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ENVIRONMENTAL TECHNOLOGY

API PIPING PLANS

API 682 4th Edition

“To check out mechanical seal flushing arrangements and piping plans, I have consistently found this to be the most useful and permanent pocket-sized document. This high-quality booklet comprehensively describes both configurational parameters and application criteria”.

Heinz P. Bloch P.E.
Independent Professional Engineer

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The API Plans elaborated in this section are as defined by API 682 4th edition / API 610 11th edition. These are standardized flushing piping arrangements that are widely used in the industry. Customer specific variants of these plans are possible.

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PROCESS SIDE API PLANS

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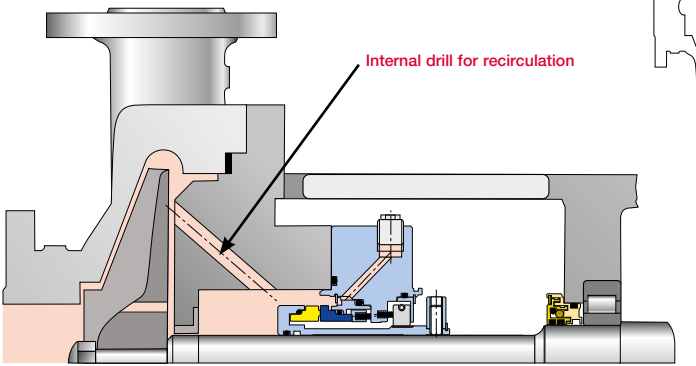
API PLAN 99

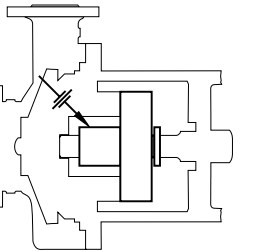
0.6%

"Of **all** the worlds water **97.4%** is salt water, **2%** is solid in ice caps and only **0.6%** is suitable for industrial use and human consumption."

PROCESS SIDE API PLANS

API PLAN 01





API PLAN **01**

Description

Integrated (internal) product recirculation from pump discharge to seal chamber. Flush port is plugged for possible future circulating fluid or venting on vertical pumps.

Features

1. Minimizes risk of freezing / polymerizing of fluid in flush piping plans exposed to atmosphere.
2. Removes heat from the seal chamber as well as acting as a vent connection in horizontal pumps.

Use

1. Recommended in clean fluids.
2. Recommended for fluids which thicken at ambient temperature.

Caution

1. Ensure that the recirculation is sufficient for seal heat removal.

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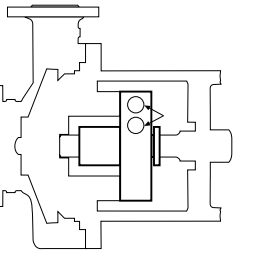
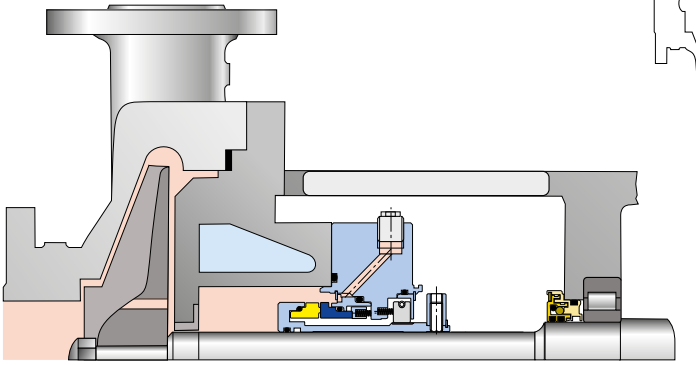
API PLAN 02





Description

Dead ended seal chamber with no flush fluid circulation. Flush port is plugged for possible future circulating fluid or venting on vertical pumps.

Features

1. Applicable to low seal chamber pressure and process temperature.
2. Can be used with tapered seal chambers, especially for slurries.
3. Normally is used along with a jacketed seal chamber.

Use

1. In cool clean fluids with high specific heat, such as water, in relatively low speed pumps.

Caution

1. To avoid flashing, process fluid temperature must be taken into consideration.
2. Avoid use without cooling / heating jacket (for cylindrical chambers).
3. Ensure top point vent in throat bush (for cylindrical chambers in horizontal pumps).

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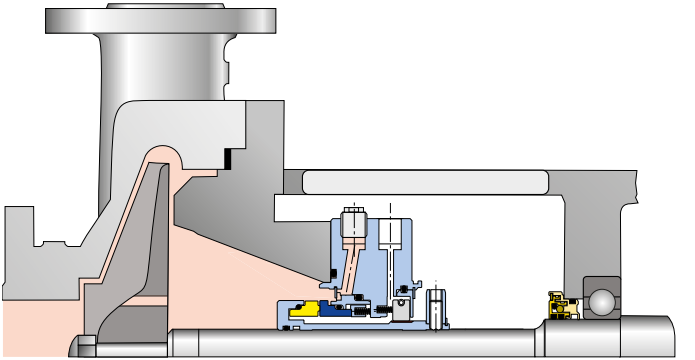
API PLAN 03



Description

Circulation between the seal chamber and pump is created by seal chamber design. Flush port is plugged for possible future circulating fluid or venting on vertical pumps.

Features

1. The mechanical seal is cooled by product flow created by seal chamber design.
2. Seal chamber design provides improved venting of air or vapours.
3. Typically, the seal chamber is tapered and does not have a throat bush.

Use

1. Generally used in applications where there is not significant seal heat generated.
2. Where solids could collect in a traditional seal chamber.

Caution

1. Not suitable for cylindrical bore seal chambers.
2. May not be suitable for high pressure or high temperature seal chambers.

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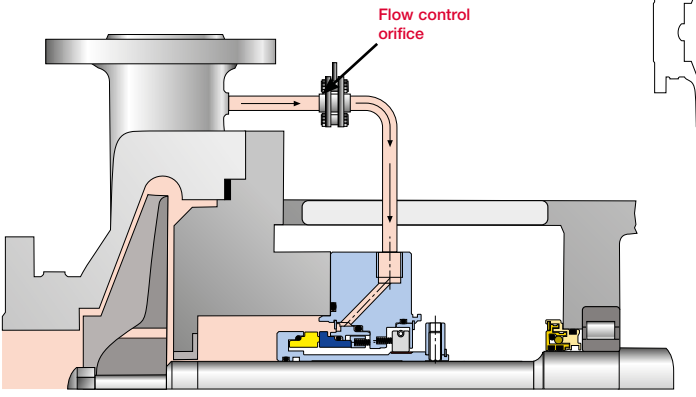
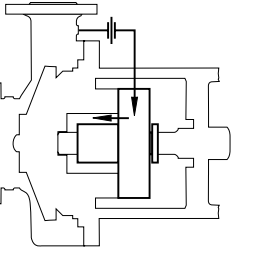
API PLAN 11





Description

Product recirculation from pump discharge to seal through a flow control orifice.

Features

1. Prevents product from vaporizing by maintaining positive pressure above vapour pressure.
2. Becomes a self-venting plan for horizontal pumps.
3. Default API Plan for most single seals.

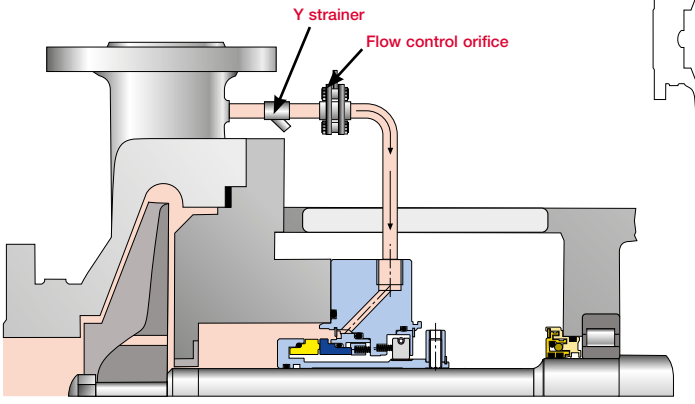
Use

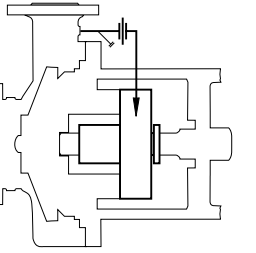
1. In general, applications with clean non-polymerizing fluids with moderate temperatures.

Caution

1. Calculation of recirculation flow rate, heat removal and orifice size are required.
2. Orifice size should be at least 1/8" (3.2mm).
3. Check the margin between discharge pressure and seal chamber pressure to ensure proper flow of fluid.
4. Do not use with media containing solids and abrasives.
5. With purchaser approval, the flow control orifice may be omitted if it is not needed to achieve the required flush flow rate.

API PLAN 12





API PLAN 12

Description
Product recirculation from pump discharge through a Y strainer and a flow control orifice to seal chamber.

Features
1. Becomes a self-venting plan for horizontal pumps.
2. Can handle dirty liquids to some extent.

Use
1. In general used in slightly dirty and non-polymerizing fluids.

Caution
1. Always ensure that orifice is placed after the Y strainer.
2. This plan is normally discouraged due to unreliability of Y strainer. This plan is not proven to achieve a three year operating life.
3. Calculation of recirculation is required.
4. With purchaser approval, the flow control orifice may be omitted if it is not needed to achieve the required flush flow rate.

