

Piping plans booklet **API 682 4th edition**



Classification

Mechanical seals to API 682 4th edition can be specified according to the table below. Category I seals are used for not API 610 pumps whereas category II and III seals are made for API 610 dimensioned pumps. The next classification is made according to three different types. Type A includes rotary pusher seals while bellows seals are covered by Type B and C. Possible seal arrangements are single acting seal (arrangement 1), double acting seal unpressurized (arrangement 2) and double acting seal pressurized (arrangement 3).

Categories

- 1** Seals for not API 610 pumps
(Up to 260 °C & 20 barg)
- 2** Seals for API 610 dimensioned pumps
(Up to 400 °C & 40 barg)
- 3** Seals for API 610 dimensioned pumps
(Up to 400 °C & 40 barg)

Types

- A** Rotary pusher seal (o-ring type)
- B** Rotary bellows seal (o-ring type)
- C** Stationary bellows seal
(flexible graphite type)

Arrangements

- 1.** Single Seal
- 2.** Dual Seal (unpressurized)
- 3.** Dual seal (pressurized)

Code

Category:

designated as 1, 2 or 3

Arrangement:

designated as 1, 2 or 3

Type:

designated A, B or C

Containment Device:

- P** plain gland with no bushing
- L** floating throttle bushing
- F** fixed throttle bushing
- C** containment seal
- S** floating, segmented carbon bushing
- X** unspecified (to be specified separately)

Gasket Material:

- F** fluoroelastomer (FKM)
- G** polyfluorotetraethylene (PTFE)
- H** nitrile
- I** perfluoroelastomer (FFKM)
- R** flexible graphite
- X** unspecified (to be specified separately)

Category	Seal		Design Options				Shaft Size (mm)	Plan
	Arrangement	Type	Containment Device	Gasket Material	Face Material			
1	2	A	-	P	F	O	-	050 - 11/52

Face Materials:

- M** carbon vs nickel bound WC
- N** carbon vs reaction bonded SiC
- O** reaction bonded SiC vs nickel bound WC
- P** reaction bonded SiC vs reaction bonded SiC
- Q** sintered SiC vs sintered SiC
- R** carbon vs sintered SiC
- S** graphite loaded, reaction bonded SiC vs reaction bonded SiC
- T** graphite loaded, sintered SiC vs sintered SiC
- X** unspecified (to be specified separately)

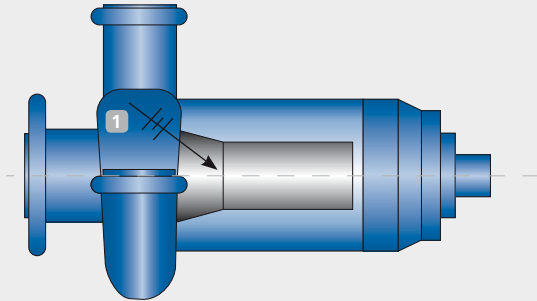
Shaft Size:

size in mm

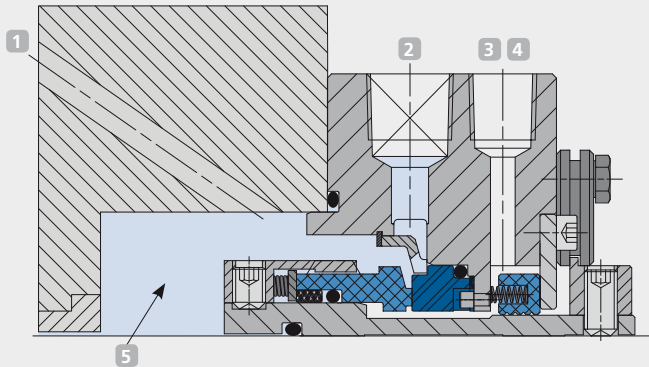
Plan:

plan number; multiple plans separated by “/”

API Plan 01

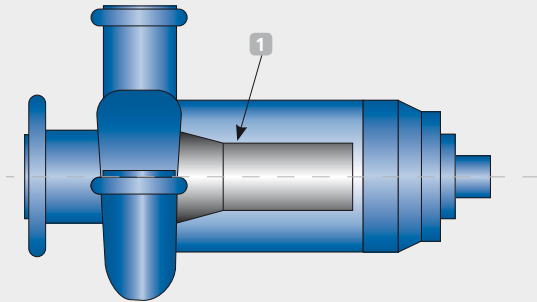


- 1 Inlet
- 2 Flush (F)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber

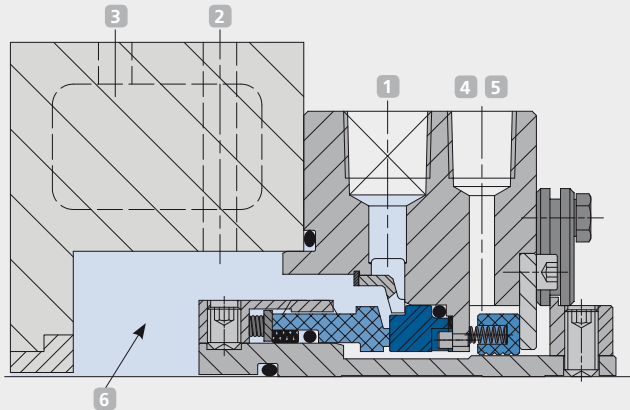


- Internal circulation from the discharge nozzle to the seal chamber
- The flow of the flush fluid provides cooling to the seal chamber by removing the heat which is generated by the seal faces
- Only for clean fluids to avoid clogging of the circulation line
- Internal circulation prevents fluids from freezing or solidifying at low ambient temperatures

API Plan 02

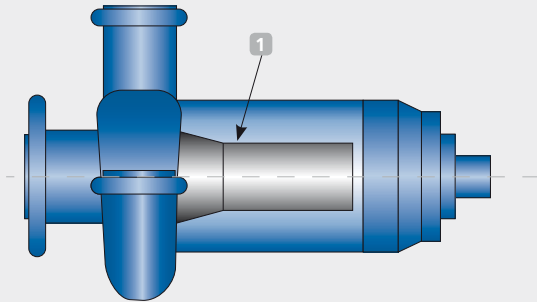


- 1 Flush (F)
- 2 Vent (V)
- 3 Heating-cooling inlet (HI or CI)
- 4 Quench (Q)
- 5 Drain (D)
- 6 Seal chamber

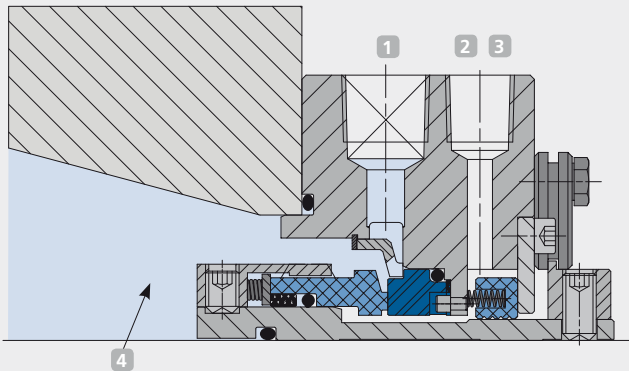


- Cylindrical dead end seal chamber with no circulation
- Used to avoid heat increase with very hot fluids
- Prevents the circulation of any solids which are present in the fluid
- Often used with cooling or heating jackets to control the temperature in the seal chamber

