

# Rosemount™ DP Level Transmitters and 1199 Diaphragm Seal Systems



## Safety Messages

### NOTICE

For technical assistance, contacts are listed below:

#### Customer Central

Technical support, quoting, and order related questions.

|                                   |                                             |
|-----------------------------------|---------------------------------------------|
| <b>United States:</b>             | 1-800-999-9307 (7:00 a.m. to 7:00 p.m. CST) |
| <b>Asia Pacific:</b>              | 65 777 8211                                 |
| <b>Europe/Middle East/Africa:</b> | 49 (8153) 9390                              |

#### North American Response Center

Equipment service needs

1-800-654-7768 (24 hours - includes Canada)

Outside of these areas, contact your local Emerson representative.

### ⚠ WARNING

#### Follow instructions

Failure to follow these installation guidelines could result in death or serious injury.

Ensure only qualified personnel perform the installation.

#### Explosion

Explosions could result in death or serious injury.

Do not remove the transmitter cover in explosive atmospheres when the circuit is live.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Both transmitter covers must be fully engaged to meet explosion-proof requirements.

Verify the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

#### Electrical hazard

Electrical shock could cause death or serious injury.

If the sensor is installed in a high-voltage environment and a fault or installation error occurs, high voltage may be present on transmitter leads and terminals.

Use extreme caution when making contact with the leads and terminals.

#### Process leaks

Process leaks could result in death or serious injury.

Install and tighten all four flange bolts before applying pressure.

Do not attempt to loosen or remove flange bolts while the transmitter is in service.

Replacement equipment or spare parts not approved by Emerson for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

Use only bolts supplied or sold by Emerson as spare parts.

#### Manifold installation

Improper assembly of manifolds to traditional flange can damage sensor module.

For safe assembly of manifold to traditional flange, bolts must break back plane of flange web (i.e., bolt hole) but must not contact sensor module housing.

## **⚠ WARNING**

### **Sensor module and electronics housing**

Sensor module and electronics housing must have equivalent approval labeling in order to maintain hazardous location approvals.

When upgrading, verify sensor module and electronics housing certifications are equivalent. Differences in temperature class ratings may exist, in which case the complete assembly takes the lowest of the individual component temperature classes (for example, a T4/T5 rated electronics housing assembled to a T4 rated sensor module is a T4 rated transmitter.)

### **Physical access**

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

## **⚠ CAUTION**

### **The products described in this document are NOT designed for nuclear-qualified applications.**

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.



# Contents

|                  |                                                                              |           |
|------------------|------------------------------------------------------------------------------|-----------|
| <b>Chapter 1</b> | <b>Introduction.....</b>                                                     | <b>7</b>  |
|                  | 1.1 Using this manual.....                                                   | 7         |
|                  | 1.2 Product recycling/disposal.....                                          | 7         |
| <b>Chapter 2</b> | <b>Remote Seal Systems.....</b>                                              | <b>9</b>  |
|                  | 2.1 DP Level and remote seal system measurement.....                         | 9         |
|                  | 2.2 Terminology of system components.....                                    | 9         |
|                  | 2.3 Seal system performance.....                                             | 10        |
|                  | 2.4 Balanced vs. Tuned-System assemblies.....                                | 12        |
|                  | 2.5 Specifying the right solution for vacuum applications.....               | 14        |
|                  | 2.6 Diaphragm weld types.....                                                | 15        |
|                  | 2.7 Differences between electronic remote sensors and capillary systems..... | 17        |
|                  | 2.8 Instrument Toolkit: seal ordering and application process.....           | 17        |
|                  | 2.9 Rosemount Thermal Range Expander: proper use and applications.....       | 18        |
|                  | 2.10 Thermal optimizer: proper use and applications.....                     | 20        |
| <b>Chapter 3</b> | <b>Installation.....</b>                                                     | <b>23</b> |
|                  | 3.1 Seal handling and installation.....                                      | 23        |
|                  | 3.2 Gaskets.....                                                             | 25        |
|                  | 3.3 Tagging.....                                                             | 26        |
|                  | 3.4 Torque sequence.....                                                     | 27        |
|                  | 3.5 FFW flush flanged seal.....                                              | 28        |
|                  | 3.6 RFW remote flanged seal.....                                             | 31        |
|                  | 3.7 EFW extended flanged seal.....                                           | 34        |
|                  | 3.8 PFW pancake seal.....                                                    | 36        |
|                  | 3.9 FCW flush flanged seal—ring type joint (RTJ) gasket surface.....         | 38        |
|                  | 3.10 RCW remote flanged seal - ring type joint (RTJ) gasket surface.....     | 40        |
|                  | 3.11 FUW flush flanged groove type seals.....                                | 42        |
|                  | 3.12 FVW flush flanged tongue type seals.....                                | 43        |
|                  | 3.13 RTW remote threaded type seals.....                                     | 45        |
|                  | 3.14 HTS male threaded seal.....                                             | 47        |
|                  | 3.15 SCW hygienic Tri-Clover Tri Clamp seals.....                            | 48        |
|                  | 3.16 SSW hygienic tank spud seal.....                                        | 51        |
|                  | 3.17 STW hygienic thin wall tank spud seal.....                              | 55        |
|                  | 3.18 EES hygienic flanged tank spud extended seal.....                       | 56        |
|                  | 3.19 VCS Tri Clamp in-line seal.....                                         | 57        |
|                  | 3.20 SVS VARIVENT <sup>®</sup> compatible hygienic connection seal.....      | 59        |
|                  | 3.21 SHP hygienic Cherry-Burrell <sup>®</sup> “I” line seal.....             | 60        |

|                  |                                                                         |           |
|------------------|-------------------------------------------------------------------------|-----------|
|                  | 3.22 SLS dairy process connection–female thread seal per DIN 11851..... | 61        |
|                  | 3.23 WSP saddle seal.....                                               | 62        |
|                  | 3.24 UCP union connection pipe mount seal.....                          | 64        |
|                  | 3.25 PMW paper mill sleeve seal.....                                    | 67        |
|                  | 3.26 CTW chemical tee seal.....                                         | 69        |
|                  | 3.27 TFS wafer style In-line seal.....                                  | 70        |
|                  | 3.28 WFW flow-thru flanged seal.....                                    | 72        |
| <b>Chapter 4</b> | <b>Configuration.....</b>                                               | <b>75</b> |
|                  | 4.1 Calculating range points.....                                       | 75        |
|                  | 4.2 DP Level transmitter installation best practices.....               | 82        |
| <b>Chapter 5</b> | <b>Fill Fluids.....</b>                                                 | <b>89</b> |
|                  | 5.1 Quality.....                                                        | 89        |
|                  | 5.2 Fill fluid selection.....                                           | 89        |
|                  | 5.3 Fill fluid vapor pressure curves.....                               | 90        |
| <b>Chapter 6</b> | <b>Maintenance and Troubleshooting.....</b>                             | <b>93</b> |
|                  | 6.1 Cleaning.....                                                       | 93        |
|                  | 6.2 Troubleshooting.....                                                | 93        |
|                  | 6.3 Return of materials.....                                            | 95        |
|                  | 6.4 Service support.....                                                | 95        |
| <b>Chapter 7</b> | <b>Reference data.....</b>                                              | <b>97</b> |
|                  | 7.1 Product certifications.....                                         | 97        |
|                  | 7.2 Ordering information, specifications, and drawings.....             | 97        |
|                  | 7.3 Spare parts.....                                                    | 97        |

# 1 Introduction

## 1.1 Using this manual

This manual is designed to assist in installing, operating, and maintaining the Rosemount 1199 Diaphragm Seal Systems for Pressure Transmitters and diaphragm seal systems that are part of Rosemount DP Level Transmitters including the Rosemount 3051SAL, Rosemount 3051L and Rosemount 2051L. The manual contains information about the seal system assemblies that are not covered in the corresponding transmitter manuals. For information regarding transmitter configuration, operation, and maintenance, reference the appropriate transmitter manual.

The information is organized into the following categories:

- [Remote Seal Systems](#) provides an overview of Remote Seal Systems.
- [Installation](#) contains mechanical and electrical installation instructions.
- [Configuration](#) outlines how to range a DP Level Remote Seal System.
- [Fill Fluids](#) describes the offering of fill fluids available with Remote Seal Systems.
- [Maintenance and Troubleshooting](#) provides techniques for cleaning and maintaining the system as well as addressing the most common operating problems.
- [Reference data](#) provides resources for product certifications, ordering information, specifications, drawings, and spare parts.

See Rosemount DP Level Transmitters and 1199 Seal Systems [Product Data Sheet](#) for more detailed information on specific Rosemount Remote Seals.

A remote seal system consists of a pressure transmitter, a remote diaphragm, and either a direct mount or capillary style connection filled with a secondary fill fluid.

## 1.2 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.





## 2 Remote Seal Systems

### 2.1 DP Level and remote seal system measurement

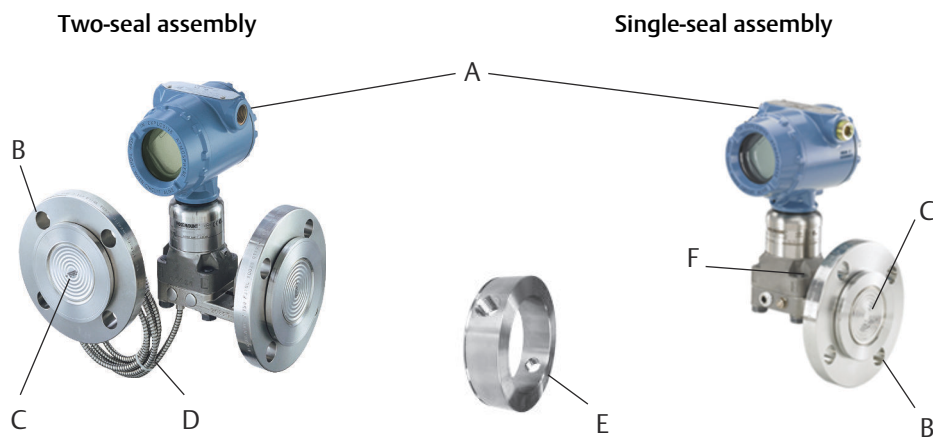
DP Level is a reliable measurement solution for measuring level, density, interface, or mass of a process media inside a tank.

Remote seal system measurement is unaffected by agitation, foam, or internal obstacles. Remote diaphragm seals extend limitations due to process conditions such as high and low temperatures, corrosive processes, viscous mediums, and hygienic applications.

### 2.2 Terminology of system components

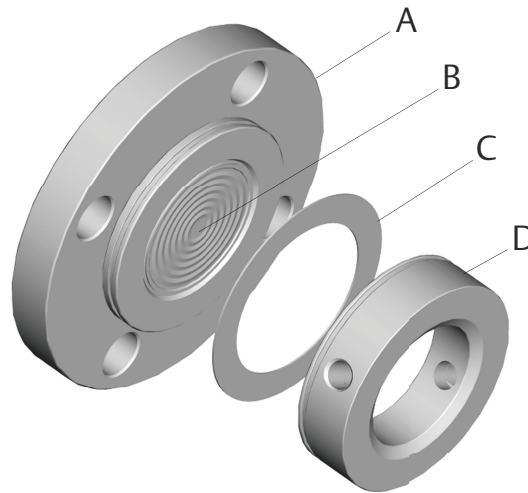
Figure 2-1 lists the basic components for seal assemblies.

**Figure 2-1: Components on a Two- and Single-Seal Assembly**



- A. Pressure, differential pressure, or multivariable transmitter
- B. Process flange
- C. Remote diaphragm
- D. Capillary
- E. Flushing ring (optional)
- F. Direct mount

**Figure 2-2: FFW Seal and Components**



- A. Process flange
- B. Diaphragm
- C. Gasket
- D. Flushing ring (optional)

## 2.3 Seal system performance

### 2.3.1 Volume temperature effects (process temperature effects)

Fill fluids expand or contract with temperature changes, creating a volume change that is absorbed by the diaphragm seal and is seen as back pressure at the transmitter. This back pressure creates a shift in the transmitter reading. For symmetrical or balanced systems, this error is usually minimal due to the back pressure being equal on both sides. However, head temperature effect is still present.

#### Note

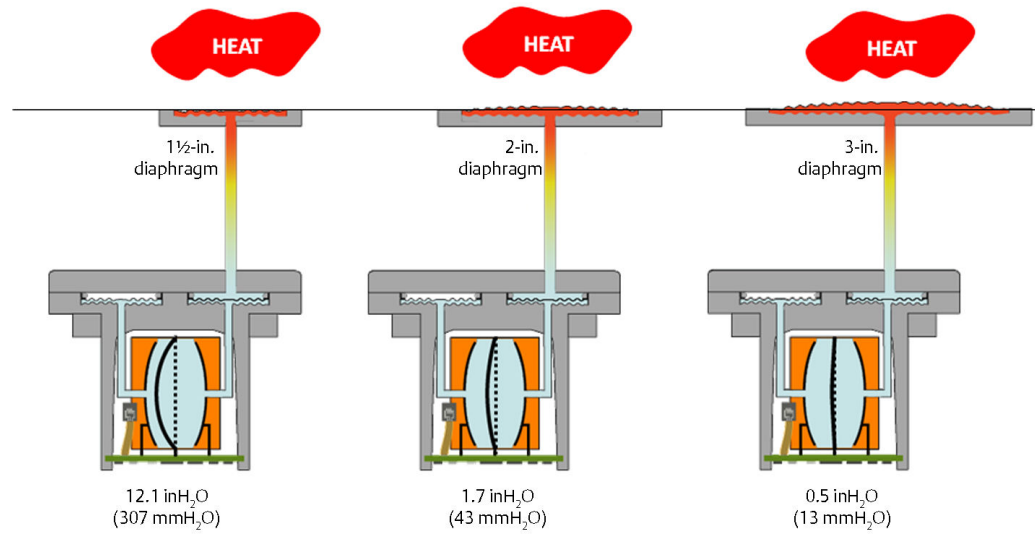
Other factors that affect seal temperature effect include diaphragm thickness, seal type and size, capillary length, and inner diameter.

Figure 2-3 shows how diaphragm size can affect the measurement reading at the transmitter. For smaller seal sizes, such as the 1½-in. size, the amount of back pressure on the transmitter causes an additional 12.1 inH<sub>2</sub>O (307 mmH<sub>2</sub>O) error. Moving to the 2-in. size gives 1.7 inH<sub>2</sub>O (43 mmH<sub>2</sub>O) and the largest 3-in. size shown only has 0.5 inH<sub>2</sub>O (13 mmH<sub>2</sub>O) error. Using a larger diaphragm can drastically improve performance and provides a more stable reading.

**Note**

Calculations done in Instrument Toolkit™ with Silicone 200 fill fluid with Rosemount 3051 Transmitter.

**Figure 2-3: Back Pressure on Diaphragm Causing Error**



**Note**

Diaphragm temperature effects decrease as seal size increases.

## 2.3.2 Density temperature effects (head temperature effects)

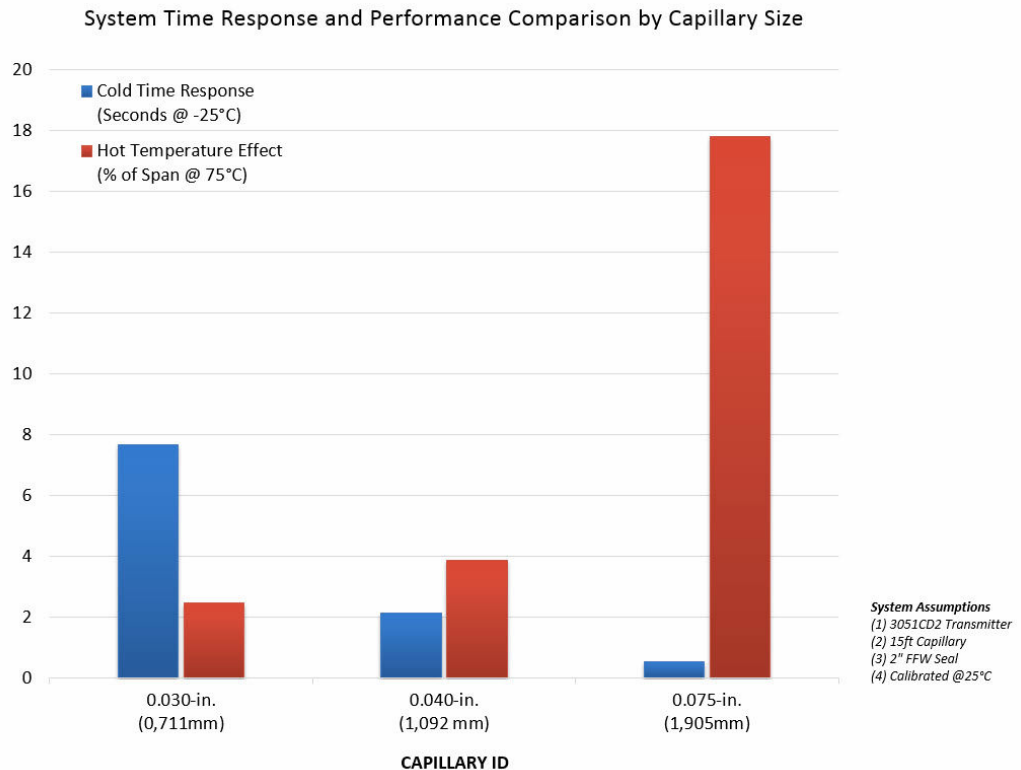
Density temperature effect is due to the change in specific gravity of the fill fluid caused by a change in ambient temperature. When installed, the weight of the fill fluid will produce an initial pressure read by the transmitter, equaling the height between the high and low connection taps multiplied by the fill fluid's specific gravity. As ambient temperature changes, the fill fluid specific gravity will change causing the weight of the fill fluid to change, thus changing the pressure read by the transmitter. Density effect will be seen in both

Tuned-System™ Assemblies and Balanced System Assemblies and will have the same impact on the transmitter regardless of where the transmitter is mounted.

## 2.3.3 System time response and performance

The time response of a system is based on the type of transmitter, its sensor range, the length and inner diameter (ID) of the capillary, and the viscosity of the fill fluid (which is directly affected by the process and ambient temperatures). These factors all play a role in the overall performance of any seal system. The relationship between system time response and temperature error is illustrated in Figure 2-4. It can be seen that changing the capillary ID has an inverse affect between the time response and temperature effect of a capillary system. As the capillary ID is increased, the time response of the system decreases while the temperature effect increases.

**Figure 2-4: Response Time vs. Total Performance Example**



**Note**

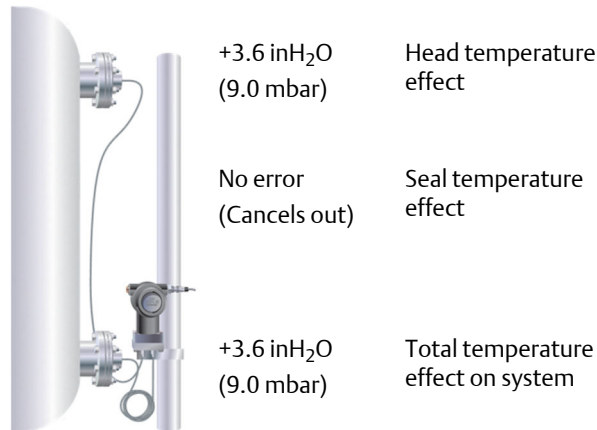
Calculations conducted using Instrument Toolkit.

Parameters: Silicone 200 fill fluid, Rosemount 3051CD2 Transmitter, 15 ft. capillary length, 2-in. FFW Seal, and calibrated at 25 °C.

## 2.4 Balanced vs. Tuned-System assemblies

A balanced remote seal system is a symmetrical system that utilizes equal seals and capillary length on the high and low pressure sides of the transmitter. Since the capillary lengths are the same, each side ideally has the same amount of fill fluid, minimizing or completely eliminating the seal temperature effect due to equal pressure on both sides of the transmitter diaphragm. The balanced systems are still affected by the head pressure as shown in [Figure 2-5](#).

**Figure 2-5: Balanced System**

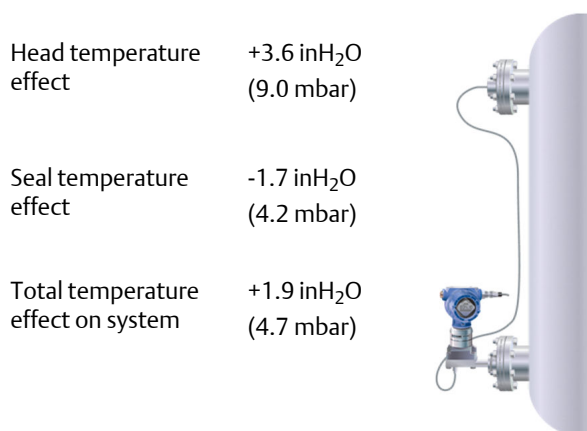


**Note**

Temperature effects were calculated in Instrument Toolkit using a 2-in. (DN 50) FFW seal, Silicone 200, 10 ft. (3 m) between the taps, over a 50 °F (28 °C) temperature change.

Tuned-Systems assemblies are asymmetrical remote seal systems with one seal directly mounted to the high side of the differential pressure transmitter, and the other side connected to a seal via capillary. Another possible Tuned-System assembly is any remote seal system with unequal lengths of capillary or two different remote seals on the high and low pressure connections. Due to the unequal lengths of capillary, there are seal temperature effects. However, this seal temperature effect counters the head pressure from the oil-filled capillary and reduces total temperature effects on the entire system.

**Figure 2-6: Tuned-System Assembly**



**Note**

Temperature effects were calculated in Instrument Toolkit using a 2-in. (DN 50) FFW seal, Silicone 200, 10 ft. (3 m) between the taps, over a 50 °F (28 °C) temperature change.

## 2.5 Specifying the right solution for vacuum applications

### 2.5.1 Vacuum application overview

When a vessel is operating in a vacuum (negative gauge pressure), it is important to specify the correct transmitter remote seal system to measure level accurately and reliably. Failure to do so can result in output drift or complete system failure. The combination of high process temperature and vacuum process pressure conditions creates additional requirements when specifying the transmitter remote seal system.

### 2.5.2 Vacuum applications

There are three primary transmitter-seal system components necessary to successfully specify vacuum application solutions:

- Seal system construction
- Fill fluid selection
- Transmitter mounting position

### 2.5.3 Seal system construction for vacuum applications

Emerson offers welded-repairable or all-welded vacuum system construction styles on diaphragm seal assemblies.