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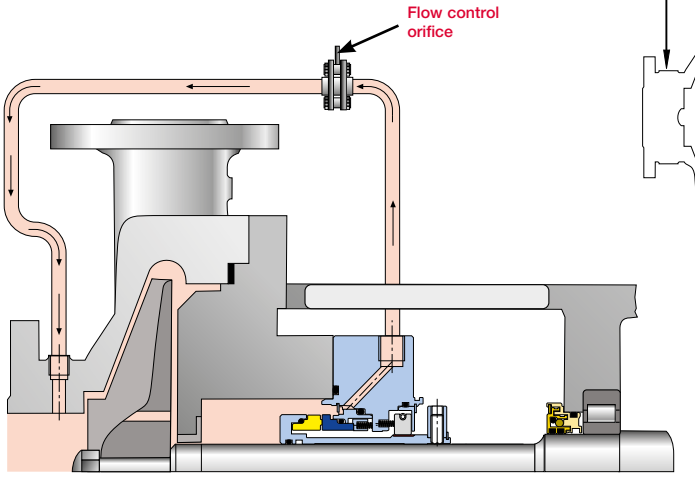
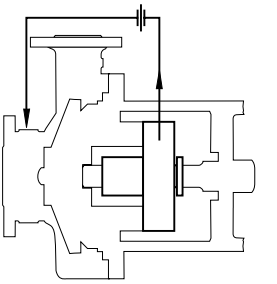
API PLAN 13





Description

Product recirculation from seal chamber to pump suction via a flow control orifice.

Features

1. Provides continuous vent for vertical pumps.

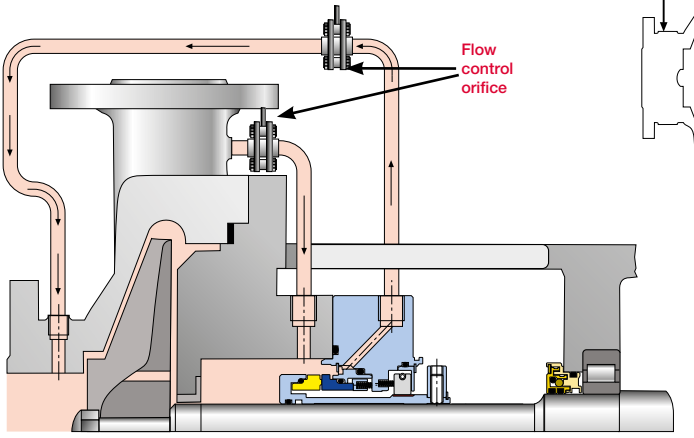
Use

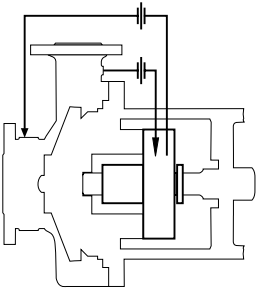
1. Wherever Plan 11 is not usable due to low-pressure margin between discharge and seal chamber pressure.
2. Used in vertical pumps provided differential pressure is sufficient to provide.

Caution

1. Check margin between seal chamber pressure and suction pressure.
2. Orifice size should be at least 1/8" (3.2mm).
3. With purchaser approval, the flow control orifice may be omitted if it is not needed to achieve the required flush flow rate.
4. A distributed flush injection is not recommended with a piping plan 13.

API PLAN 14





Description

Product recirculation from pump discharge to seal chamber through a flow control orifice and seal chamber back to suction through another flow control orifice.

Features

1. Ensures product recirculation as well as venting.
2. Increase cooling of seal chamber.
3. Combination of plan 11 and plan 13.

Use

1. Used in vertical pumps.
2. Used in light hydrocarbon services.

Caution

1. Check for pressure margin between discharge to seal chamber pressure and seal chamber to suction pressure.
2. A distributed flush injection is not recommended with a piping plan 14.

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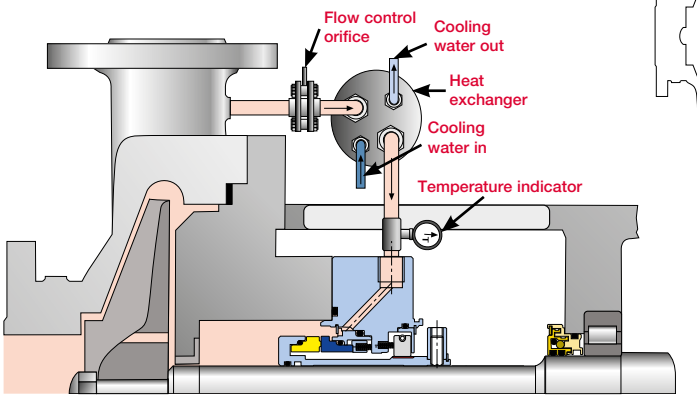
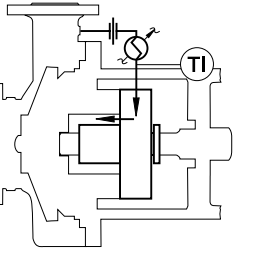
API PLAN 21


Flow control orifice
Cooling water out
Heat exchanger
Cooling water in
Temperature indicator


TI

Description

Product recirculation from discharge through flow control orifice and heat exchanger to seal chamber.

Features

1. Improves pressure margin over vapour pressure.
2. Improves temperature margin to meet secondary sealing element limits, to reduce coking or polymerizing and to improve lubricity.
3. Self venting plan.
4. Provides sufficient pressure difference to allow proper flow rate.

Use

1. For high temperature applications e.g. hot water application (temperature > 80°C), hot hydrocarbons etc.
2. In hot non-polymerizing fluids.

Caution

1. Always ensure that cooler is placed after the orifice.
2. Check pressure difference between discharge and seal chamber.
3. Cooler duty is high leading to fouling on waterside.
4. Potential plugging on process side if fluid viscosity rises quickly.

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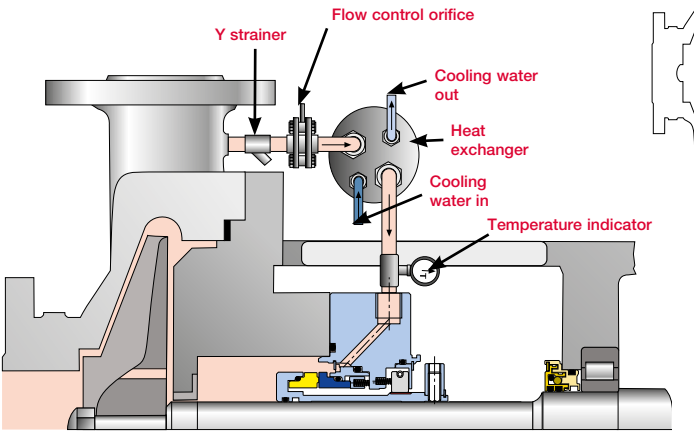
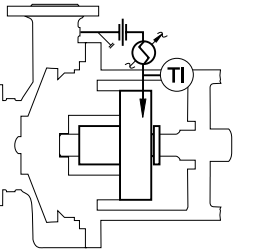
API PLAN 22


Y strainer
Flow control orifice
Cooling water out
Heat exchanger
Cooling water in
Temperature indicator


TI

Description

Product recirculation from pump discharge through a Y strainer, a flow control orifice and a heat exchanger to seal chamber.

Features

1. Improves pressure margin over vapour pressure.
2. Improves temperature margin to meet secondary sealing element limits, to reduce coking or polymerizing and to improve lubricity.
3. Self venting plan.
4. Provides sufficient pressure difference to allow proper flow rate.

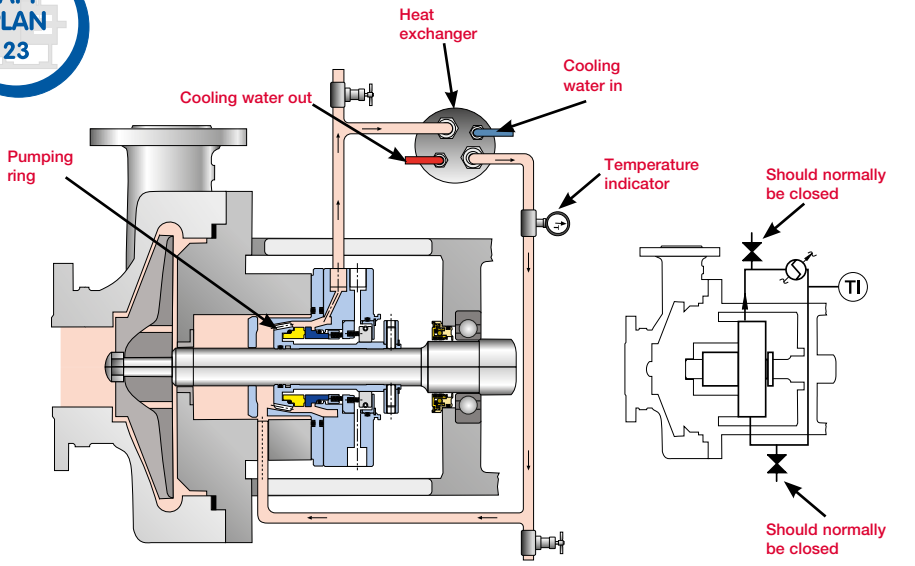
Use

1. For high temperature applications with slightly dirty liquid.

Caution

1. Always ensure that orifice is placed after the Y strainer.
2. Check pressure difference between discharge and seal chamber.
3. Cooler duty is high leading to fouling on waterside.
4. This plan is normally discouraged due to non-reliability of Y strainer. This plan is not proven to achieve a three year operating life.

API PLAN 23


Heat exchanger
Cooling water in
Cooling water out
Pumping ring
Temperature indicator
Should normally be closed
TI
Should normally be closed

Description

Product recirculation from seal chamber to heat exchanger and back to seal chamber.

Features

1. Circulation is maintained by pumping ring.
2. In idle condition heat transfer is maintained by thermosyphon effect and in running condition by a pumping ring.
3. Lower product stabilization temperature is achieved.
4. Establishes required margin between fluid vapour pressure and seal chamber pressure.

