

Diaphragm Seals

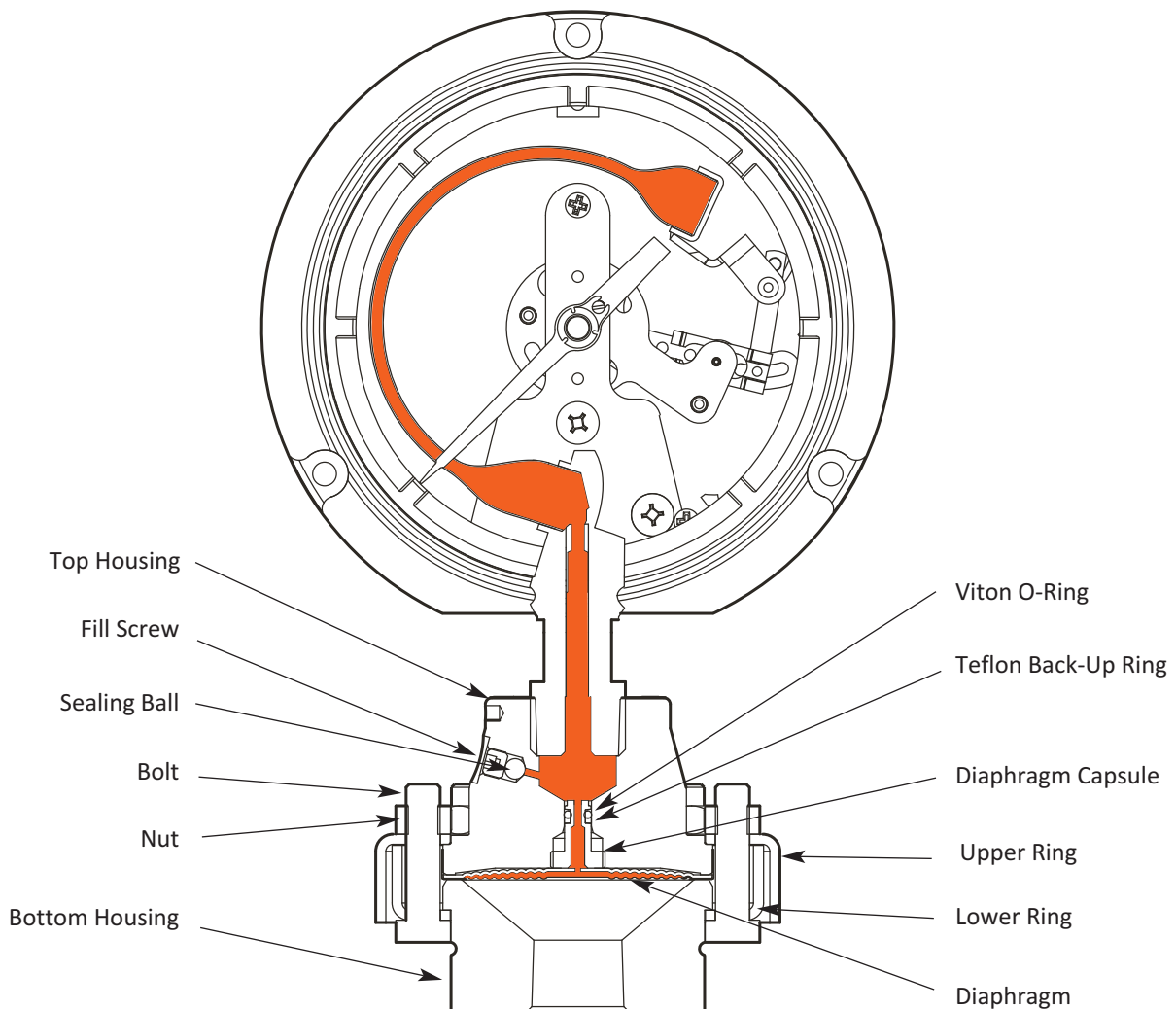
DS/PI-82E

MINIMUM/MAXIMUM PRESSURES FOR DIAPHRAGM SEALS

The comprehensive line of Ashcroft diaphragm seals will meet a variety of applications and installation requirements. To take full advantage of Ashcroft's seal technology it is important to understand the products operating principles and pressure measurement characteristics. This information provides a guideline when isolating an instrument from the process; reference Table 2 for the Minimum/Maximum operating pressure matrix.

