Technical Note
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Selecting the correct process seal for Rosemount™ 5300 Level Transmitter

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Introduction

Rosemount 5300 Level Transmitter probes are available with a variety of process seal connections to meet pressure and temperature demands and other process conditions of level applications. This document outlines the structural differences between the process seals, the pressure and temperature limits, and guidelines for selection of the correct process seal.

Overview of the process seal options

The Rosemount 5300 is designed to be used in a wide variety of level applications. To meet the installation and application demands, five types of process seals are available and are chosen as part of the model code sequence.

Table 1: Process Seal Options

Process seal type	Model code
Standard Temperature (Std)	S
Medium Temperature / Medium Pressure (MTMP)	M
High Pressure (HP)	P
High Temperature / High Pressure (HTHP)	H
Cryogenic Temperature (C)	C

Most application conditions can be met with the Standard process seal. However, some more extreme temperature or pressure conditions will require the use of a seal designed for those conditions.

When designing a process seal, it's crucial to ensure that the microwave signal can pass through the seal with minimal degradation. Commonly used materials for this purpose include PTFE and ceramic alloys.

PTFE is known for its excellent chemical compatibility and microwave properties. However, it has limitations regarding pressure and temperature capabilities. On the other hand, ceramic alloys offer strong mechanical capabilities but have a higher dielectric constant, which leads to more signal degradation compared to PTFE. Therefore, a balance must be struck between selecting a material that supports microwave function and one that provides a robust pressure and temperature seal.

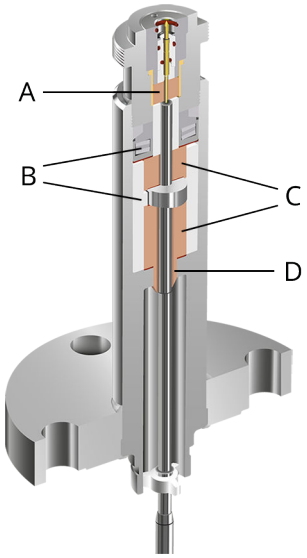
Contents

Extreme pressure and temperature process seals

The Medium Temperature/Medium Pressure, High Pressure, High Temperature/High Pressure, and Cryogenic Temperature process seals are designed to prevent leakage and perform reliably when exposed to extreme process conditions. Materials and design are selected to avoid stress fractures commonly induced by changes in temperature and pressure conditions.

The primary pressure seal portion is the same on all four seals. The use of ceramic provides the temperature and pressure seal and serves as the primary microwave transport material. The use of ceramic is restricted to areas where the pressure and temperature sealing is necessary. Figure 1 describes the general design of the process seal.

Figure 1: Extreme Temperature and Pressure Seal Design



A. Brazed hermetic/gas-tight ceramic seal is isolated from the process and is unaffected by temperature shocks, variations and outside forces on the probe.
B. Flexible probe load and locking system compensates for stress and protects the ceramics.
C. Insulators and graphite gaskets provide a robust thermal and mechanical barrier and offer chemical resistance.
D. Sleeve for condensation and dirt protection.

The four versions differ in the area that has direct contact with the process. The following sections provide a description of the different process seal options.

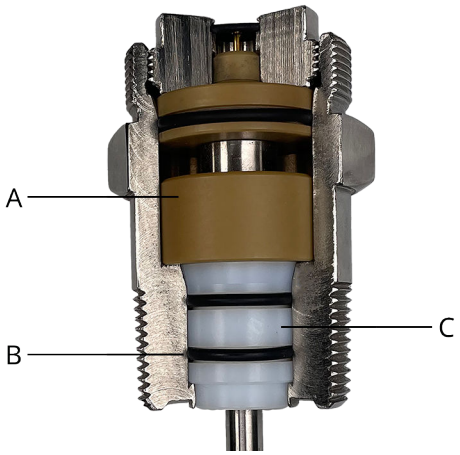
Process seal construction

Standard Temperature (Std) process seal

The Standard process seal is designed for applications up to 302 °F (150°C). The wetted parts include a body and probe constructed of a combination of PTFE, Polyetherimide (PEI) plastics, and 316 SST. The body and the probe are also available with Alloy 400, Alloy-276, Alloy 2205, or Alloy 825.

