

1. Introduction

A diaphragm seal is a device that attaches to the process side of a pressure-measuring instrument to separate the instrument from the process fluid while transmitting pressure across a flexible membrane. The volume enclosed by the diaphragm, the top housing, and the measuring element is completely filled with a pressure transfer fluid.



A change in pressure at the process connection causes a displacement of the filling fluid due to deflection of the diaphragm, transferring the change in pressure to the sensing element of the pressure instrument.

2. Safety Information

WARNING: Serious injury or equipment damage can result from failure to properly install, maintain, or operate these components. To assure safe operation and maintenance procedures, read carefully and follow the instructions in this manual.

- Follow all instructions in this document to avoid exposure to pressurized fluid
- Use proper tools and safety equipment in installing or maintaining components
- Assure that process pressure and temperatures are properly monitored and maintained, and the process fluid is appropriate and compatible with the wetted materials of the diaphragm seal
- Follow all of your company's safety procedures in the event of a leak or diaphragm seal failure

3. Diaphragm Seal Components

Though the exact components will vary between specific models, most diaphragm seals will share the same essential parts.

3.1 Top Housing

The top housing of the diaphragm seal is used to connect to the pressure measurement instrument. The fill port allows for assemblies to be vacuum filled, then sealed with a ball bearing in a conical seat and secured with a set screw.



3.2 Diaphragm

The diaphragm serves to separate the process fluid from the filling fluid, and as such is a component wetted to the process. 700-series diaphragm seals have a diaphragm welded to the top housing. Changes in pressure cause the diaphragm to deflect, displacing fill fluid and transmitting pressure to the pressure-measuring instrument. It is important to ensure that a diaphragm has sufficient displacement to operate a pressure-measuring instrument across its entire span. For detailed diaphragm seal and instrument compatibility, see Ashcroft Product Information Page DS-PI-82, "Minimum and Maximum Pressures for Diaphragm Seals," found at Ashcroft.com

3.3 PTFE Gasket

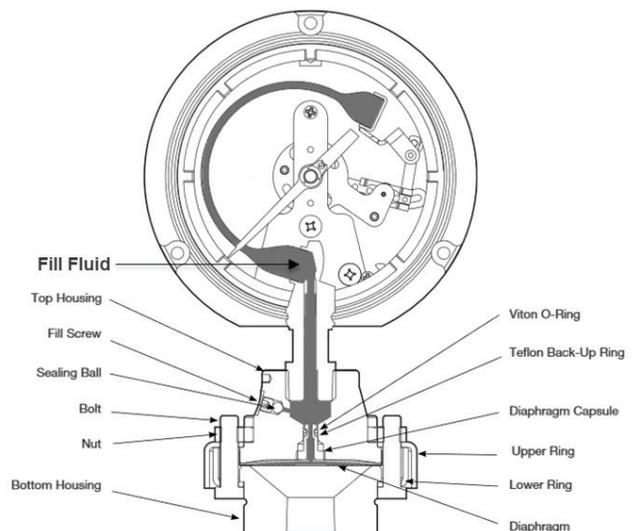
All 700-series seals are supplied with a single-use Gylon/PTFE gasket. Refer to Section 4.2.2 for process considerations related to these gaskets.

3.4 Lower Housing

The lower housing connects a diaphragm seal to the end user's process, and is also therefore a wetted part. Lower housings are designed to mate with an end user's process and come in a wide variety of connection styles, both flanged and threaded. Lower housings can optionally be provided with threaded flushing connections which can be used to clean the inside of the seal or to flush out process media.

3.5 Fill Fluid

A filling fluid (sometimes referred to as "system fill," "pressure sensing fluid," or "hydraulic fluid") is required to transmit pressure from the diaphragm membrane to the pressure sensing device. Diaphragm seal assemblies are filled via a vacuum filling process that ensures the system contains no air gaps. Fill fluids are normally selected based on operating conditions; primarily temperature. Though normally not in contact with the process media, a diaphragm failure may bring process media in contact with the fill fluid, so compatibility with the process media should be a consideration.



4. Specifications

4.1 700 Series High-Displacement Seals

Connections:	702 Flanged process process 703 Flanged process connection with flushing port 740 Threaded process connection 741 Threaded process connection with flushing port
Process Connection Sizes:	Various; refer to data sheet for sizes
Instrument Connection Sizes:	¼ or ½ NPT female
Pressure Ratings:	750 psi
Added Instrument Tolerance:	± 0.5% typical
Wetted Components:	Diaphragm, lower housing, Gylon gasket
Non-Wetted Components:	Top housing & assembly hardware

4.2 Temperature Information

4.2.1 Thermal Dissipation

Seals will dissipate thermal energy, though ambient and process conditions will greatly affect the amount of heat that can be lost through the seal. Accessories designed for dissipating heat, such as siphons or capillaries, should be used whenever dealing with elevated process temperatures.

