Technical Note
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Combining Guided Wave Radar with Rosemount 9901 Chambers to provide a Complete Point Solution

Introduction

This document is intended to assist with best practices in sizing and installing Rosemount Guided Wave Radar (GWR) instruments with Rosemount 9901 Chambers.

The Rosemount 9901 chamber is designed for complete compatibility with Rosemount level measurement instruments. A combined Rosemount 9901 chamber and Rosemount GWR solution (also known as complete point solution) is designed for safety, meeting highest industry standards, and delivers an integrated bolt-on level solution.

This complete point solution offers these advantages:

- Complete measurement solution, ready to install out of the box
- Designed and built to meet the pressure and temperature (P/T) rating for the tank connection
- Built with traceable material
- Manufactured by qualified welders and welding procedures
- Consolidated and configured at factory before shipping (if XC option is selected)
- Site customer inspection option
- Proven performance and technology

ROSEMOUNT®

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Process Management

Complete Point Solution Data Sheet

Model codes

	Tag	Model code (see Product Data Sheet)
GWR		
9901		

Application data

Media	
Design temperature	
Design pressure	
Operating temperature	
Operating pressure	

Material of construction

GWR	
9901	

Chamber size and design

(Example: 3 in. / 80 mm (DN80)

(Example: T-Piece Design

Size	
Design	

Probe length (see Table 5 and Table 6)(1)

(1) *Dynamic Vapor Compensation option requires longer dimension (A) according to Table 5 or Table 6 and G1/G2 options in 9901.*

Centering disc (see Table 7)

(Example: 4 in. PTFE)

Size/Type	

Special request

Instrument connection(1)

(Example: Std seal)

(Example: 4 in. flange RF)

