Installation & Maintenance Instructions

# HORIZON™ MODEL 704

## Guided Wave Radar Level Transmitter


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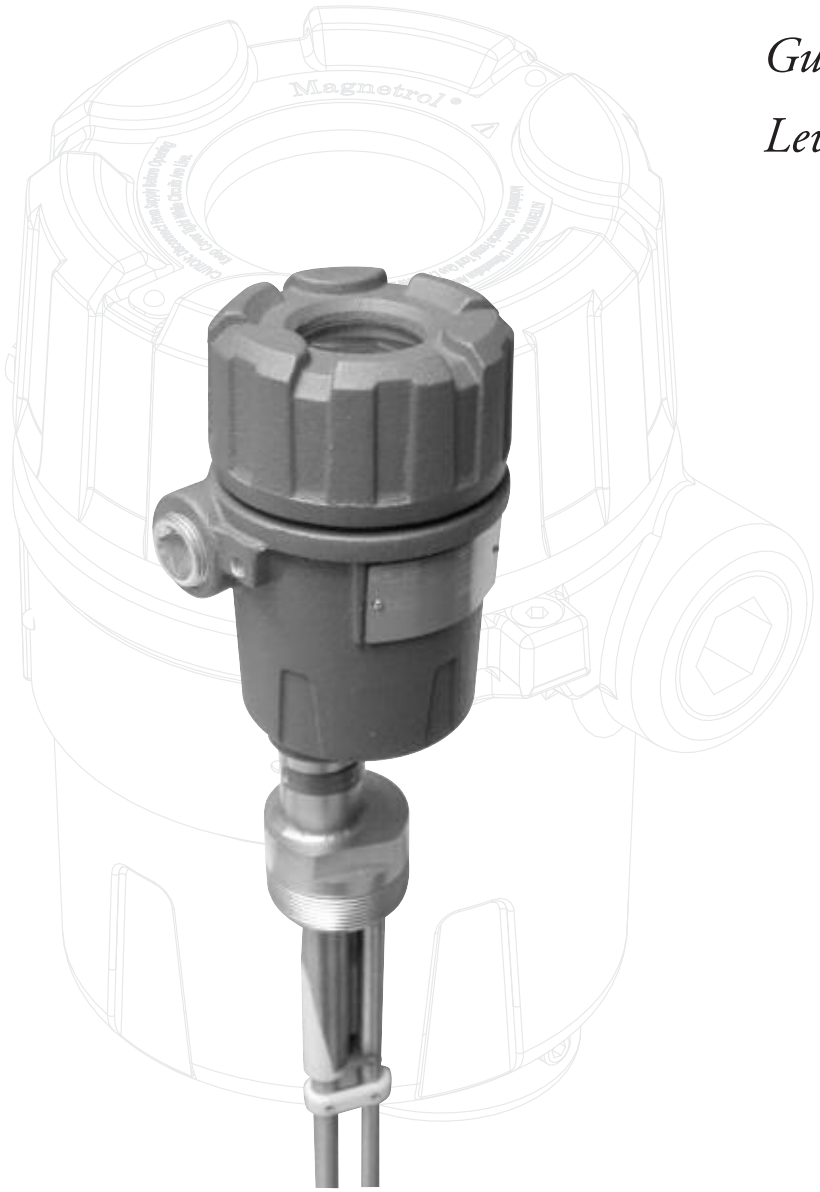
HORIZON™

# Model 704

704 software v1.0

**Installation and Operating Manual**



*Guided Wave Radar*

*Level Transmitter*

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**Read this Manual Before Installing**
This manual provides information on the Horizon transmitter. It is important that all instructions are read carefully and followed in sequence. The *QuickStart Installation* instructions are a brief guide to the sequence of steps for experienced technicians to follow when installing the equipment. Detailed instructions are included in the *Complete Installation* section of this manual.

**Conventions Used in this Manual**
Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

**Notes**
Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

**Cautions**
Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

**Warnings**
Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

**Safety Messages**
The Horizon system is designed for use in Category II, Pollution Degree 2 installations. Follow all standard industry procedures for servicing electrical and computer equipment when working with or around high voltage. Always shut off the power supply before touching any components. Although high voltage is not present in this system, it may be present in other systems.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe safety procedures when working with electrostatic sensitive components.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

**WARNING!** Explosion hazard. Do not connect or disconnect transmitters rated Explosion-proof or Non-incendive unless power has been switched off and/or the area is known to be non-hazardous.

**Low Voltage Directive**
For use in Installations Category II, Pollution Degree 2. If equipment is used in a manner not specified by the manufacturer, protection provided by equipment may be impaired.

**Notice of Copyright and Limitations**


Performance specifications are effective with date of issue and are subject to change without notice. Magnetrol® reserves the right to make changes to the product described in this manual at any time without notice. MAGNETROL makes no warranty with respect to the accuracy of the information in this manual.

**Warranty**
All MAGNETROL electronic level and flow controls are warranted free of defects in materials or workmanship for eighteen months from the date of original factory shipment. If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, MAGNETROL will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

MAGNETROL shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some MAGNETROL products.

**Quality Assurance**
The quality assurance system in place at MAGNETROL guarantees the highest level of quality throughout the company. MAGNETROL is committed to providing full customer satisfaction both in quality products and quality service.

the MAGNETROL quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

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# Horizon Guided Wave Radar Transmitter

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# 1.0 QuickStart Installation

The QuickStart Installation procedures provide the key steps for mounting, wiring, and configuring the Horizon level transmitter. These procedures are intended for experienced installers of electronic level measurement instruments. Refer to *Complete Installation, Section 2.0* for detailed installation instructions.

***WARNING!*** Guided Wave Radar probes should be installed so the maximum overfill level is a minimum of 6" (150 mm) below the process connection. This may include utilizing a nozzle or spool piece to raise the probe. Consult factory to ensure proper installation.

## 1.1 Getting Started

Have the proper equipment, tools, and information available before beginning the QuickStart Installation procedures.

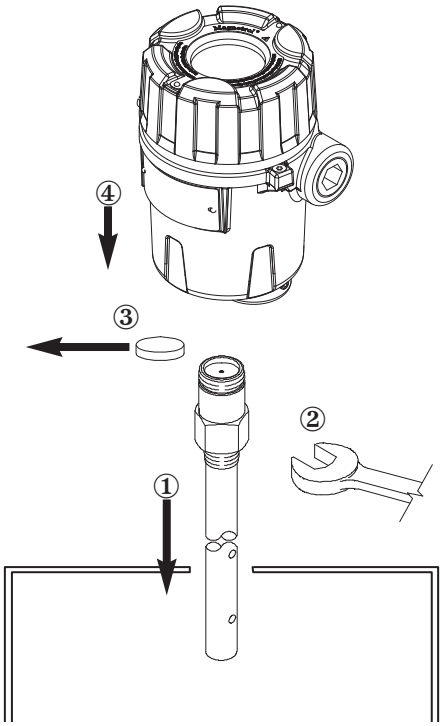
### 1.1.1 Equipment and Tools

- Open-end wrenches or adjustable wrench to fit the process connection size and type. Coaxial probe 1½" (38 mm), twin rod probes 1⅞" (47 mm).
- Flat-blade screwdriver
- Digital multimeter or digital volt/ammeter
- 24 VDC power supply, 23 mA minimum

### 1.1.2 Configuration Information

Some key information is needed to configure the Model 704 Horizon™ transmitter. Complete the following operating parameters table before beginning configuration.

| Display | Question | Answer |
|---|---|---|
| Units | What units of measurement will be used? (inches or centimeters) | _____ |
| | What is the distance from the probe process connection to the tank bottom? | _____ |
| Probe Model | What probe model is listed on the model information? (first four digits of probe model number) | _____ |
| Probe Length | What probe length is listed on the model information? | _____ |
| Offset | What is the distance from the probe tip to the desired 0% level point? | _____ |
| Dielectric (sensitivity) | What is the dielectric constant of the process medium? | _____ |
| Set 4.0 mA | What is the 0% reference point for the 4.0 mA value? | _____ |
| Set 20.0 mA | What is the 100% reference point for the 20.0 mA value? (Top 4" (100 mm) of 7XB Twin Rod probe is inactive) | _____ |




## 1.2 QuickStart Mounting

NOTE: Confirm the configuration style and process connection size/type of the Horizon transmitter. Ensure it matches the requirements of the installation before continuing with the QuickStart installation.