The all-welded vacuum construction was designed specifically for vacuum applications. In this construction, the sensor module gaskets are removed and a disk is welded over the sensor isolators. This eliminates the possibility of air being drawn into the seal system in deep vacuum conditions. This premium design is strongly suggested for vacuum pressures below 6 psia (310 mmHgA).

### 2.5.4 Transmitter mounting position

Mounting the pressure transmitter at or below the bottom vessel tap is an important factor to ensure a stable measurement with vacuum applications. The static pressure limit for a differential pressure transmitter is 0.5 psia (25 mmHgA), which ensures the transmitter sensor module fill fluid remains within the liquid phase of the vapor pressure curve.

If the vessel static limit is below 0.5 psia, mounting the transmitter below the bottom tap provides a capillary fill fluid head pressure on the module. A general rule is to always mount the transmitter approximately 3 ft. (1 m) below the bottom tap of the vessel.

## 2.5.5 Fill fluid selection

When the process is under vacuum conditions, the fill fluid can vaporize at a lower temperature than when it is under normal atmospheric or greater pressure. Each fill fluid has a specific vapor-pressure curve. The vapor-pressure curve indicates the pressure and temperature relationship where the fluid is in a liquid or a vapor state. Proper seal operation requires the fill fluid to remain in a liquid state.

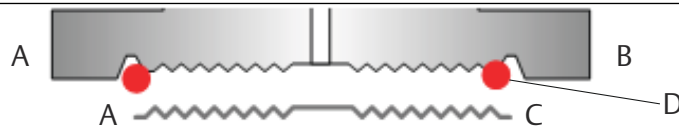
For vacuum applications, specify fluids that are specifically designed for use in these types of applications such as Silicone 704 for vacuum applications, Silicone 705 for vacuum applications, or UltraTherm™ 805 for vacuum applications. These fluids have been specially processed to deliver the maximum vapor pressure curve performance possible. For more information on Rosemount Diaphragm Seal fill fluids, reference the Rosemount 1199 Fill Fluid Specifications [Technical Note](#).

## 2.6 Diaphragm weld types

Weld-type is factory-determined as best for the seal typed specified. PFW and FFW seals have ordering options that specify welding options.

### 2.6.1 Solid faceplate design

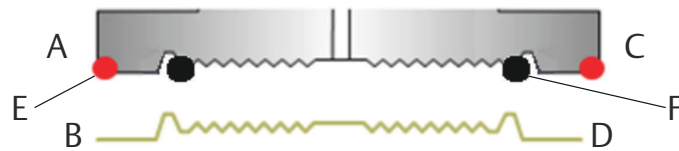
The solid faceplate design is used when diaphragm and upper housing material are the same.



- A. Material A
- B. Upper housing
- C. Diaphragm
- D. TIG weld point

## 2.6.2 Seam weld design

A seam weld design is used when the upper housing material is different from the diaphragm material. The seam welded design has a hermetic weld at the inner diameter of the diaphragm and a TIG weld at the outer edge. The diaphragm floats on the upper housing over the gasket surface area and could tear if a metallic gasket were used.

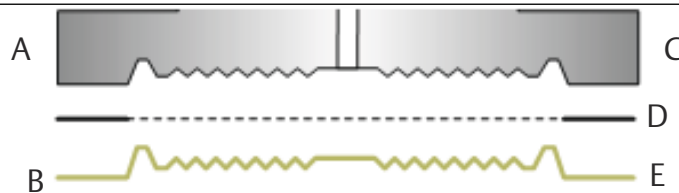


- A. Material A
- B. Material B
- C. Upper housing
- D. Diaphragm
- E. TIG weld point
- F. Seam weld point

## 2.6.3 Brazed design

This process uses a brazing ring where the metals are brazed to attach the diaphragm to the upper housing. This allows the gasket surface area to solidify as it is melted to the upper housing.

This option is used with Tantalum diaphragm when a metallic gasket is required.



- A. Material A
- B. Tantalum
- C. Upper housing
- D. Brazing ring
- E. Diaphragm



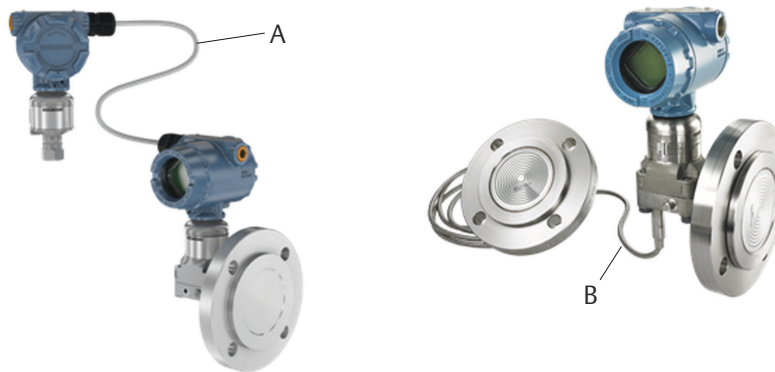
## 2.7 Differences between electronic remote sensors and capillary systems

Rosemount 3051S Electronic Remote Sensors (ERS™) System technology utilizes two Rosemount 3051S Pressure Transmitters connected via an electrical wire instead of a single pressure transmitter with remote seals and capillary tubing. As the Rosemount 3051S ERS System calculates the differential pressure between the two transmitters, capillary tubing is not needed, and thus eliminates all head temperature affects on the system. Seals are not required, but may still be necessary on certain applications that include high temperature, corrosive, or viscous processes. For more information, refer to the Rosemount 3051S Series [Product Data Sheet](#).

**Figure 2-7: ERS vs. Capillary**

Rosemount 3051S ERS

Traditional capillary system



- A. Non-proprietary electrical cable
- B. Oil-filled capillary system

## 2.8 Instrument Toolkit: seal ordering and application process

Rosemount Instrument Toolkit Software is an instrumentation specification tool that can be used to assist in product selection. This program analyzes application and process conditions against a configured Rosemount model number and calculates the total system performance including expected head and seal temperature effects and system response times.

Visit the Emerson website for information on how to obtain and use Instrument Toolkit.

## 2.9 Rosemount Thermal Range Expander: proper use and applications

Figure 2-8: Rosemount Thermal Range Expander



- A. Intermediate diaphragm
- B. High temperature fill fluid (viscous)
- C. Ambient temperature fill fluid

The Rosemount Thermal Range Expander increases the application range where DP Level technology can be used by expanding the ambient and process temperature ranges of the system.

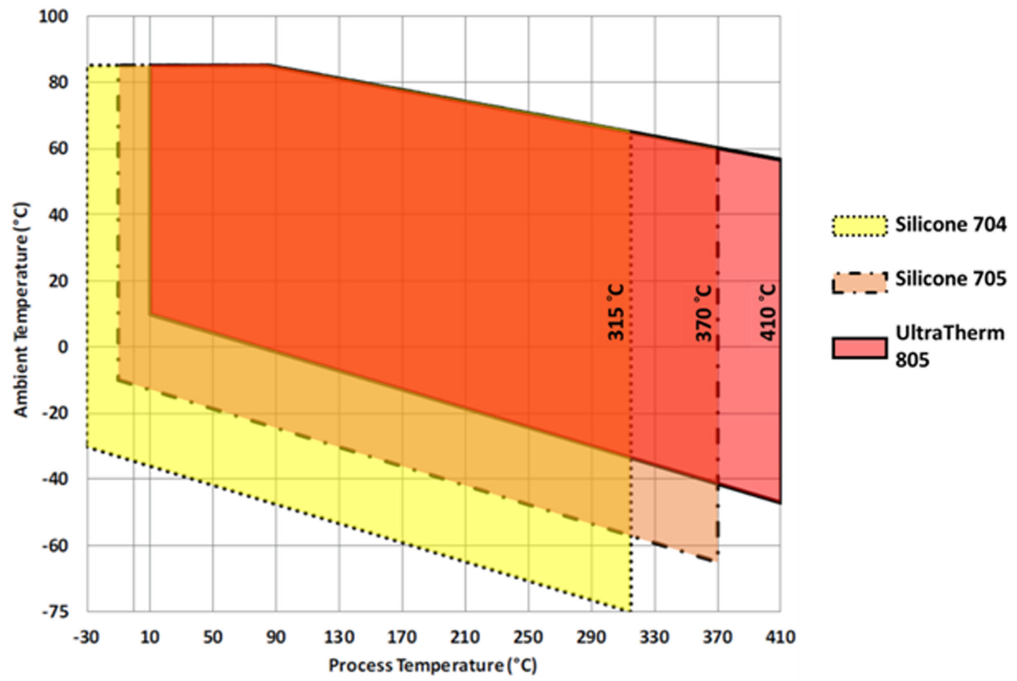
Traditional remote seal systems are filled with a single fill fluid to operate in applications with varying ambient and process conditions. Silicone 704 and 705 are commonly used fluids for hot process applications going above 570 °F (300 °C); these fluids must be kept above 32 °F (0 °C) and 68 °F (20 °C), respectively, in order to properly transmit the pressure signal to the transmitter. This can prove to be difficult for outdoor installations where extremely cold ambient conditions cause these fill fluids to gel.

The Rosemount Thermal Range Expander is a seal system that uses two different fill fluids to extend the operating temperature range of the system. A high temperature fill fluid, which is next to the hot process, is kept warm enough to stay responsive. A second fill fluid, located on the other side of the intermediate diaphragm, operates over a wide ambient temperature range. The Rosemount Thermal Range Expander can operate in ambient temperatures as low as -103 °F (-75 °C), and process temperatures up to 770 °F (410 °C) and 850 °F (454 °C) design temperature<sup>(1)</sup>. This improves response time up to 46 percent and eliminates the need for mechanical heat tracing.

The Rosemount Thermal Range Expander can be used with any Rosemount 3051S DP Level configuration including Balanced Systems, Tuned-System Assemblies, Electronic Remote Sensors (ERS), or direct mounted to a transmitter.

(1) UltraTherm 805 supports maximum design temperature of 850 °F (454 °C). Design temperature rating is for non-continuous use with a cumulative exposure time less of than 12 hours. Continuous use temperature is rated to 770 °F (410 °C).

Figure 2-9: Rosemount Thermal Range Expander Temperature Operating Range



## 2.10 Thermal optimizer: proper use and applications

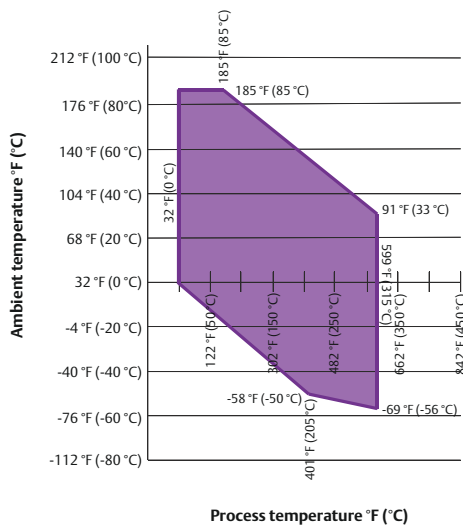


The thermal optimizer keeps fill fluids from gelling in cold ambient temperatures by using high process temperatures to heat the transmitter and capillary.

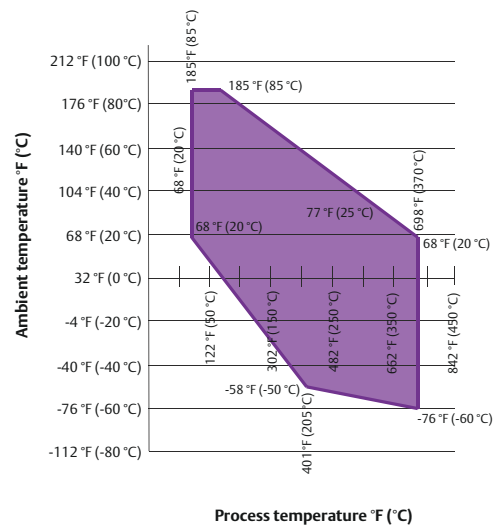
High temperature silicone fill fluid has a low temperature limit in ambient conditions below 32 °F (0 °C). The thermal optimizer allows direct mounting down to -94 °F (-70 °C).

Figure 2-10: Fill Fluid Temperature Limits

Thermal optimizer with Silicone 704



Thermal optimizer with Silicone 705



## 2.10.1 Thermal optimizer limitations

Figure 2-10 shows the process and ambient temperature limits for the thermal optimizer with Silicone 704 and Silicone 705 Fill Fluids respectively. The shaded areas represent the temperature limitations; applications outside of the shaded area cannot be used with a thermal optimizer.

For example, an application with an ambient temperature of 50 °F (10 °C) and a process temperature of 300 °F (149 °C) is within the limits, a thermal optimizer can be used in this application.

However, an application with an ambient temperature of 122 °F (50 °C) and a process temperature of 464 °F (240 °C) is outside of the limits. These high temperatures would be detrimental to the transmitter electronics.



## 3 Installation

### 3.1 Seal handling and installation

#### 3.1.1 Diaphragm

The remote seal diaphragm is designed to withstand pressure and wear from process, but outside of process connection conditions, remote seals are delicate and should be handled with care.

The protective cover should remain on the seal until the moment before installation. Try to avoid touching the diaphragm with fingers or objects and refrain from setting the diaphragm side of the seal down on a hard surface.

Even minor dents or scratches in the diaphragm material may impair the performance of the seal system assembly. Care should be taken to ensure the seal diaphragm is not dented or damaged during seal installation.

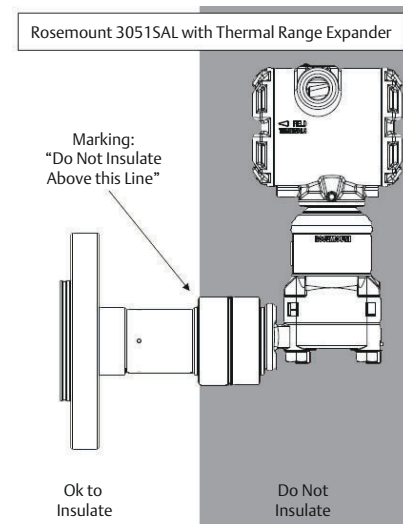
#### 3.1.2 Capillary

When unpacking or handling seal system assemblies, do not lift the seal or transmitter by gripping the capillaries. Avoid sharply bending or crimping the capillary tubing. The minimum bending radius of the capillary tubing is 3-in. (8 cm).

#### 3.1.3 Rosemount Thermal Range Expander

The Rosemount Thermal Range Expander system uses the heat from the process in order to keep both fluids within the system functioning properly; therefore insulation is not always required. However, it is always best practice to insulate systems to keep them functioning with optimum performance. The Rosemount Thermal Range Expander should never be insulated above the line marked on the seal itself.

**Figure 3-1: Rosemount 3051SAL with Rosemount Thermal Range Expander Insulation Guidelines**



### 3.1.4 Heat tracing

When using heat or steam tracing, exercise caution if PVC coating is added onto capillary, as PVC coating should not be exposed to temperatures above 212 °F (100 °C) to avoid the possibility of thermal breakdown.

Best practice for heat and steam tracing is to regulate the temperature slightly above the maximum ambient temperature for a consistent result. To avoid accuracy effects and thermal stress, the capillary should not be partially heated.

#### **⚠ CAUTION**

**NEVER attempt to disconnect the seals or capillaries from the transmitter or loosen bolts.**

Doing so will result in loss of fill fluid and will void the product warranty.

Failing to recognize incorrect materials during installation may cause process leaks, which can result in damage to the diaphragm seal system or death and/or serious injury to personnel. Proper wetted material is required for specific process materials.



## 3.2 Gaskets

### ⚠ WARNING

When installing remote seal systems which employ a gasket or a gasket and flushing connection ring, make sure the gasket is aligned properly on the gasket sealing surface. The user is responsible to ensure the gasket used does not exceed the temperature limits of the process. Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

In addition, make sure the gasket does not press down upon the diaphragm face. Anything pressing on the diaphragm will be read by the transmitter as pressure. A misaligned gasket may cause a false reading.

The intermediate gasket between the seal and lower housing is supplied when the lower housing or flushing connection is provided. The default gaskets are listed in [Table 3-1](#) based on seal type. The process gasket must be supplied by the end user. Tantalum diaphragms are not supplied with default gasket, so a gasket option must be selected when applicable.

If a lower housing is supplied, then the following gaskets are the default gaskets for each seal unless another gasket option is selected.

**Table 3-1: Gasket Materials**

| Seal type                       | Gaskets                   |
|---------------------------------|---------------------------|
| <b>Flanged seals assemblies</b> |                           |
| FFW                             | Thermo-Tork® TN-9000      |
| RFW                             | Klinger C-4401            |
| EFW                             | No gasket is supplied     |
| PFW                             | Thermo-Tork TN-9000       |
| FCW                             | No gasket is supplied     |
| RCW                             | Klinger C-4401            |
| FUW/FVW                         | No gasket is supplied     |
| <b>Threaded seal assemblies</b> |                           |
| RTW                             | Klinger C-4401            |
| HTS                             | No gasket is supplied     |
| <b>Hygienic seal assemblies</b> |                           |
| SCW <sup>(1)</sup>              | No gasket is supplied     |
| SSW                             | Ethylene propylene O-ring |
| STW                             | Ethylene propylene O-ring |
| EES                             | No gasket is supplied     |
| VCS <sup>(1)</sup>              | No gasket is supplied     |
| SVS <sup>(1)</sup>              | No gasket is supplied     |

**Table 3-1: Gasket Materials (continued)**

| Seal type              | Gaskets                           |
|------------------------|-----------------------------------|
| SHP                    | No gasket is supplied             |
| SLS <sup>(1)</sup>     | No gasket is supplied             |
| <b>Specialty seals</b> |                                   |
| WSP                    | Klinger C-4401                    |
| UCP                    | Barium-Sulfate filled PTFE O-ring |
| CTW                    | No gasket is supplied             |
| TFW                    | No gasket is supplied             |
| WFW                    | Klinger C-4401                    |

(1) Use EHEDG approved gasket for EHEDG conformity.

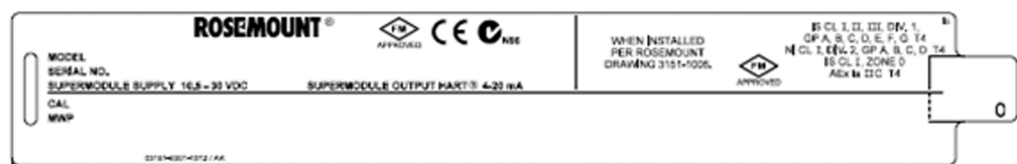
**⚠ WARNING**

The end-user is responsible for choosing a gasket and ensuring the process temperature does not exceed the temperature limits of the gasket used. Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

### 3.3 Tagging

Each remote seal system is tagged in accordance with the end-user requirements. The remote seal model number is identified on the transmitter label, shown in Figure 3-2, Figure 3-3, and Figure 3-4.

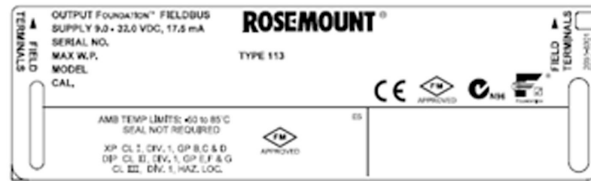
**Figure 3-2: Rosemount 3051S Sample Label**



**Figure 3-3: Rosemount 3051 Sample Label**



Figure 3-4: Rosemount 2051 Sample Label



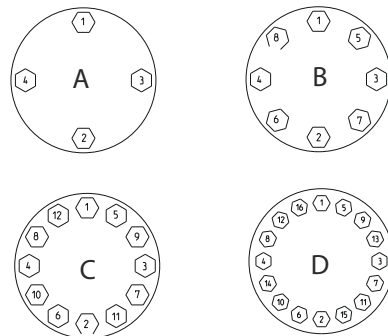
### 3.3.1 Max working pressure

The maximum working pressure (MWP) of the seal system assembly is stamped on the transmitter neck tag. This can be dependent upon the maximum pressure rating of the seal system or transmitter upper range limit.

## 3.4 Torque sequence

When tightening the assembly bolts, use a cross-pattern to ensure even installation. Best practice is to tighten 20 to 30 percent, check the gap, tighten 50 to 70 percent, check flange gap and uniformity, and continue to tighten in the appropriate pattern until you reach 100 percent torque value. Time permitting, wait a minimum of four hours and repeat the torque pattern to restore any short-term creep/relaxation in the connection.

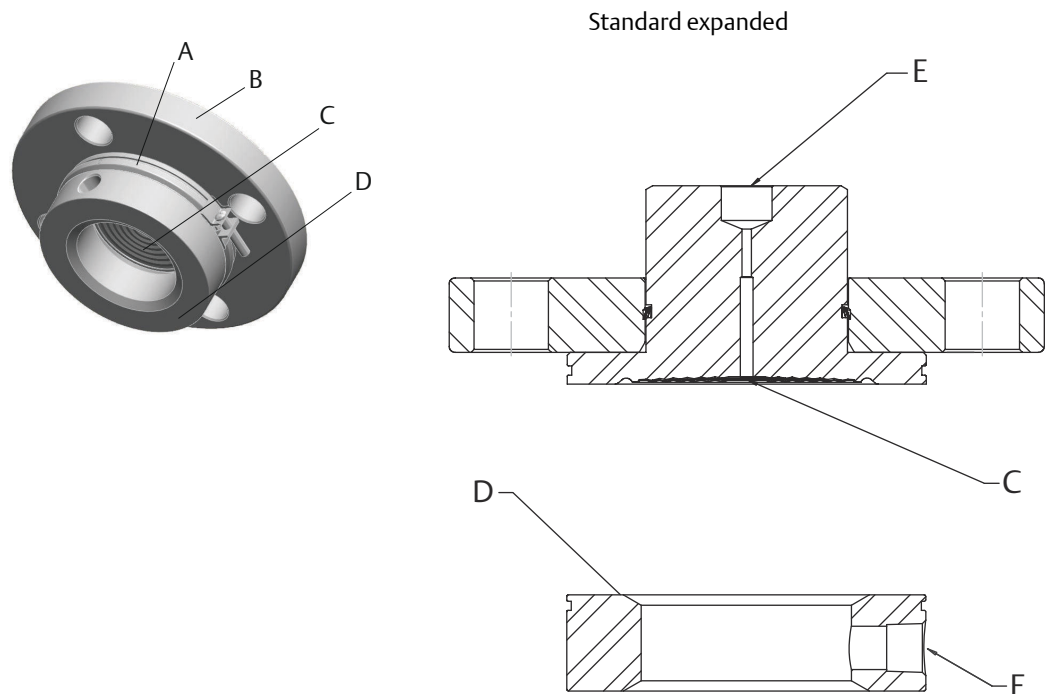
Figure 3-5: Cross-Pattern Sequence



- A. 4-bolt flange
- B. 8-bolt flange
- C. 12-bolt flange
- D. 16-bolt flange

## 3.5 FFW flush flanged seal

Figure 3-6: FFW Two-Piece Design (Shown with Optional Flushing Ring)



- A. Alignment clamp (option code SA)
- B. Process flange
- C. Diaphragm
- D. Flushing ring (optional)
- E. Connection to transmitter
- F. Flushing connection

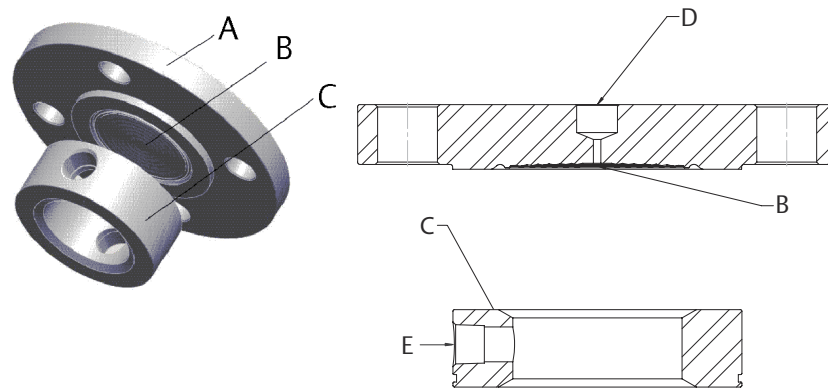
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### Note

Two-piece design seal assembly and process flange are separate components and can be rotated independent of each other. Alignment clamp (A) can be ordered using option code SA.

