

# Specify the Right Remote Diaphragm Seal Solution for Vacuum Applications

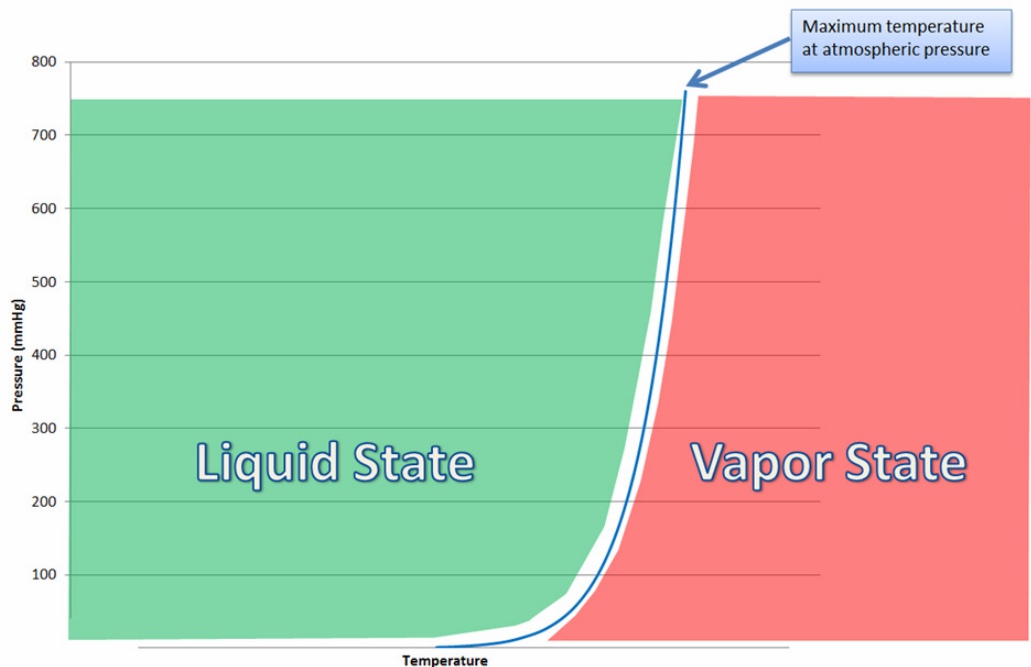
## 1.1 Introduction

When an application operates at pressures below atmospheric pressure (14.7 psia [1 bar-a]), it is important to specify the correct remote seal system and mount it correctly to measure level accurately and reliably. Failure to do so will result in output drift or complete pressure measurement system failure. The combination of high process temperature and vacuum process pressure creates additional requirements when specifying the remote seal system.