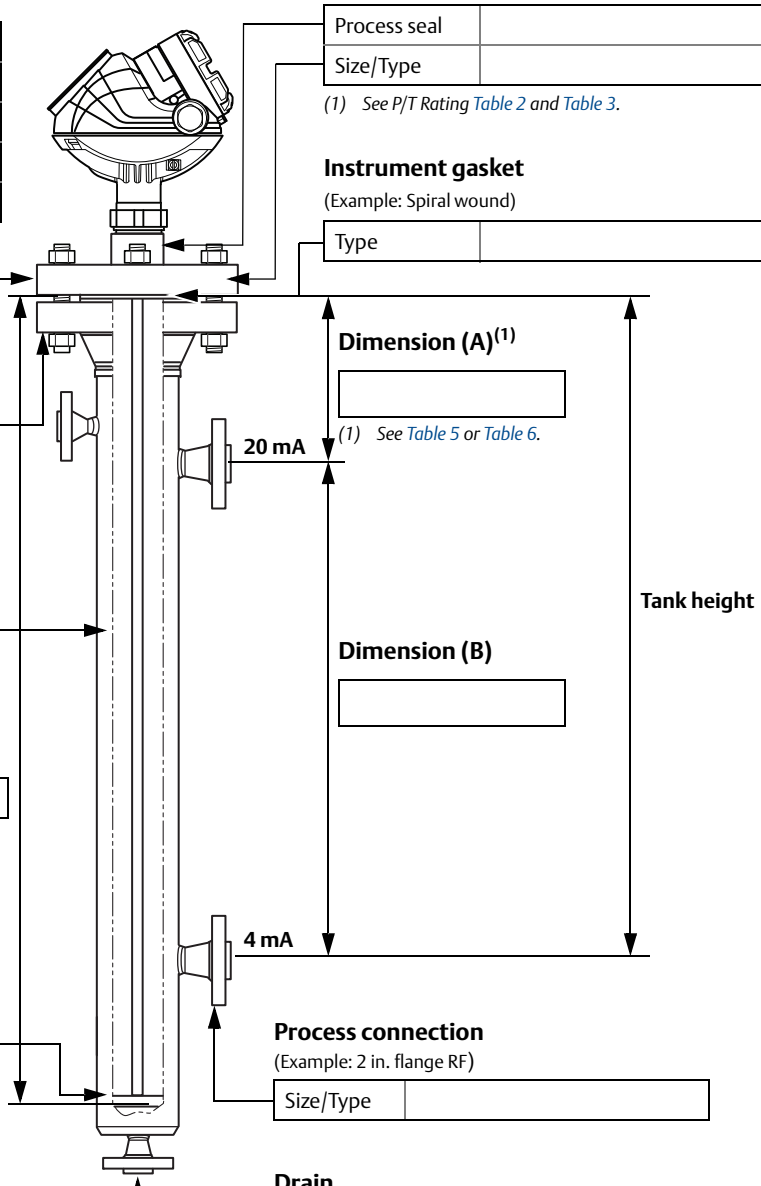
Process seal	
Size/Type	

(1) *See P/T Rating Table 2 and Table 3.*

Instrument gasket

(Example: Spiral wound)

Type	



Process connection

(Example: 2 in. flange RF)

Size/Type	

Drain

(Example: 3/4 in. flange RF)

Size/Type	

Vent

(Example: 3/4 in. flange RF)

Size/Type	

Installation guidelines for guided wave radar in chamber

Chambers are used to obtain a level measurement from the outside of a process vessel. It is important that the level measurement within the chamber replicates the level inside the vessel. To achieve this, there are some key considerations: Chamber and connection sizes, GWR probe selection and installation can all impact the level measurement accuracy.

GWRs may be used in 2-in., 3-in., or 4-in. diameter chambers, although the 9901 is only available in 3-in. and 4-in. options. Emerson encourages the use of larger diameter chambers to avoid potential issues described later in this document.

Several parameters can impact level measurement results in chambers. See Table 1 for size considerations.

Table 1. Installation parameters and chamber size summary

Installation parameter	Chamber diameter	
	3 in.	**4 in.**
Rigid probe (type 4A or 4B)(1)	OK	OK
Flexible probe(2)	Fair	OK
Dynamic Vapor Compensation probe (type 3V)	OK	OK
Side connections, large (2”)	Fair	OK
Side connections, small (1”)	OK	OK
Low DC fluid (down to 1.4)	OK	OK
High DC fluid	OK	OK
Rapid fill rates	OK	OK
Boiling, turbulences	Fair	OK
Gas lift	Fair	OK
Viscous, clogging fluids	Heat trace	Heat trace

(1) Use centering disc.
(2) Use centering disc at the end of the weight.

The chamber length is specified to accommodate the desired measurement span. While overall weight and cost are key considerations, ultimately the reliability of the measurement may be impacted by the diameter of the chamber, the connections to it and the ambient conditions.

Some common issues seen in chamber applications include:

Out-gassing effects

If a fluid is subject to out-gassing effects when the system pressure drops, then gas bubbles may cause the level surface to be pushed artificially higher in the chamber. A larger chamber diameter is more tolerant and any bubbles have less effect on the liquid level.

Chamber diameter

Narrow diameter chambers are more susceptible to the probe touching or getting close to the wall of the chamber, especially as the length increases. Centering discs may be used along the length of the probe to provide additional stability. These can be places for dirt to build up, so they should be used carefully.

Rigid probes are preferred in narrow chambers, but these must be installed carefully in order to avoid bending. If flexible probes are used, then accommodation must be made to pull the probe taut so that it does not touch the wall.

Temperature changes

The fluid in a chamber may change temperature, causing the volume within to expand or contract, thus changing its representation of the level. Use of insulation/ lagging around the chamber can help to prevent this effect.

Condensation from vapors

Condensation from vapors can result in the build-up of additional fluids in the chamber that are not present in the vessel. This is especially common with light end hydrocarbon vapors where the fluid stratifies on top of the measured fluid. Insulation of the chamber can reduce this occurrence.

Fluid circulation

With all chamber installations, good fluid circulation will ensure a good representation of the actual level. To accomplish this, minimize any restrictions between the vessel and the chamber and use both larger connections and short process connection piping distances. Insulation and heat tracing will minimize the temperature change and prevent vapor condensation, freezing, or solidification of fluids. If the fluid is viscous, dirty, or tends to build up debris, then a flushing mechanism is essential.

