



วัสดุโครงสร้างเครื่องสูบน้ำ และการเลือกใช้ ให้เหมาะสม



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PUMP SELECTION

ข้อพิจารณาเบื้องต้นในการเลือกเครื่องสูบน้ำ
ให้เหมาะสม:

- 1) LIQUID TO BE PUMPED.
- 2) FLOW RATE REQUIRED.
- 3) TOTAL DYNAMIC HEAD.
- 4) NET POSITIVE SUCTION HEAD AVAILABLE.
- 5) OPERATING TEMPERATURE.
- 6) OPERATING PRESSURE.
- 7) SPECIFIC GRAVITY.
- 8) NATURE OF LIQUID.
- 9) OPERATIONAL EXPERIENCE.



DIFFERENT TYPES OF LIQUIDS HANDLED BY PUMPS

HYDROCARBONS
PETROLEUM BASE PRODUCTS

CHEMICALS
ACIDS, ALKALINES OR OXIDIZING AGENTS
THAT ARE DESTRUCTIVE TO BOTH EQUIPMENT
AND ENVIRONMENT

SLURRIES
MIXTURE OF SOLID PARTICLES IN LIQUID

WATER



MATERIALS FOR PUMPING VARIOUS LIQUIDS

This list has been compiled for the convenience of pump users and represents the best known practice for handling various liquids. Viscosity in Seconds Saybolt Universal (S. S. U.) except as noted.

Liquid	Condition	Chem. Symb.	Sp. Gr.	Visc.	Material Recommended
Acid, Acetic	Conc.	CH ₃ COOH	1.050	22 @ 68° F.	Lead, Alum. Brs., Monel, Cr. Ni, Stainless St.
Acid, Acetic	Dil.	AS ₂ O ₅			Lead, Monel, Cr. Ni, Stainless St.
Acid, Arsenic		AS ₂ O ₅			All Iron, Cr. Ni, Stainless St.
Acid, Boric		B ₂ O ₃			Alum., Brs., Monel, Cr. Ni, Stainless St.
Acid, Carbonic (Phosph.)	Conc.	CaH ₂ O ₃	1.071	36 @ 68° F.	All Iron
Acid, Carbonic		CO ₂ + H ₂ O			All Bronze
Acid, Citric		CaH ₂ O ₃ + H ₂ O	1.34		Plain Steel, Cr. Ni, Stainless St.
Acid, Cyanic		CNOH			All Iron
Acid, Fatty					Aluminum Bronze, Monel
Acid, Fruit					Monel, Cr. Ni, Stainless St.
Acid, Hydrochloric	Conc.	HCl	1.16 (20 Ba)	31.5 (EST)	Enamel, High Silicon Iron, Hastelloy
Acid, Hydrocyanic		HCN	.70		All Iron
Acid, Hydrofluosulfuric		H ₂ SO ₄			Alum., Brs., Monel
Acid, Mine Water					High Lead Brs., Cr. Ni, Stainless St.
Acid, Muriatic					See Acid Hydrochloric
Acid, Nitric	Conc. Dil.	HNO ₃	1.41	31 @ 68° F.	Lead, Cr. Ni, Stainless St.
Acid, Nitric	To 30%				All Iron, Cr. Ni, Stainless St.
Acid, Oxalic	Conc. Crude 90%	CO ₂ HO ₂ H ₂ HO ₂	1.36-1.4		High Si. Iron, Cr. Ni, Stainless St.