API Plan 03

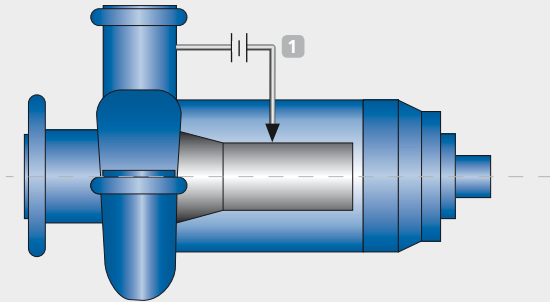


- 1 Flush (F)
- 2 Quench (Q)
- 3 Drain (D)
- 4 Seal chamber

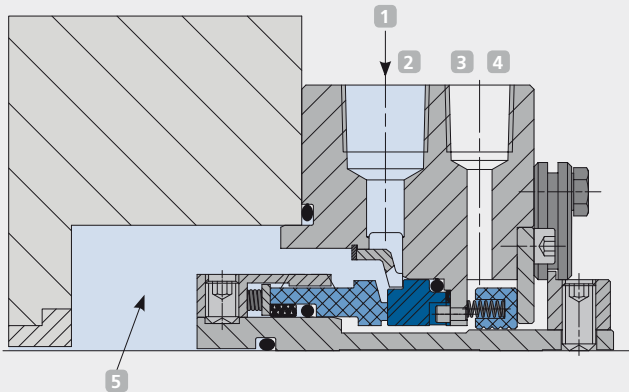


- Conical dead end seal chamber
- Design allows a good circulation between the seal chamber and the pump
- Seal chamber geometry creates circulation around the seal faces
- Vent air and vapors from the seal chamber
- Used in applications where there are solids that could pack in a cylindrical seal chamber

API Plan 11

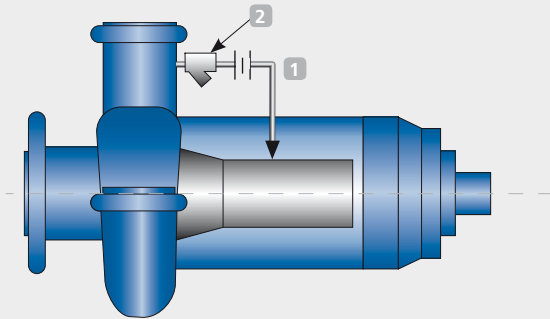


- 1 From pump discharge
- 2 Flush (F)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber

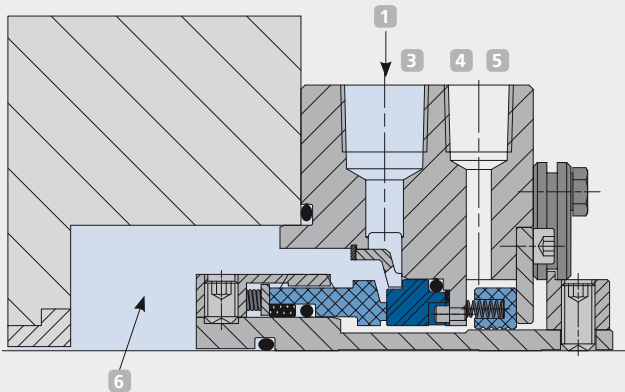


- External circulation from the discharge nozzle through a flow control orifice to the seal chamber
- The flow of the flush fluid provides cooling to the seal chamber by removing the heat which is generated by the seal faces and helps to increase the vapor pressure margin
- Only for clean fluids to avoid clogging of the orifice
- Usually used for arrangement 1 and 2 seals

API Plan 12

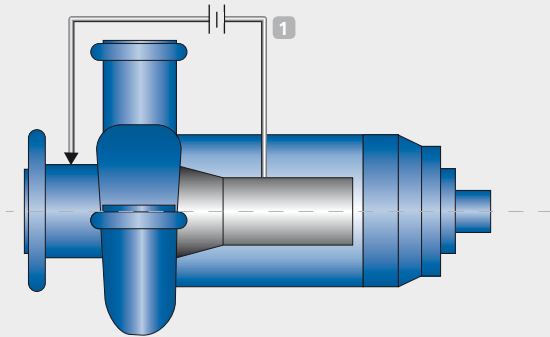


- 1 From pump discharge
- 2 Strainer
- 3 Flush (F)
- 4 Quench (Q)
- 5 Drain (D)
- 6 Seal chamber

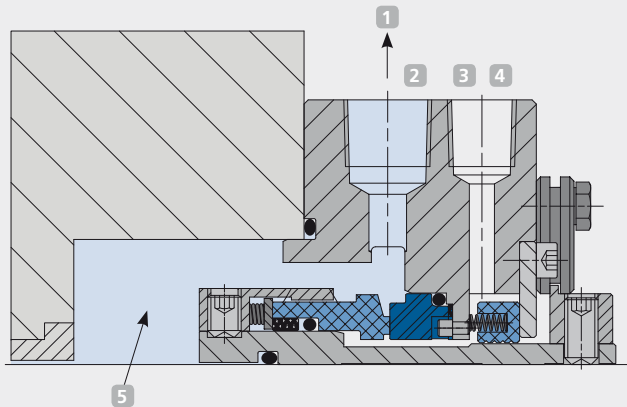


- External circulation from the discharge nozzle through a strainer and flow control orifice into the seal chamber
- The flow of the flush fluid provides cooling to the seal chamber by removing the heat which is generated by the seal faces
- The strainer removes occasional particles
- Strainers are not commonly recommended in pipes because their blockage will cause a seal failure

API Plan 13

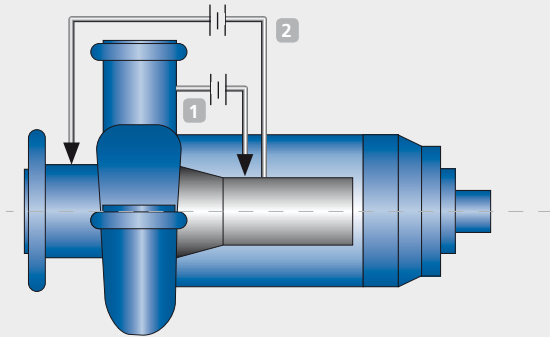


- 1 To pump suction
- 2 Flush (F)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber

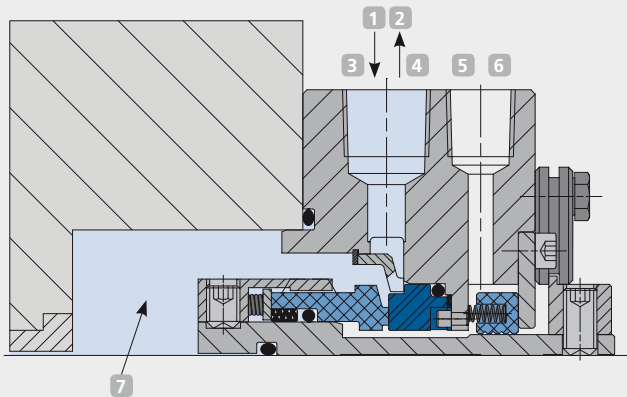


- Circulation from the seal chamber through a flow control orifice back to the pump's suction side
- Standard plan selection for vertical pumps to balance the seal chamber pressure because usually vertical pumps without bleed bushing would operate at full discharge pressure
- Provides cooling to the seal and it is used to vent air from the seal chamber

API Plan 14

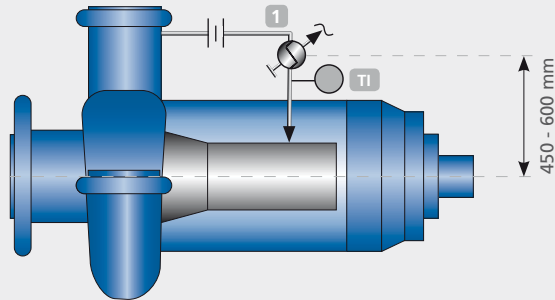


- 1 From pump discharge
- 2 To pump suction
- 3 Flush inlet (FI)
- 4 Flush outlet (FO)
- 5 Quench (Q)
- 6 Drain (D)
- 7 Seal chamber

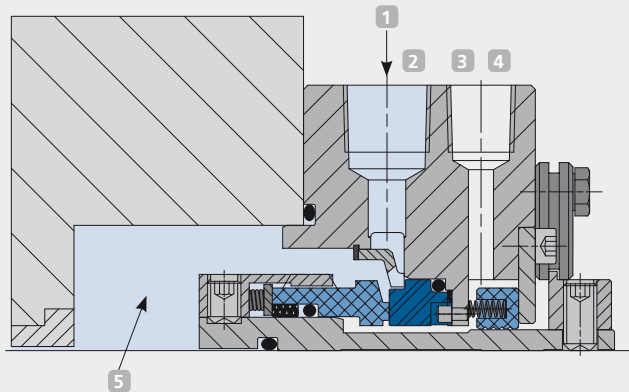


- Combination of plan 11 and 13
- Circulation from the pump's discharge side into the seal chamber and from the seal chamber back to the suction side
- Provides cooling while continuously venting the seal chamber
- Most commonly used on vertical pumps