Probe and chamber selection guidelines

For most applications, single probes are the best choice. When a GWR transmitter is used in a chamber, the microwave signals are guided and contained within the chamber. This results in a stronger signal from the fluid surface which is an advantage for turbulent and/or low dielectric fluids. Single probes are less susceptible to buildup and are more tolerant in the case of coating than twin or coaxial probes. In very low dielectric but clean fluids, such as liquefied gases like LNG, a coaxial probe may be used.

In steam applications, such as high pressure feed-water heaters and boilers, when the pressure is greater than 400 psi (27.6 bar), the dielectric of the steam vapor will impact the level accuracy. To compensate for this, a special probe (type 3V for 3 or 4" chambers) with a built-in reference reflector should be used. This probe allows the measurement of the steam dielectric by using the built-in reference reflector to complete an on-line calculation of the steam dielectric.

When using the Dynamic Vapor Compensation probe, it is important that the reference reflector is always above the liquid surface and away from any potential disturbances. For this reason, the chambers used for the Dynamic Vapor Compensation probe must have a longer top dimension (A), see Figure 5 on page 8.

How to select and size your chamber and GWR

Step 1. Select a 9901 chamber

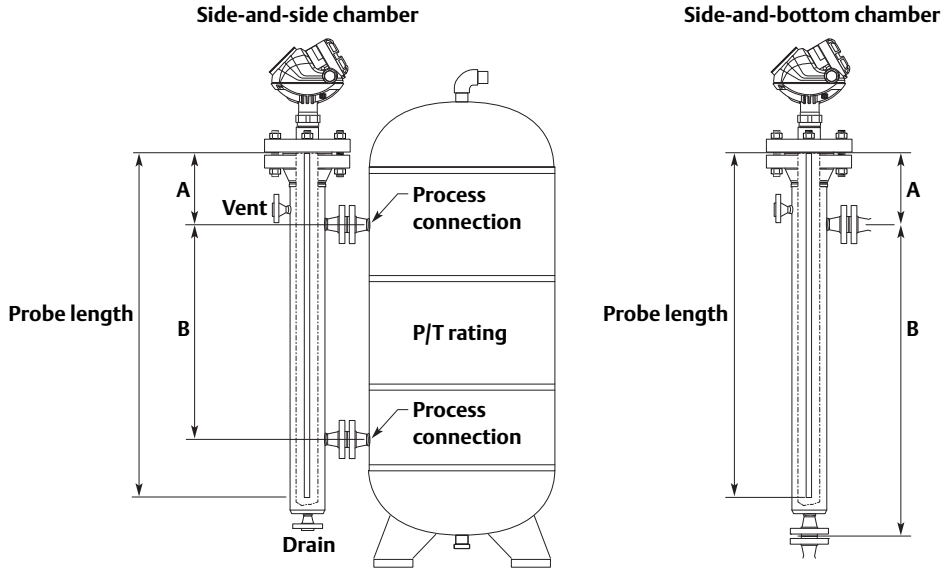
For use with a GWR, select option 9901G. For full specifications, refer to the 9901 Product Data Sheet 00813-0100-4601.

The chamber process connections and instrument connection should be sized to match the vessel and instrument connections respectively.

The location of the bottom process connection will determine the chamber style (side-and-side or side-and-bottom process connections). The chamber center-to-center dimension (B) is critical and must match the process vessel center-to-center, see Figure 1.

Once total chamber length is determined, it is important to verify that there is sufficient clearance above and below the chamber, allowing for GWR, drain etc.

