

# SHICO. GUIDED WAVE RADAR LEVEL TRANSMITTER

MODEL : MT5000

MT5000 has a graphic display to provide a user friendly function in the transmitter configuration. The graphic display allows customers to choose multiple language in setup menu such as English, Spanish and Chinese, etc, for easy commissioning throughout the world. By incorporation of the graphic display, the electronics are converted to a digital format. This provides better signal recognition capability and ability to include an "onboard oscilloscope" as a support for tough troubleshooting application.

## ■ FEATURES

- Graphic display with waveform screen
- Widest selection of wetted materials
- Radar signal travels along the waveguide
- Eliminates false echoes and minimizes signal loss
- No moving parts / • Liberalization Table
- Lengths from 1 to 200ft./0.3 to 61 meters
- Rigid, Flexible cable & coaxial probes
- All digital electronics

### ■ Options

- HART Protocol / Glass viewing window
- SS316L Stainless steel enclosure
- Modbus / Foundation Fieldbus

### ■ Accessories

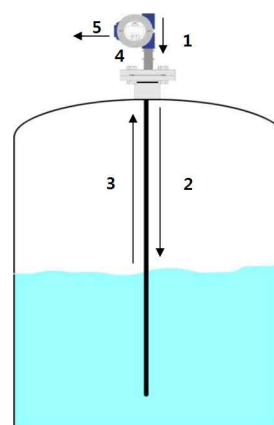
- K-COM™ Communications software
- External chamber / Stilling Wells
- Loop indicators

## ■ SPECIFICATIONS

|                       |   |
|-----------------------|---|
| Housing               | Dual Compartment Powder Coated Aluminum or Stainless Steel  |
| Electrical Connect    | 1/2" FNPT or M20  |
| Power                 | 13.5 - 36 VDC, Standard; 9-32 VDC Foundation Fieldbus; 10 - 18 VDC MODBUS                                   |
| Wiring                | Standard and Foundation Fieldbus - 2 wire MODBUS-4 wire plus shield (2power, 2data - half duplex)           |
| Output                | Single 4-20 mA, HART, Foundation Fieldbus (ITK 5.0.1), MODBUS (RTU or ASCII)                                |
| Graphic Display       | Field Selectable Units in Feet, Inches, Millimeters, Centimeters, Meters or Percentage and Waveform Screens |
| Accuracy              | +/- 0.1 in/3mm for coaxial probes*, +/-0.2 in/5 mm for all other configurations                             |
| Resolution            | +/- 0.063 in / 1.6 mm   |
| Repeatability         | 0.1 in. / 3 mm *  |
| Range                 | 1 to 200 ft. / 0.3 to 61 meters   |
| Process Connection    | 3/4" NPT Standard   |
| Sensor Material       | 316L SS Standard, Other Materials Optional  |
| Process Pressure      | Up to 5000 psi (344 bar)  |
| Process Temperature   | Up to 800°F (427°C)   |
| Dielectric Constant   | Minimum 1.4   |
| Process Max Viscosity | 1500 cp   |



## ■ PRINCIPLE OPERATIONS



### ■ Introduction of operation

1. A very short "pulse" of microwave energy is applied at the coupler, to the Probe.
2. The pulse travels along the length of the probe and when it encounters a discontinuity that is a dielectric constant change, such as the product surface, some of the energy is reflected and travels back towards the coupler.
3. When the reflected energy reaches the coupler, it is sensed by the electronics. By measuring the time elapsed between the initial pulse and the reflected one, the electronics can calculate the product level.
4. Since the microwave energy travels at the speed of light, one complete measurement cycle is made up of several thousands of Pulses. The electronics uses Time Domain Reflectometry (TDR), a sampling technique to reconstruct a waveform duplicating the actual real time signal, but at a much lower speed, so that it can be processed by the microprocessor. This process can be compared to using the stroboscope effect as when observing a piece of machinery turning at high speed with a strobe light.
5. The measurement cycles are made 2 times per second and processed by special filtering techniques, before generating a current output proportional to the level of the product.



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# SHICO.