---

**Figure 3-7: FFW One-Piece Design (Shown with Optional Flushing Ring)**



- A. Process flange
- B. Diaphragm
- C. Flushing ring (optional)
- D. Connection to transmitter
- E. Flushing connection

**Note**

Alignment clamp (option code SA) not available for FFW one-piece design.

### 3.5.1 Parts required for installation

The parts required to install the FFW flush flanged seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

**Note**

Flushing rings include an Emerson-supplied gasket. If an alignment clamp is used, a Phillips or slotted screwdriver is required for installation

Verify the gasket materials are appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

## 3.5.2 Installation steps

If a flushing ring is ordered and no alignment clamp is used, it is recommended that two people install the FFW flush flanged seal to ensure proper alignment during installation.

Follow these steps to install the FFW flush flanged seal on an existing flanged process connection:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. If installing a flushing ring, ensure flushing connections are sealed before completing installation. Flushing rings may be ordered with or without, one or two threaded flushing connections, factory supplied plugs, or drain vent valves. If no flushing ring was purchased, proceed to [Step 3](#). Assemble the flushing ring, Emerson-supplied gasket, and remote seal together. If using an alignment clamp (option code SA) attach the flushing ring to the remote seal. Place the alignment clamp in the machined groove on both the remote seal and the flushing ring. Using the applicable screwdriver, tighten the screw on the clamp to hold the flushing ring in place.
3. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
4. Place the appropriate end-user-supplied gasket on the remote seal or flushing ring and align the gasket so that it is not inside the diaphragm weld as this will induce errors.

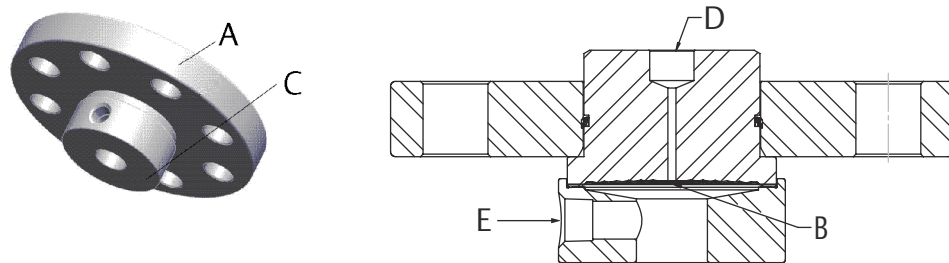
### **▲ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Using the previously installed bolts, attach the remote seal and gasket to the process connection. Secure with nuts and hand-tighten.
6. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
7. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.6 RFW remote flanged seal

Figure 3-8: RFW Standard Design

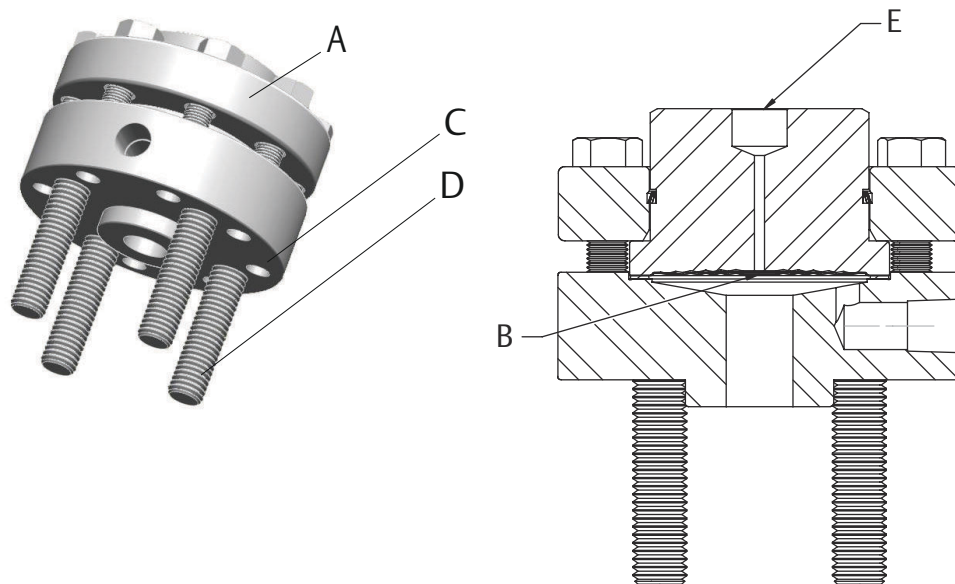


- A. Process flange
- B. Diaphragm
- C. Lower housing or flushing ring
- D. Connection to transmitter
- E. Flushing connection

**Note**

Lower housing always required for RFW remote flanged seal.

Figure 3-9: RFW Stud Bolt Design



- A. Upper housing
- B. Diaphragm
- C. Lower housing or flushing ring
- D. Stud bolts
- E. Connection to transmitter

**Table 3-2: RFW Upper Housing Torque Values**

| Materials (nuts and bolts) | Bolt thread size | Class          | Torque                  |
|----------------------------|------------------|----------------|-------------------------|
| SST                        | 3/8–24 NF        | 150/300/600 lb | 23 ft-lb                |
| CS                         | 3/8–24 NF        | 150/300/600 lb | 23 ft-lb <sup>(1)</sup> |
| CS                         | 1/2–20 NF        | 900/1500 lb    | 53 ft-lb <sup>(1)</sup> |

(1) 53 ft-lb for 4.1-in. diaphragm size.

**Note**

This is the specification for connecting the remote seal to the lower housing, not the torque specification for the lower housing onto the process flanged connection. The lower housing bolts should be torqued to the applicable flange requirements.

### 3.6.1 4.1-in. (104 mm) diaphragm diameter option

The standard diaphragm size for the RFW remote flanged seal is 2.4-in. A larger, 4.1-in. (104 mm), diaphragm size is offered for small spans to reduce temperature error when taking process measurements.

### 3.6.2 Parts required for installation

The parts required to install the RFW remote flanged seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (lower housing to process flange) (end-user-supplied)
- Gasket (remote seal to lower housing) (Emerson-supplied)

**Note**

Typically, the stud bolt design includes Emerson-supplied stud bolts.

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.6.3 Standard design installation steps

It is recommended that two people install the standard design RFW remote flanged seal to ensure proper alignment during installation.

Follow these steps to install the standard design RFW remote flanged seal on an existing process flange:

**Procedure**

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.



2. Ensure flushing connections are sealed before completing installation. Flushing rings may be ordered with or without, one or two threaded flushing connections, factory supplied plugs, or drain vent valves.
3. Assemble the flushing ring, Emerson-supplied gasket, and remote seal together. Place the Emerson-supplied gasket inside the recessed cavity within the flushing ring which is designed to hold the gasket in place.
4. Assemble to remote seal assembly to the process flange. Place the appropriate end-user-supplied gasket between the flushing ring and process flange. Ensure that the end-user-supplied gasket is centered on both the flushing ring and process flange. Ensure the flange bolt holes between the remote seal and the process flange are aligned.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Put the first end-user-supplied bolt through one of the holes on the bottom of the seal and process flange. Secure with a nut and hand-tighten.
6. Install the remaining end-user-supplied bolts in a cross pattern, hand-tightening each nut as the bolts are installed.
7. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.6.4 Stud bolt installation steps

Follow these steps to install the stud bolt design RFW remote flanged seal on an existing process flange:

### Procedure

1. Ensure flushing connections are sealed before completing installation. Lower housing may be ordered with or without, one or two threaded flushing connections, factory supplied plugs, or drain vent valves.
2. Install the stud bolts onto the lower housing.
3. Assemble the lower housing to the process flange. Place the appropriate end-user-supplied gasket between the lower housing and process flange. Ensure that the end-user-supplied gasket is centered on both the lower housing and process flange.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

4. Hand-tighten nuts onto the studs.

5. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The nuts should be torqued to the applicable flange requirements.
6. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
7. Assemble the remote seal, Emerson-supplied gasket, and lower housing. Place the Emerson-supplied gasket inside the recessed cavity within the lower housing which is designed to hold the gasket in place.

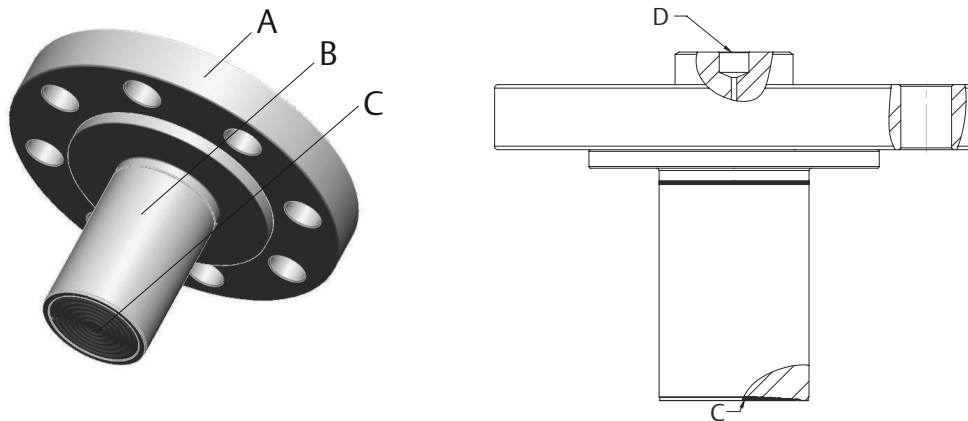
**⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

8. Install the bolts in a cross pattern and hand-tighten.
9. Using a torque wrench on the bolt, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued per [Table 3-2](#) based on size and bolt material. Consider leak checking the installation to ensure a robust connection.

## 3.7 EFW extended flanged seal

Figure 3-10: EFW Extended Flanged Seal Assembly



- A. Process flange
- B. Extension
- C. Diaphragm
- D. Connection to transmitter

**Note**

Flushing ring/lower housing not available for EFW extended flanged seal.

### 3.7.1 Parts required for installation

The parts required to install the EFW extended flanged seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.7.2 Installation steps

Follow these steps to install the EFW extended flanged seal on an existing process flange:

#### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
3. Place the appropriate end-user-supplied gasket on the remote seal.

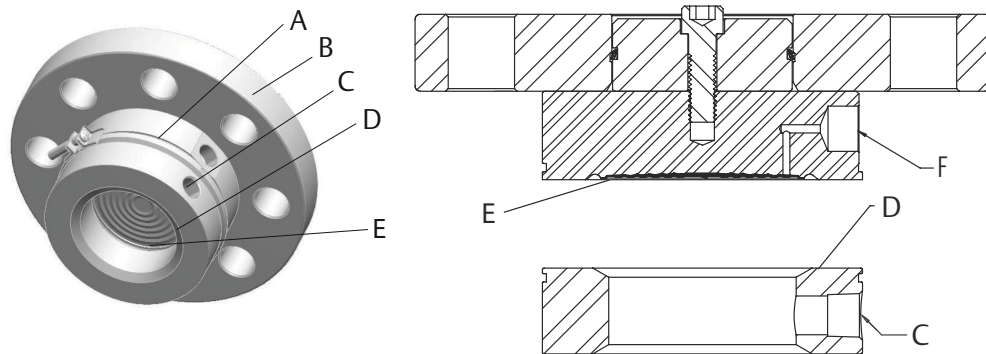
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

4. Using the previously installed bolts, attach the remote seal and gasket to the process flange. Secure with nuts and hand-tighten.
5. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
6. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.8 PFW pancake seal

Figure 3-11: PFW Pancake Seal



- A. Alignment clamp (option code SA)
- B. Process flange
- C. Flushing connection
- D. Flushing ring (optional)
- E. Diaphragm
- F. Connection to transmitter

### Note

Alignment clamp (A) can be ordered using option code SA.

### 3.8.1 Capillary support tube

A common option for the pancake type seal is the 4-in. capillary support tube. Due to the side capillary-to-seal connection, the support tube provides a handle for aligning the pancake seal during installation. The support tube should not be used for supporting any weight.

### 3.8.2 Process flange

Emerson offers the option of supplying the process flange, otherwise the process flange is furnished by the end-user. There is a 5/16–24 threaded connection on the back of the PFW pancake seal. For certain pancake seal assemblies, the Emerson-supplied process flange has a machined hole through the center of the flange that corresponds to the threaded connection in the back of the pancake seal. This allows the flange to be connected to the seal before installation to make handling easier. If the process flange is furnished by the end-user, a 2 1/64-in. to 3/8-in. through hole could be drilled into the flange to support ease of installation.

### 3.8.3 Parts required for installation

The parts required to install the PFW pancake seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

---

#### Note

Flushing rings include an Emerson-supplied gasket. If an alignment clamp is used, a Phillips or slotted screwdriver is required for installation.

---

Verify the gasket materials are appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.8.4 Installation steps

If no alignment clamp is used on the flushing ring, it is recommended that two people install the PFW pancake seal to ensure proper alignment during installation.

Follow these steps to install the PFW pancake seal on an existing process flange:

#### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. If installing a flushing ring, ensure flushing connections are sealed before completing installation. Flushing rings may be ordered with or without, one or two threaded flushing connections, factory supplied plugs, or drain vent valves. If no flushing ring was purchased, proceed to [Step 3](#). Assemble the flushing ring, Emerson-supplied gasket, and remote seal together. If using an alignment clamp (option code SA) attach the flushing ring to the remote seal. Place the alignment clamp in the machined groove on both the remote seal and the flushing ring. Using the applicable screwdriver, tighten the screw on the clamp to hold the flushing ring in place.
3. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
4. Place the appropriate end-user-supplied gasket on the remote seal or optional flushing ring and align the gasket so that it is not inside the diaphragm weld as this will induce errors.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

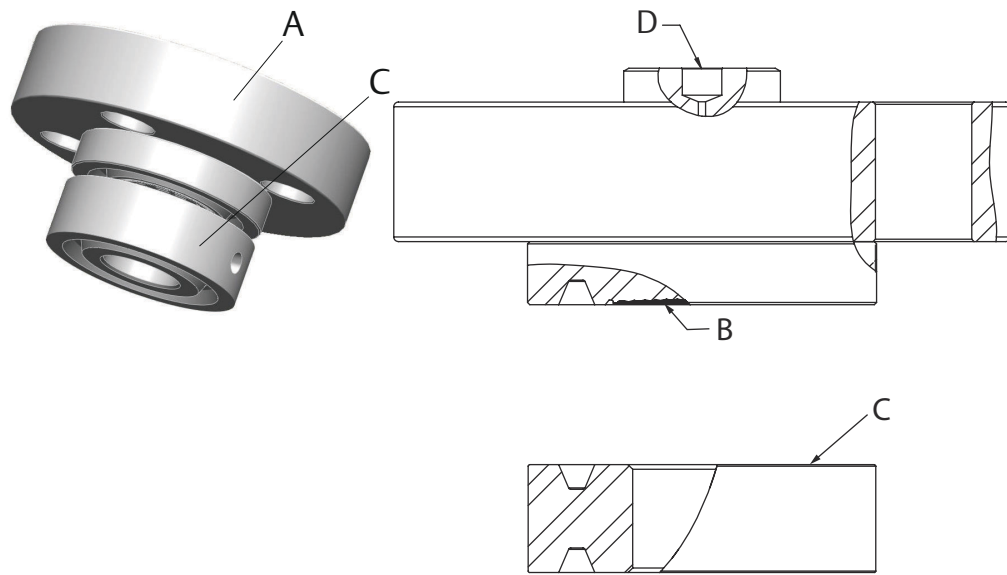
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5. Using the previously installed bolts, attach the remote seal and gasket to the process flange. Secure with nuts and hand-tighten.

6. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
7. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.9 FCW flush flanged seal—ring type joint (RTJ) gasket surface

Figure 3-12: FCW Two-Piece Design (Shown with Flushing Ring)



- A. Process flange
- B. Diaphragm
- C. Flushing ring (optional)
- D. Connection to transmitter

### 3.9.1 Parts required for installation

The parts required to install the FCW flush flanged seal with RTJ gasket surface will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

Verify the gasket materials are appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

## 3.9.2 Installation steps

Follow these steps to install the FCW flush flanged seal with RTJ gasket surface on an existing process flange:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. If installing a flushing ring, ensure flushing connections are sealed before completing installation. Flushing rings may be ordered with or without, one or two threaded flushing connections, factory supplied plugs, or drain vent valves. If no flushing ring was purchased, proceed to [Step 3](#). Assemble the flushing ring, appropriate end-user-supplied gasket, and remote seal together.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, and measurement errors which can result in death or serious injury.

3. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
4. Place the appropriate end-user-supplied gasket on the remote seal or optional flushing ring.

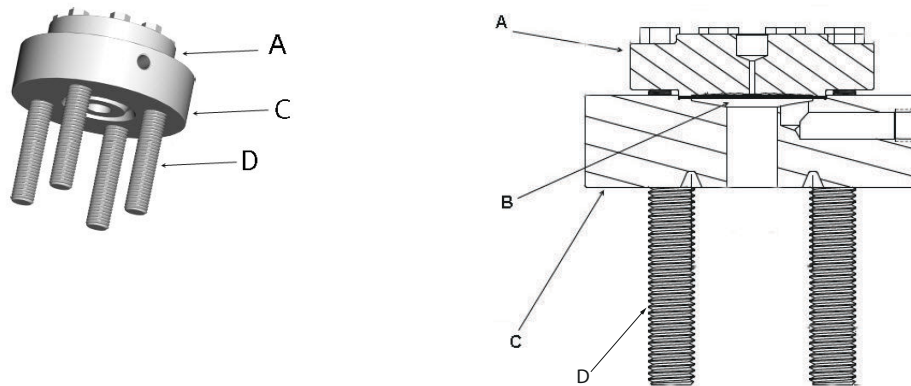
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Using the previously installed bolts, attach the remote seal and gasket to the process flange. Secure with nuts and hand-tighten.
6. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
7. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.10 RCW remote flanged seal - ring type joint (RTJ) gasket surface

Figure 3-13: RCW Flanged Remote Seal RTJ and Flushing Connection Ring



- A. Upper housing
- B. Diaphragm
- C. Lower housing or flushing ring
- D. Stud bolts

### Note

A lower housing is always required for the RCW type seal.

Table 3-3: RCW Upper Housing Torque Values

| Material (nuts and bolts) | Bolt thread size | Class            | Torque                  |
|---------------------------|------------------|------------------|-------------------------|
| SST                       | 3/8-24 NF        | 150/300/600 lb   | 23 ft-lb                |
| CS                        | 3/8-24 NF        | 150/300/600 lb   | 23 ft-lb <sup>(1)</sup> |
| SST                       | 1/2-20 NF        | 900/1500 lb      | 50 ft-lb                |
| CS                        | 1/2-20 NF        | 900/1500/2500 lb | 105 ft-lb               |

(1) 53 ft-lb for 4.1-in. diaphragm size.

### Note

This is the specification for connecting the remote seal to the lower housing, not the torque specification for the lower housing onto the process flanged connection. The lower housing bolts should be torqued to the applicable flange requirements.

### 3.10.1 4.1-in. (104 mm) diaphragm diameter option

The standard diaphragm size for the RCW remote flanged seal with RTJ gasket surface is 2.4-in. A larger, 4.1-in. (104 mm), diaphragm size is offered for small spans to reduce temperature error when taking process measurements.



## 3.10.2 Parts required for installation

The parts required to install the RCW remote flanged seal with RTJ gasket surface will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (lower housing to process connection) (end-user-supplied)
- Gasket (remote seal to lower housing) (Emerson-supplied)

---

### Note

Typically, Emerson-supplied stud bolts are included.

---

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

## 3.10.3 Installation steps

Follow these steps to install the RCW remote flanged seal with RTJ gasket surface on an existing process flange:

### Procedure

1. Ensure flushing connections are sealed before completing installation. Lower housing may be ordered with or without, one or two threaded flushing connections, factory supplied plugs, or drain vent valves.
2. Install the stud bolts onto the lower housing.
3. Assemble the lower housing to the process flange. Place the appropriate end-user-supplied gasket between the lower housing and process flange.

### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, and measurement errors which can result in death or serious injury.

---

4. Hand-tighten nuts onto the studs.
5. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The nuts should be torqued to the applicable flange requirements.
6. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
7. Assemble the remote seal, Emerson-supplied gasket, and lower housing. Place the Emerson-supplied gasket inside the recessed cavity within the lower housing which is designed to hold the gasket in place.

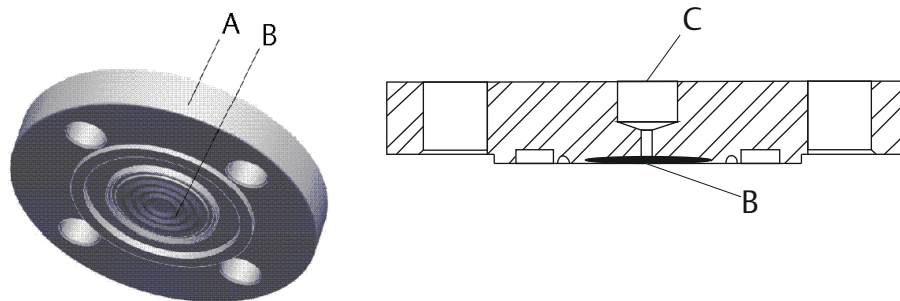
**▲ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

8. Install the bolts in a cross pattern and hand-tighten.
9. Using a torque wrench on the bolt, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The bolts should be torqued per [Table 3-3](#) based on size and bolt material. Consider leak checking the installation to ensure a robust connection.

