



Auxiliary Systems for mechanical seals

Technical Manual

Since 1962

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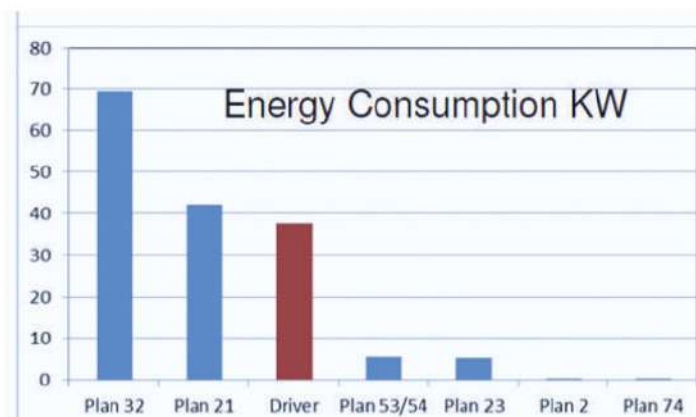
Introduction

Mechanical seals are devices fitted on pumps, mixers or other rotating equipment operating at heavy duty conditions and handling with highly toxic, flammable and lethal fluids. In pharma and food industry, mechanical seals must avoid emissions to atmosphere, but also prevent process fluid contamination coming from outside atmosphere. To grant above mentioned conditions, mechanical seal has to be double type and **flushed** or **pressurized**, which avoids process liquid leakage to atmosphere or atmosphere contaminants can come into process fluid (please see *"Alfa seminar – double mechanical seals"* section).



Together with double seal, an auxiliary system is properly designed and sized according operating conditions, including instrumentation for buffer / barrier fluid operating conditions, highlighting any possible abnormal conditions. Some services working with single mechanical seals require an **auxiliary system** to maintain proper lubrication from cooling down process fluid or using an external flushing media to maintain cleanliness into seal chamber. **Since 1962 Fluiten manufactures mechanical seals for a wide range of markets** and its technical department designed and developed auxiliary systems solutions customized in accordance with customer's specifications.

Fluiten is a member of the **European Sealing Association**. One of the main issues under focus is related to the correct selection of mechanical seals fitted on equipment with rotating shaft, especially pumps. The pump manufacturers' association is also sensitive to this topic, given wide use in various product sectors and applications. In a sample analysis, it has been seen that the correct auxiliary system selection is very important in terms of energy savings. The graph here below represents the relation between the **API Plan** selected and its Energy consumption.



SINGLE SEALS:

Plan 23 / Plan 21: Air or water heat exchanger is used to cool down process fluid to avoid its vaporization between seal faces.

Plan 31: Cyclone separates solid / abrasive particles, to have clean flushing fluid cooling seal area for lubrication purposes.

Plan 32: External flushing fluid flowing toward the process, whenever accepted by customer, maintain high seal area cleanliness.

Plan 33: Static quench placed on seal atmospheric side prevents process fluid crystallization, maintaining proper seal elasticity and operations.

Plan 65A / B: Pot detecting liquid phase process fluid leakages and highlighting any abnormal conditions by means of level alarm.

Plan 66 A/B: Mechanical seal atmospheric leakage is highlighted by a pressure alarm connected to seal



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Plan 76: Gas phase leakage is controlled and directed toward flare or gas treatment area.

DOUBLE PRESSURIZED SEALS:

Plan 53A: Pressurized reservoir grants zero process fluid emissions to atmosphere, maintaining a cooled and clean liquid between inner and outer seal faces.

Plan 53B: Pressurized bladder accumulator grants zero process fluid emissions to atmosphere and cooled and clean liquid between inner and outer seal faces.

Plan 78: Pressurization by means of inert gas (e.g. Nitrogen) grants process fluid emissions to atmosphere and proper double seal operations.

Flushing Fluid Selection

THE CHOICE OF AUXILIARY LIQUID

Pressurized flushing fluid (plan 52): pressurized clean fluid injected into stuffing box area

Buffer fluid: used in a dual mechanical seal configuration, unpressurized

Barrier fluid: used in a double mechanical seal configuration, pressurized

Quench: external flushing fluid injected at atmospheric pressure, normally water, dry steam or nitrogen

FLUSHING FLUID MUST NOT BE HARMFUL TO PEOPLE AND THE ENVIRONMENT, DANGEROUS, TOXIC OR FLAMMABLE.

