



CHEMICAL SEAL

- CORROSIVE APPLICATIONS ● VISCOUS LIQUIDS & SLURRIES ●
- PULSATING PROCESSES ●



Switzer offers a variety of Chemical Seals for use with its range of Pressure, Differential Pressure Switches, Pressure transmitters and Differential Pressure Indicators, for applications where corrosive, highly viscous or slurry process media are encountered.

Since total isolation is provided by the chemical seal, hazard of leakage of corrosive and dangerous chemicals is reduced.

The design principles applied to Switzer Chemical Seals ensure process pressure variations to be precisely transmitted to the instrument's sensing element without its coming in contact with the process medium.

The seal, capillary in the case of remote seals and pressure sensing element of the instrument are carefully filled with suitable pressure transfer fluid. Any pressure applied to the seal diaphragm is hydraulically transmitted to the pressure sensing element.

Besides the protection provided by isolating the process medium from the instrument, the chemical seal can also be used as a protection against high process temperatures, pulsations / vibrations.

A Chemical Seal extends the service life of the instrument, eliminates repetitive replacements and reduces maintenance costs. Thus its initial investment cost will be recovered in a short duration.

GENERAL SPECIFICATIONS

Body		Process Connection	Screwed Type : 1/2" NPT Flange Type : 1" to 3" ANSI #150, 300, 600 rating, Raised face. Other sizes & ratings as well as Tongue & Groove, Ring Type Joint flanges available on request
Top Housing (Non-wetted part)	304 SS		
Bottom Housing	316 SS Std. Hastalloy C and Monel optional		
Seal Diaphragm	316 SS Std. Hastalloy C and Monel optional	Fill Fluid	Std. Silicone oil Optional Fluorolube (for use with Oxygen and oxidising agents)
Optional Protection		Flushing arrangement	– Direct without Flushing Ring For Flanged type , 1/8" NPTF for 1" size, 1/4" NPTF from 1½" to 3" size (port in bottom flange) For Screwed type, 1/2" NPTF (port in bottom housing) OR – Via removable Flushing Ring 1/4" or 1/2" NPTF ports for seals with flanged connection
For wetted parts	For Screwed Type - PTFE sheath for diaphragm For flanged type PTFE sheath for diaphragm and PTFE insert on flanges		
Construction	Replaceable / Welded diaphragm		
Remote Seal	With 304 SS armoured 316 SS capillary		

What is a Chemical Seal?

A pressure or differential pressure measuring instrument can not always be connected directly to a process when the process medium can render the measurement ineffective or can cause irreversible damage to the sensing element.

In such cases it is necessary to introduce a seal system between the pressure instrument and the process medium, isolating it from the process medium.

A flexible diaphragm fixed suitably between two rigid plates, where one side of the diaphragm is in contact with the process medium and the other side is connected to pressure sensing element. The space between the diaphragm and the sensing element is completely filled with a neutral liquid called as the Fill or Transfer fluid.

When pressure is applied to the seal arrangement, it is transmitted by the flexible diaphragm through the Fill fluid to the pressure sensing element.

Sometimes a capillary tube is provided between the seal diaphragm housing and the sensing element to facilitate remote mounting of the pressure instrument.

This type of seal arrangement is variedly known as Diaphragm Seal, Chemical Seal or Process Separator in the industry.

When a Chemical Seal is required?

A Chemical seal is necessary to be used in the following conditions to overcome:

- The risk of clogging of the pressure sensing element when used with slurries or media that can crystallize at ambient temperature
- The risk of corrosion and chances of failure of the sensing element when used with acids and chemicals
- The risk of inaccurate measurement when used with highly viscous media

Optional use of Chemical Seal with capillary (Remote Seal)

- Most pressure and differential pressure measuring devices are designed to work with process temperature between 70° and 90°C only. In high temperature applications, a seal with the capillary will bring down the process temperature at the instrument to near ambient.

For such applications suitable 'O' Rings, Teflon gaskets must be used.

- While monitoring pressure of dangerous substances, the pressure sensing device can be mounted away from the process which will provide safety to the plant personnel.
- To reduce the effects of pulsations and vibrations being transmitted to the sensing element, since the combination of the fill liquid and the flexible diaphragm act as a pulsation dampener
- Where mounting the pressure measuring device directly on to the equipment or pipe is difficult or not possible due to space constraints

Construction

The two halves of the chemical seal arrangement are the Top Housing which is connected to the instrument and the Bottom Housing which is connected to the process. The Top Housing is made of AISI 304 SS as it does not come in contact with the process (Non Wetted Part), while the Bottom Housing is made of either AISI 304SS / 316 SS, which is compatible with most of the chemicals and acids. In the case of very aggressive chemicals special materials such as Hastalloy and Monel are used.

A flexible metallic diaphragm is clamped between these two halves of the seal, with a gasket or 'O' ring to ensure perfect sealing. Refer Fig.1 & Fig.2. The diaphragm can also be welded to the top housing.