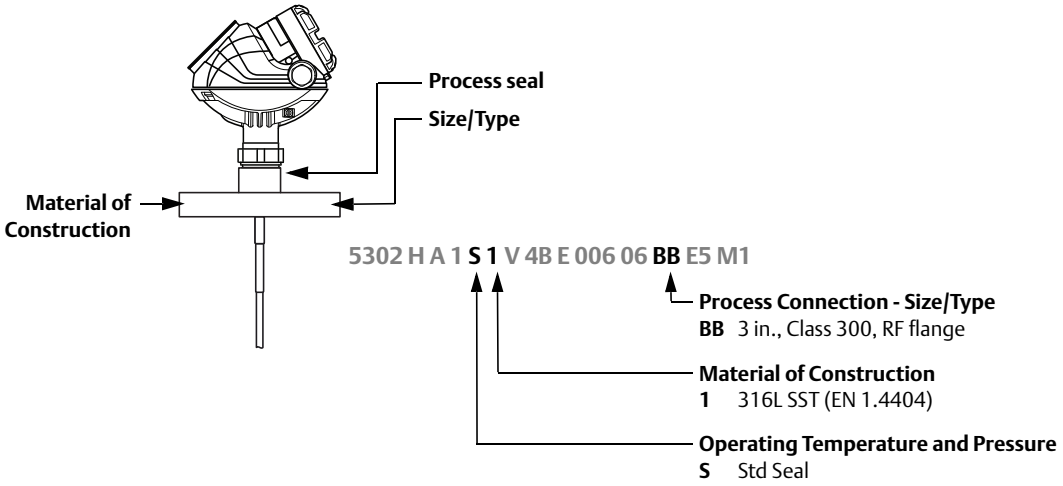
Figure 1. Key chamber considerations



Step 2. Select a GWR transmitter

Select GWR material of construction for flange, process seal, and flange size/rating, see model code example in Figure 2.

Figure 2. Model code example - GWR instrument connection and material of construction



For full GWR specifications, refer to the Product Data Sheets.

- Rosemount 3300 Series Product Data Sheet (Document No. 00813-0100-4811)
- Rosemount 3308 Series Product Data Sheet (Document No. 00813-0100-4308)
- Rosemount 5300 Series Product Data Sheet (Document No. 00813-0100-4530)

Step 3. Verify pressure/temperature (P/T) rating of complete solution

The final P/T rating of the complete solution is limited by the lowest rated component of the whole system. This could be a flange or it could be the process seal and o-ring of the GWR, see Figure 3.

Figure 3. Pressure/temperature (P/T) rating considerations

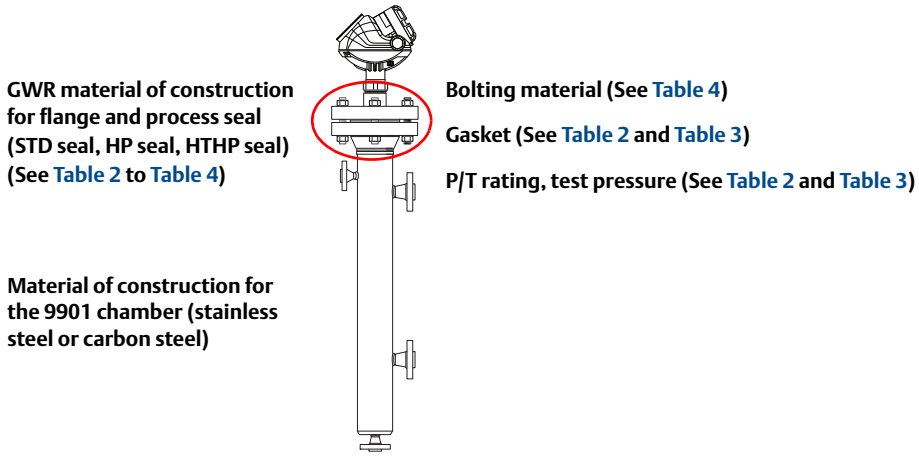


Table 2. Std seal - Pressure/Temperature rating for GWR 316Lflange welded connections when used with stainless steel or carbon steel 9901 chamber

ASME B16.5	Gasket	P/T @ RT		P/T @ 150 °C/300°F		TP @ RT	
Class		Std seal		Std seal(1)		Std seal	
		Bar	Psi	Bar	Psi	Bar	Psi
150#	1a	15.8	230	12.1	175	23.7	345
300#	1a	41.3	600	31.3	455	62.0	900
600#	1a	41.3	600	40	580	62.0	900

(1) Final min and max temperature rating depends on o-ring selection (for more information see Product Data Sheets).