Use

1. In hot and clean services e.g. in boiler feed water and hot hydrocarbon services.

Caution

1. Maintain maximum 0.6m horizontal distance from seal chamber to heat exchanger.
2. Vent valve required at highest point of piping system.
3. Ensure that pump has a close clearance throat bush.
4. Ensure that the seal outlet connection is in the top half of the gland.
5. Ensure that the cooler is mounted above the pump centre line.
6. Vent the system fully before start up.
7. A distributed flush injection is not recommended with a piping plan 23.

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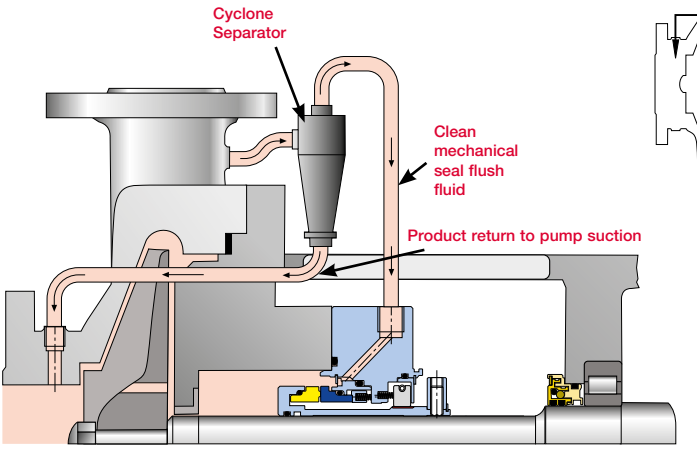
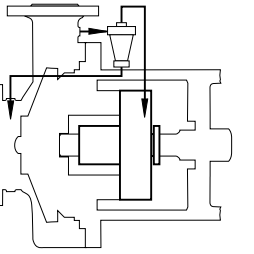
API PLAN 31


Cyclone
Separator
Clean
mechanical
seal flush
fluid
Product return to pump suction



API PLAN 31

Description
Product recirculation from discharge through a cyclone separator, which directs clean fluid to the seal and solids back to pump suction.

Features
1. Removes entrained solids from the process fluid.
2. Particles from cyclone separator are returned to suction.

Use
1. Used in media with suspended solids.

Caution
1. Pump throat bushing is recommended.
2. Ensure use for services containing solids with specific gravity twice or more than that of process fluid.
3. Efficiency of a cyclone separator is proportional to the diameter. A larger cyclone diameter leads to less efficient separation, a smaller cyclone diameter provides more efficient separation.
4. If the process stream is very dirty or is a slurry, Piping Plan 31 typically is inadequate and is not recommended.
5. The use of a throat bush is recommended.
6. This plan has not proven to consistently achieve a three year operating life.

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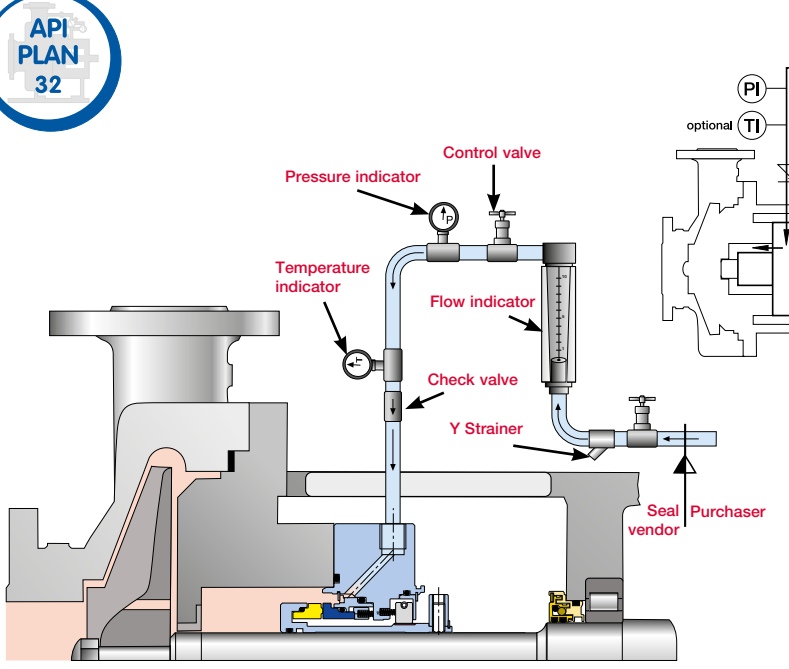
API PLAN 32


optional
FI
PI
optional
TI
seal vendor
purchaser
Control valve
Pressure indicator
Temperature indicator
Flow indicator
Check valve
Y Strainer
Seal vendor
Purchaser

API PLAN 32

Description
Injection of clean or cool liquid from external source into the seal chamber.

Features
1. Reduces flashing or air intrusion across seal faces by providing a positive flush.
2. Maintains vapour pressure margin.
3. Always provided at a pressure greater than seal chamber pressure.
4. If maintained properly the best of all single seal plans (subject to acceptance of contamination).

Use
1. Dirty or contaminated fluids.
2. High temperature applications.
3. Polymerizing and oxidizing fluids.
4. Media with poor lubrication properties.

Caution
1. External source should be continuous and reliable at all times, even during start up and shut down.
2. Flush fluid must be compatible with process fluid due to product contamination.
3. Product degradation can occur.
4. Ensure use with close clearance throat bushing to maintain pressure in stuffing box and control the rate of contamination of pumped media.
5. Careful selection of flush fluid required to ensure that it does not vaporized on entering the seal chamber.
6. Fluid expenditure of Plan 32 may be as expensive as one or more seals per year.

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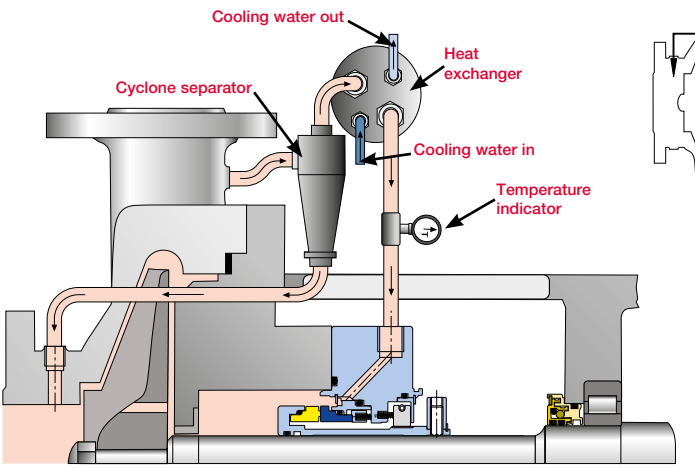
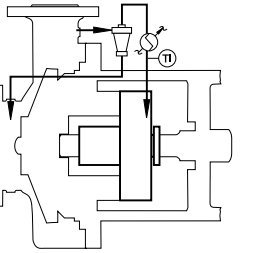
API PLAN 41


Cooling water out
Heat exchanger
Cyclone separator
Cooling water in
Temperature indicator



Description

Product recirculation from discharge through a cyclone separator and a heat exchanger to seal chamber.

Features

1. Improves pressure margin to vapour pressure.
2. Improves temperature margin to meet secondary sealing element limits, to reduce coking or polymerizing and to improve lubricity.
3. Removes entrained solids from the process fluid.
4. Particles from cyclone separator are returned to suction.

Use

1. In hot services containing suspended solids.

Caution

1. Pump throat bushing is recommended.
2. Ensure use for services containing solids with specific gravity twice or more than that of process fluid.
3. Cooler duty is high leading to fouling on waterside.
4. Efficiency of a cyclone separator is proportional to the diameter. A larger cyclone diameter leads to less efficient separation, a smaller cyclone diameter provides more efficient separation.

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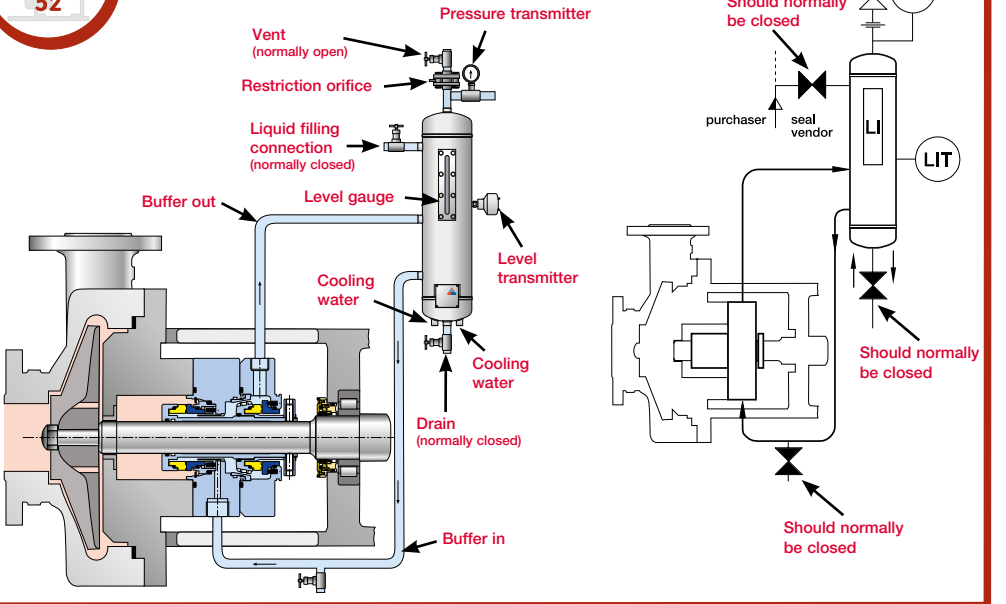
Water Savings

25 billion gallons

"**AESSEAL®** Seal Support Systems save in excess of **25 billion** US gallons / **95 billion** litres of water for customers **each year**."