For proper cooling performances, promoting good lubrication and avoiding overheating, mechanical seal must work with a liquid film between seal faces or gas in "gas lift-off" seals using Fluidift patented technology. Mechanical seals and auxiliary systems selections are based on operating conditions and process fluid characteristics. It is essential to ensure that the selected fluid is compatible with the process fluid and the seal components.



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• It shall be compatible with process fluid and with material of mechanical seal and auxiliary system. Final approval / selection of the same must be done by end user to certify its compatibility with process fluid.

• Buffer / barrier fluid shall circulate through auxiliary system circuit to remove heat generated by seal faces. For this reason its viscosity cannot be too high.

TYPE OF AUXILIARY LIQUID CIRCULATION	VISCOSITY (cSt): 1 cSt-1 mm ² /s
Natural circulation "Thermosiphoning effect"	Max 1 cSt @ 40°C
Forced circulation with pumping ring on the seal (Plan 52, Plan 53)	Max 14 cSt @ 40°C
Forced circulation with external pump (Plan 54)	Max 32 cSt @ 40°C

In applications with rotation speeds higher than 20 m/s and pressures higher than 20 bar it is necessary to limit the coefficient of friction and the heat generated, limiting the viscosity value of the barrier liquid keeping it below 14 cSt. A low viscosity value prevents blistering on graphite. The pressurized solution with inert gas (see "gas lift-off Fluidift" seals) is a very good alternative to "Wet" seals where operating conditions allow it.

LIQUID	FEATURES	APPLICATION	USE & PROCESS TEMPERATURE
Water Distilled Water Deionized Water	•Lubrication capacity: low •Heat transmission: excellent Not recommended when sliding face combination is hard vs hard (i.e. both are in silicon carbide or tungsten carbide).	•Low duty services, food and pharma industry. •Water pour point must be considered carefully when selecting it as flushing fluid.	10 + 80 °C
Water + Ethylene Glycol	•Lubrication capacity: good •Heat transmission: good To be used without salt.	•Medium duty services. •Suitable as flushing liquid with light hydrocarbons. •It is not recommended to select a glycol concentration above 50%.	-20 + 100 °C (30%/70%) -35 + 110 °C (40%/60%)



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			-120 + 80 °C (Propand)
Mineral Oil	•Lubrication capacity: excellent •Heat transmission: good Desparates from distillation and hydrogenation processes and represents the highest quality for lubrication purposes products. Mineral oil, if working for long time at high temperatures modifies its properties, being not suitable for seal lubrication anymore. Coking deposition on seal atmospheric side can start around 80°C.	•Medium and heavy-duty services. •Hydrocarbons services. •Recommended viscosity between 5 and 32 cSt. •Barrier fluid temperature should be kept below 80°C.	0 + 120°C

Flushing Fluid Selection

LIQUID	FEATURES	APPLICATION	USE & PROCESS TEMPERATURE
Synthetic Oil	Lubrication capacity: good. Heat transmission: low Derivates from chemical synthesis normally based on polyoliphatic base (PAOs). Characteristics comparable to mineral oils, but with increased chemical stability. If it contains additives, degradation can start around 120°C, creating particles/deposits in seal area.	• Medium and heavy-duty services. • Applications with hydrocarbons (including high temperatures). • In case plan 528 is selected and content of additives inside oil, it is recommended to verify its compatibility with seal gaskets and bladder accumulation. • Recommended viscosity between 5 and 32 cSt. • Barrier fluid must be kept below 120°C.	0 + 120°C



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"White" oil for food use	Lubrication capacity: good. Heat transmission: low Derivates from paraffin oil through refining process. High purity and compatibility grade, but limited stability for temperature fluctuations.	• Food, cosmetic and pharmaceutical services. • Barrier fluid must be kept below 60°C.	0 + 60°C
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Not recommended flushing fluids are listed here below:

- Gas oil, Kerosene and Diesel, due to the high flammability and toxicity
- Methanol, due to low lubricating properties and high toxicity
- Oils for engines, gears and turbines, due to the high content of additives
- Automotive antifreeze fluids, due to the high content of additives
- Silicone oils, due to the additives or the formation of silicates that can damage the seal faces

When designing auxiliary systems, several parameters must be considered, concerning correct sizing and pressure vessels operating limits as stated into international or local standards and, finally, specifications by customer.

