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Product Guide

Diaphragm Seal Pressure & Temperature Min/Max Guide

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Highly Effective Protection for Your Pressure Instrumentation

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Introduction

Isolators, such as diaphragm seals and isolation rings, play a critical role in protecting pressure measurement instrumentation from harsh corrosive media, high-temperature processes or clogging that can occur at different points of an operation. These seals, which are commonly used in water and wastewater treatment plants, chemical processing and mining facilities, are designed to help keep applications running safely and efficiently.

Selecting the right seal depends on many factors including installation requirements, pressure and temperature limitations and media composition, among others.

As an industry leader in pressure and temperature instrumentation, Ashcroft has been helping customers find the best, most reliable solutions to their most challenging issues. We created this guide to help you find the diaphragm seal that will provide the best solution for your specific needs.

Use this as a quick reference guide for the specifications needed for diaphragm seals to work properly with gauges, switches and sensors. Also be sure to familiarize yourself with assembly limitations, low-pressure and high-pressure seal options and instruments that are not compatible for use with a seal.

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Minimum Pressure Requirements for **Low-Pressure** Assemblies

Mechanical Gauges for Diaphragm Seals

To ensure proper pressure transmission for low-pressure applications, your diaphragm seal must provide sufficient displacement to drive the sensing element of the instrument(s) attached. The chart below provides a convenient reference for determining the minimum span allowable for pressure instruments when attached to different diaphragm seal models. It is important to note that the values found in the table below are **minimum spans, not ranges.** For example, a 0-30 psi gauge and a Vac/15 psi gauge have the same overall span of 30 psi.

TABLE 1
Minimum Low-Pressure Limits for Diaphragm Seals and Isolation Rings

Diaphragm Seal Series		Material	2.5″ / 3.5″ 1009	1279/1377/ 1379/2462/1009	1259/1209 T5500/T6500	1187/1188 1189	5503/5504	1125/1127 1128
Values represent minimum SPANS, NOT RANGES								
100, 200, 400, 500		Metallic Diaphragms	15 psi	30 psi	30 psi	N/A	N/A	N/A
200, 300		PTFE Diaphragms	15 psi	30 psi	30 psi	N/A	N/A	N/A
200, 300		Viton™ & Kalrez® Diaphragms	15 psi	15 psi	15 psi	60 IWC	10 psid*	15 psid*
700		Metallic Diaphragm	15 psi	15 psi	15 psi	60 IWC**	10 psid	15 psid
510/511	Standard	Metallic Diaphragm	30 psi	30 psi	30 psi	N/A	N/A	N/A
	XHP Version	Metallic Diaphragm	100 psi	100 psi	100 psi	N/A	N/A	N/A
330 Flush Mini-Seal		Metallic Diaphragm	60 psi	N/A	N/A	N/A	N/A	N/A
310/315 Mini-Seal		Metallic Diaphragm	15 psi	N/A	N/A	N/A	N/A	N/A
311/312 Midi-Seal		Metallic Diaphragm	15 psi	30 psi	30 psi	N/A	N/A	N/A
320 Tri-Clamp® Seal	1½″	Metallic Diaphragm	15 psi	N/A	N/A	N/A	N/A	N/A
	2″	Metallic Diaphragm	15 psi	30 psi	30 psi	N/A	N/A	N/A
80, 81, 82 Isolation Rings	1″, 1½″, 2″	Elastomeric & PTFE	15 psi***	15 psi***	15 psi***	N/A	N/A	N/A
	3″+	Elastomeric & PTFE	15 psi	15 psi	15 psi	N/A	N/A	N/A
DF Seals	1″	Metallic Diaphragm	160 psi	160 psi	160 psi	N/A	N/A	N/A
	1½″	Metallic Diaphragm	60 psi	60 psi	60 psi	N/A	N/A	N/A
	2″	Metallic Diaphragm	15 psi	15 psi	15 psi	N/A	N/A	N/A
	3″+	Metallic Diaphragm	15 psi	15 psi	15 psi	60 IWC**	10 psid*	15 psid

Notes: * Consider static max pressure readings of instrument; consider max pressure of diaphragm
** VAC ranges N/A
*** VAC, VAC/15#, & VAC/30# ranges N/A

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Low-Pressure Options

The following models are examples of diaphragm seals and gauges for high-pressure spans. See tables 1 & 2 as a reference.