4.2.2 PTFE Gasketing

The highest acceptable process temperature for PTFE gaskets is 500°F. The lowest acceptable temperature is limited by the fill fluid, the lowest of which is Syltherm XLT, rated to -150°F. For process temperatures below -150°F or exceeding 500°F, consider a temperature dissipating device, such as a capillary or a finned siphon. For processes that are not compatible with PTFE, consider an all-welded diaphragm seal.

5. Fill Fluid Specifications

Fill Fluid	Temperature	Viscosity (cSt at RT)	Variation Code	Notes
Glycerin (food grade)	0°F to 400°F (-18°C to 204°C)	1,300	CG	Direct-mounting only. Not for use with vacuum service
50 cSt Silicone	-40°F to 500°F (-40°C to 260°C)	50	CK	
10 cSt Silicone	-40°F to 500°F (-40°C to 260°C)	10	DJ	
Halocarbon® 4.2	-70°F to 300°F (-57°C to 199°C)	4.2	CF	For use with oxygen/oxidizing process media
Syltherm® 800	-40°F to 750°F (-40°C to 400°C)	10	HA	High temperature applications
Syltherm® XLT	-150°F to 500°F (-100°C to 260°C)	1.4	CC	Low temperature applications
Calflo® AF	-20°F to 600°F (-29°C to 316°C)	60	KF	High temperature, silicone-free
Mineral Oil	10°F to 400°F (-12°C to 204°C)	75	MY	
Neobee® M-20 (food grade)	5°F to 400°F (-15°C to 204°C)	9.5	NM	
Silicone (food grade)	-40°F to 500°F (-40°C to 260°C)	350	CZ	
Distilled Water	40°F to 185°F (4°C to 85°C)	0.9	FJ	
50/50 Glycerin/Water	15°F to 200°F (-9°C to 93°C)	30	GH	
Propylene Glycol	-50°F to 325°F (-46°C to 163°C)	54	CV	
Ethylene Glycol	20°F to 325°F (-7°C to 163°C)	14	FK	
50/50 Ethylene Glycol/Water	-25°F to 190°F (-32°C to 88°C)	2.9	CT	
80/20 Glycerin/Water	15°F to 225°F (-9°C to 107°C)	270	GR	
95/5 Water/Propylene Glycol	40°F to 185°F (4°C to 85°C)	1.0	PY	

6. Installation

6.1 General Information

Instruments attached and filled to diaphragm seals should never be tightened or loosened at the top housing. Doing so will alter the dynamics of the fill fluid and diaphragm movement, causing errors in the reading. Assemblies should ONLY be installed and/or tightened at the diaphragm seal lower housing. 700-series seals can be purchased with the instrument welded to the top housing of the seal to prevent tampering (XDU).

Diaphragm seals should be installed in accordance with any safety precautions or installation specifications applicable to the end user. That said, the general principles in the following sections still apply.

6.2 Threaded Seals

Use of flushing ports is application-specific – they are often used in cases where process media has the potential to clog inside the lower housing, whether due to process media solidification, suspended solids, polymerization, or other factor. Diaphragm seals with flushing ports must have the flushing ports plugged prior to startup. Flushing ports on most seals are ¼ NPT, though some configurations may have ¼ or ½ NPT flushing ports. Diaphragm seals can be ordered with the flushing ports pre-plugged with the “XPU” variation. Note that to prevent thread galling or stripping, factory-installed flush plugs may not be fully tightened and should be checked for tightness prior to pressurization.

6.3 Flanged Seals 702 and 703

The following steps must be followed to ensure a leak-tight connection between the mating flange and the flanged diaphragm seal. 1.

1. Select nuts, bolts, washers, gasket, and thread lubricant in accordance with process requirements and ASME PCC-1-2010.
2. Center the gasket between the mating flange and diaphragm seal face, lining up the bolt pattern on each flange. Ensure that the gasket does not cover the active surface of the diaphragm.
3. Thread nuts and washers onto one end of each bolt, and insert through the bolt holes on the mating flange, passing up through the bolts holes on the diaphragm seal. Attach nuts and washers to the opposite end of the bolts and finger-tighten.
4. Refer to ASME PCC-1-2010 to determine the necessary torque based on gasket material and bolt/lubricant frictions factors. Using a torque wrench leveraged with a conventional wrench, tighten each bolt to 30% of the target torque for the flange in a crisscross tightening sequence. Next, tighten each bolt to 70% of the target torque using the same sequence, and finally 100% of the required torque.