### 1.2.1 Probe

① Carefully place the probe into the vessel. Align the probe process connection with the threaded or flanged mounting on the vessel.

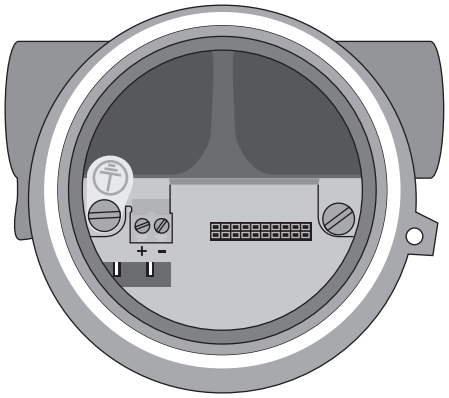
② Tighten the hex nut of the probe process connection or flange bolts.

NOTE: If the transmitter is to be installed at a later time, do not remove the protective cap from the probe. Do not use sealing compound or TFE tape on probe connection to transmitter. This connection is sealed using a Viton® O-ring.

### 1.2.2 Transmitter

③ Remove the protective plastic caps from the top of the probe and at the bottom of the transmitter and store for future use. Make sure the high frequency connector (female) is clean and dry. Clean with isopropyl alcohol and cotton swabs if necessary.

④ Place the transmitter on the probe. Hand-tighten the connection securely.




**Model 704**

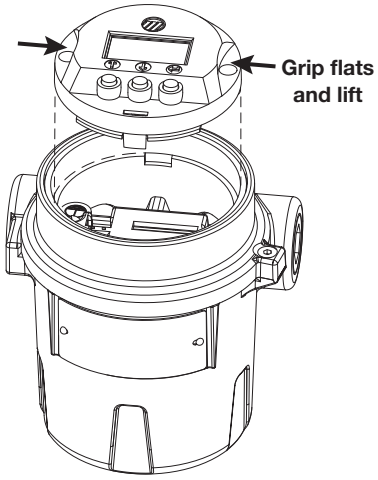
## 1.3 QuickStart Wiring

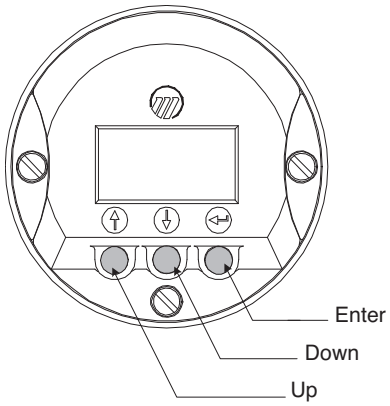
***WARNING!*** Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

NOTE: Ensure that the electrical wiring to the Horizon transmitter is complete and in compliance with all regulations and codes.

NOTE: Do not apply more than 10 ft. lbs. to conduit entries on the Valox housing.

1. Remove the cover of the transmitter.
2. Gripping the display module by the flats, remove the module from the assembly as shown on the next page.
3. Attach a conduit fitting and mount the conduit plug in the spare opening. Pull the power supply wires through the conduit fitting.
4. Connect shield to an earth ground at power supply and at the transmitter.
5. Connect an earth ground to the green ground screw.




6. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal. For Explosion Proof Installations, refer to *Wiring, Section 2.5.3*.
7. Carefully reconnect the display module to the 20-pin connector.
8. Replace the cover of the transmitter.

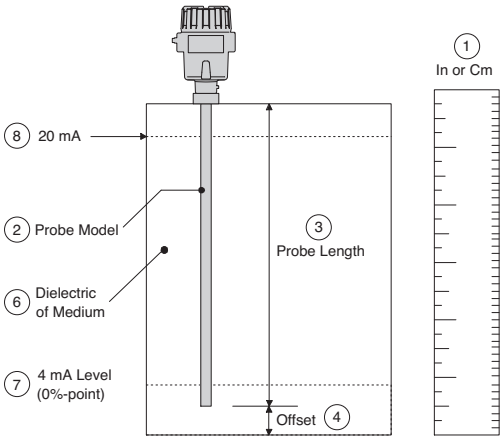
## 1.4 QuickStart Configuration

The Model 704 Horizon transmitter is configured with factory default values but should be reconfigured in the shop (disregard fault message due to unattached probe). The minimum configuration instructions required in the field are shown on the next page. Use the information from the operating parameters table in Section 1.1.2 before beginning configuration.

1. Apply power to the transmitter.

   The display changes approximately every 2 seconds to show one of the three measured values: Level, %Output, and Loop current.
2. Remove the cover of the transmitter.
3. Use the Up or Down Arrow keys (⇧⇩) to move from one step of the configuration program to the next step.
4. To change a particular parameter, press the Enter Arrow key (↵). The last character in the first line of the display changes to an exclamation point (!).

   ```
   Units!
   xxx
   ```
5. Use the Up or Down Arrow keys (⇧⇩) to increase or decrease the value in the display or to scroll through the choices.
6. Press the Enter Arrow key(↵) to accept a value, then move to the next step of the configuration program.
7. After entering the last value, allow 5 seconds before removing power from the transmitter.




Note: A small transition zone (0-6") may exist at the top and bottom of the probe. See Specifications, Section 3.5.

The following configuration entries are the minimum required for configuration.

| | | |
|---|---|---|
| ① | `Units xxx` | Select the **Units** of measurement for the level readout (cm or inches). |
| ② | `Prb Model (select)` | Select the **Probe Model** to be used 7xA-x, 7xB-x, 7xF-P |
| ③ | `Probe Ln xxx.x` | Enter the exact **Probe Length** as indicated on the probe nameplate. |
| ④ | `Offset xxx.x` | Enter the **Offset** value: the distance from the probe end to the desired 0% level point. (The unit is shipped from the factory with offset=0; i.e., all measurements are referenced to the bottom of the probe). Refer to *Offset Description, Section 2.6.5.* |
| ⑤ | `Lvl Trim xxx.x` | Enter a distance correction to account for mounting variations (this step should be performed after installation). |
| ⑥ | `Dielctrc (select)` | Enter the **Dielectric** range for the material to be measured (only applicable for coaxial and twin rod probes 7XA & 7XB). |
| ⑦ | `Set 4mA xxx.x` | Enter the minimum level value (0% point) for the **4 mA** point. |
| ⑧ | `Set 20mA xxx.x` | Enter the maximum level value (100% point) for the **20 mA** point. |

# 2.0 Complete Installation

This section provides detailed procedures for properly installing and configuring the Horizon Guided Wave Radar Level Transmitter.

## 2.1 Unpacking

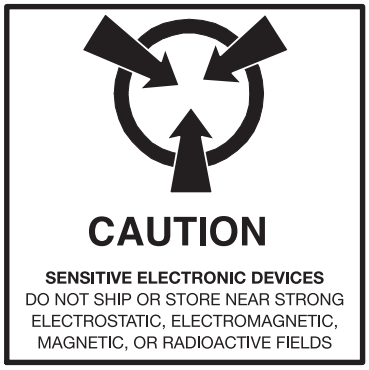
Unpack the instrument carefully. Make sure all components have been removed from the packing material. Verify all contents correspond to the packing slip. Report any discrepancies to the factory.

Before proceeding with the installation, do the following:

- Inspect all components for damage. Report any damage to the carrier within 24 hours.
- Make sure the nameplate model number on the probe and transmitter correspond with the packing slip and purchase order.
- Record the model and serial numbers for future reference when ordering parts.

Model Number _____

Serial Number _____




## 2.2 Electrostatic Discharge (ESD) Handling Procedure

Magnetrol® electronic instruments are manufactured to the highest quality standards. These instruments use electronic components that may be damaged by static electricity present in most work environments.

The following steps are recommended to reduce the risk of component failure due to electrostatic discharge.

