INSTALLATION GUIDE

RF Capacitance Probe

We do our level best

Schneider Electric Systems USA, Inc.
1602 Mustang Drive
Maryville, TN 37801
Phone: (865) 981-3100 Fax: (865) 981-3168
http://www.robertshawindustrial.com

NUMBER

909GF289

Revision C

February 26, 2019

Due to unique requirements of each installation it is not possible to show in detail exactly how to install the probe. Therefore, this document is intended only to provide guidelines for the installation of a probe in a vessel and should be used for reference purposes only. All local codes must be adhered to.

This document is intended to provide useful information to be used during the installation so as to minimize the need to trouble shoot and/or correct an installation.

This document is written based upon the probe and instrument having been previously determined to be the appropriate instrument and probe for the application However, this document does contain some helpful information which may be used to verify that the instrument and probe are correct for the application.

WARNINGS

Do not exceed temperature/pressure rating of probe. Refer to temperature/pressure rating table.

Do not use probe in vacuum unless rated for vacuum service. Refer to temperature/pressure rating table.

Do not use a non-conductive sealant or Teflon tape to seal pipe threads on probe.

Do not use a bare (uninsulated) probe in a conductive process for point level detection with differential or for continuous level measurement.

Do not apply torque to the small hex gland at the instrument end of the probe except as noted in this installation guide for the model 702A probe. This gland is found on 702A, 728B, 729A, 729B, 736B, 738A, 739B-A, 739B-B, 739B-D and 739B-J probes.

Do not use probes without having a ground reference. Refer to section on ground reference.

Do not use probe (and capacitance instrument) to measure blown-in granular products due to the presence of static electricity.

Principal Of Capacitance Instrumentation For Level Controls:

A capacitance signal is generated between two conductors (or plates), the probe rod and a ground reference serve as these conductors. These conductors are electrically insulated from each other. Between these two conductors there is a given capacitance value. As the product which is to be measured rises, it displaces the material (usually air) which is between the conductors which in turn changes the capacitance value. The more the product rises the more the capacitance value changes.

The instrument detects the change in capacitance and is calibrated to convert a given capacitance value to a predetermined product level. The instrument may simply trip a relay at the given level or it may provide a continuous signal proportional to the amount of capacitance (value) or both.

CAPACITANCE PROBE TEMPERATURE/PRESSURE RATINGS

PROBE MODEL	VACUUM SERVICE RATING	TEMPERATURE / PRESSURE
702A	-30 Hg @ 120° F	1000 PSIG @ 120° F, derated to 500 PSIG @ 235° F, and 100 PSIG @ 350° F
728B	-30 Hg @ 100° F	1000 PSIG @ 100° F, derated to 500 PSIG @ 225° F, and 0 PSIG @ 350° F
729A-C 729A-E 729A-H Polyethylene insulated	not rated	1000 PSIG @ 70° F, derated to 500 PSIG @ 110° F, and 0 PSIG @ 150° F
729A-A 729A-B 729A-D 729A-F 729A-G 729B uninsulated or Teflon insulated	not rated	1000 PSIG @ 100° F, derated to 500 PSIG @ 225° F, and 0 PSIG @ 350° F
732A	-30 Hg @ 100° F	1000 PSIG @ 100° F, derated to 500 PSIG @ 225° F, and 0 PSIG @ 350° F
736B-A 736B-B with ground wire	not rated	0 PSIG at all temperatures. Maximum temperature 350° F
736B-A without ground wire	-30 Hg @ 120° F	Flange pressure rating at 120° F, derated to 100 PSIG at 350° F (For Class 150 and 300 flanges)
736B-B without ground wire	-30 Hg @ 100° F	Flange pressure rating at 100° F, derated to 0 PSIG at 350° F (For Class 150 and 300 flanges)
737A	-30 Hg @ 600^0 F	3000 PSIG @ 0^0 F to 600^0 F
738A	not rated	3000 PSIG @ 300° F, derated to 2000 PSIG @ 500° F, and 1000 PSIG @ 1000° F
739B	not rated	For 1" & 1-1/2" size: 500 PSIG @ 70° F, derated to 250 PSIG @ 250° F For 2" size: 450 PSIG @ 70° F, derated to 250 PSIG @ 250° F For 2-1/2" size: 400 PSIG @ 70° F, derated to 200 PSIG @ 250° F For 3" size: 350 PSIG @ 70° F, derated to 150 PSIG @ 250° F For 4" size: 200 PSIG @ 70° F, derated to 125 PSIG @ 250° F
740A	-30 Hg @ 100° F	2000 PSIG @ 100° F, derated to 1000 PSIG @ 225° F, and 0 PSIG @ 350° F
741A	-30 Hg @ 100° F	600 PSIG @ 100° F, derated to 300 PSIG @ 225° F, and 0 PSIG @ 350° F

INSTRUMENTS USED WITH PROBES

INSTRUMENT MODEL NUMBER	TYPE OF MEASUREMENT
167	Continuous level
310	Point level with differential. May also be used without differential
314B	Point level with differential. May also be used without differential
5318B	Point level.
352	Conductivity
5100-XX-(A, B, E or F)	Point level with differential. May also be used without differential
5100-XX-(C, D, G or H)	Point level without differential
5400A	Point level with differential. May also be used without differential
7000	Continuous level

Pipe Thread Sealant:

To seal threads and prevent galling use LED PLATE No. 250 manufactured by Armite Laboratories or an equivalent electrically conductive anti-seize compound on pipe threads. Do not use Teflon tape or a non-conductive sealant on pipe threads as this may break the ground path between the instrument, the probe gland and the vessel.

If Teflon tape or a non-conductive sealant must be used, the enclosure mounted on the probe must be electrically bonded to the probe gland and to the vessel. If the vessel is not an unlined metal vessel, an alternate ground reference is required. Refer to section on grounding.

Flexible Probes:

Some flexible probes are supplied with a termination for adding a weight or to fasten the flexible cable to the bottom of the vessel. This is to reduce movement in a non-conductive product as the movement may cause the level reading to change or cause a bare probe to short out to the vessel wall. Weights, when required, are usually ordered with the probe. Turnbuckles for fastening the probe to the bottom of the vessel may also be ordered for the probe.

When fastening the cable to the bottom of the vessel, leave some slack to compensate for expansion and contraction of the vessel and/or cable. Without slack the probe may be damaged.