## 3.11 FUW flush flanged groove type seals

Figure 3-14: FUW Flush Flanged Type Seal—EN1092-1 Type D



- A. Process flange
- B. Diaphragm
- C. Connection to transmitter

### 3.11.1 Parts required for installation

The parts required to install the FUW flush flanged groove type seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

## 3.11.2 Installation steps

Follow these steps to install the FUW flush flanged groove type seal on an existing process flange:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
3. Place the appropriate end-user-supplied gasket on the remote seal.

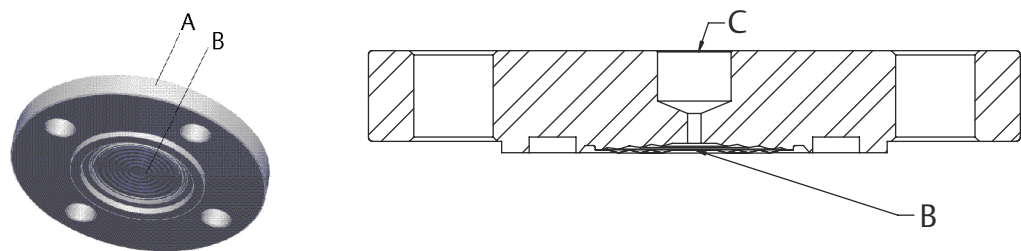
### ⚠ WARNING

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

4. Using the previously installed bolts, attach the remote seal and gasket to the process flange. Secure with nuts and hand-tighten.
5. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
6. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.12 FWW flush flanged tongue type seals

Figure 3-15: FWW Flush Flanged Type Seal—EN1092-1 Type C



- A. Process flange
- B. Diaphragm
- C. Connection to transmitter

### 3.12.1 Parts required for installation

The parts required to install the FVW flush flanged tongue type seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.12.2 Installation steps

Follow these steps to install the FVW flush flanged tongue type seal on an existing process flange:

#### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
3. Place the appropriate end-user-supplied gasket on the remote seal.

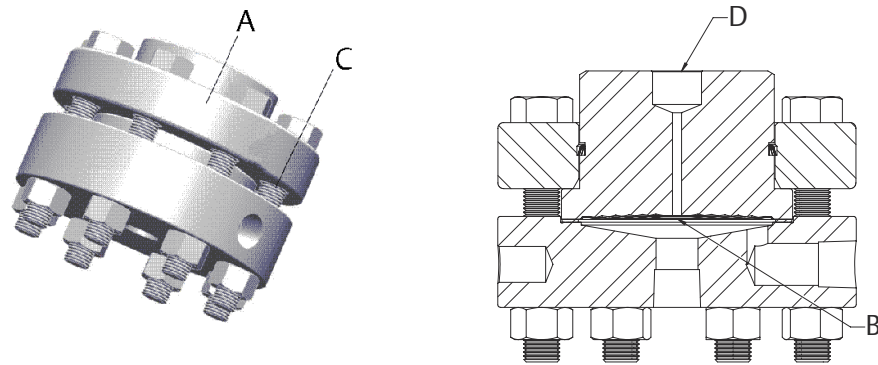
#### **▲ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

4. Using the previously installed bolts, attach the remote seal and gasket to the process flange. Secure with nuts and hand-tighten.
5. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
6. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation ([Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

### 3.13 RTW remote threaded type seals

Figure 3-16: RTW Threaded Seal



- A. Upper housing
- B. Diaphragm
- C. Lower housing or flushing ring
- D. Connection to transmitter

**Note**

A lower housing is always required for the RTW type seal.

Table 3-4: RTW Upper Housing Torque Values

| Material (nuts and bolts) | Bolt thread size | MWP (psi)           | Torque    |
|---------------------------|------------------|---------------------|-----------|
| CS and SST                | 3/8–24 NF        | 1500 <sup>(1)</sup> | 23 ft-lb  |
| CS                        | 3/8–24 NF        | 2500                | 23 ft-lb  |
| SST                       | 3/8–24 NF        | 2500                | 23 ft-lb  |
| CS                        | 3/8–24 NF        | 5000                | 53 ft-lb  |
| SST                       | 1/2–20 NF        | 5000                | 50 ft-lb  |
| CS                        | 1/2–20 NF        | 10000               | 105 ft-lb |

(1) 1500 psi MWP RTW's are only available on 4.1-in. diaphragm sizes.

**Note**

This is the specification for connecting the remote seal to the lower housing, not the torque specification for the lower housing onto the process threaded connection. Standard NPT torque values for the size threads in the lower housing should be applied here.

### 3.13.1 Parts required for installation

The parts required to install the RTW remote threaded type seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Spanner wrench
- Mounting hardware (Emerson-supplied)
- Gasket (Emerson-supplied)
- Thread sealant

Thread sealant must meet the requirements of the application. An example thread sealant is PTFE tape.

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.13.2 Installation steps

Follow these steps to install the RTW remote threaded type seal on an existing threaded process connection:

#### Procedure

1. Apply thread sealant to the male threaded end of the connection. This will be the process connection if using a female threaded lower housing, or the remote seal itself if using a male threaded lower housing.
2. Thread the lower housing to the process connection. The lower housing includes a small hole designed for a spanner wrench to facilitate installation and applying the required torque. The applied torque should comply with ANSI B1.20.1 for NPT connections or applicable torque requirements for pipe connections.
3. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
4. Place the Emerson-supplied gasket into the groove of the lower housing.
5. Place the remote seal on top of the gasket ensuring alignment with the lower housing groove.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

6. Install the bolts and hand-tighten.
7. Using a torque wrench on the bolt, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued per [Table 3-4](#) based on size and bolt material. Consider leak checking the installation to ensure a robust connection.

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**Note**

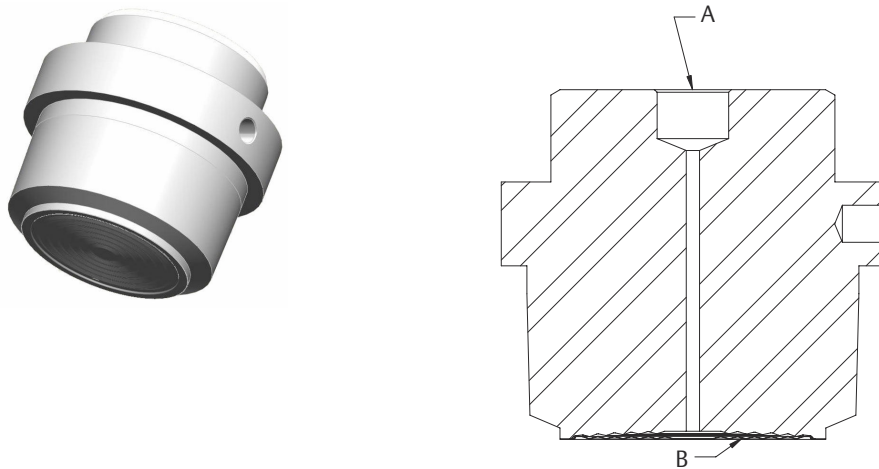
RTW remote threaded type seals with a 10,000 PSI pressure rating are supplied with carbon steel bolts only.

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## 3.14 HTS male threaded seal

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Figure 3-17: HTS Male Threaded Seal



- A. Connection to transmitter  
B. Diaphragm
- 

### 3.14.1 Parts required for installation

The parts required to install the HTS male threaded seal will be defined here. Prior to installation, you will need the following:

- Thread sealant

Thread sealant must meet the requirements of the application. An example thread sealant is PTFE tape.

## 3.14.2 Installation steps

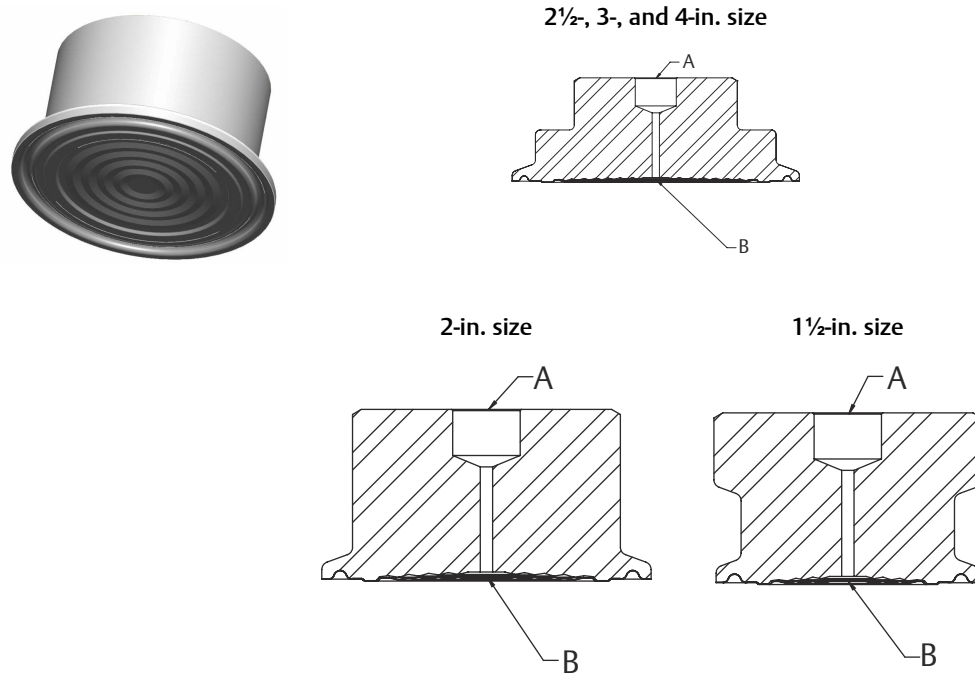
Follow these steps to install the HTS remote threaded seal on an existing process flange:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Apply the thread sealant to the male thread.
3. Thread the remote seal onto the process connection. The remote seal is designed with a small hole to facilitate installation and applying torque. The applied torque should comply with ANSI B1.20.1 for NPT connections or applicable torque requirements for pipe connections.

## 3.15 SCW hygienic Tri-Clover Tri Clamp seals

Figure 3-18: SCW Tri Clamp Seal



- A. Connection to transmitter  
B. Diaphragm



### 3.15.1 Clamp and gasket

The clamp is furnished by the end-user with the exception of an optional Emerson-supplied high pressure Ladish™ clamp. Maximum pressure rating of the system is dependent upon the clamp pressure rating.

The gasket is furnished by the end-user with the exception of an optional Emerson-supplied Nitrile Butadiene (NBR) gasket.

**Table 3-5: High Pressure Ladish Clamp Maximum Working Pressure**

| Process connection size | 70 °F (21 °C)       | 250 °F (121 °C)    |
|-------------------------|---------------------|--------------------|
| 1½-in.                  | 1,500 psi (103 bar) | 1,200 psi (83 bar) |
| 2-in.                   | 1,000 psi (69 bar)  | 800 psi (55 bar)   |
| 2½-in.                  | 1,000 psi (69 bar)  | 800 psi (55 bar)   |
| 3-in.                   | 1,000 psi (69 bar)  | 800 psi (55 bar)   |
| 4-in.                   | 600 psi (41 bar)    | 500 psi (34 bar)   |

### 3.15.2 Parts required for installation

The parts required to install the SCW hygienic Tri Clamp seal will be defined here. Prior to installation, you will need the following:

- Clamp
- Gasket
- Wrench (optional, depending on clamp)

Verify the gasket material is appropriate for the application. Ensure to use an EHEDG approved gasket if EHEDG conformance is needed.

### 3.15.3 Installation steps

Follow these steps to install the SCW hygienic Tri Clamp seal:

#### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Place the appropriate gasket for the application on the remote seal and align the gasket so that it is not contacting the diaphragm as this will induce errors.

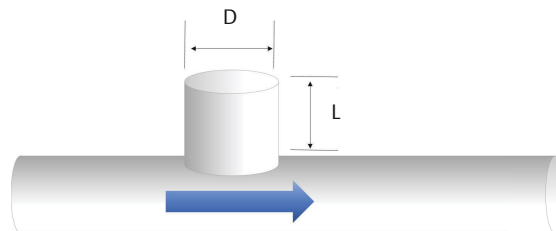
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

3. Ensure that the SCW hygienic Tri Clamp seal is flush with the process connection.
4. Install clamp and tighten to manufacturer's specifications

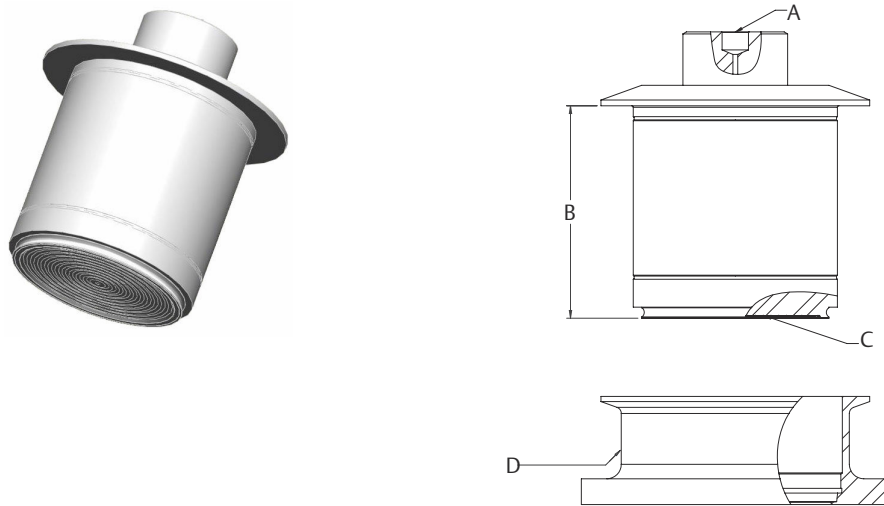
#### **Note**

EHEDG requirement on T-stub installations: the length (L) divided by the diameter (D) of the tee is to be less than 1 (i.e.  $L/D < 1$ ).



## 3.16 SSW hygienic tank spud seal

Figure 3-19: SSW Tank Spud Seal



- A. Connection to transmitter
- B. Extension length
- C. Diaphragm
- D. Tank spud

### 3.16.1 Parts required for installation

The parts required to install the SSW hygienic tank spud seal will be defined here. Prior to installation, you will need the following:

- O-ring (Emerson-supplied)
- Clamp (Emerson-supplied)

Cutting and welding equipment required if installing a new tank spud.

Verify the O-ring material is appropriate for the application.

### 3.16.2 Installation steps

Follow these steps to install the SSW hygienic tank spud seal:

#### Procedure

1. Prepare the tank, see [Tank preparation](#).
2. Weld the tank spud onto the tank per plant procedures, see [Welding](#). Ensure the tank spud is not assembled to the pressure transmitter and/or the remote seal prior to welding.
3. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.

4. Place the Emerson-supplied O-ring onto the groove.

**▲ WARNING**

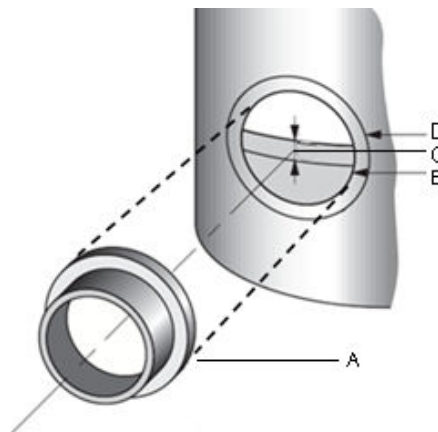
Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Insert the SSW hygienic tank spud seal into the tank spud.
6. Attach the Emerson-supplied clamp and hand-tighten the connection.

### 3.16.3 Tank preparation

When preparing the tank, ensure an area with a minimum diameter of 9¼-in. (235 mm) is available to properly weld the tank spud. The center of the tank spud should be at least 1½-in. (38 mm) below the minimum measurement level. To get a proper process fluid measurement, half of the remote seal diaphragm must be covered.

**Figure 3-20: Tank Preparation**

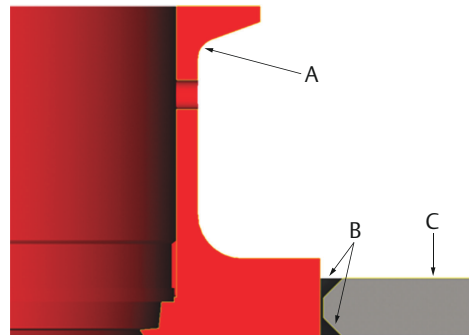


- A. Tank spud
- B. Hole cut
- C. Center of the hole
- D. Weld

Attempt to cut the hole as smoothly and as circular as possible. A torch cut is not recommended. The tank spud O.D. is 5.98-in. ± 0.010-in. (152 mm ± 0.25 mm). When cutting the hole for the tank spud, the gap between the hole diameter and spud O.D. should be held to a minimum. It is recommended that the hole be no larger than 6.020-in. (153 mm). Anything larger than 6.020-in. (153 mm) could increase the amount of tank spud distortion.

If a bevel(s) is required, an angle no larger than 37.5° is recommended; see ASME B16.25 for more details. Bevels can be made on one or both sides of the tank. Do not grind or cut the bevel to a sharp point. Attempt to leave a flat area.

**Figure 3-21: Bevel Example**



- A. Tank spud
- B. Bevel
- C. Tank

The flat area should be large enough to minimize spud distortion but small enough so that tank weld requirements can be met. Minimizing the bevel angle will decrease the amount of fill required during weld and minimize the number of weld passes. These best practices will decrease heat input and help mitigate distortion.

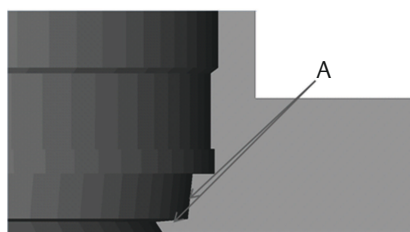
### 3.16.4 Welding

#### **⚠ CAUTION**

Excessive heat will distort the tank spud. Allow adequate cooling time between passes.

Ensure spud is not assembled to transmitter and/or remote seal prior to welding. Do not nick the sealing surfaces of the tank spud, the inner angled surfaces where the O-ring sits shown in [Figure 3-22](#), as any irregularities may cause leaks.

**Figure 3-22: O-ring Sealing Surfaces**



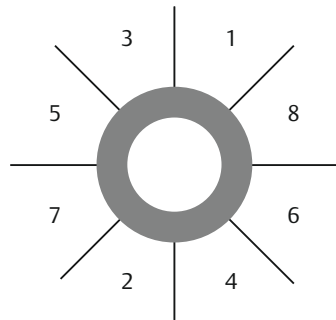
- A. Sealing surfaces

With the spud centered in the tank hole, make sure the inner surface of the spud is flush with the inner surface of the tank. The leak detection hole in the spud should be at the bottom of the spud. With the spud properly located, tack weld it into place using four tack welds, 90° from each other.

Begin welding on the inside of vessel. Weld in sections similar to the sequence in [Figure 3-23](#).

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**Figure 3-23: Welding Sections**



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Allow time to cool between weld sections. Weld should be cooled to 350 °F (177 °C) or less after each pass while being cool to the touch is preferred. Use of a damp cloth or compressed air is allowed if rapid cooling is desired. Repeat procedure on the outside of the tank.

---

**Note**

The number of weld passes should be kept to a minimum while maintaining tank weld standards and sanitary requirements. Additional weld passes are a significant contributor to spud distortion due to additional heat input and added filler material in beveled area of hole. When fill passes are required, a 1/16-in. (1.58 mm) diameter weld rod is recommended.

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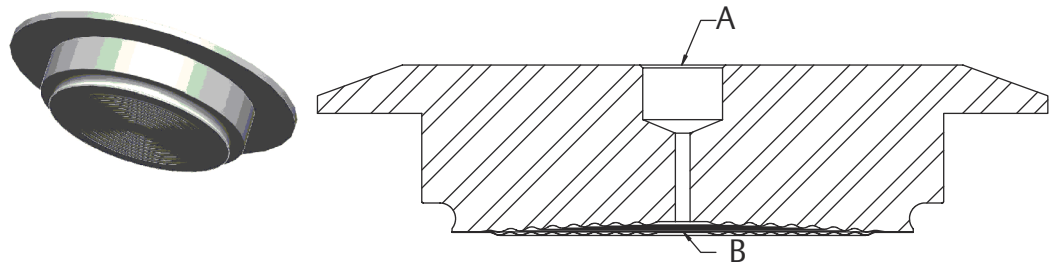
**Note**

For high pressure clamps up to 1,000 psi (69 bar), contact the factory.

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## 3.17 STW hygienic thin wall tank spud seal

Figure 3-24: STW Hygienic Thin Wall Tank Spud Seal



- A. Connection to transmitter  
B. Diaphragm

### 3.17.1 Parts required for installation

The parts required to install the STW hygienic thin wall tank spud seal will be defined here. Prior to installation, you will need the following:

- O-ring (Emerson-supplied)
- Clamp (Emerson-supplied)

Cutting and welding equipment required if installing a new tank spud.

Verify the O-ring material is appropriate for the application.

### 3.17.2 Installation steps

Follow these steps to install the STW hygienic thin wall tank spud seal:

#### Procedure

1. Remove the plastic cover from the diaphragm of the remote seal.
2. Weld the tank spud onto the tank per plant procedures, see [Welding](#).

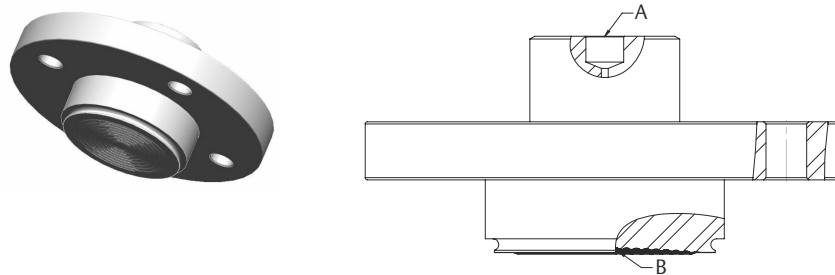
#### **▲ WARNING**

Ensure the tank spud is not assembled to the pressure transmitter and/or the remote seal prior to welding.

3. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
4. Place the Emerson-supplied O-ring onto the groove. Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.
5. Insert the STW hygienic thin wall tank spud seal into the tank spud.
6. Attach the Emerson-supplied clamp and hand-tighten the connection.

## 3.18 EES hygienic flanged tank spud extended seal

Figure 3-25: EES Hygienic Flanged Tank Spud Extended Seal



- A. Connection to transmitter  
B. Diaphragm

### 3.18.1 Parts required for installation

The parts required to install the EES hygienic flanged tank spud extended seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- O-ring (Emerson-supplied)

Cutting and welding equipment required if installing a new tank spud.

Verify the O-ring material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.18.2 Installation steps

Follow these steps to install the EES hygienic flanged tank spud extended seal:

#### Procedure

1. Prepare the tank, see [Tank preparation](#).
2. Weld the tank spud onto the tank per plant procedures, see [Welding](#). Ensure the tank spud is not assembled to the pressure transmitter and/or the remote seal prior to welding.
3. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
4. Insert end-user-supplied bolts in the bottom two bolt holes of the flange on the remote seal.
5. Place the Emerson-supplied O-ring onto the groove.



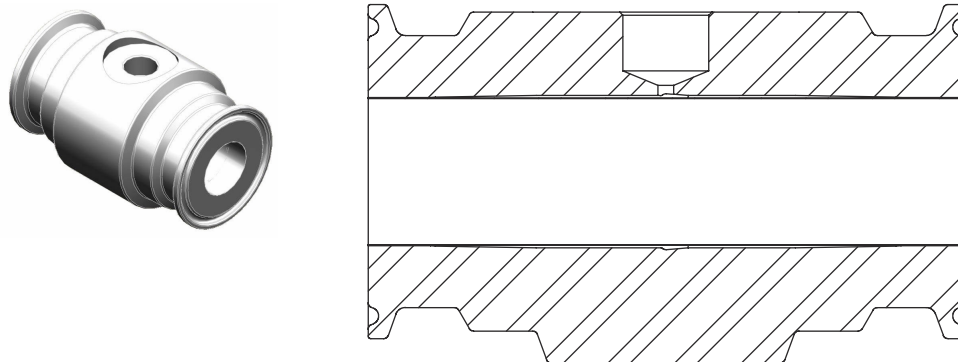
### ⚠ WARNING

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

6. Insert the EES hygienic flanged tank spud extended seal into the tank spud.
7. Using the previously installed bolts, attach the remote seal and gasket to the process connection. Secure with nuts and hand-tighten.
8. Insert end-user-supplied bolts in the top two bolt holes of the flange on the remote seal. Secure with nuts and hand-tighten.
9. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.19 VCS Tri Clamp in-line seal

Figure 3-26: VCS Tri Clamp In-line Seal



### 3.19.1 Parts required for installation

The parts required to install the VCS hygienic Tri Clamp seal will be defined here. Prior to installation, you will need the following:

- Clamps (end-user-supplied)
- Gaskets (end-user-supplied)
- Wrench (optional, depending on clamp)

Verify the gasket material is appropriate for the application. Ensure to use an EHEDG approved gasket if EHEDG conformance is needed.

## 3.19.2 Installation steps

Follow these steps to install the VCS hygienic Tri Clamp seal:

### Procedure

1. Place the appropriate end-user-supplied gasket for the application on the remote seal.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

2. Align one end of the VCS hygienic Tri Clamp seal flush with the process piping.
3. Attach the clamp and tighten to manufacturer's specifications (wrench might be required depending on clamp style).
4. Place the second appropriate end-user-supplied gasket for the application on the remote seal.

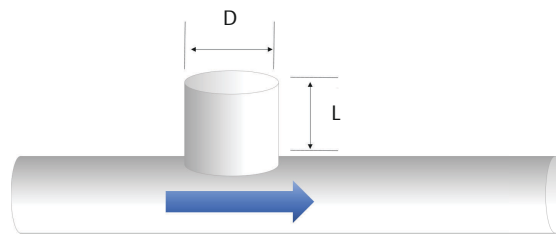
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Align the other end of the VCS hygienic Tri Clamp seal with the process piping.
6. Attach the clamp and tighten to manufacturer's specifications (wrench might be required depending on clamp style).

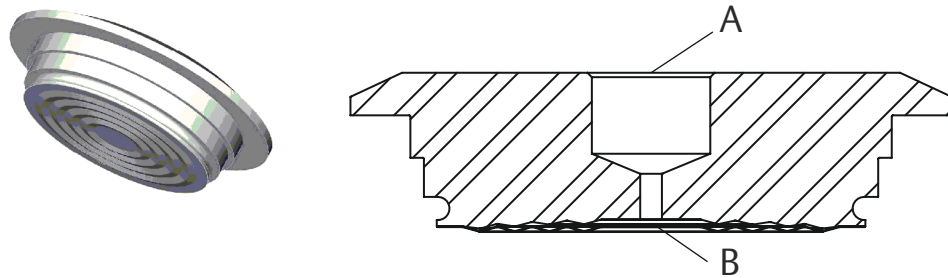
### Note

EHEDG requirement on T-stub installations: the length (L) divided by the diameter (D) of the tee is to be less than 1 (i.e.  $L/D < 1$ ).



## 3.20 SVS VARIVENT<sup>®</sup> compatible hygienic connection seal

Figure 3-27: SVS VARIVENT Compatible Connection Seal



- A. Connection to transmitter  
B. Diaphragm

### 3.20.1 Parts required for installation

The parts required to install the SVS VARIVENT seal will be defined here. Prior to installation, you will need the following:

- Clamp (end-user-supplied)
- Gasket (end-user-supplied)
- Wrench (optional, depending on clamp)

Verify the gasket material is appropriate for the application. Ensure to use an EHEDG approved gasket if EHEDG conformance is needed.

### 3.20.2 Installation steps

Follow these steps to install the SVS VARIVENT seal:

#### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Place the appropriate gasket for the application on the remote seal.

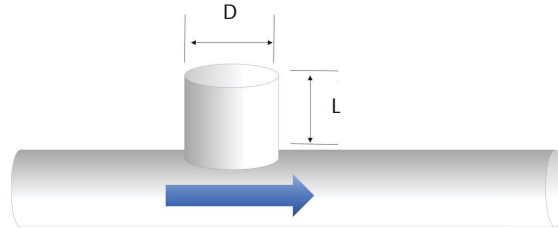
#### **▲ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

3. Ensure that the SVS VARIVENT seal is flush with the process connection.
4. Install clamp and tighten to manufacturer's specifications.

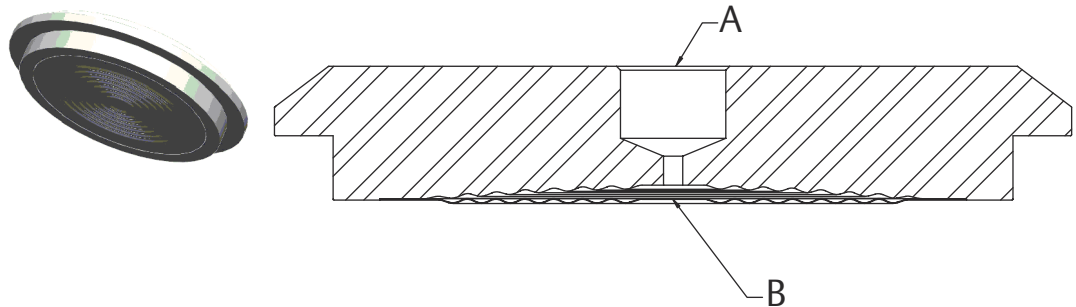
**Note**

EHEDG requirement on T-stub installations: the length (L) divided by the diameter (D) of the tee is to be less than 1 (i.e.  $L/D < 1$ ).



## 3.21 SHP Hygienic Cherry-Burrell® “I” line seal

Figure 3-28: SHP Cherry-Burrell “I” Line Seal



- A. Connection to transmitter
- B. Diaphragm

### 3.21.1 Parts required for installation

The parts required to install the SHP Cherry-Burrell seal will be defined here. Prior to installation, you will need the following:

- Clamp (end-user-supplied)
- Gasket (end-user-supplied)
- Wrench (optional, depending on clamp)

Verify the gasket material is appropriate for the application.

### 3.21.2 Installation steps

Follow these steps to install the SHP Cherry-Burrell seal:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Place the appropriate gasket for the application on the remote seal.

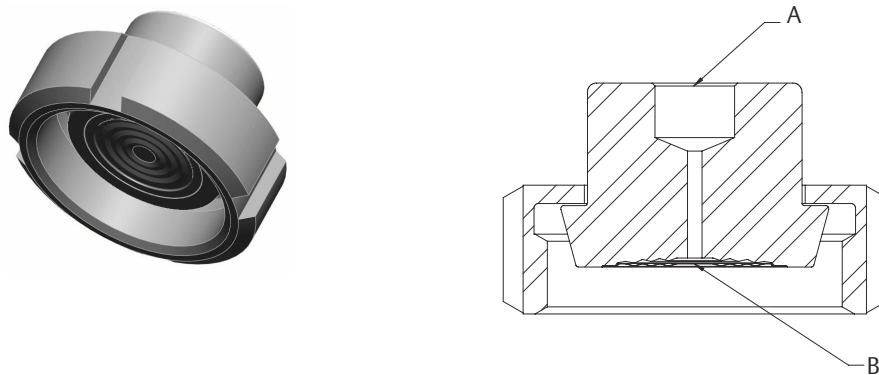
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

3. Ensure that the SHP Cherry-Burrell seal is flush with the process connection.
4. Install clamp and tighten to manufacturer's specifications.

## 3.22 SLS dairy process connection–female thread seal per DIN 11851

Figure 3-29: SLS Hygienic Dairy Process Connection Female Thread Seal per DIN 11851



### 3.22.1 Parts required for installation

The parts required to install the SLS dairy process connection seal will be defined here. Prior to installation, you will need the following:

- Gasket (end-user-supplied)
- Wrench (optional, depending on clamp)

Verify the gasket material is appropriate for the application. Ensure to use an EHEDG approved gasket if EHEDG conformance is needed.

### 3.22.2 Installation steps

Follow these steps to install the SLS dairy process connection seal:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Place the appropriate gasket for the application on the remote seal.

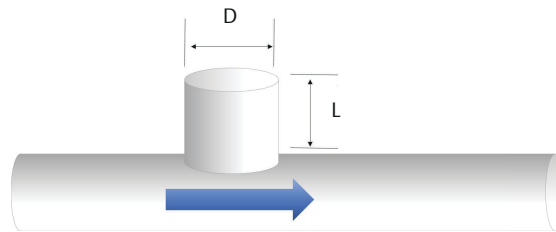
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

3. Ensure that the SLS dairy process connection seal is flush with the process connection.
4. Tighten the nut onto the process connection per DIN 11851. Care should be taken not to overtighten.

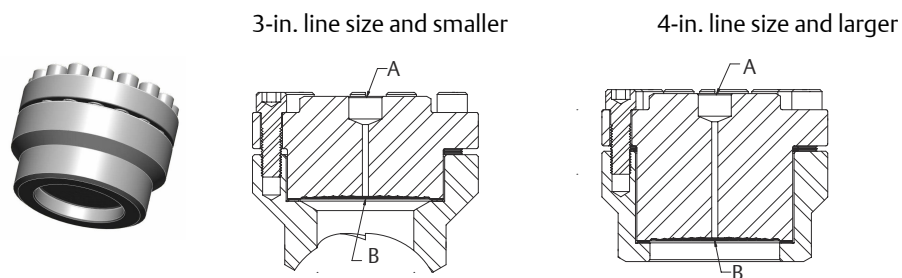
#### **Note**

EHEDG requirement on T-stub installations: the length (L) divided by the diameter (D) of the tee is to be less than 1 (i.e.  $L/D < 1$ ).



## 3.23 WSP saddle seal

Figure 3-30: WSP Saddle Seal



- A. Connection to transmitter
- B. Diaphragm

### 3.23.1 Parts required for installation

The parts required to install the WSP saddle seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (Emerson-supplied)
- Gasket (Emerson-supplied)

Cutting and welding equipment required if installing a new saddle lower.

Verify the gasket material is appropriate for the application.

## 3.23.2 Installation steps

Follow these steps to install the WSP saddle seal:

### Procedure

1. Prepare the tank and weld the saddle lower onto the tank per plant procedures. Ensure the saddle lower is not assembled to the pressure transmitter and/or the remote seal prior to welding.

#### ⚠ CAUTION

Excessive heat will distort the saddle lower. Allow adequate cooling time between passes.

2. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
3. Place the appropriate gasket for the application on the remote seal.

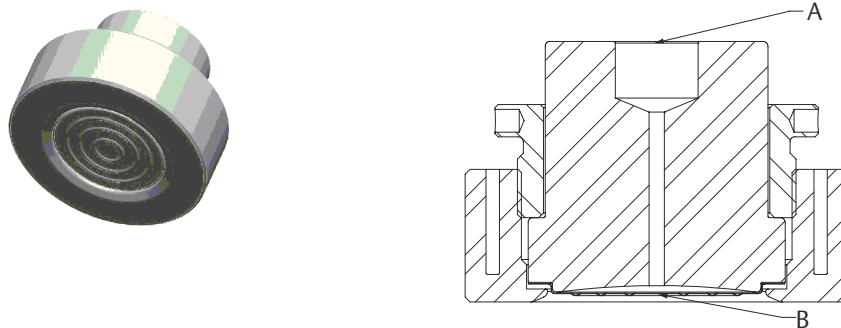
#### ⚠ WARNING

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

4. Insert the WSP saddle seal into the saddle lower.
5. Install the bolts in a cross pattern and hand-tighten.
6. Using a torque wrench on the bolt, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to 180 in-lb (20 N-m) with stainless or carbon steel bolts. Consider leak checking the installation to ensure a robust connection.

## 3.24 UCP union connection pipe mount seal

Figure 3-31: UCP Threaded Pipe Mount Seal



- A. Connection to transmitter  
B. Diaphragm



### 3.24.1 Parts required for installation

The parts required to install the UCP union connection seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Gasket (Emerson-supplied)

Cutting and welding equipment required if installing a new lower housing.

Verify the gasket material is appropriate for the application.

### 3.24.2 Installation steps

Follow these steps to install the UCP union connection seal:

#### Procedure

1. Using the appropriate size hole saw, cut a hole in the process vessel to accept the lower housing. The diameter for a lower housing with a heat isolator groove is 2.37-in. (60 mm). The hole should produce a tight, uniform fit when coupled with the lower housing.
2. Bevel the edge of the vessel hole to accept filler material (see [Figure 3-32](#)). An angle no larger than 37.5° is recommended; see ASME B16.25 for more details. Bevels can be made on one or both sides of the tank. Do not grind or cut the bevel to a sharp point. Attempt to leave a flat area. The flat area should be large enough to minimize spud distortion but small enough so that tank weld requirements can be met. Minimizing the bevel angle will decrease the amount of fill required during weld and minimize the number of weld passes. These best practices will decrease heat input and help mitigate distortion.
3. Position the lower housing weld spud in the vessel hole, place heat sink and tack the housing in place using the welding sequence shown in [Figure 3-32](#). Cool each section with a wet cloth before proceeding to the next section.

#### **CAUTION**

Do not place the seal in the lower housing prior to welding. Do not nick the sealing surfaces of the weld spud, the inner angled surfaces where the gasket sits shown, weld spud where the gasket sits, shown in [Figure 3-32](#), as any irregularities may cause leaks.

4. Weld the housing in place using 0.030- to 0.045-in. (0,762 to 1,143 mm) stainless steel rod as filler in the beveled area. Using between 100 and 125 A, adjust the amperage for 0.080-in. (2,032 mm) penetration. Allow time to cool between weld sections. Weld should be cooled to 350 °F (177 °C) or less after each pass while being cool to the touch is preferred. Use of a damp cloth or compressed air is allowed if rapid cooling is desired. Repeat procedure on the outside of the tank.

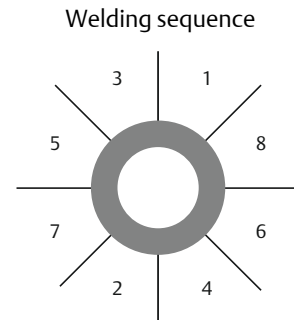
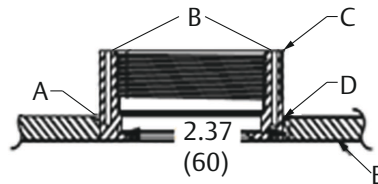
#### Note

The number of weld passes should be kept to a minimum while maintaining tank weld standards and process requirements. Additional weld passes are a significant

contributor to spud distortion due to additional heat input and added filler material in beveled area of hole.

**Figure 3-32: Installing the Weld Spud**

Preparing the vessel hole



- A. 100–125 A recommended
- B. Heat isolation grooves
- C. Weld spud
- D. Bevelled edge
- E. Process vessel

Dimensions are in inches (millimeters).

5. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
6. Place the gasket into the lower housing make sure the gasket is properly aligned on the gasket sealing surface.

**⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

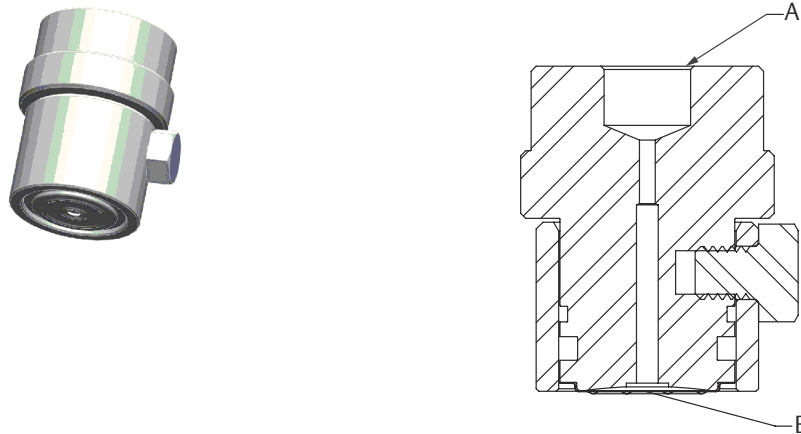
7. Insert the UCP union connection seal into the lower housing and tighten the jam nut.

**⚠ CAUTION**

Excessive heat will distort the weld spud. Allow adequate cooling time between passes.

## 3.25 PMW paper mill sleeve seal

Figure 3-33: PMW Threaded Pipe Mount Seal



- A. Connection to transmitter
- B. Diaphragm

### 3.25.1 Parts required for installation

The parts required to install the PMW paper mill seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Gasket (Emerson-supplied)

Cutting and welding equipment required if installing a new lower housing.

Verify the gasket material is appropriate for the application.

### 3.25.2 Installation steps

Follow these steps to install the PMW paper mill seal:

#### Procedure

1. Using the appropriate size hole saw, cut a hole in the process vessel to accept the lower housing. The diameter for a lower housing with a heat isolator groove is 1.32-in. (33,4 mm). The hole should produce a tight, uniform fit when coupled with the lower housing.
2. Bevel the edge of the vessel hole to accept filler material (see [Figure 3-34](#)). An angle no larger than 37.5° is recommended; see ASME B16.25 for more details. Bevels can be made on one or both sides of the tank. Do not grind or cut the bevel to a sharp point. Attempt to leave a flat area. The flat area should be large enough to minimize spud distortion but small enough so that tank weld requirements can be met. Minimizing the bevel angle will decrease the amount of fill required during weld and

minimize the number of weld passes. These best practices will decrease heat input and help mitigate distortion.

3. Position the weld spud in the vessel hole, place heat sink and tack the housing in place using the welding sequence shown in Figure 3-34. Cool each section with a wet cloth before proceeding to the next section.

**⚠ WARNING**

Do not place the seal in the lower housing prior to welding. Do not nick the inner angled sealing surfaces of the weld spud where the gasket sits, shown in Figure 3-34, as any irregularities may cause leaks.

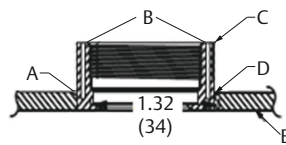
4. Weld the housing in place using 0.030- to 0.045-in. (0,762 to 1,143 mm) stainless steel rod as filler in the beveled area. Using between 100 and 125 A, adjust the amperage for 0.080-in. (2,032 mm) penetration. Allow time to cool between weld sections. Weld should be cooled to 350 °F (177 °C) or less after each pass while being cool to the touch is preferred. Use of a damp cloth or compressed air is allowed if rapid cooling is desired. Repeat procedure on the outside of the tank.

**Note**

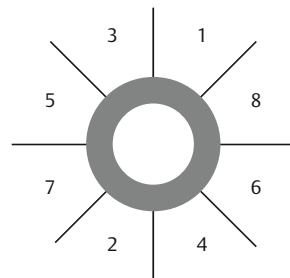
The number of weld passes should be kept to a minimum while maintaining tank weld standards and process requirements. Additional weld passes are a significant contributor to spud distortion due to additional heat input and added filler material in beveled area of hole.

**Figure 3-34: Installing the Weld Spud**

Preparing the vessel hole



Welding sequence



- A. 100 to 125 A recommended
- B. Heat isolation grooves
- C. Weld spud
- D. Bevelled edge
- E. Process vessel

Dimensions are in inches (millimeters).

**⚠ CAUTION**

Excessive heat will distort the weld spud. Allow adequate cooling time between passes.

5. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
6. Place the O-rings onto the seal body.

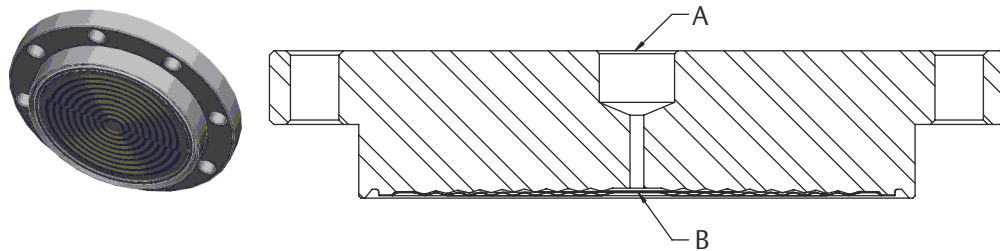
**⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

7. Insert the PMW paper mill seal into the lower housing.
8. Install capture bolt and torque to 7.5 ft-lb.

## 3.26 CTW chemical tee seal

Figure 3-35: CTW Chemical Tee Seal



- A. Connection to transmitter  
B. Diaphragm

### 3.26.1 Parts required for installation

The parts required to install the CTW chemical tee seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.26.2 Installation steps

Follow these steps to install the CTW chemical tee seal on an existing flanged process connection:

### Procedure

1. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
2. Place the appropriate end-user-supplied gasket on the remote seal.