Acid, Phosphoric		H ₃ PO ₄			Cr. Ni, Stainless Steel
Acid, Picric					High Si. Iron, Cr. Ni, Stainless St.
Acid, Pyrogalllic					Cr. Ni, Stainless St.
Acid, Pyromegmatic					All Brs., Cr. Ni, Stainless St.
Acid, Sulphuric	Conc. Hot 60° Be Dil.	H ₂ SO ₄	1.835	66 @ 68° F.	All Iron, High Silicon Iron
Acid, Sulphuric			1.07		High Silicon Iron
Acid, Sulphuric	Fuming Conc.	H ₂ SO ₄ + SO ₃			Silicon Brs., Alum. Brs., Lead, Monel
Acid, Sulphurous		H ₂ SO ₃			Plain Fitted, Steel
Acid, Tartaric		H ₂ C ₄ O ₆			Enamel, Lead, Aluminum Brs.
Alcohol (Grain)		C ₂ H ₅ OH	.7929	33 @ 68° F.	All Brs., Monel, Cr. Ni, Stainless St.
Alcohol (Wine)		CH ₃ OH	.7965	31 @ 68° F.	All Bronze
Alkaline Liquid	Conc. & Dil. H ₂ O & Acid.				Enamel, All Iron
Aluminum Sulphate		N ₂ SO ₄			Plain Fitted, High Silicon Iron
Ammonia	Aq. Sol.	NH ₃	.623 @ 52° F.	29 @ 32° F.	All Iron
Ammonium Bicarbonate	Aq. Sol.	NH ₄ HCO ₃			All Iron
Ammonium Chloride	Aq. Sol.	NH ₄ Cl			All Iron, Cr. Ni, Stainless Steel Alloy
Ammonium Nitrate	Aq. Sol.	NH ₄ NO ₃			All Iron, Cr. Ni, Stainless Steel Alloy
Antimony Sulphate	Aq. Sol.	(NH ₄) ₂ SO ₄			All Iron, Cr. Ni, Stainless Steel Alloy
Antine Water					All Iron
Asphaltum	Hot		.96-1.4		All Iron
Barium Chloride		BaCl ₂			All Iron, Cr. Ni, Stainless Steel Alloy
Barium Nitrate		Ba(NO ₃) ₂	1.81	33 @ 68° F.	All Iron, Cr. Ni, Stainless Steel Alloy
Beer					All Bronze, Cr. Ni, Stainless Steel Alloy
Beer Wort					All Bronze, Cr. Ni, Stainless Steel Alloy
Beet Juice (Thin)					All Bronze, Cr. Ni, Stainless Steel Alloy
Benzene (Coal Tar Product)		C ₆ H ₆	.88	31 @ 68° F.	All Iron
Benzine (Oil Dist. Product)			66-66		Brs. Fitted
Bichloride of Mercury	Dil.	HgCl ₂			All Iron, Cr. Ni, Stainless St.
Bitterwater					All Bronze
Black Solutions					Bronze Fitted
Braze Calcium Chloride	Pure	CaCl ₂	Up to 1.3	37-42 @ 60° F.	All Iron
Brine, Calcium & Sodium Chloride					All Bronze
Brine Gun Cotton	3% Salt	NaCl	1.02	32-35 @ 60° F.	All Bronze
Brine Sodium Chloride	Over 3% Salt	NaCl	1.02-1.20	32-33 @ 60° F.	All Brs., Monel, Cr. Ni, Stainless St.