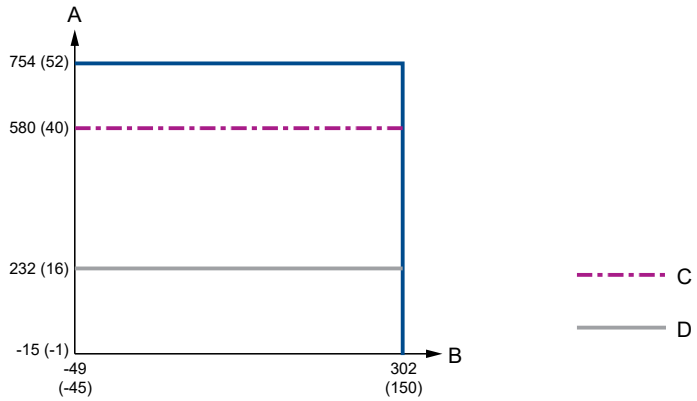
It is available with a choice of O-rings for process compatibility. O-ring materials include Fluoroelastomer (FKM), Ethylene Propylene (EPDM), Kalrez®, Nitrile Butadiene (NBR), and Fluorsilicone (FVMQ). Figure 2 shows the cut-out of the Standard process seal.

Figure 2: Standard Seal



A. Polyetherimide (PEI) bushing
B. O-rings
C. PTFE process protection

Figure 3: Standard Tank Connection (Code S)



A. Pressure psig (bar)
B. Temperature °F (°C)
C. O-ring material code B (Nitrile Butadiene)
Overfill prevention code U1 (Overfill prevention according to WHG/TUV)
Protective plate: Alloy C-276 (Material of construction code 2) or Alloy 400 (Material of construction code 3)
D. Protective plate: PTFE (Material of construction code 7)

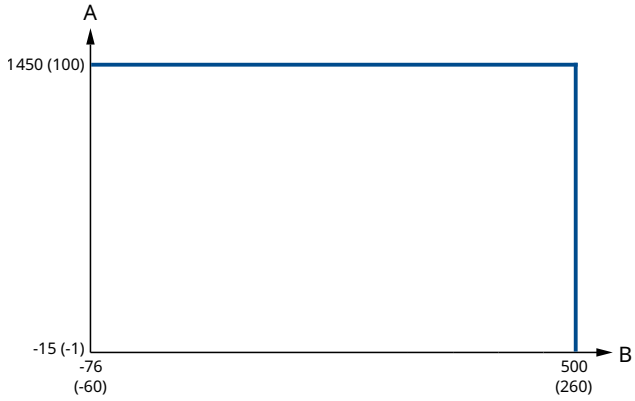
Medium Temperature / Medium Pressure (MTMP) process seal

The MTMP process seal is designed for applications up to 500 °F (260 °C). The wetted parts include a body and probe in 316 SST, Ceramic (Al_2O_3), an Alloy 718 spring, Graphite, and PTFE. The body and the probe are only available with SST. There are two slightly different versions available. The single lead version has a large PTFE filled cavity. The coaxial version has a smaller PTFE drip-off sleeve similar to the ceramic drip-off sleeve in the HTHP seal.

MTMP is the preferred seal for pressure applications in the range 754 to 1450 psi (52 to 100 bar) where the temperature is below 500 °F (260 °C). This seal is O-ring free, making it an ideal choice for applications where the temperatures are below 302 °F (150°C) but where the process media environments prevent the use of O-rings.

