Installation Instructions

Seal Support Reservoir

Flowserve seal support system for dual unpressurized and dual pressurized operation

Experience In Motion

Introduction

This manual covers the installation and operation of Flowserve Seal Support Systems for dual unpressurized (API Plan 52/ANSI Plan 7352) and dual pressurized seals (API Plan 53A, 53B, 53C/ANSI Plan 7353). The following instructions describe the appropriate system, buffer/barrier fluids, installation, start-up and maintenance.

Reservoir

The standard supply tank is designed in accordance with ASME Code Section VIII, Division 1. All tanks are welded in accordance with ASME Code Section IX. Tanks include inlet, outlet, vent and fill, along with mounting lugs as minimum connection.

Sealing System Description

Supply tank assemblies can be used as reservoirs for dual seal designs. The sealing system produced is defined as being either a thermal convection system or a forced circulation system.

Support System Descriptions

API Plan 53A, 53B, 53C/ANSI Plan 7353A for dual pressurized seals

An API Plan 53A/ANSI 7353A is a pressurized dual seal system which is used in services where no process leakage to atmosphere is tolerated. The system consists of dual mechanical seals with a barrier fluid between them. The barrier fluid in the supply tank is pressurized to a higher pressure than the seal chamber, normally 15 to 25 psig (1 to 1.7 bar). Primary (inboard) seal leakage will be barrier fluid into the product. A small amount of leakage is customary.

An API Plan 53A/ANSI Plan 7353A is usually chosen over an API Plan 52/ ANSI Plan 7352 for dirty, abrasive or polymerizing products which would either damage the seal faces or cause problems with the barrier fluid system if an API Plan 52/ ANSI Plan 7352 is used. There are two disadvantages to an API Plan 53A/ANSI Plan 7353A which must be considered. First, there will always be some leakage of barrier fluid into the product. Normally, this leakage will be minute, and the leakage rate can be monitored via the level gauges or other instrumentation. However, the product must be able to accommodate a small amount of contamination from the barrier fluid. Secondly, an API Plan 53A/ANSI Plan 7353A system is dependent on having the supply tank pressure maintained at the proper level. If the supply tank pressure drops, seal leakage direction will be reversed and the barrier fluid will be contaminated with the process fluid.

An Induced Circulation System is essentially the same as the thermal convection system, except for the addition of a circulating device in the seal cavity which provides for positive flow in the system. The addition of the circulating device provides for positive flow of barrier/buffer fluid shown in Figure 1. Because supply tanks provide for poor radiation and convection of heat to the atmosphere, it is common to add cooling coils inside the reservoir as a means of removing heat.

Dual Inside Seal with Induced Circulation Through Supply Tank with Cooling Coil

Figure 1

Plan 53A/ANSI Plan 7353A

What

Pressurized barrier fluid circulation through reservoir.

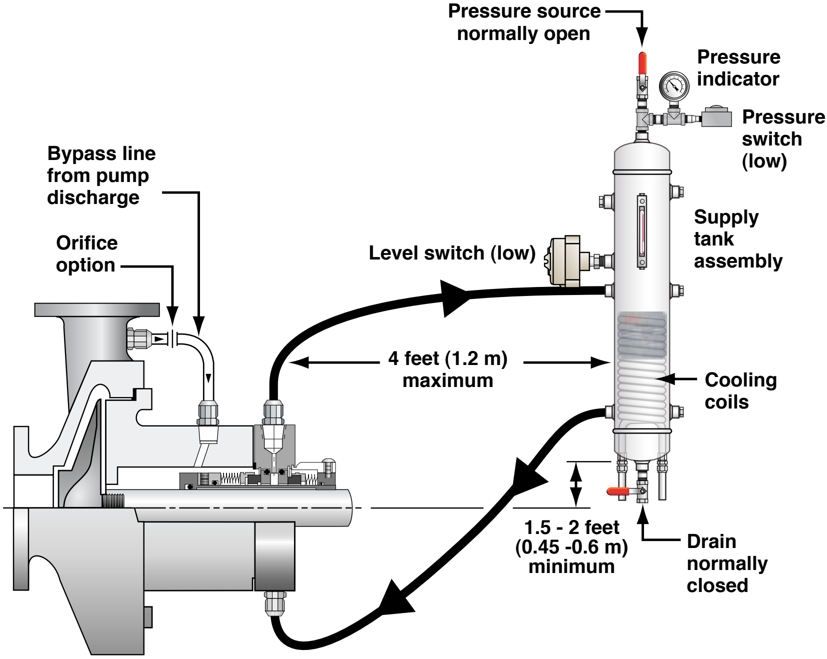
Fluid is circulated by a pumping ring in the dual seal assembly

Why

Isolate process fluid

Zero process emissions

Typically used <150 psig (10.3 bar) pressure



Plan 53B/ANSI Plan 7353B

What

Pressurized barrier fluid circulation with bladder accumulator.