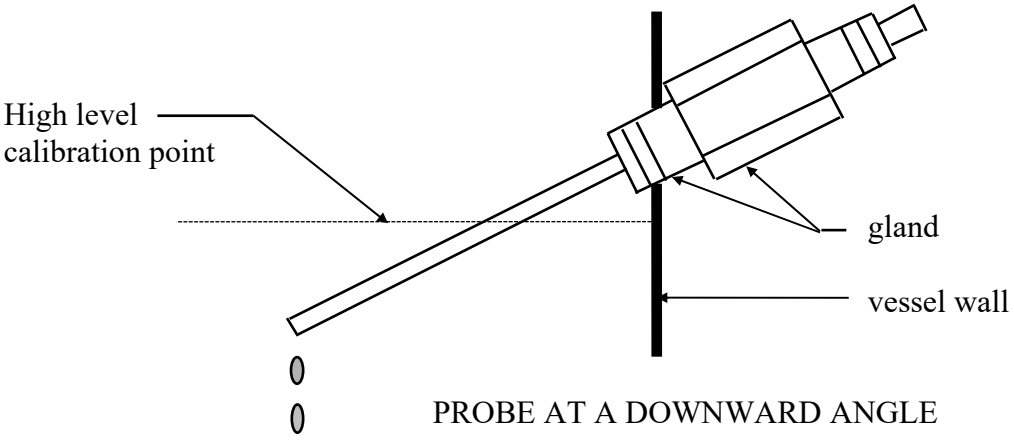
Flexible probes are not usually fastened or tethered to the bottom of the vessel in most granular applications as side loading could tear the termination loose.

Horizontal Mounting For Point Level Without Differential:

For point level detection without differential, horizontally mounted rigid rod type probes are the best choice. They provide the closest control since a level change to, or near, the probe will produce a large capacitance change. These probes must be installed in the vessel at the desired point of level detection. The probe should be located so that the product does not flow on the probe during filling as this will cause false readings and may damage the probe.

Horizontal mounting is limited to short probes, generally up to 18 inches in length, as the weight and strength of the probe rod combined with any forces caused by the process may bend the probe rod. The installer should determine the suitability of a probe for horizontal mounting.

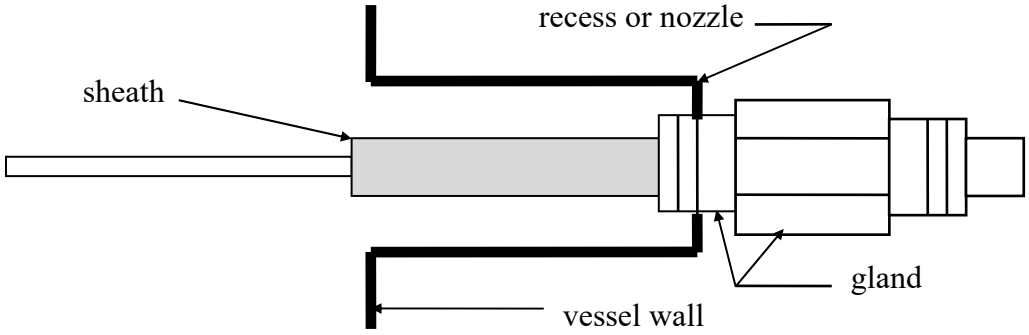
On applications involving non-conductive viscous or powder-like products, the probe should be mounted on a slight downward angle to permit draining of the product from the probe. The instrument actuation point should be set so that the high level point is always below the gland.



PROBE AT A DOWNWARD ANGLE

If the product is conductive, a short-stop probe and an instrument with anti-coating circuitry must be used.

If the probe is to be installed in a recess or nozzle, a "sheathed" probe should be used unless the probe is a short-stop probe and the instrument has anti-coating circuitry. This is required to eliminate false operation caused by any condensation or product that may collect within the nozzle recess. A sheathed probe has an inactive (sheathed) portion near the mounting gland. The probe will not generate any capacitance change when product or condensate surrounds the sheath.



SHEATHED PROBE

MOUNTED HORIZONTAL

Vertical Mounting:

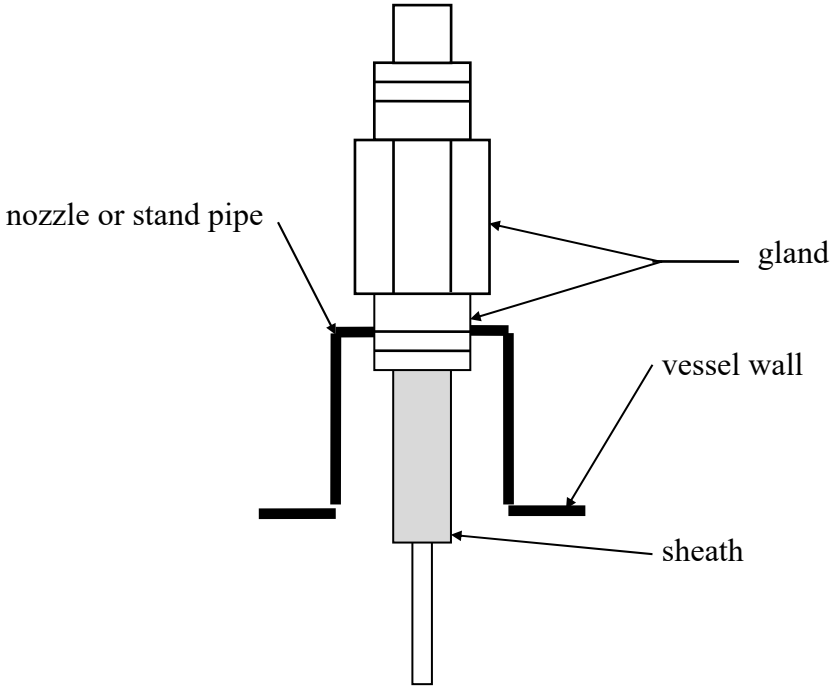
Vertical mounting of probes is required for point level detection with differential and for continuous level measurement. Vertical mounting may also be used for point level detection without differential.

Vertical mounted probes can be mounted in top or the bottom of the vessel. The installer must determine the suitability of mounting the probe in the bottom of the vessel as long probe lengths combined with any forces caused by the product may bend the probe. Some probes that have been bent at the factory to customer specifications may be considered as a vertical mounted probe even though they are mounted from the side of the vessel. An example of this is a probe bent at 90° and hangs down inside the vessel.

The trip point for an uninsulated probe in a conductive product is the tip of the probe except when using a Model 352 conductivity switch. For all other instruments this can only be used for point level detection without differential as no differential or continuous level measurement is possible with this condition. With the Model 352 the set point and differential is adjustable up and down the probe.