Figure 4: Medium Temperature and Pressure Process Seal - Coaxial Version

Figure 5: MTMP - Medium Temperature and Medium Pressure (Code M)



A. Pressure psig (bar)
B. Temperature °F (°C)

High Pressure (HP) process seal

The HP process seal's pressure-retaining components are designed for occasional temperatures up to 752 °F (400 °C), with a maximum operating temperature of 500 °F (260 °C). The wetted parts include a body and probe in 316 SST, Ceramic (Al_2O_3), an Alloy 718 spring, Graphite, and PTFE. The body and probe are also available in Alloy-276, Duplex 2205 and Alloy 825.

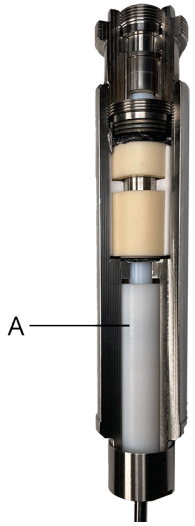
There are two slightly different versions available. The single lead version has a large PTFE filled cavity. The coaxial version has a smaller PTFE drip-off sleeve similar to the ceramic drip-off sleeve in the HTHP seal.

The PTFE process protection sleeve prevents highly viscous or dirty products from entering the seal area. The PTFE material fills the open space to eliminate plugging with minimal degradation of the microwave signal.

For this reason the HP seal is the preferred seal in applications with a flange temperature less than 500 °F (260 °C) where sticky or dirty fluids may enter the recessed area, e.g. during times of overfill or in submerged probe interface applications.

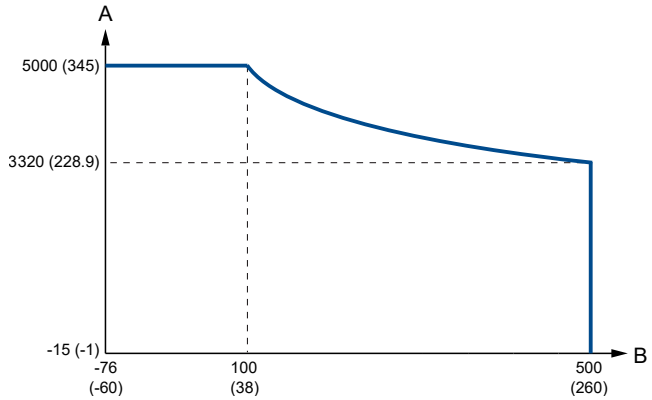
The coaxial probe uses a smaller PTFE drip-off sleeve. Since the coaxial probe can only be used in clean applications and is intended for fluids with very low dielectric constants, this small PTFE part prevents condensation droplets from occurring in the most critical area which could cause signal degradation.

Figure 6: High Pressure Process Seal – Single Probe Version



A. PTFE process protection sleeve

Figure 7: HP - High Pressure Tank Connection (Code P)



A. Pressure psig (bar)
B. Temperature °F (°C)

High Temperature / High Pressure (HTHP) process seal

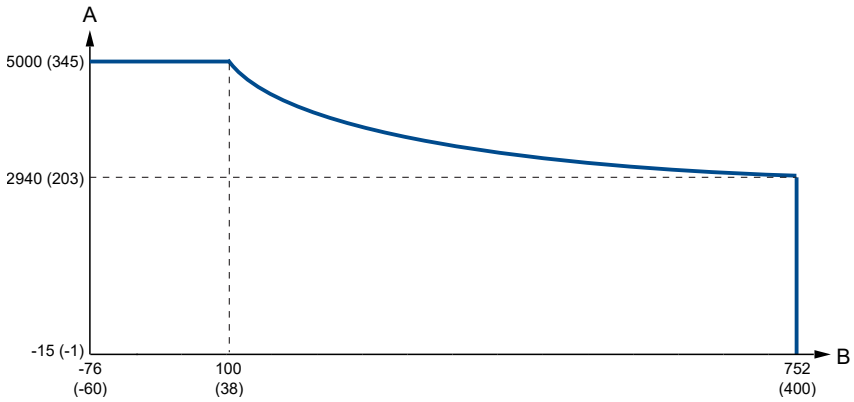
The HTHP seal is designed for applications up to 750 °F (400 °C). The wetted parts include a body and probe in 316 SST, Ceramic (Al_2O_3), an Alloy 718 spring, and Graphite. The body and probe are also available in Alloy-276, Duplex 2205 and Alloy 825.