API Plan 21

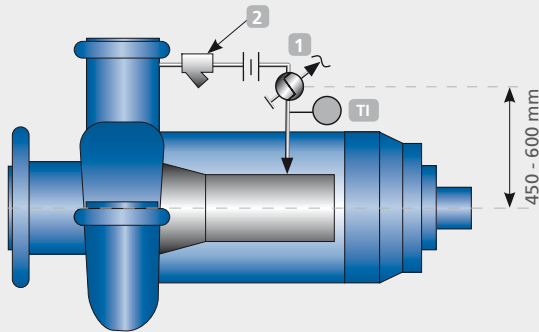


- 1 From pump discharge
 - 2 Flush (F)
 - 3 Quench (Q)
 - 4 Drain (D)
 - 5 Seal chamber
- TI Temperature indicator

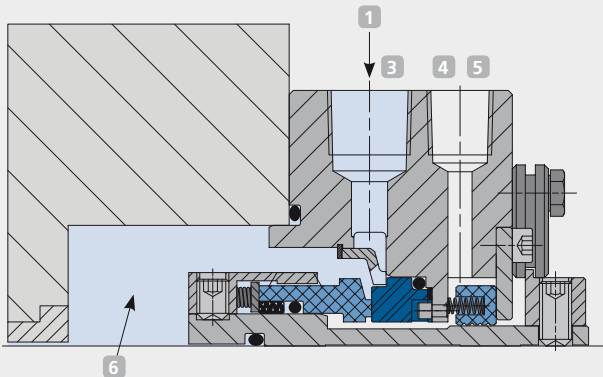


- Circulation from the pump's discharge side through a flow control orifice and a cooler into the seal chamber
- Provides cooling to the seal chamber and increases the vapor pressure margin
- Cooler has to cool continuously the hot pump liquid
- Not suitable for polymerizing fluids or fluids with high solid content

API Plan 22

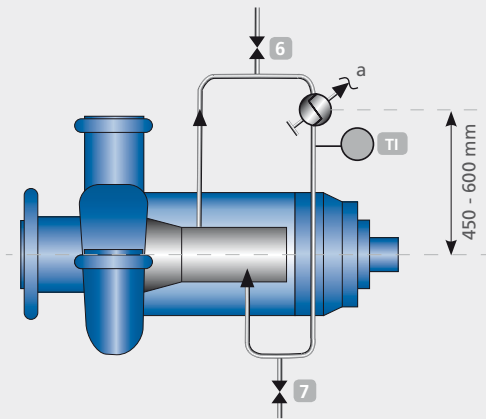


- 1 From pump discharge
 - 2 Strainer
 - 3 Flush (F)
 - 4 Quench (Q)
 - 5 Drain (D)
 - 6 Seal chamber
- TI Temperature indicator



- Circulation from the discharge nozzle through a strainer, a flow control orifice and a cooler into the seal chamber
- Similar to plan 21 with the addition of a strainer
- Provides cool and clean flush liquid to the seal chamber
- Strainers are not commonly recommended in pipes because their blockage will cause a seal failure

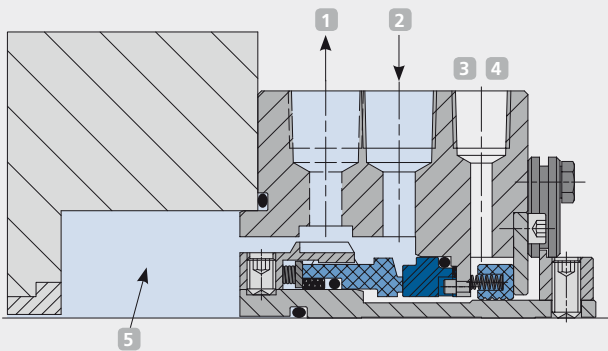
API Plan 23



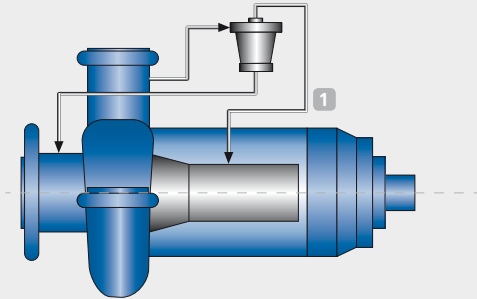
- 1 Flush outlet (FO)
- 2 Flush inlet (FI)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber
- 6 Vent (normally closed)
- 7 Drain (normally closed)

- TI Temperature indicator
- a Vertically oriented finned air cooler shall be installed if specified

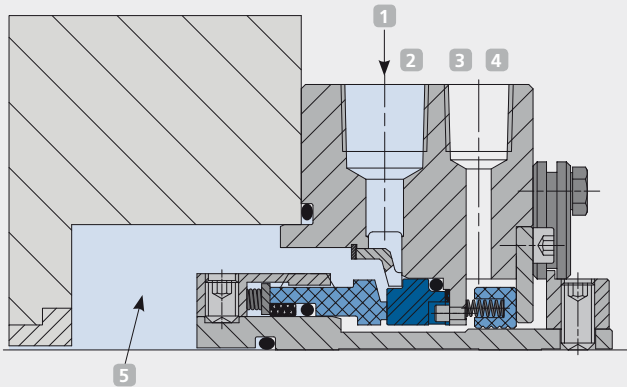
- Circulation from the seal chamber to a cooler and back
- Cooled product in the seal chamber is isolated from the hot pumping liquid by a throat bushing
- Plan of choice for all hot water and many hydrocarbon services where it is necessary to cool the fluid to establish the required vapor pressure margin
- High efficiency because the cooled fluid in the seal chamber does not enter the process



API Plan 31

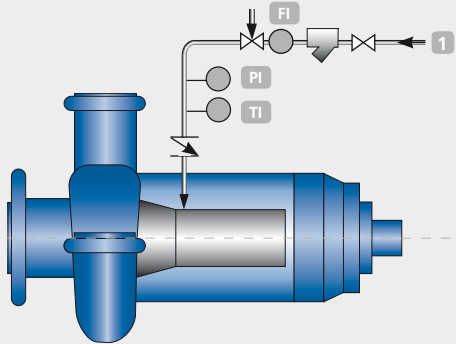


- 1 From clean discharge connection of cyclone separator
- 2 Flush (F)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber



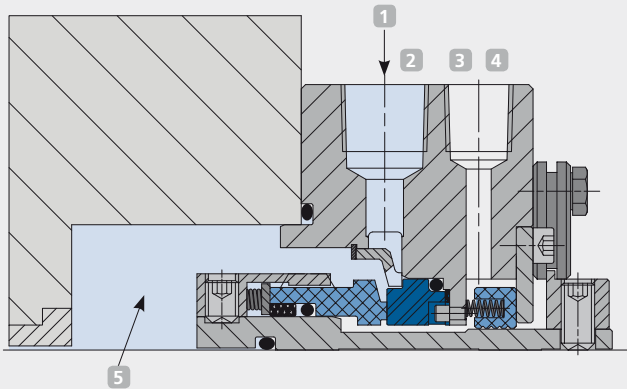
- Circulation from the discharge nozzle through a cyclone separator delivering the clean fluid to the seal chamber
- Solids are delivered to the pump suction side
- Flushes and lubricates the seal with fluid cleaned from solids
- Not recommended for very dirty process fluids or slurry