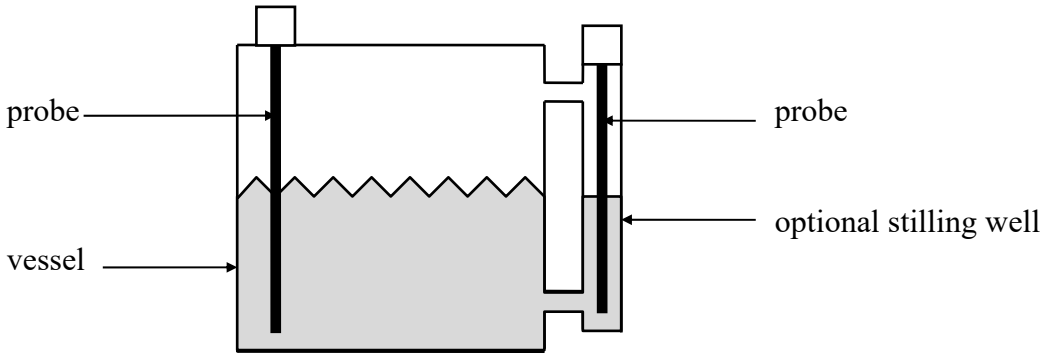
The trip point for point level detection without differential must be a minimum of 4 inches from the tip of the probe in a non-conductive product. This is required to ensure that there is enough capacitance change to trip the instrument. The trip point on an insulated probe in a conductive product should be at least 1 inch from the tip.

If the probe is to be mounted through a nozzle or stand pipe, and the product has high vapor content or is subject to condensate forming in the nozzle or stand pipe, a sheathed probe should be used. This is required to eliminate false operation caused by condensate or condensed vapor that may collect in the nozzle or stand pipe. A sheathed probe has an inactive (sheathed) portion near the mounting gland. The probe will not generate any capacitance change when condensate or condensed vapor surrounds the sheath. It must be noted that outdoor installations are usually subjected to condensation.



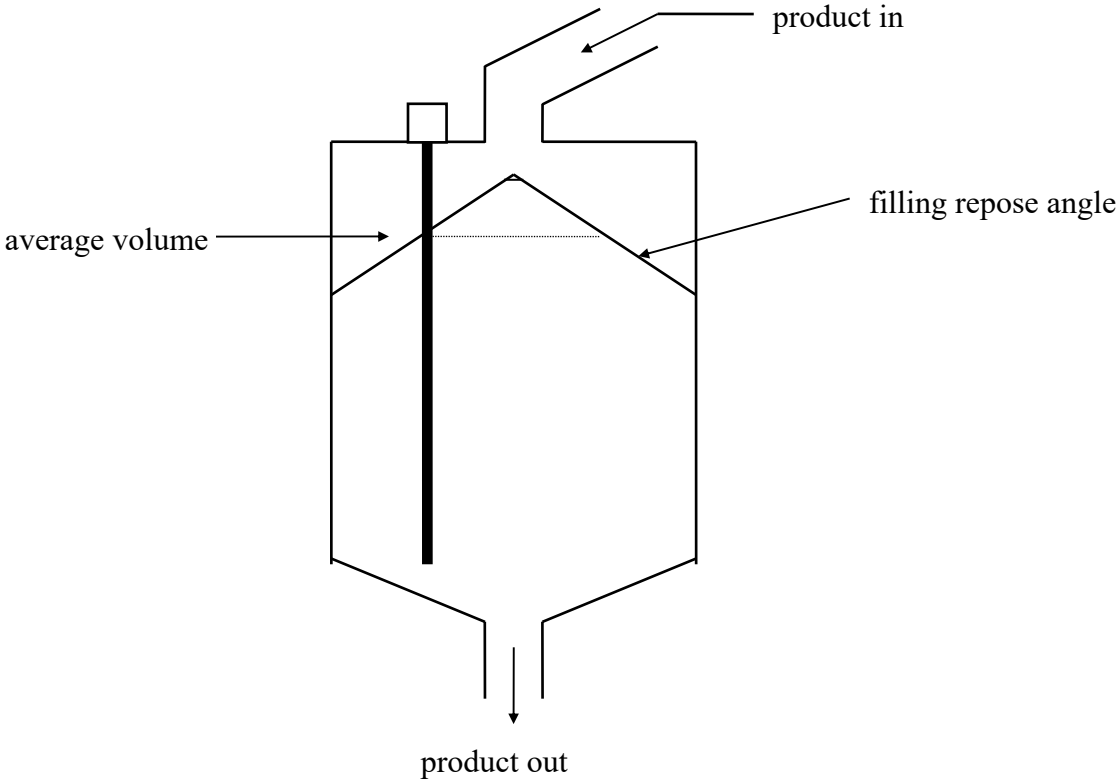
SHEATHED PROBE MOUNTED VERTICAL

The probe should be located so that the product does not flow on the probe during filling as this will cause false readings and may damage the probe. In applications where considerable turbulence of the liquid occurs, it is suggested that a "stilling well" be installed to prevent damage to the probe and to prevent erratic level detection.



The proximity of the probe to a vessel wall is not critical when the product is conductive, when the probe has a concentric shield or ground wire, or when a ground rod is employed. When the product is non-conductive, the closer the probe is to the ground reference (vessel wall or ground rod) the greater the capacitance change will be during level change. This will provide increased resolution and accuracy.

For granular products the probe is normally mounted midway between the center and side wall of the vessel, as shown below. In this way, it measures the average volume of material in the vessel even when the product has a large angle of repose.



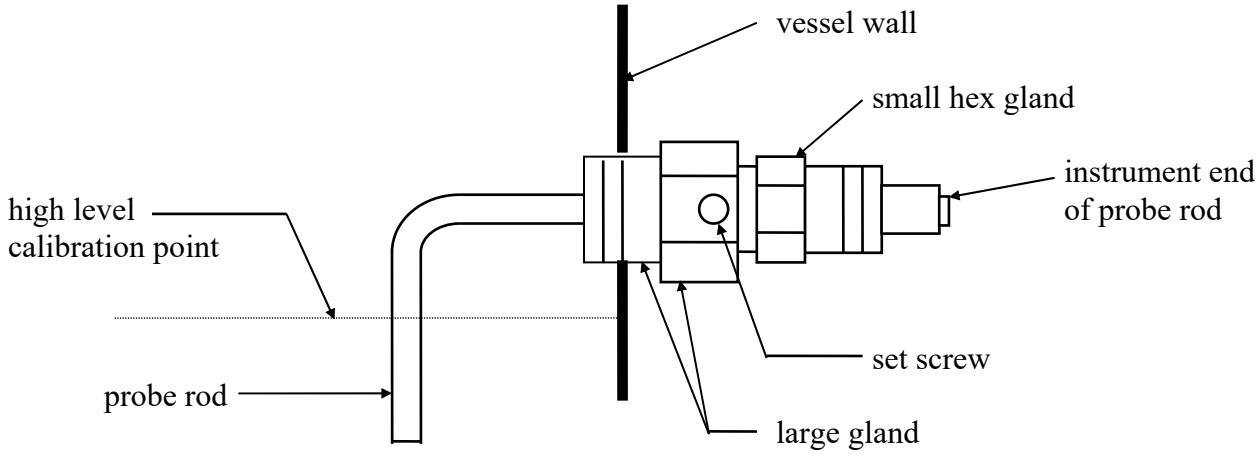
Bent Probes:

