Carotek Seal Pot Installation Manual

Date: June 3, 2019

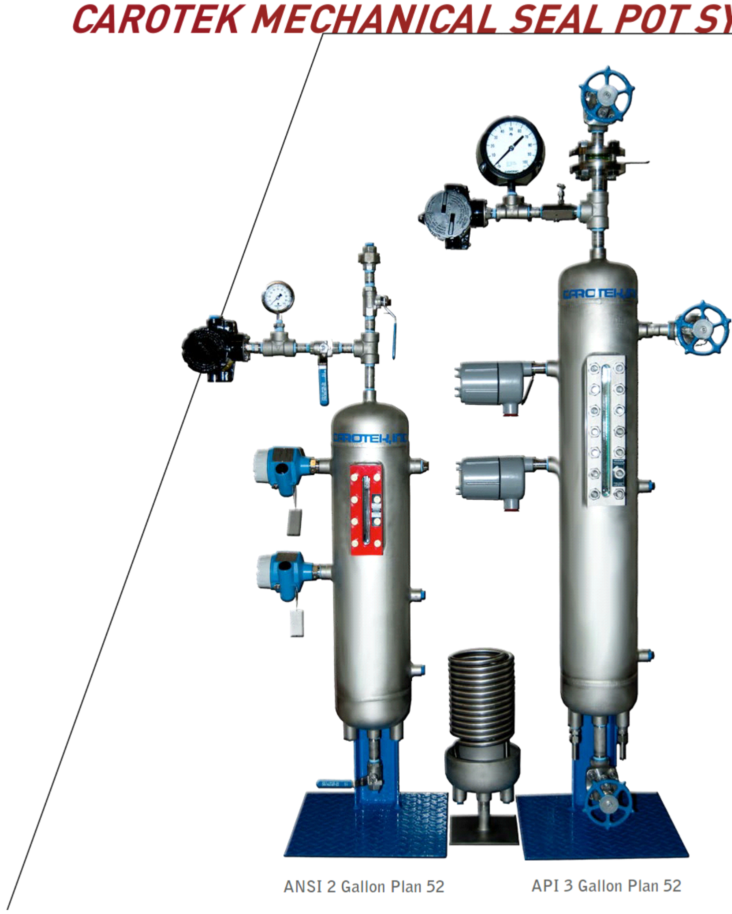
Thanks for purchasing Carotek Seal Pots. The following instructions should answer most of your installation questions. If you need further assistance, please let us know.

Carotek's reservoir-based seal support systems are designed for both unpressurized (API Plan 52/ANSI Plan 7352) and pressurized (API Plan 53A/ANSI Plan 7353) dual seal systems. This manual explains Carotek Mechanical Seal Pot Systems and details how to install and operate them, including specific seal support reservoirs, selection of buffer/barrier fluids, installation, start-up, and maintenance.

Reservoirs and Sealing Systems

Carotek's basic seal pot reservoir design complies with ASME Code Section VIII, Division 1, and tanks are welded in accordance with ASME Code Section IX. Each reservoir configuration features an inlet, outlet, vent and fill, low and high level ports, cooling coil connections when coil is selected, and mounting lugs.

CAROTEK MECHANICAL SEAL POT SYSTEMS



ANSI 2 Gallon Plan 52 API 3 Gallon Plan 52

Carotek seal support systems are either unpressurized (API Plan 52/ANSI Plan 7352) or pressurized (API Plan 53A/ANSI Plan 7353) dual seal systems, depending on the application. Both types of systems are used in applications where no leakage to the atmosphere is allowed. As with any application that involves dual seals, a barrier/buffer fluid must be circulated between the seals to prevent the generation of unwanted heat and seal leaks to atmosphere. All Carotek seal pot reservoirs for dual seal designs can be used with either thermal convection or induced circulation systems.

A *Thermal Convection System* circulates barrier/buffer fluid via thermal convection. An *Induced Circulation System* is similar to a Thermal Convection System with the addition of a circulation device in the seal cavity that is used to develop positive flow of the barrier/buffer fluid. There are optional, external barrier fluid circulation pumps available for forced fluid circulation. Cooling coils are often added inside the reservoir for heat removal since supply tanks allow limited convection and radiation of heat to the atmosphere.