- Ship and store circuit boards in anti-static bags. If an anti-static bag is not available, wrap the board in aluminum foil. Do not place boards on foam packing materials.
- Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is recommended.
- Handle circuit boards only by the edges. Do not touch components or connector pins.
- Make sure that all electrical connections are completely secure and none are partial or floating. Ground all equipment to a good, earth ground.

## 2.3 Before You Begin

### 2.3.1 Site Preparation

Each Horizon transmitter is built to match the specific physical specifications of the required installation. Make sure the probe connection is correct for the threaded or flanged mounting on the vessel or tank where the transmitter will be placed. Refer to *Mounting, Section 2.4.*

Make sure that the wiring between the power supply and Horizon transmitter are complete and correct for the type of installation. Refer to *Specifications, Section 3.5.*

When installing the Horizon transmitter in a general purpose or hazardous area, all local, state, and federal regulations and guidelines must be observed. Refer to *Wiring, Section 2.5.*

### 2.3.2 Equipment and Tools

No special equipment or tools are required to install the Horizon transmitter. The following items are recommended:

- Open-end wrenches or adjustable wrench to fit the process connection size and type; 1½" (38 mm) for a coaxial probe, 1⅞" (47 mm) for twin rod probes.
- Flat-blade screwdriver
- Digital multimeter or digital volt/ammeter
- 24 VDC power supply, 23 mA minimum

### 2.3.3 Operational Considerations

Operating specifications vary based on Probe model number. Refer to *Specifications, Section 3.5.*

## 2.4 Mounting

The Horizon transmitter can be mounted to a tank using a variety of process connections. Generally either a threaded or flanged connection is used. For information about the sizes and types of connections available, refer to *Probe Model Number, Section 3.7.2.*

NOTE: Do not place insulating material around any part of the Horizon transmitter including the probe flange as this may cause excessive heat buildup.

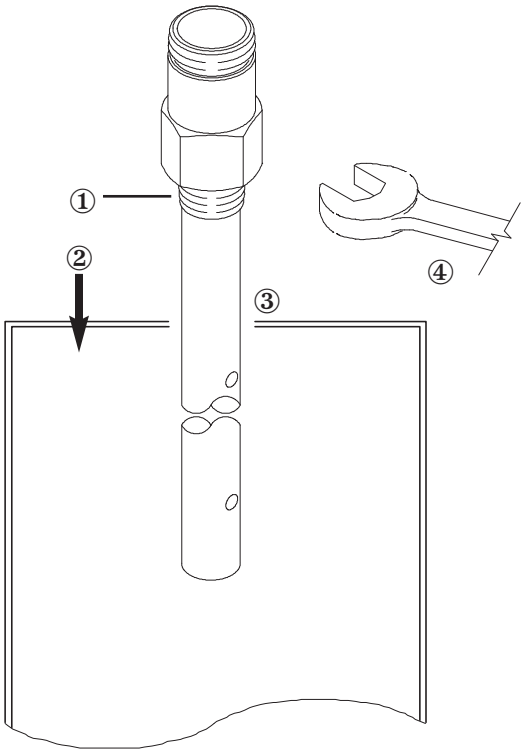
***WARNING!*** Guided Wave Radar probes should be installed so the maximum overfill level is a minimum of 6" (150 mm) below the process connection. This may include utilizing a nozzle or spool piece to raise the probe. Consult factory to ensure proper installation.

***WARNING!*** Do not disassemble probe when it is in service and/or under pressure.

### 2.4.1 Installing a Coaxial Probe

Before installing, make sure the:

- Probe has adequate room for installation and has unobstructed entry to the bottom of the vessel. Refer to *Physical Specifications, Section 3.5.5.*
- Process temperature, pressure, dielectric, and viscosity are within the probe specifications for the installation. Refer to *Specifications, Section 3.5.*




**To install a coaxial probe:**

① Make sure the process connection is at least ¾" NPT or a flanged mounting.

② Carefully place the probe into the vessel. Align the gasket on flanged installations.

③ Align the probe process connection with the threaded or flanged mounting on the vessel.

④ For threaded connections, tighten the hex nut of the probe process connection. For flanged connections, tighten flange bolts.

NOTE: If the transmitter is to be installed at a later time, do not remove the protective cap from the probe. Do not use sealing compound or TFE tape on probe connection to transmitter. This connection is sealed using a Viton® O-ring.

### 2.4.2 Installing a Twin Rod Probe

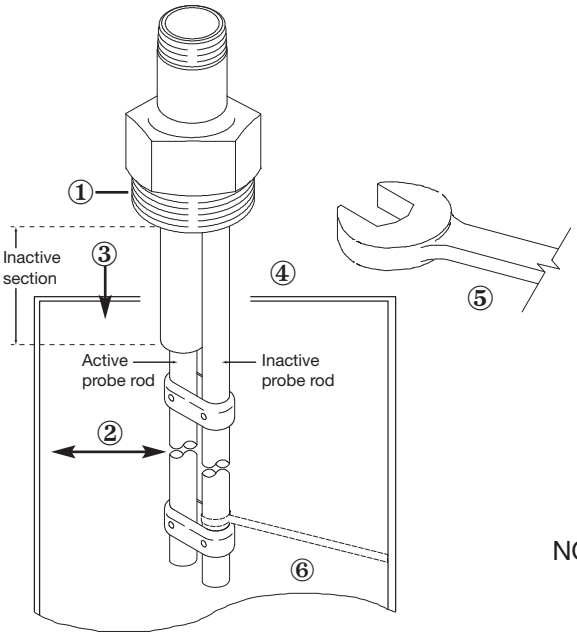
Before installing, make sure the:

- Probe has adequate headroom for installation and has unobstructed entry to the bottom of the vessel.
- Process temperature, pressure, dielectric, viscosity, and media buildup are within the probe specifications for the installation. Refer to *Specifications, Section 3.5.*

**Nozzles:**

The 7XB Twin Rod probe may be susceptible to objects that are in close proximity. The following rules should be followed for proper application:

- Nozzles should be 3" (80 mm) diameter or larger.
- For nozzles < 3" (80 mm) diameter, the bottom of the inactive section of the probe should be at least flush with the bottom of the nozzle or extend into the vessel.
- 7XB Twin rod probe should be installed such that the active rod is > 1" (25 mm) from metallic objects such as pipes, ladders, etc. (a bare tank wall parallel to the probe is acceptable).




① Make sure the process connection is at least 2" NPT or a flanged mounting.

② Make sure that there is at least 1" (25 mm) spacing between the active probe rod and any part of the tank (walls, stillwell, pipes, support beams, mixer blades, etc.). Minimum stillwell diameter for a twin rod probe is 3" (80 mm).

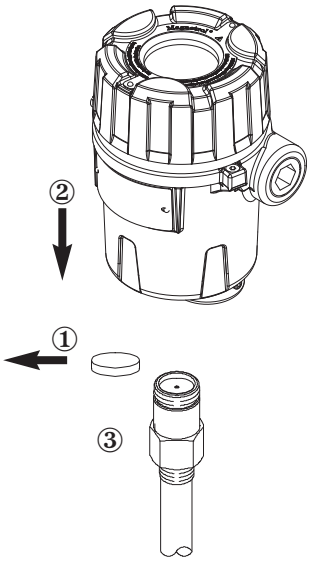
③ Carefully place the probe into the vessel. Align the gasket on flanged installations.

④ Align the probe process connection with the threaded or flanged mounting on the vessel.

⑤ For threaded connections, tighten the hex nut of the probe process connection. For flanged connections, tighten flange bolts.

⑥ Probe can be stabilized by attaching the inactive probe rod to vessel.

NOTE: If the transmitter is to be installed at a later time, do not remove the protective cap from the probe. Do not use sealing compound or TFE tape on probe connection to transmitter. This connection is sealed using a Viton® O-ring.




### 2.4.3 Installing the Transmitter

The Horizon transmitter can only be ordered for installation as an integral configuration.

NOTE: Model 704 transmitters may not show an error and indicate a LEVEL value > 0 when disconnected from probe.

