

Instruction

MI 020-369
April 2014

**Pressure Seals
For Use With
I/A Series Pressure Transmitters**



i n v e n s i s
Foxboro®

Contents

Figures	v
Tables	vii
1. Introduction	1
General Description	1
How To Use This Instruction	2
Specifications	2
Process Pressure Limits	2
PSFLT Flanged, (Direct Mount) Seals	2
PSFPS and PSFES (Flanged, Remote Mount) Seals	3
PSFFR and PSFFD (Flanged) Seals	3
PSFAR and PSFAD (Flanged) Seals	4
PSTAR and PSTAD (Threaded) Seals	5
PSISR and PSISD (In-Line Saddle Weld) Seals	5
PSSCR and PSSCT (Sanitary) Seals	5
PSSSR and PSSST (Sanitary Tank Spud) Seals	5
Process Temperature Limits	5
Process Wetted Materials	6
PSFFR and PSFFD (Flanged, Flush Diaphragm)	6
PSFLT, PSFPS, and PSFES (Flanged, Flush or Extended Diaphragm)	6
PSFAR and PSFAD (Flanged, Recessed Diaphragm)	6
PSTAR and PSTAD (Threaded)	6
PSISR and PSISD (In-Line Saddle Weld)	7
PSSCR and PSSCT (Sanitary)	7
PSSSR and PSSST (Sanitary Tank Spud)	7
2. Installation	9
PSFLT (Flanged, Direct Mount) Seals	9
Mounting The Transmitter	9
Transmitter Piping	9
PSFPS and PSFES (Flanged, Remote Mount) Seals	10
Typical Liquid Level Installation	10
Installing Pressure Seals	10
PSFFR (Flanged Flush, Remote Mount) Seals	11
PSFFD (Flanged, Direct Mount) Seals	12
PSFAR (Flanged, Remote Mount) Seals	12

PSFAD (Flanged, Direct Mount) Seals	13
PSTAR (Threaded, Remote Mount) Seals	13
PSTAD (Threaded, Direct Mount) Seals	14
PSISR (In-Line Saddle Weld, Remote Mount) Seals	14
PSISD (In-Line Saddle Weld, Direct Mount) Seals	15
PSSCR (Sanitary, Remote Mount) Seals	15
PSSCT (Sanitary, Direct Mount) Seals	16
PSSSR (Sanitary Tank Spud, Remote Mount) Seals	16
PSSST (Sanitary, Tank Spud, Direct Mount) Seals	18
3. Calibration	19
Determining Transmitter Input Range Values	19
Transmitter For Liquid Level Applications	19
Typical Liquid Level Calculations	19
Typical Liquid Density Calculations	24
Typical Liquid Interface Level Calculations	25
Field Calibration Setup	26
Transmitter With PSFLT or PSSST Seal	26
Transmitter With Other Flanged Pressure Seals	26
Transmitter With Threaded Pressure Seals	27
Bench Calibration Setup	27
Transmitter With PSFLT or PSSST Seal	27
Transmitter With Other Flanged Seals	28
Transmitter With Threaded Seals	28
Transmitter With In-Line Seals	29
Transmitter With Sanitary Seals	29
4. Maintenance.....	31
Index	33

Figures

1	Mounting Transmitter	9
2	Installing Pressure Seals	11
3	Mounting of PSFFR Pressure Seals	11
4	Mounting of PSFFD Pressure Seals	12
5	Mounting of PSFAR Pressure Seals	12
6	Mounting of Transmitter With PSFAD Seals	13
7	Mounting of PSTAR Pressure Seals	13
8	Mounting of Transmitter With PSTAD Seals	14
9	Mounting of PSISR Pressure Seals	14
10	Mounting of Transmitter With PSISD Seals	15
11	Mounting of PSSCR Pressure Seals	16
12	Mounting of PSSCT Seals	16
13	Mounting of PSSSR Pressure Seals	17
14	Welding Procedure	17
15	Mounting of PSSST Seals	18
16	Transmitter Connected to Open Tank	19
17	Transmitter Connected to Closed Tank with Dry Leg	19
18	Transmitter Connected to Closed Tank with Wet Leg	20
19	Transmitter Connected to Closed Tank With Dual Seals	20
20	Transmitter Connected to Open Tank with Constant Level	24
21	Transmitter Connected to Open Tank with Varying Level	24
22	Transmitter Connected to Open Tank with Constant Overflow	25
23	Transmitter Connected to Closed Tank with Wet Leg	25
24	Field Calibration Setup With PSFLT or PSSST Seal	26
25	Field Calibration Setup With Other Flanged Seals	26
26	Field Calibration Setup With Threaded Seals	27
27	Bench Calibration Setup When Low Pressure Side is Vented or Connected to a Dry Leg ...	27
28	Bench Calibration Setup When Low Pressure Side is Connected to a Wet Leg	27
29	Bench Calibration Setup With Other Flanged Seals	28
30	Bench Calibration Setup With Threaded Seals	28
31	Bench Calibration Setup With In-Line Seals	29
32	Bench Calibration Setup With Sanitary Seals	29

Tables

1	Pressure Seal PSFLT Pressure Limits	2
2	Pressure Seal PSFPS and PSFES Pressure Limits	3
3	Pressure Seal PSFFR and PSFFD Pressure Limits	3
4	Pressure Seal PSFAR and PSFAD Pressure Limits	4
5	Pressure Seals PSTAR and PSTAD Pressure Limits	5
6	Seal Fill Fluid and Operating Temperature Limits	5

1. Introduction

General Description

Pressure seals are used with I/A Series Pressure Transmitters when it is necessary to keep the transmitter isolated from the process. The sealed measurement system, comprised of a transmitter sensing element, pressure seal, and connecting tubing (when applicable), is evacuated and filled with an appropriate fill fluid that transmits pressure changes. The pressure seal can be remotely mounted to the transmitter using an interconnecting capillary or direct connected to some transmitters.

Pressure seals are available with various mounting, diaphragm, and connection designs.

The **PSFLT** seals are flange connected and direct connected and can be used with the IDP10, IDP10S, IGP20, and IDP25 transmitters.

The **PSFFR** (remote mounted) seals are flange connected and can be used with the IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, and IDP25 transmitters.

The **PSFFD** (direct mounted) seals are flange connected and can be used with the IAP10, IAP10S, IGP10, IGP10S and IGP25 transmitters.

The **PSFPS** (flush diaphragm) seals are flange connected and remote mounted. They can be used with the IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25 and IGP25 transmitters.

The **PSFES** (extended diaphragm) seals are flange connected and remote mounted. They can be used with the IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25, and IGP25 transmitters.

The **PSFAR** (remote mounted) seals have a recessed diaphragm and a flanged connection. They can be used with IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25, and IGP25 transmitters.

The **PSFAD** (direct mounted) seals have a recessed diaphragm and a flanged connection. They can be used with IAP10, IGP10, IGP10S and IGP25 transmitters.

The **PSTAR** (remote mounted) seals have a recessed diaphragm and a threaded connection. They can be used with IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25, and IGP25 transmitters.

The **PSTAD** (direct mounted) seals have a recessed diaphragm and a threaded connection. They can be used with IAP10, IAP10S, IGP10, IGP10S, and IGP25 transmitters.

The **PSISR** (remote mounted) seals have a recessed diaphragm and are designed for in-line, saddle welding. They can be used with IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25, and IGP25 transmitters.

The **PSISD** (direct mounted) seals have a recessed diaphragm and are designed for in-line, saddle welding. They can be used with IAP10, IAP10S, IGP10, IGP10S, and IGP25 transmitters.

The PSSCR (sanitary, remote mounted) seals have a flush diaphragm and are designed to be secured to the process pipe with a Tri-Clover Clamp. They can be used with IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25, and IGP25 transmitters.

The PSSCT (sanitary, direct mounted) seals have a flush diaphragm and are designed to be secured to the process pipe with a Tri-Clover Clamp. They can be used with IDP10, IDP10S, IGP20, and IDP25 transmitters.

The PSSSR (sanitary tank spud, remote mounted) seals have an extended diaphragm and are designed to be secured to a tank spud with a Tri-Clover Clamp. They can be used with IDP10, IDP10S, IAP10, IAP10S, IGP10, IGP10S, IAP20, IGP20, IDP25, and IGP25 transmitters.

The PSSST (sanitary tank spud, direct mounted) seals have an extended diaphragm and are designed to be secured to a tank spud with a Tri-Clover Clamp. They can be used with IDP10, IDP10S, IGP20, and IDP25 transmitters.

How To Use This Instruction

This instruction covers the specifications and installation of the seals. It also covers those aspects of calibration that are specifically related to the seals. The instruction is meant to be used with the Universal Instruction Manual for I/A Series Pressure Transmitters, MI 020-359, and detailed instructions on your specific transmitter.

Specifications

Process Pressure Limits

PSFLT Flanged, (Direct Mount) Seals

Table 1. Pressure Seal PSFLT Pressure Limits

ANSI Carbon Steel and 316L SS Flanges (a)						
Process Temperature (b)	Maximum Working Pressure: Carbon Steel (c)			Maximum Working Pressure: 316L SS (d)		
	Class 150	Class 300	Class 600	Class 150	Class 300	Class 600
-20 to 100°F	285 psig	740 psig	1480 psig	275 psig	720 psig	1440 psig
200°F	260 psig	680 psig	1360 psig	235 psig	620 psig	1240 psig
300°F	230 psig	655 psig	1310 psig	215 psig	560 psig	1120 psig
400°F	200 psig	635 psig	1265 psig	195 psig	515 psig	1025 psig
DIN Carbon Steel and 316 SS Flanges (e)						
Process Temperature (b)	Maximum Working Pressure: Carbon Steel (c)			Maximum Working Pressure: 316L SS (d)		
	PN 10/40	PN 10/16	PN 25/40	PN 10/40	PN 10/16	PN 25/40
-10 to +100°C	40 bar	16 bar	40 bar	40 bar	16 bar	40 bar
150°C	37.5 bar	14.5 bar	37.5 bar	36.3 bar	14.5 bar	36.3 bar
200°C	35 bar	13 bar	35 bar	33.7 bar	13.4 bar	33.7 bar
250°C	32 bar	11 bar	32 bar	31.8 bar	12.7 bar	31.8 bar

a. ANSI flanges per ASME/ANSI B16.5 - 2003.