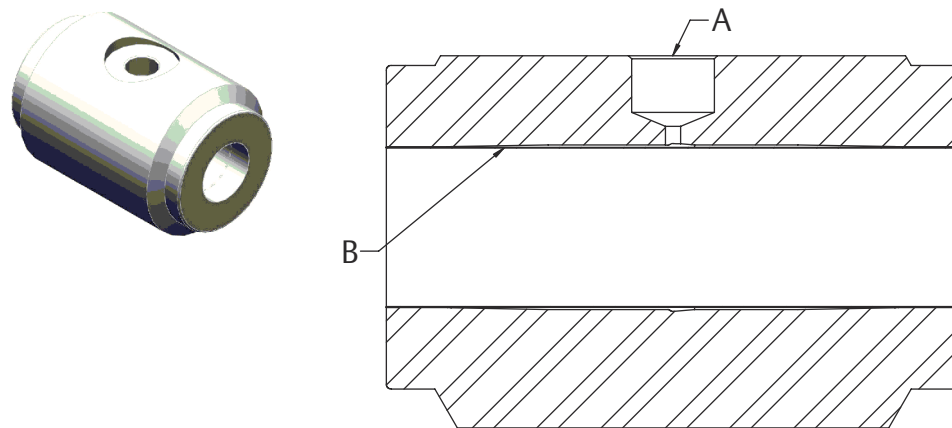
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

3. Attach the remote seal and gasket to the process connection. Insert end-user-supplied bolts, secure with nuts, and hand-tighten.
4. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.27 TFS wafer style In-line seal

Figure 3-36: TFS Wafer Style In-Line Seal



- A. Connection to transmitter  
B. Diaphragm

### 3.27.1 Parts required for installation

The parts required to install the TFS wafer style In-line seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (end-user-supplied)

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

## 3.27.2 Installation steps

Follow these steps to install the TFS wafer style In-line seal on an existing flanged process connection:

### Procedure

1. Place the appropriate end-user-supplied gasket for the application on one end of the remote seal.

#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

2. Align that end of the TFS wafer style In-line seal flush with the process flange.
3. Insert end-user-supplied bolts, secure with nuts, and hand-tighten
4. Place the second appropriate end-user-supplied gasket for the application on the other end of the remote seal.

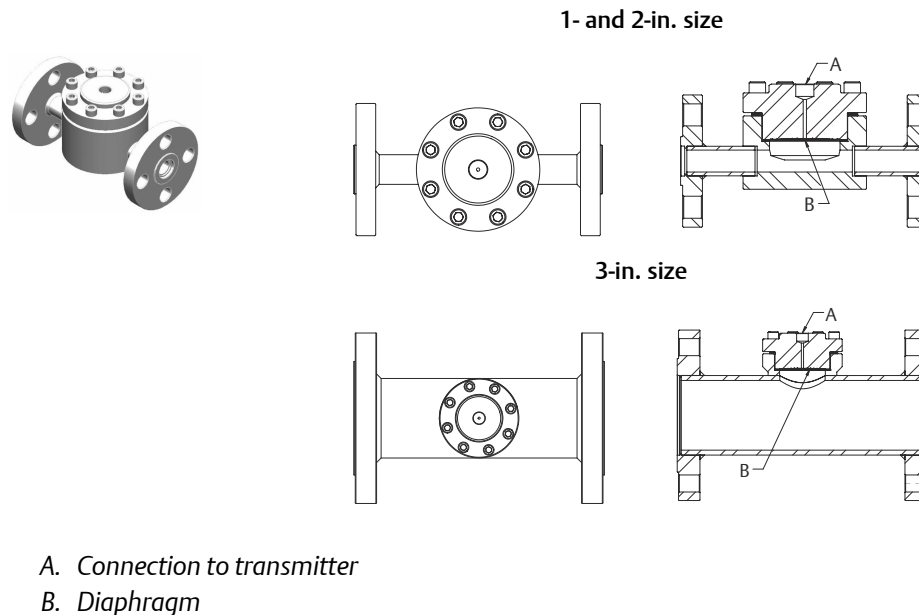
#### **⚠ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Align that end of the TFS wafer style In-line seal flush with the process flange.
6. Insert end-user-supplied bolts, secure with nuts, and hand-tighten.
7. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.

## 3.28 WFW flow-thru flanged seal

Figure 3-37: WFW Flow-Thru Flanged Seal



### 3.28.1 Parts required for installation

The parts required to install the WFW flow-thru flanged seal will be defined here. Prior to installation, you will need the following:

- Torque wrench
- Mounting hardware (end-user-supplied)
- Gasket (lower housing to process flange) (end-user-supplied)
- Gasket (remote seal to lower housing) (Emerson-supplied)

Verify the gasket material is appropriate for the application.

Inspect bolts to ensure the material is compatible with industry standards per the application such as ASME PCC-1.

### 3.28.2 Installation steps

Follow these steps to install the WFW flow-thru flanged seal on an existing process piping system:

#### Procedure

1. Place the appropriate end-user-supplied gasket for the application on one end of the lower housing flange.



**▲ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

2. Align that end of the WFW flow-thru flanged seal flush with the process flange.
3. Insert end-user-supplied bolts, secure with nuts, and hand-tighten.
4. Place the second appropriate end-user-supplied gasket for the application on the other end of the lower housing flange.

**▲ WARNING**

Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.

5. Align that end of the WFW flow-thru flanged seal flush with the process flange.
6. Insert end-user-supplied bolts, secure with nuts, and hand-tighten
7. Using a torque wrench on the nut, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are end-user-supplied. Consider leak checking the installation to ensure a robust connection.
8. Remove the protective cover from the diaphragm of the remote seal. Use extreme caution during installation to ensure the diaphragm is not damaged.
9. Assemble the remote seal, Emerson-supplied gasket, and lower housing. Failure to properly install the gasket may cause process leaks, which can result in death or serious injury.
10. Install the bolts in a cross pattern and hand-tighten.
11. Using a torque wrench on the bolt, tighten the assembly in a cross-pattern to ensure even installation (see [Torque sequence](#)). The bolts should be torqued to 180 in-lb (20 N-m) with stainless or carbon steel bolts. Consider leak checking the installation to ensure a robust connection.



## 4 Configuration

### 4.1 Calculating range points

#### 4.1.1 Remote seals

##### Calculating range points

- Open tank (zero based)<sup>(2)</sup>
- Open tank (non-zero based)
- Closed tank (non-zero based)

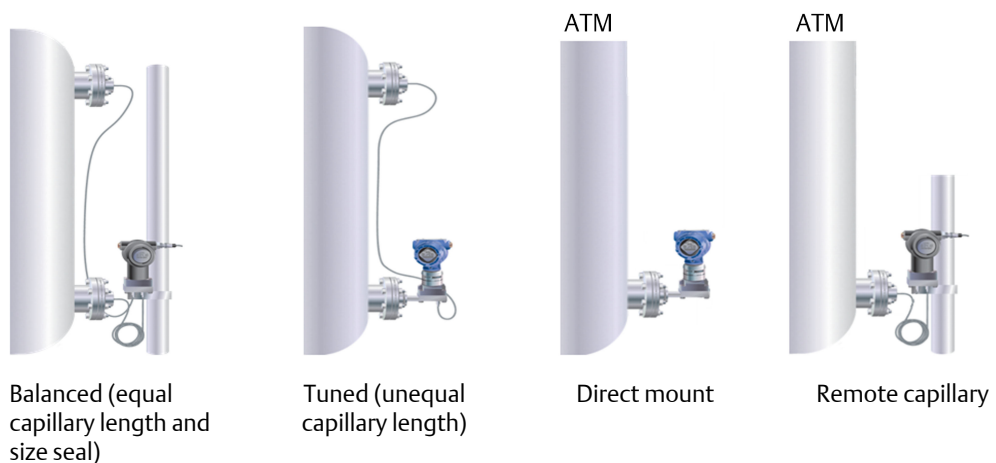
##### Transmitters installation best practice

- Open tank (zero based)<sup>(2)</sup>
- Closed tank (non-zero based)
- Zero trim via Field Communicator
- Re-range via zero button
- Re-range via Field Communicator
- Scale display

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#### Figure 4-1: Remote Seals

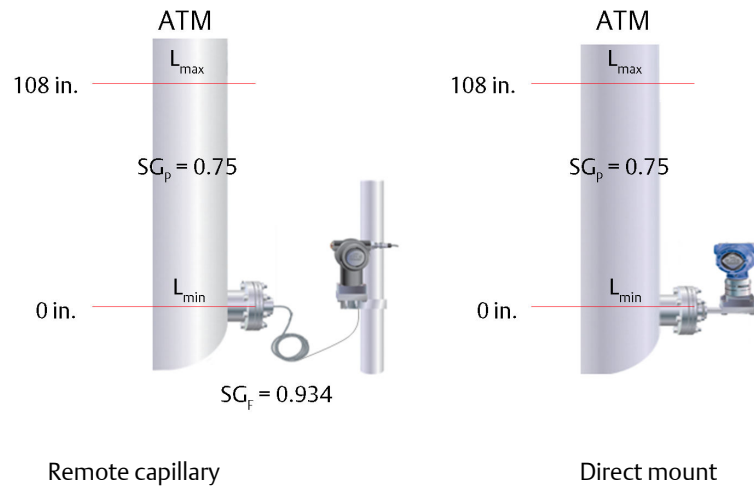
ATM = open to atmosphere



<sup>(2)</sup> "Zero based" means 4 mA equals 0 in H<sub>2</sub>O.

## 4.1.2 Zero-based lower range value

**Figure 4-2: Remote Capillary and Direct Mount**



- ATM** = open to atmosphere
- d<sub>H</sub>** = vertical distance from transmitter to high pressure seal
- d<sub>L</sub>** = vertical distance from transmitter to low pressure seal
- L<sub>max</sub>** = the maximum level of process above the high pressure seal and typically the 20 mA lower range value
- L<sub>min</sub>** = the minimum level of process above the high pressure seal and typically the 4 mA lower range value
- SG<sub>F</sub>** = specific gravity of fill fluid
- SG<sub>P</sub>** = specific gravity of process fluid

---

|                  |                                                                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tank span</b> | $= L_{\max} \times SG_P - L_{\min} \times SG_P$ $= (108 \text{ in.} \times 0.75) - (0 \text{ in.} \times 0.75) = 81 \text{ inH}_2\text{O}$ |
| <b>4 mA</b>      | $= L_{\min} \times SG_P + d_H \times SG_F$ $= (0 \text{ in.} \times 0.75) + (0 \text{ in.} \times 0.934) = 0 \text{ inH}_2\text{O}$        |
| <b>20 mA</b>     | $= L_{\max} \times SG_P + d_H \times SG_F$ $= (108 \text{ in.} \times 0.75) + (0 \text{ in.} \times 0.934) = 81 \text{ inH}_2\text{O}$     |
| <b>Span</b>      | $= 81 \text{ inH}_2\text{O} (81 \text{ to } 0 \text{ inH}_2\text{O})$                                                                      |

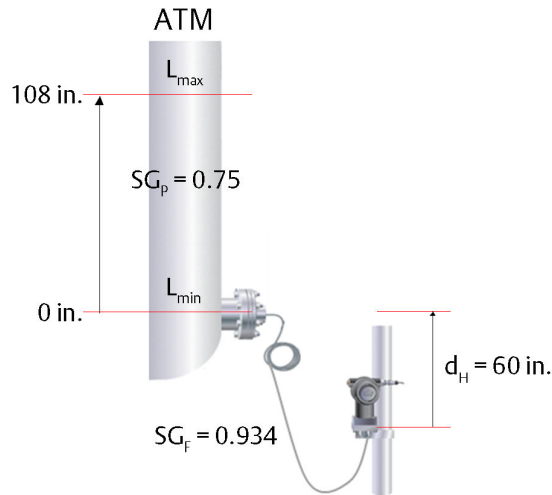
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**Note**  
Both installations would have the same calculated range points.

**Note**  
Silicone 200 has a specific gravity of 0.934.

### 4.1.3 Non-zero based lower range value

**Figure 4-3: Remote Capillary**



**ATM** = open to atmosphere

**d<sub>H</sub>** = vertical distance from transmitter to high pressure seal

**d<sub>L</sub>** = vertical distance from transmitter to low pressure seal

**L<sub>max</sub>** = the maximum level of process above the high pressure seal and typically the 20 mA lower range value

**L<sub>min</sub>** = the minimum level of process above the high pressure seal and typically the 4 mA lower range value

**SG<sub>F</sub>** = specific gravity of fill fluid

**SG<sub>P</sub>** = specific gravity of process fluid

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|                  |                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tank span</b> | $= L_{\max} \times SG_P - L_{\min} \times SG_P$ $= (108 \text{ in.} \times 0.75) - (0 \text{ in.} \times 0.75) = 81 \text{ inH}_2\text{O}$    |
| <b>4 mA</b>      | $= L_{\min} \times SG_P + (d_H \times SG_F)$ $= (0 \text{ in.} \times 0.75) + (60 \text{ in.} \times 0.934) = 56.04 \text{ inH}_2\text{O}$    |
| <b>20 mA</b>     | $= L_{\max} \times SG_P + (d_H \times SG_F)$ $= (108 \text{ in.} \times 0.75) + (56.04 \text{ inH}_2\text{O}) = 137.04 \text{ inH}_2\text{O}$ |
| <b>Span</b>      | $= 81 \text{ inH}_2\text{O} (137.04 \text{ to } 56.04 \text{ inH}_2\text{O})$                                                                 |

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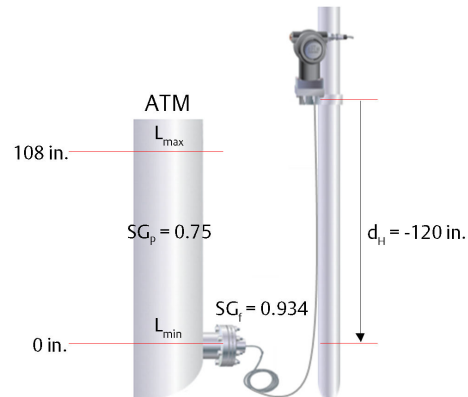
**Note**

Silicone 200 has a specific gravity of 0.934.

---

## 4.1.4 Non-zero based lower range value (transmitter mounted above seal)

**Figure 4-4: Remote Capillary**



**ATM** = open to atmosphere

**d<sub>H</sub>** = vertical distance from transmitter to high pressure seal

**d<sub>L</sub>** = vertical distance from transmitter to low pressure seal

**L<sub>max</sub>** = the maximum level of process above the high pressure seal and typically the 20 mA lower range value

**L<sub>min</sub>** = the minimum level of process above the high pressure seal and typically the 4 mA lower range value

**SG<sub>F</sub>** = specific gravity of fill fluid

**SG<sub>P</sub>** = specific gravity of process fluid

$$\begin{aligned} \text{Tank span} &= L_{\max} \times SG_P - L_{\min} \times SG_P \\ &= (108 \text{ in.} \times 0.75) = 81 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{4 mA} &= L_{\min} \times SG_P + (d_H \times SG_F) \\ &= (0 \text{ in.} \times 0.75) + (-120 \text{ in.} \times 0.934) = -112.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{20 mA} &= L_{\max} \times SG_P + (d_H \times SG_F) \\ &= (108 \text{ in.} \times 0.75) + (-120 \text{ in.} \times 0.934) = -31.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\text{Span} = 81 \text{ inH}_2\text{O} (-112.08 \text{ to } -31.08 \text{ inH}_2\text{O})$$

### Note

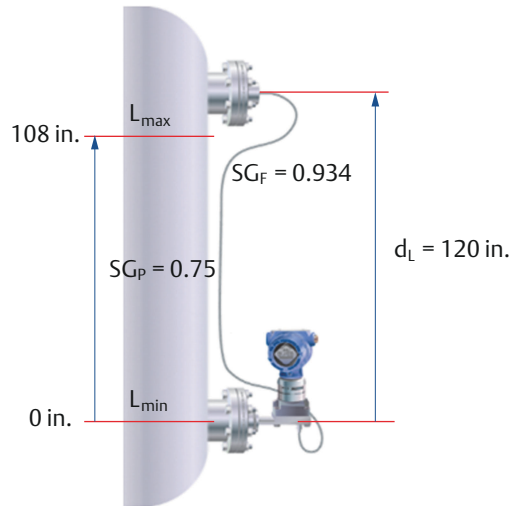
The height of the transmitter ( $H_d \times S_g$ ) should not be greater than approximately 394 inH<sub>2</sub>O (14.2 PSI) not to exceed the 0.5 PSIA sensor limits of a coplanar DP or GP.

### Note

Silicone 200 has a specific gravity of 0.934.

## 4.1.5 Non-zero based lower range value (Tuned-System assembly)

Figure 4-5: Tuned-System™



$d_H$  = vertical distance from transmitter to high pressure seal

$d_L$  = vertical distance from transmitter to low pressure seal

$L_{max}$  = the maximum level of process above the high pressure seal and typically the 20 mA lower range value

$L_{min}$  = the minimum level of process above the high pressure seal and typically the 4 mA lower range value

$SG_F$  = specific gravity of fill fluid

$SG_P$  = specific gravity of process fluid

$$\begin{aligned} \text{Tank span} &= L_{max} \times SG_P - L_{min} \times SG_P \\ &= (108 \text{ in.} \times 0.75) = 81 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{4 mA} &= L_{min} \times SG_P - (d_L \times SG_F) \\ &= (0 \text{ in.} \times 0.75) - (120 \text{ in.} \times 0.934) = -112.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{20 mA} &= L_{max} \times SG_P - (d_L \times SG_F) \\ &= (108 \text{ in.} \times 0.75) - (120 \text{ in.} \times 0.934) = -31.08 \text{ inH}_2\text{O} \end{aligned}$$

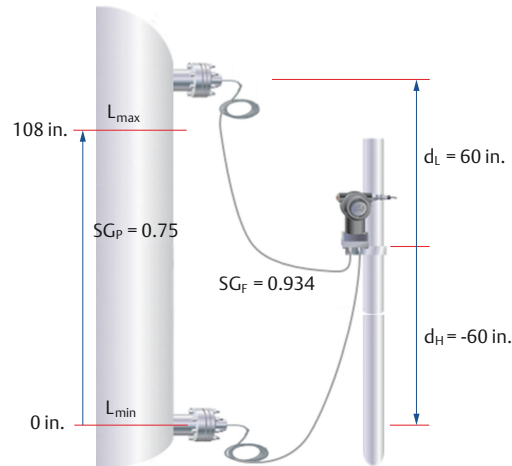
$$\text{Span} = 81 \text{ inH}_2\text{O} (-112.08 \text{ to } -31.08 \text{ inH}_2\text{O})$$

### Note

Silicone 200 has a specific gravity of 0.934.

## 4.1.6 Non-zero based lower range value (balanced system with transmitter between seals)

**Figure 4-6: Balanced System**



$d_H$  = vertical distance from transmitter to high pressure seal

$d_L$  = vertical distance from transmitter to low pressure seal

$L_{max}$  = the maximum level of process above the high pressure seal and typically the 20 mA lower range value

$L_{min}$  = the minimum level of process above the high pressure seal and typically the 4 mA lower range value

$SG_F$  = specific gravity of fill fluid

$SG_P$  = specific gravity of process fluid

$$\begin{aligned} \text{Tank span} &= L_{max} \times SG \\ &= 108 \text{ in.} \times 0.75 = 81 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{4 mA} &= L_{min} \times SG_P - (d_L \times SG_F) + (d_H \times SG_F) \\ &= (0 \text{ in.} \times 0.75) - (60 \text{ in.} \times 0.934) + (-60 \text{ in.} \times 0.934) = -112.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{20 mA} &= L_{max} \times SG_P - (d_L \times SG_F) + (d_H \times SG_F) \\ &= (108 \text{ in.} \times 0.75) - (60 \text{ in.} \times 0.934) + (-60 \text{ in.} \times 0.934) = -31.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\text{Span} = 81 \text{ inH}_2\text{O} (-112.08 \text{ to } -31.08 \text{ inH}_2\text{O})$$

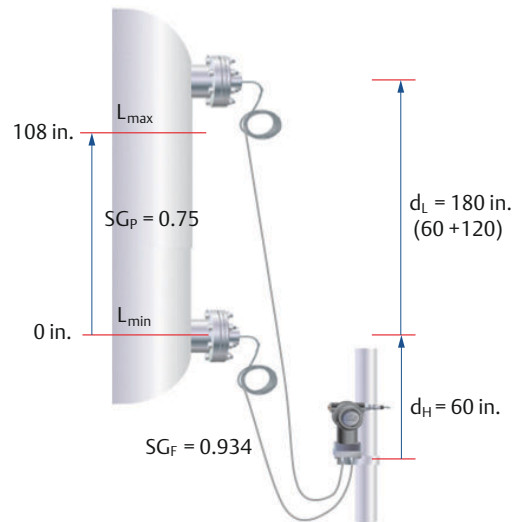
**Note**

Silicone 200 has a specific gravity of 0.934.



## 4.1.7 Non-zero based lower range value(balanced system with transmitter below seals)

Figure 4-7: Remote Capillary



$d_H$  = vertical distance from transmitter to high pressure seal

$d_L$  = vertical distance from transmitter to low pressure seal

$L_{max}$  = the maximum level of process above the high pressure seal and typically the 20 mA lower range value

$L_{min}$  = the minimum level of process above the high pressure seal and typically the 4 mA lower range value

$SG_F$  = specific gravity of fill fluid

$SG_P$  = specific gravity of process fluid

$$\begin{aligned} \text{Tank span} &= L_{max} \times SG \\ &= 108 \text{ in.} \times 0.75 = 81 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{4 mA} &= L_{min} \times SG_P - (d_L \times SG_F) + (d_H \times SG_F) \\ &= (0 \text{ in.} \times 0.75) - (180 \text{ in.} \times 0.934) + (60 \text{ in.} \times 0.934) = -112.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\begin{aligned} \text{20 mA} &= L_{max} \times SG_P - (d_L \times SG_F) + (d_H \times SG_F) \\ &= (108 \text{ in.} \times 0.75) - (180 \text{ in.} \times 0.934) + (60 \text{ in.} \times 0.934) = -31.08 \text{ inH}_2\text{O} \end{aligned}$$

$$\text{Span} = 81 \text{ inH}_2\text{O} (-112.08 \text{ to } -31.08 \text{ inH}_2\text{O})$$

### Note

Silicone 200 has a specific gravity of 0.934.