API Plan 32



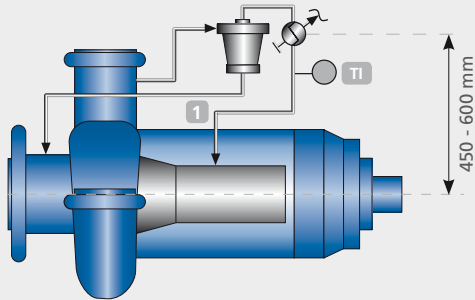
- 1 From external source
- 2 Flush (F)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber

- FI Flow indicator (optional)
- PI Pressure indicator
- TI Temperature indicator (optional)



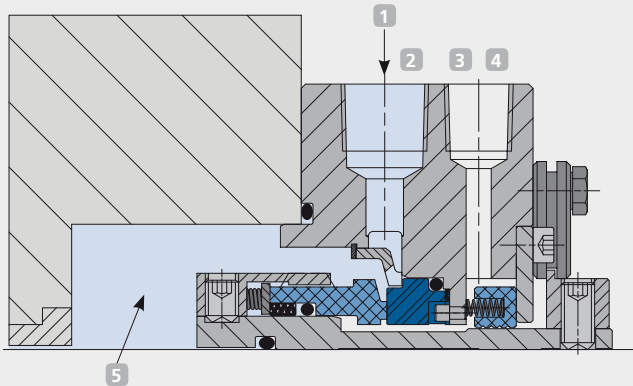
- Flush is injected in the seal chamber from an external source
- Clean fluid supplied in the seal chamber
- Possible to raise the seal chamber pressure to an acceptable level
- In combination with a throat bushing it is possible to isolate the pump product from the seal chamber

API Plan 41



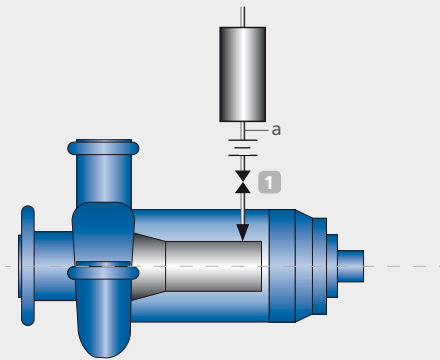
- 1 From cooler
- 2 Flush (F)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber

TI Temperature indicator



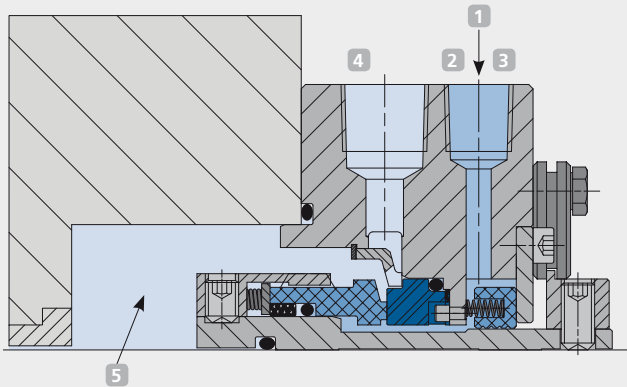
- Circulation from the discharge nozzle through a cyclone separator and a cooler into the seal chamber
- Combination of plan 21 and 31
- Allows to supply clean and cooled fluid to the seal chamber
- Typical used in hot water service to remove sand or pipe slag

API Plan 51



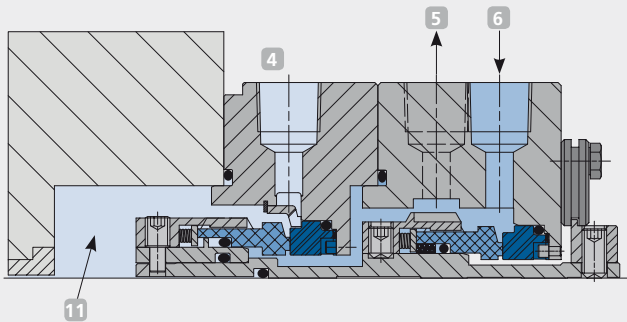
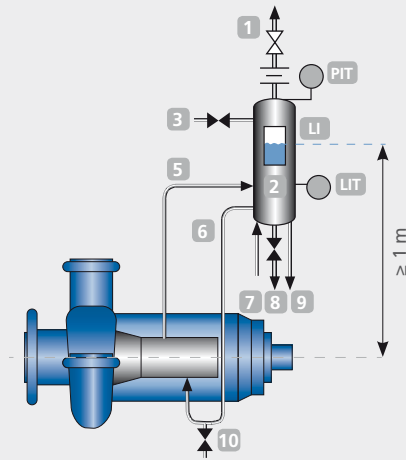
- 1 From reservoir
- 2 Quench (Q)
- 3 Drain (D), plugged
- 4 Flush (F)
- 5 Seal chamber

- a Items below this line shall be provided by the vendor. Items above this line are the responsibility of the purchaser



- External reservoir provides an atmospheric dead end quench fluid to arrangement 1 seals
- Used for example to avoid ice formation or salt crystallization on the atmospheric side of the seal
- In processes with the presence of salt in solution it avoids crystallization at the atmospheric side of the seal

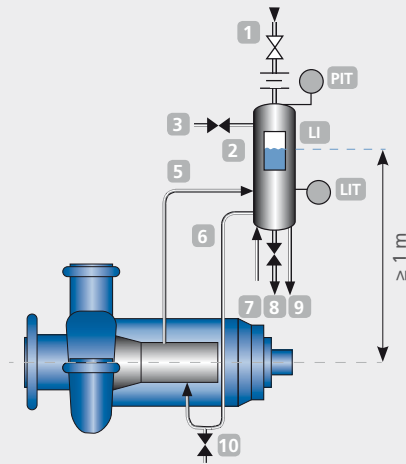
API Plan 52



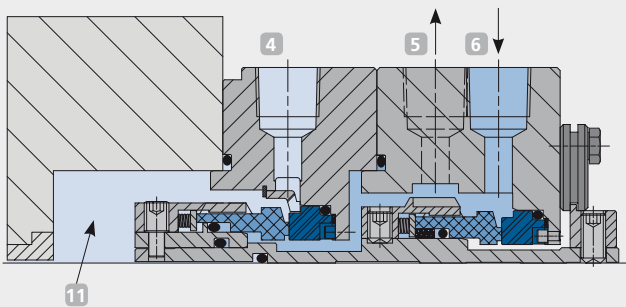
- | | | | |
|---|------------------------------|-----|---|
| 1 | To collection system | 10 | Buffer fluid drain |
| 2 | Reservoir | 11 | Seal chamber |
| 3 | Make-up buffer liquid | LI | Level indicator |
| 4 | Flush (F) | LIT | Level transmitter with local indicator |
| 5 | Liquid buffer out (LBO) | PIT | Pressure transmitter with local indicator |
| 6 | Liquid buffer in (LBI) | | |
| 7 | Cooling water in | | |
| 8 | Reservoir buffer fluid drain | | |
| 9 | Cooling water out | | |

- External reservoir providing non-pressurized buffer fluid to arrangement 2 seals
- Buffer liquid is circulated by an internal circulating device
- Used to minimize or contain the leakage to atmosphere of the process fluid
- Also used in applications where the process fluid may solidify in contact with atmosphere or where additional heat removal from the inner seal is required

API Plan 53A

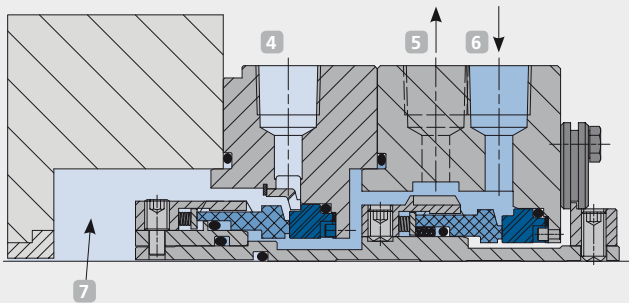
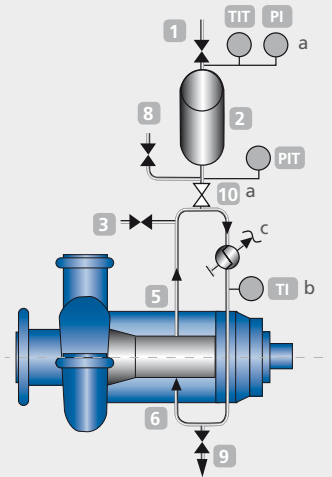