- b. Flange temperature/pressure ratings only; seal temperature ratings may be lower. Refer to Table 6.
- c. ASME/ANSI Material Group 1.1; Linear Interpolation acceptable.
- d. ASME/ANSI Material Group 2.2; Linear Interpolation acceptable.
- e. DIN flanges per EN 1092-1.

PSFPS and PSFES (Flanged, Remote Mount) Seals

Table 2. Pressure Seal PSFPS and PSFES Pressure Limits

ANSI Carbon Steel and 316L SS Flanges (a)						
Process Temperature (b)	Maximum Working Pressure: Carbon Steel (c)			Maximum Working Pressure: 316L SS (d)		
	Class 150	Class 300	Class 600	Class 150	Class 300	Class 600
-20 to 100°F	285 psig	740 psig	1480 psig	275 psig	720 psig	1440 psig
200°F	260 psig	680 psig	1360 psig	235 psig	620 psig	1240 psig
300°F	230 psig	655 psig	1310 psig	215 psig	560 psig	1120 psig
400°F	200 psig	635 psig	1265 psig	195 psig	515 psig	1025 psig
500°F	170 psig	605 psig	1205 psig	170 psig	480 psig	955 psig
600°F	140 psig	570 psig	1135 psig	140 psig	450 psig	900 psig
DIN Carbon Steel and 316L SS Flanges (e)						
Process Temperature (b)	Maximum Working Pressure: Carbon Steel (c)			Maximum Working Pressure: 316L SS (d)		
	PN 10/40	PN 10/16	PN 25/40	PN 10/40	PN 10/16	PN 25/40
-10 to +100°C	40 bar	16 bar	40 bar	40 bar	16 bar	40 bar
150°C	37.5 bar	14.5 bar	37.5 bar	36.3 bar	14.5 bar	36.3 bar
200°C	35 bar	13 bar	35 bar	33.7 bar	13.4 bar	33.7 bar
250°C	32 bar	11 bar	32 bar	31.8 bar	12.7 bar	31.8 bar
300°C	30 bar	9 bar	30 bar	29.7 bar	11.8 bar	29.7 bar
350°C	27.8 bar	7.5 bar	27.8 bar	28.5 bar	11.4 bar	28.5 bar

- a. ANSI flanges per ASME/ANSI B16.5 - 2003.
- b. Flange temperature/pressure ratings only; seal temperature ratings may be lower. Refer to Table 6.
- c. ASME/ANSI Material Group 1.1; Linear Interpolation acceptable.
- d. ASME/ANSI Material Group 2.2; Linear Interpolation acceptable.
- e. DIN flanges per EN 1092-1.

PSFFR and PSFFD (Flanged) Seals

Table 3. Pressure Seal PSFFR and PSFFD Pressure Limits

ANSI Carbon Steel and 316L SS Flanges (a)						
Process Temperature (b)	Maximum Working Pressure: Carbon Steel (c)			Maximum Working Pressure: 316L SS (d)		
	Class 150	Class 300	Class 600	Class 150	Class 300	Class 600
-20 to 100°F	285 psig	740 psig	1480 psig	275 psig	720 psig	1440 psig
200°F	260 psig	680 psig	1360 psig	235 psig	620 psig	1240 psig
300°F	230 psig	655 psig	1310 psig	215 psig	560 psig	1120 psig
400°F	200 psig	635 psig	1265 psig	195 psig	515 psig	1025 psig
500°F	170 psig	605 psig	1205 psig	170 psig	480 psig	955 psig
600°F	140 psig	570 psig	1135 psig	140 psig	450 psig	900 psig

Table 3. Pressure Seal PSFFR and PSFFD Pressure Limits (Continued)

DIN Carbon Steel and 316 SS Flanges (e)						
Process Temperature (b)	Maximum Working Pressure: Carbon Steel (c)			Maximum Working Pressure: 316L SS (d)		
	PN 10/40	PN 10/16	PN 25/40	PN 10/40	PN 10/16	PN 25/40
-10 to +100°C	40 bar	16 bar	40 bar	40 bar	16 bar	40 bar
150°C	37.5 bar	14.5 bar	37.5 bar	36.3 bar	14.5 bar	36.3 bar
200°C	35 bar	13 bar	35 bar	33.7 bar	13.4 bar	33.7 bar
250°C	32 bar	11 bar	32 bar	31.8 bar	12.7 bar	31.8 bar
300°C	30 bar	9 bar	30 bar	29.7 bar	11.8 bar	29.7 bar
350°C	27.8 bar	7.5 bar	27.8 bar	28.5 bar	11.4 bar	28.5 bar

- a. ANSI flanges per ASME/ANSI B16.5 - 2003.
- b. Flange temperature/pressure ratings only; seal temperature ratings may be lower depending on mounting and fill fluid. Refer to Table 6.
- c. ASME/ANSI Material Group 1.1; Linear Interpolation acceptable.
- d. ASME/ANSI Material Group 2.2; Linear Interpolation acceptable.
- e. DIN flanges per EN 1092-1.

PSFAR and PSFAD (Flanged) Seals

Table 4. Pressure Seal PSFAR and PSFAD Pressure Limits

ANSI Carbon Steel and 316L SS Flanges (a)								
Process Temperature (b)	Maximum Working Pressure (c): Carbon Steel (d)				Maximum Working Pressure(c): 316L SS (e)			
	Class 150	Class 300	Class 600	Class 1500	Class 150	Class 300	Class 600	Class 1500
-20 to 100°F	285	740	1480	3705	275	720	1440	3600
200°F	260	680	1360	3395	235	620	1240	3095
300°F	230	655	1310	3270	215	560	1120	2795
400°F	200	635	1265	3170	195	515	1025	2570
500°F	170	605	1205	3015	170	480	955	2390
600°F	140	570	1135	2840	140	450	900	2255

- a. ANSI flanges per ASME/ANSI B16.5 - 2003.
- b. Flange temperature/pressure ratings only; seal temperature ratings may be lower. Refer to Table 6.
- c. The maximum working pressure with the non-metallic pte and PVC lower housing materials is 150 psig (1035 kPa) regardless of the higher allowable flange pressure range.
- d. ASME/ANSI Material Group 1.1; Linear Interpolation acceptable.
- e. ASME/ANSI Material Group 2.2; Linear Interpolation acceptable.

PSTAR and PSTAD (Threaded) Seals

Table 5. Pressure Seals PSTAR and PSTAD Pressure Limits (a)

Process Temperature	Stainless Steel Bolts (Bolting Code S)		Carbon Steel and High Strength 300 Series SS Bolts (Bolting Codes C and H)	
	Diaphragm Codes 2 and 3	Diaphragm Code 4	Diaphragm Codes 2 and 3	Diaphragm Code 4
-20 to +100°F	1250 psig	750 psig	2500 psig	1500 psig
200°F	1075 psig	645 psig	2150 psig	1290 psig
300°F	975 psig	585 psig	1950 psig	1170 psig
400°F	900 psig	540 psig	1800 psig	1080 psig
500°F	835 psig	500 psig	1670 psig	1000 psig
600°F	760 psig	460 psig	1525 psig	920 psig

a. Flange temperature/pressure ratings only; seal temperature ratings may be lower depending on mounting and fill fluid. Refer to Table 6.

PSISR and PSISD (In-Line Saddle Weld) Seals

The maximum working pressure is equivalent to a nominal 3- or 4-inch Schedule 40 pipe as defined by ASME/ANSI standards.

PSSCR and PSSCT (Sanitary) Seals

The maximum working pressure of the seal process connection varies with the clamping device used. Refer to Tri-Clover Tri-Clamp standards to determine the pressure limits of the clamping system that you are using.

PSSSR and PSSST (Sanitary Tank Spud) Seals

The maximum working pressure of mini tank spud seal is 1.55 MPa at 120°C (225 psi at 250°F). That of the standard tank spud seal is 1.38 MPa at 120°C (200 psi at 250°F).

Process Temperature Limits

The operating temperature limits at the seals are dependent upon the type of fill fluid used. The temperature limits per each fill fluid are shown in Table 6.

Table 6. Seal Fill Fluid and Operating Temperature Limits

Code	Fill Fluid	Temperature Limits	
		Direct Connected PSFLT, PSFFD, PSFAD, PSTAD, PSISD	Remote Connected PSFPS, PSFES, PSFFR, PSFAR, PSTAR, PSISR, PSSCR
1	DC200, 10cS, Silicone	-40 and +204°C (-40 and +400°F)	-40 and +204°C (-40 and +400°F)
2	FC77 Fluorinert	-59 and +82°C (-75 and +180°F)	-59 and +82°C (-75 and +180°F)
3	DC200, 3cS, Silicone	-40 and +149°C (-40 and +300°F)	-40 and +149°C (-40 and +300°F)
4	DC704 (HTF) Silicone	0 and +204°C (32 and 400°F)	0 and +304°C (32 and 580°F)

Table 6. Seal Fill Fluid and Operating Temperature Limits

Code	Fill Fluid	Temperature Limits	
		Direct Connected PSFLT, PSFFD, PSFAD, PSTAD, PSISD	Remote Connected PSFPS, PSFES, PSFFR, PSFAR, PSTAR, PSISR, PSSCR
5	Neobee	-18 and +204°C (0 and 400°F)	-18 and +204°C (0 and 400°F)
6	Halocarbon 4.2	-45 and +160°C (-49 and +320°F)	-45 and +160°C (-49 and +320°F)
7	Syltherm XLT	-73 and +149°C (-100 and +300°F)	-73 and +149°C (-100 and +300°F)

PSFAR, PSFAD, PSTAR, PSTAD, PSISR, and PSISD seals with ptfе gaskets are limited to 60°C (140°F).

PSSSR and PSSST with EPDM O-ring as supplied are limited to 121°C (250°F).

Process Wetted Materials

PSFFR and PSFFD (Flanged, Flush Diaphragm)

Flush Diaphragm Seal: 316 ss, nickel alloy (equivalent to Hastelloy C[®]-276) (a), or Tantalum
 Extended Diaphragm Seal: 316 ss or nickel alloy (equivalent to Hastelloy C[®]-276)

a. Hastelloy is a registered trademark of Haynes International, Inc.