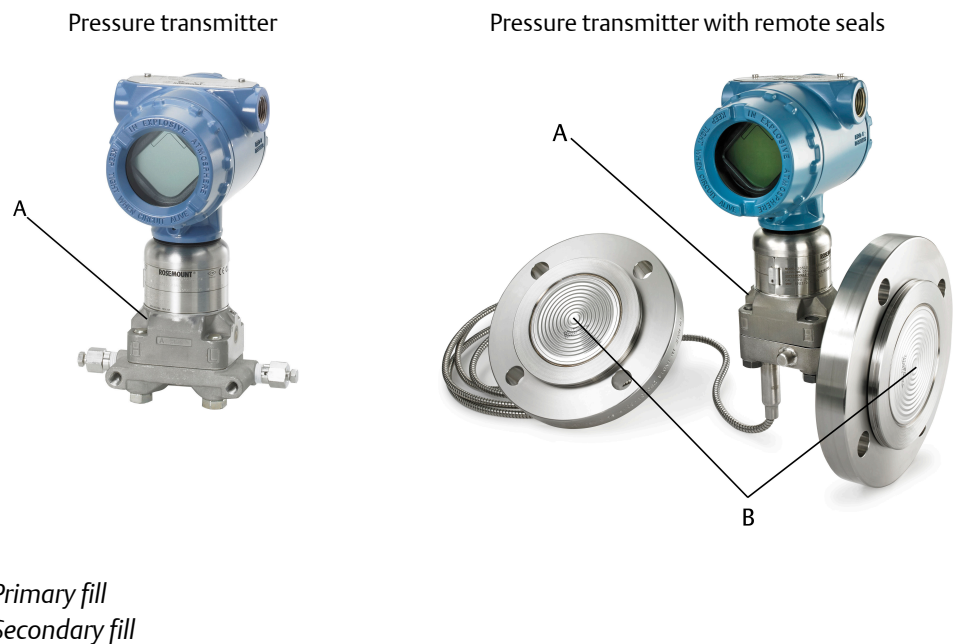
### Note

The transmitter location in a closed tank does not effect the 4 mA and 20 mA set points as shown in example A, B, and C.

## 4.2 DP Level transmitter installation best practices

Pressure transmitters have a sensor module with a primary fill fluid. Therefore, the mounting position of a standard transmitter with silicon fill could read approx  $\pm 1.25$  inH<sub>2</sub>O worst case after installation. This is simply zeroed out using a Field Communicator after installation so that it will read zero pressure. With a remote seal attached you have additional components that will create additive pressure that would increase the amount of potential shift. This would include the secondary fill fluid in the remote seal assembly along with the potential of torquing effects when the assembly is bolted to the process. For these reasons, the transmitter's digital output will most likely not match the exact values calculated on paper. Even a redundant transmitter would most likely not read the exact digital values after being installed. For these reasons, a re-range function is common practice after all installations.

**Figure 4-8: Installation Example**



What is important is the calculated span (level height  $\times$  specific gravity of the process). After the transmitter is mounted, it is common and best practice to re-range the transmitter so that the 4 mA point will be the installed digital value. The 20 mA point would then be set based on the calculated span value setting it above the installed digital value.

The procedure would be based on mounting configuration (zero based) 4 mA = 0 inH<sub>2</sub>O or (non-zero based) 4 mA exceeds the  $\pm 3\%$  of the upper sensor limit (USL).

### 4.2.1 Open tank (zero based)

With open tank level applications this value can typically be zeroed out using a HART device as long as it is  $< 3\%$  USL. The maximum value that can be zeroed out is 3% of the USL or 7.5 inH<sub>2</sub>O for a range 2 (250 inH<sub>2</sub>O) sensor.

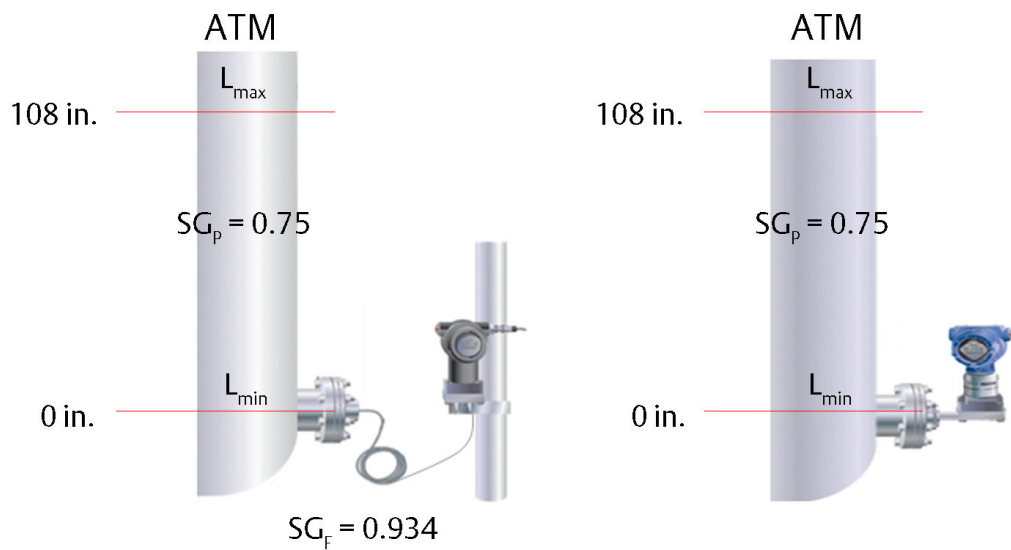
## 4.2.2 Closed tank (non-zero based)

For closed tank level applications, this value is most likely too high and cannot be zeroed out due to the applied pressure of the secondary fill fluid. For this reason, the transmitter would simply be re-ranged so that the 0% value (4 mA) would equal the installed value. The 100 percent, (20 mA) would be adjusted to the required calculated span.

## 4.2.3 Open tank example (zero-based lower range value) with Field Communicator

Perform a zero trim via Field Communicator after installation for zero based lower range values.

**Figure 4-9: Open Tank**



ATM: open to atmosphere.

Figure 4-10: Before Zero Trim Using Field Communicator



Figure 4-11: After Zero Trim Using Field Communicator

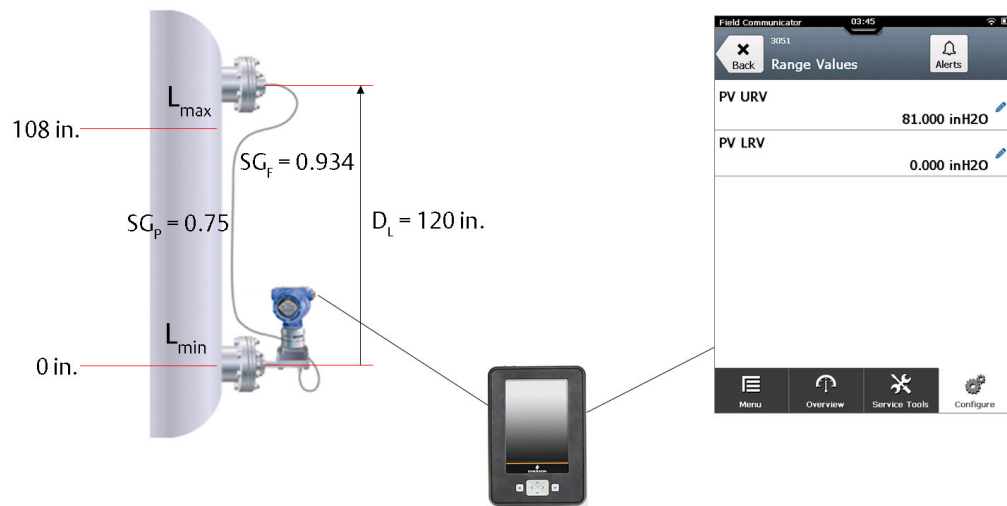


## 4.2.4 Closed tank example (non-zero based lower range value)

### Note

For FOUNDATION™ Fieldbus, refer to the AI Function Blocks in reference manual.

**Figure 4-12: Tuned-System**



### Procedure

1. Set seals at the same elevation for bench pressure verification, if required to range transmitter. If the transmitter does not require bench pressure verification, proceed to [Step 2](#).

#### Bench pressure verification

Power and range the transmitter using a Field Communicator to the required tank span. (Figure 4-12 example) With the required calibration fixture attached to the seal assemble apply pressure.

$$4 \text{ mA} = 0 \text{ inH}_2\text{O}$$

$$20 \text{ mA} = 81 \text{ inH}_2\text{O}$$

2. Install the tuned system by assembling the seals to the process taps. Common practice is to mount the high-pressure side seal to the low process tap and the low-pressure side seal to the high process tap.
3. Wire and apply power to the transmitter.
4. If the transmitter has a zero button, see [Figure 4-13](#) and [Figure 4-14](#), push the Zero button. This will automatically re-range the transmitter so the LRV (4 mA) will equal the current applied pressure value and the URV (20 mA) will be adjusted to the required calculated span.

#### Example 1: Re-range using transmitter zero button

Transmitter is ranged per [Figure 4-12](#):

4 mA = 0 inH<sub>2</sub>O

20 mA = 81 inH<sub>2</sub>O

After installing and pushing the Zero button, the transmitter will now be ranged per example from Figure 4-5:

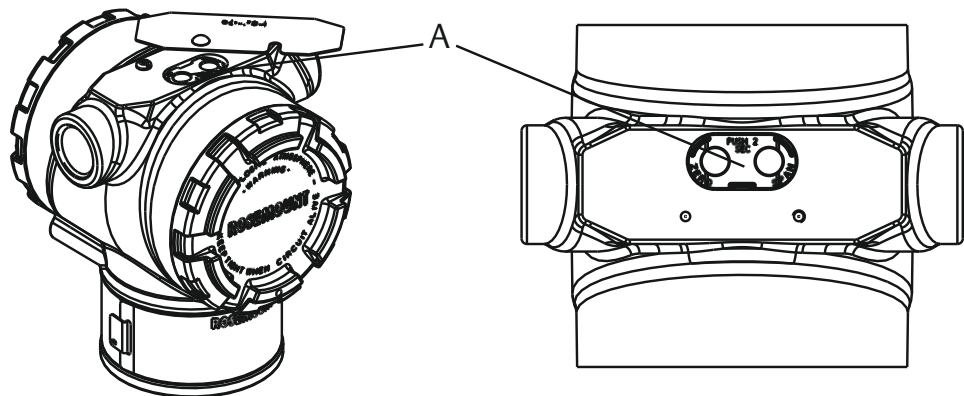
4 mA = -112.08 inH<sub>2</sub>O

20 mA = -31.08 inH<sub>2</sub>O

**Note**

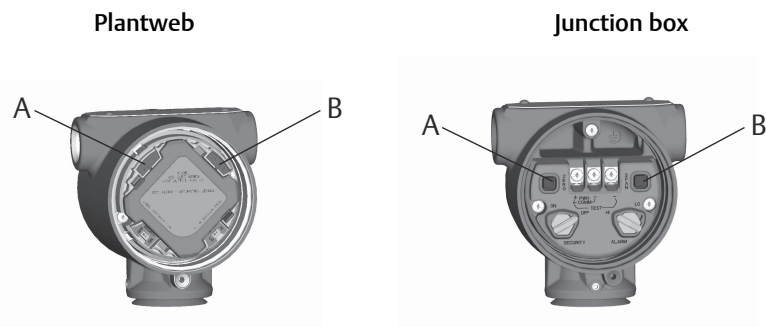
If you have a Field Communicator device connected when the **Zero** button is pushed, you must re-boot the Field Communicator to see the change.

**Figure 4-13: Zero and Span Buttons on Rosemount 2088, 2051, and 3051**



A. Zero and span buttons

**Figure 4-14: Zero and Span Buttons on Rosemount 3051S**



A. Zero  
B. Span

5. If the transmitter does not have a Zero button, use a Field Communicator to re-range the transmitter.

**Example 2: Re-range using a Field Communicator**

Transmitter is ranged per Figure 4-13:

4 mA = 0 inH<sub>2</sub>O

20 mA = 81 inH<sub>2</sub>O

After mounting transmitter, the pressure reads -112.08 inH<sub>2</sub>O, see [Figure 4-14](#).

Using a Field Communicator, re-range the transmitter, see [Figure 4-14](#). The transmitter will now be ranged per example from [Figure 4-5](#):

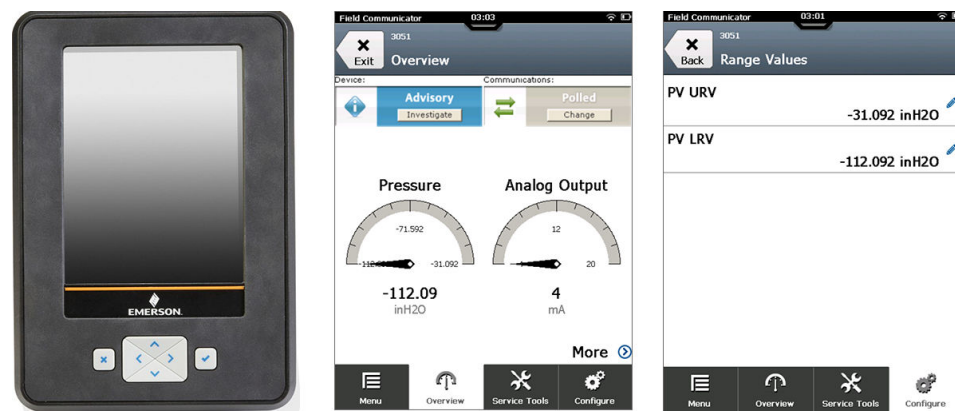
4 mA = -112.08 inH<sub>2</sub>O

20 mA = -31.08 inH<sub>2</sub>O

**Figure 4-15: Before Re-range Using Field Communicator**



**Figure 4-16: After Re-range Using Field Communicator**



6. If the device has a display and you want to configure the output to an engineering unit other than the standard defaults, go to [Scale display with Field Communicator](#).

## 4.2.5 Scale display with Field Communication

After the transmitter is installed, you can scale the display to match the DCS or PLC as required but, often 0 to 100 percent is sufficient. As an example, in [Figure 4-12](#), the display should be 0 to 81 inH<sub>2</sub>O. This can be done using a Field Communicator, example shown below for the Rosemount 3051S. See the transmitter reference manual for steps to configure the display.

---

**Note**

Depending on the HART device (Field Communicator/AMS Wireless Configurator) DD the following steps may be slightly different.

For the Rosemount 3051S, in the HART menu tree, go to the **Scaled variable Config** (under guided set up). Follow the steps below: Bold text indicates entered value.

**Procedure**

1. Enter SV unit: (enter) **inH<sub>2</sub>O**
2. Select Scaled data option: (select) **Linear**
3. Enter Pressure value position 1: (enter) **-112.08**
4. Enter Scaled Variable position 1: (enter) **0**
5. Enter Pressure value position 2: (enter) **-31.08**
6. Enter Scaled Variable position 2: (enter) **81**
7. Enter Linear Offset: (enter) **0.00**
8. Go to **Display** (under manual setup).
9. Pressure: **OFF**
10. Scaled Variable: **ON**
11. Module Temperature: **OFF**
12. Percent of range: **OFF**

---

**Note**

The transmitter is ranged -112.08 to -31.08 inH<sub>2</sub>O, but the display will show 0 inH<sub>2</sub>O at (4 mA) and 81 inH<sub>2</sub>O at (20 mA).

---



## 5 Fill Fluids

This section discusses the process of selecting the appropriate fill fluid using vapor pressure curves. To see the list of available Rosemount fill fluids, view the Rosemount DP Level Fill Fluid Specifications [Technical Note](#), or reference the Rosemount DP Level Transmitters and 1199 Remote Seals [Product Data Sheet](#).

### 5.1 Quality

#### 5.1.1 Specialized processing

Emerson has implemented proprietary processes to eliminate impurities and contaminations in the fill fluid. This additional processing ensures stable measurement and optimal performance under extreme temperatures and vacuum conditions. The proprietary equipment and procedures used to build remote seal systems for high temperature/high vacuum applications are continuously improved to deliver products that meet ever increasing application demands. Tight quality control measures such as helium leak checking of system welds ensures the reliability of every seal system. Additional quality checks include continual station leak and health tests to confirm the fill quality of the finished seal system.

#### 5.1.2 Testing

Emerson's vapor pressure curves are derived from empirical lab testing in real devices at both vacuum conditions and at the maximum continuous temperature at one atmosphere of pressure. The maximum continuous temperature at one atm of pressure correlates to the thermal stability of the fill fluid, which is the maximum temperature the fill fluid will remain in its original molecular form. Over time, exceeding the maximum recommended temperature may result in the decomposition or vaporization of the fill fluid, resulting in device failure.

### 5.2 Fill fluid selection

Fill fluid selection is very important to the safety and reliability of your measurement application.

#### 5.2.1 Type of fill fluid

Different types of fill fluids exist to meet the needs of different applications. An all-purpose fill fluid can be used in most applications. However, some processes might require a fill fluid that is chemically inert to avoid reactions with oxygen. In the food and pharmaceutical industries, a hygienic fill fluid may be needed that meets various industry standards.

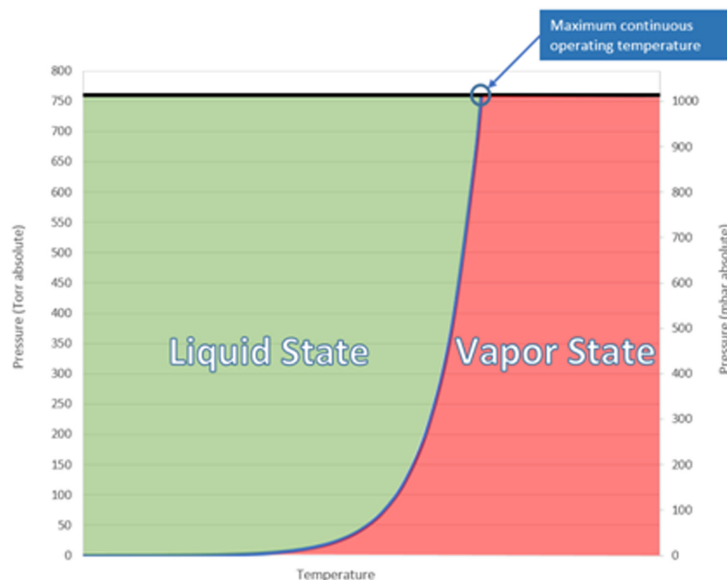
## 5.2.2 Maximum and minimum temperatures

When selecting a fill fluid, the process and ambient temperatures must be within the specified temperature range of the fill fluid. Too hot can cause the fill fluid to vaporize or yield thermal stability issues. Too cold can cause the fill fluid to gel, which slows the time response or can even render the system unresponsive.

## 5.2.3 Process pressure and temperature

When the process is under vacuum conditions (below 14.7 psia), the fill fluid will vaporize at a lower temperature than when it is operating under normal atmospheric or greater pressure. If the fill fluid vaporizes, the seal system is permanently damaged. Emerson offers numerous types of fill fluids for remote seal systems, each fill fluid has a specific vapor-pressure curve. The vapor-pressure curve indicates the pressure and temperature relationship where the fluid is in a liquid or vapor state. Safe and reliable system operation requires the fill fluid to remain in a liquid state.

**Figure 5-1: Liquid vs. Pressure State Under Vacuum**



The thermal stability point of a fill fluid is equal to its maximum temperature at one atmosphere. This point translates to the maximum continuous operating temperature of the fill fluid.

## 5.3 Fill fluid vapor pressure curves

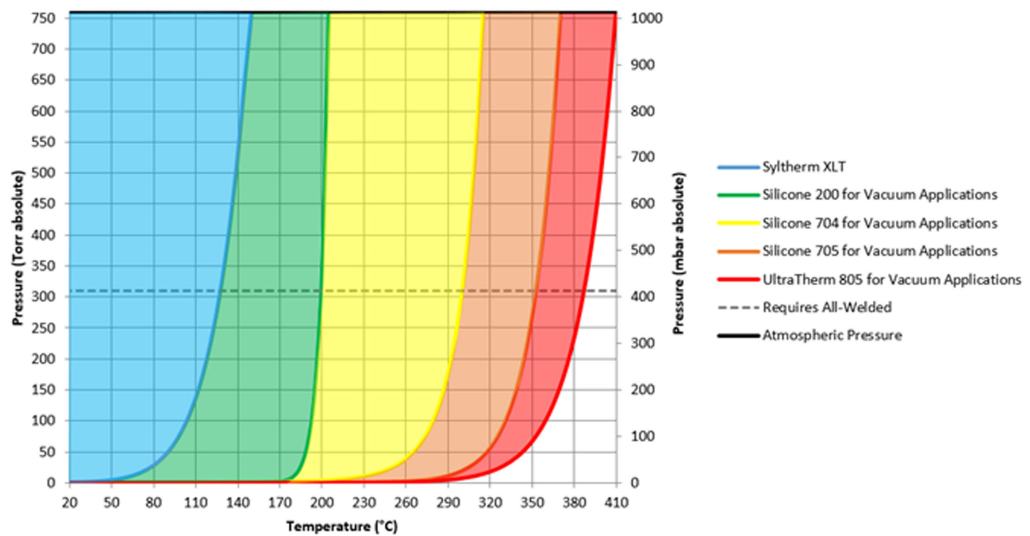
### 5.3.1 How to use vapor pressure curves

Take each temperature and pressure of your process cycle and find where each point falls on the graph above (Figure 5-1). Whichever fill fluid that is farthest to the right containing a point of your process cycle is most likely the correct fill fluid for your application.

**Note**

Fill fluids can operate at lower temperatures than their shaded section shown in [Figure 5-2](#). For exact minimum operating temperatures, consult the Rosemount DP Level Fill Fluid Specifications [Technical Note](#).

**Figure 5-2: Vapor Pressure Curves of General Use Fill Fluids**



### 5.3.2 Fill fluid selection example

In an application that has a maximum process temperature of 284 °F (140 °C) and a maximum pressure of 700 Torr, SYLTHERM™ XLT would be recommended. However, say the process pressure drops to 200 Torr and 284 °F (140 °C) at one point during the process cycle, then Silicone 200 for vacuum applications would be recommended because it is the fill fluid farthest to the right that the process falls into.

### 5.3.3 Fill fluid specifications

Rosemount fill fluid properties, vapor pressure curves, and specifications can be found in the Rosemount DP Level Fill Fluid Specifications [Technical Note](#).



# 6 Maintenance and Troubleshooting

## 6.1 Cleaning

Avoid using abrasive agents or high pressure water jets when cleaning the remote seals.

## 6.2 Troubleshooting

Remote seal systems are factory filled systems that cannot be refilled in the field. Do not attempt to disconnect the seals or capillaries from the transmitter. Doing so can damage the seal system assembly and voids the product warranty. Listed below are the possible problems, their potential causes, and, where applicable, a corrective action.