740/741 & 702/703
High Displacement Seals

Larger surface area diaphragms provide high displacement of fill fluid to drive low-pressure span instruments and achieve low-pressure set points on switches.

- Continuous duty design contains system fill if top housing is removed.
- Available in wide range of metallic diaphragm and lower housing materials.
- Flushing port available.
- Enlarged welded diaphragm.

200/201 & 202/203
Flexible Seals with Viton™ or Kalrez® Diaphragms

Flexible diaphragms such as Viton™ or Kalrez® provide enough displacement to the instruments allowing for low-pressure readings on mechanical pressure gauges and low-pressure set points on switches.

- Continuous duty design contains system fill if top housing is removed.
- 316L Stainless steel top housing.
- Flushing port available.

P5500/P6500
Low-Pressure Gauge with Diaphragm Sensing Element

This low-pressure gauge offers another option for challenging low-operating pressure applications with high over-load protection.

- Comes with internal diaphragm sensing element.
- Uses “dry cell” mechanism to avoid media contamination.
- Optional overload protection up is up to 10 times full-scale range over pressure capability (XHP option).

3-inch/4-inch DF Seal
Flush Flanged Seal

DF seals designed for 3- or 4-inch piping uses a diaphragm with a large surface area for high displacement. For smaller pipe sizes, flange adaptors can be provided to reduce the 3-inch flange down to a 1-inch, 1.5-inch or 2-inch flange connection.

- All welded construction.
- Flush design omits lower housing, reducing clogging points and cost.
- Flushing rings available if required.

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Mechanical Pressure Switches for **Low-Pressure** Assemblies

TABLE 2
Minimum Set Points for Mechanical Pressure Switches

	Set Point Range	Switch Series	Direct Connection		Remote Mounting		
			Diaphragm Available Products/ Material	Fill Fluid (refer to table 5)	Diaphragm Available Products/ Material	Fill Fluid (refer to table 5)	Max. Capillary Length
Pressure	6 psi and Above	A, B, F, G, L, P	All Seals and Isolation Rings	All Fill Fluids	All Diaphragm Seals and Isolation Rings	DJ, CT, CF, HA, MY, CC, PY	50 Feet
	30 in. H_20 and Above	B, G, L, P	700 series/ All 200 Series/ Viton™ or Kalrez®	DJ, CT, CF, HA, MY, CC, PY	700 series/ All Viton™ or Kalrez®	DJ, CT, CF, HA, CC, PY	10 Feet
	20 in. H_20 and Above	B, G, L, P	200 Series/ Viton™ or Kalrez®	DJ, CT, CF, HA, MY, CC, PY	Not Recommended		
	10in. H_20 and Above	B	200 Series/ Viton™ or Kalrez®	DJ, CT, CF, HA, MY, CC, PY	Not Recommended		
Vacuum	1 in. Hg to 3 in. Hg	B	200 Series/ Viton™ or Kalrez®	DJ, CT, CF, HA, MY, CC, PY	Not Recommended		
	3.1 in. Hg to Vac	B, G, L, P	700 series/ All 200 Series/ Viton™ or Kalrez®	DJ, CT, CF, HA, MY, CC, PY	700 series/ All 200 Series/ Viton™ or Kalrez®	DJ, CT, CF, HA, CC, PY	10 Feet

A - Series
Pressure Switch

B - Series
Pressure Switch

G - Series
Pressure Switch

L - Series
Pressure Switch

P - Series
Pressure Switch

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Sensor-Based Instruments for **Low-Pressure** Assemblies

Digital Gauges, Transducers, Transmitters and Electronic Pressure Switches on Diaphragm Seals
While displacement issues are not a big concern, all sensor-based products require a minimum of 15 psi span. The lower the pressure the more impact temperature change can have on calibration when attached to an isolator.