Probe rods may be bent at the factory to customer specifications. Although there are several reasons for bending the probe rod, the most common are to allow for the probe to avoid obstacles in the vessel or so that a probe may be mounted from the side of the vessel and yet function as a vertically mounted probe.

When installing a bent probe care must be taken to ensure that the probe rod ends up in the proper position. One probe, the model 702A, can have its rod oriented after the probe is installed. This only applies to the model 702A and must not be attempted with any other probe or else damage to the probe and/or leakage may occur.

If a model 702A probe is to be oriented after the probe is installed follow these steps:

1. Remove the set screw from the large gland. Please note that the set screw was secured at the factory with Loctite.
2. Loosen the small hex gland just enough so that the probe rod may be rotated inside of the large gland.
3. If, after installation, you will be unable to see the position of the bent portion of the probe rod, place a mark on the instrument end of the rod in relation to the bent portion.
4. Install the probe.
5. Rotate the rod to the required position.
6. Tighten the small hex gland. Torque to 280 inch pounds. Retorque after 24 hours.
7. Apply Loctite to set screw and reinstall.



MODEL 702A BENT PROBE
VERTICAL MOUNTING THROUGH SIDE OF VESSEL

Grounding:

In most cases the probe is mounted in a metal vessel and the probe gland is grounded to the vessel. The probe rod acts as one plate of a capacitor while the metal wall of the vessel acts as the second plate of the capacitor. However, in some cases the vessel is either non-metallic (fiberglass, concrete, etc.) thereby eliminating one plate of the capacitor, or the vessel is lined with a non-metallic substance thereby creating 2 capacitors in parallel. These conditions will result in improper capacitance change which will cause errors in the level measurement. In order to correct this a second plate or ground must be added.

In some cases a metal vessel lined with a non-metallic substance will serve as an adequate ground reference. However, this will not always work and should be tested for proper operation. Therefore, it is recommended that a metal vessel lined with a non-metallic substance be treated the same as a non-metallic vessel.

For highly conductive products, such as water, it is only necessary to make contact with the product as the product itself is one plate of the capacitor. For non-conductive or low conductive products the plate or ground must be parallel to, and at least as long as, the active portion of the probe. Preferably it should be slightly longer. The following are some methods which may be employed to add the ground:

a. The preferred choice for a non-conductive or slightly conductive product is a ground rod installed parallel to the probe at a minimum distance of 2 inches. The maximum distance between the probe and the ground rod is critical. Unless it can be determined that the combination of probe, instrument, product dielectric and required span will allow for greater distances, it is recommended that the maximum distance between the probe and the ground rod be 2 inches for probes up to 3 feet in length, 7 inches for 4 foot long probes, and 10 inches for probes 5 feet and longer. If agitation will cause the distance between the probe and the rod to fluctuate, the level reading may change. Therefore, if such a condition exists, add plastic spacers between the probe and the rod or otherwise secure them to vessel wall with insulators. Ground rods should be made of a material which will not corrode in the application and cause a loss of continuity.

   A second probe, which is uninsulated, may be employed as a ground rod in either conductive or non-conductive product. When this is the case the center conductor (rod) of the second probe must be grounded to the enclosure mounted on the probe. Grounding to the gland of the ground rod probe is meaningless.

b. For highly conductive products any unlined metal pipe, valve or similar metal device which enters the vessel and is in contact with the product may be used to ground the probe mounted enclosure to the product. (The product serves as one plate.) The pipe, valve or other device should be made of a material which will not corrode in the application and cause a loss of continuity

c. Use a probe with a concentric shield (in either a conductive or non-conductive product). Concentric shields may only be used in liquids that are not viscous and that do not contain solids.

d. The least preferred choice is to use a probe with a ground wire (in either conductive or non-conductive product). This applies to insulated probes only and should not be used in a process that contains solids or material that may cling to, or catch on, the ground wire.