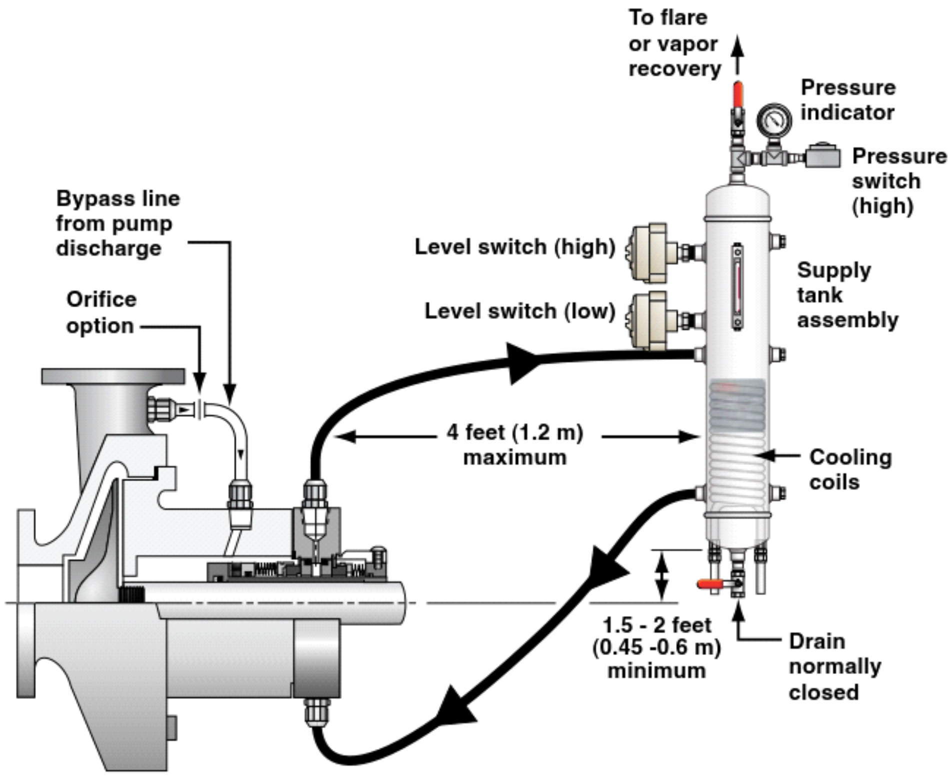
API Plan 52/ANSI Plan 7352 (Dual Unpressurized Seals)

An unpressurized Dual Seal System (API Plan 52/ANSI Plan 7352) consists of two mechanical seals with a *buffer* fluid between them, contained in a seal pot reservoir. To keep the buffer fluid pressure near atmospheric pressure, the reservoir is vented to a flare. With this design, any primary (inboard) seal leakage will be process fluid leakage into the buffer fluid.

API Plan 52/ANSI Plan 7352 systems are best suited for products that:

- are clean and non-polymerizing
- have a vapor pressure higher than the buffer fluid pressure

Products that meet these criteria will flash in the seal pot reservoir, allowing the vapor to escape to the vent system. However, if the process fluid had a vapor pressure lower than the buffer fluid or seal pot reservoir pressure, the leakage would remain a liquid and would raise the buffer fluid level. Early detection of any excessive primary (inboard) seal leakage is important. Otherwise, increased seal wear can occur due to displacement of the buffer fluid by heavier process fluid. Low and high level pressure switches can be installed for fluid level detection.



API Plan 53A/ANSI Plan 7353A (Dual Pressurized Seals)

