AP	SEAL RING SHELL	1	SS316
5D	GLAND PLATE	1	SS316	5R	SLEEVE	1	SS316
✓AX	GASKET	1	PTFE	✓9I	SUPPORT RING	1	GFT
✓5Q	'O' RING	1		✓9J	LOCATING TABS	4	PLASTIC
✓6P	ALLEN CAP SCREW	4	SS304	9K	DRIVE COLLAR	1	SS304
✓6Q	GRUB SCREW	4	SS316	9X	BUSH	1	BRONZE
✓6R	DOG POINT GRUB SCREW	4	SS316				

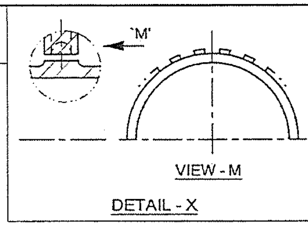
NOTE : 1) CONNECT 'A' TO PUMP DISCHARGE FOR PRODUCT FLUSHING.
2) QUENCH THRO' 'C' & 'D' LOW PRESS. STEAM/WATER AT 10 PSIG
3) PARTS MARKED ✓ THUS ARE RECOMMENDED SPARES.
4) PARTS MARKED * THUS ARE CUSTOMER'S SUPPLY.

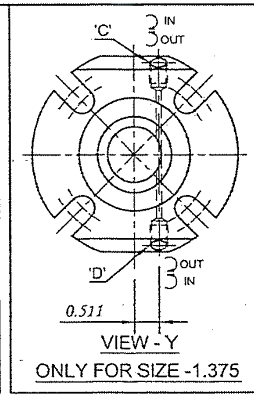
ALL DIMENSIONS IN INCH	SEAL TYPE - SAF-02	SIZE - 1"-2.875"
DOCUMENT NO.		
SAF DWG#900508-6006991		

*NOTE: The following prints are for sizing mechanical seals based on shaft diameter