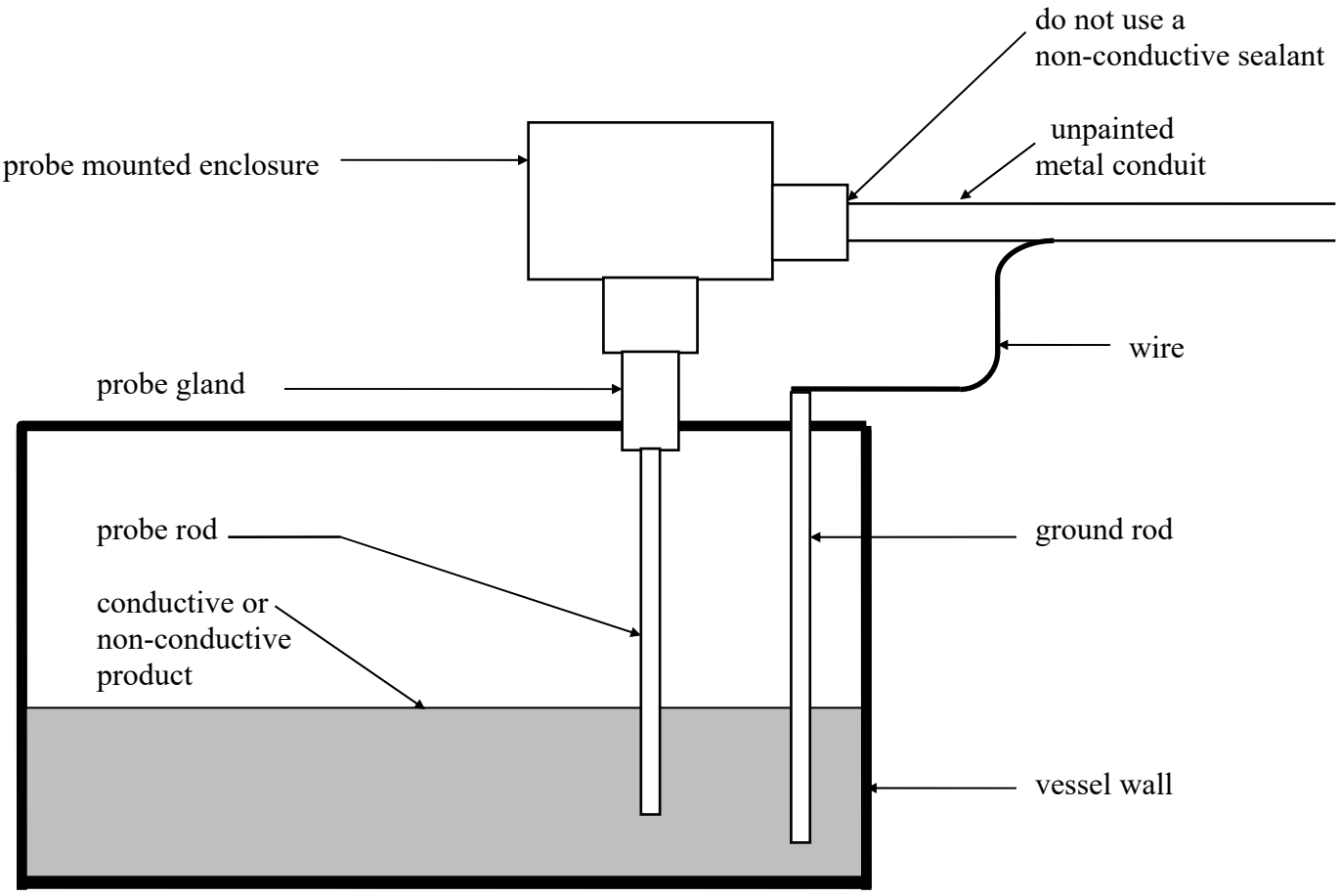
Concentric shields and ground wires are part of the probe and therefore grounded to the probe gland which in turn is grounded to the probe mounted enclosure. The addition of a ground rod or the use of an unlined pipe, valve or similar device, requires a connection to the enclosure mounted on the measuring probe gland. The probe mounted enclosure may be an instrument enclosure or a junction box. The

connection does not have to be directly to the enclosure. The cable or wire from the ground connection may be terminated at any point which will insure that the enclosure is electrically bonded to the ground reference.

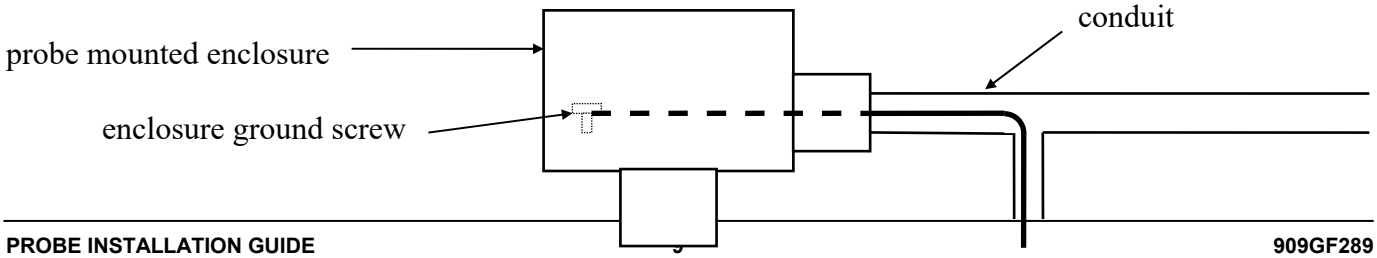
Some termination methods that may be employed are as follows:

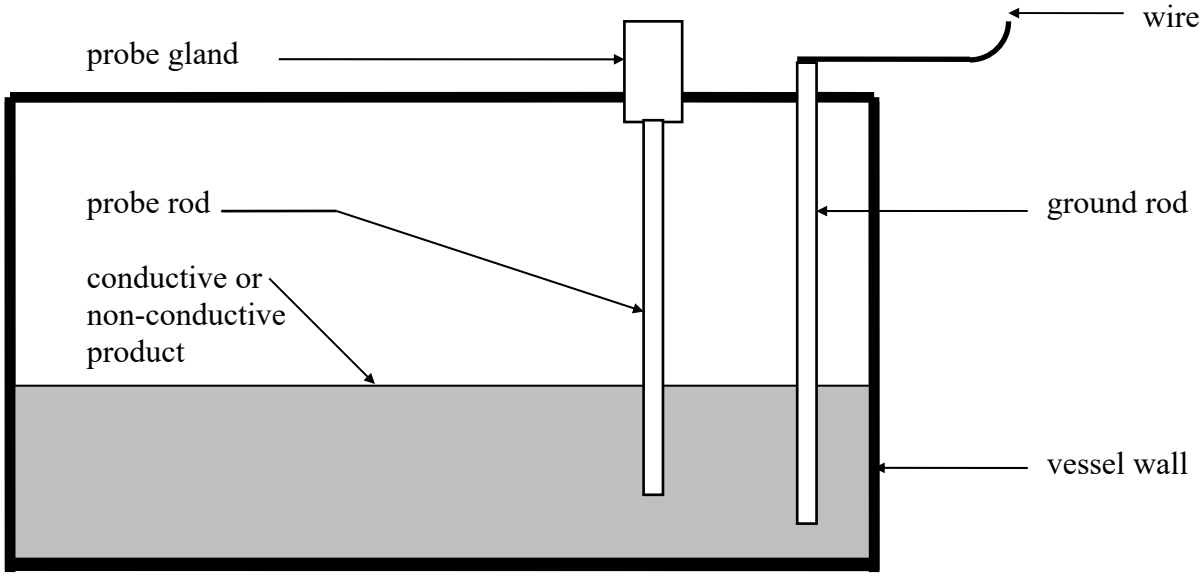
Clamp the wire to an unpainted portion of metal conduit which is screwed into the probe mounted enclosure.
Clamp the wire to the gland of the measuring probe.
Attach the wire to the ground screw located inside of the probe mounted enclosure.
Clamp the wire to a cooling extension (if employed).

The following figures illustrate typical grounding methods.