FIGURE 1
Temperature Bandwidth Example

Heavily Affected by Temperature Change

Less Affected by Temperature Change

Recommended Sensor Based Instruments

E2 Transducer
- Analog output options
- 0.25% accuracy
- Zero/Span adjustment on all versions (including Haz Loc)

Industrial Digital Gauges
- 4-20 mA option
- One or two SPDT dry contact switch output options
- 0.25% accuracy
- Zero adjustment

NPI-Switch
- SPDT 10 amp relay output
- 0.5% accuracy
- Set point adjustment

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Maximum Pressure Requirements for **Threaded** Diaphragm Seals

The table below contains the maximum pressures for the various types of seals. Instruments attached to a seal must have a range less than or equal to the seal's maximum pressure.

TABLE 3
Maximum Pressure Range for Instrument Assemblies (Threaded, Clamped and Weld-in Seals)

Diaphragm Seal Series	Diaphragm and Lower Housing Material	Pressure Test	Maximum Instrument Range	Maximum Instrument Range With High Pressure Option (XHP)	Notes
100, 200	All-metallic construction	Standard	2,500 psi	5,000 psi	
		Hydrotest (X1H)	1,600 psi	3,000 psi	
101, 201	All-metallic construction	Standard	2,500 psi	5,000 psi	
		Hydrotest (X1H)	1,600 psi	3,000 psi	
200, 300, 201, 301	PTFE Diaphragm	Standard	2,500 psi	N/A	
		Hydrotest (X1H)	1,600 psi		
100, 200, 300, 101, 201, 301	PVC or PVDF Lower Housing	Standard	200 psi	N/A	
		Hydrotest (X1H)	100 psi		
104, 204, 105, 205, 107, 207, 108, 208	Metallic/PTFE Diaphragm	Standard	2,500 psi	N/A	
		Hydrotest (X1H)	1,600 psi		
	Viton™ or Kalrez® Diaphragm	Standard	500 psi	N/A	
		Hydrotest (X1H)	300 psi		
400	All-metallic construction	Standard	4,400 psi	9,000 psi	
		Hydrotest (X1H)	3,000 psi	6,000 psi	
401	All-metallic construction	Standard	4,400 psi	5,000 psi	
		Hydrotest (X1H)	3,000 psi	3,000 psi	
400 with SS Rings (XSE)	All-metallic construction	Standard	2,500 psi	5,000 psi	
		Hydrotest (X1H)	1,600 psi	3,000 psi	
401 with SS Rings (XSE)	All-metallic construction	Standard	2,500 psi	5,000 psi	
		Hydrotest (X1H)	1,600 psi	3,000 psi	
500, 501	All-metallic construction	Standard	500 psi	N/A	
		Hydrotest (X1H)	100 psi		
510	All-metallic construction	Standard	1,500 psi	10,000 psi	Mechanical Pressure Gauges Only
		Hydrotest (X1H)	1,000 psi	6,000 psi	
511	All-metallic construction	Standard	1,500 psi	5,000 psi	Mechanical Pressure Gauges Only
		Hydrotest (X1H)	1,000 psi	3,000 psi	
510, 511	All-metallic construction	Standard	1,500 psi	3,000 psi	Transducers/Switches
		Hydrotest (X1H)	1,000 psi	2,000 psi	
311, 312	All-metallic construction	Standard	1,000 psi	N/A	
		Hydrotest (X1H)	600 psi		
310, 315	All-metallic construction	Standard	2,500 psi	N/A	
		Hydrotest (X1H)	1,600 psi		
740, 741	All-metallic construction	Standard	750 psi	N/A	
		Hydrotest (X1H)	500 psi		
330	All-metallic construction	Standard	3,000 psi	N/A	
		Hydrotest (X1H)	2,000 psi		
320	All-metallic construction	Standard	1,500 psi	N/A	1.5 Inch Connection
		Hydrotest (X1H)	1,000 psi		
320	All-metallic construction	Standard	1,000 psi	N/A	2 Inch Connection
		Hydrotest (X1H)	600 psi		

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Maximum Pressure Requirements for **Flanged** Diaphragm Seals and Isolation Rings

The table below contains the maximum pressures for the various types of seals. Instruments attached to a seal must have a range less than or equal to the seal's maximum pressure.