BETWEEN SEALS API PLANS

API PLAN 52


Vent
(normally open)
Pressure transmitter
Restriction orifice
Liquid filling
connection
(normally closed)
Buffer out
Level gauge
Level
transmitter
Cooling
water
Cooling
water
Drain
(normally closed)
Buffer in
Should normally
be closed
PIT
purchaser
seal
vendor
LI
LIT
Should normally
be closed
Should normally
be closed

Description

Depressurised buffer fluid circulation in outboard seal of a dual seal configuration through a seal support system. Circulation is maintained by using pumping ring in running condition and by thermosyphon effect in stand still condition.

Features

1. No process contamination.
2. No direct process leakage to atmosphere.
3. No need to maintain pressure system as in Plan 53A.

Use

1. For media where product dilution is not allowed but leakage to atmosphere in diluted form may be allowed.
2. Preferred for clean, non-polymerizing media with vapour pressure higher than buffer fluid pressure (Is also used for lower vapour pressure media).

Caution

1. Keep the sealant vessel vent continuously open, which is necessary to maintain buffer fluid pressure close to atmospheric pressure and vent the vapours to flare.
2. Should not be used in dirty or polymerizing products.
3. A restriction orifice is necessary in vent line to maintain back pressure in pot and facilitate quick release of vapours to flare.
4. Pressure switch setting should be done above minimum flare back pressure in order to avoid false alarms.
5. Never run the system with level in the sealant vessel being at low level as marked on the level gauge.
6. Check for temperature difference in inlet and outlet lines to ensure that circulation is on.
7. Vent the system properly before start up.

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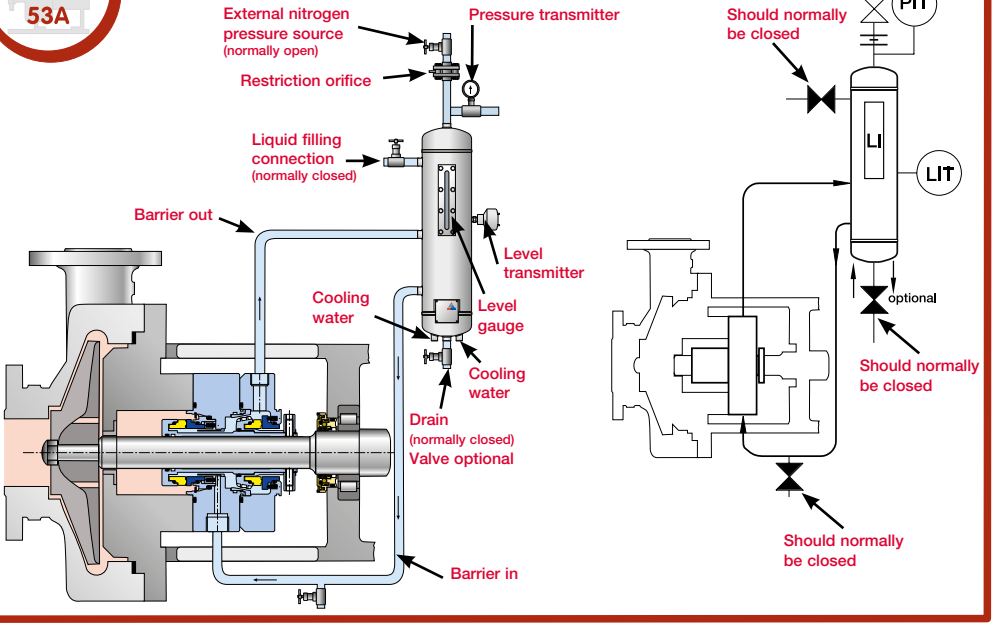
API PLAN 53A


External nitrogen pressure source (normally open)
Pressure transmitter
Restriction orifice
Liquid filling connection (normally closed)
Barrier out
Level transmitter
Level gauge
Cooling water
Cooling water
Drain (normally closed) Valve optional
Barrier in
Should normally be closed
PIT
LI
LIT
optional
Should normally be closed
Should normally be closed

API PLAN **53A**

Description

Pressurised barrier fluid circulation in outboard seal of dual seal configuration through a seal support system. Circulation is maintained by using pumping ring in running condition and with thermosyphon effect in stand still condition.

Features

1. In no case will media leak to atmosphere (Provided the seal support system pressure is not lost).
2. Clean fluid film formation between the inboard seal faces gives better seal life.
3. Works as a Plan 52 arrangement if barrier fluid pressure is lost.

Use

1. Applications where no leakage to atmosphere can be tolerated e.g. hazardous, toxic, inflammable media.
2. For dirty, abrasive or polymerizing products where media is unsuitable as a lubricant for inboard seal faces.

Caution

1. There will always be some leakage of barrier fluid into the product. Check compatibility of barrier fluid with product.
2. Always ensure that the pressure source maintains higher pressure at the seal support system so that process does not dilute the barrier fluid.
3. Vent the system properly before start up.
4. In certain cases the inert gas can dissolve in the barrier media.
5. Product quality can deteriorate due to barrier fluid contamination.

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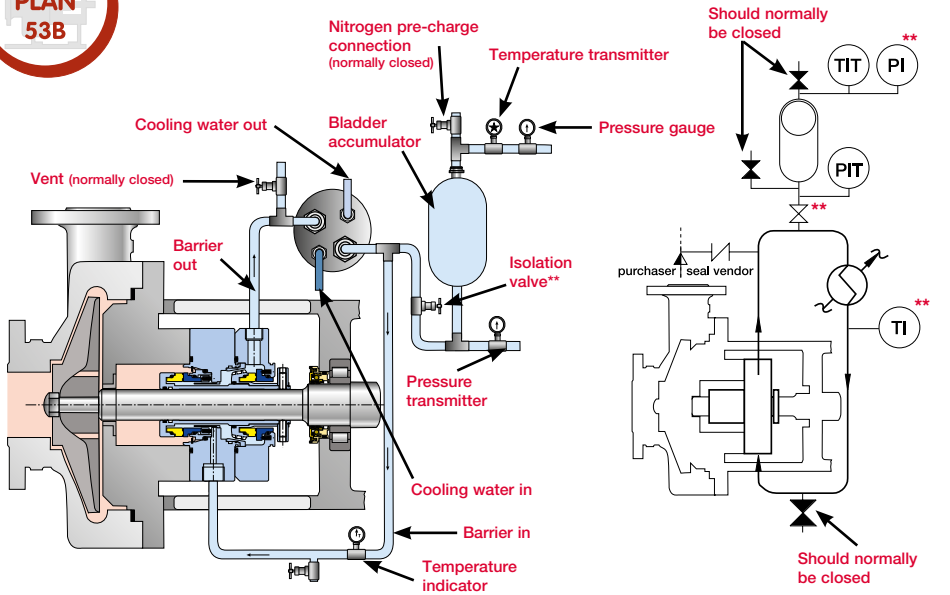
API PLAN 53B



** If specified

API PLAN **53B**

Description

Pressurised barrier fluid circulation in outboard seal of dual seal configuration. Circulation is maintained by using pumping ring in running condition and with thermosyphon effect in stand still condition. The pressure is maintained in the seal circuit by a bladder accumulator.

Features

1. Keeps barrier fluid and pressurised gas (inert gas) separate by using a bladder.
2. Heat is removed from the circulation system by an air-cooled or water-cooled heat exchanger.
3. Being a stand-alone system does not rely upon a central pressure source. Hence much more reliable than a Plan 53A.
4. In no case will media leak to atmosphere.
5. Clean fluid film formation between the inboard seal faces gives better seal life.

Use

1. Applications where no leakage to atmosphere can be tolerated e.g. hazardous, toxic, inflammable media.
2. For dirty, abrasive or polymerizing products where media is unsuitable as a lubricant for inboard seal faces.

Caution

1. There will always be some leakage of barrier fluid into the product. Check compatibility of barrier fluid with product.
2. Low volume of barrier fluid in system, hence heat dissipation is totally dependent on cooler efficiency.
3. Always precharge bladder to 0.9 times the minimum working pressure.
4. Vent the system properly before start up.
5. Product quality can deteriorate due to barrier fluid contamination.

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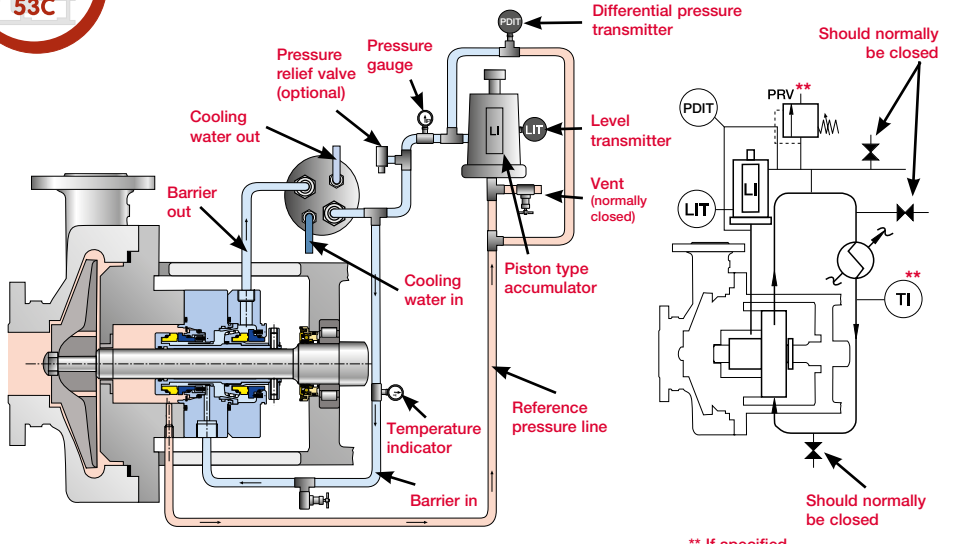
API PLAN 53C


PDIT
Differential pressure transmitter
Should normally be closed
Pressure relief valve (optional)
Pressure gauge
Cooling water out
LI
LIT
Level transmitter
Barrier out
Vent (normally closed)
Cooling water in
Piston type accumulator
Reference pressure line
Temperature indicator
Barrier in
PRV **
PDIT
LIT
LI
TI **
Should normally be closed
** If specified

API PLAN **53C**

Description

Pressurised barrier fluid circulation in outboard seal of dual seal configuration. Circulation is maintained by using pumping ring in running condition and with thermosyphon effect in stand still condition.
The pressure is maintained and fluctuations are compensated in the seal circuit by a piston type accumulator.