Operating Principle

A diaphragm seal is attached to the process connection of the instrument. The hermetically sealed system is vacuum filled with liquid, or fill fluid. The pressure applied to the diaphragm is hydraulically transmitted to the pressure instrument.



Diaphragm Seal and Instrument Assembly

To ensure that the pressure is correctly transmitted from the diaphragm to the instrument the following must be considered:

1. Fluid Displacement

- a. **Volumetric Displacement:** The volume of fluid a diaphragm can displace. variables involved. However, we know it can be influence by:

DIAPHRAGM SEAL DISPLACEMENT

DIAPHRAGM SEAL TYPE	DIAPHRAGM MATERIAL	MAXIMUM DISPLACEMENT	
		CUBIC INCHES	CUBIC CENTIMETERS
100, 200	Metal	0.7	1.14
200, 300	Teflon	0.14	2.23
200, 300	Viton	0.5	8
300	Kalrez	0.5	8
310	Metal	0.025	0.41
311, 312	Metal	0.032	0.52
320 (1½" process)	Metal	0.025	0.41
320 (2" process)	Metal	0.07	1.14
330	Metal	0.018	0.41
400	Metal	0.07	1.14
500	Metal	0.07	1.14
702/703	Metal	0.43	7
740/741	Metal	0.43	7

Table 1

- b. **Control Volume or Instrument Displacement:** The volume of fluid needed to obtain full deflection of the instrument, or 0-100% range.

To obtain a successful transfer of pressure from the diaphragm to the pressure instrument the volumetric displacement of the diaphragm **must be greater** than the control volume of the instrument.

2. Instrument Pressure Range

Instruments offering **low pressure** ranges (i.e. series 1188 gauges, inches of water range switches and low differential pressure gauges, such as 5503), typically have a high control volume. Consequentially, these instruments require a high volumetric displacement diaphragm seal. As noted on **Table 1**, the 700 series seals and the Viton/Kalrez diaphragms offer the highest volumetric displacement. In fact, low pressure instruments such as 1188, 5503 and inches of water switches **must be** mounted to the 700 series or a seal with Viton or Kalrez. Please reference Table 2 Min/Max.

In addition, the diaphragm seal must be **rated for pressure greater than the full scale of the instrument**. For threaded seals, please refer to the datasheet. For flanged seals, please refer to DS/PI- 83 Diaphragm Seal Flange Ratings, found on ashcroft.com

3. Fill Fluid

Ashcroft offers a variety of fill fluids to meet customer requirements. When selecting the appropriate fill fluid for the application please consider the following:

a. Safety: In the unlikely event of a diaphragm rupture, the fill fluid will come into contact with the process media. Applications where oxidizing agents are present, (i.e. chlorine, bromine, oxygen etc.) require Halocarbon fill, as they may cause fires or violent reactions in the event that glycerin, silicone or oil are utilized. For a complete list of oxidizing agents please use our guide at ashcroft.com

In the case of food/beverage and pharmaceutical applications, a non-toxic food grade fluid may be required. Ashcroft offers food grade glycerin, silicone and mineral oil.

b. Pressure Ranges: Applications in vacuum, compound or low pressure require low viscosity fluid; 1188 series gauges must be filled with low viscosity fluids as silicone. Glycerin is high viscosity (1,300cSt) and not recommended for such applications.

c. Temperature: The fill fluid must be able to withstand the min./max. of the process temperature. The following table provides a list of common fluids and their temperature ratings.