TABLE 4
Maximum Pressure Range for Instrument Assembiles (Flanged Seals/Isolation Rings)

		Flange Class					
Flanged Diaphragm Seals	Pressure Test	150	300	600	900	1500	2500
All-Metallic Construction	Standard	300 psi	750 psi	1,500 psi	2,000 psi	2,500 psi	2,500 psi
	Hydrotest (X1H)	200 psi	500 psi	1,000 psi	1,300 psi	1,600 psi	1,600 psi
Viton™, Kalrez® Diaphragm (metallic lower housing)	Standard	300 psi	500 psi	500 psi	500 psi	500 psi	500 psi
	Hydrotest (X1H)	200 psi	300 psi	300 psi	300 psi	300 psi	300 psi
PTFE Diaphragm (metallic lower housing)	Standard	300 psi	750 psi	1,500 psi	2,000 psi	2,500 psi	2,500 psi
	Hydrotest (X1H)	200 psi	500 psi	1,000 psi	1,300 psi	1,600 psi	1,600 psi
PVC Lower Housing	Standard	200 psi	N/A	N/A	N/A	N/A	N/A
	Hydrotest (X1H)	100 psi					
PVDF Lower Housing	Standard	75 psi	N/A	N/A	N/A	N/A	N/A
	Hydrotest (X1H)	50 psi					
PTFE Lower Housing	Standard	200 psi	N/A	N/A	N/A	N/A	N/A
	Hydrotest (X1H)	100 psi					
702, 703 Series	Standard	300 psi	750 psi	750 psi	750 psi	N/A	N/A
	Hydrotest (X1H)	200 psi	500 psi	500 psi	500 psi		
80, 81 Series Metallic End Plates	Standard	300 psi	600 psi	N/A	N/A	N/A	N/A
	Hydrotest (X1H) Calibration Certificates	Consult Factory					
80, 81 Series Plastic End Plates	Standard	600 psi		N/A	N/A	N/A	N/A
	Hydrotest (X1H) Calibration Certificates	Consult Factory					
82 Series (threaded)	Standard	150 psi (threaded connection)					
	Hydrotest (X1H) Calibration Certificates	Consult Factory					

Note: Instrument assemblies should not exceed pressure and temperature guidelines for flange installations. Refer to ASME B16.5 for flange ratings.

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High-Pressure Options for **Threaded** Seals

The following models are examples of diaphragm seals and gauges for high-pressure instruments with larger pressure spans. See table 4 on previous page as a reference.

200/201 Series
Modular Diaphragm Seals

This continuous duty design has the diaphragm welded to the top housing and a removable bottom housing. All metallic configurations realize pressures up to 2,500 psi (standard) or 5,000 psi (XHP option).

400/401 Series
All-Welded Diaphragm Seals

This all-welded design has the top housing welded to the diaphragm and lower housing. It can see pressures up to 4,400 psi (standard), 9,000 psi (XHP option) or 5,000 psi (401-XHP).

510/511 Series
Compact Diaphragm Seals

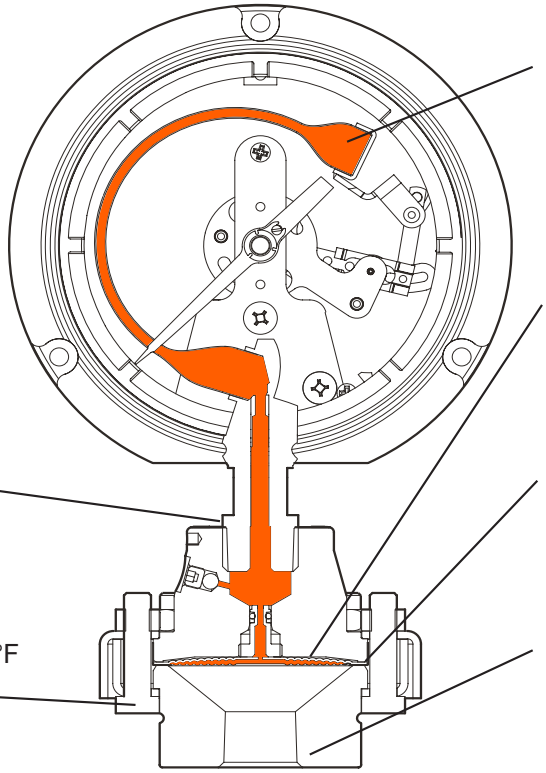
This compact diaphragm seal is all welded and can see pressures up to 1,500 psi (standard) and 10,000 psi (XHP option) or 5,000 psi (511-XHP).