PSFLT, PSFPS, and PSFES (Flanged, Flush or Extended Diaphragm)

Flush Diaphragm Seal: 316 ss, nickel alloy (equivalent to Hastelloy C[®]-276), or Tantalum
 Extended Diaphragm Seal: 316 ss or nickel alloy (equivalent to Hastelloy C[®]-276)

PSFAR and PSFAD (Flanged, Recessed Diaphragm)

Lower Housing: 316 ss, Carbon steel, nickel alloy (equivalent to Hastelloy C[®]-276), Tantalum Plate, Titanium Grade 4, Inconel 600, Monel 400, Nickel 200, glass-filled ptfе, or PVC
 Diaphragm: 316 ss, nickel alloy (equivalent to Hastelloy C[®]-276), Tantalum, Titanium Grade 4, Inconel 600, Monel 400, or Nickel 200
 Gasket: Organic Fiber with Nitrile Binder, Silver Plated 316 ss, ptfе, Buna-N, Viton, Grafoil, or Silver plated nickel alloy (equivalent to Hastelloy C[®]-276)

PSTAR and PSTAD (Threaded)

Lower Housing: 316 ss, Carbon steel, nickel alloy (equivalent to Hastelloy C[®]-276), Titanium Grade 4, Inconel 600, Monel 400, or Nickel 200
 Diaphragm: 316 ss, nickel alloy (equivalent to Hastelloy C[®]-276), Tantalum, Titanium Grade 4, Inconel 600, Monel 400, or Nickel 200
 Gasket: Organic fiber with Nitrile Binder, ptfе, Buna-N, Viton, or Grafoil

PSISR and PSISD (In-Line Saddle Weld)

Lower Housing:	316 ss, Carbon steel, nickel alloy (equivalent to Hastelloy C [®] -276), Titanium Grade 4, Inconel 600, Monel 400, or Nickel 200
Diaphragm:	316L ss, nickel alloy (equivalent to Hastelloy C [®] -276), Tantalum, Titanium Grade 4, Inconel 600, Monel 400, or Nickel 200
Gasket:	Organic fiber with Nitrile Binder, or ptfе

PSSCR and PSSCT (Sanitary)

Housing:	316 ss
Diaphragm	
PSSCR:	316 ss or nickel alloy (equivalent to Hastelloy C [®] -276)
PSSCT	316L ss
Gasket:	Provided by user

PSSSR and PSSST (Sanitary Tank Spud)

Housing:	316 ss
Diaphragm:	316L ss
O ring:	EPDM

NOTE

For EPDM with O ring the maximum temperature is 121°C (250°F).

2. Installation

NOTE

1. Do **not** crush, cut, or twist tubing on remote mounted seals. If any part of the pressure connection is damaged, the entire sealed pressure assembly (sensor, armored tubing, and seal) must be returned to Foxboro for repair.
 2. Do **not** loosen any external screws or nuts associated with the sealed pressure system. These are painted red.
-

PSFLT (Flanged, Direct Mount) Seals

Mounting The Transmitter

Position the transmitter vertically as shown in Figure 1. Tighten the nuts on the flange gradually and uniformly. Flange gaskets, studs, nuts, and so forth, are supplied by the user. See DP 020-342 for dimensional information. Refer to ANSI B16.5 or EN 1092 as applicable for proper mounting hardware.

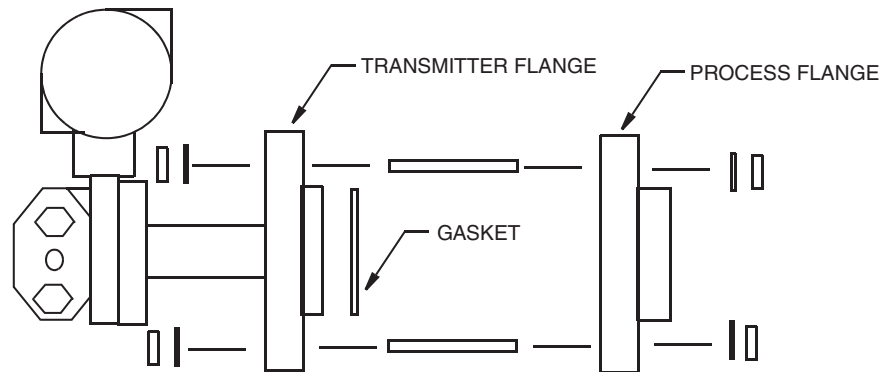


Figure 1. Mounting Transmitter

Transmitter Piping

Vented Low Pressure Connection

Additional piping is not required for the following measurements: Liquid level in an open tank, liquid density with level constant, and liquid interface level in an open tank with constant overflow. For these applications, vent the low pressure NPT connection to atmosphere (IDP10, IDP10S, and IDP25 only).

NOTE

1. Remove the plug (if any) from the low pressure connection (IDP10, IDP10S, and IDP25 only).
2. Protect the vent opening from rain and other liquids that could accumulate in the low side chamber (IDP10, IDP10S, and IDP25 only).
3. When used with IGP20, there is no NPT low side connection but the low side is vented. Protect the low side vent from becoming plugged with external coatings such as pulp stock.

Dry Leg

If a dry leg is used for liquid level measurement in a closed tank, connect the dry leg to the low pressure NPT connection. Use DN 15 pipe or 10 x 1 mm tubing (1/2 in pipe or 0.375 in tubing). Connection can be made to the 1/2 NPT removable process connector or to the 1/4 NPT connection on the process cover.

Wet Leg

A wet leg can be used in a liquid level measurement in a closed tank. A wet leg must be used for liquid density measurement with varying level and for liquid interface level measurement without constant overflow. Connect the wet leg to the low pressure 1/2 NPT connection. Use DN 15 pipe or 10 x 1 mm tubing (1/2 in pipe or 0.375 in tubing). Connection can be made to the 1/2 NPT removable process connector or to the 1/4 NPT connection on the process cover.

PSFPS and PSFES (Flanged, Remote Mount) Seals

Typical Liquid Level Installation

In liquid level applications, the transmitter can be used with a closed tank or an open tank. In either case, the HIGH seal is typically mounted below the LOW seal. With a vacuum application, the transmitter must be mounted at or below the level of the lower pressure seal.

Installing Pressure Seals

NOTE

1. Flange gaskets, studs, nuts, and so forth are supplied by the user. See DP 020-342 for dimensional information. Refer to ANSI B16.5 or EN 1092 as applicable for proper mounting hardware.
2. If the connector flange has been supplied by Foxboro, the pressure seal may already be attached to the flange. When this is the case, omit Step 1 and proceed to Step 2.
3. Once the installation is complete, readjust the zero output to eliminate any position zero effects associated with transmitter mounting.

1. Align the pressure seal with the connector flange as shown in Figure 2.
2. Position the gasket as shown in Figure 2.

3. Secure the connector flange to the process flange using the flange studs and nuts. Tighten the nuts gradually and uniformly to the torque required for the flange pressure rating.

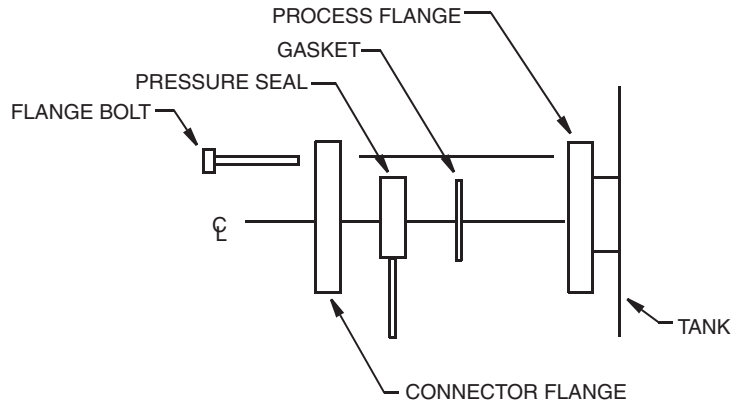


Figure 2. Installing Pressure Seals

PSFFR (Flanged Flush, Remote Mount) Seals

Install PSFFR pressure seals as shown in Figure 3. See DP 020-356 for dimensional information.

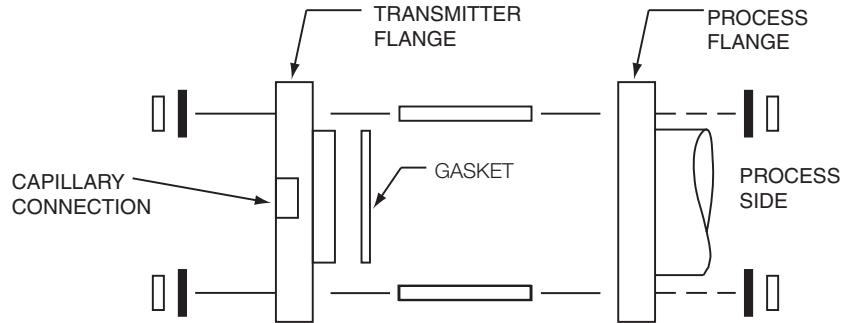


Figure 3. Mounting of PSFFR Pressure Seals

PSFFD (Flanged, Direct Mount) Seals

Install PSFFD pressure seals as shown in Figure 4. See DP 020-357 for dimensional information.

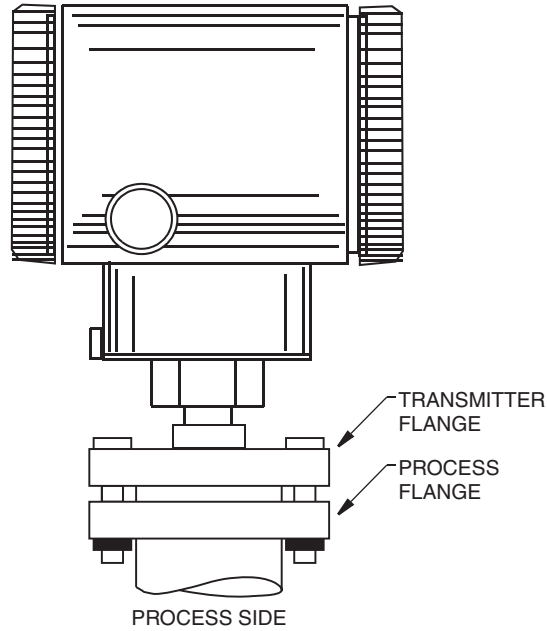


Figure 4. Mounting of PSFFD Pressure Seals

PSFAR (Flanged, Remote Mount) Seals

Install PSFAR pressure seal as shown in Figure 5. See DP 020-345 for dimensional information.