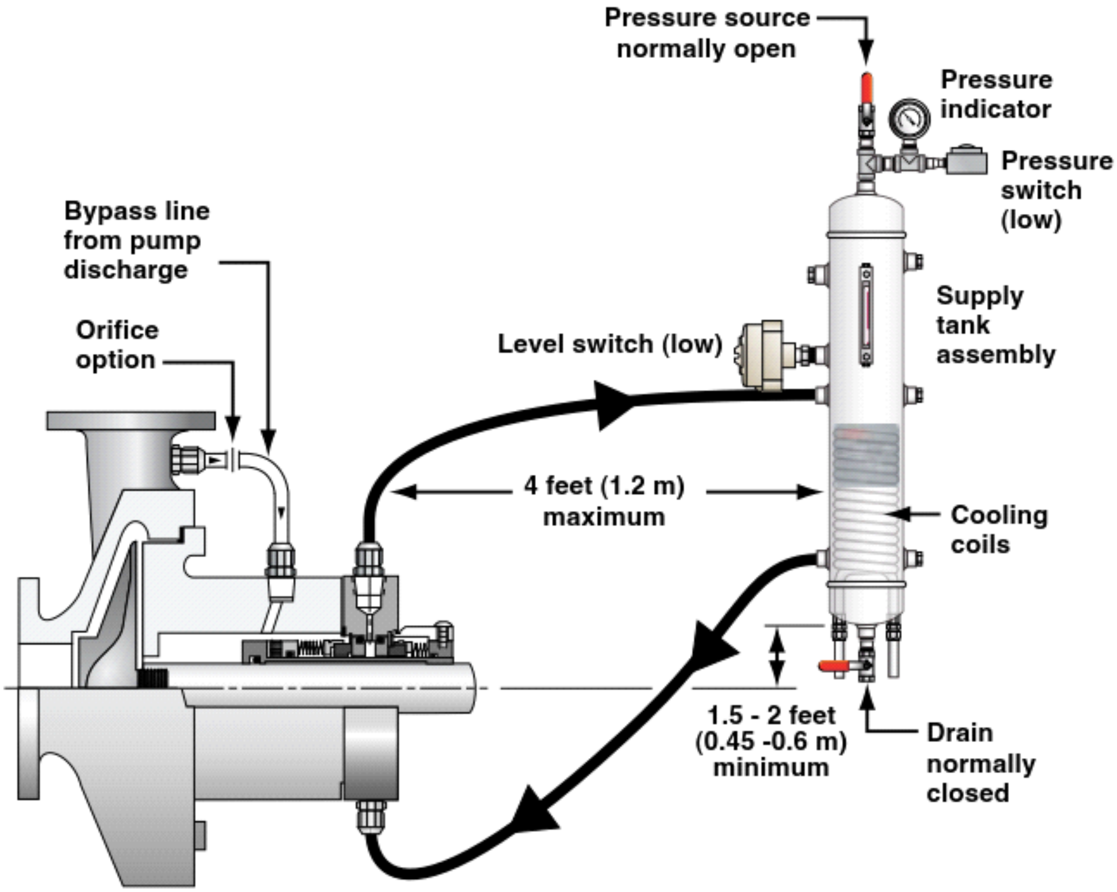
A Pressurized Dual Seal System (API Plan 53A/ANSI Plan 7353) is used for a double mechanical seal arrangement with a *barrier* fluid between the inboard and outboard seals. The barrier fluid in the supply tank is pressurized to a higher pressure than the seal chamber. Generally the supply tank is pressurized 15 to 25 PSIG (1 to 1.7 bar) higher than the seal chamber, so any primary (inboard) seal leakage is barrier fluid leaking into the process fluid. A small amount of leakage is expected. This ensures the process fluid does not leak out of the process and potentially into the atmosphere.

API Plan 53A/ANSI Plan 7353A systems are best suited for products that meet any of these criteria:

- dirty
- abrasive
- polymerizing
- Toxic
- Environmentally hazardous
- Expensive products

Products that have these characteristics could damage the seal faces or cause problems with the barrier fluid system of an API Plan 52/ANSI Plan 7352 system. It is important to note that:

1. Barrier fluid can become contaminated if reverse seal leakage occurs. This can happen if pressure in the barrier fluid supply tank is not maintained at the proper level.
2. A small amount of barrier fluid leakage into the process fluid is expected, although this leakage can be monitored with instrumentation like level gauges.



Choosing a Barrier/Buffer Fluid

When selecting a barrier/buffer fluid for a seal pot system, evaluate the fluid requirements according to temperature, toxicity and volatility, and continuous operation requirements. The barrier/buffer fluid must be compatible with:

1. the materials of the construction of the seal pot reservoir and seal flush system
2. the process fluid to avoid reactions with or the formation of gels or sludge when the fluids mix

Temperature and Viscosity

Check the viscosity of the barrier/buffer fluid over the entire operating temperature range, paying special attention to start-up conditions. The viscosity should be less than 500 cSt at the minimum operating temperature. It also should not freeze at the minimum site ambient temperature.

For services in these ranges, hydrocarbon barrier/buffer fluids in these ranges have shown proper operating characteristics:

Service Range	**Viscosity**
above 50° F (10° C)	below 100 cSt at 100° F (37.8° C) and between 1 and 10 cSt at 212°F
below 50° F (10° C)	between 5 and 40 cSt at 100° F (37.8° C) and between 1 and 10 cSt

For aqueous streams, mixtures of water and ethylene glycol or propylene glycol are usually suitable, although ethylene glycol used as a barrier fluid may be considered hazardous waste and/or hazardous material. Never use commercially available automotive antifreeze as a buffer/barrier fluid, because these products generally contain additives that leave a residue on the seal face, which in turn forms a gel and causes seal failure.