① Remove the protective plastic caps from the top of the probe and bottom of the transmitter. Put the caps in a safe place in the event transmitter has to be removed later.

② Place the transmitter on the probe. Be careful not to bend or dirty the gold high frequency (male) connector.

③ Hand-tighten the connection securely.

## 2.5 Wiring

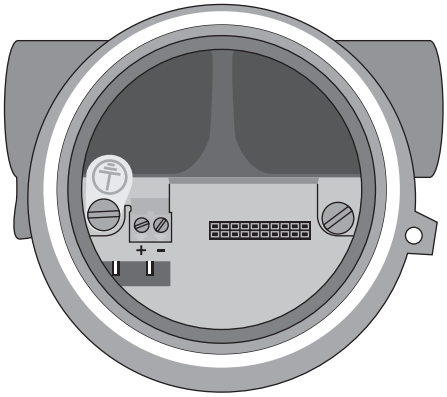
**Caution:** The Horizon transmitter operates at voltages of 12-28 VDC. Higher voltage will damage the transmitter.

Wiring between the power supply and the Horizon transmitter should be made using 18-22 AWG shielded twisted pair instrument cable. Within the transmitter enclosure, connections are made to the terminal strip and the ground connections. The instructions for wiring the Horizon transmitter depend on the application:

- General Purpose or Non-Incendive (Cl I, Div. 2)
- Intrinsically Safe
- Explosion Proof

***WARNING!*** Explosion hazard. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

NOTE: Do not apply more than 10 ft. lbs. to conduit entries on the Valox housing.

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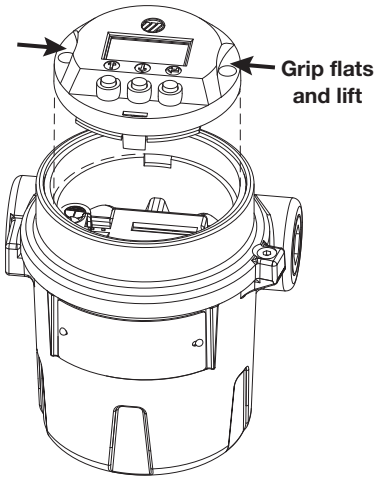
### 2.5.1 General Purpose or Non-Incendive (Cl I, Div. 2)

- A general purpose installation does not have flammable media present.
- Areas rated Non-Incendive (Cl I, Div. 2) have flammable media present only under abnormal conditions (no special electrical connections are required).
- If flammable media is contained in the vessel, the transmitter must be installed per Cl I, Div. 1 standards of area classification.




**To install General Purpose or Non-Incendive wiring:**

1. Remove the cover of the transmitter. Install the conduit plug in the unused opening.
2. Gripping the display module by the flats, remove the module from the assembly. See drawing at left.
3. Install a conduit fitting and pull the supply wires through.
4. Connect shield to an earth ground at power supply and at the transmitter.
5. Connect an earth ground wire to the green ground screw.
6. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
7. Carefully reconnect the display module to the 20-pin connector.
8. Replace the cover of the transmitter.

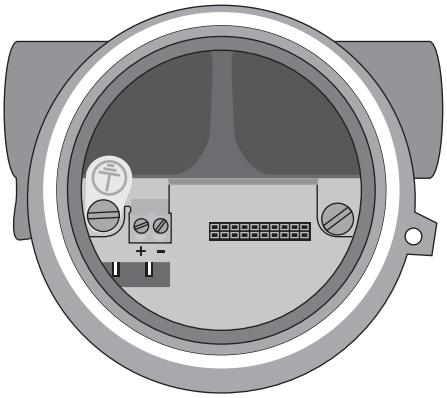
### 2.5.2 Intrinsically Safe

An intrinsically safe (IS) installation potentially has flammable media present. An approved IS barrier must be installed in the non-hazardous (safe) area. Refer to Agency Drawing – Intrinsically Safe Installation, Section 3.4.1.

**To install Intrinsically Safe wiring:**

1. Make sure the IS barrier is properly installed in the safe area (refer to local plant or facility procedures). Complete the wiring from the barrier to the Horizon transmitter. Refer to *Agency Specifications – Intrinsically Safe Installations, Section 3.4.1.*
2. Gripping the display module by the flats, remove the module from the assembly. See drawing at left.
3. Remove the cover of the transmitter. Install the conduit plug in the unused opening.
4. Install a conduit fitting and pull the supply wires through.
5. Connect shield to an earth ground at power supply and at the transmitter.
6. Connect an earth ground wire to the nearest green ground screw.
7. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
8. Carefully reconnect the display module to the 20-pin connector.
9. Replace the cover of the transmitter.

### 2.5.3 Explosion Proof

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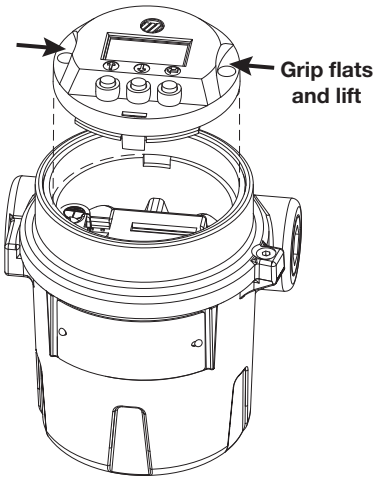
Explosion Proof (XP) is a method of designing equipment for installation in hazardous areas. A hazardous location is an area in which flammable gases or vapors are or may be present in quantities sufficient to produce explosive or ignitable mixtures. The wiring for the transmitter must be contained in explosion proof conduit extending into the safe area. Due to the specialized design of the Horizon transmitter, no explosion proof conduit fitting (EY seal) is required within 18" of the transmitter. An explosion proof conduit fitting (EY seal) is required between the hazardous and safe areas. Refer to *Agency Specifications, Section 3.4.*



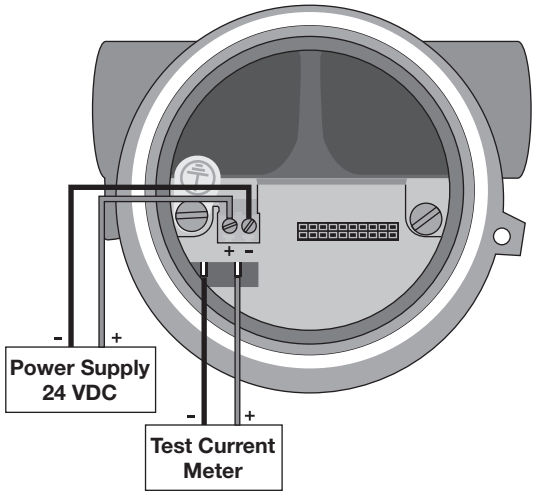

**To install Explosion Proof wiring:**

1. Install explosion proof conduit from the safe area to the conduit connection of the Horizon transmitter (refer to local plant or facility procedures).
2. Gripping the display module by the flats, remove the module from the assembly. See drawing at left.
3. Remove the cover of the transmitter.
4. Connect shield to an earth ground at the power supply and at the transmitter.
5. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
6. Carefully reconnect the display module to the 20-pin connector.
7. Replace the cover of the transmitter before applying power.

## 2.6 Configuring the Model 704 Transmitter

The Horizon Model 704 transmitter comes configured from the factory but can easily be reconfigured in the shop (an error message may be displayed due to unattached probe). Bench configuration provides a convenient and efficient way to set up the transmitter before going to the tank site to complete the installation.

Before configuring the Model 704 transmitter, collect the operating parameters information (refer to Section 1.1.2). Apply power to the transmitter on the bench and follow through the step-by-step procedures for the menu-driven transmitter display. Information on configuring the transmitter using a HART communicator is in *Configuration Using HART, Section 2.7.*




**Model 704**

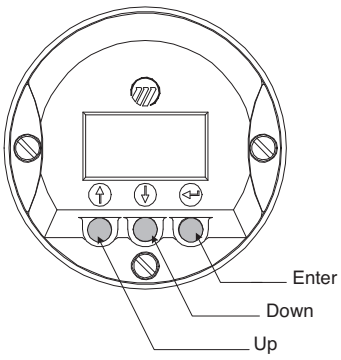
### 2.6.1 Operating Parameters

Some key information is needed to calibrate the Horizon transmitter. Complete the configuration information table in *Configuration Information, Section 1.1.2.*

### 2.6.2 Setting Up for Bench Configuration

The Horizon Model 704 transmitter can be configured at a test bench by connecting a 24 VDC power supply directly to the transmitter terminals as shown in the accompanying diagram. An optional digital multimeter is shown if current measurements are desired.