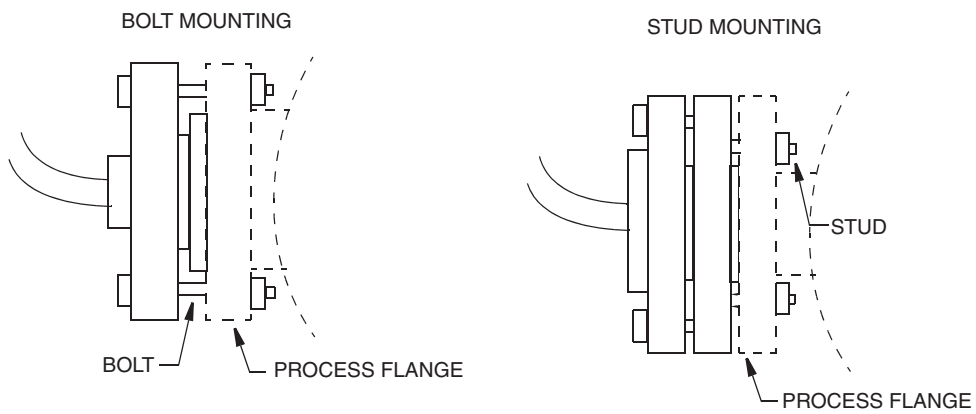


Figure 5. Mounting of PSFAR Pressure Seals

PSFAD (Flanged, Direct Mount) Seals

Install PSFAD pressure seal as shown in Figure 6. See DP 020-346 for dimensional information.

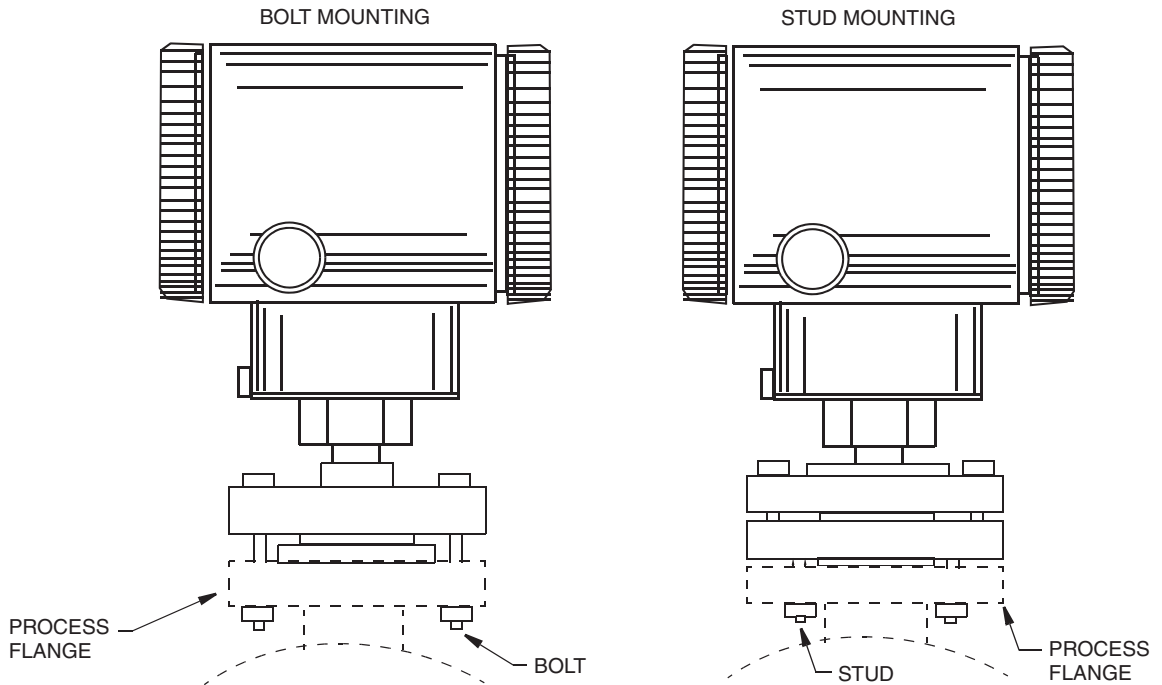
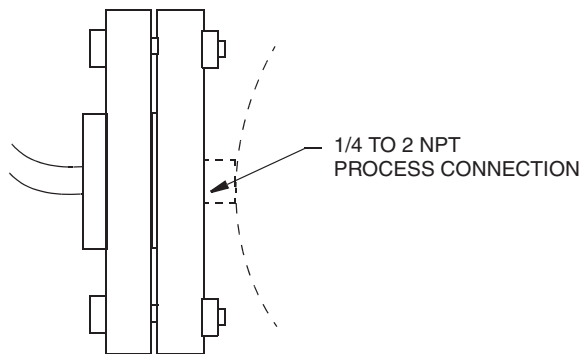


Figure 6. Mounting of Transmitter With PSFAD Seals

PSTAR (Threaded, Remote Mount) Seals

Install PSTAR pressure seal as shown in Figure 7. See DP 020-347 for dimensional information.



NOTE:
INSTALLATION OF PSTAR THREADED SEALS MAY REQUIRE REMOVAL OF THE LOWER HOUSING FROM THE UPPER HOUSING TO ALLOW ATTACHMENT OF LOWER HOUSING TO THE PROCESS PIPING.

Figure 7. Mounting of PSTAR Pressure Seals

PSTAD (Threaded, Direct Mount) Seals

Install PSTAD pressure seal as shown in Figure 8. See DP 020-348 for dimensional information.

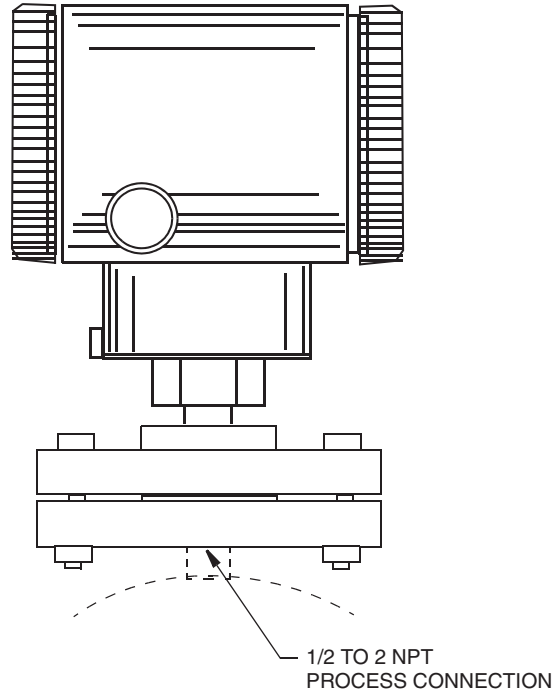


Figure 8. Mounting of Transmitter With PSTAD Seals

PSISR (In-Line Saddle Weld, Remote Mount) Seals

Install PSISR pressure seal as shown in Figure 9. See DP 020-349 for dimensional information.

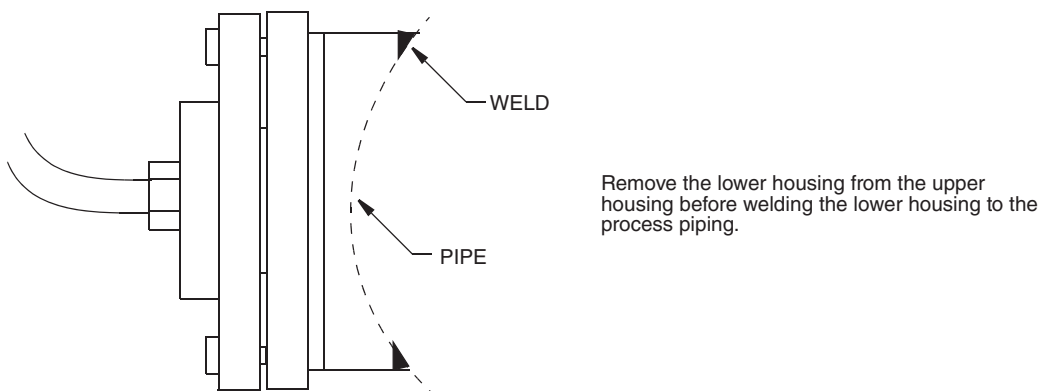


Figure 9. Mounting of PSISR Pressure Seals

PSISD (In-Line Saddle Weld, Direct Mount) Seals

Install PSISD pressure seal as shown in Figure 10. See DP 020-350 for dimensional information.

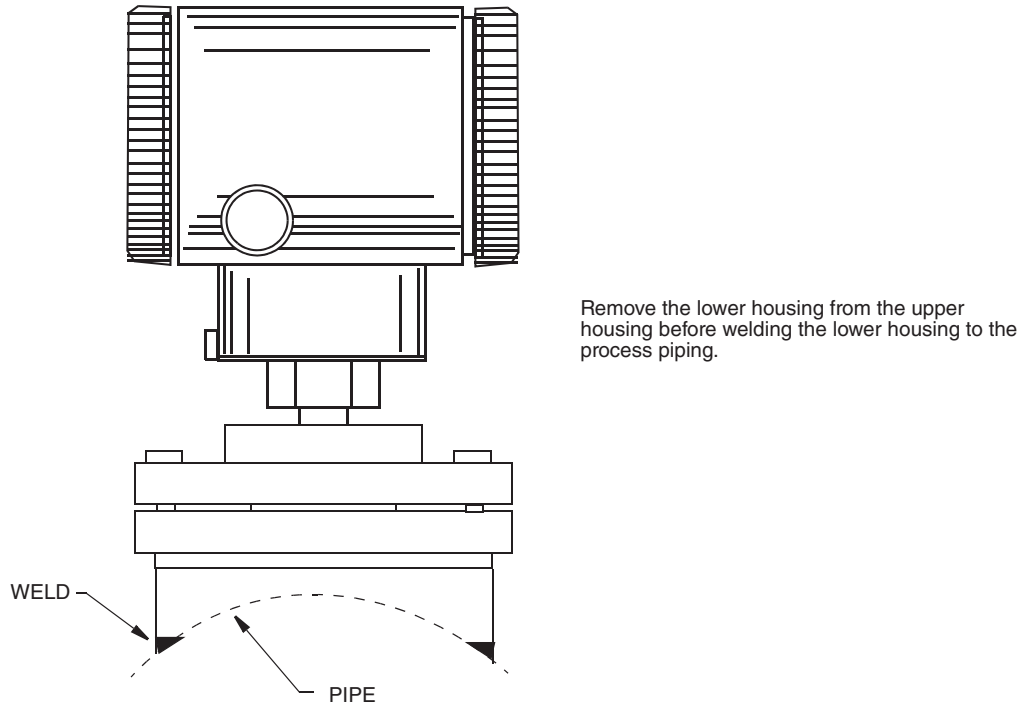


Figure 10. Mounting of Transmitter With PSISD Seals

PSSCR (Sanitary, Remote Mount) Seals

! CAUTION

The process wetted surface (diaphragm convolutions) should be installed so that process does not pool between convolutions when the vessel is empty.