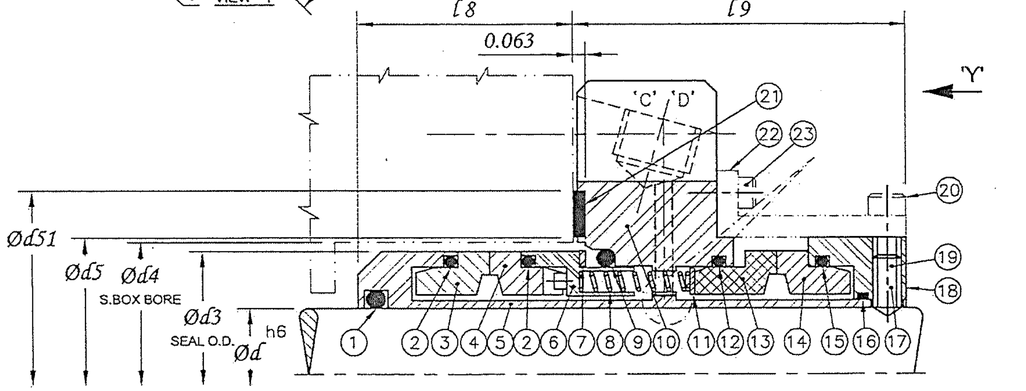
FOLLOW THE INSTALLATION INSTRUCTIONS (OVERLEAF) WHILE INSTALLING THE SEAL







CONN.	SIZE	ROTATION	
		CW	CCW
'C'	3/8" NPT	IN	OUT
'D'	3/8" NPT	OUT	IN



SEAL SIZE Ød	Ød3	Ød4	Ød5	Ød51	Ød10	Ød11	ℓ8	ℓ9	S
1.000	1.594	1.625	1.771	2.106	4.000	2.224	1.129	2.047	0.551
1.125	1.708	1.750	1.909	2.283	4.125	2.421	1.129	2.047	
1.250	1.865	2.000	2.037	2.362	4.250	2.500	1.129	2.047	
1.375	1.950	2.000	2.145	2.145	4.250	2.696	1.129	2.047	
1.500	2.172	2.250	2.368	2.736	5.000	2.815	1.129	2.047	
1.625	2.283	2.375	2.460	2.854	4.500	2.972	1.129	2.047	
1.750	2.401	2.500	2.578	2.992	5.000	3.062	1.129	2.047	
1.875	2.537	2.625	2.755	3.110	5.250	3.188	1.129	2.047	
2.000	2.670	2.750	2.834	3.267	5.500	3.307	1.129	2.188	
2.125	2.795	2.875	2.952	3.385	5.750	3.503	1.129	2.188	0.709
2.250	2.913	3.000	3.110	3.503	6.500	3.622	1.129	2.188	
2.375	3.037	3.125	3.228	3.700	6.500	3.818	1.129	2.188	
2.500	3.288	3.375	3.464	3.858	7.000	3.976	1.488	2.720	
2.625	3.410	3.500	3.543	3.937	7.000	4.055	1.488	2.720	
2.750	3.617	3.625	3.779	4.251	7.000	4.370	1.488	2.720	
3.000	3.795	4.000	4.173	4.960	7.480	5.079	1.488	2.720	
3.125	3.929	4.133	4.291	5.078	7.677	5.196	1.488	2.720	
3.250	4.044	4.251	4.409	5.196	7.677	5.314	1.488	2.720	
3.375	4.196	4.370	4.527	5.314	7.795	5.472	1.531	2.720	0.865
3.500	4.350	4.500	4.665	5.452	7.795	5.590	1.531	2.720	
3.625	4.437	4.625	4.783	5.570	8.070	5.708	1.531	2.720	
3.750	4.545	4.744	4.921	5.708	8.188	5.826	1.531	2.720	
3.875	4.685	4.881	5.039	5.826	8.188	5.944	1.531	2.720	
4.000	4.822	5.000	5.157	5.944	8.582	6.062	1.531	2.720	

SEAL FLUSHING

MODE	PRODUCT TEMP.(T)	API PLAN	FLUSHING PRESS.	FLOW
BACK TO BACK	T < 248°F / 120°C	53	S.BOX PRESS. + 1.5 BAR BUT NOT GREATER THAN 11.5 BAR	CONVECTION
	248°F / 120°C < T < 392°F / 200°C	54		6 - 8 LPM
TANDEM	T < 248°F / 120°C	52	UNPRESSURISED	CONVECTION
	248°F / 120°C < T < 392°F / 200°C	54	S. BOX PRESS. x 0.5	6 - 8 LPM

NOTES :-

1) REMOVE SETTING CLAMP (P.NO.22) AFTER FINAL ASSLY. & BEFORE START UP.
2) FLUSH THE SEAL CAVITY CONTINUOUSLY WITH COMPATIBLE BARRIER FLUID.
3) S. BOX PRESSURE NOT TO EXCEED 145 psi / 10 bar
4) PARTS MARKED ✓ THUS ARE RECOMMENDED SPARES.
5) PARTS MARKED * THUS ARE CUSTOMER'S SUPPLY.

PT.NO.	DESCRIPTION	QTY.	MATERIAL
✓ 1	'O' RING	1	
✓ 2	'O' RING	2	
✓ 3	ROTARY FACE-CS SHORT	1	SiC
✓ 4	ST. FACE-CS SHORT	1	SiC
5	SLEEVE	1	SS316
6	SEAL RING SHELL	1	SS316
✓ 7	SUPPORT RING	1	GFT
✓ 8	SPRING	–	HAST-C
✓ 9	'O' RING	1	
10	GLAND PLATE	1	SS316
✓ 11	THRUST WASHER-SP	1	SS316
✓ 12	'O' RING	1	
✓ 13	ST. FACE-SP	1	CARBON-RI
✓ 14	ROTARY FACE-CS SHORT	1	SiC
✓ 15	'O' RING	1	
✓ 16	'O' RING	1	
✓ 17	GRUB SCREW	4	SS316
18	SEAT HOLDER	1	SS316
✓ 19	DOG POINT GRUB SCREW	4	SS316
20	ALLEN CAP SCREW	4	SS304
✓ 21	GASKET	1	PTFE
22	SETTING CLAMP	4	PLASTIC
23	ALLEN CAP SCREW	4	SS304