Features

1. Vent system properly before start up.
2. Heat is removed from the circulation system by an air-cooled or water-cooled heat exchanger.
3. In no case will the media leak to the atmosphere.
4. Clean fluid film formation between the inboard seal faces gives better seal life.
5. This allows successful operation of dual seals lacking reverse balance feature at inboard seal, when having highly variable seal chamber pressure.

Use

1. Applications where no leakage to atmosphere can be tolerated e.g. hazardous, toxic, inflammable media.
2. For dirty, abrasive or polymerizing products where media is unsuitable as a lubricant for inboard seal faces.
3. Where pump pressure varies during operation needing an auto setting of barrier fluid pressure, thus maintaining the same differential throughout.

Caution

1. Always connect reference pressure line from seal chamber to accumulator and keep it open.
2. There will always be some leakage of barrier fluid into the product. Check compatibility of barrier fluid with product.
3. Vent the system properly before start up.
4. Product quality can deteriorate due to barrier fluid contamination.

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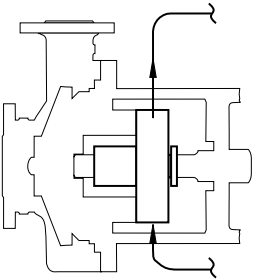
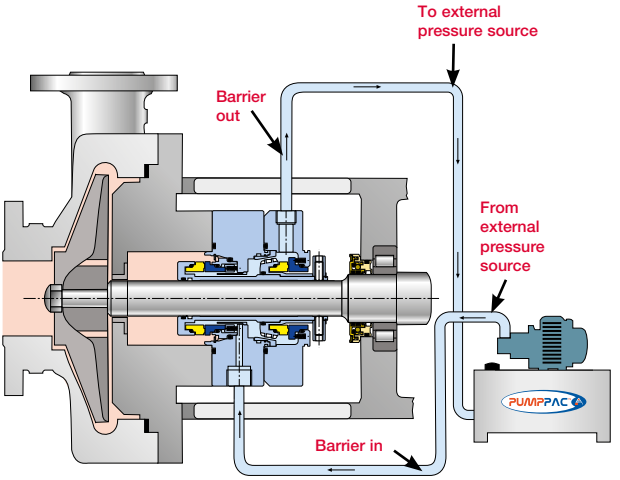
ENVIRONMENTAL TECHNOLOGY

API PLAN 54




To external pressure source
Barrier out
From external pressure source
Barrier in
PUMPPAC

API PLAN 54

Description:

Pressurised external barrier fluid circulation from a central pressure source or by a stand alone pumping unit (e.g. AESSEAL® PUMPPAC™).

Features:

1. Ensures higher flow rate, better heat dissipation and positive circulation of barrier fluid.
2. If maintained properly, is the most reliable pressurised plan for dual seals as compared to Plan 53 A/B/C.
3. Can also be given as a stand alone unit per pump.
4. Increases cooler efficiency due to higher flow rate to the heat exchanger.

Uses:

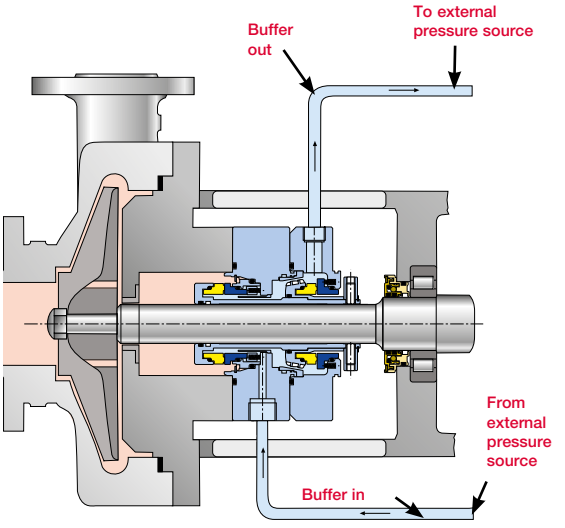
1. Applications where no leakage to atmosphere can be tolerated e.g. hazardous, toxic, inflammable.
2. For dirty, abrasives or polymerizing products where media is unsuitable as a lubricant for inboard seal faces.
3. For media with high pressure and / or high temperature and / or high heat generation between faces.
4. Wherever Plan 53 A/B/C circulation is insufficient to dissipate heat.

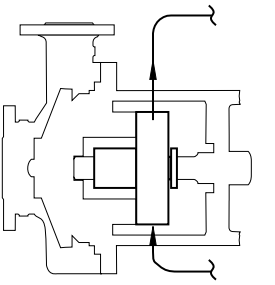
Caution:

1. Carefully consider the reliability of barrier fluid source, if a central source is used.
2. Circulating system must be pressurised at least 1.5 bar greater that the pressure in the seal chamber.
3. Product contamination does occur. Barrier fluid selected should be compatible with the process fluid.
4. Always check filter / strainer in the system for any possible blockages.
5. Loss of pressure in system can lead to entire barrier liquid contamination.
6. Product quality can deteriorate due to barrier fluid contamination.

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

API PLAN 55


Buffer out
To external pressure source
From external pressure source
Buffer in



Description:

Unpressurised external buffer fluid circulation from a central pressure source or by a stand alone pumping unit

Features:

1. Ensures higher flow rate, better heat dissipation and positive circulation of buffer fluid.
2. Can also be given as a stand-alone unit per pump.
3. Increases cooler efficiency due to higher flow rate to the heat exchanger.
4. No process contamination.
5. No direct leakage to atmosphere.

Uses:

1. For media where product dilution is not allowed but leakage to atmosphere in diluted form maybe allowed
2. Preferred for clean, non-polymerizing media that may solidify in contact with atmosphere.
3. For media with high pressure and / or high temperature and / or high heat generation between faces.
4. Wherever Plan 52 circulation is insufficient to dissipate heat.

Caution:

1. Carefully consider the reliability of buffer fluid source, if a central source is used.
2. Circulating system pressure must be less than seal chamber pressure and less than 28bar
3. Always check filter / strainer in the system for any possible blockages.
4. Not suitable for polymerizing media.
5. Ensure suitable flow is maintained at all times.

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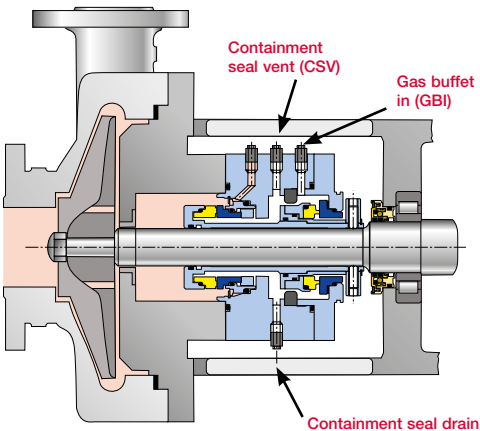
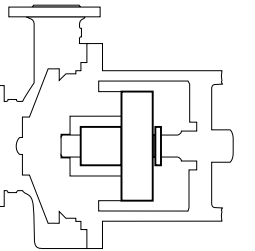
API PLAN 71


Containment
seal vent (CSV)
Gas buffet
in (GBI)
Containment seal drain



Description

Plugged connections for future provision to supply a buffer gas to a dual containment seal.

Features

1. Vent port can be piped to use as ‘CSV’ in Plan 76.
2. Drain port can be piped to use as ‘CSD’ in Plan 75.
3. GBI port can be piped to use as in Plan 72.

Use

1. For future provisions for API Plans 72, 75 and 76.

Caution

1. Always keep the ports plugged.
   Used for: 2CW-CS.

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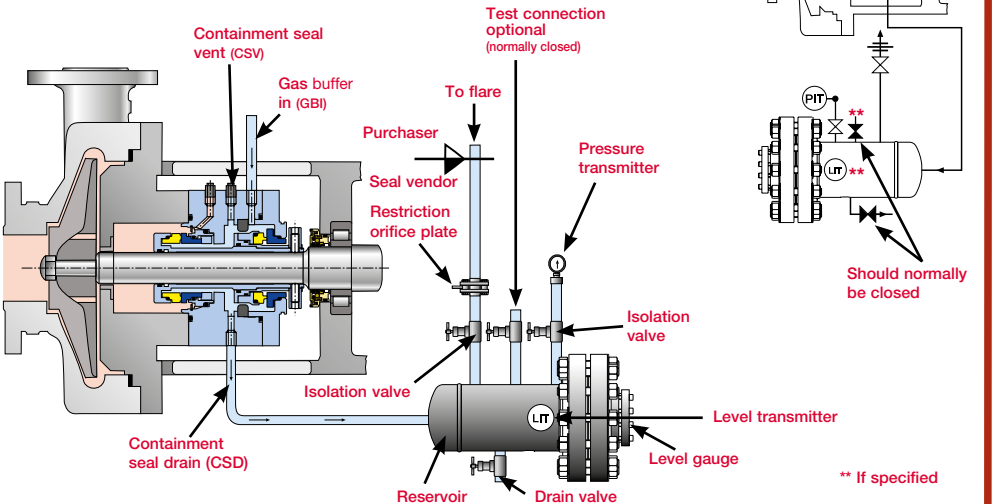
API PLAN 75


Containment seal vent (CSV)
Gas buffer in (GBI)
Test connection optional (normally closed)
To flare
Purchaser
Seal vendor
Pressure transmitter
Restriction orifice plate
Isolation valve
Isolation valve
Level transmitter
Level gauge
Containment seal drain (CSD)
Reservoir
Drain valve
PIT
LIT
**
**
Should normally be closed
** If specified

Description

Leakage of condensate from inboard seal of a dual containment seal is directed to a liquid collector.