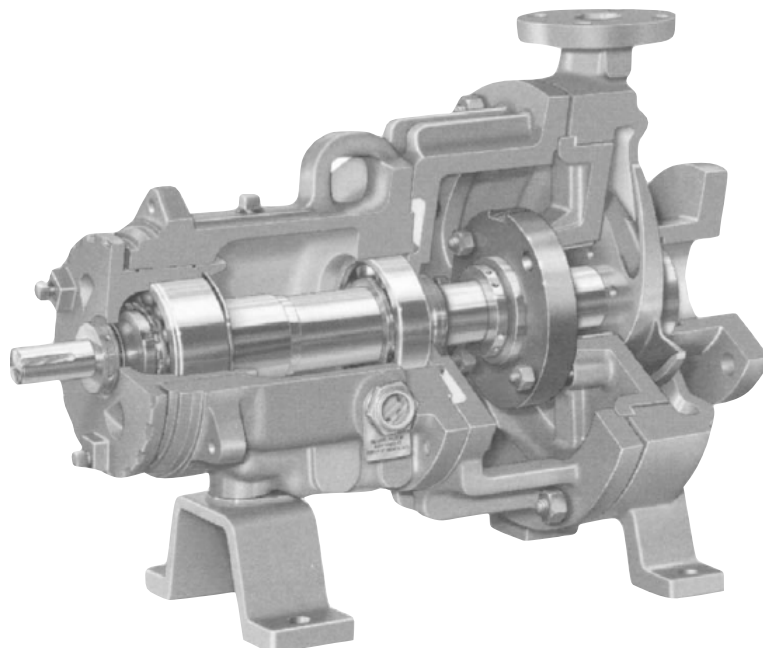
MATERIAL OF CONSTRUCTION

ITEM	CAST IRON BRONZE FITTED		ALL IRON		DUCTILE IRON BRONZE FITTED		ALL BRONZE	
	MATERIAL	SPEC. NO.	MATERIAL	SPEC. NO.	MATERIAL	SPEC. NO.	MATERIAL	SPEC. NO.
Casing	Cast Iron	A48	Cast Iron	A48	Ductile Iron	A536	Bronze	B145
Case Wear Rings	Bronze	SAE 660	Cast Iron	A48	Bronze	SAE 660	Bronze	SAE 660
Bearing Housing	Cast Iron	A48	Cast Iron	A48	Ductile Iron	A536	Bronze	B145
Casing Bolts	Steel	Grade 5 Com. Std.	Steel	Grade 5 Com. Std.	Steel	ASTM Grade 8	St. Steel	AISI-300
Brg. Housing "O" Ring	Synthetic	Buna-N	Synthetic	Buna-N	Synthetic	Buna-N	Synthetic	Buna-N
Case Gasket	Vegetable Fiber	HYD-401	Vegetable Fiber	HYD-401	Vegetable Fiber	HYD-401	Vegetable Fiber	HYD-401
Brg. Housing Bolts	Steel	Grade 5 Com. Std.	Steel	Grade 5 Com. Std.	Steel	ASTM Grade 8	St. Steel	AISI-300
Bearing Cap	Cast Iron	A48	Cast Iron	A48	Cast Iron	A48	Cast Iron	A48
Bearing Cap Bolts	Steel	Grade 5 Com. Std.	Steel	Grade 5 Com. Std.	Steel	Grade 5 Com. Std.	St. Steel	AISI-300
Bearing Cap Gasket	Vegetable Fiber	HYD-401	Vegetable Fiber	HYD-401	Vegetable Fiber	HYD-401	Vegetable Fiber	HYD-401
Impeller	Bronze	B145	Cast Iron	A48	Bronze	B145	Bronze	B145
Impeller Wear Rings	Bronze	SAE 660	Cast Iron	A48	Bronze	SAE 660	Bronze	SAE 660
Impeller Key	Steel	C1018	Steel	C1018	Steel	C1018	St. Steel	AISI-300
Shaft	Steel	High Tensile	Steel	High Tensile	Steel	High Tensile	St. Steel	AISI-300
Shaft Sleeve	Bronze	SAE 660	St. Steel	AISI-300	Bronze	SAE 660	Bronze	SAE 660
Packing Gland	Ductile Iron	A536	Ductile Iron	A536	Ductile Iron	A536	Bronze	B145
Gland Studs	Brass	SAE 40	Brass	SAE 40	Brass	SAE 40	St. Steel	AISI-300
Recirculation Lines	Copper Tubing	Com. Std.	St. Steel Tubing	AISI-300	Copper Tubing	Com. Std.	Copper Tubing	Com. Std.
Recirculation Fittings	Brass NPT	Com. Std.	Steel NPT	Com. Std.	Brass NPT	Com. Std.	Brass NPT	Com. Std.
Lantern Ring (optional)	TFE	TFE	TFE	TFE	TFE	TFE	TFE	TFE
Shaft O-Rings	Synthetic	Buna-N	Synthetic	Buna-N	Synthetic	Buna-N	Synthetic	Buna-N
Mechanical Seal	Refer to mechanical Seal Selection Guide (section B1g.1 page 5) for appropriate seal construction.							