MODEL : MT5000

## GUIDED WAVE RADAR LIQUID LEVEL TRANSMITTER

### ■ ORDERING INFORMATION

• MT5000 /a/b/c/d/e/f/g/h/i/j/k

|   |  |
|---|--|
| /a Probe Material   |  |
| S6  | 316L Stainless Steel Standard  |
| S4  | 304L (Rigid Probe Only)  |
| HC  | Hastelloy C-276 (Rigid Probes Only, P43 probe HSC-270)   |
| HB  | Hastelloy B3 (Rigid Probes Only)   |
| MO  | Monel  |
| TI  | Titanium (Rigid Probes Only)   |
| IN25  | Inconel 625  |
| /b Transmitter Configuration  |  |
| L   | Local Transmitter Standard   |
| LW  | Local Transmitter with Window Cover Standard   |
| R   | Remote Mounted Electronics with 5 ft. Cable (Dielectric > 35)  |
| RW  | Remote Mounted Electronics with Window Cover and 5 ft. Cable (Dielectric > 35)   |
| /c Transmitter Housing  |  |
| A   | Dual Compartment Aluminum Housing Standard   |
| S   | Dual Compartment 316L Stainless Steel Housing  |
| /d Process Connection / Waveguide Coupler   |  |
| Pxxoo   | xx Probe Code (Table 3)  |
|   | oo Sanitary Probe Finish (P41, P42 and P43 Sanitary Probes Only)<br>1F - 180 Grit / 2F - 240 Grit / EP - 240 Grit and Electro-polish   |
| /f X  | None   |
| CDyyz-ww  | Clamp On Centering Disk (Solid Rod Probes) Note: Rigid probes installed in stilling wells or external chambers require centering disk  |
| CWyyz-ww  | Clamp On Centering Weight (Cable Probes) Note: Cable probes require a centering weight or end fitting to stabilize bottom of cable   |
| E   | Eyelet (Cable Probes)  |
| /g Process Temperature  |  |
| H0  | 32 to 250°F / 0 to 121°C   |
| H6  | C1 thru C7 and C10 couplers: Above 250°F / 121°C or below 32°F / 0°C   |
|   | Electronics enclosure is extended 6" above process connection  |
|   | C8 and C9 couplers: Above 500°F / 260°C  |
| Extends electronics enclosure an additional 6" above process connection (Refer to Table 1 for maximum and minimum process temperatures) |  |
| /h Electronic Module  |  |
| X   | None   |
| M7A   | One Level, Graphic Display , 4-20 mA Output, HART / Add suffix "M" for MODBUS (not Intrinsically Safe) / Add suffix "F" for Foundation Fieldbus  |
| /i Select the Approval  |  |
| X   | None   |
| FM  | Factory Mutual Research Corporation and Canadian Standards Association   |
| GR  | GOST - Russian (M7AM option not Intrinsically Safe)  |
| CEX   | ATEX Flameproof  |
| CEI   | ATEX I.S.  |
| IEI   | International Electromechanical Commission I.S.  |
| IEX   | International Electromechanical Commission Flameproof  |
| UKR   | Ukraine SEPRO  |
| /j Process Connection   |  |
| P   | Standard as shown on Probe Process Connection Table (Table 1)  |
| FL  | Loose flange or plug for use with probe NPT threads; Specify type, material and rating from Flange Designation Chart (SLG-0001-1)  |
| WP  | Welded process connection Specify type, material and rating from Flange Designation Chart (SLG-0001-1)<br>The Flange Designation Guide is available under Data Sheets on the MT5000 Product Page on ABB's Website (www.abb.com/level)<br>Welded Flanges 400# and above may require the use of an H6 extension. |
| /k Length   |  |
| L   | Insertion length from face of coupler in inches or millimeters.<br>-12in / 305mm minimum / - maximum based on probe type   |
| Available Accessories:  |  |
| M20 ISO Fitting: M20 Female Electrical Connection (Brass or Stainless Steel)  |  |
| MM Brass / MMS Stainless Steel  |  |