All of these high-pressure models:

- Feature 316L Stainless steel top housing.
- Protect measurement instruments from corrosive media.
- Offer a wide range of wetted material options for process compatibility.
- Have flushing port(s) available for easy cleaning.

Temperature Limitations for **Diaphragm Seals**

To confirm the maximum and minimum temperature limitations on a diaphragm seal assembly, there are multiple points of consideration. To ensure safe installation, it is important to check all potential limits.



System Fill Fluid:
Refer to table 5 for system fluid temperature limits.

Diaphragm:
Refer to table 6 for diaphragm material temperature limits.

Connection:
Threaded 450 °F
Welded 750 °F

Gasket:
PTFE Gasket 480 °F

Bolts:
Zinc plated steel 380 °F
316L SS 750 °F

Lower Housing:
Refer to table 7 for lower housing temperture limits.

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Temperature Limitations for **Diaphragm Seals**

TABLE 5
Systems Fill Fluid Temperature Limits

Fill Fluid	Temperature	Viscosity (cSt at 70 °F (21 °C)	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. Minimum span 15 psi.
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	Minimum span 60 in. H_20.
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	

TABLE 6
Diaphragm Material Temperature Limits

Non-Metallic Diaphragm Seal/ Isolation Ring Temperature Limits	
PTFE	400 °F
Viton™	300 °F
Kalrez®	200 °F
Buna N	150 °F
EPDM	175 °F
Natural Rubber	120 °F

TABLE 7
Diapragm Seal Lower Housing Temperature Limits

Non-Metallic Lower Housing Materials	
PVDF/PVC (threaded)	200 psi - 74 °F 125 psi - 125 °F 80 psi - 150 °F
PVDF	180 °F
PVC	100 °F
PTFE	150 °F