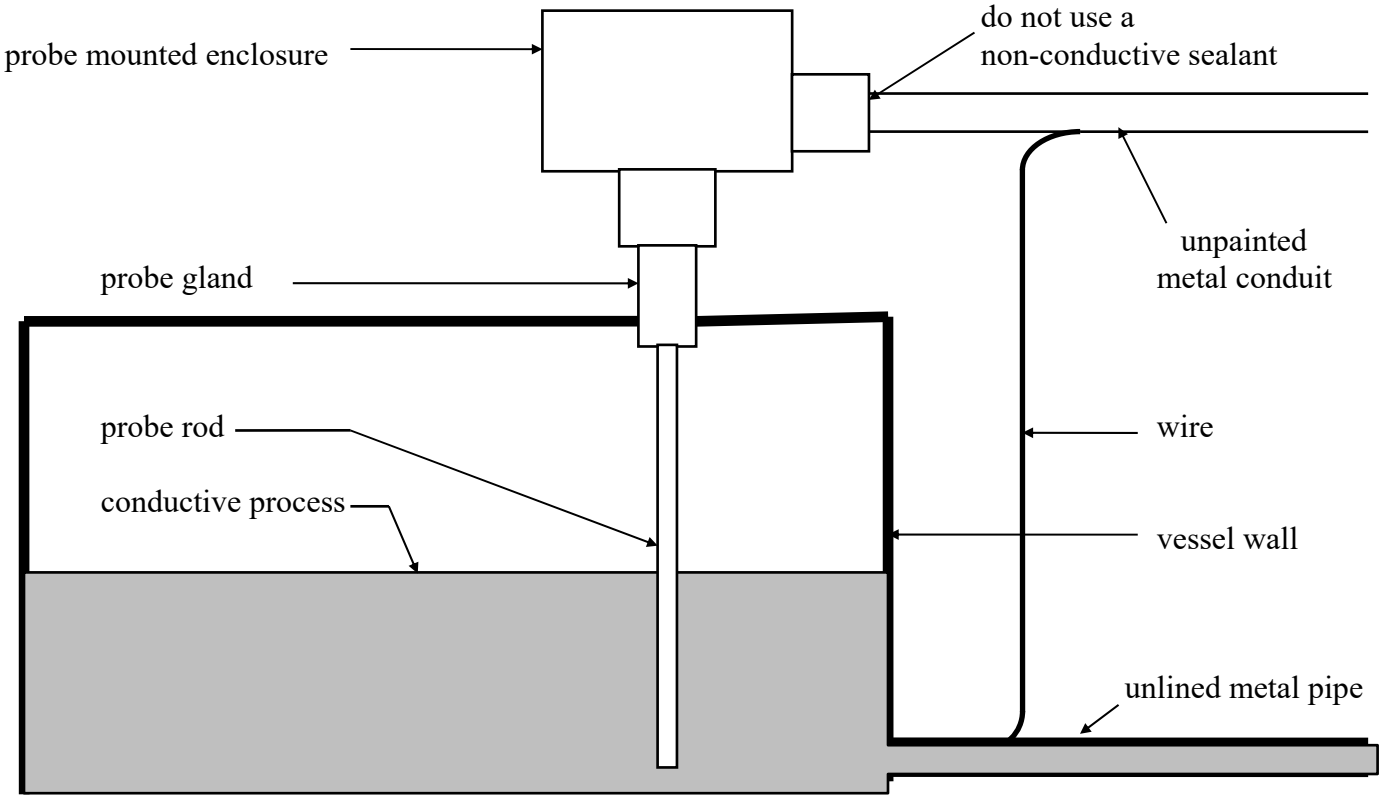


CUSTOMER INSTALLED GROUND ROD EMPLOYED

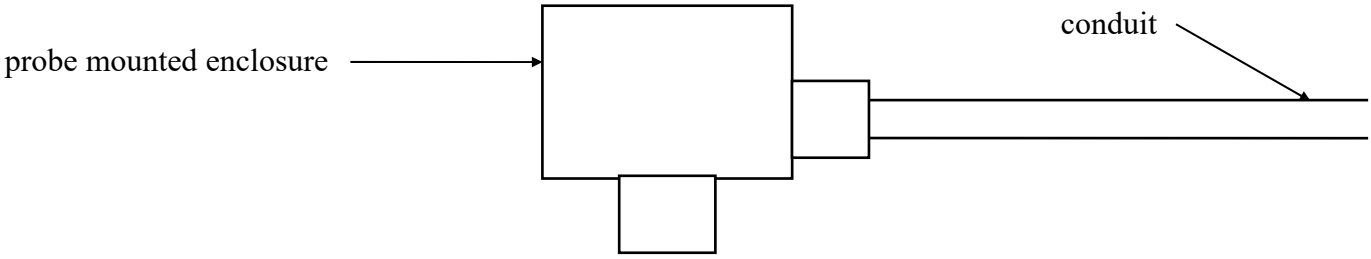


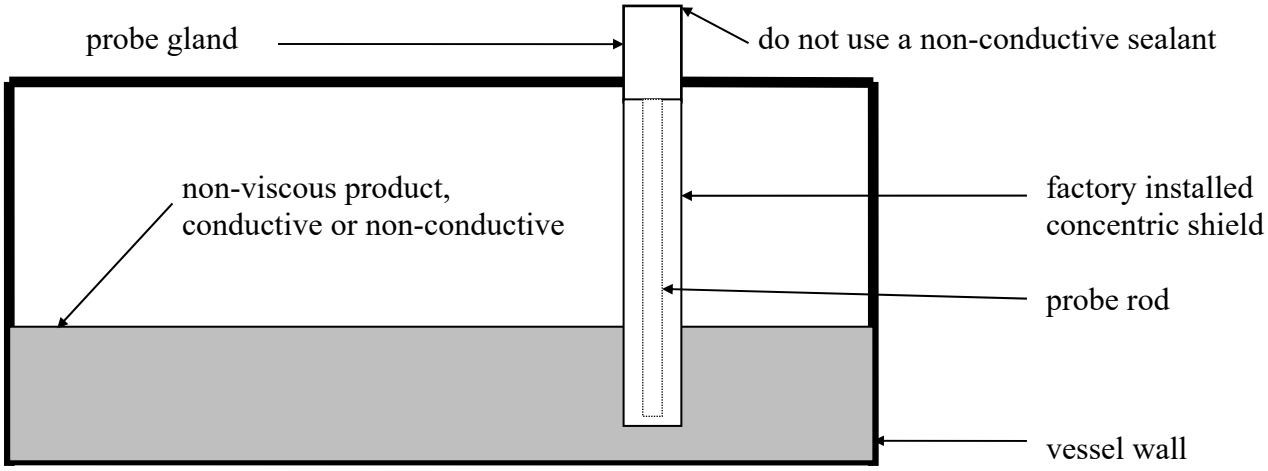


CUSTOMER INSTALLED GROUND ROD EMPLOYED