1. When using a HART communicator for configuration, a minimum 250 Ω line load resistance is required. See the HART communicator manual for more information.
2. The transmitter can be configured without the probe. Disregard the error message due to the unattached probe (the Horizon transmitter may not show an error and indicate a LEVEL value > 0 when disconnected from probe).
3. After entering the last value, allow 5 seconds before removing power from the transmitter. This allows the transmitter to store values.




### 2.6.3 Transmitter Display and Keypad

The Horizon Model 704 transmitter has an optional liquid crystal display (LCD) capable of showing two lines of 8 characters each. Transmitter measurements and configuration menu screens are shown on the LCD.

The transmitter default display is the measurement screen. It cycles every 5 seconds to display LEVEL, %OUTPUT, and LOOP information. The transmitter defaults to this display after 5 minutes elapses with no keystrokes.

The keypad has three arrows used to scroll through the displays and to calibrate the transmitter. The Up and Down Arrow keys (⇧⇩) and the Enter key (↵).

| Arrows | Function in Display Mode | Function in Configuration Mode |
|---|---|---|
| Up and Down ⇧ ⇩ | Moves forward and backward in the configuration program from one display to another. | Increases or decreases the value displayed or moves to another choice.<br>*Note: Hold arrow key for rapid scrolling.* |
| Enter ↵ | Enters the configuration mode (noted by an exclamation point as the last character in the top display line). | Accepts a value |

### 2.6.4 Menu: Step By Step Procedure

The following table provides a complete explanation of the software menus displayed by the Model 704 transmitter. Use this table as a step-by-step guide to configure the transmitter.

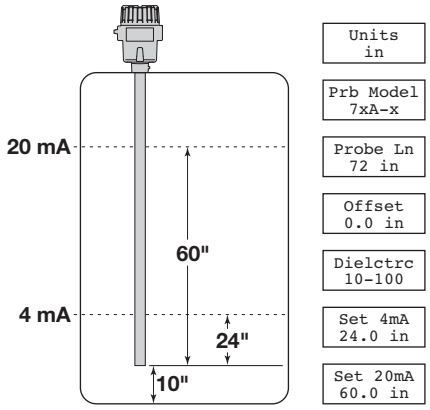
The first column presents the menus shown on the transmitter display. The displays are in the order they would appear if the arrow keys were used to scroll through the menu. The numbers are not shown on the display. They are only provided as a reference.

The second column provides the actions to take when configuring the transmitter. Additional information or an explanation of an action is given in the third column.

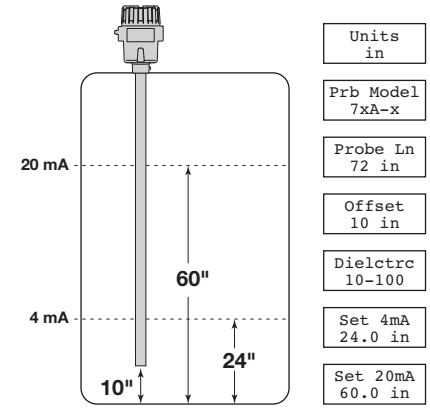
### 2.6.4.1 Model 704 Transmitter (probes: Coaxial, Twin Rod, Overfill, Single Rod)

| | Display | Action | Comment |
|---|---|---|---|
| ① | Level<br>%Output<br>Loop | Transmitter Display | Transmitter default display. *Level, % Output,* and *Loop* values cycle every 5 seconds. |
| ② | Level<br>xxx.x cm | Transmitter Display | Transmitter displays *Level* measurement in cm or in. |
| ③ | %Output<br>xx.x% | Transmitter Display | Transmitter displays *% Output* measurement as derived from the 20 mA span. |
| ④ | Loop<br>xx.xx mA | Transmitter Display | Transmitter displays *Loop* value (mA). |
| ⑤ | Units<br>(select) | **Select** units for level measurement readout | **cm** or **inches** |
| ⑥ | PrbModel<br>(select) | **Select** the type of probe used | Select from dual element probes **7xA-x, 7xB-x** or **7xR**. |
| ⑦ | Probe Ln<br>xxx.x | **Enter** the exact length of probe | Probe length is printed on the nameplate and order information. It is the last three digits of the probe model number. |
| ⑧ | Offset<br>xxx.x | **Enter** the offset value | Offset is the distance from the probe tip to the desired 0% level point (-10 to 192" (-25 to 488 cm)). See Section 2.6.5. |
| ⑨ | Lvl Trim<br>xxx.x | **Enter** the Level Trim Value | Level Trim may be necessary to account for installation variances |
| ⑩ | Dielctrc<br>(select) | **Enter** the dielectric range value of the media | **1.7–10; 10–100**<br>(for dual element probes) |
| ⑪ | Set 4mA<br>xxx.x | **Enter** the level value for the 4 mA point | A small transition zone (0-6") may exist at the top/bottom of the probe. Refer to *Functional Specifications Probe, Section 3.5.2*. |
| ⑫ | Set 20mA<br>xxx.x | **Enter** the level value for the 20 mA point | A small transition zone (0-6") may exist at the top/bottom of the probe. Top 4" (100 mm) of 7XB Twin Rod Probe is inactive. Refer to *Functional Specifications Probe, Section 3.5.2*. |
| ⑬ | Damping<br>xx sec | **Enter** the damping factor | A Damping factor (0-10 seconds) may be added to smooth a noisy display and/or output due to turbulence. |
| ⑭ | Fault<br>(select) | **Enter** the fault value | Select **3.6 mA, 22 mA** or **HOLD** (last value). 3.6 mA is not valid if unit includes **both** digital display **and** HART. |
| ⑮ | Deadband<br>xx.x | **Enter** the deadband value | Deadband may have to be adjusted for installation variances |
| ⑯ | Poll Adr<br>xx | **Enter** HART ID number | **Select** a HART poll address (0–15). Enter 0 for a single transmitter installation. |
| ⑰ | Trim 4<br>xxxx | Fine tune the 4 mA point | **Attach** a mA meter to the output. If the output does not equal 4.0 mA, adjust the value on the display until meter reads 4.00 mA. |
| ⑱ | Trim 20<br>xxxx | Fine tune the 20 mA point | **Attach** a mA meter to the output. If the output does not equal 20.0 mA, adjust the value on the display until meter reads 20.00 mA. |
| ⑲ | Loop Tst<br>xx.x mA | **Enter** a mA Output value | Set mA Output to any given value to perform loop test. |
| ⑳ | Fid Tick | None, do not adjust | Diagnostic, factory setting |
| ㉑ | Conv Fct<br>xx.xxx | None, do not adjust | Diagnostic, factory setting |

| Display | Action | Comment |
|---|---|---|
| (22) Scl Offs xx.x | None, do not adjust | Diagnostic, factory setting |
| (23) # Ticks xxxx | None, do not adjust | Diagnostic, factory setting |
| (24) Threshld (select) | **Select** the type of threshold | Unit default **CFD**. Only select **Fixed** in application with low dielectric material over higher dielectric material and unit is reading incorrect level. Example: Oil over water. Select **Dielectric Range** of upper material. Adjustment of **Lvl Trim** may be necessary when threshold is changed. |
| (25) Model 704 Ver xx.xx | None, do not adjust | Diagnostic, factory setting (**Ver** refers to software version) |




**Example 1**




**Example 2**

### 2.6.5 Offset Description

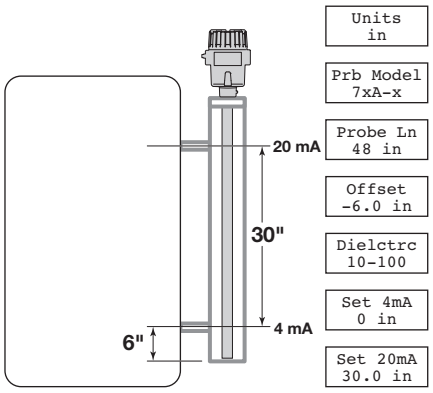
The parameter referred to as OFFSET in the Horizon menu is the distance from the bottom of the probe to the desired 0% level point. The Horizon transmitter is shipped from the factory with OFFSET set to 0. With this configuration, all measurements are referenced from the bottom of the probe. See Example 1.