When gas blanket for pressurization is used with an API Plan 53A/ANSI Plan 7353A system, application conditions affect barrier fluid selection. When temperature and pressure increase, gas solubility in the barrier fluid increases as well. Conversely, as temperatures decrease or pressure is reduced, gas released from the solution may cause foaming and the loss of barrier fluid circulation. Higher viscosity barrier fluids like lube oils used at pressure of 150 PSIG or more will often foam; synthetic barrier fluids may provide better compatibility and better operating ranges as well.

Toxicity/Volatility

The buffer/barrier fluid must be approved for leakage to atmosphere without posing an environmental hazard due to fluid volatility and toxicity.

- If oxygen is present, the fluid flash point cannot be greater than the service temperature.
- The initial boiling point of the fluid should be at least 50° F greater than the temperature it will be exposed to.

Continuous Operation

Ensure that the barrier fluid meets the minimum 3-year continuous seal operation criteria without deteriorating in ways that would adversely affect operation, such as coking, polymerizing, or forming sludge.

- For hydrocarbon streams, paraffinic-based high purity oils with minimal or no additives for wear/oxidation resistance or synthetic based oils are often suitable.
- Be cautious of commercial turbine oils as a barrier fluid. Anti-wear and oxidation-resistant additives in these products have been known to plate out on seal faces.

Installing the Reservoir

Complete these steps to install the reservoir. Make sure to complete all steps before starting the system.

1. Mount the basic seal pot reservoir vertically with no more than 3 feet (0.9 meters) between the seal gland and the vertical centerline of the reservoir. Mount the bottom of the reservoir between 18 and 24 inches (45.7 to 61 centimeters) above the horizontal centerline of the pump.
2. Flush the reservoir with clean fluid before equipment start-up until all foreign debris has been removed.
3. Ensure that all lines from the seal cavity to the reservoir slope upward a minimum of 1/4 inch per foot at all points. And all bends should be large radius, with a minimum tubing size of 3/4 inch diameter.

4. Connect the lower seal connection on the reservoir (supply connection) to the lower (inlet) gland connection.
5. Connect the upper seal connection on the reservoir (return connection) to the upper (outlet) gland connection.
6. (Only for reservoirs 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. (Only for systems with weld pad level gauges) Bolts generally loosen during transport, so if the system is equipped with a weld pad level gauge, re-torque the bolts on the cover to 20 ft/lbs by tightening each bolt in 5 ft/lb increments. Start with the center bolts and work out from there.
10. (Only for API Plan 52 systems) Connect the vent connection to the flare or vapor recovery system.
11. Fill the reservoir with barrier/buffer fluid to the middle of the sight glass. Because thermal expansion will occur during operation, allow at least 25% of the reservoir's total volume for gas volume.
12. (Only for API Plan 52 systems) Open the vent valve once the reservoir has been filled.
13. Bleed all air from the highest point in the system.
14. (Only for API Plan 53A (Dual Seal) systems) Connect external pressurization to the reservoir. 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 the reservoir is filled before pressurizing.

Start-Up

API Plan 52/ANSI Plan 7352 System Startup

1. Slowly open the valve to the vent or flare system.

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

Once these steps are completed, the pump can be commissioned for start-up. Follow equipment manufacturer recommendations for start-up, as well as all plant safety and start-up procedures.

API Plan 53A/ANSI 7353 System Startup

1. Slowly open the valve between the reservoir and external pressurization supply, and increase the pressure gradually to prevent gas from being ingested into the reservoir.
2. While the unit is being pressurized, check for any leaks. Depending on the seal design, operating pressure is normally 15 to 25 psig (1 to 1.7 bar) above seal cavity pressure. Use a pressure gauge to monitor system pressure.
3. If the system is equipped with cooling coils, open the valve to allow water to flow through the coils.

Once these steps are completed, the pump can be commissioned for start-up. Follow equipment manufacturer recommendations for start-up, as well as all plant safety and start-up procedures.

Maintenance

Proper maintenance during planned plant shutdowns helps remove any particles that may have entered the reservoir, and also helps maintain the quality of the barrier/buffer fluid used to lubricate the seals. Therefore, three actions are recommended during shutdown:

- drain the barrier/buffer fluid
- flush the reservoir
- refill the reservoir with new fluid

When changing or cleaning the glass on weld pad level gauges, always install new gaskets and re-torque bolts to proper specifications.