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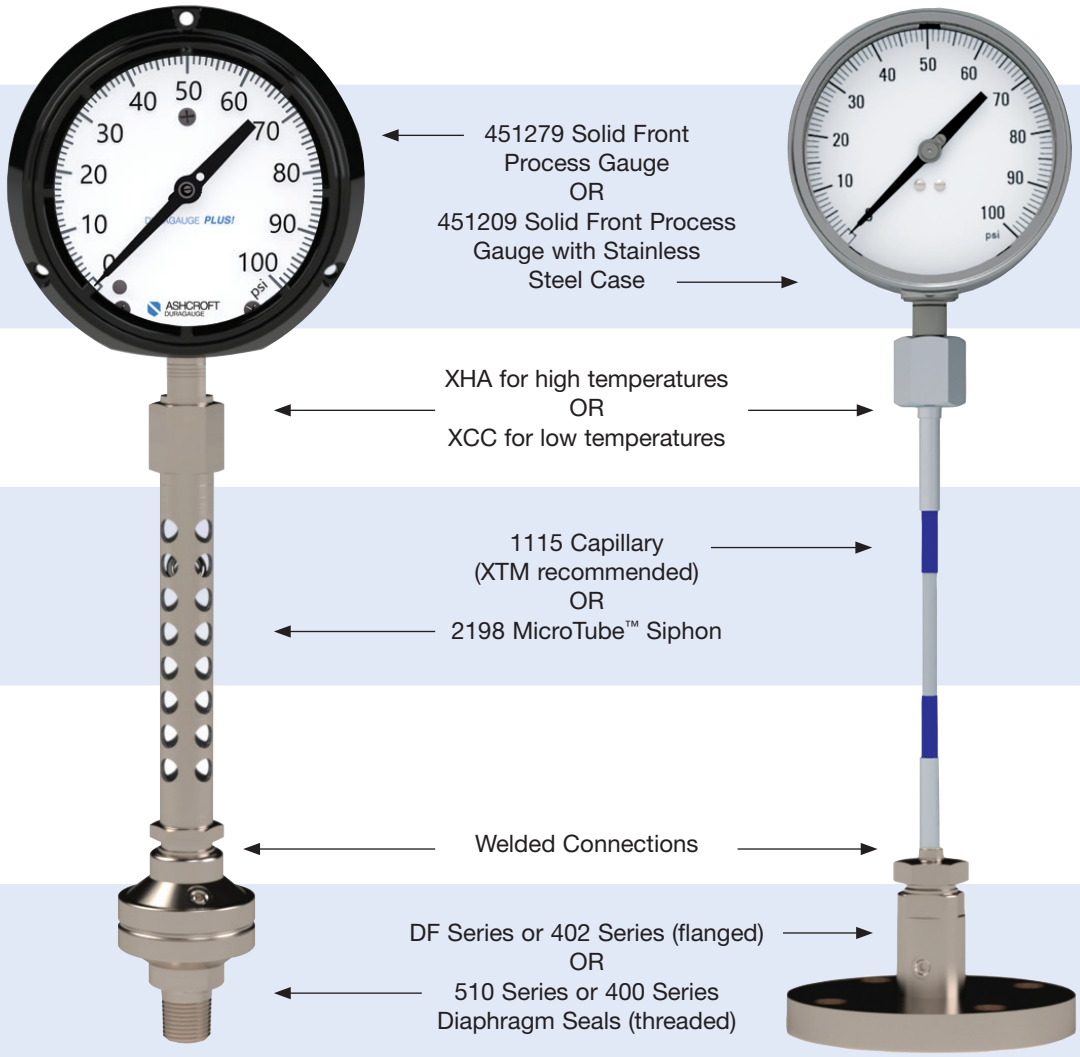
Assemblies for **Extreme** Temperatures

Based on the limitations described on previous page 11 below are the best recommendations for extreme temperature applications (high and low):



Use instruments meant for process applications (e.g. solid front designs, tepera-ture resistant materials).

451279 Solid Front Process Gauge
OR
451209 Solid Front Process Gauge with Stainless Steel Case

Fill assemblies with Sylthern®.

XHA for high temperatures
OR
XCC for low temperatures

Use temperature dissipators 2198 or 1115 (if using capillary include mounting brackets and/or surface mounting cases).

1115 Capillary
(XTM recommended)
OR
2198 MicroTube™ Siphon

Weld all connections to avoid thread sealant.

Welded Connections

Use all welded diaphragm seals that do not have gaskets which may limit temperature rating (510, 400/402 Series, DF Series).

DF Series or 402 Series (flanged)
OR
510 Series or 400 Series Diaphragm Seals (threaded)

Avoid using flush ports.

Diaphragm Seal Attachment Exceptions for **Assemblies**

Please note the following limitations on assemblies:

Pressure ranges of all instruments must match.

Porosity of snubbers must be designed for oils.

Weight and height restrictions should be considered.

Assemblies with capillaries are recommended with 10 cTs silicone (XDJ) for general applications or Halocarbon® (XCF) for applications that require an inert fill.

Glycerin cannot be used on assemblies with 1115 Capillary or 1112 Pressure Snubber.

Glycerin cannot be used for vacuum service or pressure spans less than 15 psi.

All instruments or accessories that are connected directly to the isolator must be ordered with a ¼ or ½ Male or Female NPT connection. Exceptions may apply for custom assemblies or Safe Quick Release™ (SQR™) attachments.

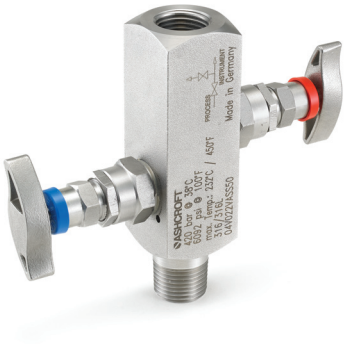
Titanium components can only be welded to titanium (example diaphragms to top housings).