It is possible to find here below a list of main Bodies that can be found on the market across the world:

 ABS	American Bureau of Shipping
 ANSI	American National Standards Institute
 API	American Petroleum Institute
 ASH	Nigerian Hydrocarbon Regulation
 ASME	American Society of Mechanical Engineers
 ASTM	American Society for Testing and Materials



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 NEMA	National Electrical Manufacturers Association
 DIN	Deutscher Normen Verband
 NR13	Boiler and Pressure Vessels (Brazil)
 ISO	International Standards Organization
 OSHA	Occupational Safety and Health Agency
 PED 2014/68/EU	Pressure Equipment Directive
 GOST R	Measurement Certificate with Primary Calibration for Instruments (Russia)
 GB (T) 150	China Manufacturer License



Instrumentation

Instrumentation mounted on auxiliary systems is very important to monitor proper seal operation. Working conditions can be controlled by means of transmitters, able to continuously measure physical parameter and to set alarm levels.

Main instruments can be divided as follows:

PRESSURE GAUGES

It is very important that readings is included between 20 and 80 % of instrument range. In case of high vibrations coming from the pump, they need to be filled with liquid.

LEVEL INDICATORS

Reflex:

They can be welded or external with flanged connections. Borosilicate glass reflects light in a different way, indicating liquid level.

Magnetic:

Can be only external mounted, a floating element inside a metallic tube giving a rotation to flags of different coloured sides, indicating the liquid level. Recommended whenever fluid is



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They allow to set an alarm remotely.

Transmitters:

They can be analogue (4-20mA) or digital and can continuously monitor the pressure. Currently, they are the basic solution required by API Standard 682.

Can be ultrasonic, vibrating or floating types.

They allow to set an alarm remotely.

Transmitters:

They measure the liquid differential pressure and can be analogue (4-20mA) or digital, continuously monitoring the level. Currently, they are the basic solution required by API Standard 682.

FLOW INDICATORS/ALARMS

They operate on the principle of a body floating inside a pipe with variable section, gas control. The graduated scale shown on the glass tube of the instrument is calibrated to the gas operating conditions therefore, when changed the measurement is no longer correct. For variable gas pressure conditions, the use of a mass flow meter is recommended.



"Wick Type" gas expansion thermometer



Float type thermometer

Test to be carried out, including Non-Destructive Tests (NDT) are part of customer's project specifications and inside Calculation code applied to the selected auxiliary systems. Normally they include:

Hydrostatic: for components working under pressure

Air test: for fittings (Gas panel: Plan 72 or 74)

Functional: for flushing units (Plan 54)

PENETRATING LIQUIDS FOR CHECKING SURFACE DEFECTS ON WELDS

Advantages: relatively simple to carry out

Disadvantages: limited to surface defects and requires a considerable degree of cleaning.

X RAYS

See in depth section of R&D construction welds.



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MAGNETIC PARTICLES FOR WELDING

Advantages: relatively simple to carry out

Disadvantages: the application is limited to ferromagnetic materials, such as iron, nickel and cobalt, and is limited to examining the surface. Despite its simplicity, incorrect execution may will not disclose defects.

PMI (POSITIVE MATERIAL IDENTIFICATION)

To check the exact composition of the metal parts elements. There are two different types of analysis:

1. X-ray fluorescence analysis (XRF): X-rays hit the surface, which re-emits radiation depending on its constituent elements. Metal surface is not damaged, but some elements are not detected (Carbon, Boron and Silicon)
2. Spectrographic Analysis (OES): an electric arc is generated between the sample and a tungsten electrode, the light spectrum of this arc identifies the elements, leaving a mark on the surface. It is used to detect elements such as Carbon, which are not detected by the XRF technique.

8 Liters Reservoir (Plan S2/S3A)

DESCRIPTION

8 liters reservoir (Fluiten code 507624010) can be used in two different configurations, based on the process fluid: Plan S2 or Plan S3A. If the process fluid atmospheric emissions of the process fluid must be reduced or diluted, Plan S2 should be considered. If these are not acceptable, you must consider configuration with Plan S3A. In case process fluid emissions are not acceptable, Plan S3A and barrier fluid must be considered. Its design is very similar to Plan S2, but nitrogen must be injected into the reservoir to pressurize barrier fluid.