ALL DIMENSIONS IN INCH	SEAL TYPE - SAF-03	SIZE - 1"- 4.000"
DOCUMENT NO.		
SAF DWG#600724 SAF-03		

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sales@cppdist.com

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9804 - 54 Avenue NW Edmonton, AB. T6E 0A9 CANADA	______________________ ______________________ **Contact:** **Phone:** **Fax:** **Email:**

Seal Application Information:

Pump Model: ______________________

RPM: ______________________

Fluid Pumped: ______________________

pH: ______________________

Fluid Temperature: ______________________

Stuffing Box Pressure/Vacuum: ______________________

Shaft Condition: ______________________

Check one of the following:

- ☐ **Failure analysis**
- ☐ **Quote new seal & repair**
- ☐ **Quote for rebuild only**
- ☐ **Return old parts**
- ☐ **Quote & rebuild**
- ☐ **Quote repair kit**

Notes:

Internal Information:

Quote #: ______________________

Date received: ______________________

Serial #: ______________________

Date returned: ______________________

Mechanical Seal - Trouble Shooting

Common Causes for Seal Failures

1. Cavitation

2. Heat

3. Poor Equipment Conditions

4. Mishandling of Seal Components

5. Incorrect Seal Assembly

6. Improper Seal Selection

7. Improper start-up or Operating Procedures

8. Fluid Contamination

Trouble Shooting

A careful examination of the parts can often indicate the source of the seal failure. This is a very complex subject and will only be lightly covered.

COLLECT THE ENTIRE SEAL

EXAMINE THE ENTIRE SEAL FACE

LOOK AT THE WEAR TRACK

CHECK DRIVE PINS

CHECK THE HARDWARE

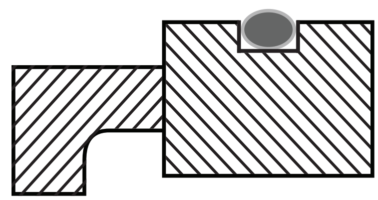
CHECK THE ELASTOMERS

CHECK FOR RUBBING

Construction of Seals

Primary Sealing Face

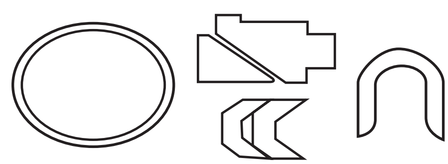
Face Combination



Carbon, Stellite, Ni-Resist, Ceramic, Tungsten Carbide Silicon Carbide, etc.

Secondary Sealing Face

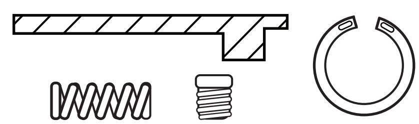
Elastomer



Square Packing, Molded Rubber Boot, Chevrons, U-Cups, Teflon Wedges, Delta Rings, O'Rings