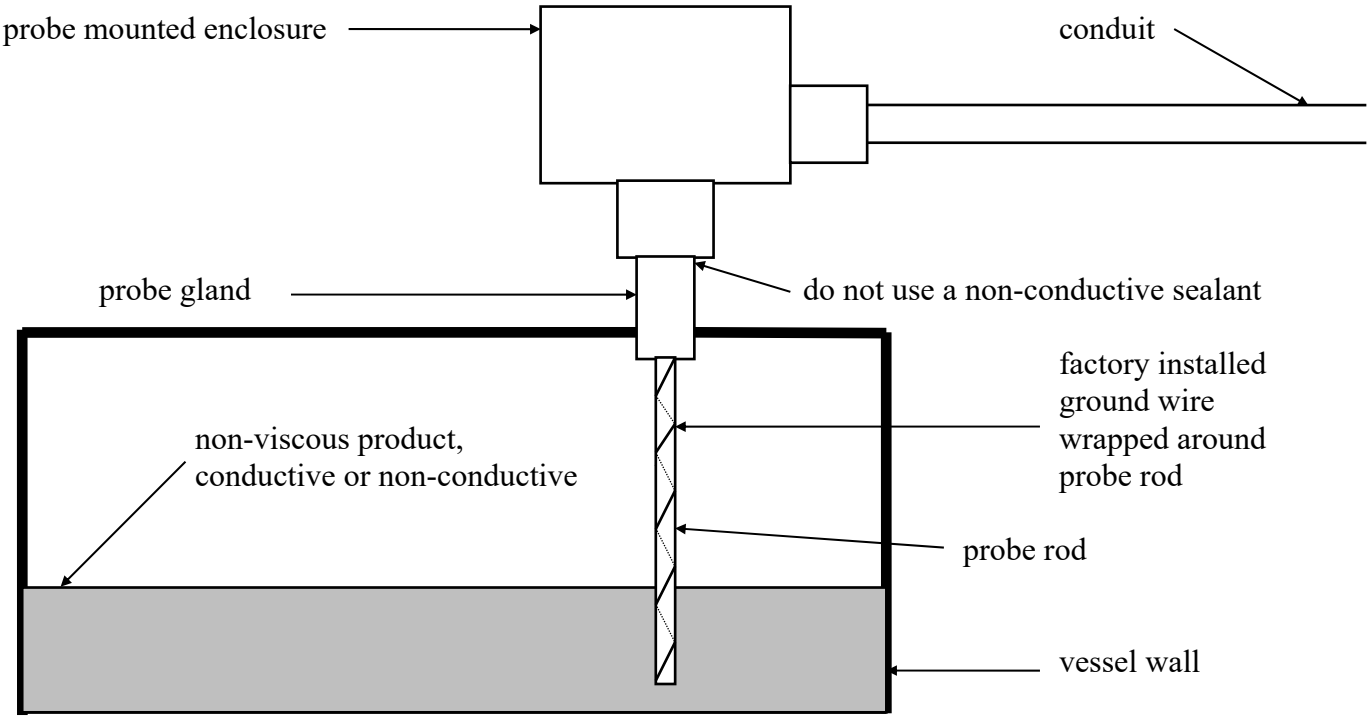


METAL PIPE GROUND REFERENCE





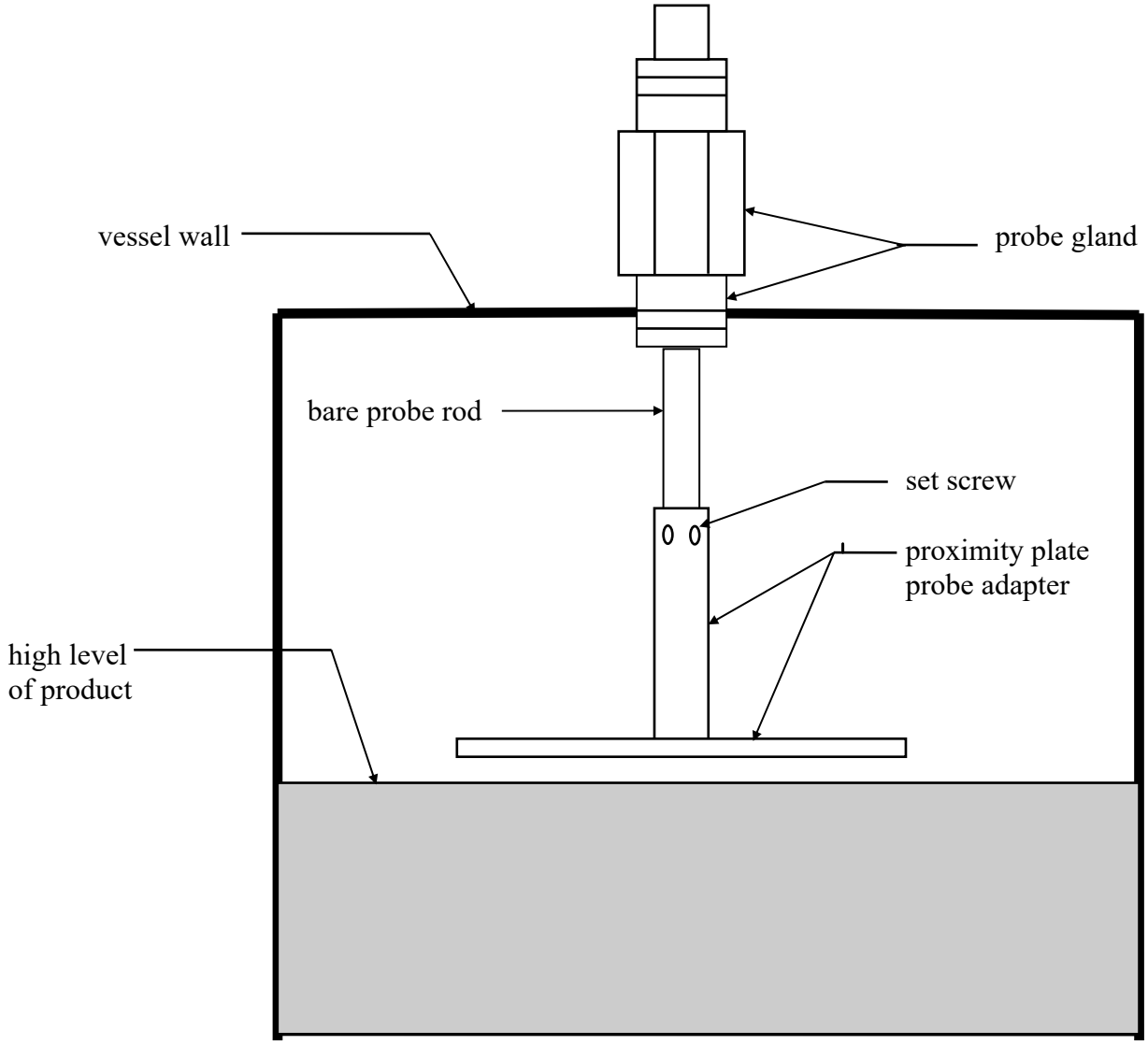
PROBE WITH CONCENTRIC SHIELD GROUNDING



PROBE WITH GROUND WIRE

Proximity Plate Probe Adapter:

The Proximity Plate probe Adapter is used with the either a 702A-C or 741A-A probe having a 7/16" diameter bare (uninsulated) rod. The probe adapter is intended for non-contacting level sensing applications. The probe adapter mounts onto the probe rod by two set screws and provides ±1" of adjustment.



PROXIMITY MEASUREMENT IN A VESSEL

The proximity plate must be at least 1" from the sides of the vessel or any rolls or mechanisms.

The ground reference for a non-conductive product in a metal vessel is the vessel itself. If the product is conductive and the vessel is either non-metallic or metallic but lined with a non-metallic substance, a ground reference must be provided. Refer to the section on grounding. If the product is non-conductive and the vessel is either non-metallic or metallic but lined with a non-metallic substance, proximity measurement should not be used.

Testing And Calibrating Prior To Installing In A Vessel:

A probe may be connected to an instrument when the probe is not installed in a vessel for the purposes of testing an instrument or probe, or to calibrate an instrument before installing in a vessel

The major concern is having a good ground reference. Without the proper ground reference the instrument will not function properly. (Refer to section on grounding.)

Do not use a plastic pipe or bucket unless you are using a probe with a factory installed concentric shield or ground wire, or unless the product is conductive. If the probe has a concentric shield or ground wire no additional ground connection is required. However, if the probe does not have a concentric shield or ground wire, the addition of a wire from the product to the probe gland or probe mounted enclosure is required.

If the probe does not have a factory installed concentric shield or ground wire, and the product is not conductive, the probe must be placed in a metal pipe or bucket, The probe gland or probe mounted enclosure must also be connected to the metal pipe or bucket to obtain a ground reference. Again, if the probe has a concentric shield or ground wire, no additional ground connection is required.

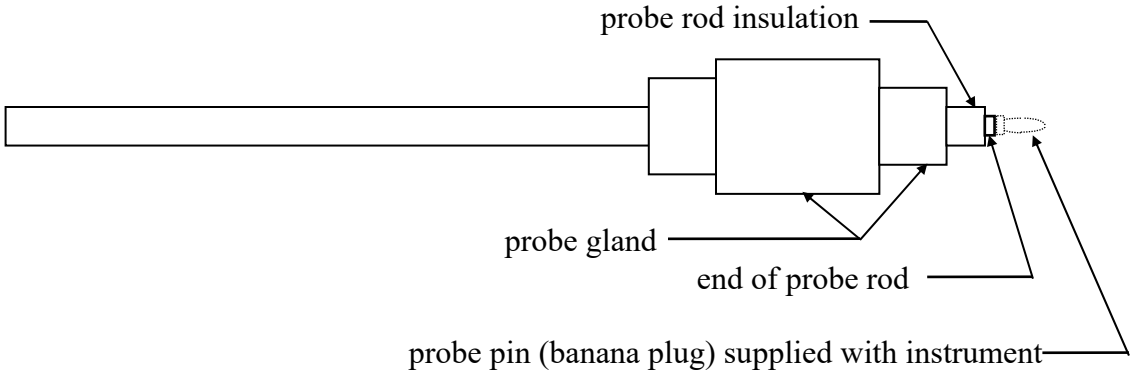
Calibrating an instrument while connected to a probe that has not yet been installed in a vessel requires the use of the product itself or a substitute that has a similar dielectric. Usually water can be employed in lieu of a conductive (water based) product.

To calibrate for a low dielectric (non-conductive) product using a probe with a concentric shield or ground wire, any size or shape substitute vessel is suitable and a fair degree of accuracy can be obtained.

Calibration outside the product vessel for a low dielectric product using a probe without a factory installed concentric shield or ground wire should not be done. Calibration for these conditions should only be done with the probe installed in the product vessel. This will require varying the product level for most instruments.

Troubleshooting:

Probes have no moving parts and are therefore relatively trouble free. However, probes may become damaged due to mishandling, misuse, or if subjected to severe conditions in the application. Probes may also fail to perform if improperly installed. Listed below are some guidelines for which may be used for troubleshooting.



1. Probe shorted:

   This will cause an instrument to indicate a high level condition. An instrument with a 4-20 ma output may have an output much higher than 20 ma. To verify this condition, disconnect the power to the instrument, remove the instrument and connect an ohmmeter across the probe gland and the end of the probe rod where the probe pin is installed. The circuit should read open; if not, the probe is shorted. This test should be performed while the probe is installed in the vessel, immersed in the process and the vessel pressurized (if applicable). If the short is caused by a leak in the insulation, this test will not usually verify the condition if performed outside of the vessel.

   Condensation can cause a bare probe to be shorted. If this is the case the probe is incorrect for the application and is not defective.

   If the product is non-conductive a leak in the insulation will result in little or no error and may not even be noticed unless the product is seeping out of the vessel through the probe.

2. Probe open:

   This will cause an instrument to indicate a low level condition. An instrument with a 4-20 ma output will have an output of 4 ma or less.

   This condition is usually caused by an improper ground reference. Refer to section on grounding.

   This condition can also be caused by a missing probe pin or a probe pin which is not making contact with the socket in the instrument. To verify this condition disconnect power to the instrument and remove the instrument enclosure cover. With the instrument on the probe, loosen the three screws which secure the electronics to the enclosure base. Lift the electronics out of the enclosure and verify that the probe pin is in place. Gently lower the electronics back into the enclosure. A slight resistance should be felt before the electronics bottom out indicating that the probe pin is engaging socket in the electronics.

Schneider Electric Systems USA, Inc.
1602 Mustang Drive
Maryville, TN 37801
Phone: (865) 981-3100 Fax: (865) 981-3168
http://www.robertshawindustrial.com

(2/19) **Printed in U.S.A.**