FILLING	SERVICE	CONNECTION TO INSTRUMENT	TEMPERATURE LIMITS RANGE		CODE
			°F	°C	
Glycerin	Pressure	Direct Only	0/400	0/204	CG
Silicone	Pressure/Vacuum	Direct or Remote Line	-40/600	-40/315	CK
Halocarbon	Pressure/Vacuum in Presence of Strong Oxidizing Agent	Direct or Remote Line	-80/392	-62/200	CF
Syltherm	Pressure/Vacuum	Direct or Remote Line	-40/750	-40/399	HA
Food Grade Silicone	Pressure/Vacuum	Direct or Remote Line	-40/500	-40/260	CZ
Distilled Water	Pressure/Vacuum	Direct or Remote Line	40/185	4/85	FJ
Ethylene Glycol & Water	Pressure/Vacuum	Direct or Remote Line	20/325	-7/163	CT
Propylene Glycol	Pressure/Vacuum	Direct or Remote Line	20/325	-7/163	CV
Mineral Oil	Pressure/Vacuum	Direct or Remote Line	10/400	-12/204	HY
Silicone 10 cST	Pressure/Vacuum	Direct or Remote Line	-40/500	-40/260	DJ

In extreme high or low temperature applications, the fill fluid may experience thermal expansion. This could result in added pressure to the closed system, thereby creating an error in accuracy. The DS/PI-14 Product Information page (found at ashcroft.com) provides a detailed explanation of the temperature impact as well as how to calculate increase in pressure;

<http://www.ashcroft.com/products/upload/DS-PI-14-2.pdf>

4. Mounting

a. Pressure Instruments: Gauges, transducers and pressure switches can be direct or remote mounted.

b. The fill fluid must be coded on both seals and instruments.

c. The seal instrument connection must match the instrument process connection.

i. Switches: X06 or O6 connection (1/2 NPT) will match O4T seal connection.

d. Differential Pressure Instruments: Differential gauges, switches and transmitters must be mounted to seals using a capillary. A low viscosity fluid is required for remote mount systems. Each instrument requires two seals and two capillaries.

e. **Multiple Instrument Assemblies:** Only available with low viscosity fill fluid. Not available with Glycerin.

5. Response Time

This is the period of time required for the pressure instrument to indicate 90% of the value of a sudden pressure variation. Unfortunately, response time cannot be quantified due to the many variables involved yet it is understood to be influenced by:

a. Configuration of the System:

- i. **Direct or Remote Mounted:** Direct mounted assemblies provide faster response times.
- ii. **Pressure or Differential Pressure.**
- iii. **Length of Capillary:** Limiting the length of capillary will improve response time.
- iv. **Multiple Instrument Assemblies.**

b. **Fill Fluid:** Low viscosity fill fluids will have reduced response time.

c. **Diaphragm Size:** Larger diaphragms, ie. type 700, will respond faster to changes in pressure.

6. Diaphragm Materials

Ashcroft offers a diversity of diaphragm materials to withstand a variety of processes. The mechanical properties of each material might impact the sensitivity of the diaphragm. Figure 2 shows a qualitative representation of diaphragm sensitivity based on material.



Figure 2

Ashcroft has compiled the above information on this Easy and Simple to read table. This is a guide, please contact inside sales if you have any questions.