- | | | | |
|---|-------------------------------|-----|---|
| 1 | From external pressure source | 10 | Barrier fluid drain |
| 2 | Reservoir | 11 | Seal chamber |
| 3 | Make-up barrier liquid | LI | Level indicator |
| 4 | Flush (F) | LIT | Level transmitter with local indicator |
| 5 | Liquid barrier out (LBO) | PIT | Pressure transmitter with local indicator |
| 6 | Liquid barrier in (LBI) | | |
| 7 | Cooling water in | | |
| 8 | Reservoir buffer fluid drain | | |
| 9 | Cooling water out | | |



- External reservoir providing pressurized barrier fluid to arrangement 3 seals
- Barrier fluid is circulated by an internal circulating device
- For dirty, abrasive or hot products that would damage the seal faces
- Also used in applications where no leakage to atmosphere can be tolerated
- Seal faces are always lubricated with clean barrier liquid
- Prevents dry running of the mechanical seal

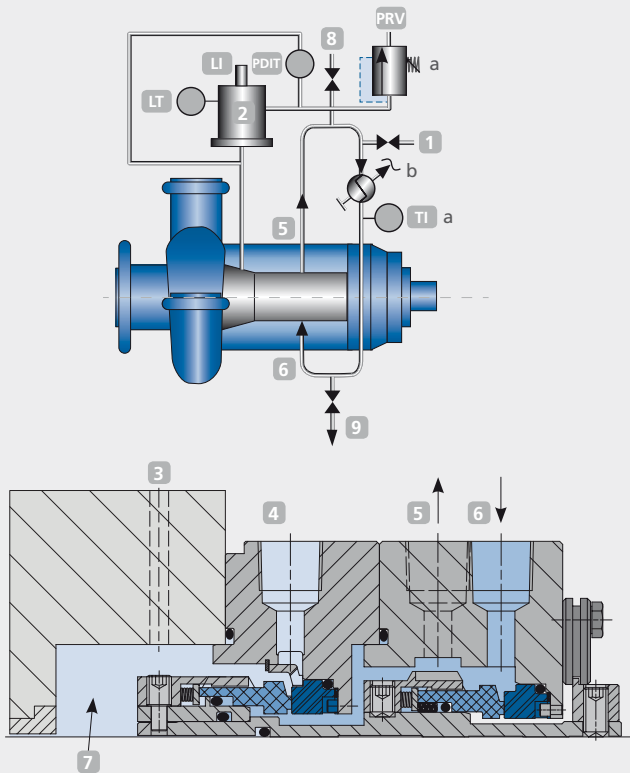
API Plan 53B



- | | | | |
|----|--|-----|---|
| 1 | Bladder charge connection | PI | Pressure indicator |
| 2 | Bladder accumulator | PIT | Pressure transmitter with local indicator |
| 3 | Make-up barrier liquid | TI | Temperature indicator |
| 4 | Flush (F) | TIT | Temperature transmitter local indicator |
| 5 | Liquid barrier out (LBO) | a | If specified, PI and Valve 10 shall be installed for checking bladder integrity |
| 6 | Liquid barrier in (LBI) | b | If specified |
| 7 | Seal chamber | c | Vertically oriented finned air cooler installed if specified |
| 8 | Vent | | |
| 9 | Barrier fluid drain | | |
| 10 | Valve (to check accumulator integrity) | | |

- External reservoir providing pressurized barrier fluid to arrangement 3 seals
- Barrier fluid is circulated by an internal circulating device
- Barrier fluid is pressurized by a bladder accumulator
- Accumulator prevents contact between pressurization gas and barrier liquid. This prevents gas absorption into the barrier liquid
- Used in applications where no leakage to atmosphere can be tolerated or for dirty, abrasive or hot products that would damage the seal faces

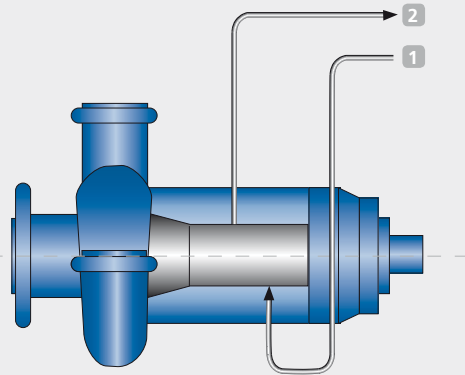
API Plan 53C



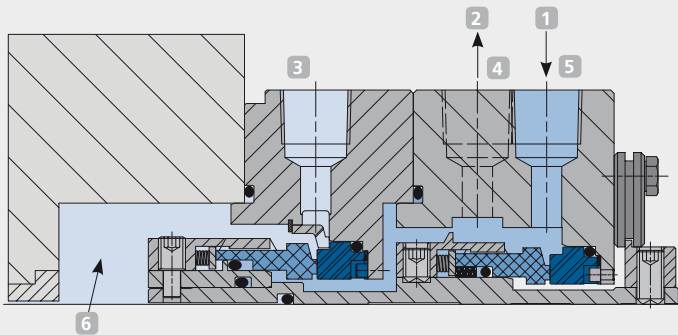
- | | | | |
|---|--------------------------|--------|---|
| 1 | Make-up barrier liquid | LI | Level indicator |
| 2 | Piston accumulator | LT | Level transmitter |
| 3 | Pressure reference | PRV | Pressure relief valve |
| 4 | Flush (F) | PDI/TI | Differential pressure transmitter with local indicator |
| 5 | Liquid barrier out (LBO) | TI | Temperature indicator |
| 6 | Liquid barrier in (LBI) | a | if specified |
| 7 | Seal chamber | b | vertically oriented finned air cooler provided if specified |
| 8 | Vent | | |
| 9 | Barrier fluid drain | | |

- External reservoir providing pressurized barrier fluid to arrangement 3 seals
- Barrier fluid is pressurized by a piston accumulator
- Barrier fluid is circulated by an internal circulating device
- The system is self energizing and reacts to fluctuations in the seal chamber pressure
- Applications are similar to Plan 53B

API Plan 54

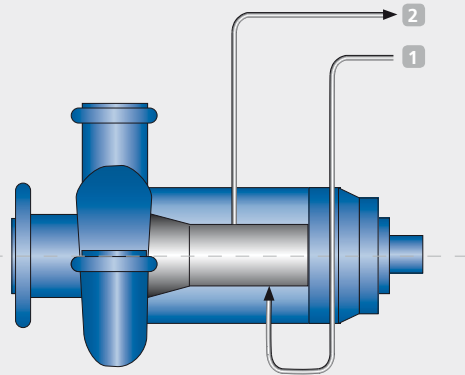


- 1 From external source
- 2 To external source
- 3 Flush (F)
- 4 Liquid buffer out (LBO)
- 5 Liquid buffer in (LBI)
- 6 Seal chamber

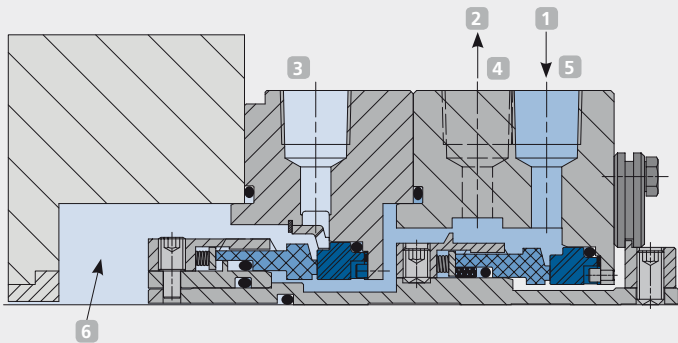


- External barrier fluid system supplying clean, cool and pressurized liquid to arrangement 3 seals
- Barrier liquid is circulated by an external pump or pressure system
- Often used in services where the pumped fluid is hot or contaminated with solids
- Also used in applications where no leakage to atmosphere can be tolerated