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## GUIDED WAVE RADAR LIQUID LEVEL TRANSMITTER

## ■ TABLE DESCRIPTION

TABLE 1 - PROCESS CONNECTION / WAVEGUIDE COUPLER

| Base Code <sup>4</sup>                   | Insulator                | Process Connection                | Seal options Table 2 | Maximum Pressure  | Min Temp <sup>6</sup> | Max Temp <sup>6</sup> | Compatible Probes                         |
|--|--------------------------|-----------------------------------|----------------------|---|-----------------------|-----------------------|---|
| <b>SINGLE PROBE / COAXIAL PROBE</b>      |                          |                                   |                      |   |                       |                       |   |
| C1o <sup>1,2</sup><br>C2o <sup>1,2</sup> | Teflon                   | 3/4" NPT <sup>8</sup><br>1.5" NPT | V, K,<br>E, A        | 1500 psi @ 100°F / 103 bar @ 38°C<br>600 psi @ 400°F / 41 bar @ 204°C   | -60°F<br>50°C         | 400°F<br>204°C        | P01, P03, P11,<br>P51, P91 <sup>5</sup> , |
| C8<br>(SS316 only)                       | Borosilicate Glass       | 1.5" NPT                          | Hermetic             | 5000 psi @ 100°F / 344 bar @ 38°C<br>1500 psi @ 800°F / 103 bar @ 427°C<br>Not for Hot water or steam service | -60°F<br>-50°C        | 800°F<br>427°C        | P11 <sup>9</sup> , P71<br>(SS316 only)    |
| C8<br>(SS316 only)                       | Alumina Ceramic          | 1.5" NPT                          | Aegis                | 2000 psi @ 635°F / 138 bar @ 335°C  | -60°F<br>-50°C        | 635°F<br>335°C        | P11 <sup>5</sup> , P81<br>(SS316 only)    |
| <b>DUAL PROBE</b>                        |                          |                                   |                      |   |                       |                       |   |
| C4o <sup>1,2</sup><br>C5o <sup>1,2</sup> | Teflon                   | 1.5" NPT<br>2" NPT                | V, K,<br>E, A        | 1500 psi @ 100°F / 103 bar @ 38°C<br>600 psi @ 400°F / 41 bar @ 204°C   | -60°F<br>-50°C        | 400°F<br>204°C        | P31<br>P22, P32                           |
| <b>TRI-TAPE PROBE</b>                    |                          |                                   |                      |   |                       |                       |   |
| C10on <sup>1,2,7</sup>                   | Teflon                   | 2" or 3" NPT                      | V, K,<br>E, A        | 1500 psi @ 100°F / 103 bar @ 38°C<br>600 psi @ 400°F / 41 bar @ 204°C   | -60°F<br>-50°C        | 400°F<br>204°C        | P34 (316SS only)                          |
| <b>SANITARY PROBE</b>                    |                          |                                   |                      |   |                       |                       |   |
| C4o <sup>1,2</sup>                       | Teflon                   | 1.5" or larger<br>Tri-Clamp       | V, K,<br>E, A        | 50 psi / 13.4 bar   | -60°F<br>-50°C        | 400°F<br>204°C        | P41, P43                                  |
| C5o <sup>1,2</sup>                       |                          | 1.5" or larger<br>Tri-Clamp       |                      |   |                       |                       | P42, P43                                  |
| <b>CUSTOM</b>                            |                          |                                   |                      |   |                       |                       |   |
| CXo                                      | Custom (Consult Factory) |                                   |                      |   |                       |                       |   |

Note 1. Add the suffix "H" to the Base Code (example: /C1HV) to increase the maximum pressure to:

3000 psi @ 100 F / 207 bar @ 38 C / 1200 psi @ 400 F / 83 bar @ 204 C

2. Add the suffix "S" to the Base Code to include a hermetic seal (example: /C4SV)

3. Tri-Clamp size "nn" as follows: 1.5" = 15, 2" = 20, 2.5" = 25, 3.0" = 30 (example: /C6V20)

4. o-Enter seal code from table 2 (example /C2V. Not required for /C8)

5. Requires installation in a stilling well or external chamber

6. Consult Table 2 for o-ring temperature specifications.

7. Thread size "n" as follows: 2" NPT = 2, 3" NPT = 3 (example: /C10V3)

8. The P91 probe has a 1" MNPT adjustable compression fitting equipped with Teflon ferrules as the standard process connection.

The maximum process pressure utilizing the Teflon ferrules is 50 psi (3.4 bars).

9.Requires installation in a stilling well or external chamber - minimum L1 is 12"

TABLE 2 - O-RING SEALS

| Suffix | Description | Min. Temp      | Max. Temp      | Compatible With   | Not Compatible With   |
|--------|-------------|----------------|----------------|---|---|
| V      | Viton       | -15°F<br>-26°C | 400°F<br>204°C | General Purpose, Ethylene   | Ketones (MEK, Acetone), Skydrol Fluids, Amines, Anhydrous Ammonia, Low Molecular Weight Esters and Ethers, Hot Hydrofluoric or Chlorosulfuric Acids, Sour HCs |
| K      | Kalrez      | -40°F<br>-40°C | 400°F<br>204°C | Inorganic and Organic Acids to Include HH and Nitric, Aldehydes, Ethylene, Glycols, Organic Oils, Silicone Oils, Vinegar, Sour HCs, Amines, Ethylene Oxide, Propylene Oxide | Black Liquor, Hot Water, Hot Aliphatic Amines, Molten Sodium, Molten Potassium  |
| E      | EPDM        | -60°F<br>-50°C | 250°F<br>125°C | Acetone, MEK, Skydrol Fluids, Anhydrous Ammonia   | Petroleum Oils, Di-Ester Base Lubricants, Propane   |
| A      | Aegis       | -14°F<br>-10°C | 572°F<br>300°C | Most Chemicals  | Brake Fluid   |



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SHICO.