**Example 1 (Offset=0 as shipped from factory):**
Application calls for a 72-inch NPT coaxial probe in water with the bottom of the probe 10 inches above the bottom of the tank. The user wants the 4 mA point at 24 inches and the 20 mA point at 60 inches as referenced from the bottom of the probe.

In applications in which it is desired to reference all measurements from the bottom of the vessel, the value of OFFSET should be changed to the distance between the bottom of the probe and the bottom of the vessel as shown in Example 2.

**Example 2:**
Application calls for a 72 inch NPT coaxial probe in water with the bottom of the probe 10 inches above the bottom of the tank. The user wants the 4 mA point at 24 inches and the 20 mA point at 60 inches as referenced from the bottom of the tank.

When the Horizon transmitter is mounted in a chamber/bridle, it is usually desirable to configure the unit with the 4 mA (0%) point at the lower process connection and the 20 mA (100%) point at the upper process connection. In other words, the span is the center-to-center dimension. In this case a negative OFFSET needs to be entered. In doing so, all measurements are then referenced at a point up on the probe as shown in Example 3.




**Example 3**

### 2.6.5 Offset Description (cont.)

**Example 3:**
Application calls for a 48-inch coaxial flanged probe measuring water in a chamber with the bottom of the probe 6 inches below the lower process connection. The user wants the 4 mA point to be 0 inches at the bottom process connection and the 20 mA point to be 30 inches at the top process connection.

## 2.7 Configuration Using HART

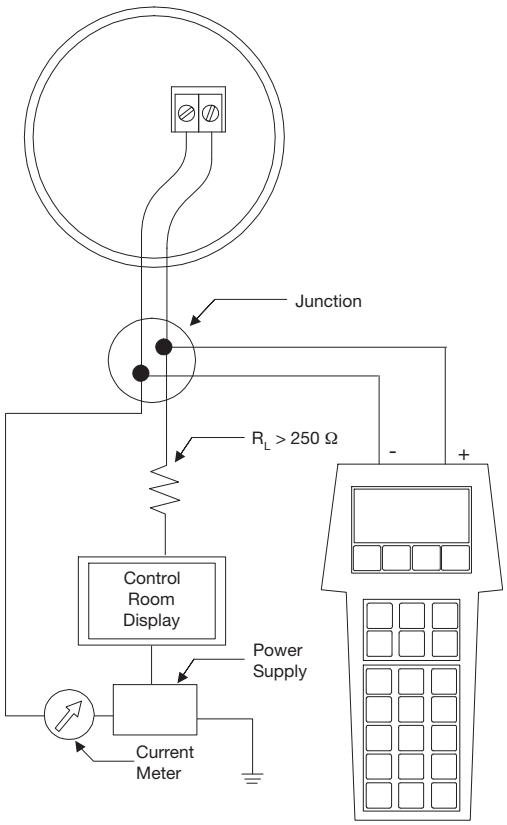
A HART (Highway Addressable Remote Transducer) remote unit, such as a HART communicator, can be used to provide a communication link to the Horizon Model 704 transmitter. When connected to the control loop, the same system measurement readings shown on the transmitter are shown on the communicator. In addition, the communicator can be used to configure the transmitter.

The HART communicator may need to be updated to include the Horizon software (Device Descriptors). Contact your local HART Service Center for additional information.

### 2.7.1 Connections

A HART communicator can be operated from a remote location by connecting it to a remote junction or by connecting it directly to the terminal block in the electronics housing of the Horizon transmitter.

HART uses the Bell 202 frequency shift key technique of high-frequency digital signals. It operates on the 4-20 mA loop and requires 250 Ω load resistance. A typical connection between a communicator and the Horizon transmitter is illustrated.



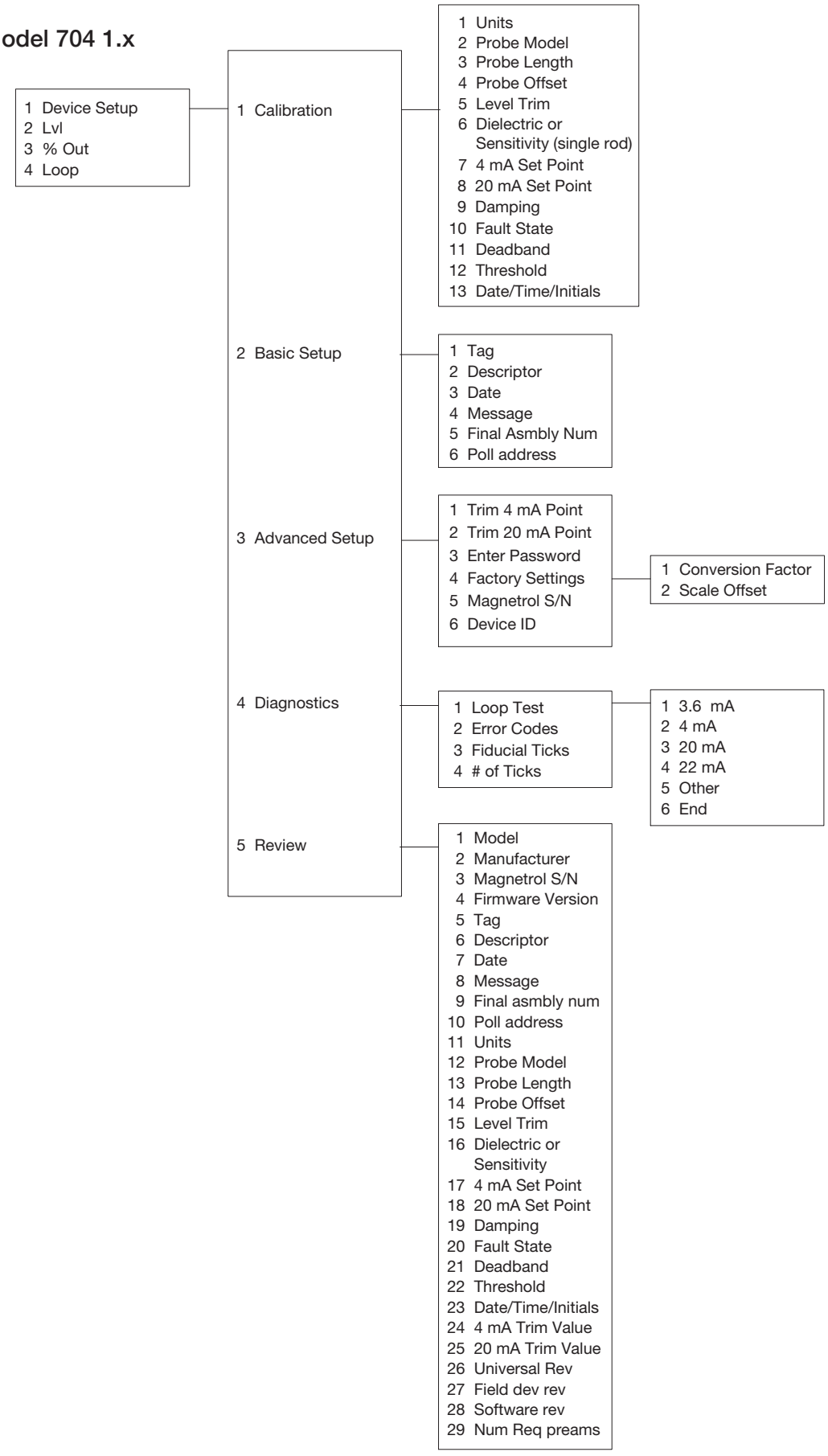

### 2.7.2 Display Menu

A typical communicator display is an 8 line × 21 character LCD. When connected, the top line of each menu displays the model (Model 704) and its tag number or address. Usually the bottom line of each menu is reserved for software-defined function keys (F1-F4). For detailed operating information, refer to the instruction manual provided with the HART communicator.