RT: Room temperature
TP: Test pressure
Std seal: Standard process seal
1a: Soft gasket (9901 Instrument Gasket code 1)

Table 3. HTHP/HP seal - Pressure/Temperature rating for GWR 316L flange welded connections when used with stainless steel or carbon steel 9901 chamber

ASME B16.5	Gasket	P/T @ RT		P/T @ 200 °C/400°F		P/T @ 400 °C/750°F		TP @ RT	
Class		HTHP/HP seal		HP seal		HTHP seal		HTHP/HP seal	
		Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi
150#	1a/1b	15.8	230	11.2	160	6.5	95	23.7	345
300#	1a/1b	41.3	600	29.2	420	24.3	355	62.0	900
600#	1a/1b/RTJ	82.7	1200	58.2	840	48.6	705	124	1800
900#	1a/1b/RTJ	124.1	1800	87.5	1260	72.9	1060	186.2	2700
1500#	1a/1b/RTJ	206.8	3000	145.8	2100	121.5	1765	310.2	4500

RT: Room temperature
TP: Test pressure
HP seal: High pressure seal
HTHP seal: High temperature/high pressure seal
Std seal: Standard process seal
1a: Soft gasket (9901 Instrument Gasket code 1)
1b: Spiral wound gasket (9901 Instrument Gasket code 2)
RTJ: Ring joint (9901 Instrument Gasket code 3)

Table 4. Standard bolting materials supplied with Rosemount GWR and 9901 chamber

Material of construction in GWR´s model code	Bolting material(1) (2)
SST, B16.5, flange connection(3)	Stainless steel SA193 B8M Cl. 2
Alloy C-276 plate design with backing flange in stainless steel	Stainless steel SA193 B8M Cl. 2
SST EN1092-1, flange connection(3)	Stainless steel SA193 B8M Cl. 2

(1) For other types of bolting materials, please contact customer care in your world area.
(2) For bolt torques, see Rosemount 9901 Reference Manual (Document No. 00809-0100-4601).
(3) The Rosemount GWR can be paired with stainless steel or carbon steel chamber. For other materials, please contact customer care in your world area.

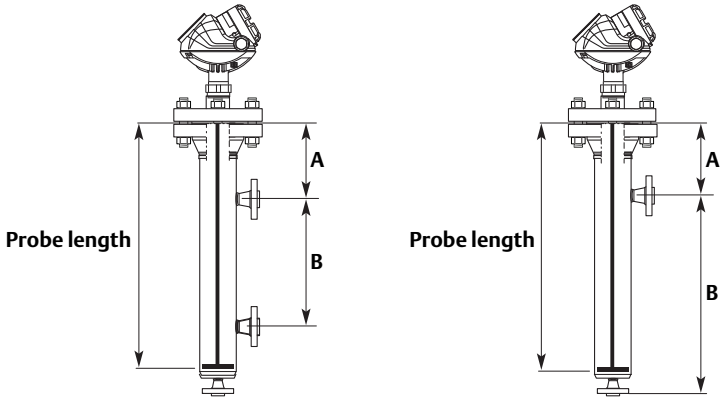
For other materials, see Product Data Sheet for availability or contact Customer care in your world area.

Step 4. Determine probe length

Standard probes

Rosemount 9901 chambers are designed to maximize level measurement reliability over the desired measurement span. The upper and lower portions of the chambers are designed to accommodate the upper and lower transition zones of the GWR for any probe type and application. Therefore, the probe length is determined by the center-to-center dimension (B) plus a common standard length adder for each chamber style (refer to Table 5 or Table 6). This ensures that the probe is long enough to extend into the lower portion of the chamber with a small amount of clearance from the base. If the probe is too long, it might get bent when installed into the chamber, causing incorrect readings.