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ANSI PROCESS PUMPS

AMERICAN NATIONAL STANDARDS INSTITUTE

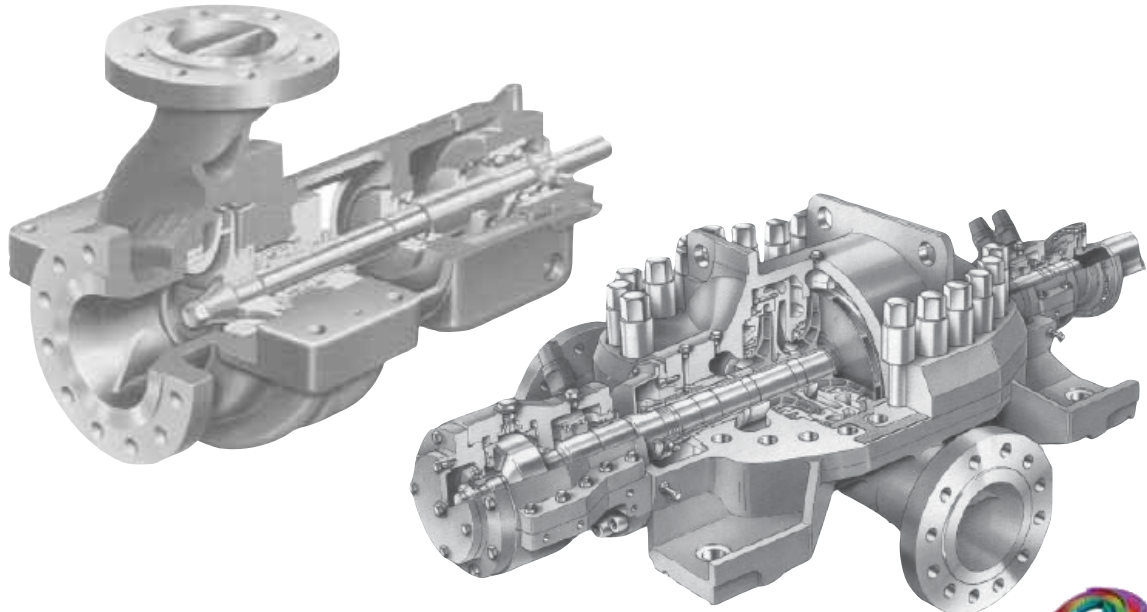


ANSI PUMP RATING = 300 PSIG AT 150 C



API PROCESS PUMPS

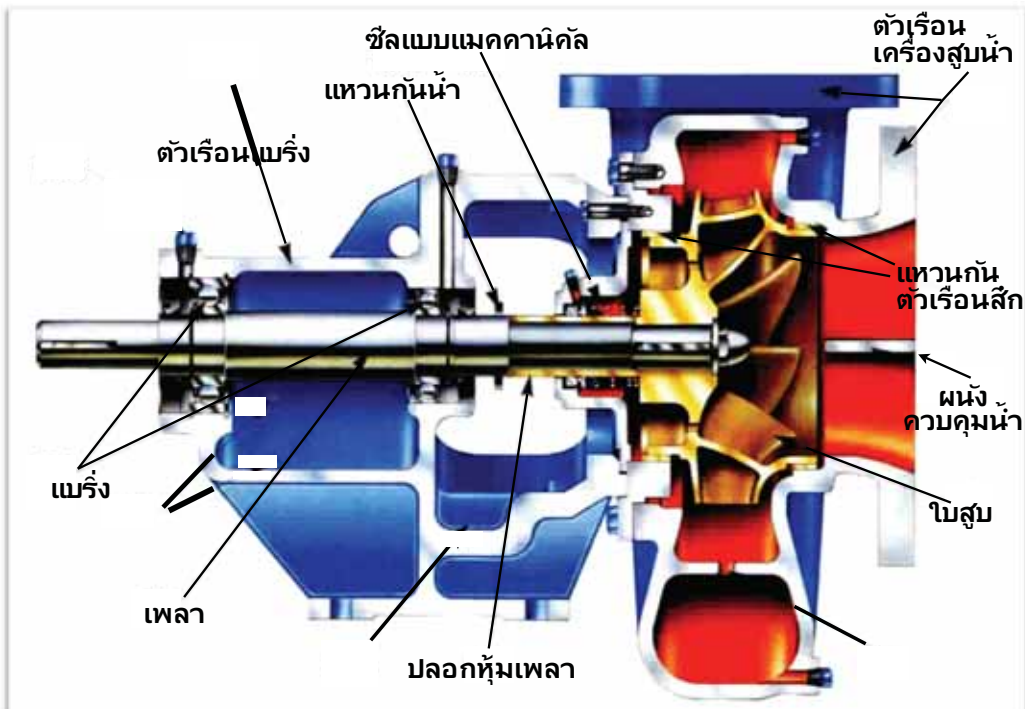
AMERICAN PETROLEUM INSTITUTE



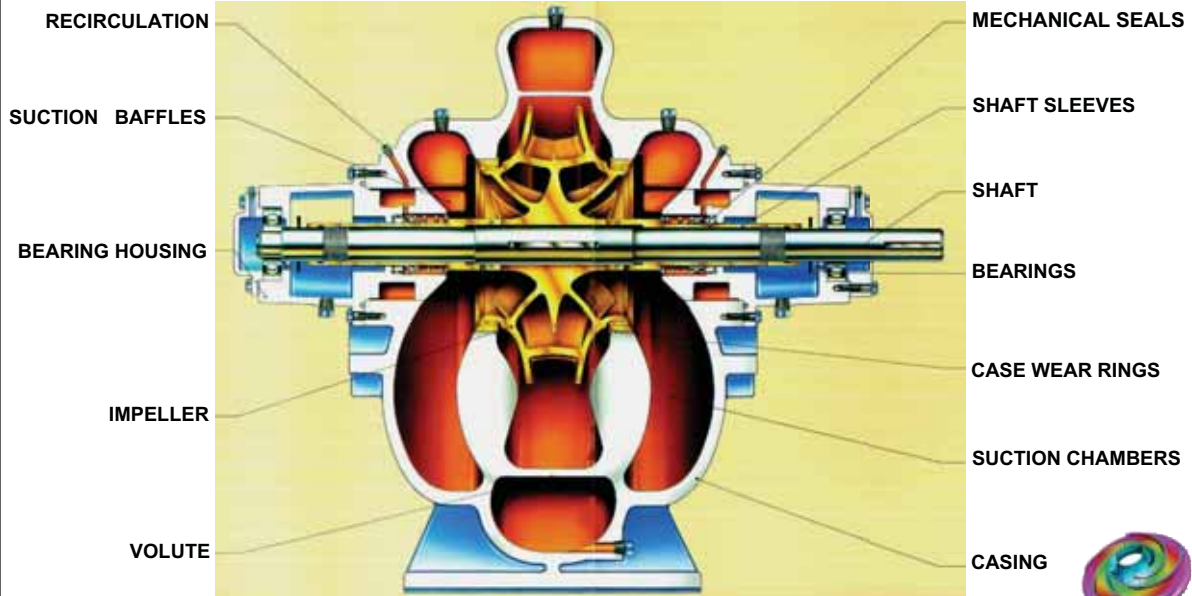
API PUMP RATING = 750 PSIG AT 260 C

โครงสร้างของเครื่องสูบน้ำแบบ

END SUCTION CENTRIFUGAL PUMP



โครงสร้างของเครื่องสูบน้ำแบบ DOUBLE SUCTION HORIZONTAL SPLIT CASE CENTRIFUGAL PUMP



ความดันใช้งานเครื่องสูบน้ำ WORKING PRESSURE LIMITATION