MODEL : MT5000

## GUIDED WAVE RADAR LIQUID LEVEL TRANSMITTER

TABLE 3 - PROBE TYPES

| Code   | O.D                           | Notes  | Max length                | Attachment options |
|--|-------------------------------|--|---------------------------|--------------------|
| <b>SINGLE RIGID ROD</b>  |                               |  |                           |                    |
| P01  | 0.25in (6mm)                  |  | 10ft (3.05m) <sup>1</sup> | CD                 |
| P02  | 0.50in (13mm)                 |  | 20ft (6.10m) <sup>2</sup> |                    |
| P03  | 0.38in (9mm)                  |  | 10ft (3.05m) <sup>1</sup> |                    |
| <b>SINGLE FLEXIBLE CABLE</b>   |                               |  |                           |                    |
| P11  | 0.1875in (5mm)                |  | 100ft (9.1m) <sup>3</sup> | CD, CW E           |
| P12  | 0.25in (6mm)                  |  |                           |                    |
| <b>DUAL RIGID ROD</b>  |                               |  |                           |                    |
| P22  | 0.50in (13mm)                 |  | 30ft (9.1m)               | CD                 |
| <b>DUAL FLEXIBLE CABLE</b>   |                               |  |                           |                    |
| P31  | 0.1875in (5mm)                |  | 100ft (19.8m)             | CW                 |
| P32  | 0.25in (6mm)                  |  |                           |                    |
| <b>TRI-TAPE</b>  |                               |  |                           |                    |
| P34  | 2.00in (51mm)                 | 316 Stainless steel only   | 50ft (15.24m)             | CW (included)      |
| <b>SANITARY RIGID ROD</b>  |                               |  |                           |                    |
| P41  | 0.25in (6mm)                  | Finish Options:<br>1F - 180 Grit Finish (std)<br>2F - 240 Grit Finish<br>EP - 240 Grit and Electro polished <sup>4</sup> | 10ft (3.05m)              | CD (custom)        |
| P42  | 0.50in (13mm)                 |  | 20ft (6.10m)              |                    |
| P43  | 0.125in (3mm)                 | 316 SS and HSC-270   | 50ft (6.10m)              | CW (included)      |
| <b>COAXIAL (clean liquids only)</b>  |                               |  |                           |                    |
| P51  | 0.875in (22mm)                |  | 22ft (6.71m)              |                    |
| P71  | 1.315in (34mm)                | 316 Stainless steel only   |                           |                    |
| P81  | 0.875in (22mm)                | 316 Stainless steel only   |                           |                    |
| P91  | 1.00in (25mm)                 |  |                           |                    |
| <b>CUSTOM</b>  |                               |  |                           |                    |
| /PXX   | Custom Probe, Consult Factory |  |                           |                    |
| <p>Note 1. 5ft (1.52m) maximum probe length when installed in a stilling well or EC chamber (minimum 2" diameter)</p> <p>2. 10ft (3.05m) maximum probe length when installed in a stilling well or EC chamber (minimum 3" diameter)</p> <p>3. Lengths greater than 7ft (2.13m) require cable spacers at 5ft (1.52m) maximum intervals when installed in a 2" or smaller stilling well or EC chamber. Lengths greater than 10ft (3.05m) require cable spacers at 10ft (3.05m) maximum intervals when installed in 2.5" - 3" stilling well or EC chamber.</p> <p>4. Certificate of RA and Passivation available upon request. Specify RA finish.</p> |                               |  |                           |                    |



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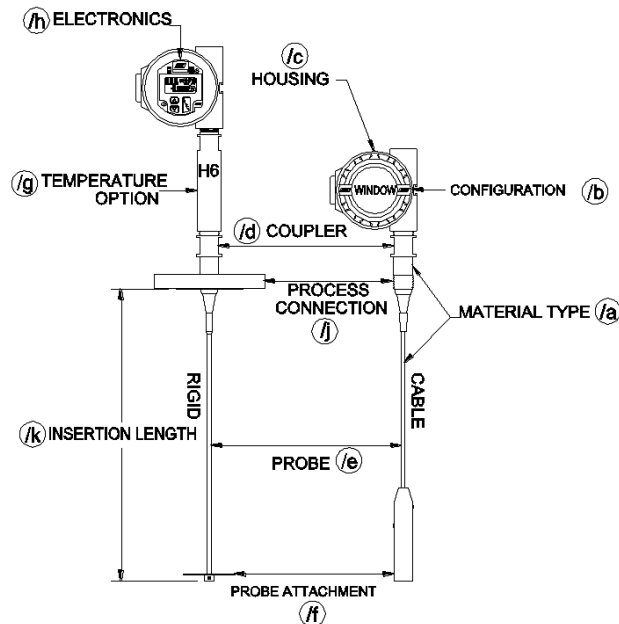
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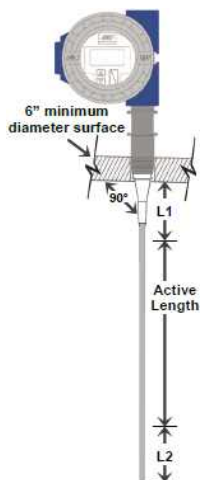
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### DESCRIPTION OF ORDERING INFORMATION