The transmitters should be mounted in such a way that the non process wetted surfaces are self draining.

The design of these devices does not comply with paragraph D10.1.2 for 3-A compliance, 74-03.

Install PSSCR pressure seal as shown in Figure 11. See DP 020-351 for dimensional information.

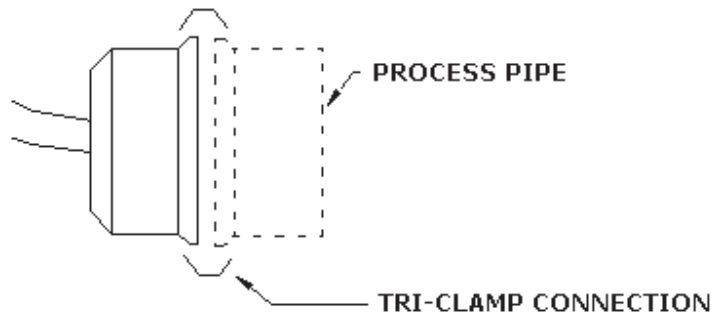


Figure 11. Mounting of PSSCR Pressure Seals

PSSCT (Sanitary, Direct Mount) Seals

! CAUTION
See CAUTION for PSSCR seal on page 15.

Install PSSCT pressure seal as shown in Figure 12. See DP 020-355 for dimensional information.

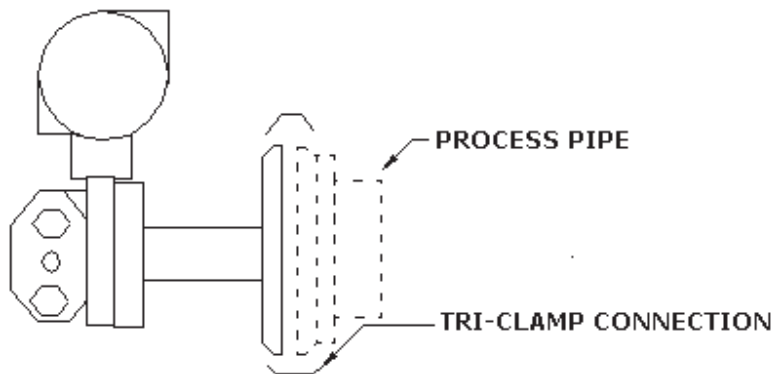


Figure 12. Mounting of PSSCT Seals

PSSSR (Sanitary Tank Spud, Remote Mount) Seals

! CAUTION
See CAUTION for PSSCR seal on page 15.

Install PSSSR pressure seal as shown in Figure 13. See DP 020-353 for dimensional information.

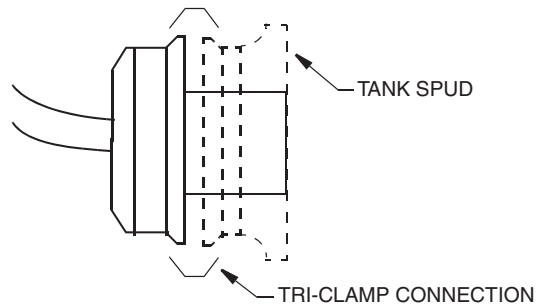


Figure 13. Mounting of PSSSR Pressure Seals

The tank spud must be welded into a hole cut in the tank as follows:

1. Cut a $6.00 +0.06 -0.00$ inch ($152.4 +1.6 - 0$ mm) or $3.75 +0.06 -0.00$ inch ($95.3 +1.6 - 0$ mm) diameter hole into the tank. To assure that the seal is always covered by process fluid, the top of the hole should be below the minimum measurement level.
2. Position the spud mounting ring so that it aligns as close as possible with the inside wall of the tank and that the weep hole is at the bottom.
3. Tack weld the spud mounting ring to the outside of the tank in four places.
4. Weld the spud mounting ring to the inner surface of the tank per the following notes.

NOTE

1. Spud is 316L stainless steel. Use compatible welding rod. Do not distort spud mounting ring by using excessive heat.
 2. Weld the spud mounting ring in sections as indicated in the following figure.
 3. After each section is welded, cool right with water until the temperature is less than 700°F (370°C) before welding the next section.
-

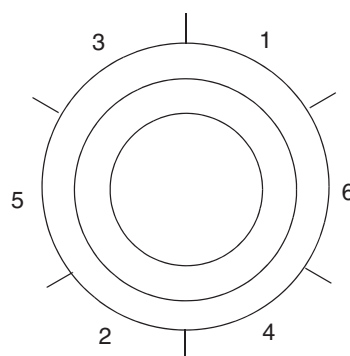


Figure 14. Welding Procedure

5. Grind the weld smooth so that the surface is free from irregularities where dirt can lodge.
6. Outer surface can be welded if desired after inner weld is completed.

PSSST (Sanitary, Tank Spud, Direct Mount) Seals

! CAUTION

See CAUTION for PSSCR seal on page 15.

Install PSSST pressure seal as shown in Figure 15. See DP 020-354 for dimensional information.

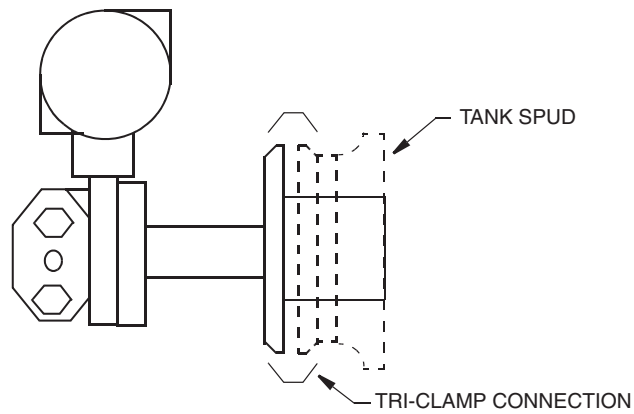


Figure 15. Mounting of PSSST Seals

The tank spud must be welded into a hole cut in the tank. For details, see preceding section.

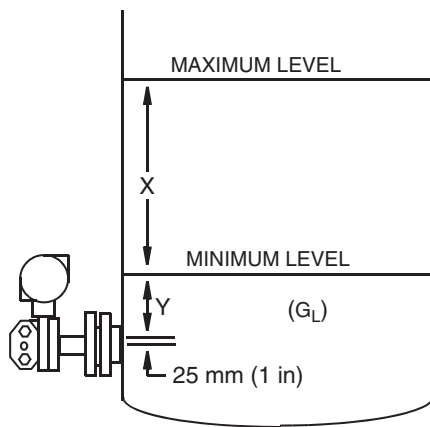
3. Calibration

Determining Transmitter Input Range Values

The following sections are for reference in determining upper and lower range values. Also refer to TI 1-50a, TI 001-051, and TI 001-052 for liquid density, interface, and level measurement methods respectively.

Transmitter For Liquid Level Applications

Typical Liquid Level Calculations

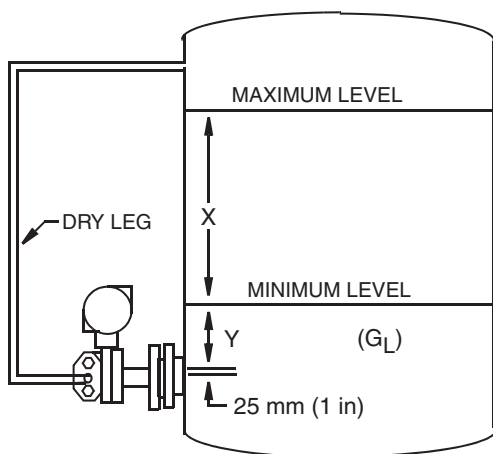


$$\begin{aligned} \text{Span} &= (X)(G_L) \\ \text{LRV} &= (Y)(G_L) \\ \text{URV} &= (X+Y)(G_L) \\ \text{Range} &= \text{LRV to URV} \end{aligned}$$

where:

- X and Y are in the same units, such as in or mm
- G_L = Specific gravity of the tank liquid
- LRV = Lower Range Value at minimum level
- URV = Upper Range Value at maximum level
- LRV and URV are in units of Equivalent Head of Water, such as inH₂O or mmH₂O

Figure 16. Transmitter Connected to Open Tank

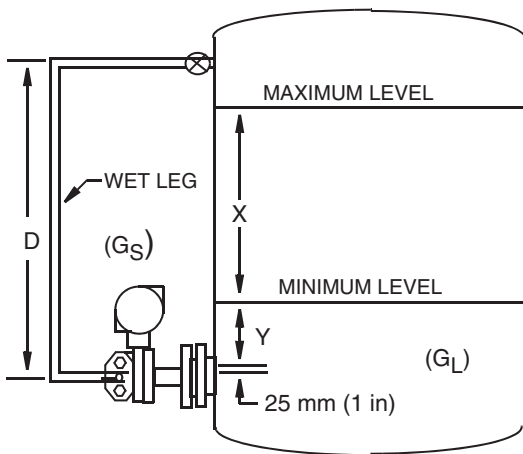


$$\begin{aligned} \text{Span} &= (X)(G_L) \\ \text{LRV} &= (Y)(G_L) \\ \text{URV} &= (X+Y)(G_L) \\ \text{Range} &= \text{LRV to URV} \end{aligned}$$

where:

- X and Y are in the same units, such as in or mm
- G_L = Specific gravity of the tank liquid
- LRV = Lower Range Value at minimum level
- URV = Upper Range Value at maximum level
- LRV and URV are in units of Equivalent Head of Water, such as inH₂O or mmH₂O