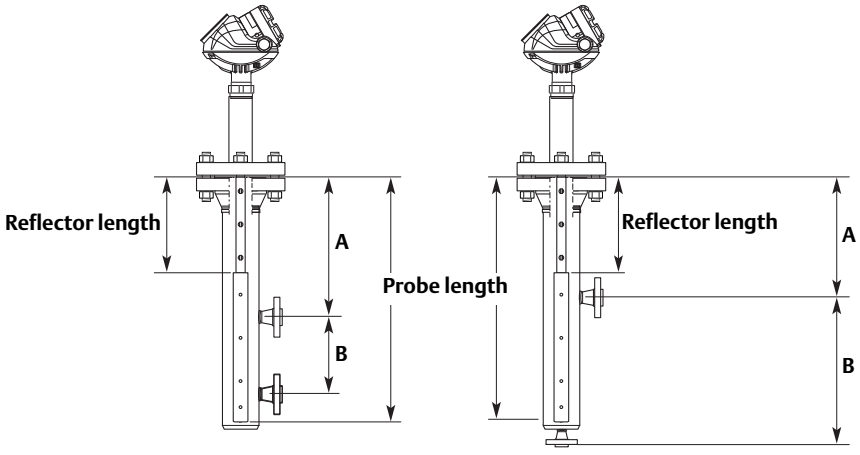
Figure 4. Side-and-side and side-to-bottom chambers for standard probes



Dynamic Vapor Compensation probes

New options are available with the Rosemount 9901 chamber for use with Dynamic Vapor Compensation probes. The reference reflector is contained within the upper section of the chamber so the Rosemount 9901 requires a longer top dimension (A). The Rosemount 9901 chamber has two options available for dimension (A), G1 and G2, when used with a Dynamic Vapor Compensation probe. The G1 option for the 9901 is for use with the short reflector while the G2 option is for use with the long reflector. Refer to Table 5 or Table 6.

Figure 5. Side-and-side and side-to-bottom chambers for Dynamic Vapor Compensation probes



Calculating the probe length for compatibility with 9901G Chamber

It is very important to ensure that the probe length of the GWR is compatible with the chamber length to ensure correct operation.

To size the probe length of a Rosemount GWR, first identify the chamber process connection orientation, process connection center-to-center dimension (B) and the dimension (A), which is determined by the selected chamber. The probe length for a given process connection center-to-center dimension is identified in Table 5 and Table 6.

Table 5. Probe length determination for side-and-side chamber

Chamber	Dimension A	Probe Length
9901 Standard	275 mm (10.8 in.)	B + 48 cm (19 in.)
9901 with option G1(1)	560 mm (22 in.)	B + 65 cm (25 in.)
9901 with option G2(2)	710 mm (27.5 in.)	B + 92 cm (36 in.)

(1) For use with Dynamic Vapor Compensation probe and short reference reflector (GWR option code R1).
(2) For use with Dynamic Vapor Compensation probe and long reference reflector (GWR option code R2).

Table 6. Probe length determination for side-to-bottom chamber

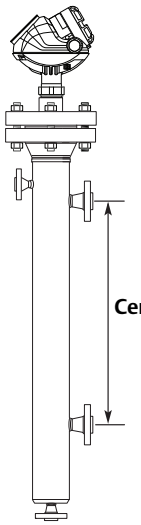
Chamber	Dimension A	Probe Length
9901 Standard	275 mm (10.8 in.)	B + 10 cm (4 in.)
9901 with option G1(1)	560 mm (22 in.)	B + 26 cm (10 in.)
9901 with option G2(2)	710 mm (27.5 in.)	B + 53 cm (21 in.)

(1) For use with Dynamic Vapor Compensation probe and short reference reflector (GWR option code R1).
(2) For use with Dynamic Vapor Compensation probe and long reference reflector (GWR option code R2).

Probe length calculation in metric - worked example

If the Rosemount 9901 (side-and-side type) is specified in metric units, GWR probe length equals center-to-center dimension + 48 cm.