Table 2: MIN/MAX OPERATING PRESSURES FOR DIAPHRAGM SEALS

Process Connection Type	Diaphragm Seal Type	Duragauge & 4 1/2" & Larger Gauges ⁽²⁾	Unigaugue, 2 1/2" & 3 1/2", Type 1009 ⁽¹⁾	1259, 5500/6500 ⁽¹⁾	Low Pressure Bellows Gauges (1188 Series) ^(3,4)	5503 DP Gauge ⁽¹⁾	Digital Gauges ^(5,6)	Transducers ⁽⁸⁾	Switches
THREADED	100/101/200/201 METAL DIAPH.	15psi & Vac (compound), 30psi to 2500psi (XHP to 5000#)	Vac to 2500psi (XHP to 5000#)	15psi & Vac (compound), 30psi to 2500psi (XHP to 5000#)	N/A	N/A	Vac to 2500psi (XHP to 5000#)	Vac to 2500psi (XHP to 5000#)	6psi & Above Setpoint
	200/201/300/301 TEFLON DIAPH.	Vac to 2500psi	Vac to 2500psi	Vac to 2500psi	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to 2500psi	Vac to 2500psi (XHP to 5000#)	6psi & Above Setpoint
	200/201/300/301 VITON, OR KALREZ DIAPH.	Vac to 500psi	Vac to 500psi	Vac to 500psi	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to 500psi	Vac to 500psi	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
	310/315 ("MINI")	N/A	Vac to 2500psi	N/A	N/A	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	311/312 ("MINI")	15psi & Vac (compound), 30psi to 1000psi	Vac 15psi to 1000psi 6psi to 3000psi	15psi & Vac (compound), 30psi to 1000psi	N/A	N/A	Vac	Vac (compound) Vac to 1000psi	6psi & Above Setpoint
	330 (FLUSH)	N/A	45psi & Vac (compound), 6psi to 3000psi	N/A	N/A	N/A	Vac	Vac (compound) Vac to 1000psi	6psi & Above Setpoint
	400/401 (WELDED)	15psi & Vac (comp), 30psi to 4400psi (400 XHP to 9000psi) (401 XHP to 5000psi)	Vac to 4400psi (400 XHP to 9000psi) (401 XHP to 5000psi)	15psi & Vac (comp), 30psi to 4400psi (400 XHP to 9000psi) (401 XHP to 5000psi)	N/A	N/A	Vac to 4400psi (XHP to 9000psi)	Vac to 4400psi (XHP to 9000psi)	6psi & Above Setpoint
	500/501 (WELDED)	15psi & Vac (compound), 30psi to 500psi	Vac to 500psi	15psi & Vac (compound), 30psi to 500psi	N/A	N/A	Vac to 500psi	Vac to 500psi	6psi & Above Setpoint
	500/511	30psi to 1500psi (XHP to 5000psi)	30psi to 1500psi (XHP to 5000psi)	30psi to 1500psi (XHP to 5000psi)	N/A	N/A	100psi to 1500psi (XHP to 5000psi)	100psi to 1500psi (XHP to 5000psi)	6psi & Above Setpoint
	740/741 (LP)	Vac to 750psi	Vac to 750psi	Vac to 750psi	15MW & 15WC, 30WC to 10psi	10psid to 40psid	Vac to 750psi	Vac to 750psi	30" H ₂ O & Above Setpoint
IN-LINE THREADED	104/204 METAL DIAPH.	15psi & Vac (compound), 30psi to 2500psi	Vac to 2500psi	15psi & Vac (compound), 30psi to 2500psi	N/A	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	204 TEFLON DIAPH.	Vac to 2500psi	Vac to 2500psi	Vac to 2500psi	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to 2500psi	Vac to 2500psi (XHP to 5000#)	6psi & Above Setpoint
	204 VITON, OR KALREZ DIAPH.	Vac to 500psi	Vac to 500psi	Vac to 500psi	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to 500psi	Vac to 500psi	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
	102/103/202/203/402/403 METAL DIAPH.	15psi & Vac (compound), 30psi to Class 2500# (Per Group 1.1 Materials, Per ASME B16.5-2003)	15psi & Vac (compound), 30psi to Class 2500# (Per Group 1.1 Materials, Per ASME B16.5-2003)	15psi & Vac (compound), 30psi to Class 2500# (Per Group 1.1 Materials, Per ASME B16.5-2003)	N/A	N/A	Vac to Class 2500# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 2500# (Per Group 1.1 Materials, Per ASME B16.5-2003)	6psi & Above Setpoint
	202/203/302/303 TEFLON DIAPH.	Vac to Class 900# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 900# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 900# (Per Group 1.1 Materials, Per ASME B16.5-2003)	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to Class 900# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 900# (Per Group 1.1 Materials, Per ASME B16.5-2003)	6psi & Above Setpoint
	202/203/302/303 VITON, OR KALREZ DIAPH.	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