Features

1. Can be used with Plan 72 with buffer gas or with Plan 71 without buffer gas systems.
2. Collection can be redirected to process fluid by using separate pumping device.
3. Can also be used with a single containment seal.
4. Test connection is provided to check the inner seal by closing the block isolation valve while pump is in operation and noting the time / pressure build-up relationship in the collector.

Use

1. Duties with condensing leakages.
2. Hazardous, toxic fluids.
3. May also be used for non-condensing leakages. In such cases, the collector can help in collecting condensate from the vapour recovery system.

Caution

1. Ensure that collection system is located below the seal drain with sloping pipelines.
2. Drain port should be at bottom of containment seal to allow the leakage to flow to the collection system.
3. Collection system should always be vented releasing vapours of process liquid to vapour recovery system.
4. Valves that are installed should be accessible to operator relative to ground clearance and other obstructions.
5. A flow control orifice is required to create back pressure on collection system and to have effective condensation of vapours.
6. Pressure transmitter should be set to alarm at a gauge pressure of 0.7 bar.

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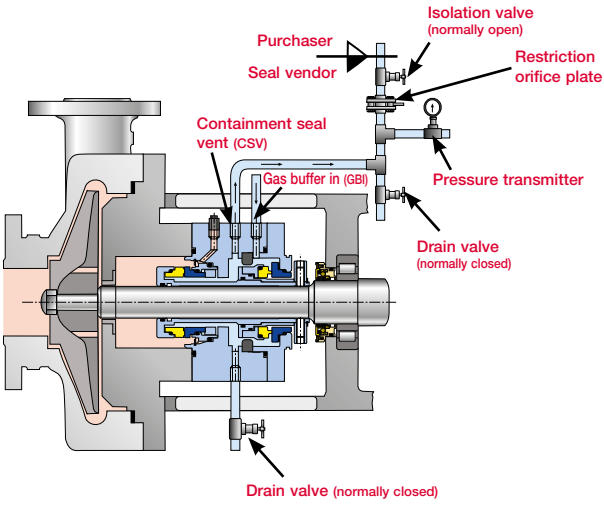
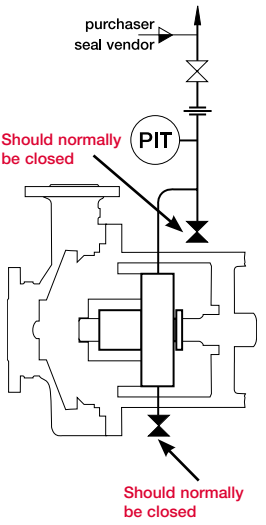
API PLAN 76


Isolation valve
(normally open)
Purchaser
Seal vendor
Restriction
orifice plate
Containment seal
vent (CSV)
Gas buffer in (GBI)
Pressure transmitter
Drain valve
(normally closed)
Drain valve (normally closed)


purchaser
seal vendor
Should normally
be closed
PIT
Should normally
be closed

Description

Vapour leakages from inboard seal of dual containment seal are directed to a vapour recovery system via a vent connection.

Features

1. Can be used with Plan 72 with buffer gas or with Plan 71 without buffer gas system.
2. Vapour leakage collection ensures zero to very low process emissions from outboard containment seal.

Use

1. For high vapour pressure fluids, light hydrocarbons.
2. For hazardous or toxic media.

Caution

1. Do not use for condensing media.
2. Ensure continuous vent to low pressure vapour recovery or flare system.
3. Tubing shall be 1/2” (13mm) minimum diameter and shall rise continuously from the CSV connection to the piping / instrumentation harness.
4. A flow control orifice is required to generate back pressure.
5. Ensure proper support to harness piping.
6. Ensure a low point drain in the system.

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ENVIRONMENTAL TECHNOLOGY

Environmental Benefit

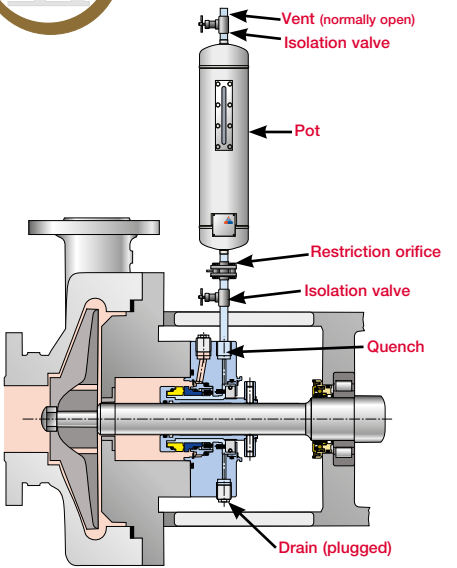
Charity registration number 288701

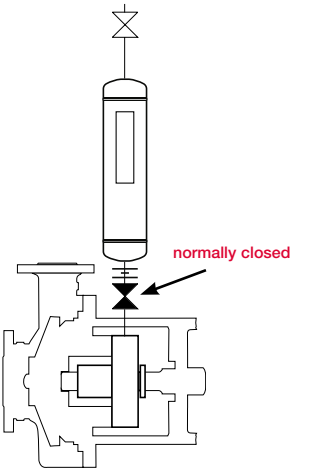
www.wateraid.org

AESSEAL® feel that the **environmental impact** of global water consumption is too big an issue to ignore. WaterAid is an international charity **dedicated** to their vision of helping people all over the globe escape the stranglehold of **poverty** and **disease** caused by living without water and sanitation. **AESSEAL®** share in this vision and as a result we have entered into an **agreement with WaterAid**, where we **donate** a percentage of our profits from Seal Support Systems to the **charity**. This means that when you install a Seal Support System **you are helping** WaterAid to provide clean water and sanitation to those who really need it.

ATMOSPHERE API PLANS

API PLAN 51


Vent (normally open)
Isolation valve
Pot
Restriction orifice
Isolation valve
Quench
Drain (plugged)


normally closed

Description

External reservoir providing a dead-ended blanket for fluid to the quench connection of the gland.

Features

1. Can prevent ice formation on the atmospheric side of the seal.
2. No need to maintain pressure system as in Plan 53A.

Use

1. Preferred for clean, non-polymerizing media with vapour pressure higher than buffer fluid pressure.
2. One method of operation is to fill the quench reservoir with a suitable liquid. While preparing the pump for start up the block valve below reservoir is opened allowing the quench fluid to sit in the area between the seal and throttle bushing. Prior to start-up block valve is closed to ensure the pot is only exposed to atmospheric pressure.

Caution

1. Keep pot vent continuously open, which is necessary to maintain buffer fluid pressure close to atmospheric pressure and vent the vapours to flare.
2. Should not be used with dirty or polymerizing products.
3. Never run the system with level in the sealant vessel at low level as marked on the level gauge.
4. Vent the system properly before start up.
5. This piping plan is only recommended for vertical applications.

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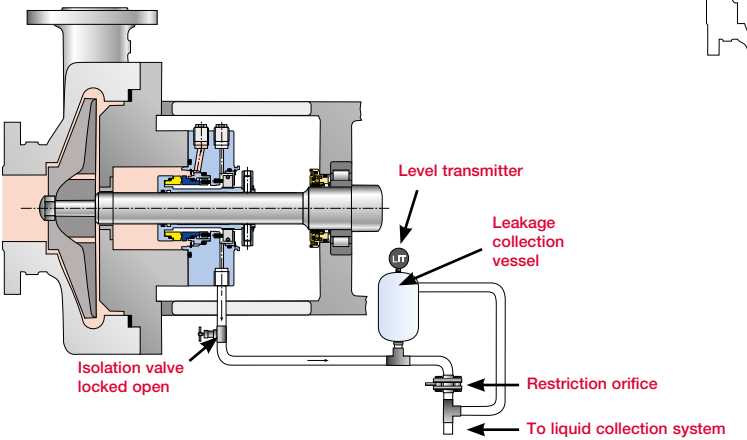
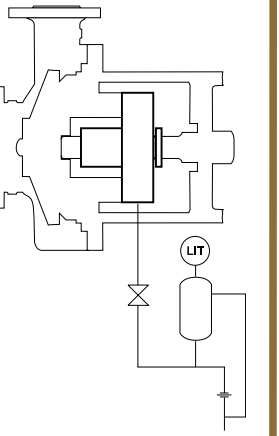
API PLAN 65A


Level transmitter
LIT
Leakage collection vessel
Isolation valve locked open
Restriction orifice
To liquid collection system


LIT

API PLAN **65A**

Description

Leakage from seal faces is directed to a liquid collection system. A vessel with a high level alarm is provided for detection of excess leakage.

Features

1. Normally used with single seals where the leakage is expected to be mostly liquid.
2. Piping is connected to the drain connection of the gland plate.
3. Excessive flowrates are restricted by the orifice downstream of the vessel causing leakage to accumulate in the vessel activating level alarm.
4. Vessel overflow prevents vessel pressurisation in event of seal failure.

Use

1. In services where seal leakage is condensing.
2. Used for single seals.

Caution

1. Vent connection should always be plugged.
2. Orifice downstream of the level switch should be located in vertical piping leg to avoid accumulation of fluid in drain piping.
3. Shut down the pump as soon as high-level alarm is activated and attend the seal.
4. Reservoir must be located below seal gland.