API Plan 55

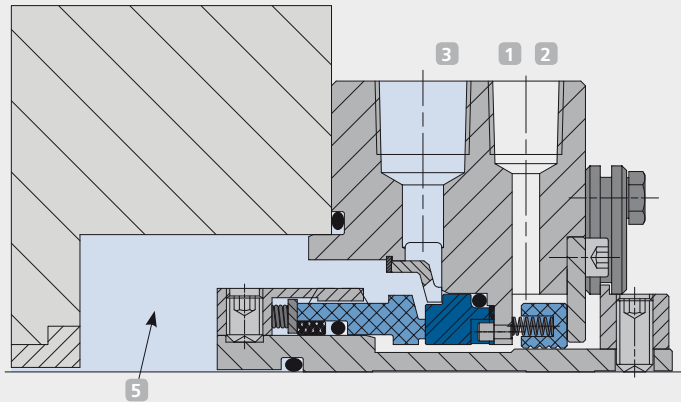
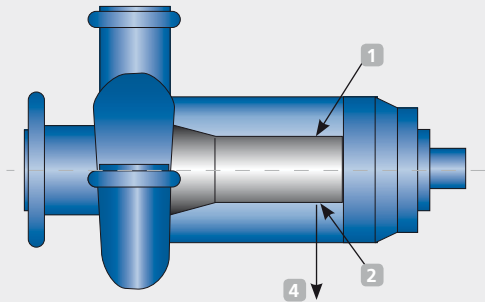


- 1 From external source
- 2 To external source
- 3 Flush (F)
- 4 Liquid buffer out (LBO)
- 5 Liquid buffer in (LBI)
- 6 Seal chamber



- External buffer fluid system supplying clean, cool and unpressurized liquid to arrangement 2 seals
- Barrier liquid is circulated by an external pump or pressure system
- For services where the process fluid leakage to atmosphere should be minimized and contained
- Used where additional heat removal from inner seal is required

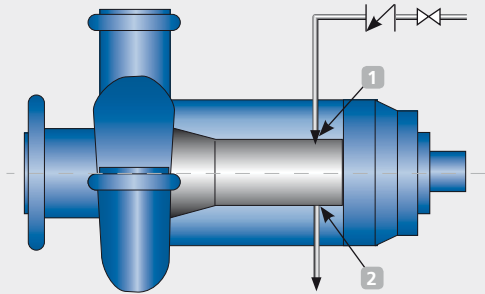
API Plan 61



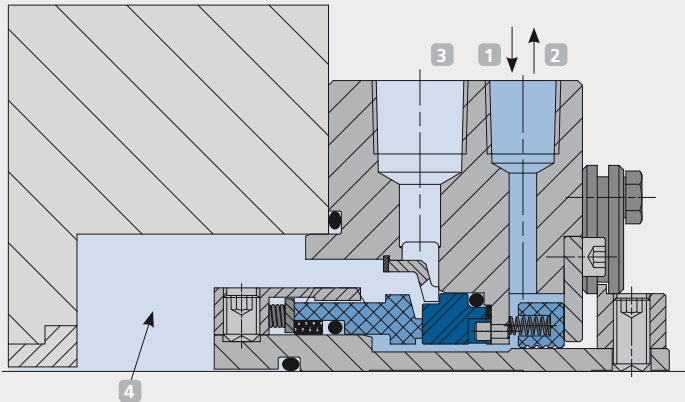
- 1 Quench (Q), plugged
- 2 Drain (D)
- 3 Flush (F)
- 4 To connection port
- 5 Seal chamber

- Plugged atmospheric side connection for purchaser's use
- Allows to connect tubing to the drain port and direct leakage to a collection point
- All ports must be plugged with plastic plugs during the shipment

API Plan 62

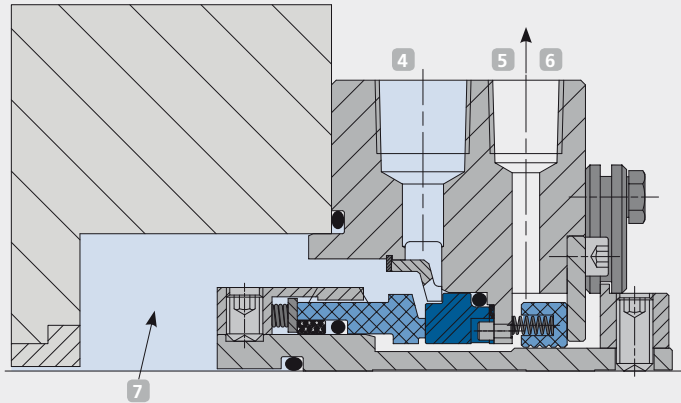
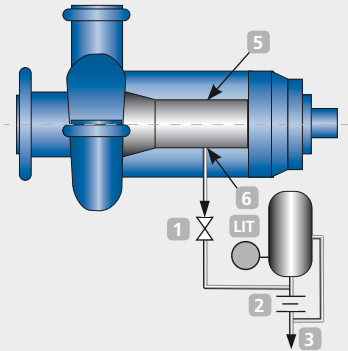


- 1 Quench (Q)
- 2 Drain (D)
- 3 Flush (F)
- 4 Seal chamber



- Quench stream is brought from an external source to the atmospheric side of the seal faces
- Depending on the kind of bushing the quench stream can be low pressure steam, nitrogen or clean water
- Used in single seal applications to avoid for example ice formation or salt crystallization on the atmospheric side of the seal

API Plan 65A

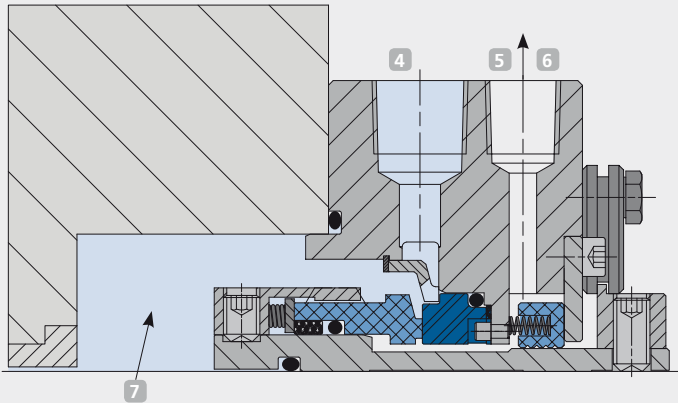
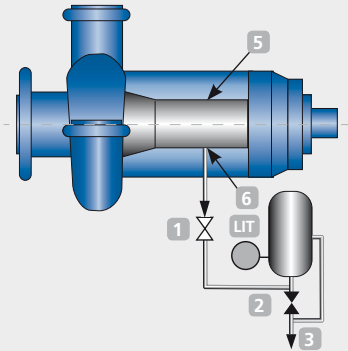


- 1 Valve
- 2 Orifice
- 3 To liquid collection system
- 4 Flush (F)
- 5 Quench (Q)
- 6 Drain (D)
- 7 Seal chamber

LIT Level transmitter with local indicator

- Atmospheric leakage collection and detection system for condensing leakage
- Seal failure will be detected by an excessive flow rate into the leakage collection system
- Flow rates would be restricted by an orifice located downstream of the reservoir and detected through a level transmitter which activates an alarm

API Plan 65B

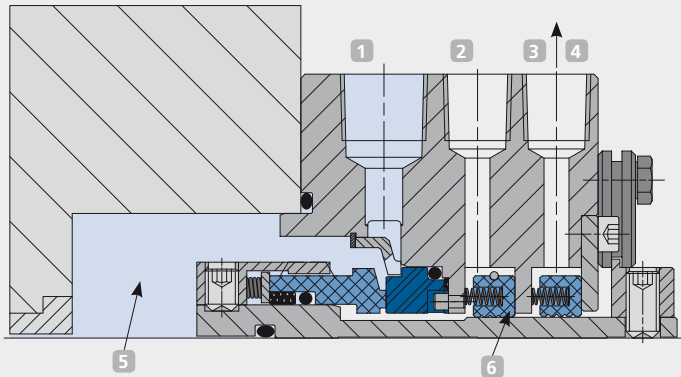
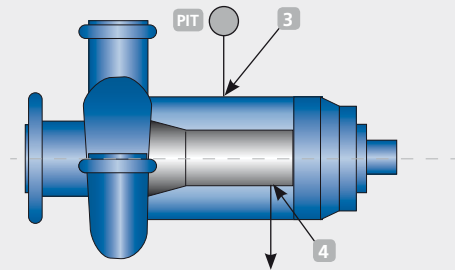