	702/703	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	15MW & 15WC (compound), 10WC to 10psi	10psid to Class 300#	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	30" H ₂ O & Above Setpoint
	106/206 METAL DIAPH.	15psi & Vac (compound), 30psi to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	15psi & Vac (compound), 30psi to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	15psi & Vac (compound), 30psi to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	N/A	N/A	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	6psi & Above Setpoint
	206 TEFLON DIAPH.	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	6psi & Above Setpoint
	206 VITON, OR KALREZ DIAPH.	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 150# (Per Group 1.1 Materials, Per ASME B16.5-2003)	6psi & Above Setpoint
IN-LINE SOCKET WELD	107/207 METAL DIAPH.	15psi & Vac (compound), 30psi to 2500psi	15psi & Vac (compound), 30psi to 2500psi	15psi & Vac (compound), 30psi to 2500psi	N/A	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	207 TEFLON DIAPH.	Vac to 2500psi	Vac to 2500psi	Vac to 2500psi	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	207 VITON, OR KALREZ DIAPH.	Vac to 500psi	Vac to 500psi	Vac to 500psi	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to 500psi	Vac to 500psi	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
	108/208 METAL DIAPH.	15psi & Vac (compound), 30psi to 2500psi	Vac to 2500psi	15psi & Vac (compound), 30psi to 2500psi	N/A	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	208 TEFLON DIAPH.	Vac to 2500psi	Vac to 2500psi	Vac to 2500psi	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	208 VITON, OR KALREZ DIAPH.	Vac to 500psi	Vac to 500psi	Vac to 500psi	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to 500psi	Vac to 500psi	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
	105/205 METAL DIAPH.	15psi & Vac (compound), 30psi to 2500psi	Vac to 2500psi	15psi & Vac (compound), 30psi to 2500psi	N/A	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	205 TEFLON DIAPH.	Vac to 2500psi	Vac to 2500psi	Vac to 2500psi	30MW & 30WC (compound), 60WC to 10psi	N/A	Vac to 2500psi	Vac to 2500psi	6psi & Above Setpoint
	205 VITON, OR KALREZ DIAPH.	Vac to 500psi	Vac to 500psi	Vac to 500psi	5MW & 5WC (compound), 10WC to 10psi	10psid to 40psid	Vac to 500psi	Vac to 500psi	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
	ISO RING	TYPE 80	Vac to 1000psi (with High Pressure Clamps) (2" Tri-Clamp Only)	Vac to 1000psi (with High Pressure Clamps)	Vac to 1000psi (with High Pressure Clamps) (2" Tri-Clamp Only)	N/A	N/A	Vac to 1000psi	Vac to 1000psi
TYPE 81		Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	N/A	N/A	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	Vac to Class 300# (Per Group 1.1 Materials, Per ASME B16.5-2003)	6psi & Above Setpoint
TYPE 85		Vac to 500psi	Vac to 500psi	Vac to 500psi	N/A	N/A	Vac to 500psi	Vac to 500psi	10" H ₂ O & Above (B-Series only) 20" H ₂ O & Above All Others
TYPE 86		Vac to 1000psi (with High Pressure Clamps) (2" Tri-Clamp Only)	Vac to 1000psi (with High Pressure Clamps)	Vac to 1000psi (with High Pressure Clamps) (2" Tri-Clamp Only)	N/A	N/A	Vac to 1000psi	Vac to 1000psi	6psi & Above Setpoint
QUICK CONNECT TYPE 20	320	Vac to 1000psi (with High Pressure Clamps) (2" Tri-Clamp Only)	Vac to 1000psi (with High Pressure Clamps)	Vac to 1000psi (with High Pressure Clamps) (2" Tri-Clamp Only)	N/A	N/A	Vac to 1000psi	Vac to 1000psi	6psi & Above Setpoint

NOTES: 1. 1008 not available with seals.
 2. 1125/1127/1128 same system as Duragauge, use static pressure of the system to define compatibility.
 3. 1188 gauges/seal assemblies NOT available with glycerine.
 4. 5503 must be assembled with capillaries.
 5. Glycerine NOT available per Vac and compound ranges.
 6. Lower limits are guidelines for direct mount only. For remote mount consult factory.