Note that the chamber dimensions require more measurement precision in order to perfectly match the center-to-center dimensions of the process vessel connections. Thus, the Rosemount 9901 is sized to within a millimeter (metric) or 1/10 in. (English). The GWR probes however do not require this precision and are sized to within 1 cm (metric) or 1 in. (English).



M = Metric
01500 = 1500 mm

9901G1C3ABR1B1ABR**M01500**D9RV9RWEQ81Q73XC

01: Meters **500: Millimeters**

Center-to-center dimension (B) = 1500 mm

If GWR Unit is M = Metric then:

9901 center-to-center = M01500 (B = 150 cm)

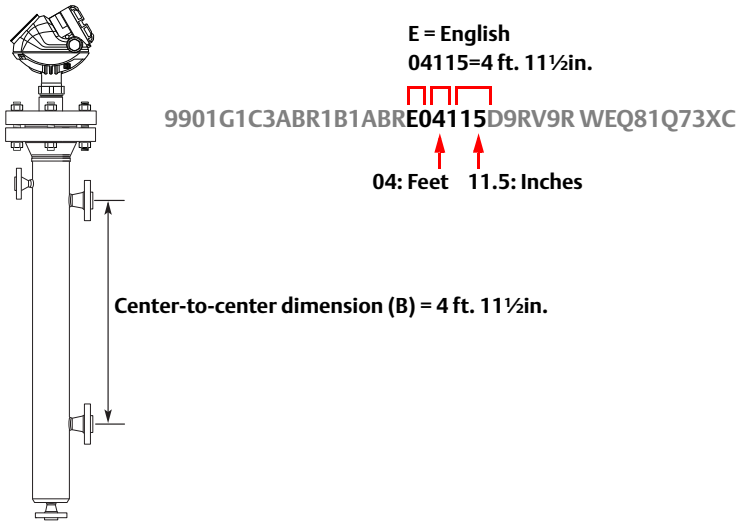
Probe length (in cm) = B + 48 cm = 150 cm + 48 cm = 198 cm

5300 model code probe length = 5301HA1S1V4B**M00198**BBE5M1

Note
For this GWR model, dimensions are in cm. Probe length to order is 198 cm. This is defined as M00198 in the 5300 GWR model code or M0198 in the 3300 GWR model code.

Probe length calculation in English units- worked example

If the Rosemount 9901G (side-and-side process connections) is specified in English units, the standard probe length is the center to center dimension + 19 in. Please note that for GWR's, the probe length in the model code is specified in feet and whole inches.



If GWR Unit is E = English then:

9901 center-to-center = E04115 (B = 4 ft. 11.5 in.)

Probe length (in inches) = B + 19 in. = 4 ft. + 11.5 in. + 19 in. = 6 ft. 6.5 in.

In this example the probe length would need to be 6 ft. 6.5 in. which should be rounded to 6 ft. 6 in.

Therefore probe length = 6 ft. 6 in.

5300 model code probe length = 5301HA1S1V4BE00606BBE5M1

Step 5. Select centering discs and weight

To prevent the probe from contacting the pipe wall in the chamber, a centering disc is recommended for single rigid and single flexible probes. The centering disc is attached to the end of the probe.

For higher-rated or T-Piece design chambers, the centering disc should be sized 1 in. smaller than the chamber diameter (See Table 7).

Figure 6. Centering discs

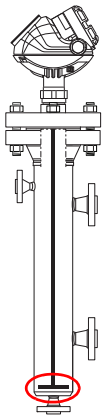


Table 7. Centering discs

Chamber size	Chamber rating	Centering disc
3 in.	Up to Class 600/PN 100	3 in.
	Class 900, 1500/PN160, 250	2 in.
3 in. T-piece	Up to Class 600/PN 100	2 in.
4 in.	Up to Class 600/PN 100	4 in.
	Class 900, 1500/PN160, 250	3 in.

Step 6. Configuration

If XC option is selected, then default factory settings are configured into the transmitter according to model codes of the chamber and transmitter characteristics. See Figure 7.