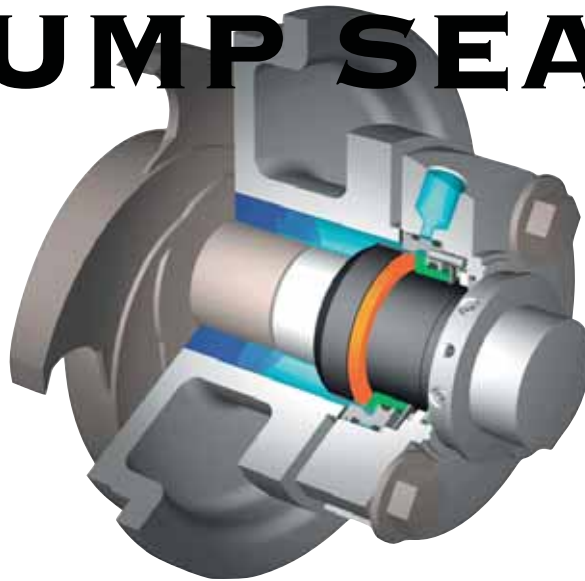
$$\text{WORKING PRESSURE} = \text{STATIC PRESSURE} + \text{TDH}$$

KP:⁽¹⁾ CASE WORKING PRESSURE LIMITATIONS
 AT 150° F: FLAT-FACE FLANGES.

CASING MATERIAL	125/150 LB FLANGE DRILLING		250/300 LB FLANGE DRILLING	
	CWP ⁽²⁾	HYDRO ⁽²⁾	CWP ⁽²⁾	HYDRO ⁽²⁾
Cast Iron (ASTM A48)	175 psi	265 psi	250 psi	375 psi
Ductile Iron (ASTM A536)	175 psi	265 psi	400 psi	600 psi
All Bronze (ASTM B145)	175 psi	265 psi	250 psi	375 psi



PUMP SEALS



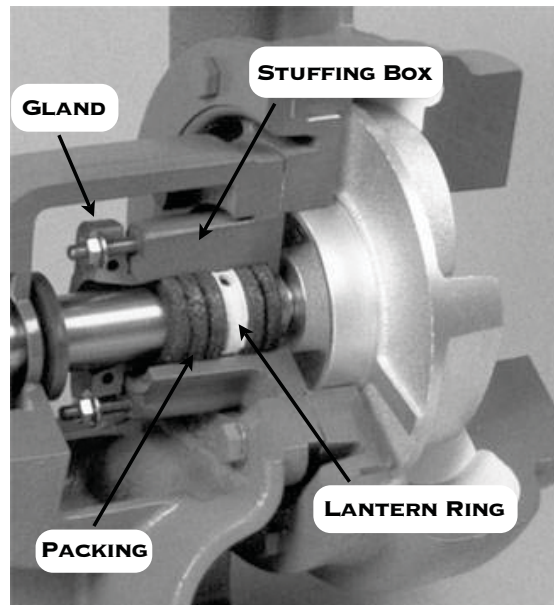
PACKING

ข้อดี:

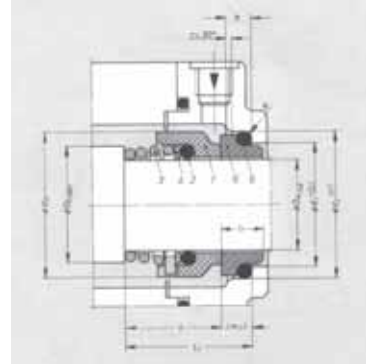
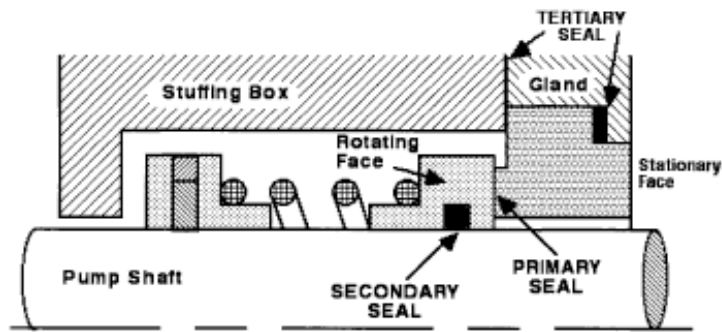
- ราคาถูก
- สามารถปรับแต่ง หรือ เปลี่ยนได้โดยไม่ต้องถอดประกอบ

ข้อเสีย:

- ลดทอนประสิทธิภาพของเครื่องสูบน้ำ
- มีน้ำหยดตลอดเวลา
- ต้องมีการปรับแต่งอย่างสม่ำเสมอ
- มีการสึกหรอที่ปลอกหุ้มเพลาส่ง



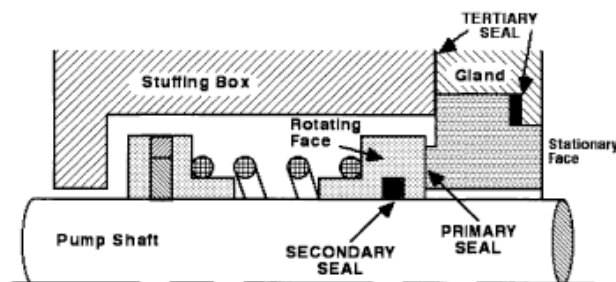
MECHANICAL SEALS



MECHANICAL SEALS ทำงานป้องกันน้ำรั่วโดยมีหน้าสัมผัสสองส่วนที่มีผิวเรียบมาก (LAPPED FACES) หมุนเสียดสีกัน โดยหน้าสัมผัสส่วนที่หมุนจะรัดตรึงกับเพลลา และส่วนที่อยู่กับที่จะนั่งอยู่ภายใน GLAND เนื่องจากมีส่วนที่หมุนเคลื่อนที่ จึงเรียกชื่อประเภทนี้ว่า **DYNAMIC SEAL**



MECHANICAL SEALS



ชื่อประเภทนี้จะมีโอกาสที่น้ำรั่วซึมได้ 4 ตำแหน่ง คือ

- 1) ระหว่างหน้าสัมผัสของส่วนที่เคลื่อนที่กับส่วนที่อยู่กับที่ (PRIMARY SEAL)
- 2) ระหว่างส่วนที่เคลื่อนที่กับเพลลา (SECONDARY SEAL)
- 3) ระหว่างส่วนที่อยู่กับที่กับ GLAND
- 4) ระหว่าง GLAND กับ STUFFING BOX



MECHANICAL SEALS

ปัจจัยที่ใช้ในการพิจารณาเลือกใช้ซีลให้เหมาะสม คือ

- **PRESSURE**
- **TEMPERATURE**
- **ROTATIONAL SPEED**
- **CORROSIVENESS**
- **ABRASIVENESS**
- **VISCOSITY**
- **TOXICITY**
- **OPERATIONAL FREQUENCY**



