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One supply system for several seals

Comparison of different supply systems for several liquid-lubricated dual mechanical seals.

Often several liquid-lubricated dual mechanical seals are installed in a production plant, and there are various possibilities for supply systems which users can choose from. A dedicated supply system can be provided for each dual mechanical seal, or several dual seals can share a supply system. Deciding which option is best is not always easy, and this article is intended to provide guidance during the decision making process.

The sealing chamber between the product and atmospheric side must be completely filled with a clean medium to ensure that a dual mechanical seal functions properly. A so-called supply system delivers the medium, and it is called a barrier system if the supply medium pressure exceeds the process pressure. Barrier medium or fluid is the name which is used for the supply medium or fluid.

The barrier system also performs other functions:
- pressurization in the sealing chamber
- seal cooling
- leakage compensation
- barrier fluid circulation and cooling

There are two basic types of barrier systems for liquid lubricated mechanical seals, namely open and closed loop systems. In open systems a pressurized barrier fluid system unit such as the EagleBurgmann SPA ensures circulation and pressure build-up in the sealing chamber. The barrier medium is expanded after each circulation, and it is collected in an unpressurized reservoir.

All components are kept at the same pressure in a closed loop system. Pressurization is provided from an external source, for example nitrogen (TS system), an automatic refill unit (SPN) or a pressure booster system (DRU) which uses the process pressure.

If the plant operator has to supply barrier fluid to several dual seals there are two possibilities. One possibility is to provide a dedicated supply system for each dual seal, or several dual seals can share a supply system. The decision depends on a number of factors including purchase and operating costs, operating parameters such as pressure and temperature and local conditions at the production site like the location of the seals and repair/maintenance capacity. Providing a dedicated barrier system for each dual seal makes sense when:
- seals are installed on equipment which have very different operating conditions (pressure, temperature, RPM)
- there is considerable distance between the machines on which the seals are installed
- there are considerable differences in seal heat dissipation
- different barrier fluids have to be used.

Plant engineers should consider a shared supply system for several dual seals when the following conditions are met:
- similar process temperatures, pressures and speeds
- the same or similar types of seals are installed
- the same barrier fluid is supplied to all seals
- the sealed machines are in close proximity

Reduced maintenance outlay is a big advantage of this solution, because there is no need to regularly check and top up each individual barrier system.

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A variety of instrumentation and configuration options are available for these systems. The first step is to define the arrangement of the seals in the supply circuit. The seals can be installed either in series (one behind the other in a loop) or in parallel. A series configuration of dual seals is generally not recommended, because the seals can not be supplied independently. The heat generated in each seal raises the temperature of the barrier medium, impeding reliable heat dissipation, and this is a major disadvantage. There are cases however where this solution is reasonable, for example on machines with two dual seals where the process conditions for both seals are the same.

Normally, the seals are arranged in parallel. Barrier fluid is supplied to each seal individually, which is a big advantage. The heat generated in the seal can be reliably dissipated and the seal lasts longer. However, this solution involves increased pipework and instrumentation cost.

EagleBurgmann TS1016 Thermosiphonsystem

EagleBurgmann Cartex®-DN Dual cartridge seal for pumps

Basically, there are two types of systems:

1) Pressurized barrier fluid system, e.g. the EagleBurgmann SPA; a single compact unit provides all of the functionality of a barrier system. Fig. 1 contains a diagram of this type of system.

2) Central automatic refill unit, e.g. the EagleBurgmann SPN, which pressurizes the barrier fluid, compensates the leakage and acts as a reservoir. Each dual seal has its own loop system, e.g. the EagleBurgmann SPO, for cooling and circulation. Circulation can either be natural or forced using a circulation device in the mechanical seal or using an external circulation pump. Pressure, temperature and leakage can be monitored separately on each seal, because each seal has a dedicated loop system. Fig. 2 contains a sample diagram for this type of supply system.

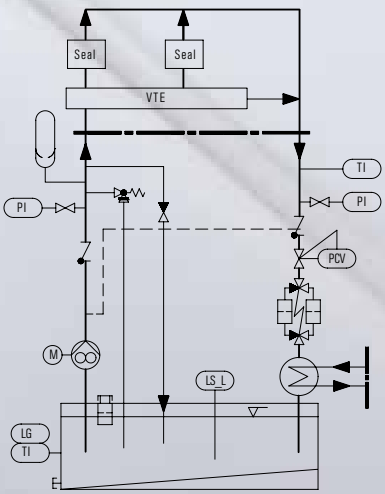

Fig. 1: Sample diagram of a pressurized barrier fluid system with a distributor unit (VTE).

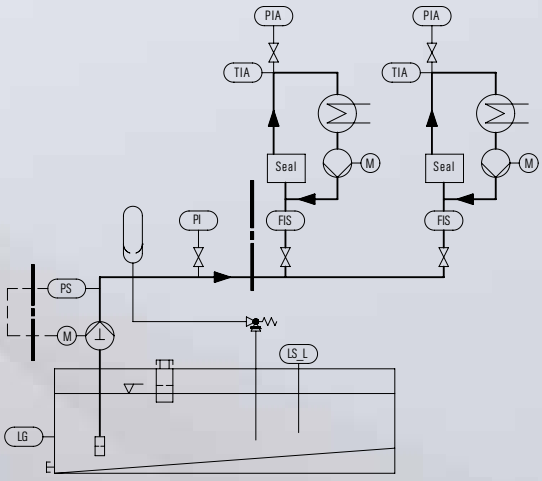

Fig. 2: Sample diagram of a central automatic refill unit with 2 loop systems.