- 1 Valve
- 2 Drain valve
- 3 To liquid collection system
- 4 Flush (F)
- 5 Quench (Q)
- 6 Drain (D)
- 7 Seal chamber

LIT Level transmitter with local indicator

- Atmospheric leakage collection and detection system for condensing leakage
- Leakage would be restricted by a valve located downstream of the reservoir
- Seal failure will be detected by a level transmitter in a cumulative leakage system
- Valve 2 is closed during operation

API Plan 66A

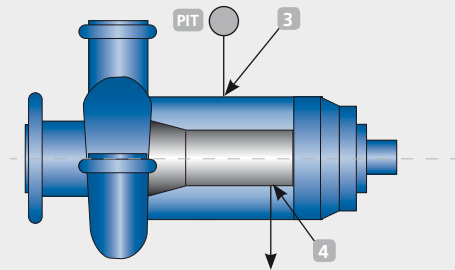


- 1 Flush (F)
- 2 Pressure transmitter sensing port (PIT)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Seal chamber
- 6 Segmental bushing

PIT Pressure transmitter indicator

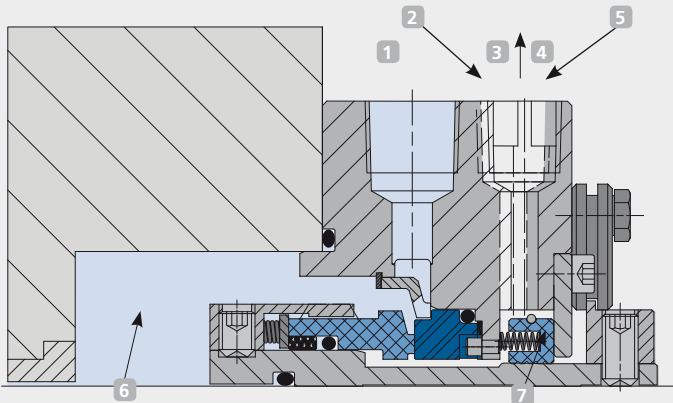
- Intended for use with arrangement 1 seals
- Seal gland is equipped with throttle bushings to minimize the seal leakage of arrangement 1 seals
- Inner bushing shall be segmented and the external floating
- This plan is required to limit leakage in case of a seal failure or to monitor excessive leakage

API Plan 66B



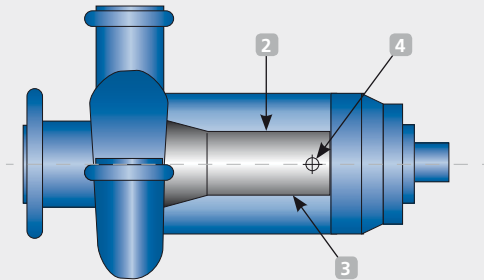
- 1 Flush (F)
- 2 Pressure transmitter sensing port (PIT)
- 3 Quench (Q)
- 4 Drain (D)
- 5 Orifice plug
- 6 Seal chamber
- 7 Segmental bushing

PIT Pressure transmitter indicator

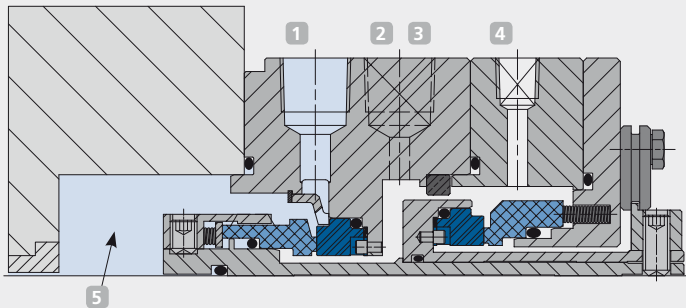


- Intended for use with arrangement 1 seals
- An orifice plug in the drain port minimizes the seal leakage and allows for detection of a seal failure
- This plan is required to limit and to monitor excessive leakage
- Orifice plug limits the amount of leakage leaving the gland
- As the leakage rate increases, the pressure will increase and a pressure transmitter will identify increasing leakage rate

API Plan 71

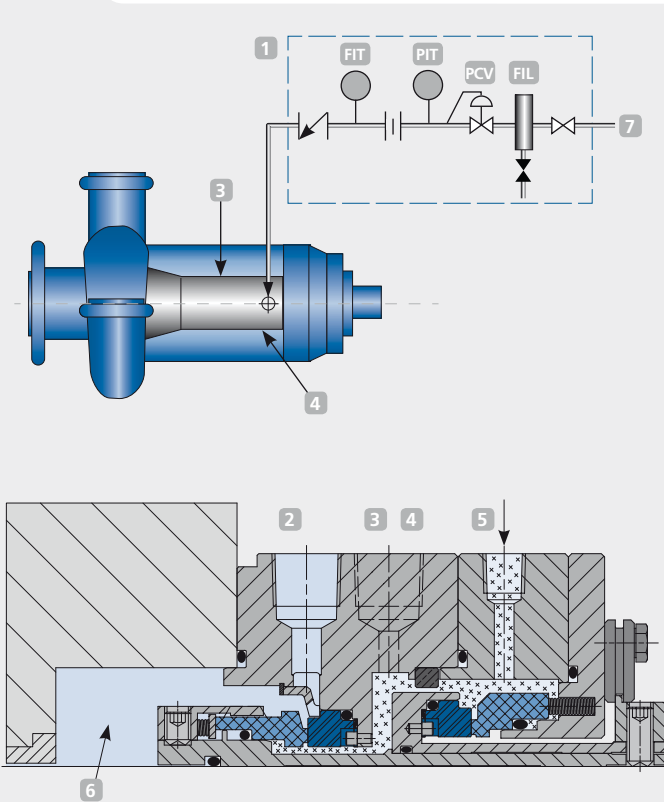


- 1 Flush (F)
- 2 Containment seal vent (CSV), plugged
- 3 Containment seal drain (CSD), plugged
- 4 Gas buffer inlet (GBI)
- 5 Seal chamber



- Tapped connections for purchaser's use
- Used for arrangement 2 unpressurized dual seals which utilize a dry containment seal and where no buffer gas is supplied
- Seal might also work with a buffer gas if required
- Used to sweep inner seal leakage away from the outer seal into a collection system

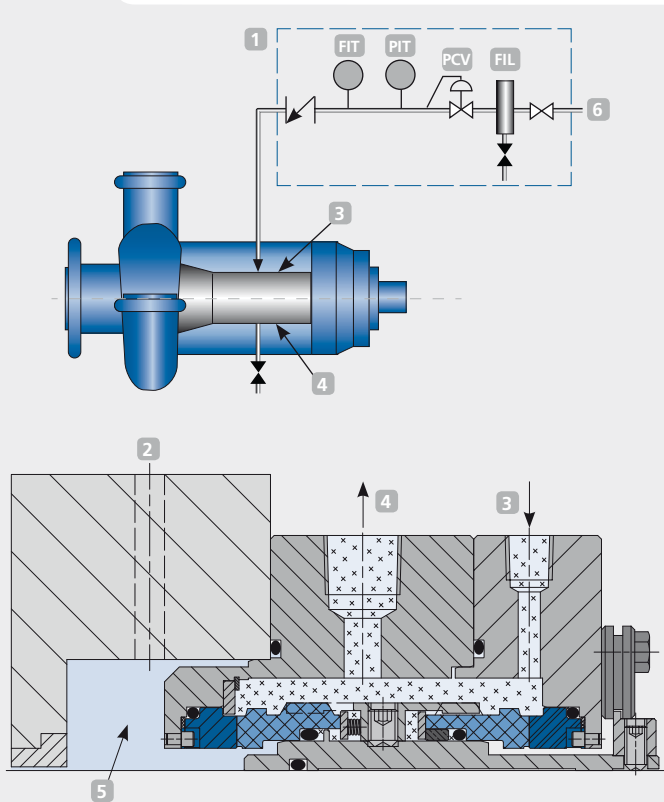
API Plan 72



- | | | | |
|---|------------------------------|-----|---------------------------------------|
| 1 | Barrier gas panel | FIL | Coalescing filter |
| 2 | Flush (F) | FIT | Flow transmitter with local indicator |
| 3 | Containment seal vent (CSV) | PCV | Pressure control valve |
| 4 | Containment seal drain (CSD) | PIT | Pressure transmitter indicator |
| 5 | Gas buffer inlet (GBI) | | |
| 6 | Seal chamber | | |
| 7 | From buffer gas supply | | |