SEAL MATERIAL OF CONSTRUCTION



MATING RING	: CERAMIC
PRIMARY SEALING RING	: CARBON
ELASTOMER BELLOWS	: BUNA-N
SPRING	: ST STEEL
COLLAR, RETAINER	: ST STEEL



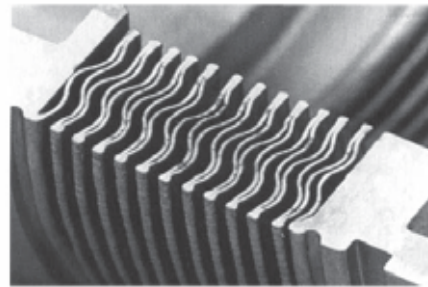
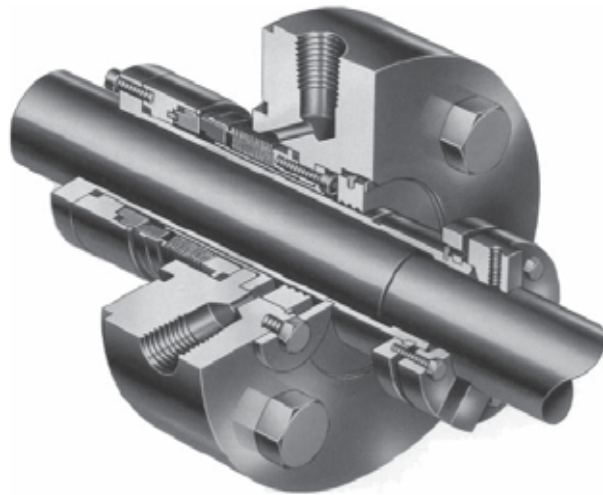
SEAL MATERIAL OF CONSTRUCTION

Materials of Construction

- Bellows: Alloy 718
- Rotating Face: Silicon Carbide
- Stationary Face: Carbon or Silicon Carbide
- Gasketing: Graphite
- Metal Parts: Rotating Assembly: 316 SS
Stationary Assembly: Alloy 718, Low Expansion Alloy, 316 SS

Operating Parameters

- Maximum Pressure: Up to 300 psi (2070 kPa)
- Seal Chamber Temperature: -100°F to 800°F (-73°C to 427°C)
- Surface Speed: Up to 150 ft./sec. (46 m/sec.)
- Liquids: Hydrocarbons, Heat Transfer Fluids, Cryogenics
Shaft Sizes: From 1 inch (25.4mm) to 5-1/8 inches (101.6mm)



Modern bellows seal
and close-up (Source: Ref. 8-6)

VARIOUS SIZES OF SEALS

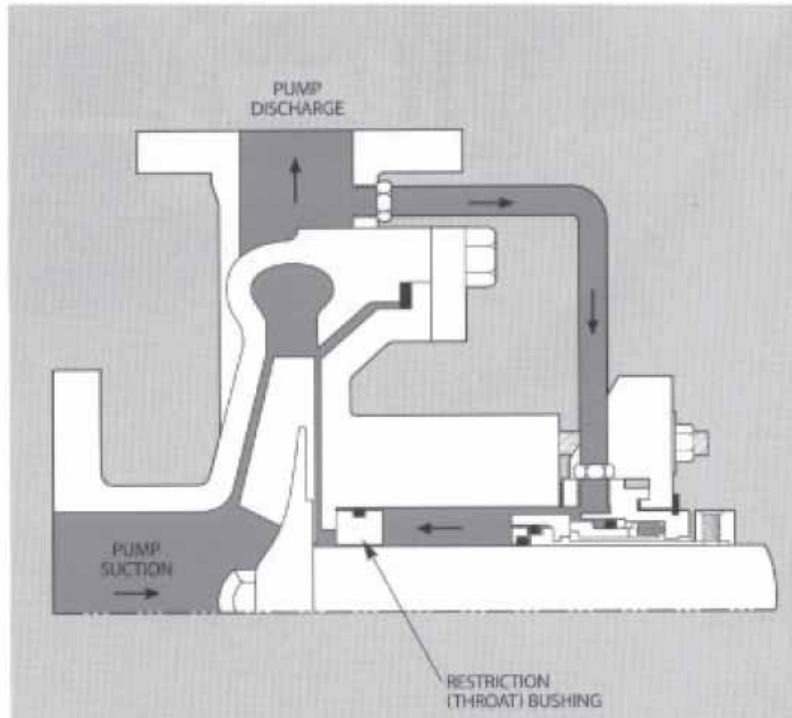


API PLANS FOR VARIOUS CIRCULATION SYSTEMS

PLAN 11

Discharge Recirculation

- Use with a single seal
- Cools seal
- Increases pressure in seal chamber
- Clean fluids only—solids can erode seal
- An orifice can be used to reduce flow