Figure 17. Transmitter Connected to Closed Tank with Dry Leg



$$\text{Span} = (X)(G_L)$$

$$\text{LRV} = Y(G_L) - D(G_S)$$

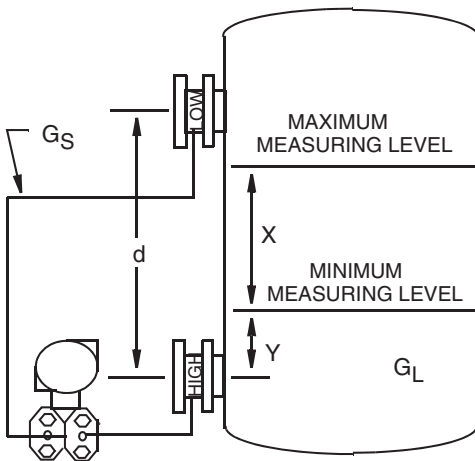
$$\text{URV} = (X+Y)(G_L) - D(G_S)$$

$$\text{Range} = \text{LRV to URV}$$

where:

- X, Y, and d are in the same units
- LRV = Lower Range Value at minimum level
- URV = Upper Range Value at maximum level
- LRV and URV are in units of Equivalent Head of Water, such as inH₂O or mmH₂O
- G_L = Specific gravity of the tank liquid
- G_S = Specific Gravity of the capillary fill fluid

Figure 18. Transmitter Connected to Closed Tank with Wet Leg



$$\text{Span} = (X)(G_L)$$

$$\text{LRV} = (Y)(G_L) - (d)(G_S)$$

$$\text{URV} = (Y + X)(G_L) - (d)(G_S)$$

$$\text{Range} = \text{LRV to URV}$$

where:

- X, Y, and d are in the same units
- LRV = Lower Range Value at minimum level
- URV = Upper Range Value at maximum level
- LRV and URV are in units of Equivalent Head of Water, such as inH₂O or mmH₂O
- G_L = Specific gravity of tank liquid
- G_S = Specific Gravity of capillary fill fluid

Silicone (DC200, 10 cSt):	0.94
Fluorinert (FC77):	1.76
Silicone (DC200, 3 cSt):	0.89
Silicone (DC704):	1.07
Neobee:	0.92
Halocarbon 4.2:	1.85
Syltherm XLT:	0.85

Figure 19. Transmitter Connected to Closed Tank With Dual Seals

There are several methods that can be used to set up the transmitter for liquid level applications. These methods assume:

- ◆ The installation is complete, including any dry legs, wet legs (filled), and any seals are in place.

- ◆ The “zero level reference” is at or above the bottom pressure tap.
- ◆ The electronics have a 4 to 20 mA output (Analog) or 4 to 20 mA + digital output (HART or FoxCom).

Method #1 - Calculating the range values

- ◆ This method relies on calculations only, so it can be used when there is no liquid in the tank yet or if there is liquid but at an unknown level.
- ◆ The 4 & 20 mA output points correspond to the calculated LRV and URV. Because the 4 to 20 mA signal is reranged to the entered LRV and URV, the transmitter calibration is unaffected.
- ◆ The local indicator, if present, can be set up to display 0 to 100%.
- ◆ If not configured for percent, the indicator will display the measured pressure, not the level. This is a drawback if you want to have the display read in level units (m, mm, in, or ft).
 - ◆ If you use a FoxCom transmitter, it supports custom units that can be used to display level.
 - ◆ If you have a HART or Analog transmitter, you can use a pressure unit such as mmH₂O or ftH₂O to simulate mm or ft, if the specific gravity of the liquid is 1 or close enough to 1 to meet the required accuracy for display. Also, this requires that the minimum level point correspond to the elevation of the transmitter and it only applies to open tanks and closed tanks with a dry leg.

Procedure for Method #1

Set LRV and URV equal to the calculated values.

Method #2 - Using the Transmitters to Determine the Range Values

- ◆ This method uses the transmitter to determine the LRV and URV rather than having to calculate the values. It also has the advantage of zeroing the transmitter to account for minor installation tilt. However it requires the ability to change the liquid level in the tank to known points (minimum level corresponding to LRV and maximum level corresponding to URV).
- ◆ If the level can be put at the point corresponding to LRV but cannot be brought up to the point corresponding to URV, this method can also be used to automatically determine the LRV. Then the span can be calculated from the equations shown above and added to the LRV to determine URV for manual entry into the transmitter database. This variation on Method #2 can also be used when there is no liquid in the tank if the minimum level point is to be at the elevation of the bottom tap.
- ◆ The local indicator, if present, can be set up to display 0 to 100%.
- ◆ If not configured for percent, the indicator will display the measured pressure, not the level. This is a drawback if you want to have the display read in level units (m, mm, in, or ft).
 - ◆ A FoxCom transmitter supports custom units that can be used to display level.

- ◆ A HART or Analog transmitter can use a pressure unit such as mmH₂O or ftH₂O to simulate mm or ft, if the specific gravity of the liquid is 1 or close enough to 1 to meet the required accuracy for display. However, this requires that the minimum level point correspond to the elevation of the transmitter and it only applies to open tanks and closed tanks with a dry leg.

Procedure for Method #2

- ◆ For HART transmitters, using a HART Communicator having the appropriate DD installed, use the function “Rerange with Applied Pressure” when the liquid is at the minimum level point.

If the level can be raised to the maximum level, use “Rerange with applied pressure” for URV when the level is at the maximum point in the tank. If it is not practical or possible to raise the level to the maximum point, read the LRV that has been automatically entered and manually set $URV = LRV + \text{Span}$.

- ◆ For FoxCom and Analog transmitters, record the pressure reading at the minimum level point and enter it into the database for the LRV. Then, determine URV the same way or by adding the calculated span value to LRV.

Method #3 - Getting the Local Indicator and Transmitted Value to Indicate Level - HART Transmitters

- ◆ When using a pressure unit, for example inH₂O or mmH₂O, to indicate level (liquids with SG =1), if the transmitter is not at the elevation corresponding to minimum level or if there is a wet leg or dual seals, the offset function can be used to have “zero” correspond to any desired level point regardless of the liquid head on the high or low side of the transmitter at that point.
- ◆ This does not affect the calibration of the transmitter.
- ◆ This offset procedure may be used for FoxCom transmitters but it is not required because custom units can be used.

Procedure for Method #3

- ◆ Even if the calculated LRV is not 0, set $LRV = 0$ and set $URV = \text{Span}$ (calculated).
- ◆ With the level at the minimum level measurement point in the tank, read and record the pressure value displayed on the local indicator (if present) or the pressure value read from a HART Communicator.
- ◆ Enter this value for the M1EOFF parameter (called PV Offset if using a HART Communicator). Maintain the sign; that is, if the value is negative, enter it as a negative value.
- ◆ This procedure zeroes the transmitter and sets the 4 and 20 mA points corresponding to minimum and maximum level, respectively. The 20 mA point is based on the calculated span.

- ◆ If the liquid has the same density as water, the equivalent head of water units such as inH₂O or mH₂O can be used to represent the level in inches or meters on the local display or HART Communicator.

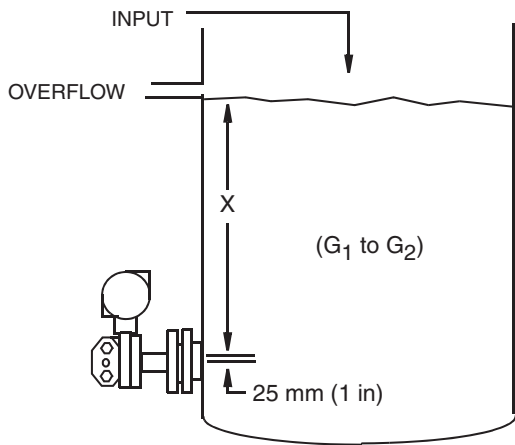
Method #4 - Getting the Local Indicator and Transmitted Value to Indicate Level - Analog Output Transmitters

- ◆ The analog output transmitters do not have the offset function described above. Use this method if you want to use a pressure unit to indicate level when the pressure is not zero at minimum level, such as when a wet leg or dual seal is used. The liquid must have the same density as water in order to use equivalent head of water units such as inH₂O to indicate inches of level.

Procedure for Method #4

- ◆ Even if the calculated LRV is not 0, set LRV = 0 and set URV = Span (calculated).
- ◆ With the level at the minimum level measurement point in the tank, zero the transmitter as if it had zero pressure on it (CAL AT 0) using the local display). This procedure zeroes the transmitter and sets the 4 and 20 mA points corresponding to minimum and maximum level, respectively. The 20 mA point is based on the calculated span.
- ◆ The measured and indicated pressure at the minimum level measurement point is zero.
- ◆ This method shifts the calibration and is not suitable if the offset is greater than 50% of the maximum span limit for the selected transmitter. For example, if the range is -140 to -20 inH₂O, the transmitter would have to be a 'C' range span or greater for this method to work. The maximum span of a 'B' sensor is 200 inH₂O and 50% of that is 100 inH₂O. Since the absolute value of the LRV in our example (140 inH₂O) is more than 100 inH₂O. A 'B' range sensor would not work. However since the maximum span of a 'C' range sensor is 840 inH₂O and 50% of that is 420 inH₂O, it would work.

Typical Liquid Density Calculations

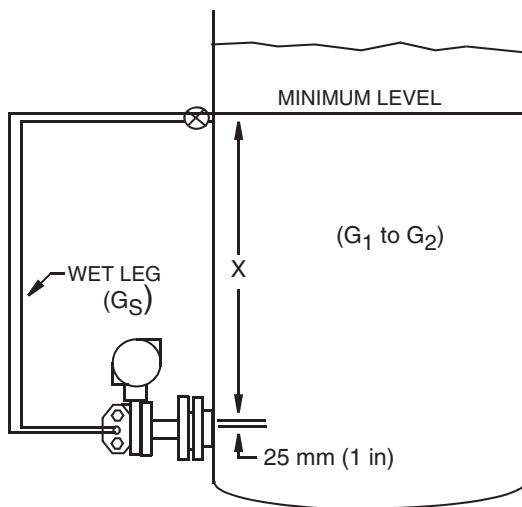


$$\begin{aligned} \text{Span} &= (X)(G_2 - G_1) \\ \text{LRV} &= X(G_1) \\ \text{URV} &= X(G_2) \\ \text{Calibrated range} &= \text{LRV to URV} \end{aligned}$$

where:

- LRV = Lower Range Value at minimum density
- URV = Upper Range Value at maximum density
- G_1 = Minimum specific gravity of tank liquid
- G_2 = Maximum specific gravity of tank liquid

Figure 20. Transmitter Connected to Open Tank with Constant Level



$$\begin{aligned} \text{Span} &= (X)(G_2 - G_1) \\ \text{LRV} &= X(G_1 - G_S) \\ \text{URV} &= X(G_2 - G_S) \\ \text{Calibrated range} &= \text{LRV to URV} \end{aligned}$$

where:

- LRV = Lower Range Value at minimum density
- URV = Upper Range Value at maximum density
- G_1 = Minimum specific gravity of tank liquid
- G_2 = Maximum specific gravity of tank liquid
- G_S = Specific gravity of seal liquid

Figure 21. Transmitter Connected to Open Tank with Varying Level

Typical Liquid Interface Level Calculations

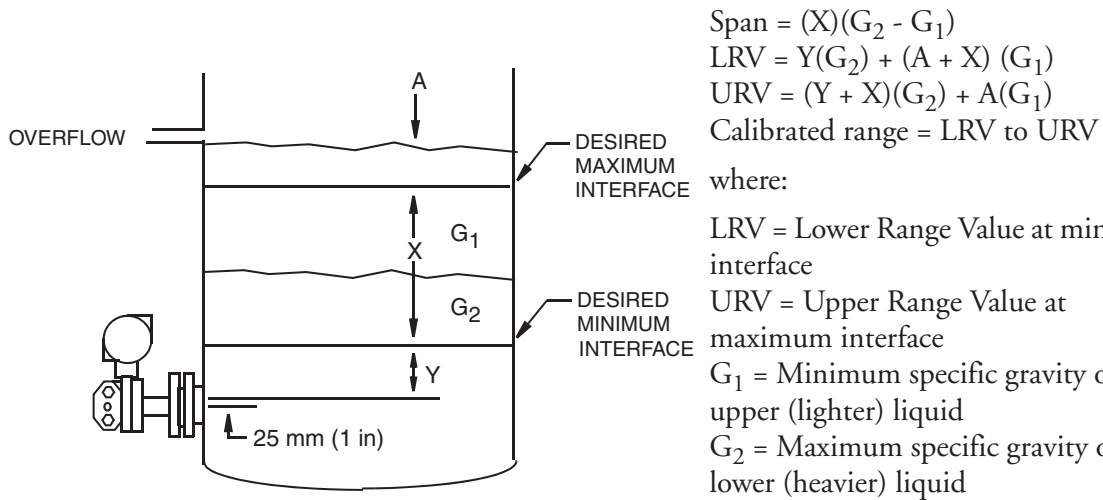


Figure 22. Transmitter Connected to Open Tank with Constant Overflow

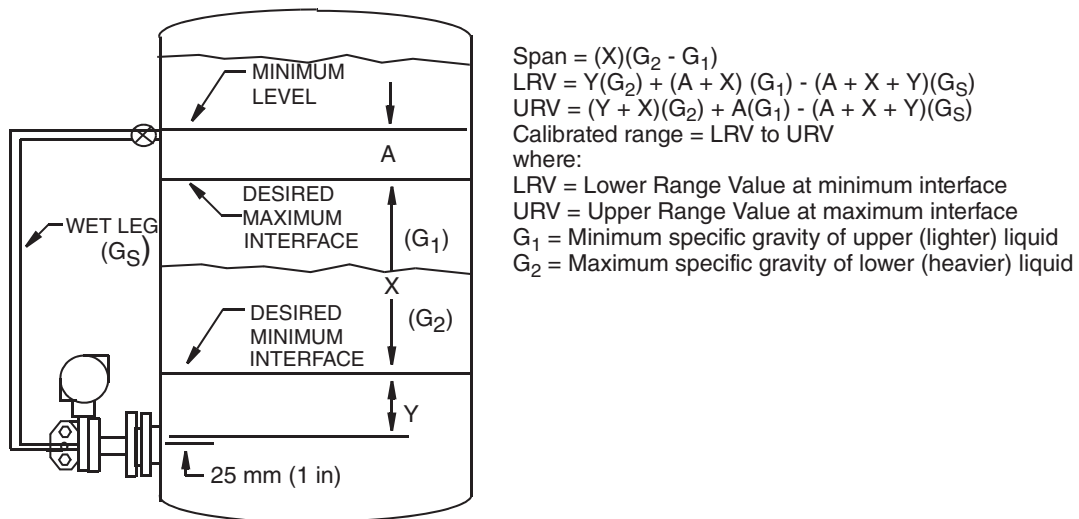


Figure 23. Transmitter Connected to Closed Tank with Wet Leg

Field Calibration Setup

Field calibration is performed without disconnecting the transmitter pressure seals from the process tank (or pipe). If the pressure seals are to be removed from the process tank for calibration, refer to the “Bench Calibration Setup” procedure.

If shutoff valves have been installed between the pressure seals and the tank, air pressure can be used for the calibrating signal. See the figures below for typical field calibration setups. For liquid level applications, calibrating signals can be generated by varying the level of the liquid in the process tank. In-line saddle weld and sanitary seals are not conducive to field calibration. Field calibration of seals that are direct connected to IAP10, IAP10S, IGP10, or IGP10S Transmitters may also be impractical.

Transmitter With PSFLT or PSSST Seal

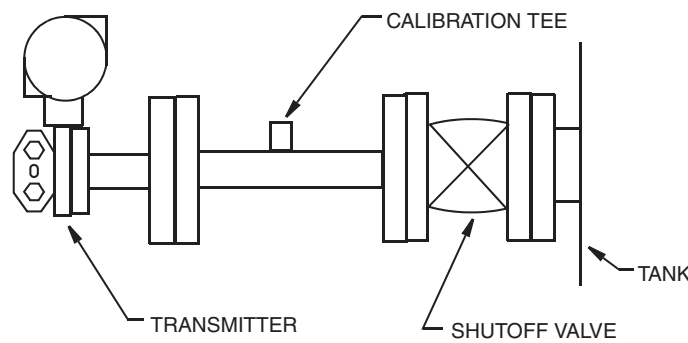


Figure 24. Field Calibration Setup With PSFLT or PSSST Seal

Transmitter With Other Flanged Pressure Seals

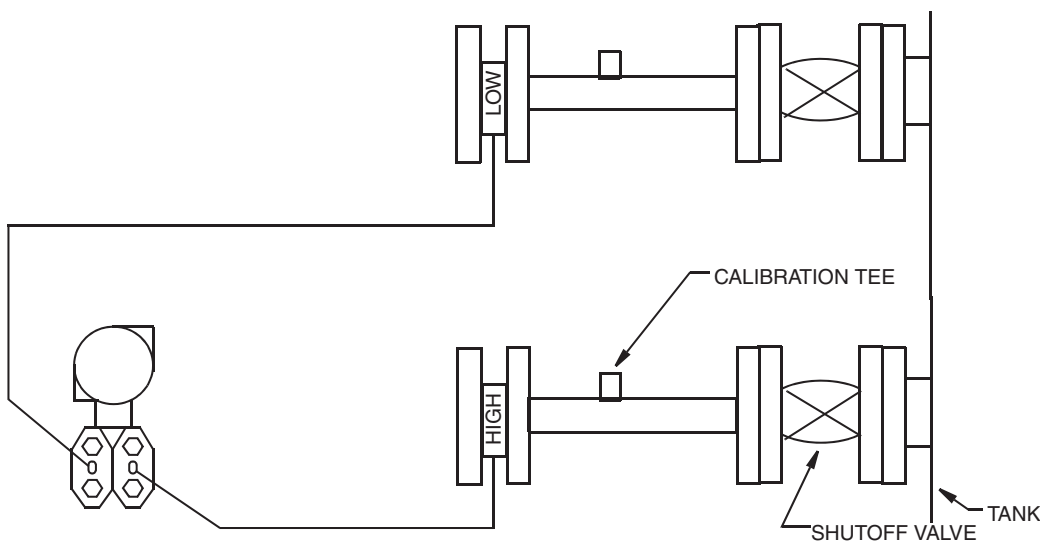


Figure 25. Field Calibration Setup With Other Flanged Seals

Transmitter With Threaded Pressure Seals

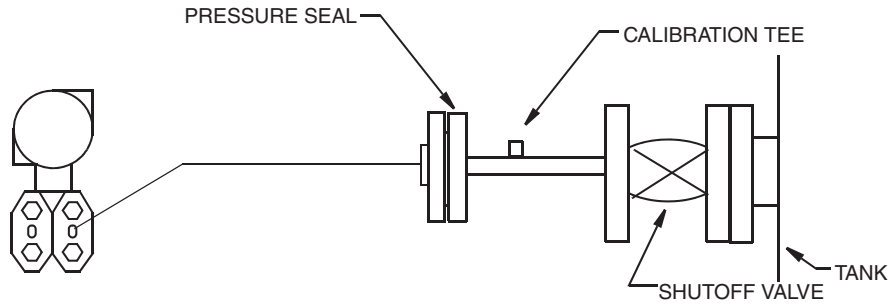


Figure 26. Field Calibration Setup With Threaded Seals

Bench Calibration Setup

The bench calibration setup requires disconnecting the transmitter from the process tank (or pipe). For calibration setup without disconnecting the process piping, refer to the “Field Calibration Setup” procedure. See the figures below for typical bench calibration setups.