The ceramic sleeve below the primary pressure seal works as a drip-off sleeve and prevents liquid droplets from blocking the microwave signal transmission. The ceramic seal allows good transmission of microwave signals while also meeting the high temperature requirements.

For the HTHP seal, there are two additional versions designed for Dynamic Vapor Compensation (DVC). These versions are used to compensate for vapor space dielectric in steamy applications. For more information about using Rosemount 5300 with Dynamic Vapor Compensation in high pressure saturated steam applications, refer to High Pressure Steam Applications Technical Note.

Figure 8: High Temperature / High Pressure Process Seal – DVC Version Single Rigid

Figure 9: HTHP - High Temperature and High Pressure Tank Connection (Code H)



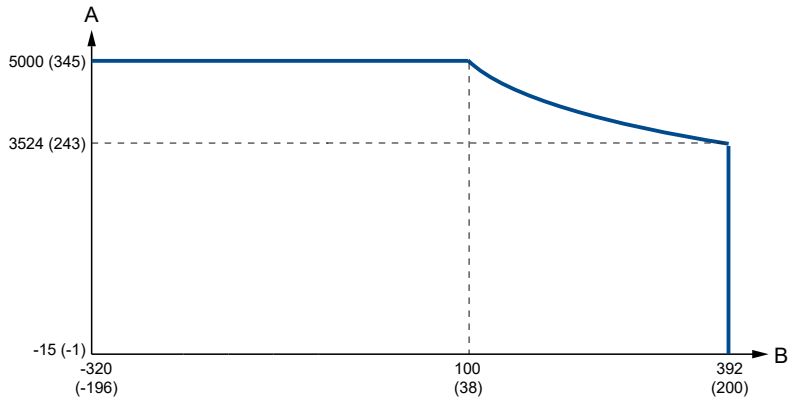
A. Pressure psig (bar)
B. Temperature °F (°C)

Cryogenic Temperature (C) process seal

The Cryogenic process seal is design for applications down to -320 °F (-196 °C). The wetted parts include a body and probe in 316 SST, Ceramic (Al_2O_3), an Alloy 718 spring, Graphite, and PTFE. The cryogenic seal is constructed using special welding techniques suitable for cryogenic applications, otherwise it is identical to the HP process seal.

Note
The Cryogenic Temperature seal is not available in Alloy-276, Duplex 2205, Alloy 825, or Alloy 400.

Figure 10: C - Cryogenic Temperature Tank Connection (Code C)



A. Pressure psig (bar)
B. Temperature °F (°C)

Process seal wetted materials

Table 2 summarizes the wetted materials associated with each process seal.

Table 2: Wetted Materials in each Process Seal

Wetted materials	Standard	MTMP	HP	HTHP	C
SST	Yes	Yes	Yes	Yes	Yes
Alloy C-276 (UNS N10276)	Yes	No	Yes	Yes	No
Alloy 400 (UNS N04400)	Yes	No	No	No	No
Duplex 2205 (EN 1.4462/UNS S31803)	Yes	No	Yes	Yes	No
Alloy 825 (UNS N08825)	Yes	No	Yes	Yes	No
PTFE	Yes	Yes	Yes	No	Yes
Ceramic (Al_2O_3)	No	Yes	Yes	Yes	Yes
O-rings (choice of five)	Yes	No	No	No	No
Alloy 718 spring	No	Yes	Yes	Yes	Yes
Graphite	No	Yes	Yes	Yes	Yes