The Horizon transmitter online menu tree is shown in the following illustration. Open the menu by pressing the alphanumeric key 1, Device Setup, to display the second level menu.

## 2.7.3 Model 704 1.x HART Menu

### 2.7.3.1 Model 704 1.x



### 2.7.4 HART Revision Table (Model 704)

| HART Version | HCF Release Date | Compatible with 704 Software |
|---|---|---|
| Dev V1 DD V1 | January 2003 | Version 1.0A and later |

# 3.0 Reference Information

This section presents an overview of operating the Horizon Guided Wave Radar Level Transmitter as well as information on troubleshooting common problems, listings of agency approvals, lists of replacement parts, and detailed physical, functional, and performance specifications.

## 3.1 Description

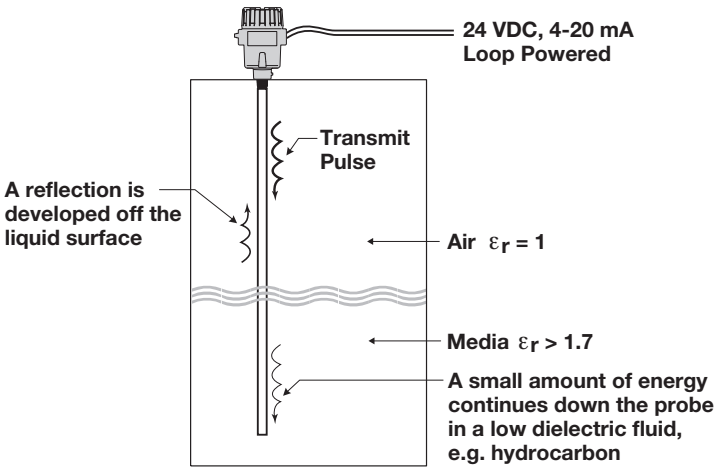
Horizon is a loop-powered two-wire, 24 VDC, level transmitter based on the concept of Guided Wave Radar. Guided Wave Radar (GWR) is a relatively new level measurement technology.

The Horizon electronics are housed in a single compartment housing available in either cast aluminum or Valox.

## 3.2 Theory of Operation

### 3.2.1 Micropower Impulse Radar

GWR combines TDR (time domain reflectometry), ETS (equivalent time sampling) and modern low power circuitry. This synthesis of technologies brings to the level market a high-speed radar circuit (speed of light transmission) at a small fraction of the cost of conventional radar. The electromagnetic pulses are propagated via a waveguide that yields a system many times more efficient than through-air radar.



### 3.2.2 Time Domain Reflectometry (TDR)

TDR uses pulses of electromagnetic (EM) energy to measure distances or levels. When a pulse reaches a dielectric discontinuity (created by media surface), part of the energy is reflected. The greater the dielectric difference, the greater the amplitude (strength) of the reflection.

Although TDR is relatively new to the industrial level measurement industry, it has been used in the telephone, computer, and power transmission industries for years. In these industries, it is used to successfully find wire or cable breaks and shorts. An EM pulse is sent through the wire traveling unimpeded until it finds a line break or short. A reflection is then returned from the break and a timing circuit pinpoints the location.

In the Horizon transmitter, a waveguide with a characteristic impedance in air is used as a probe. When part of the probe is immersed in a material other than air, there is lower impedance due to the increase in the dielectric. When the EM pulse is sent down the probe and meets the dielectric discontinuity, a reflection is generated.

### 3.2.3 Equivalent Time Sampling (ETS)

ETS is used to measure the high speed, low power EM energy. ETS is a critical key in the application of TDR to vessel level measurement technology. The high speed EM energy (1000 ft/µs) is difficult to measure over short distances and at the resolution required in the process industry. ETS captures the EM signals in real time (nanoseconds) and reconstructs them in equivalent time (milliseconds), which is much easier to measure with today's technology.

ETS is accomplished by scanning the waveguide to collect thousands of samples. Approximately 8 scans are taken per second.

## 3.3 Troubleshooting

The Horizon transmitter is designed and engineered for trouble-free operation over a wide range of operating conditions. Common transmitter problems are discussed in terms of their symptoms and recommended corrective actions. Information on how to handle material buildup on the probe is also provided in this section.

***WARNING!*** Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

### 3.3.1 Model 704 System Problems

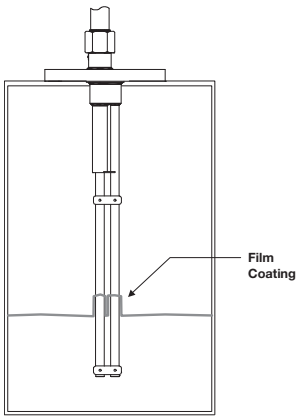
| Symptom | Problem | Solution |
|---|---|---|
| LEVEL, % OUTPUT and LOOP values are all inaccurate | Basic configuration data is questionable | Reconfigure the Probe Model, Probe Length or Offset<br>1) Ensure the Level is accurate<br>2) Verify 4 mA and 20 mA Loop values |
| LEVEL readings are repeatable but consistently high or low from actual by a fixed amount | Configuration data does not accurately match probe length or tank height | Ensure proper Probe Model and Probe Length |
| | Installation Variance | Adjust Level Trim |
| LEVEL, % OUTPUT and LOOP values fluctuate | Turbulence | Increase the Damping factor until the readings stabilize |
| | High Frequency connection | Check Fid Ticks (should be stable within ±10 counts) |
| LEVEL, % OUTPUT and LOOP values all reading low vs. actual | Lower dielectric material over higher dielectric material, e.g., oil over water | Select Fixed Threshold option |
| | Coating, clumping or buildup on probe | Expected inaccuracies due to affect on pulse propagation |
| | Dense, water based foam | Expected inaccuracies due to affect on pulse propagation |
| LEVEL reading on Display is correct but LOOP is stuck on 4 mA | Basic configuration data is questionable | Set POLL ADR to 0 if not using HART multi-drop |
| HART device only: handheld will only read Universal Commands | Most current Device Descriptors (DDs) are not installed in handheld | Contact local HART service center for the latest DDs |
| Level Reading on Display is stuck at full scale, loop is stuck at 20.5 mA | Software believes probe is flooded (level near very top of probe) | Check actual level. If probe is not flooded, Check for buildup or obstructions near top of probe. Select higher dielectric range or set sensitivity to Low |
| LEVEL, % OUTPUT and LOOP values all at maximum level | Possible configuration Issue | 1) Increase DEADBAND<br>2) Decrease SENSITIVITY |
| LEVEL, % OUTPUT and LOOP values all reading high vs. actual | Possible obstruction in tank | 1) Reduce SENSITIVITY until obstruction is ignored<br>2) Relocate probe away from obstruction |
| LEVEL value reading high when should be zero | Transmitter loose or disconnected from probe | Ensure transmitter connected securely to probe |
| | Installation Variance | Adjust Level Trim |

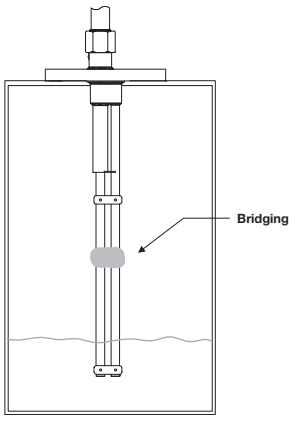
Note: When consulting the factory concerning improper operation, use the table on Page 34.
Enter all data when transmitter is working CORRECTLY and INCORRECTLY.