## 1.2 Fill fluid selection

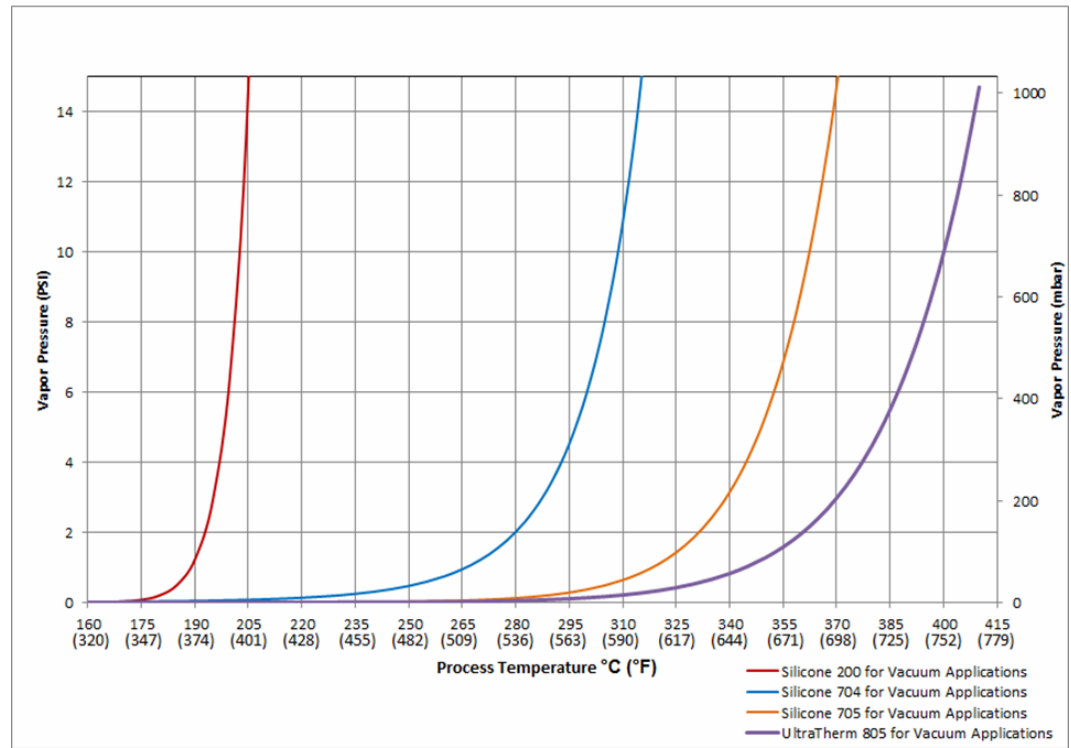
When the process is under vacuum conditions, the fill fluid will vaporize under a lower temperature than when it is operating under normal atmospheric or greater pressure. Emerson offers numerous types of fill fluids for remote seal systems, each fill fluid has a specific vapor-pressure curve. The vapor-pressure curve indicates the pressure and temperature relationship where the fluid is in a liquid or vapor state. Proper seal operation requires the fill fluid to remain in a liquid state.

Figure 1-1. Fill Fluid Vapor Pressure Curve



Emerson offers the following fill fluids specifically for vacuum applications: Silicone 200 for Vacuum Applications, Silicone 704 for Vacuum Applications, Silicone 705 for Vacuum Applications, and UltraTherm™ 805 for Vacuum Applications. These fill fluids are designed to maximize performance and operation range in vacuum applications below 14.7 psia (1 bar-a). They are available with all Rosemount 1199 Remote Seals and all Rosemount Level Transmitters. UltraTherm 805 for Vacuum Applications is only available with the Rosemount 3051SAL Thermal Range Expander system. The vapor pressure curve for fill fluids for vacuum applications is shown below.

**Figure 1-2. Vacuum Optimized Fill Fluids Vapor Pressure Curves**

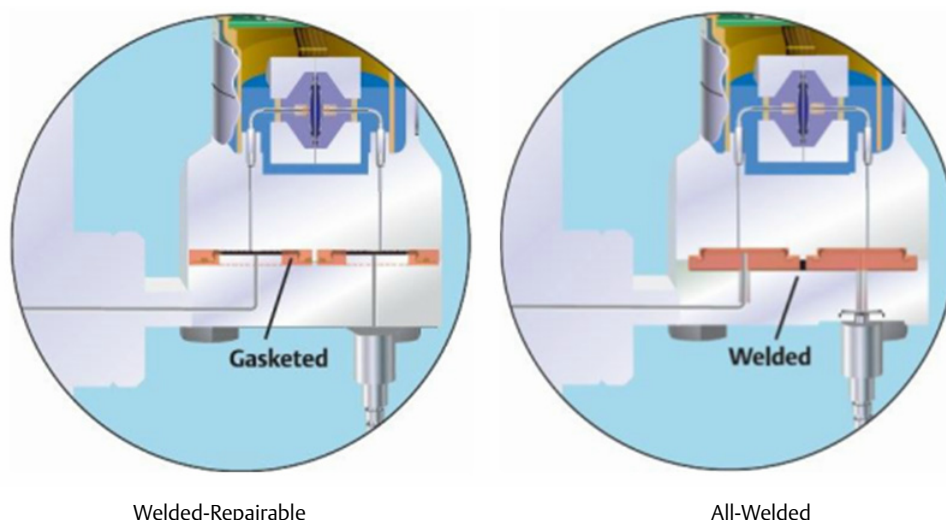


Refer to Rosemount DP Level Fill Fluid Specifications for more information regarding Rosemount fill fluids.