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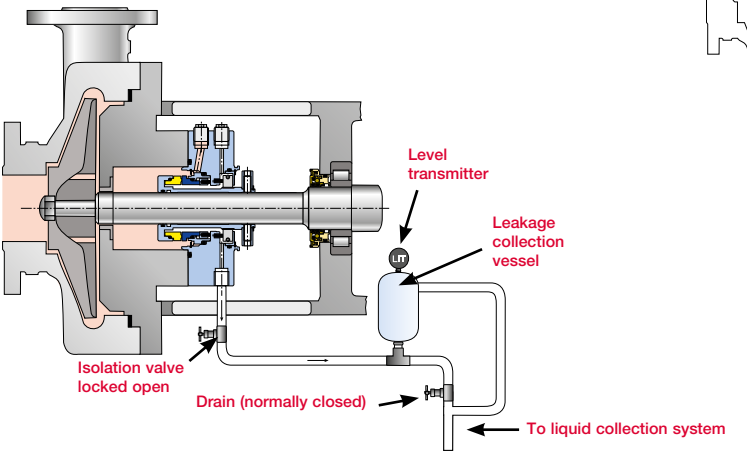
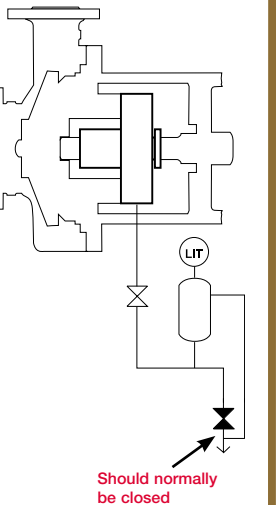
ENVIRONMENTAL TECHNOLOGY

API PLAN 65B


Level transmitter
LIT
Leakage collection vessel
Isolation valve locked open
Drain (normally closed)
To liquid collection system


LIT
Should normally be closed

API PLAN **65B**

Description

Leakage from seal faces is directed to a liquid collection system. A vessel with a high level alarm is provided for detection of cumulative leakage.

Features

1. Normally used with single seals where the leakage is expected to be mostly liquid.
2. Piping is connected to the drain connection of the gland plate.
3. Leakage is collected in the vessel until the high level alarm is reached. Excessive fill rate indicates seal failure.
4. Vessel overflow prevents vessel pressurisation in event of seal failure.

Use

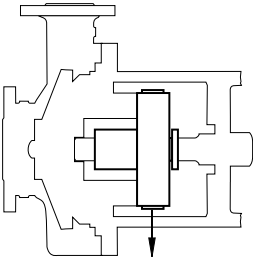
1. In services where seal leakage is condensing.
2. Used for single seals.

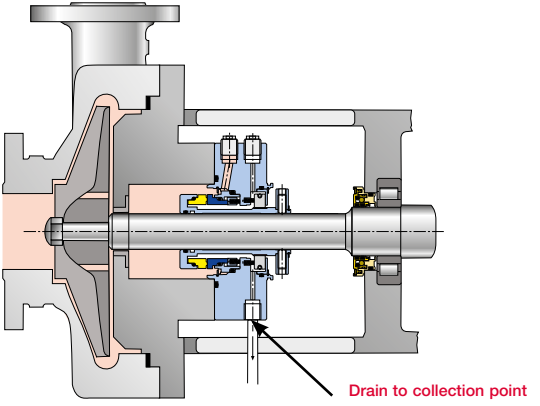
Caution

1. Vent connection should always be plugged.
2. Overflow line should bypass system drain valve.
3. The valve between seal and system must remain open during pump operation.
4. Reservoir must be located below seal gland.

AESSEAL
ENVIRONMENTAL TECHNOLOGY

API PLAN 61





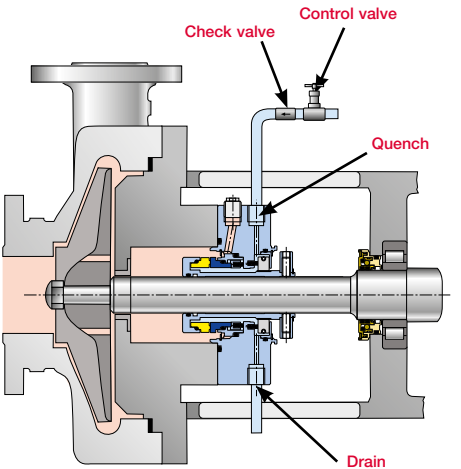
Description
Plugged connections for future use for Plan 62 or Plan 65.

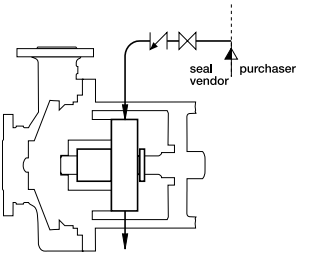
Features
1. The drain connection can be piped in order to collect leakage and use as Plan 65.
2. Both quench and drain can be piped and used as quench in and out connection as Plan 62.

Use
1. For future provision.

Caution
1. Always keep ports plugged.

API PLAN 62


Control valve
Check valve
Quench
Drain


seal vendor
purchaser

Description

An external fluid stream is brought to atmospheric side of the seal faces using quench and drain connections.

Features

1. The quench fluid acts as barrier in between atmosphere and process fluid.
2. The quench fluid reduces oxidation and coking of product and also cools seal faces.
3. Flushes away undesirable material build up under seal faces.
4. Can be used with water, steam or an inert gas.

Use

1. In caustic or crystallising fluids.
2. In oxidizing fluids or hot hydrocarbons.
3. Can be used to purge steam in hot applications especially for stationary bellows to avoid coking.

Caution

1. Ensure availability of continuous supply of low-pressure quench fluid limited to maximum 1 bar.
2. Use of throttle bushing on atmosphere side is mandatory.
3. Use proper bearing isolators to ensure that the quench fluid does not enter the bearings.

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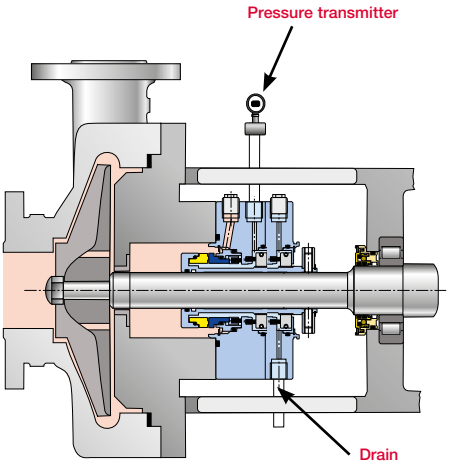
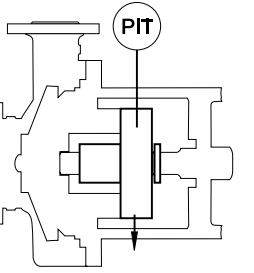
API PLAN 66A





Description:

Throttle bushing in seal gland restricts seal leakage in event of seal failure. Pressure increase is detected by a pressure transmitter.

Features:

1. Normal leakage passes, inner restriction bush to drain.
2. Excess leakage is restricted by inner bush from leaving seal gland causing pressure increase, which is sensed by the pressure transmitter.
3. Leakage is directed to liquid recovery system or sump.

Uses:

1. Intended for use with arrangement 1 seals where it is required to limit leakage in case of seal failure.

Caution:

1. Drain connection must be at the bottom position.

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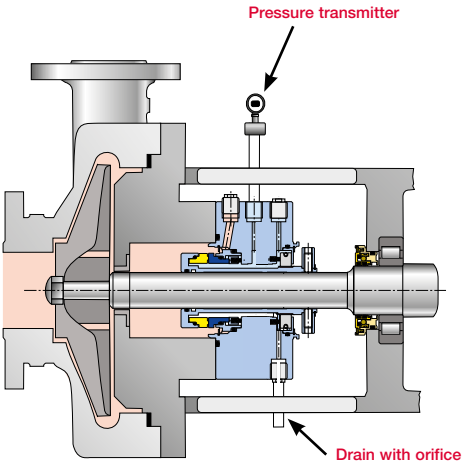
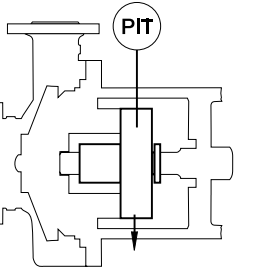
ENVIRONMENTAL TECHNOLOGY

API PLAN 66B


Pressure transmitter
Drain with orifice plug installed


PIT

API PLAN **66B**

Description:

Orifice plugs in drain port restricts seal leakage in event of seal failure. Pressure increase detected by pressure transmitter.

Features:

1. Normal leakage passes through orifice plug to drain.
2. Excess leakage is restricted by orifice plug from leaving seal gland causing pressure increase, which is sensed by the pressure transmitter.
3. Leakage is directed to liquid recovery system or sump.

Uses:

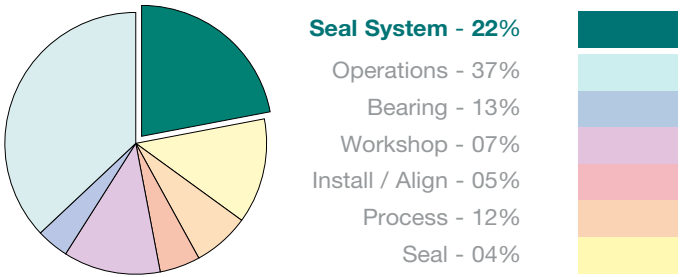
1. Intended for use with arrangement 1 seals where it is required to limit leakage in case of seal failure.

Caution:

1. Drain connection must be at the bottom position.

AESSEAL
ENVIRONMENTAL TECHNOLOGY

Reliability Enhancement



Research has **proven** that the best way to prevent mechanical seal failure is the use of **effective Seal Support Systems** (please see the pie chart). This means that no matter how well designed your mechanical seal or bearing systems are, without a reliable Seal Support System there is still the possibility of your mechanical seal failing. The **innovative and reliable** Seal Support System Range at AESSEAL® gives customers the **confidence** to remove this root cause of mechanical seal failure.