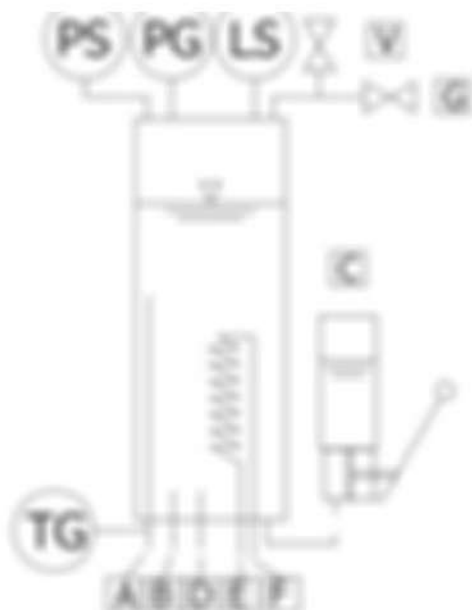
CONSTRUCTION FEATURES

- Reservoir in AISI 316, for high corrosion resistance, even on heavy-duty services.
- Modular design: optional instrumentation available on request.
- Integrated pipes for cooling water connection.
- Weight: 18 kg.
- Max. T: 200 °C.



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- | | |
|----|-------------------------|
| A) | Auxiliary fluid inlet |
| B) | Auxiliary fluid outlet |
| C) | Charging line |
| D) | Drain |
| E) | Cooling water outlet |
| F) | Drain |
| G) | Pressure gas connection |
| V) | Vent |

DESCRIPTION

12 liters reservoir (Fluitem code 50PS12) can be used in two different configurations, based on the characteristics of the process fluid: Plan S2 or Plan S3A.

Plan S2 (reservoir at atmospheric pressure) is suitable where a reduced emissions are accepted, while Plan S3A (pressurized reservoir) has to be considered when process fluid emission to atmosphere are not accepted (see Fluitem technical manual).

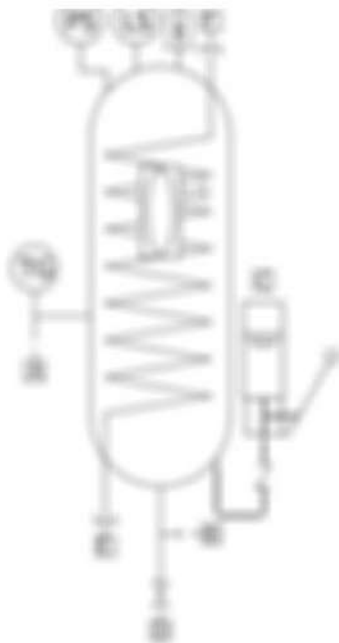
**CONSTRUCTION FEATURES**

- Reservoir in AISI 316, for high corrosion resistance, even on heavy-duty services.
- Modular design: optional instrumentation available on request.
- Integrated pipes for cooling water connection.
- Volume: 12 liters.
- Maximal: 200 °C.

MAIN FUNCTIONS

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- | | |
|----|------------------------|
| A) | Auxiliary fluid inlet |
| B) | Auxiliary fluid outlet |
| C) | Charging line |
| D) | Drain |
| E) | Cooling water outlet |
| F) | Drain |
| G) | Vent |

24 Liters Reservoir (Plan 52/53A)

DESCRIPTION

The 24 liters reservoir (Fluten code 10P-024), designed according to the latest NF-682 standard, works under the same principles of 8 and 12 liters reservoirs, reducing emissions to the atmosphere when Plan 52 is considered, or eliminating them on 53A configuration. Instruments included in the basic design are pressure transmitter, level transmitter and level indicator, which can be locally checked by operators on site.