Monel® components can only be welded to Monel® (example top housings to sockets).

Case fills on pressure gauges must be Halocarbon® when diaphragm seal assembly system fill is also Halocarbon®.

Diaphragm Seal Attachment Exceptions for **Accessories**

The following accessories CAN NOT be installed above a diaphragm seal:



Instrument Valves With Bleed Ports

Valves placed above a diaphragm seal are typically there to regulate media flow, commonly known as throttling. Valves designed for throttling are widely accepted above diaphragm seals. Using valves above diaphragm seals that are installed for isolation purposes are not practical and can mislead operators to isolate with the intention of removing the instrument. A valve with a bleed port presents an opportunity to bleed out the system fill rendering the assembly disabled.

Instrument Valves With Equalizer Valves

Instrument valves used with differential pressure instruments typically have an equalizer valve that connects both ports of a differential pressure gauge. This could impact calibration by opening each filled side to the other.

Siphons

Steam siphons, coil siphons, pig tail siphons or finned siphons protect instrumentation by the condensate water barrier that keeps the steam away from the instrument. They are not designed to be installed above a diaphragm seal.

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Instruments **Not Used** with Diaphragm Seals

Most Ashcroft® instruments are available with diaphragm seals. However, the following instruments are not designed for a separate attachment:

Crimped Stainless Steel Cases and Sanitary Products

- All 1008A Gauges
- All 8008A Gauges
- All 1032, 1036 Gauges*

Low-Pressure Gauges

- 1490 & 1495
- N5500, P5500/P6500*

Specialty Gauges

- HPX, HPT, HPS
- 1084
- SC

Differential Gauges

5509, 1130, 1131, 1132, 1133, 1134

Low-Pressure Transducers

GXLdp, CXLdp, DXLdp, RXLdp, XLdp, IXLdp, GC30

All Commercial Gauges

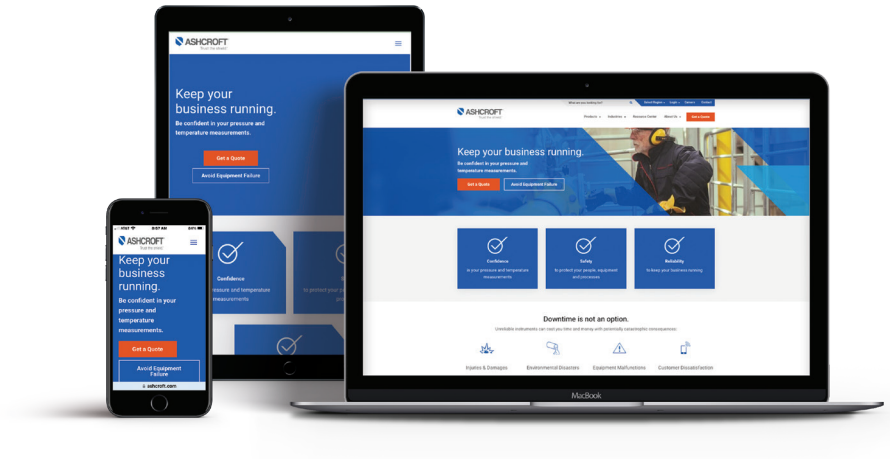
All Weksler Gauges

Consult Factory For The Following Products:

- 1290, 1008S, 8008S, 8009S
- GC52, K8, G2, T2, GC55, S1

* These models have a diaphragm sensing element built into the gauge.

Learn more about Ashcroft instrumentation by visiting our website:



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Let us help you find the right instrumentation for your needs.

Using the information in this guide, you can find the best diaphragm seal or isolation ring that will protect your pressure and temperature instruments from harsh conditions. Plus, you learned about assembly limitations and options for both low pressure and high-pressure seal applications. However, we understand that every situation is unique and you may have more questions. If you would like to discuss your unique requirements with one of our experts, please contact us directly.