After at least 4 hours, the bolts should be tightened one final time to the target torque value to account for creep/relaxation of the bolts.

6.3 Threaded Seals 740 and 741

Note: Torque should never be applied to the pressure instrument when installing the diaphragm seal. Most seals are supplied with either wrench flats or spanner holes to be used when installing the seal into process piping.

Threaded seals are most commonly supplied with NPT threads per ASME B1.20.1. NPT threads require the use of a suitable thread sealant, such as pipe dope or PTFE tape, and must be tightened securely to prevent galled threads and to ensure a leak-tight seal. Torque values will vary by connection size, though 2-3 full turns past finger-tight is often used as a guideline. Refer to ASME B1.20.1 for detailed information regarding NPT threads. For alternate thread types (metric, BSP, etc.), refer to the applicable specification.

7. Maintenance

7.1 Storage

Diaphragm seal assemblies should be stored in accordance with the storage requirements for all instruments attached, as well as any temperature limits listed above. Common instrumentation is shown in the table below. Refer to the respective data sheets or maintenance guides for detailed storage requirements for Ashcroft pressure instruments. Note that certain fill fluids (e.g., distilled water) may have storage and process temperature limitations narrower than the below data.

Pressure Instrument	Minimum Storage Temperature °F (°C)	Maximum Storage Temperature °F (°C)
Pressure Gauge (Dry)	-40 (-40)	250 (121)
Pressure Gauge (Glycerin-filled)	0 (-18)	150 (66)
B-series switches	-20 (-28)	150 (65)
A- Series Switches	-40 (-40)	257 (125)

7.2 Frequency of Inspection

Inspection frequency is application-specific and depends on the severity of the service and how critical the accuracy of the pressure instrument is. For example, a monthly inspection may be necessary for severe service applications, such as corrosive process media or heavy pulsation and vibration. Annual inspections, or even less frequent schedules, are often employed in non-critical applications.

7.3 Removal from Service

Diaphragm seals should be properly isolated and vented from the process prior to disassembly. Most diaphragms can be inspected by removing the diaphragm seal from the process (either by unthreading or by removing it from the mating flange) and viewing the diaphragm through the lower housing.

If additional inspection is needed, 700-series diaphragm seals can be disassembled by removing the clamping screws and separating the top housing and diaphragm from the lower housing. Note that the PTFE wetted gaskets on certain seals are single use, and must be replaced anytime the compression is lost. Contact Ashcroft for information on ordering replacement gaskets.

7.4 Diaphragm Seal Failures and Troubleshooting

All Ashcroft diaphragm seals, with the exception of 310 Mini Seals, are continuous duty as defined by ASME B40.2. Should the pressure instrument fail or be removed accidentally, the diaphragm will seat against a matching surface in the top housing preventing damage to the diaphragm or leakage of the process fluid.

In the event that a diaphragm failure is suspected, the assembly should be immediately isolated from the process and the cause for failure determined. Most diaphragm failures are caused by corrosion, high temperatures, or fill leakage. Process media build-up in the lower housing can also require cleaning or replacement. In the event of a diaphragm failure due to corrosion, it is critical that the wetted materials of the assembly be evaluated for compatibility before it is replaced.

7.4.1 Troubleshooting Guide (see chart on next page)

Symptom	Possible Cause	Solution
Instrument not responding to pressure	Poor filling process, loss of fill fluid	Refill diaphragm seal and instrument assembly
	Process media clog or accumulation in lower housing	Clean out lower housing; alternately, use a seal with a flushing port
Process media leaking from process connection	Threaded seals: Inadequate thread sealing	Check that the seal has been properly torqued and that the threads have been sealed with pipe dope or PTFE tape
Rusted bolts/top housing/flange	Corrosive atmosphere	In most cases rust will not affect the performance of the seal. Consider more corrosion-resistant non-wetted materials.
Upscale shift on pressure reading	Temperature error – High Temp	Consider a heat dissipation accessory, such as a capillary or MicroTube™ Siphon
	Overfilling	Refill diaphragm seal and instrument assembly
	Diaphragm permeation	Certain process media can permeate the very thin diaphragm material and react with fill fluid. Review wetted material compatibility