### 6.2.1 No output

#### Potential cause

Electrical problem

#### Recommended actions

1. See the troubleshooting section of the transmitter manual for more extensive information.
2. Check for adequate voltage to the transmitter.
3. Check the milliampere rating of the power supply against the total current being drawn for all transmitters being powered.
4. Check for shorts and multiple grounds.
5. Check for proper polarity at the transmitter terminal.
6. Check loop impedances.

#### **⚠ CAUTION**

Do not use higher than the specified voltage to check the loop, or the transmitter electronics may be damaged.

### 6.2.2 Slow response

#### Potential cause

Damping too high

#### Recommended actions

See the “Damping Adjustment” information in the Calibration section of the transmitter manual.

**Potential cause**

Cold temperature

**Recommended actions**

Fill fluid viscosity is temperature dependent. Less viscous fill fluid enhances time response. Heat traced capillaries can be added as an option to maintain constant temperatures to fill fluid.

## 6.2.3 Drifting

**Potential cause**

Drifting

**Recommended actions**

If pressure measurement is changing, refer to [Seal system performance](#) for more information. Running Instrument Toolkit will calculate the expected performance for the seal system. Refer to [Instrument Toolkit: seal ordering and application process](#) for more information.

## 6.2.4 Output reads negative pressure

**Potential cause**

Mounting effect

**Recommended actions**

The output will read negative as the remote fill fluid is applying pressure to the low side. See [Configuration](#).

## 6.2.5 No response to change in pressure

**Potential cause**

Damaged diaphragm

**Recommended actions**

Remove seal and inspect diaphragm.

## 6.2.6 Not responding to change in pressure

**Potential cause**

Multidrop mode

**Recommended actions**

See if the transmitter is in a multidrop mode. The multidrop mode locks the output at 4 mA.

## 6.3 Return of materials

Within the United States, call the North American Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

Outside of the United States, contact your local Emerson representative (support center addresses and phone numbers are on the Title Page of this manual).

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material the product was last exposed to.

### **⚠ WARNING**

Mishandling products exposed to a hazardous substance can cause death or serious injury. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

## 6.4 Service support

To expedite the return process outside of the United States, contact the nearest Emerson representative.

Within the United States, call the Emerson Instrument and Valves Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

### **⚠ CAUTION**

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

Emerson Instrument and Valves Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.





## 7 Reference data

### 7.1 Product certifications

To view current product certification, follow these steps:

#### Procedure

1. Go to the product page on [Emerson.com/Rosemount-1199](https://emerson.com/Rosemount-1199).
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. Click **Manuals & Guides**.
4. Select the appropriate Quick Start Guide.

### 7.2 Ordering information, specifications, and drawings

To view current ordering information, specifications, and drawings, follow these steps:

#### Procedure

1. Go to the product page on [Emerson.com/Rosemount-1199](https://emerson.com/Rosemount-1199).
2. Scroll as needed to the green menu bar and click **Documents & Drawings**.
3. For installation drawings, click **Drawings & Schematics** and select the appropriate document.
4. For ordering information, specifications, and dimensional drawings, click **Data Sheets & Bulletins** and select the appropriate Product Data Sheet.

### 7.3 Spare parts

Table 7-1: Flush Flanged (FFW) and Pancake (PFW) Lower Housings

| Material    | Size         | Part number    |                |                |                |
|-------------|--------------|----------------|----------------|----------------|----------------|
|             |              | One ¼-in.      | Two ¼-in.      | One ½-in.      | Two ½-in.      |
| 316 SST     | 2-in.        | DP0002-2111-S6 | DP0002-2121-S6 | DP0002-2112-S6 | DP0002-2122-S6 |
|             | 3-in.        | DP0002-3111-S6 | DP0002-3121-S6 | DP0002-3112-S6 | DP0002-3122-S6 |
|             | 4-in./DN 100 | DP0002-4111-S6 | DP0002-4121-S6 | DP0002-4112-S6 | DP0002-4122-S6 |
|             | DN 50        | DP0002-5111-S6 | DP0002-5121-S6 | DP0002-5112-S6 | DP0002-5122-S6 |
|             | DN 80        | DP0002-8111-S6 | DP0002-8121-S6 | DP0002-8112-S6 | DP0002-8122-S6 |
| Alloy C-276 | 2-in.        | DP0002-2111-HC | DP0002-2121-HC | DP0002-2112-HC | DP0002-2122-HC |
|             | 3-in.        | DP0002-3111-HC | DP0002-3121-HC | DP0002-3112-HC | DP0002-3122-HC |
|             | 4-in./DN 100 | DP0002-4111-HC | DP0002-4121-HC | DP0002-4112-HC | DP0002-4122-HC |
|             | DN 50        | DP0002-5111-HC | DP0002-5121-HC | DP0002-5112-HC | DP0002-5122-HC |

**Table 7-1: Flush Flanged (FFW) and Pancake (PFW) Lower Housings (continued)**

| Material  | Size         | Part number    |                |                |                |
|-----------|--------------|----------------|----------------|----------------|----------------|
|           |              | One ¼-in.      | Two ¼-in.      | One ½-in.      | Two ½-in.      |
|           | DN 80        | DP0002-8111-HC | DP0002-8121-HC | DP0002-8112-HC | DP0002-8122-HC |
| Alloy 400 | 2-in.        | DP0002-2111-M4 | DP0002-2121-M4 | DP0002-2112-M4 | DP0002-2122-M4 |
|           | 3-in.        | DP0002-3111-M4 | DP0002-3121-M4 | DP0002-3112-M4 | DP0002-3122-M4 |
|           | 4-in./DN 100 | DP0002-4111-M4 | DP0002-4121-M4 | DP0002-4112-M4 | DP0002-4122-M4 |
|           | DN 50        | DP0002-5111-M4 | DP0002-5121-M4 | DP0002-5112-M4 | DP0002-5122-M4 |
|           | DN 80        | DP0002-8111-M4 | DP0002-8121-M4 | DP0002-8112-M4 | DP0002-8122-M4 |

**Table 7-2: Gaskets for Flush Flanged (FFW) and Pancake (PFW) Lower Housings**

| Material | Size         | Part number       |                |                |                |
|----------|--------------|-------------------|----------------|----------------|----------------|
|          |              | Thermo-Tork® 9000 | Virgin PTFE    | GHB GRAFOIL®   | Gylon 3510     |
| 316 SST  | 2-in.        | DP0007-0201-TT    | DP0007-0201-TF | DP0007-0201-GF | DP0007-0201-GY |
|          | 3-in.        | DP0007-0301-TT    | DP0007-0301-TF | DP0007-0301-GF | DP0007-0301-GY |
|          | 4-in./DN 100 | DP0007-0401-TT    | DP0007-0401-TF | DP0007-0401-GF | DP0007-0401-GY |
|          | DN 50        | DP0007-0601-TT    | DP0007-0601-TF | DP0007-0601-GF | DP0007-0601-GY |
|          | DN 80        | DP0007-0801-TT    | DP0007-0801-TF | DP0007-0801-GF | DP0007-0801-GY |

**Table 7-3: Alignment Clamps for Flush Flanged (FFW) and Pancake (PFW) Lower Housings**

|          | Size   | Part number    |
|----------|--------|----------------|
| ANSI/JIS | 2-in.  | DP0127-2000-S1 |
|          | 3-in.  | DP0127-3000-S1 |
|          | 4-in.  | DP0127-4000-S1 |
| DIN      | DN 50  | DP0127-5000-S1 |
|          | DN 80  | DP0127-8000-S1 |
|          | DN 100 | DP0127-4000-S1 |

**Table 7-4: Plugs for Flush Flanged (FFW) and Pancake (PFW) Lower Housings**

| Material    | ¼-in.           | ½-in.           |
|-------------|-----------------|-----------------|
| SST         | 01199-7000-0502 | 01199-7000-0504 |
| Alloy C-276 | 01199-7000-0602 | 01199-7000-0604 |

**Table 7-5: Remote Flanged (RFW) Lower Housings**

| Material     | Size   | Part number            |                |                |                |                |
|--------------|--------|------------------------|----------------|----------------|----------------|----------------|
|              |        | No flushing connection | One ¼-in.      | Two ¼-in.      | One ½-in.      | Two ½-in.      |
| 316 SST      | 1-in.  | DP0004-1100-S6         | DP0004-1111-S6 | DP0004-1121-S6 | DP0004-1112-S6 | DP0004-1122-S6 |
|              | 1½-in. | DP0004-1600-S6         | DP0004-1611-S6 | DP0004-1621-S6 | DP0004-1612-S6 | DP0004-1622-S6 |
|              | DN 25  | DP0004-1700-S6         | DP0004-1711-S6 | DP0004-1721-S6 | DP0004-1712-S6 | DP0004-1722-S6 |
|              | DN 40  | DP0004-1900-S6         | DP0004-1911-S6 | DP0004-1921-S6 | DP0004-1912-S6 | DP0004-1922-S6 |
| Alloy C-276  | 1-in.  | DP0004-1100-HC         | DP0004-1111-HC | DP0004-1121-HC | DP0004-1112-HC | DP0004-1122-HC |
|              | 1½-in. | DP0004-1600-HC         | DP0004-1611-HC | DP0004-1621-HC | DP0004-1612-HC | DP0004-1622-HC |
|              | DN 25  | DP0004-1700-HC         | DP0004-1711-HC | DP0004-1721-HC | DP0004-1712-HC | DP0004-1722-HC |
|              | DN 40  | DP0004-1900-HC         | DP0004-1911-HC | DP0004-1921-HC | DP0004-1912-HC | DP0004-1922-HC |
| Carbon steel | 1-in.  | DP0004-1100-Z1         | DP0004-1111-Z1 | DP0004-1121-Z1 | DP0004-1112-Z1 | DP0004-1122-Z1 |
|              | 1½-in. | DP0004-1600-Z1         | DP0004-1611-Z1 | DP0004-1621-Z1 | DP0004-1612-Z1 | DP0004-1622-Z1 |
|              | DN 25  | DP0004-1700-Z1         | DP0004-1711-Z1 | DP0004-1721-Z1 | DP0004-1712-Z1 | DP0004-1722-Z1 |
|              | DN 40  | DP0004-1900-Z1         | DP0004-1911-Z1 | DP0004-1921-Z1 | DP0004-1912-Z1 | DP0004-1922-Z1 |
| Alloy 400    | 1-in.  | DP0004-1100-M4         | DP0004-1111-M4 | DP0004-1121-M4 | DP0004-1112-M4 | DP0004-1122-M4 |
|              | 1½-in. | DP0004-1600-M4         | DP0004-1611-M4 | DP0004-1621-M4 | DP0004-1612-M4 | DP0004-1622-M4 |
|              | DN 25  | DP0004-1700-M4         | DP0004-1711-M4 | DP0004-1721-M4 | DP0004-1712-M4 | DP0004-1722-M4 |
|              | DN 40  | DP0004-1900-M4         | DP0004-1911-M4 | DP0004-1921-M4 | DP0004-1912-M4 | DP0004-1922-M4 |

**Table 7-6: Gaskets for Remote Flanged (RFW) Lower Housings**

| Material | Size  | Part number        |                |                            |                |                    |
|----------|-------|--------------------|----------------|----------------------------|----------------|--------------------|
|          |       | C4401 Aramid fiber | PTFE           | Barium sulfate filled PTFE | GHB GRAFOIL    | Ethylene propylene |
| 316 SST  | 1-in. | DP0007-2401-K4     | DP0007-2401-TF | DP0007-2401-GY             | DP0007-2401-GF | DP0007-2401-ER     |

**Table 7-6: Gaskets for Remote Flanged (RFW) Lower Housings (continued)**

| Material | Size   | Part number        |                |                            |                |                    |
|----------|--------|--------------------|----------------|----------------------------|----------------|--------------------|
|          |        | C4401 Aramid fiber | PTFE           | Barium sulfate filled PTFE | GHB GRAFOIL    | Ethylene propylene |
|          | 1½-in. | DP0007-2401-K4     | DP0007-2401-TF | DP0007-2401-GY             | DP0007-2401-GF | DP0007-2401-ER     |
|          | DN 25  | DP0007-2401-K4     | DP0007-2401-TF | DP0007-2401-GY             | DP0007-2401-GF | DP0007-2401-ER     |
|          | DN 40  | DP0007-2401-K4     | DP0007-2401-TF | DP0007-2401-GY             | DP0007-2401-GF | DP0007-2401-ER     |

**Table 7-7: Plugs for Remote Flanged (RFW) Lower Housings**

| Material    | ¼-in.           | ½-in.           |
|-------------|-----------------|-----------------|
| SST         | 01199-7000-0502 | 01199-7000-0504 |
| Alloy C-276 | 01199-7000-0602 | 01199-7000-0604 |

**Table 7-8: Threaded (RTW) Lower Housings**

| Material    | Size          | Part number            |                |                |                |                |
|-------------|---------------|------------------------|----------------|----------------|----------------|----------------|
|             |               | No flushing connection | One ¼-in.      | Two ¼-in.      | One ½-in.      | Two ½-in.      |
| 316 SST     | ¼-18 NPT      | DP0070-1101-S6         | DP0070-1112-S6 | DP0070-1122-S6 | DP0070-111A-S6 | DP0070-112A-S6 |
|             | 3/8-18 NPT    | DP0070-1201-S6         | DP0070-1212-S6 | DP0070-1222-S6 | DP0070-121A-S6 | DP0070-122A-S6 |
|             | ½-14 NPT      | DP0070-1301-S6         | DP0070-1312-S6 | DP0070-1322-S6 | DP0070-131A-S6 | DP0070-132A-S6 |
|             | ¾-14 NPT      | DP0070-1401-S6         | DP0070-1412-S6 | DP0070-1422-S6 | DP0070-141A-S6 | DP0070-142A-S6 |
|             | 1-11.5 NPT    | DP0070-1501-S6         | DP0070-1512-S6 | DP0070-1522-S6 | DP0070-151A-S6 | DP0070-152A-S6 |
|             | 1¼-11.5 NPT   | DP0070-1601-S6         | N/A            | N/A            | N/A            | N/A            |
|             | 1½-11.5 NPT   | DP0070-1701-S6         | N/A            | N/A            | N/A            | N/A            |
|             | G½A DIN 16288 | DP0070-1901-S6         | DP0070-1912-S6 | DP0070-1922-S6 | DP0070-191A-S6 | DP0070-192A-S6 |
| Alloy C-276 | ¼-18 NPT      | DP0070-1101-HC         | DP0070-1112-HC | DP0070-1122-HC | DP0070-111A-HC | DP0070-112A-HC |
|             | 3/8-18 NPT    | DP0070-1201-HC         | DP0070-1212-HC | DP0070-1222-HC | DP0070-121A-HC | DP0070-122A-HC |
|             | ½-14 NPT      | DP0070-1301-HC         | DP0070-1312-HC | DP0070-1322-HC | DP0070-131A-HC | DP0070-132A-HC |

**Table 7-8: Threaded (RTW) Lower Housings (continued)**

| Material     | Size          | Part number            |                |                |                |                |
|--------------|---------------|------------------------|----------------|----------------|----------------|----------------|
|              |               | No flushing connection | One ¼-in.      | Two ¼-in.      | One ½-in.      | Two ½-in.      |
|              | ¾-14 NPT      | DP0070-1401-HC         | DP0070-1412-HC | DP0070-1422-HC | DP0070-141A-HC | DP0070-142A-HC |
|              | 1-11.5 NPT    | DP0070-1501-HC         | DP0070-1512-HC | DP0070-1522-HC | DP0070-151A-HC | DP0070-152A-HC |
|              | 1 ¼-11.5 NPT  | DP0070-1601-HC         | N/A            | N/A            | N/A            | N/A            |
|              | 1 ½-11.5 NPT  | DP0070-1701-HC         | N/A            | N/A            | N/A            | N/A            |
|              | G½A DIN 16288 | DP0070-1901-HC         | DP0070-1912-HC | DP0070-1922-HC | DP0070-191A-HC | DP0070-192A-HC |
| Carbon Steel | ¼-18 NPT      | DP0070-1101-Z1         | DP0070-1112-Z1 | DP0070-1122-Z1 | DP0070-111A-Z1 | DP0070-112A-Z1 |
|              | 3/8-18 NPT    | DP0070-1201-Z1         | DP0070-1212-Z1 | DP0070-1222-Z1 | DP0070-121A-Z1 | DP0070-122A-Z1 |
|              | ½-14 NPT      | DP0070-1301-Z1         | DP0070-1312-Z1 | DP0070-1322-Z1 | DP0070-131A-Z1 | DP0070-132A-Z1 |
|              | ¾-14 NPT      | DP0070-1401-Z1         | DP0070-1412-Z1 | DP0070-1422-Z1 | DP0070-141A-Z1 | DP0070-142A-Z1 |
|              | 1-11.5 NPT    | DP0070-1501-Z1         | DP0070-1512-Z1 | DP0070-1522-Z1 | DP0070-151A-Z1 | DP0070-152A-Z1 |
|              | 1¼-11.5 NPT   | DP0070-1601-Z1         | N/A            | N/A            | N/A            | N/A            |
|              | 1½-11.5 NPT   | DP0070-1701-Z1         | N/A            | N/A            | N/A            | N/A            |
|              | G½A DIN 16288 | DP0070-1901-Z1         | DP0070-1912-Z1 | DP0070-1922-Z1 | DP0070-191A-Z1 | DP0070-192A-Z1 |
| Alloy 400    | ¼-18 NPT      | DP0070-1101-M4         | DP0070-1112-M4 | DP0070-1122-M4 | DP0070-111A-M4 | DP0070-112A-M4 |
|              | 3/8-18 NPT    | DP0070-1201-M4         | DP0070-1212-M4 | DP0070-1222-M4 | DP0070-121A-M4 | DP0070-122A-M4 |
|              | ½-14 NPT      | DP0070-1301-M4         | DP0070-1312-M4 | DP0070-1322-M4 | DP0070-131A-M4 | DP0070-132A-M4 |
|              | ¾-14 NPT      | DP0070-1401-M4         | DP0070-1412-M4 | DP0070-1422-M4 | DP0070-141A-M4 | DP0070-142A-M4 |
|              | 1-11.5 NPT    | DP0070-1501-M4         | DP0070-1512-M4 | DP0070-1522-M4 | DP0070-151A-M4 | DP0070-152A-M4 |
|              | 1¼-11.5 NPT   | DP0070-1601-M4         | N/A            | N/A            | N/A            | N/A            |

**Table 7-8: Threaded (RTW) Lower Housings (continued)**

| Material | Size          | Part number            |                |                |                |                |
|----------|---------------|------------------------|----------------|----------------|----------------|----------------|
|          |               | No flushing connection | One ¼-in.      | Two ¼-in.      | One ½-in.      | Two ½-in.      |
|          | 1½-11.5 NPT   | DP0070-1701-M4         | N/A            | N/A            | N/A            | N/A            |
|          | G½A DIN 16288 | DP0070-1901-M4         | DP0070-1912-M4 | DP0070-1922-M4 | DP0070-191A-M4 | DP0070-192A-M4 |

**Table 7-9: Gaskets for Threaded (RTW) Lower Housings**

| Size          | Part number        |                 |                            |                 |                    |                 |                 |
|---------------|--------------------|-----------------|----------------------------|-----------------|--------------------|-----------------|-----------------|
|               | C4401 Aramid Fiber | PTFE            | Barium Sulfate filled PTFE | GHB GRAFOIL     | Ehtylene Propylene | Alloy 400       | Alloy C-276     |
| 2500 psi MWP  | DP0007-24 01-K4    | DP0007-24 01-TF | DP0007-24 01-GY            | DP0007-24 01-GF | DP0007-24 01-ER    | N/A             | N/A             |
| 5000 psi MWP  | DP0007-24 01-K4    | TBD             | DP0007-24 01-GY            | DP0007-24 01-GF | N/A                | N/A             | N/A             |
| 10000 psi MWP | DP0007-24 01-K4    | N/A             | N/A                        | N/A             | N/A                | DP0007-24 03-M4 | DP0007-24 03-HC |

**Table 7-10: Plugs for Threaded (RTW) Lower Housings**

| Material    | ¼-in.           | ½-in.           |
|-------------|-----------------|-----------------|
| SST         | 01199-7000-0502 | 01199-7000-0504 |
| Alloy C-276 | 01199-7000-0602 | 01199-7000-0604 |

**Table 7-11: Sanitary Tank Spud Seal (SSW) Parts**

| Part description                | Part number     |
|---------------------------------|-----------------|
| <b>Sanitary tank spud</b>       |                 |
| 2-in. extension                 | 01199-0061-0001 |
| 6-in. extension                 | 01199-0061-0002 |
| <b>Sanitary tank spud plug</b>  |                 |
| 2-in. extension                 | 01199-0552-0001 |
| 6-in. extension                 | 01199-0552-0002 |
| <b>Sanitary tank spud clamp</b> |                 |
| Clamp                           | 01199-0526-0002 |
| <b>Sanitary tank spud plug</b>  |                 |
| Buna N O-ring                   | 01199-7001-0001 |
| Viton O-ring                    | 01199-7001-0002 |

**Table 7-11: Sanitary Tank Spud Seal (SSW) Parts**  
(continued)

| Part description          | Part number     |
|---------------------------|-----------------|
| Ethylene Propylene O-ring | 01199-7001-0003 |

**Table 7-12: Sanitary Tri Clamp Seal (SCW and VCS) Parts**

| Part description | Part number     |
|------------------|-----------------|
| ¾-in.            | 01199-0035-0105 |
| 1½-in.           | 01199-0035-0115 |
| 2-in.            | 01199-0035-0120 |
| 2½-in.           | 01199-0035-0125 |
| 3-in.            | 01199-0035-0130 |
| 4-in.            | 01199-0035-0140 |

**Table 7-13: Sanitary Thin Wall Tank Spud Seal (STW) Parts**

| Part description          | Part number     |
|---------------------------|-----------------|
| Thin wall spud            | 01199-0073-0001 |
| Clamp                     | 01199-0526-0004 |
| Ethylene Propylene O-ring | 01199-7001-1003 |

**Table 7-14: Sanitary Pipe Mount Seal (UCP) and Sleeve Seal (PMW) Parts**

| Part description                 | Part number     |
|----------------------------------|-----------------|
| PTFE gasket (package of 12)      | 02088-0078-0001 |
| 316 SST weld spud (for UCP)      | 02088-0295-0003 |
| 316 SST plug/heat sink (for UCP) | 02088-0196-0001 |
| 316 SST weld spud (for PMW)      | 02088-0285-0001 |

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