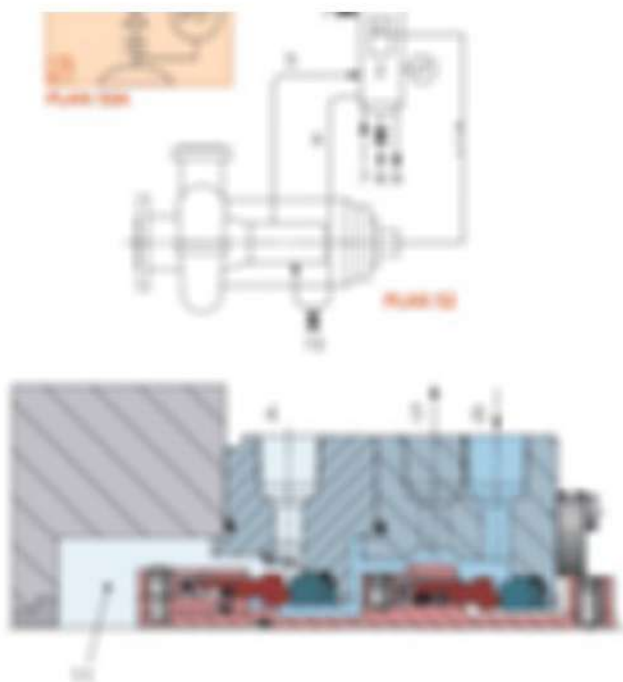
CONSTRUCTION FEATURES

- Reservoir in AISI 316L
- Welded level indicator (external forged version also available)
- Quick coupling, for fast refilling time
- Integrated pipe for cooling water connection
- Switches instead of transmitters availability: low level, high level, pressure switch. This solution can be provided if accepted by the end user



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Below you suggest the type of cooling water connection

- | | |
|------|---|
| 1) | To flow system (Plan 52) |
| | From an external pressure source (Plan 53A) |
| 2) | Tank |
| 3) | Reintegrating buffer or auxiliary fluid |
| 4) | Flushing (F) |
| 5) | Barrier fluid outlet (ABO) |
| 6) | Barrier fluid inlet (ABI) |
| 7) | Cooling water inlet |
| 8) | Tank drainage |
| 9) | Cooling water outlet |
| 10) | Barrier fluid drainage |
| 11) | Shutting box |
| 12) | Level indicator |
| 12P) | Level transmitter with display |
| 12T) | Pressure transmitter with display |

Pressurization system by a bladder accumulator (Plan 53B)

DESCRIPTION

Solution with accumulator and its diaphragm bladder pressurized by means of nitrogen.

Barrier fluid circulation is promoted by means the pumping ring integrated into seal design or through external circulating pump, necessary to remove the heat generated by the seal faces, using water or air heat exchanger (forced pipes or forced draft cooler). This solution must be used if no process fluid emissions to the atmosphere are permitted.



CONSTRUCTION FEATURES

- Accumulator in painted carbon steel or AISI 316, for corrosive environments.
- Water or air heat exchanger (forced pipes or forced draft cooler).
- N2N, water or inert.
- Seal/flushed? depending on design conditions.
- Pressure switch instead of pressure transmitter available. This solution can be provided if accepted by the end user.



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- | | |
|-----|---|
| 1) | Bladder accumulator charging connection |
| 2) | Bladder accumulator |
| 3) | Recirculating barrier fluid |
| 4) | Flushing (F) |
| 5) | Barrier fluid outlet (B/O) |
| 6) | Barrier fluid inlet (B/I) |
| 7) | Stuffing box |
| 8) | Weld |
| 9) | Barrier liquid drainage |
| 10) | Valve (bladder accumulator integrity check) |
| PI) | Pressure indicator |
| PT) | Pressure transmitter with display |
| TE) | Thermometer |
| TE) | Thermometer with display |

External flushing unit (Plan 5-4)

DESCRIPTION

A control unit equipped with circulating pump, designed and instrumented to circulate, pressurize and control barrier fluid to the mechanical seals. Ideal solution when process fluid is toxic, contains solid particles, or if a high flow rate at high barrier fluid pressure must be maintained during operation.