- Externally supplied buffer gas for arrangement 2 seals or in conjunction either a plan 75 or plan 76
- A gas from external source arrives to the seal from a control panel
- Buffer gas is maintained at a lower pressure instead of process pressure
- Used to dilute the leakage

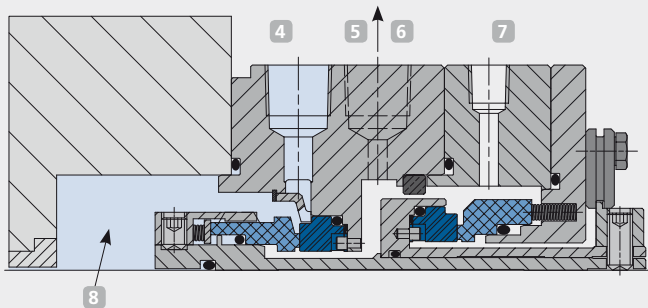
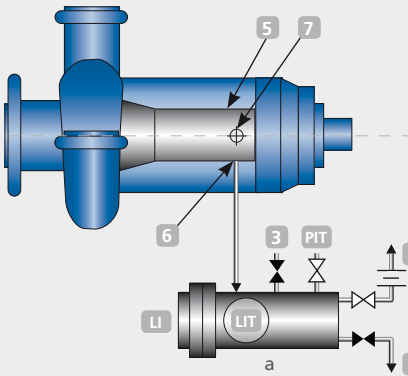
API Plan 74



- | | | | |
|---|--------------------------|-----|---------------------------------------|
| 1 | Barrier gas panel | FIL | Coalescing filter |
| 2 | Vent | FIT | Flow transmitter with local indicator |
| 3 | Gas barrier inlet (GBI) | PCV | Pressure control valve |
| 4 | Gas barrier outlet (GBO) | PIT | Pressure transmitter indicator |
| 5 | Seal chamber | | |
| 6 | From barrier gas supply | | |

- Externally supplied barrier gas for arrangement 3 seals
- Barrier gas is maintained at a higher pressure instead of process pressure
- Used for services that may contain toxic or hazardous materials whose leakage cannot be tolerated
- Advantage of the use of a barrier gas is a minimal loss into the product side

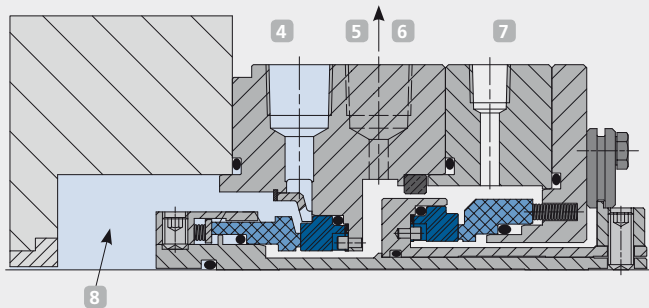
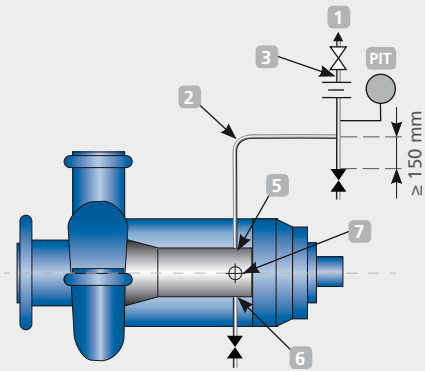
API Plan 75



- | | | | |
|---|--|-----|-----------------------------|
| 1 | To vapor collection system | LI | Level indicator |
| 2 | To liquid collection system | LIT | Level transmitter indicator |
| 3 | Test connection | PIT | Pressure transmitter |
| 4 | Flush (F) | | indicator |
| 5 | Containment Seal vent (CSV) | a | If specified |
| 6 | Containment seal drain (CSD) | | |
| 7 | Gas buffer inlet (GBI),
plugged unless with plan 72 | | |
| 8 | Seal chamber | | |

- 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 temperatures
- The collector accumulates any liquid while vapor passes through into the collection system
- An orifice in the outlet line of the collector restricts flow such that high leakage of the inner seal will cause a pressure increase and trigger the pressure transmitter to alarm

API Plan 76



- 1 To vapor collection system
 - 2 Tube
 - 3 Pipe
 - 4 Flush (F)
 - 5 Containment Seal vent (CSV)
 - 6 Containment seal drain (CSD)
 - 7 Gas buffer inlet (GBI), plugged unless with plan 72
 - 8 Seal chamber
- PIT Pressure transmitter indicator

- Containment seal chamber drain for non condensing leakage on arrangement 2 seals
- Used if the pumped fluid does not condense at ambient temperatures
- Orifice in the outlet line of the collector restricts flow such that high leakage of the inner seal will cause a pressure increase and trigger the pressure transmitter to alarm

API Plan 99



- Plan 99 is an engineered piping plan not defined by other existing plans
- Should be applied when process conditions have specific characteristics not fulfilled from other plans

KSB mechanical seals to API 682, 4th edition

4EDCB8S



Technical description

Category	I
Type	A
Arrangement	1

4EDCB8T/D



Technical description

Category	I
Type	A
Arrangement	2 or 3

Variant 4EDCB8T

Double mechanical seal for use with unpressurised buffer fluid (API Plan 52).

Variant 4EDCB8D

Double mechanical seal for use with pressurised barrier fluid (API Plan 53).

KSB mechanical seals to API 682, 4th edition

4EDBM6S/Q



Technical description

Category	II or III
Type	A
Arrangement	1

Variant 4EDBM6S

Single mechanical seal with floating throttling bush for optional connection to a gas or steam quench.

Variant 4EDBM6Q

Single mechanical seal with segmented throttling bush for use with a liquid quench.

4EDBM6T/D



Technical description

Category	II or III
Type	A
Arrangement	2 or 3

Variant 4EDBM6T

Double mechanical seal for use with unpressurised buffer fluid (API Plan 52).

Variant 4EDBM6D

Double mechanical seal for use with pressurised barrier fluid (API Plan 53).

KSB mechanical seals to API 682, 4th edition

4EDTR6HS/Q



Technical description

Category	II or III
Type	C
Arrangement	1

Variant 4EDTR6HS

Single metal-bellows seal with floating throttling bush for optional connection to a gas or steam quench.

Variant 4EDTR6HQ

Single metal-bellows seal with segmented throttling bush for use with a liquid quench.

4EDTR6HT/D



Technical description

Category	II or III
Type	C
Arrangement	2 or 3

Variant 4EDTR6HT

Double metal-bellows seal for use with unpressurised buffer fluid in the space between the two seals (API Plan 52).

Variant 4EDTR6HD

Double metal-bellows seal for use with pressurised barrier fluid in the space between the two seals (API Plan 53).

KSB auxilliary systems to API 682, 4th edition



KTS52/KTS53A
API Plan 52/53A



KTS53B-air
API Plan 53B



KTS53B-water
API Plan 53B



KWT23
API Plan 23



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