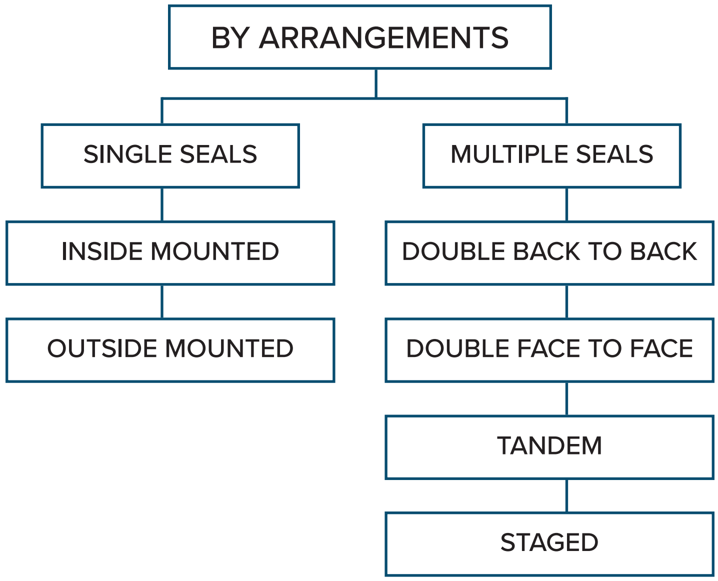
Metal Components

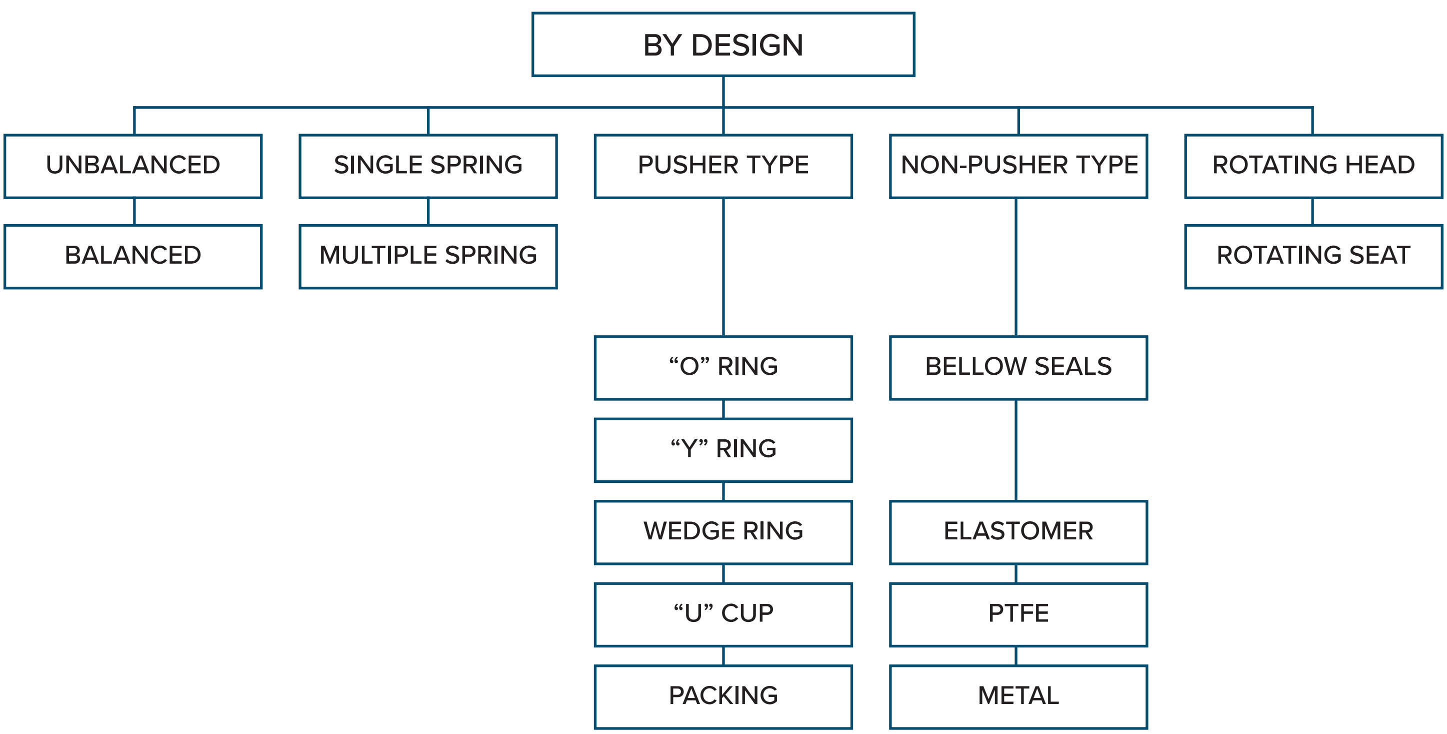
Metal Parts



Casing, set screws, springs, drive lugs, retainers, snap rings, etc.