CONSTRUCTION FEATURES

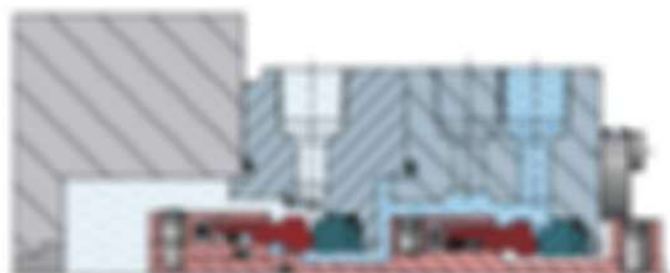
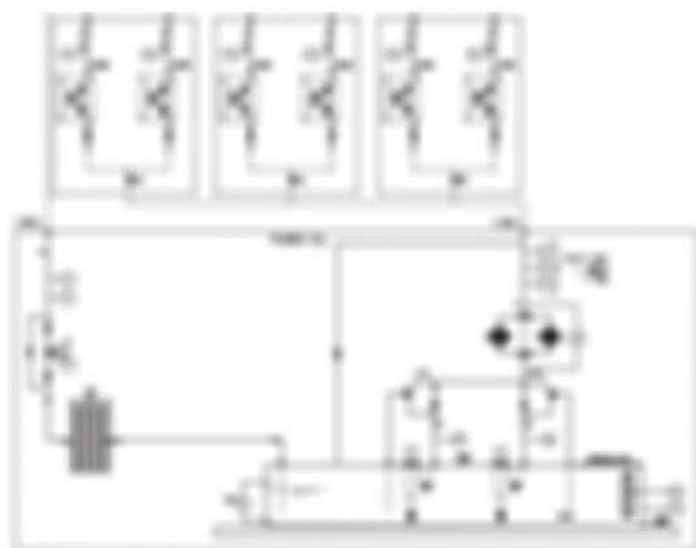
- Modular design.
- Tank sizes can be changed according to operating conditions.
- Heat exchanger power, barrier fluid flow rate and pressure designed to ensure proper seal face lubrication.
- Wide range of construction materials according to involved service type and the installation environment atmosphere.

MAIN FUNCTIONS



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DESCRIPTION

Leakage detection system, normally used with single seals, to check the mechanical seal conditions. If the seal is damaged, level inside the 3 ltr tank increases in a shorter time than when the seal operates correctly, activating level alarm. The system is equipped with an orifice (Plan 65A) or a normally closed valve (Plan 65B).