### RT5000 RECOMMENDED INSTALLATION

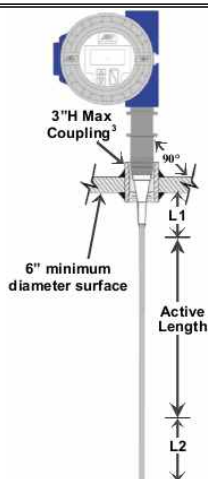


#### 1. SINGLE PROBE - FLAT PLATE

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 4                           | 20 ft. / 6.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 40 ft. / 12.2 m                     | 3 in. / 7.5 cm                         | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 100 ft. / 30.5 m                    | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

#### NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH+ 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.



#### 2. SINGLE PROBE - FLAT PLATE WITH COUPLING

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup> | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|------------------------------|---|
| 4                           | 20 ft. / 6.1 m                      | 8 in. / 20.3 cm              | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 40 ft. / 12.2 m                     | 4 in. / 10.2 cm              | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 100 ft. / 30.5 m                    | 1 in. / 2.5 cm               | 0 <sup>1</sup> (Rod / Cable)                      |

#### NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- The coupling should not extend into the vessel more than 1 in. / 2.5 cm.



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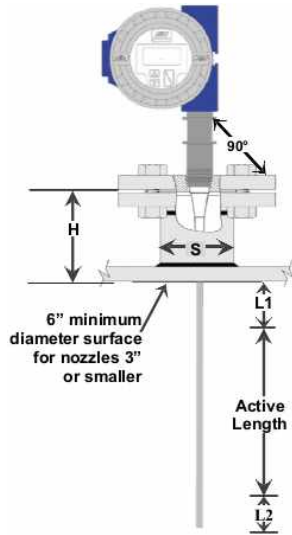
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NOTE: The following guidelines are very conservative. If you have an application that exceeds these limits consult factory for application recommendations.



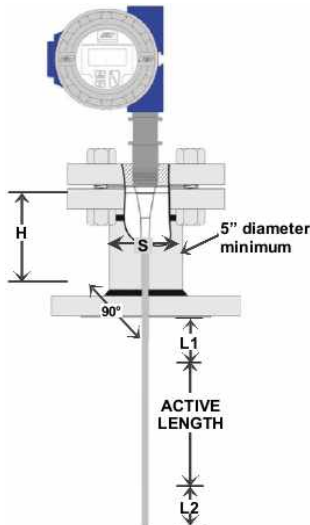
### 3A. SINGLE PROBE - NOZZLE & FLANGE

[height of nozzle (H) greater than width of nozzle (S)]

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>             | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 4                           | 20 ft. / 6.1 m                      | 8 in. / 20.3 cm                          | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 40 ft. / 12.2 m                     | 4 in. / 10.2 cm                          | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 100 ft. / 30.5 m                    | 2 <sup>1</sup> in. / 5.1 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- A one time startup adjustment is required to eliminate the effect of the nozzle. For details refer to the Blanking Parameter in the Commissioning section of the Installation & Operation Manual.



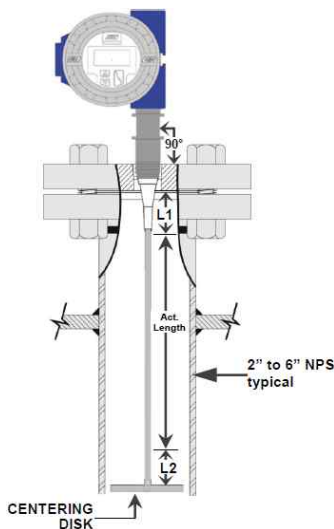
### 3B. SINGLE PROBE - NOZZLE & FLANGE

[height of nozzle (H) greater than width of nozzle (S)]

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>             | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 4                           | 20 ft. / 6.1 m                      | 6 in. / 15.24 cm                         | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 40 ft. / 12.2 m                     | 3 in. / 7.5 cm                           | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 100 ft. / 30.5 m                    | 2 <sup>1</sup> in. / 5.1 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- A one time startup adjustment is required to eliminate the effect of the nozzle. For details refer to the Blanking Parameter in the Commissioning section of the Installation & Operation Manual.