Fluid is circulated by a pumping ring in the dual seal assembly.

Why

Isolate process fluid.

Zero process emissions.

Higher pressure than Plan 53A.

Plan 53C/ANSI Plan 7353C

What

Pressurized barrier fluid circulation with piston accumulator.

Fluid is circulated by a pumping ring in the dual seal assembly.

Why

Isolate process fluid.

Zero process emissions.

Higher pressure than Plan 53A.

Dynamic tracking of system pressure.

API Plan 52/ANSI Plan 7252 for dual unpressurized seals

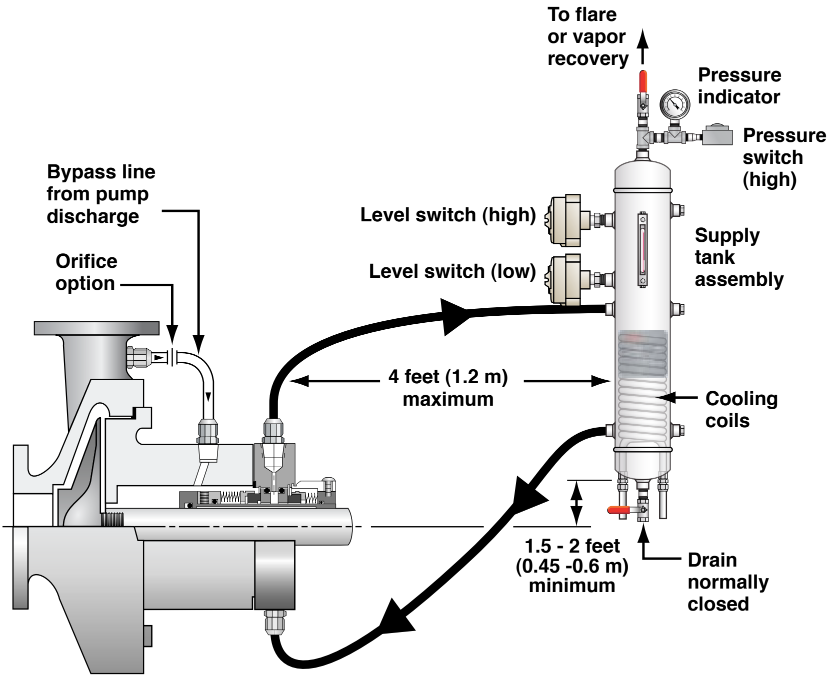
An API Plan 52/ANSI Plan 7352 is an unpressurized dual seal system which is used in services where no leakage to atmosphere is tolerated. The system consists of dual mechanical seals with a buffer fluid between the seals. The buffer fluid is contained in the seal pot which is vented to a flare, thus maintaining the buffer fluid pressure close to atmosphere. Primary (inboard) seal leakage will be product leakage into the buffer fluid. There will always be some leakage.

An API Plan 52/ANSI Plan 7352, Figure 2, works best with clean, non-polymerizing products which have a vapor pressure higher than the buffer fluid pressure. These products will flash in the supply tank and the vapor can escape to the vent system. If the product has a vapor pressure lower than the buffer fluid or supply tank pressure, the leakage will remain a liquid and will cause the barrier fluid level to rise.

Should excessive primary (inboard) seal leakage not be detected early, the heavier process fluid will displace the buffer fluid and can result in increased seal wear.

Dual Unpressurized Seal with Induced Circulation Through Supply Tank with Cooling Coils — Figure 2

API Plan 52/ANSI Plan 7352



Buffer/Barrier Fluid Selection

The following should be considered when selecting a barrier/buffer fluid:

- Compatibility of the fluid with the process pumpage being sealed so as not to react with or to form gels or sludge when the fluids are intermixed.
- Compatibility of the fluid with the metallurgy, elastomers and other materials of the seal/flush system construction.

For an API Plan 53A/ANSI Plan 7353A pressurized barrier fluid system where the method of pressurization is a gas blanket, special attention must be given to the application conditions and barrier fluid selection. Gas solubility in the barrier fluid increases with the rising temperature and pressure. As pressure is relieved or temperatures cool, the gas is released from the solution and may result in foaming and loss of circulation of the barrier fluid. This problem is normally seen where higher viscosity barrier fluids, such as lube oils, are used at pressures above 150 psig (10.3 bar). Synthetic barrier fluids offer greater compatibility and wider operating ranges where traditional fluids have problems.

The viscosity of the barrier/buffer fluid should be checked over the entire operating temperature range with special attention being given to start-up conditions. The viscosity should be less than 500 cst at the minimum operating temperature.