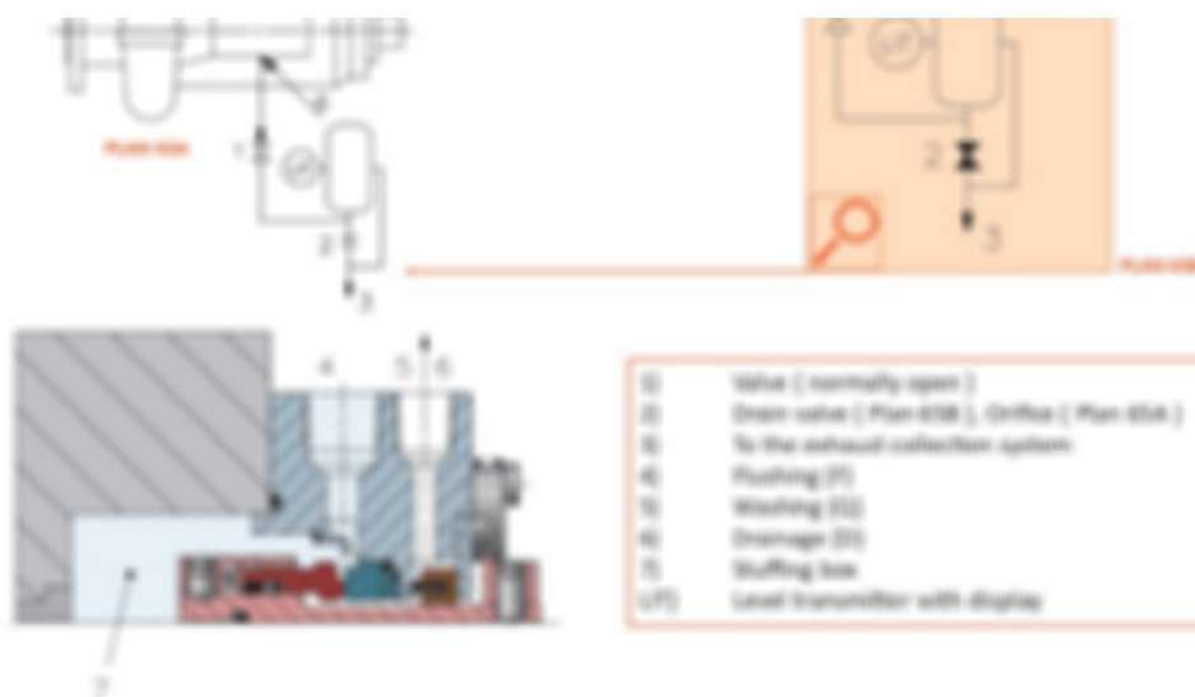
**CONSTRUCTION FEATURES**

- Low space requirements thanks to its compact design.
- Integrated monitoring level, for reliable operation.
- By-pass line, to drain the flow in case of abnormal leakage.
- Use of an orifice (Plan 65A) or a normally closed valve (Plan 65B).
- According to API 682, should be designed to withstand pump startup.



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Gas Panel (PLAN 72/74)

DESCRIPTION

Plan 72 uses a gas as flushing fluid (usually nitrogen) injected at atmospheric pressure between the two seals, in order to dilute the process fluid emissions to the atmosphere and thus limit their impact. The inner mechanical seal works wet and is lubricated by the process fluid, while the external seal works dry (technology developed by Fluiter, called Flugrid). This flushing plan can be used together with Plan 76 for fluids with vapor pressure higher than 1 bar, or with Plan 75 for fluids with both gaseous and liquid phases once in contact with (due to the heat generated by the rotating sealing surfaces) in case no emissions to atmosphere are permitted, Plan 76 must be considered.

Plan 72/74 with customer



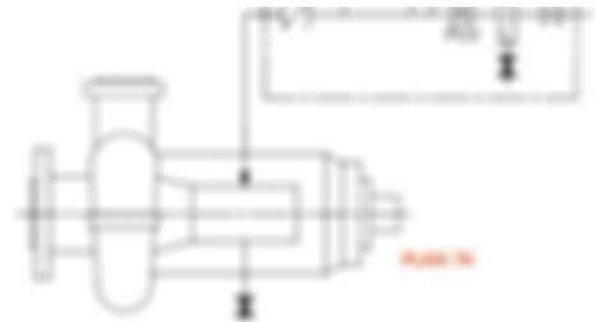
CONSTRUCTION FEATURES

- Panel mounting size and position of the components can be customized according to the customer's needs.
- Casing in A505 316 (optional version).
- Equipped with double flow indicator (low and high) and pressure switch, to allow better operations control.
- Pressure indicator promotes local control by plant operators.
- Simple and compact design.



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Leakage collection and detection system (Plan 75)

DESCRIPTION

Collection and leakage control system, for process fluids having mixed phase in contact with the atmosphere, used when reducing emissions level to the atmosphere is a must, used in combination with a dust seal (DWM-C3), where the outer back-up dry venting seal is equipped with Plugrid technology. Gaseous leakage is taken to the gas recovery system (usually represented by the flare), while liquid leakage is collected into the tank, flushing gas that can be used in combination with Plan 72.



CONSTRUCTION FEATURES

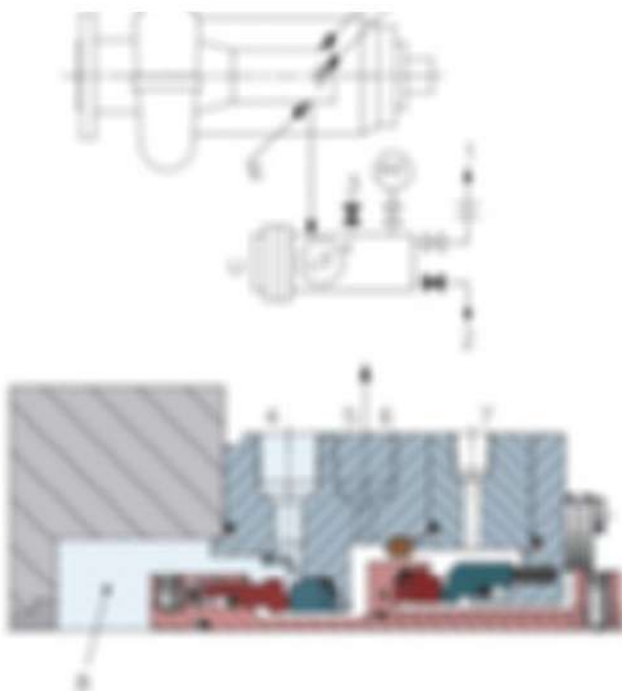
- Tank material: AISI 316
- Level indicator availability, for local control by operators
- The pressure transmitter detects any abnormal gas flow rate, indicating any critical points in the seal operations
- Level transmitter indicates the presence of excessive liquid in the tank