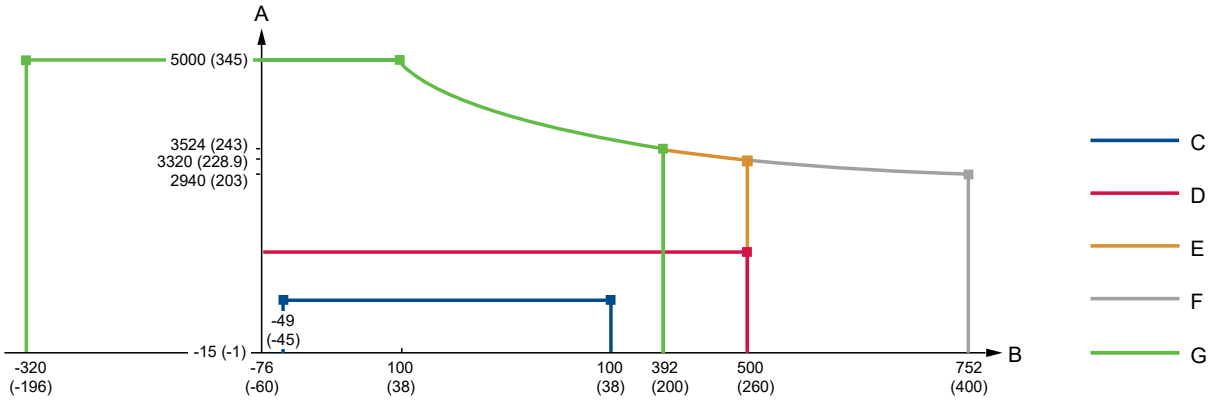
Process seal selection guidelines

The Rosemount 5300 process seals offer a wide range of pressure and temperature capabilities. In general, the basic recommendation for process seal selection is to choose the lowest rated one that can meet the temperature and pressure needs. This approach achieves two things. It will ensure the greatest signal availability for the measurement since the smallest amount of PTFE or ceramic is used. It will also ensure that sticky heavier products that can occur at lower temperatures will not build up in recessed areas of the seals.

Applications in the range 754 to 1450 psi (52 to 100 bar), which previously required the HP seal, can now be quoted with MTMP seal. For full specification and all seal rating, please refer to the Rosemount 5300 Product Data Sheet.

In the case of applications below -76 °F (-60 °C), only the cryogenic process seal should be used due to the special welding requirements.

Figure 11: Recommended Choice of Process Seal Type



A. Pressure psig (bar)
B. Temperature °F (°C)
C. Standard Temperature (Std) process seal
D. Medium Temperature / Medium Pressure (MTMP) process seal
E. High Pressure (HP) process seal
F. High Temperature / High Pressure (HTHP) process seal
G. Cryogenic Temperature (C) process seal

Application selection guidelines

Table 3 provides a general recommendation for selection of a suitable process seal depending on application.

Note that exceptions may occur and each installation should be individually reviewed for proper selection.

Table 3: Suitable Seal Types for Different Applications

Standard	MTMP/HP	HTHP	C
■ Accumulators ■ Knock-out pots ■ Separators ■ Lube oil ■ Feed tanks ■ Settling tanks ■ Desalters ■ Scrubbers ■ Catalyst hoppers ■ Towers (upper regions) ■ Amine ■ Sumps ■ Skim tanks	■ Compressor systems ■ Knock-out pots ■ Scrubbers ■ Debutanizer de-ethanizer ■ De-ethanizer tower bottoms ■ De-propanizer ■ Cold HP (High Pressure) separator ■ Coalescers (Water Boot Separator) ■ Absorber ■ Deethanizer Tower ■ De-propanizer ■ OH Accumulator ■ Towers (lower regions) ■ Ammonia	■ Steam systems measurements such as boilers ■ Steam separators ■ Feed water applications ■ Hot LP (Low Pressure) separators	■ Liquid Gases

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