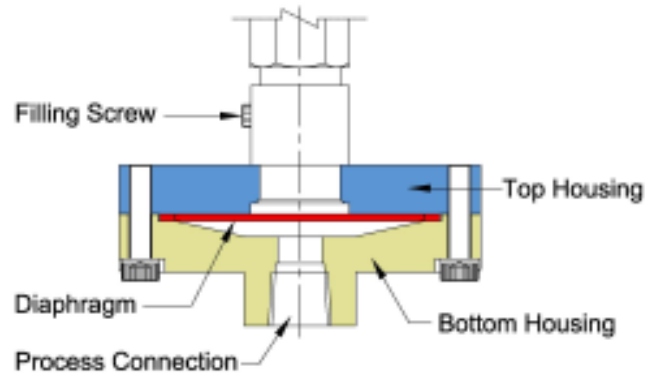


Fig.1 : Direct / Remote Mounted Screwed connection

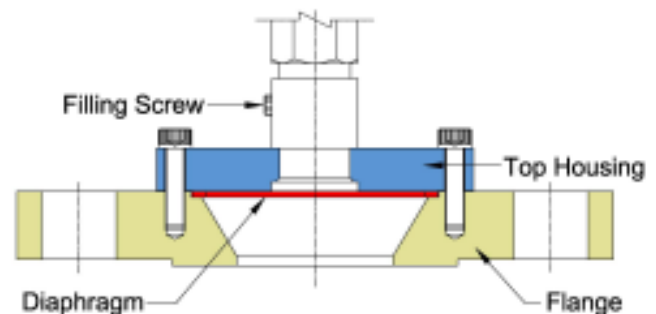


Fig.2 : Direct / Remote Mounted Flanged connection

The diaphragm can also be protected by a PTFE sheath. In addition only Flanged type seals an additional PTFE insert can be provided to protect the wetted parts. This will do away with the necessity of using exotic materials for the diaphragm and wetted parts. Refer Fig.3.

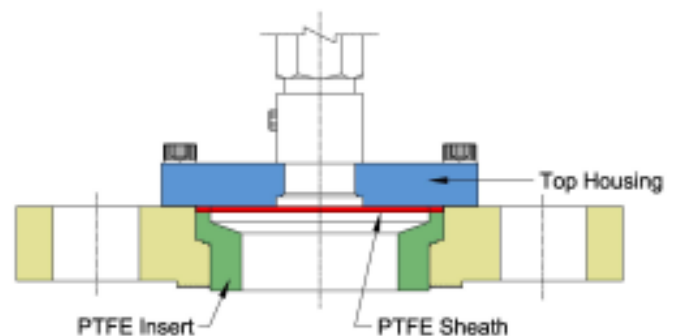


Fig.3 : Direct / Remote Mounted Flanged connection with PTFE Insert

The diaphragm can be cleaned in-situ, with steam, water, air or whichever medium is compatible with the process. Through flushing arrangements shown below.

Flushing ports can be directly in the bottom housing (refer Fig.4a & 4b) or through a flushing ring (refer Fig.5).

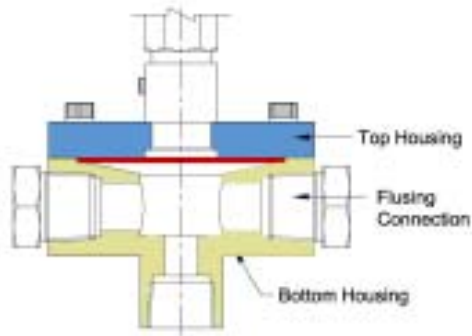


Fig.4a : Direct / Remote Mounted
Screwed connection with flushing ports

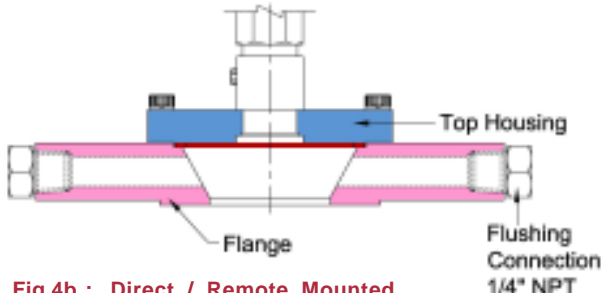


Fig.4b : Direct / Remote Mounted
Flanged connection with flushing ports

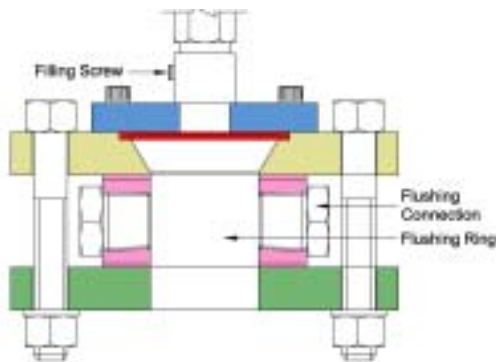


Fig.5 : Direct / Remote Mounted
Flanged connection with flushing Ring



Fig.6 : Typical Differential Pressure Gauge
with Chemical Seal

Types of Chemical Seals

Seal Type	Application	Mounting
Off Line	Corrosive, Viscous & Slurry Services (process medium does not crystallize or solidify at ambient temperature)	Screwed or Flanged
Wafer	Same as above but in easily removable wafer form	Fixed using a blind flange
In-Line (Flow through Seal)	Media which can solidify at ambient Temperature (Diaphragm in contact with flowing medium)	Welded to process pipe

Performance of a chemical seal is determined by the diaphragm, fill Liquid and the diameter & length of capillary extension. Improper selection of these influences the response time and introduces errors due to temperature variations.