### 4. SINGLE PROBE - PERMANENT STILLING WELL

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 1.7 <sup>3</sup>            | 20 ft. / 6.1 m                      | 8 in. / 20.3 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 3                           | 30 ft. / 9.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 50 ft. / 15.2 m                     | 3 in. / 7.5 cm                         | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 50 ft. / 15.2 m                     | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- Stilling well size will determine minimum dielectric constant.



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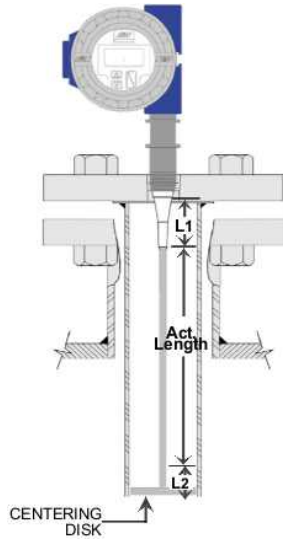
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## GUIDED WAVE RADAR LIQUID LEVEL TRANSMITTER

NOTE: The following guidelines are very conservative. If you have an application that exceeds these limits consult factory for application recommendations.

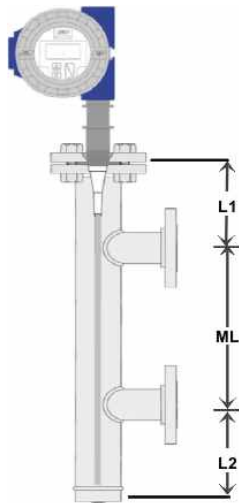


### 5. SINGLE PROBE - REMOVABLE STILLING WELL & TRI-TAPE

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 1.7 <sup>3</sup>            | 20 ft. / 6.1 m                      | 8 in. / 20.3 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 3                           | 30 ft. / 9.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 50 ft. / 15.2 m                     | 3 in. / 7.5 cm                         | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 50 ft. / 15.2 m                     | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

#### NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- Stilling well size will determine minimum dielectric constant.

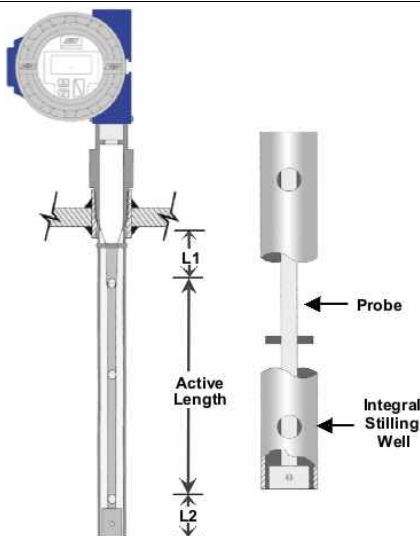


### 6. SINGLE PROBE - EXTERNAL CHAMBER

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 1.7 <sup>3</sup>            | 20 ft. / 6.1 m                      | 8 in. / 20.86 cm                       | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 3                           | 30 ft. / 9.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 50 ft. / 15.2 m                     | 3 in. / 7.5 cm                         | 0 <sup>1</sup> (Rod)<br>WH+ 3"/7.6cm (cable)      |
| 35                          | 50 ft. / 15.2 m                     | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

#### NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- Chamber size will determine minimum dielectric constant.



### 7. COAXIAL PROBE

[(rod inside of outer tube) clean liquids only]

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> |
|-----------------------------|-------------------------------------|--|------------------------------|
| 1.4                         | 20 ft. / 6.1 m                      | 4 in. / 10.2 cm                        | 1 in./2.5cm                  |
| 2.0                         | 20 ft. / 6.1 m                      | 2 in. / 5.1 cm                         | 1 in./2.5cm                  |
| 4.0                         | 20 ft. / 6.1 m                      | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0.5 in./1.3cm                |

#### NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- Typically used in low dielectric, clean liquids.



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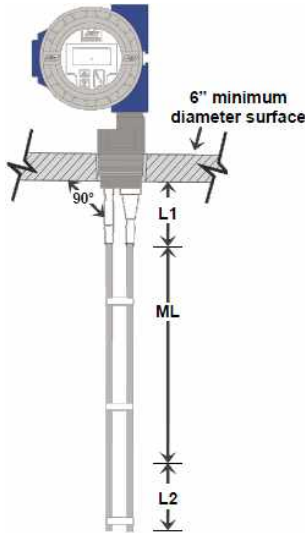
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## GUIDED WAVE RADAR LIQUID LEVEL TRANSMITTER

NOTE: The following guidelines are very conservative. If you have an application that exceeds these limits consult factory for application recommendations.