1. For services above 50°F (10°C), hydrocarbon barrier/buffer fluids having a viscosity below 100 cst at 100°F (37.8°C) and between 1 and 10 cst at 212°F have demonstrated proper operating climate.
2. For services below 50°F (10°C), hydrocarbon barrier/buffer fluids having a viscosity between 5 and 40 cst at 100°F (37.8°C) and between 1 and 10 cst have demonstrated proper operating characteristics.
3. For aqueous streams, mixtures of water and ethylene glycol or propylene glycol are usually adequate. Commercially available automotive antifreeze should never be used. The additives in antifreeze tend to plate out (leave a residue) on seal parts and cause failure as a result of gel formation. **Note**: Ethylene glycol may be considered a hazardous material and/or hazardous waste when used as a barrier fluid.
4. The fluid should not freeze at the minimum site ambient temperature.

Fluid volatility and toxicity of the fluid must be such that the leakage to the atmosphere or disposal does not impose an environmental problem.

1. The fluid should have an initial boiling point at least 50°F above the temperature to which it will be exposed.
2. The fluid should not have a flash point higher than the service temperature if oxygen is present.

The fluid should be able to meet the minimum 3-year continuous seal operation criteria without adverse deterioration. It should not form sludge, polymerize or coke after extended use.

1. For hydrocarbon streams, paraffinic-based high purity oils having little or no additives for wear/oxidation resistance or synthetic based oils have been used successfully.
2. Anti-wear/oxidation-resistant additives in commercial turbine oils have been known to plate out on seal faces.

Installation

1. The reservoir is mounted vertically not more than 3 feet (0.9 meters) from the seal gland to the vertical centerline of the reservoir. The bottom of the reservoir is mounted 18 to 24 inches (45.7 to 61 centimeters) above the horizontal centerline of the pump.
2. It is highly recommended that the reservoir be flushed with clean fluid prior to equipment start-up to remove any foreign matter from the system.
3. All lines from the seal cavity to the reservoir must slope upward at all points. The upward slope should be a minimum of 1/4 inch per foot with all bends being large radius. The minimum size for tubing should be 3/4 inch diameter. Tubing is recommended.
4. Connect the supply connection (lower seal connection on the reservoir) to the bottom (inlet) gland connection (**BI** - inlet).
5. Connect the return connection (upper seal connection on the reservoir) to the upper (outlet) gland connection (**BO** - outlet).
6. If the reservoir is equipped with cooling coils, connect water lines to the coil connections on the bottom of the reservoir.
7. Remove all plastic shipping plugs and properly seal or attach piping with metal connections.
8. Connect wiring to any instruments included with the system such as a pressure switch/transmitter or level switch/transmitter.

9. If the system is equipped with a weld pad level gauge the bolts on the cover should be retorqued to 20 ft/lbs. (Tighten in 5 ft/lb increments starting with the center bolts and working out.)

10. Connect vent connection to flare or vapor recovery system (Plan 52). Do not open vent valve until reservoir has been filled with buffer fluid.

11. **Fill reservoir with barrier/buffer fluid to the middle of the sight glass.** Gas volume of the system should be at least 25 percent of the reservoir volume to allow for thermal expansion during operation.

12. Before starting the system, bleed all air from highest point in the system.

13. Connect external pressurization to reservoir on Plan 53A, B, C (dual seal). A pressure regulator and check valve are required to maintain a constant pressure on the system. The pressure in the reservoir should be maintained at least 25 psi (1.7 bar) above the seal cavity pressure.
    Make sure reservoir is filled before pressurizing.

Start-Up

1. API Plan 52/ANSI Plan 7352 - open the valve to the vent or flare system slowly.

2. API Plan 53A, B, C/ ANSI 7353 - slowly open the valve between reservoir and external pressurization source. Slowly increase the pressure to avoid gas ingestion. Check for leaks as unit is being pressurized. Operating pressure is normally 15 to 25 psig (1 to 1.7 bar) above seal cavity pressure depending on seal design. The pressure gauge on system can be used to monitor system pressure.

3. If system is equipped with cooling coils, open the valve to allow water to flow through coils.

4. The pump can now be commissioned for start-up per the equipment manufacturer's recommendations and all plant safety and start-up procedures.

Maintenance

During planned plant shutdowns, it is recommended maintenance practice that the buffer/barrier fluid be drained, reservoir flushed and new fluid put in the reservoir. This will ensure the quality of the buffer/barrier fluid used to lubricate the seals and help remove any particles that may have accumulated in the reservoir.

When changing or cleaning the glass on armored sight gauges (weld pad level gauge), always install new gaskets and retorque bolts to proper amount. It is also recommended that the bolts be checked and retorqued prior to first operation. They can come loose during shipping and transport.

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To find your local Flowserve representative
and find out more about Flowserve Corporation,
visit www.flowserve.com

USA and Canada
Tulsa, Oklahoma, USA
Telephone: 1 918 599 6062
Telefax: 1 918 583 1071

Europe, Middle East, Africa
Essen, Germany
Telephone: 49 201 31937-0
Telefax: 49 201 2200-561

Asia Pacific
Singapore
Telephone: 65 6544 6800
Telefax: 65 6214 0541

Latin America
Mexico City
Telephone: 52 55 5567 7170
Telefax: 52 55 5567 4224