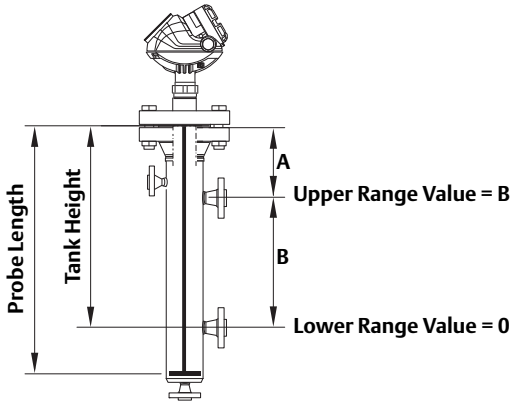
Pipe Diameter = Chamber Diameter

Tank Height (Reference Gauge Height) = Dimension (A) + (B)

Lower Range Value (4 mA) = 0 (only for HART units)

Upper Range Value (20 mA) = B (only for HART units)

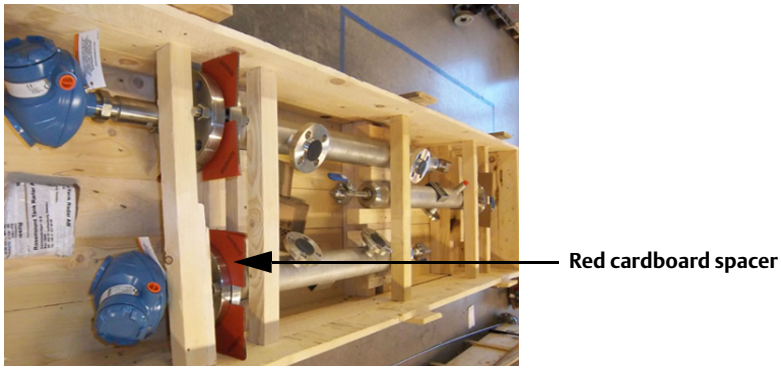
Figure 7. Transmitter will be configured so that the upper and lower range values align with the dimension (B)



Additional factory configuration is recommended and can be ordered by including the C1 option code in the transmitter model code.

XC Option (consolidate to)

Selecting the XC option on the GWR and the 9901 will result in consolidating and shipping of the two products together in one crate. This ensures the GWR and 9901 are matched, which means that the units are checked/consolidated together.



Important note

The flange bolts are shipped only hand-tightened. Prior to installation, loosen the flange bolts and carefully disassemble the device from the chamber. Remove the red cardboard spacer and place a gasket on top of the tank flange. Remount the device and tighten the flange bolts.

Long rigid probes are shipped separately in order to reduce transportation risk damage.

Emerson Process Management
Rosemount Measurement
8200 Market Boulevard
Chanhassen MN 55317 USA
Tel (USA) 1 800 999 9307
Tel (International) +1 952 906 8888
Fax +1 952 906 8889

Emerson Process Management
Blegistrasse 23
P.O. Box 1046
CH 6341 Baar
Switzerland
Tel +41 (0) 41 768 6111
Fax + 41 (0) 41 768 6300

Emerson Process Management
GmbH & Co.
Argelsrieder Feld 3
82234 Wessling
Germany
Tel +49 (8153) 9390
Fax +49 (8153) 939172

Emerson FZE
P.O. Box 17033
Jebel Ali Free Zone
Dubai UAE
Tel +971 4 811 8100
Fax +971 4 886 5465

Emerson Process Management
Asia Pacific Private Limited
1 Pandan Crescent
Singapore 128461
Tel +65 6777 8211
Fax +65 6777 0947
Enquiries@AP.EmersonProcess.com

Emerson Process Management
Latin America
1300 Concord Terrace, Suite 400
Sunrise Florida 33323 USA
Tel +1 954 846 5030

Emerson Beijing Instrument Co
No. 6 North Street, Hepingli
Dongcheng District, Beijing
100013
China
Tel +8610 6428 2233
Fax +8610 64287640

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