Transmitter With PSFLT or PSSST Seal

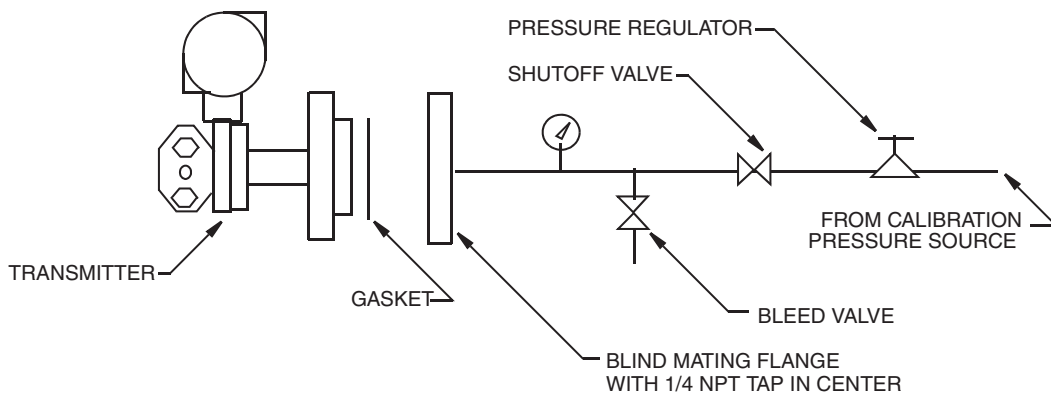


Figure 27. Bench Calibration Setup When Low Pressure Side is Vented or Connected to a Dry Leg

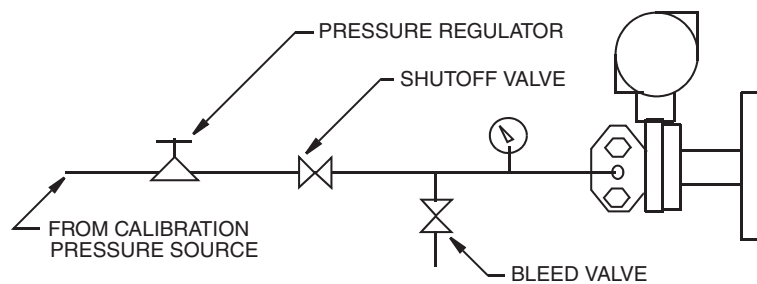
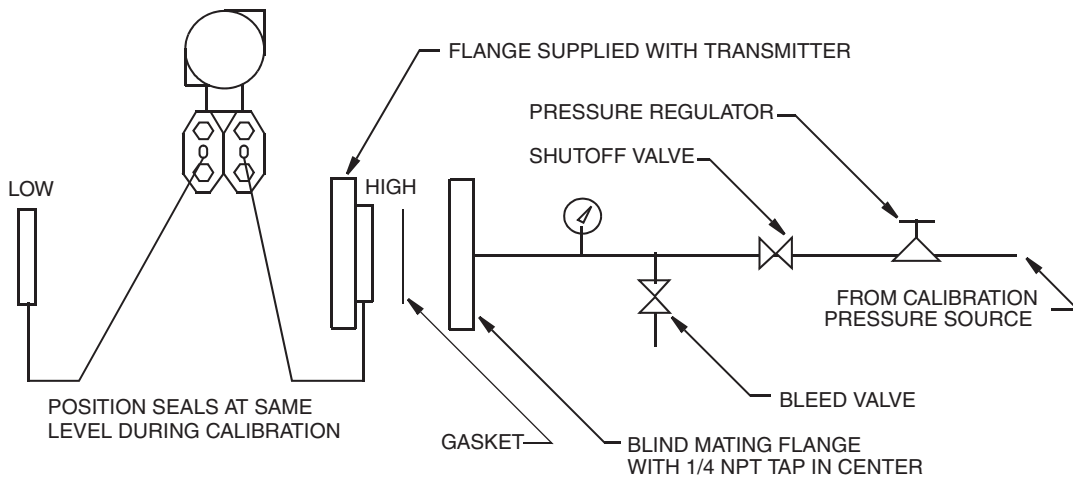


Figure 28. Bench Calibration Setup When Low Pressure Side is Connected to a Wet Leg

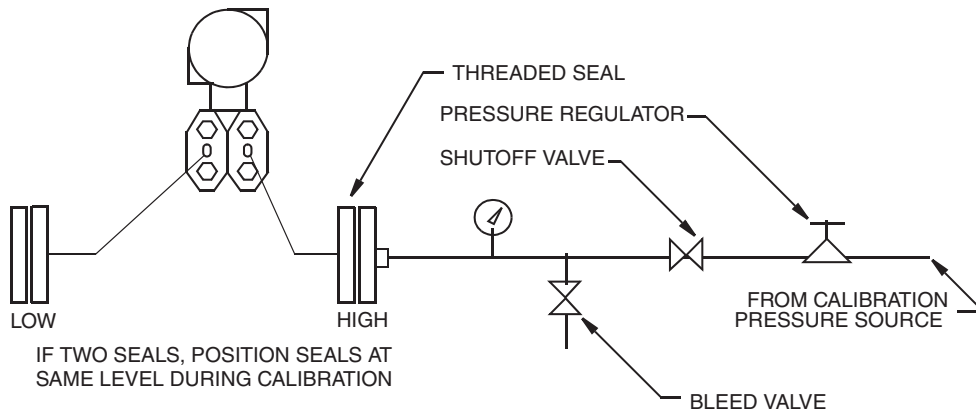
Transmitter With Other Flanged Seals



NOTE: WITH NEGATIVE RANGE VALUES, APPLY CALIBRATING PRESSURE TO

Figure 29. Bench Calibration Setup With Other Flanged Seals

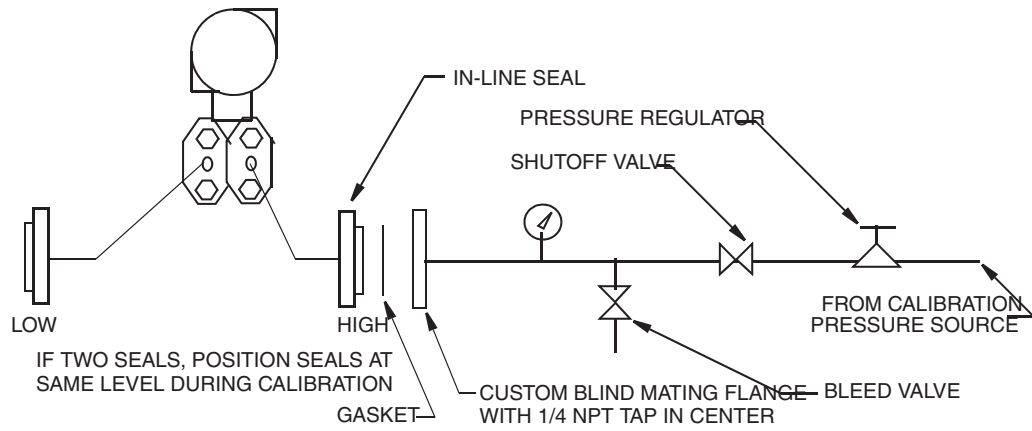
Transmitter With Threaded Seals



NOTE: WITH NEGATIVE RANGE VALUES, APPLY CALIBRATING PRESSURE TO

Figure 30. Bench Calibration Setup With Threaded Seals

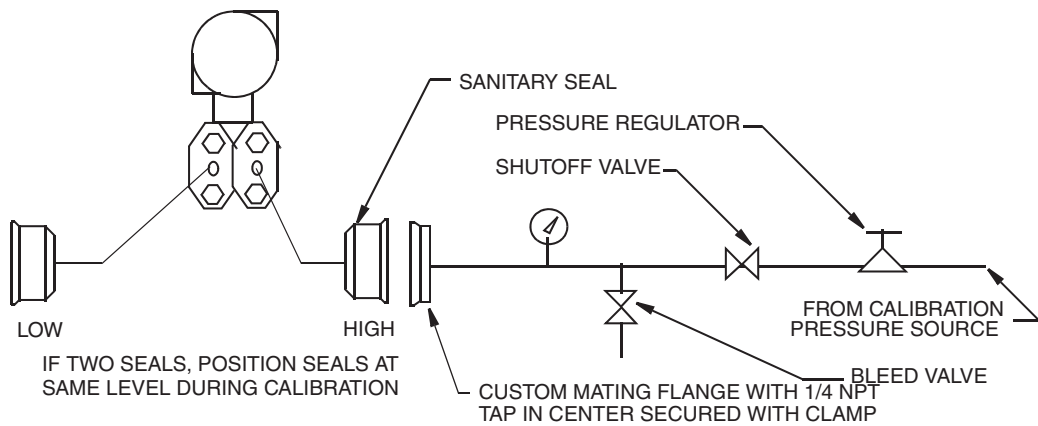
Transmitter With In-Line Seals



NOTE: WITH NEGATIVE RANGE VALUES, APPLY CALIBRATING PRESSURE TO

Figure 31. Bench Calibration Setup With In-Line Seals

Transmitter With Sanitary Seals



NOTE: WITH NEGATIVE RANGE VALUES, APPLY CALIBRATING PRESSURE TO

Figure 32. Bench Calibration Setup With Sanitary Seals

4. Maintenance

Pressure seals, whether directly connected to the transmitter or remotely connected via capillary, are units that must be filled and sealed at the factory. Therefore, the seals are not replaceable in the field.

Index

B

- Bench Calibration Setup
 - In-Line Seals 29
 - Other Flanged Seals 28
 - PSFLT or PSSST Seal 27
 - Sanitary Seals 29
 - Threaded Seals 28

C

- Calibration 19
- Calibration Setup, Bench
 - In-Line Seals 29
 - Other Flanged Seals 28
 - PSFLT or PSSST Seal 27
 - Sanitary Seals 29
 - Threaded Seals 28
- Calibration Setup, Field
 - Other Flanged Pressure Seals 26
 - PSFLT or PSSST Seal 26
 - Threaded Pressure Seals 27

D

- Determining Transmitter Input Range Values 19

F

- Field Calibration Setup
 - Other Flanged Pressure Seals 26
 - PSFLT or PSSST Seals 26
 - Threaded Pressure Seals 27

I

- Installation
 - PSFAD Seals 13
 - PSFAR Seals 12
 - PSFFD Seals 12
 - PSFFR Seals 11
 - PSFLT Seals 9
 - PSFPS and PSFES Seals 10
 - PSISD Seals 15
 - PSISR Seals 14

PSSCR Seals 15
 PSSCT Seals 16
 PSSSR Seals 16
 PSSST Seals 18
 PSTAD Seals 14
 PSTAR Seals 13

M

Maintenance 31

P

Pressure Limits

PSFAR and PSFAD Seals 4
 PSFFR and PSFFD Seals 3
 PSFLT Seals 2
 PSFPS and PSFES Seals 3
 PSISR and PSISD Seals 5
 PSSCR and PSSCT Seals 5
 PSSSR and PSSST Seals 5
 PSTAR and PSTAD Seals 5

T

Temperature Limits 5

ISSUE DATES

MAY 2003	OCT 2011
SEP 2003	MAY 2013
MAR 2007	APR 2014
AUG 2010	

Vertical lines to the right of text or illustrations indicate areas changed at last issue date.



Invensys
 10900 Equity Drive
 Houston, TX 77041
 United States of America
<http://www.invensys.com>

Global Customer Support
 Inside U.S.: 1-866-746-6477
 Outside U.S.: 1-508-549-2424 or contact
 your local Invensys representative.
 Website: <http://support.ips.invensys.com>

Invensys, Foxboro, and I/A Series are trademarks of
 Invensys plc, its subsidiaries, and affiliates.
 All other brand names may be trademarks of their
 respective owners.

Copyright 1999-2014 Invensys Systems, Inc.
 All rights reserved

MB 100

0414