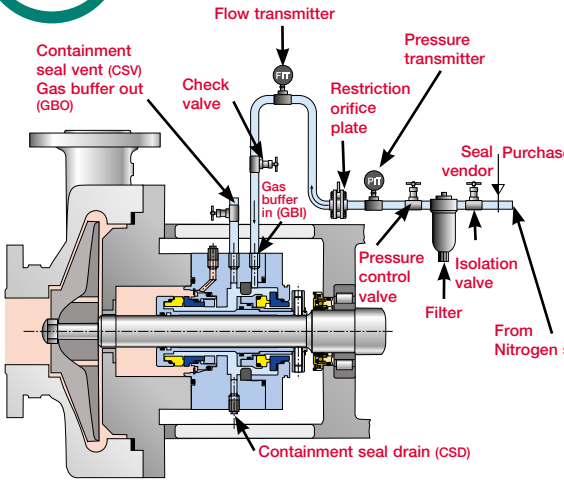
Source: Stephen Flood, Performance Plus Ltd - "Mechanical Seal Reliability - What Realistically Can Be Achieved?" presented at The Mechanical Sealing Technology Seminar, I Mech E, London, April 07

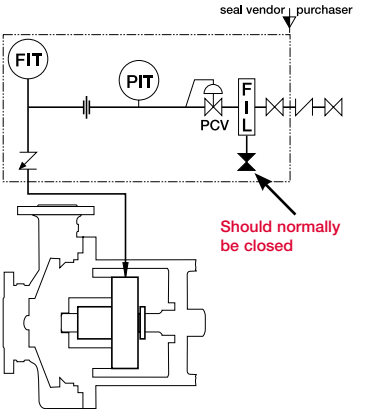
AESSEAL®

ENVIRONMENTAL TECHNOLOGY

GAS SEAL API PLANS

API PLAN 72


Flow transmitter
Containment seal vent (CSV) Gas buffer out (GBO)
Check valve
Restriction orifice plate
Pressure transmitter
Seal vendor
Purchaser
Gas buffer in (GBI)
Pressure control valve
Isolation valve
Filter
From Nitrogen source
Containment seal drain (CSD)
FIT
PIT


seal vendor
purchaser
FIT
PIT
PCV
F I L
Should normally be closed

Description

Buffer gas is passed through the containment seal chamber to sweep inner seal leakage away from outer seal to a collection system and / or dilute the leakage.

Features

1. Used in conjunction with API Plan 75 and/or 76.
2. Nitrogen provides cooling to seal faces.
3. Nitrogen blanket reduces the explosion hazard in high vapour pressure liquids.
4. This plan is used in conjunction with Plan 75 and 76.

Use

1. For flashing hydrocarbons.

Caution

1. Always ensure that buffer gas pressure is less than seal chamber pressure.
2. Set the forward Pressure control valve at minimum 0.4 bar above flare back pressure.

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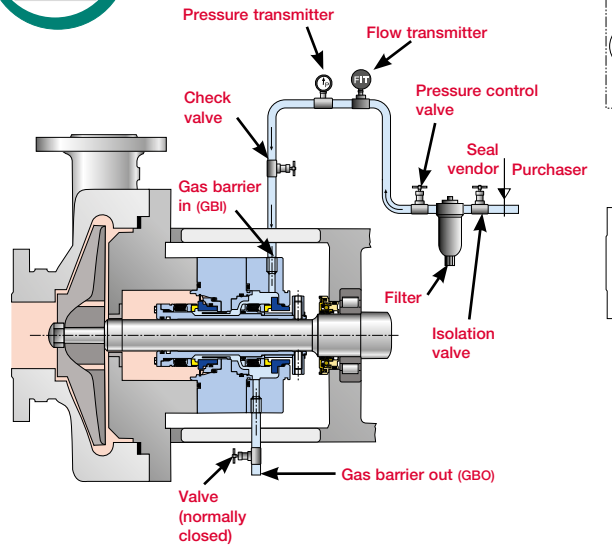
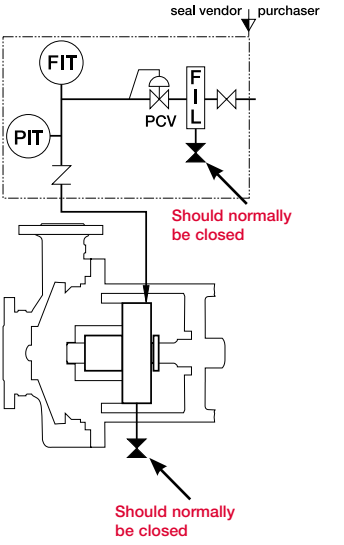
API PLAN 74


Pressure transmitter
Flow transmitter
Check valve
Pressure control valve
Seal vendor
Purchaser
Gas barrier in (GBI)
Filter
Isolation valve
Gas barrier out (GBO)
Valve (normally closed)


seal vendor
purchaser
FIT
PIT
PCV
F I L
Should normally be closed
Should normally be closed

Description

Externally pressurised barrier gas supplied through a gas control system to a dual seal arrangement. An inert gas is used as a barrier gas.

Features

1. Media leakage to atmosphere is eliminated.
2. Obtain very high reliability, as solids or other materials, which can lead to premature seal failure, are not present in barrier gas.

Use

This plan is intended to be used for dual pressurised non-contacting gas seals.

1. Used in services which are not hot (within elastomer temperature limit) but which may contain toxic or hazardous material whose leakage to atmosphere can not be tolerated.
2. Where process contamination is allowed but process liquid leakage to atmosphere is not allowed.

Caution

1. Always ensure barrier gas pressure is higher than seal chamber pressure.
2. Causes media contamination due to high-pressure nitrogen entering the pump.
3. Pressure control valve should be set at least 1.7 bar greater than the seal chamber pressure.
4. Carefully consider the reliability of barrier pressure source, if central pressure issued.
5. Always check filter for any possible blockage.
6. Do not use for sticking or polymerizing media.

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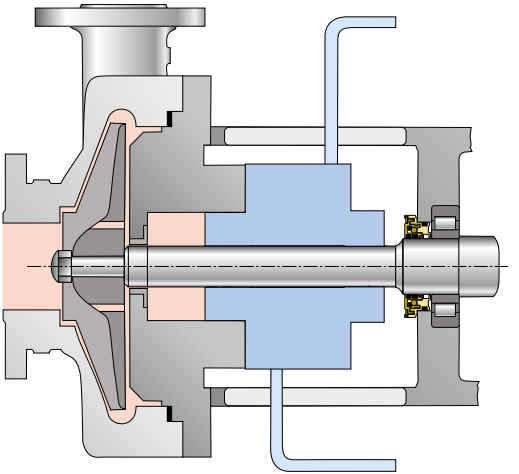
API PLAN 99



Description
Engineered piping plan not defined by other existing plans.

Features
Engineered system to suit the specific requirements of the customer.

Use
Can be applicable to any seal arrangement.

Caution
Detailed engineering and customer input required for effective solution.

AESSEAL
ENVIRONMENTAL TECHNOLOGY

API PLANS AND SYSTEMS PRODUCT GRID

	CYCL™	EasyClean™	FLOWTRUE®	SW2™	FDU™	SWM™ & SWP™	SWFF-TF™	SP2™
Plan 21								
Plan 22								
Plan 23								
Plan 31	●●●●●							
Plan 32			●●●●●					
Plan 41	●●●●●							
Plan 51								
Plan 52		●●●●●						●●●●●
Plan 53A		●●●●●		●●●●●		●●●●●	●●●●●	●●●●●
Plan 53B								
Plan 54			●●●●●		●●●●●			
Plan 62			●●●●●					

	AES-15™	PP/SOU™	PP/01™	PLAN 76 SYSTEM	AES-28™	PLAN 53B SYSTEM	API PLAN 65 (LDV)	PLAN 75 SYSTEM	GAS 10
Plan 21									
Plan 22									
Plan 23									
Plan 31									
Plan 32									
Plan 41									
Plan 51	●●●●●				●●●●●				
Plan 52	●●●●●				●●●●●				
Plan 53A	●●●●●				●●●●●				
Plan 53B						●●●●●			
Plan 54		●●●●●	●●●●●						
Plan 62									
Plan 65A							●●●●●		
Plan 65B							●●●●●		
Plan 72									●●●●●
Plan 74									●●●●●
Plan 75								●●●●●	
Plan 76				●●●●●					

BEARING PROTECTION

MagTecta™

LabTecta®66

CAPI™ Type A Category II and III Single and Dual Seals

CAPI™ Type B Category II and III Single and Dual Seals

CAPI™ Type C Single and Dual Seals

CAPI™ Containment Seals

SW Range

API PLAN 53A

FDU™
Fluid Distribution Unit

API PLAN 54

WATER MANAGEMENT SYSTEMS

SWM™ & SWP™

API PLAN 53A

SWFF-TF™

API PLAN 53A

WATER MANAGEMENT SYSTEMS

SP Range

API PLAN 52

API PLAN 53A

AES-15™

API PLAN 51

API PLAN 52

API PLAN 53A

PP/SOU™

API PLAN 54

PP/01™

API PLAN 54

PLAN 76 SYSTEM

API PLAN 76

AES-28™

API PLAN 51

API PLAN 52

API PLAN 53A

PLAN 53B SYSTEM

API PLAN 53B

API PLAN 65 - LEAKAGE DETECTION VESSEL (LDV)

API PLAN 65

API PLAN SYSTEMS

PLAN 75 SYSTEM

API PLAN 75

GAS SYSTEMS

GAS 10

API PLAN 72

API PLAN 74

PYTHON™

FDSC™

API PLAN 21

API PLAN 23

API PLAN 53A

API PLAN 53B

API PLAN 54

AES682C™

AES-CIC™

API PLAN 21

API PLAN 23

API PLAN 53A

API PLAN 53B

API PLAN 54

Our Purpose:

'To give our customers such exceptional service that they need never consider alternative sources of supply.'

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www.aesseal.com/en/contact-us

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