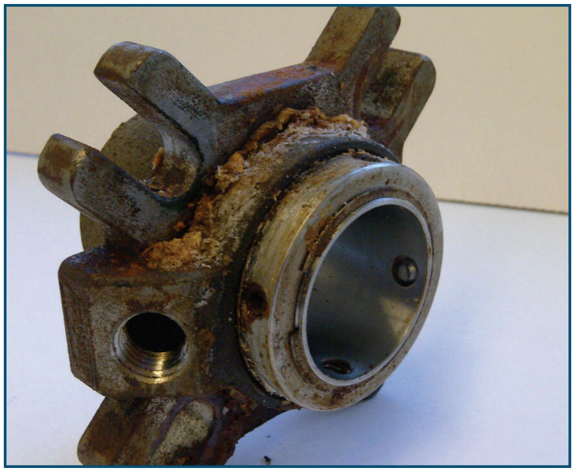
Mechanical Seal - Classifications

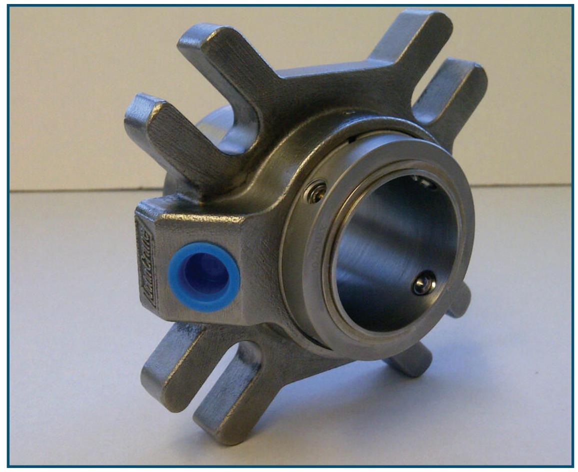


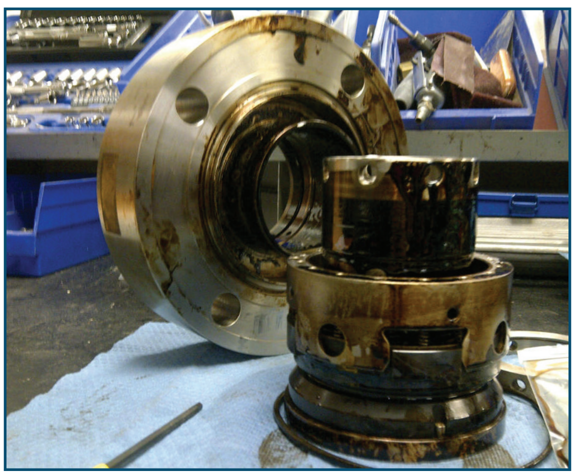


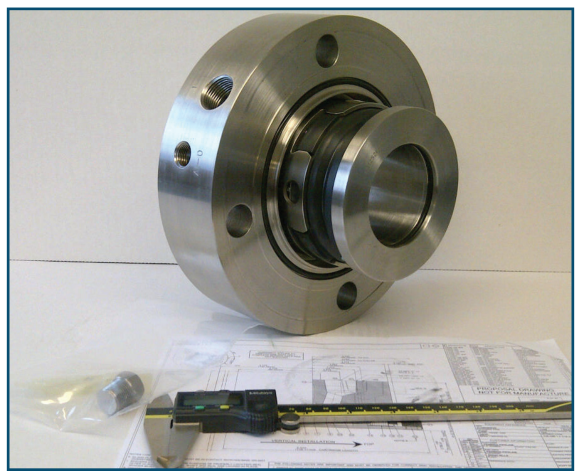
Mechanical Seal - Before vs After

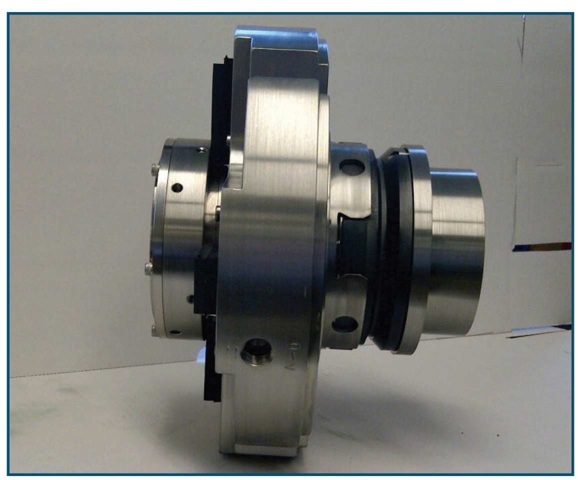
Before | **After**











NOTES

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