- **Rigidity of Diaphragm :** This is the most decisive factor. Diaphragm rigidity depends on its material, thickness and area.

A large diaphragm is more sensitive to pressure changes than a small diaphragm and so is preferred in low pressure systems. But it will suffer from changes in pressure due to temperature changes. A smaller diaphragm being less sensitive will absorb such changes in pressure.

Diaphragm rigidity also depends on protective coatings. It is better to avoid coating of the diaphragm. Better options would be to use a diaphragm material which is compatible to the process such as Hastalloy, Monel, or SS diaphragm with Silver or Gold plating etc or use a thin sheet of PTFE to protect the diaphragm. If at all coating of the diaphragm is a must then coating thickness should be maintained as low as possible.

- **Filling Liquid :** Filling liquid preferably should have lowest co-efficient of thermal expansion and lowest possible viscosity in order to minimise temperature error and better response time.

- **Capillary Extension :** The internal diameter and the length of the capillary influence the response time. Moreover the pressure head exerted by the liquid in the capillary will lead to error in pressure measurement if care is not taken during installation.

The effects of the above three components on the measurement are as below.

- **Response Time :** The response time depends upon the fill liquid, the internal diameter and the length of the capillary and the pressure in the system.

As the internal diameter of the capillary increases the response time decreases. But temperature error increases due to increase in fill volume.

The response time increases as the viscosity increases, and decreases as the system pressure increases.

Similarly longer the capillary length larger is the response time and higher the temperature error.

- **Temperature Effect :** The fill fluid in the system expands and contracts as a result of ambient temperature changes. The amount of expansion depends on the coefficient of expansion of the fill medium. The change in the fluid volume inside the sensor, on the diaphragm and in the capillary tube will impair the pressure measurement.

Error due to change in temperature up to 100°C can be 1 to 1.5% FSR when system pressure is below 2.5 bar. The error will be less than 0.25% FSR for system pressure of 25 bar. At higher pressures the error is negligible.

- **Height Error :** In the case of seals with capillary (Remote Seal), when the seal is not located at the same height as the pressure switch or transmitter, the pressure experienced by the instrument is influenced by the value of the pressure corresponding to the height of the liquid column in the capillary tube.

When the instrument is located beneath the seal, the liquid column pressure will be additive and a negative correction is required. Similarly when the instrument is located above the seal, the error will be subtractive and the correction positive.

So, when installing , the instrument must always be located at the same level as the Chemical Seal.



ORDERING MATRIX

Diaphragm Type

Replaceable _____ R
 Welded _____ W

Wetted parts

Diaphragm

Bottom housing

316SS _____	316SS _____	22
Hastalloy _____	316SS _____	H2
Monel _____	316SS _____	M2
316SS _____	304SS _____	24
Hastalloy _____	Hastalloy _____	HH
Monel _____	Monel _____	MM

Mounting Location

Direct _____ 00
 Remote capillary length 1 to 9 meters _____ 01-09

Process connection Type

Screwed _____ S
 Slip on Flange Raised Face _____ R
 Slip on Flange Flat Face _____ F
 Tongue & Groove Flange _____ T
 Ring Type Joint Flange _____ J

Process connection Size

1/2 " NPT F _____	0
Flanged, 1" #150 _____	A
Flanged, 1½" #150 _____	B
Flanged, 2" #150 _____	C
Flanged, 3" #150 _____	D
Flanged, 1" #300 _____	E
Flanged, 1½" #300 _____	F
Flanged, 2" #300 _____	G
Flanged, 3" #300 _____	H
Flanged, 1" #600 _____	I
Flanged, 1½" #600 _____	J
Flanged, 2" #600 _____	K
Flanged, 3" #600 _____	L

Options

Without Flushing arrangement _____ 00
 With Flushing ring _____ 10
 With Flushing Port _____ 1P
 Without Flushing arrangement + PTFE sheath _____ 0S
 With Flushing ring + PTFE sheath _____ 1S
 Without Flushing arrangement + PTFE sheath & Insert _____ 0T
 With Flushing ring + PTFE sheath & Insert _____ 1T

Fill Options

Silicone Oil _____ 0
 Fluorolube _____ 1

Prior notification of changes in specification is impracticable due to continuous Improvement

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<http://www.switzerinstrument.com/offices.htm>