MAIN FUNCTIONS



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- (If specified)
- 4) Flushing (F)
- 1) Containment seal vent (SCH)
- 4) Containment seal drainage (SCH)
- 7) Buffer gas inlet (BGR), plugged if not made with Plug 72
- 4) Buffer gas
- 1) Level indicator
- 1) Level transmitter with display
- 1) Pressure transmitter with display
- (If specified)

Gaseous gas leakage detection system (Plan 76)

DESCRIPTION

Leakage detection system for fluids that evaporate in contact with the atmosphere.

Used with a dust seal (D76-C3), where the external back-up dry contacting seal uses Fluitrol technology, directing process fluid leakage to the gas recovery system.

Flushing plan that can be used in combination with Plan 72.



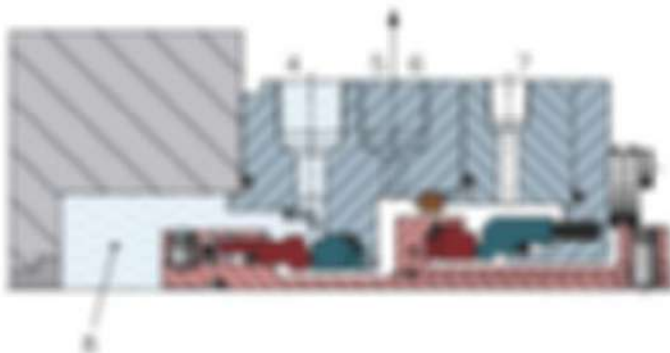
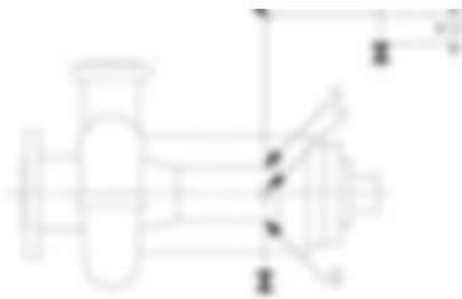
CONSTRUCTION FEATURES

- Panel mounting.
- Pressure transmitter that, together with an orifice, allows to detect a flow higher than normal and highlight any damage to the mechanical seal on the product side.



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- (1) Containment seal drainage (D76).
- (2) Buffer gas inlet (D76), plugged if not made with Fluitrol.
- (3) Flushing line.
- (4) Pressure transmitter with display.

DESCRIPTION

Water heat exchangers (Fluiten code CWC) are used to cool down the process fluid and ensure a stable, liquid phase film between the seal faces. In plan 21, thanks to a pumping ring integrated into mechanical seal, the process fluid flows through the inner tube of the heat exchanger, while the cooling water flows through the shell, or through the outer tube for the tube in tube version. Operating and environmental conditions, but also pumping ring performances are fundamental to properly evaluate heat that can be removed by the heat exchanger.

MAIN FUNCTION**CONSTRUCTION FEATURES**

- Designed according to different operating conditions, for a wide range of operations.
- Both water and the process sides can be easily vented and drained.
- Special seamless design inside the heat exchanger.
- AISI 316 components: high corrosion resistance.
- Available with flanged, straight pipe or NPT connections.
- Compact design: very useful when available space is limited.



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- Thermometer can be supplied, if required.

MAIN FUNCTIONS

- Heat removal for proper mechanical seal lubrication.
- Built according to API 682 specification, used in applications for O&G & Gas plants.

CAUTIONS

Use of the heat exchanger must be carefully evaluated, especially when the process fluid has a high pour point. The cooling efficiency can be increased by using a thrust bearing integrated into the mechanical seal design.

The heat exchanger should be placed 450 to 600 mm above the pump centerline to promote thermosiphoning effect.