Table 1 summarizes the advantages and disadvantages of each system.

The choice is obviously heavily dependent on local conditions and preferences of the plant operator.

Instrumentation and installation have a big impact on reliability. During installation, it is vital to keep the pipes as short as possible and avoid impeding the flow. Components that throttle the flow such as elbow fittings and shut-off valves should not be used. Pipe bends and ball valves are the preferred solution. Pipe diameters should be designed to withstand the barrier pressure and ensure that the flow rate does not exceed 2.5 m/s and 3 m/s at barrier pressures >20 bar.

There is a whole range of instrumentation options which should be adapted to suit local conditions and needs.

It could be, for example, that not all of the seals are always operating simultaneously, or perhaps it should be possible to remove one of the seals for repair without shutting down the entire supply system. When this is the case, a shut-off valve must be provided for each dual seal in case of using a pressurized barrier fluid system. In these applications, it is wise to monitor the flow through the seal to ensure that the shut-off valve is open again when the seal goes back into operation.

When an SPN with loop systems is deployed, a throttle which limits maximum flow to the loop systems can be installed to ensure that excessive leakage at one of the seals does not cause the barrier fluid pressure to drop at the rest of the seals.

The seals could also have very different barrier pressure requirements. When this is the case, it is better to pressurize the barrier fluid in the loop systems rather than at a central point (API 682, Plan 53B or 53C).

Table 2 lists standard instrumentation for the supply systems which are discussed in this article.

A shared supply system can significantly reduce the outlay for the maintenance of several dual seals, because each individual barrier system does not have to be regularly checked and refilled. As repair and maintenance resources are drawn down in an effort to save costs, the importance of efficient repair and maintenance continues to increase. More efficient monitoring of dual seals and better integration into the process control system of the production plant are additional advantages of a shared supply system.

	Pressurized Barrier Fluid system	Central Automatic Refill Unit + Loop Systems
Barrier Fluid	Oil or water	Any suitable fluid
Advantages	• Compact design • Only one pump (optional redundancy) • Only one heat exchanger unit (optional redundancy) • Lower instrumentation costs	• Individual and therefore optimal supply of barrier media to each seal. • Leakage volume can be used to monitor proper functioning of each individual seal. • No return line means less piping, therefore also suitable when the distance between the equipment is high. • Only the loop system and not the entire piping has to be designed to handle the whole amount of circulation fluid.
Disadvantages	• It is not possible to use leakage volume to monitor sealing function. • Pipes are very long when the distance between the equipment is high. • The entire piping must be designed to handle the whole amount of circulation fluid.	• One heat exchanger and possibly one circulation pump must be installed for every seal. • Increased instrumentation costs.

Table 1: Comparison of Pressurized Barrier Fluid Systems and Central Automatic Refill Units + Loop Systems.

	Pressurized Barrier Fluid system	Central Automatic Refill Unit + Loop Systems
Standard	• Level switch MIN (LS_L) to monitor level in the reservoir • Level gauge by a sight glass (LG) • Temperature indicator (TI) in the reservoir and in the return line • Pressure indicator (PI) in the inlet and in the return line • Distributor unit (VTE) with flow control (FC) for each seal and a pressure control valve (PCV) • Pressure control valve (PVC) in the return line	• Level switch MIN (LS_L) to monitor level in the reservoir • Level gauge by a sight glass (LG) • Pressure indicator (PI) in the inlet line In each loop system: • Temperature indicator (TI) in the return line • Flow indicator with switch (FIS)
Useful Options	• Contact pressure gauge (PIA) instead of pressure indicator (PI) • Flow monitoring through each seal (FIA) • Interlock of the supply system (circulation pump) with the device's drive unit (e.g. pump, agitator)	• Interlock of the supply system (circulation pump) with the device's drive unit (e.g. pump, agitator) In each loop system: • Contact temperature gauge (TIA) instead of temperature indicator (TI) • Contact pressure gauge (PIA)

Table 2: Standard Instrumentation of Pressurized Barrier Fluid Systems and Central Automatic Refill Units + Loop Systems.

Argentina · Australia · Austria · Belarus · Belgium · Bulgaria · Brazil · Canada · Chile · China · Colombia · Cyprus · Czech Republic · Denmark · Ecuador · Egypt · Estonia
Finland · France · Germany · Great Britain · Greece · Hungary · India · Indonesia · Iraq · Iran · Israel · Italy · Japan · Jordan · Kazakhstan · Korea · Kuwait · Latvia · Libya
Lithuania · Malaysia · Mauritius · Mexico · Morocco · Myanmar · Netherlands · New Zealand · Nigeria · Norway · Oman · Pakistan · Paraguay · Peru · Philippines · Poland
Qatar · Romania · Russia · Saudi Arabia · Singapore · Slovenia · Slovak Republic · South Africa · Spain · Sweden · Switzerland · Syria · Taiwan · Thailand · Trinidad and Tobago
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