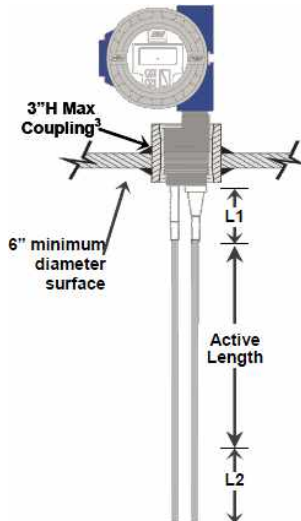


### 8. DUAL PROBE - FLAT PLATE

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 3                           | 20 ft. / 6.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 4                           | 20 ft. / 6.1 m                      | 3 in. / 7.5 cm                         | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 100 ft. / 30.5 m                    | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.

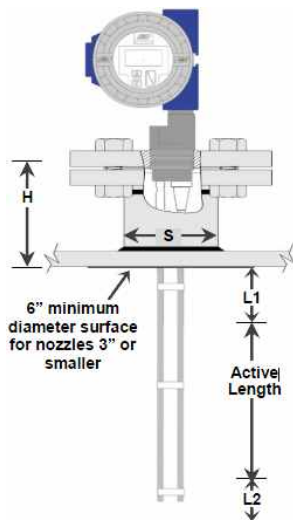


### 9. DUAL PROBE - FLAT PLATE WITH COUPLING

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 3                           | 20 ft. / 6.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 4                           | 20 ft. / 6.1 m                      | 3 in. / 7.5 cm                         | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 100 ft. / 30.5 m                    | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- The coupling should not extend into the vessel more than 1" / 25 mm.



### 10A. DUAL PROBE - NOZZLE & FLANGE

[(rod inside of outer tube) clean liquids only]

| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup>                |
|-----------------------------|-------------------------------------|--|---|
| 3                           | 20 ft. / 6.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable) |
| 4                           | 20 ft. / 6.1 m                      | 3 in. / 7.5 cm                         | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable) |
| 10                          | 10 ft. / 30.5 m                     | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                |

NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.
- A one time startup adjustment is required to eliminate the effect of the nozzle. For details refer to the Blanking Parameter in the Commissioning section of the Installation & Operation Manual.



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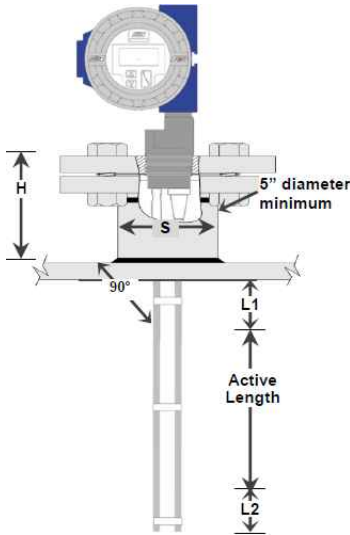


## GUIDED WAVE RADAR LIQUID LEVEL TRANSMITTER

NOTE: The following guidelines are very conservative. If you have an application that exceeds these limits consult factory for application recommendations.

### 10B. DUAL PROBE - NOZZLE & FLANGE

[height of nozzle (H) less than width of nozzle (S)]



| MINIMUM DIELECTRIC CONSTANT | L MAXIMUM PROBE LENGTH <sup>2</sup> | L1 Unmeasurable <sup>1</sup>           | L2 Unmeasurable <sup>1</sup> (WH = Weight Height) |
|-----------------------------|-------------------------------------|--|---|
| 3                           | 20 ft. / 6.1 m                      | 6 in. / 15.2 cm                        | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 4                           | 20 ft. / 6.1 m                      | 3 in. / 7.5 cm                         | 3 in./7.6cm (Rod)<br>WH+ 3in./7.6cm (cable)       |
| 10                          | 100 ft. / 30.5 m                    | 0 <sup>1</sup> in. / 0 <sup>1</sup> cm | 0 <sup>1</sup> (Rod / Cable)                      |

#### NOTES:

- L1 & L2 unmeasurable lengths of 0 may require use of linearization table and latching feature. For easiest startup use L1min ≥ 3" or as listed if greater and L2min ≥ 3" (rod) or WH + 3" (cable).
- Maximum probe lengths are limited as indicated in Table 2A.