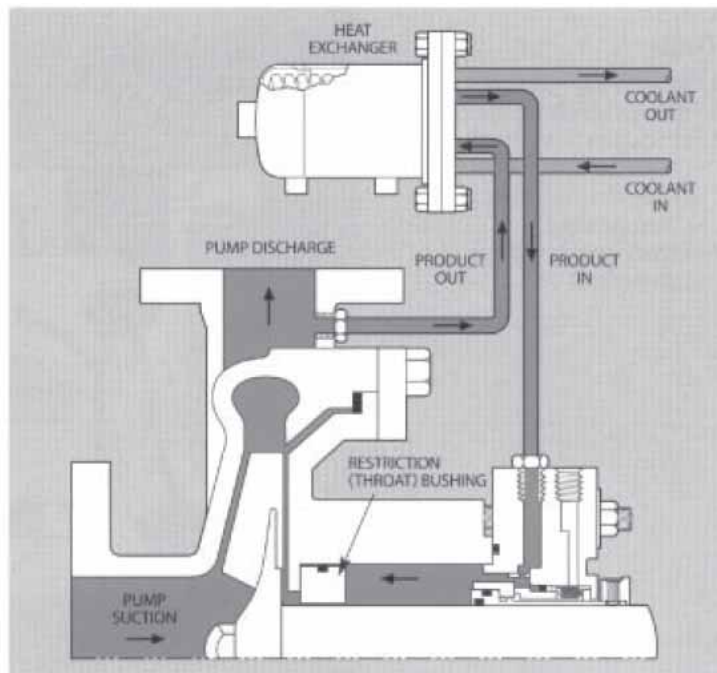
Plan 11—
Discharge recirculation

API PLANS FOR VARIOUS CIRCULATION SYSTEMS

PLAN 21

Cooled Discharge Recirculation

- Use with a single seal
- Cools seal in hot services and/or volatile fluids
- Increases pressure in seal chamber
- Solids in product can erode seal
- An orifice can be used to reduce flow
- Close clearance bushing recommended



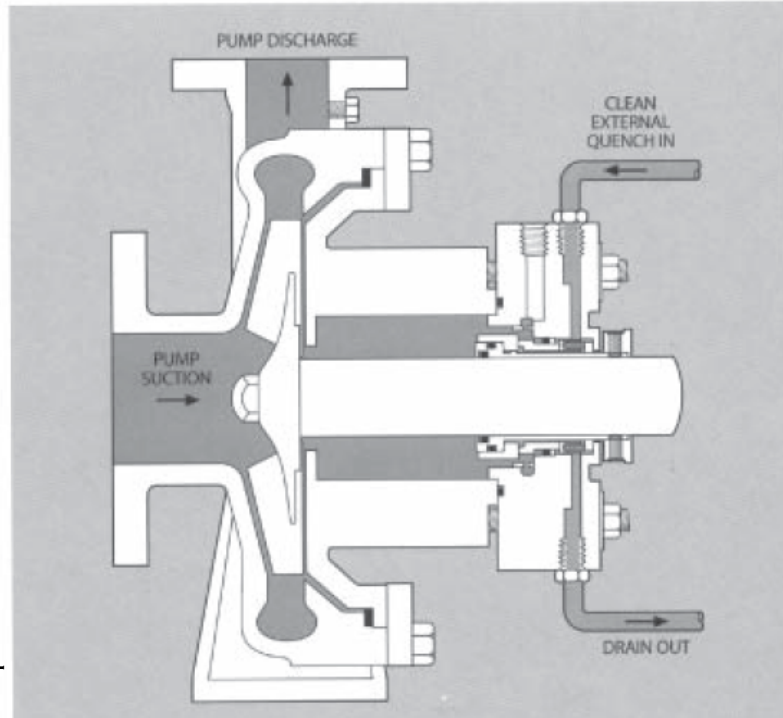
PLAN 21- COOLED
DISCHARGE RECIRCULATION

API PLANS FOR VARIOUS CIRCULATION SYSTEMS

PLAN 62

Quench

- Use with a single seal
- Prevents coking and crystallization
- Common quench fluids: steam, water, nitrogen
- Low pressure only



PLAN 62A - EXTERNAL QUENCH SUPPLY

QUESTION PLEASE