## 1.3 Seal system construction

Emerson offers Rosemount Level Transmitters and 1199 seals with welded-repairable and all welded seal system construction methods. In vacuum applications below 6 psia (413.7 mbar-a), the all welded seal system construction.

Figure 1-3. Seal Construction Type



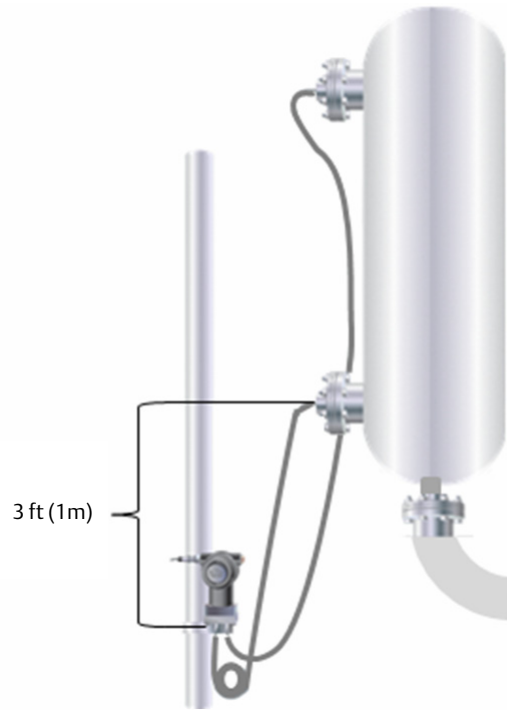
Gasketed connections have the potential to draw air into the capillary system, resulting in drift or complete pressure measurement system failure. The all welded seal system construction is designed specifically for deep vacuum applications. In this construction, the sensor module gaskets are removed and a disk is fully welded over the sensor isolators, eliminating the possibility of air being drawn into the seal system in deep vacuum conditions. This robust design is required for vacuum pressures below 6 psia (413.7 mbar-a).

## 1.4 Mounting position

Mounting the pressure transmitter at or below the bottom vessel tap is an important step to maintain a stable measurement in vacuum applications. The static pressure limit for a differential pressure or coplanar gage transmitter is 0.5 psia (34.5 mbar-a), which ensures the transmitter sensor module fill fluid (typically Silicone 200) remains within the liquid phase of the vapor pressure curve.

If the vessel static limit is below 0.5 psia (34.5 mbar-a), mounting the transmitter below the bottom tap creates a capillary fill fluid head pressure on the module. A general rule of thumb for applications going below 0.5 psia (34.5 mbar-a) is to always mount the transmitter approximately 3 feet (1 meter) below the bottom tap of the vessel. The actual head pressure can be calculated by multiplying the vertical distance between the bottom tap and transmitter by the specific gravity of the fill fluid. Finally, validate the system in your application using Instrument Toolkit™ Software to ensure the system will perform correctly under your operating conditions. In-line gage pressure transmitters do not have this restriction and can be used to a full vacuum of -14.7 psig/0 psia (-1.01 bar-g/0 bar-a).

Figure 1-4. Pressure Transmitter Mounting



## 1.5 Emerson solutions

### 1.5.1 Fill fluid preparation

Emerson has implemented proprietary processes to eliminate impurities and contaminations in the fill fluid, such as air and water. This additional processing ensures stable measurement performance under extreme vacuum conditions.

### 1.5.2 Stringent manufacturing processes

The 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. The process also monitors for any station leaks and confirms the fill quality of the finished seal system.

### 1.5.3 Electronic Remote Sensors (ERS™) System

For traditional systems using Differential Pressure transmitters, the minimum static pressure limit is 0.5 psia (34.5 mbar-a). This means that the transmitter must be remotely mounted below the bottom tap in high vacuum applications. The ERS system can be specified with In-Line or Coplanar absolute sensor designs that are not restricted by this limit. This allows ERS systems to be directly mounted with no capillary.

## 1.6 Summary

Implementing the right combination of seal system construction, fill fluid specification, and transmitter mounting position can ensure lasting stable measurement performance for high temperature vacuum applications. Rosemount is committed to providing safe, reliable, high-performing products for the most demanding and extreme applications. If you have questions on a vacuum installation, contact your local Emerson Process Management representative for application assistance.

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