■ Select mounting configuration closest to your application: (\*Not for liquid / liquid interface)

| <b>Flat Plate Or Coupling</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>1.3<sup>1</sup></td><td>100 ft./30.5 m</td></tr> <tr><td>4</td><td>20 ft./6.1 m</td></tr> <tr><td>10</td><td>40 ft./12.2 m</td></tr> <tr><td>35</td><td>100 ft./30.5 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 1.3 <sup>1</sup> | 100 ft./30.5 m | 4 | 20 ft./6.1 m | 10 | 40 ft./12.2 m  | 35  | 100 ft./30.5 m              | <b>Nozzle &amp; Flange</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>1.3<sup>1</sup></td><td>100 ft./30.5 m</td></tr> <tr><td>4</td><td>20 ft./6.1 m</td></tr> <tr><td>10</td><td>40 ft./12.2 m</td></tr> <tr><td>35</td><td>100 ft./30.5 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 1.3 <sup>1</sup> | 100 ft./30.5 m | 4  | 20 ft./6.1 m   | 10   | 40 ft./12.2 m               | 35                   | 100 ft./30.5 m | <b>Permanent Stilling Well</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>1.7</td><td>20 ft./6.1 m</td></tr> <tr><td>3</td><td>30 ft./9.1 m</td></tr> <tr><td>10</td><td>50 ft./15.2 m</td></tr> <tr><td>35</td><td>50 ft./15.2 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 1.7 | 20 ft./6.1 m   | 3   | 30 ft./9.1 m                | 10                   | 50 ft./15.2 m | 35           | 50 ft./15.2 m | <b>Removable Stilling Well</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>1.7</td><td>20 ft./6.1 m</td></tr> <tr><td>3</td><td>30 ft./9.1 m</td></tr> <tr><td>10</td><td>50 ft./15.2 m</td></tr> <tr><td>35</td><td>50 ft./15.2 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 1.7 | 20 ft./6.1 m  | 3 | 30 ft./9.1 m | 10 | 50 ft./15.2 m | 35 | 50 ft./15.2 m |
|--|-----------------------------|----------------------|------------------|----------------|---|--------------|----|----------------|---|-----------------------------|---|-----------------------------|----------------------|------------------|----------------|----|----------------|--|-----------------------------|----------------------|----------------|--|-----------------------------|----------------------|-----|----------------|---|-----------------------------|----------------------|---------------|--------------|---------------|--|-----------------------------|----------------------|-----|---------------|---|--------------|----|---------------|----|---------------|
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 1.3 <sup>1</sup>   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 4  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 40 ft./12.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 35   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 1.3 <sup>1</sup>   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 4  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 40 ft./12.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 35   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 1.7  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 3  | 30 ft./9.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 50 ft./15.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 35   | 50 ft./15.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 1.7  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 3  | 30 ft./9.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 50 ft./15.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 35   | 50 ft./15.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| <b>Dual Rod Flat Plate or Coupling</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>3</td><td>20 ft./6.1 m</td></tr> <tr><td>4</td><td>20 ft./6.1 m</td></tr> <tr><td>10</td><td>100 ft./30.5 m</td></tr> </table>   | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 3                | 20 ft./6.1 m   | 4 | 20 ft./6.1 m | 10 | 100 ft./30.5 m | <b>Dual Rod Nozzle &amp; Flange</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>2.5</td><td>20 ft./6.1 m</td></tr> <tr><td>4</td><td>20 ft./6.1 m</td></tr> <tr><td>10</td><td>100 ft./30.5 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH  | 2.5                         | 20 ft./6.1 m         | 4                | 20 ft./6.1 m   | 10 | 100 ft./30.5 m | <b>Coaxial Probe</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>1.4</td><td>20 ft./6.1 m</td></tr> <tr><td>4</td><td>20 ft./6.1 m</td></tr> <tr><td>10</td><td>100 ft./30.5 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 1.4            | 20 ft./6.1 m   | 4                           | 20 ft./6.1 m         | 10  | 100 ft./30.5 m | <b>External Chamber</b><br><br><table border="1"> <tr><th>MINIMUM DIELECTRIC CONSTANT</th><th>MAXIMUM PROBE LENGTH</th></tr> <tr><td>1.7</td><td>20 ft./6.1 m</td></tr> <tr><td>3</td><td>30 ft./9.1 m</td></tr> <tr><td>10</td><td>50 ft./15.2 m</td></tr> <tr><td>35</td><td>50 ft./15.2 m</td></tr> </table> | MINIMUM DIELECTRIC CONSTANT | MAXIMUM PROBE LENGTH | 1.7           | 20 ft./6.1 m | 3             | 30 ft./9.1 m   | 10                          | 50 ft./15.2 m        | 35  | 50 ft./15.2 m |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 3  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 4  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 2.5  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 4  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 1.4  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 4  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 100 ft./30.5 m              |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| MINIMUM DIELECTRIC CONSTANT  | MAXIMUM PROBE LENGTH        |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 1.7  | 20 ft./6.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 3  | 30 ft./9.1 m                |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 10   | 50 ft./15.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |
| 35   | 50 ft./15.2 m               |                      |                  |                |   |              |    |                |   |                             |   |                             |                      |                  |                |    |                |  |                             |                      |                |  |                             |                      |     |                |   |                             |                      |               |              |               |  |                             |                      |     |               |   |              |    |               |    |               |



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