### 3.3.2 Model 704 Error Messages

| Symptom | Problem | Solution |
|---|---|---|
| **NO FIDUCIAL** (HART error code = 0x80) | Poor circuit board/cable/probe connection or malfunctioning cable between electronics and probe | Check all of the connections from the electronics to the probe |
| | | Consult factory |
| **NO LEVEL SIGNAL** (HART error code = 0x40) | Dielectric too low | Increase sensitivity |
| | Level within DEADBAND | Decrease Level |
| | Mounted too close to concrete wall | Mount probe > 12" from concrete wall |
| | Malfunctioning analog board | Replace electronic module |
| | | Consult Factory |
| **BAD CAL PARAMTRS** (HART error code = 0x20) | Possible nozzle issues, Deadband too small | Increase DEADBAND |
| | Tank obstruction too close to probe | Decrease SENSITIVITY |
| | Incorrect probe length entered | Reconfigure proper probe length |
| **CORRUPT PARAMTRS** (HART error code = 0x10) | Internal parameters corrupted | Check all Configuration parameters |
| | | Verify Probe Type and Probe Length |
| Out of Calibration (not a fault) | Displayed when at least one parameter has been modified after corruption | Consult factory – Recalibration may be required |

Note: When consulting the factory concerning improper operation, use the table on page 34.
Enter all data when transmitter is working CORRECTLY and INCORRECTLY.

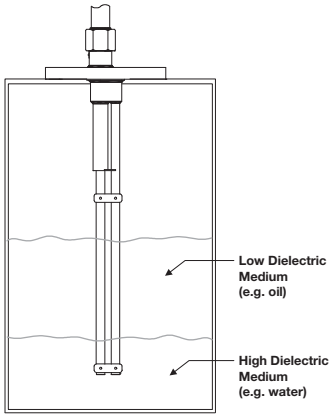



### 3.3.3 Application Concerns

There are numerous causes for application problems. Media buildup on the probe and stratification are covered here. Media buildup on the probe is not a problem in most cases–Horizon circuitry typically works very effectively. Media build-up should be viewed as two types–Film Coating and Bridging. A twin rod probe can be utilized when minor film coating is a possibility.

- **Continuous Film Coating**
  The most typical coating problems occur when the media forms a continuous coating on the probe. Horizon will continue to measure effectively with a small degradation in performance. A problem can develop if the product begins to build up on the spacers that separate the probe elements. High dielectric media (e.g., water-based) will cause the greatest error.
- **Bridging**
  Media that is viscous or solid enough to form a clog, or bridge, between the elements causes the greatest degradation in performance. High dielectric media (e.g., water-based) will show as level at the location of the bridging.




### 3.3.3 Applications Concerns (cont.)

- **Stratification/Interface**
  The standard Model 704 Horizon transmitter is designed to measure the first air/media interface it detects. However, a low dielectric over a high dielectric application can cause a measurement problem and cause the electronics to trigger on the high dielectric medium that lies beneath the low dielectric medium. Select the Fixed Threshold option to read the upper medium. Example: oil over water.

## 3.4 Agency Approvals

| AGENCY | MODEL | PROTECTION METHOD | AREA CLASSIFICATION |
|---|---|---|---|
| **FM** | 704-5XXX-14X | Intrinsically Safe | Class I, Div. 1; Groups A, B, C, & D<br>Class II, Div. 1; Groups E, F, & G<br>Class III, IP67<br>Entity |
| | 704-5XXX-54X | Explosion Proof | Class I, Div. 1; Groups C & D<br>Class II, Div. 1; Groups E, F, & G<br>Class III, IP67 |
| | 704-5XXX-14X<br>704-5XXX-54X | Non-Incendive<br>Suitable for: ① | Class I, Div. 2; Groups A, B, C, & D<br>Class II, Div. 2; Groups F & G<br>Class III, IP67 |
| **CSA** | 704-5XXX-14X | Intrinsically Safe | Class I, Div. 1; Groups A, B, C, & D<br>Class II, Div. 1; Group G<br>Class III, IP67<br>Entity |
| | 704-5XXX-54X | Explosion Proof | Class I, Div. 1; Groups C & D<br>Class II, Div. 1; Groups E, F, & G<br>Class III, IP67 |
| | 704-5XXX-14X<br>704-5XXX-54X | Non-Incendive<br>Suitable for: ① | Class I, Div. 2; Groups A, B, C, & D<br>Class II, Div. 2; Groups E, F, & G<br>Class III, IP67 |
| **ATEX** | 704-5XXX-A4X | Intrinsically Safe | ⟨Ex⟩ II 1G, EEx ia IIC T4 ② |

① Measured media inside vessel must be non-flammable only.

② Special conditions for safe use:
Materials marked as Category 1 equipment and used in hazardous areas requiring this category, shall be installed in such a way that, even in the event of rare incidents, the aluminum enclosure cannot be an ignition source due to impact or friction.

CE 0344

These units are in conformity of:

1. The EMC Directive: 89/336/EEC. The units have been tested to EN 61000-6-2/2001 and EN 61000-6-4/2001.
2. Directive 94/9/EC for equipment or protective system for use in potentially explosive atmospheres (8th digit "A" only).

## 3.4.1 Agency Specifications – Intrinsically Safe Installation (FM/CSA)

### HAZARDOUS LOCATION

### MODEL 704 LEVEL TRANSMITTER

INTRINSICALLY SAFE FOR
CLS I, DIV 1, GROUPS A, B, C, D
CLS II, DIV 1, GROUPS E, F, G (G ONLY FOR CSA)
CLS III

ENTITY
Vmax = 28.6 V
Imax = 140 mA
Pmax = 1 W (FM ONLY)
Ci = 13.9 nF
Li = 440 µH

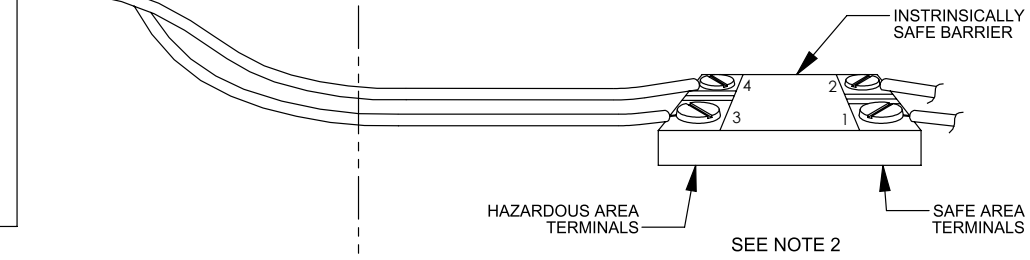
MODEL 704

### NON-HAZARDOUS LOCATION

### LIMITING VALUES

Voc ≤ 28.6V Ca ≥ 13.9 nF
Isc ≤ 140 mA La ≥ 440 µH

THE VOLTAGE (V max) AND CURRENT (I max) WHICH THE TRANSMITTER CAN RECEIVE MUST BE EQUAL TO OR GREATER THAN THE MAXIMUM OPEN CIRCUIT VOLTAGE (Voc OR V+) AND THE MAXIMUM SHORT CIRCUIT CURRENT (Isc OR IE) WHICH CAN BE DELIVERED BY THE SOURCE DEVICE. IN ADDITION, THE MAXIMUM CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE LOAD AND THE CAPACITANCE AND INDUCTANCE OF THE INTERCONNECTING WIRING, MUST BE EQUAL TO OR LESS THAN THE CAPACITANCE (Ca) OR THE INDUCTANCE (La) WHICH CAN BE DRIVEN BY THE SOURCE DEVICE.




NOTES:

1. FOR EXPLOSIONPROOF OR DUST-IGNITIONPROOF INSTALLATIONS. THE I.S. GROUND TERMINAL SHALL BE CONNECTED TO APPROPRIATE INTRINSICALLY SAFE GROUND INACCORDANCE WITH THE CANADIAN ELECTRICAL CODE [CEC] [FOR CSA] OR THE NATIONAL ELECTRINCAL CODE [NEC, ANSI/NFPA 70] [FOR FMRC]. FOR INTRINSICALLY SAFE INSTALLATIONS. THE I.S. GROUND TERMINAL DOES NOT REQUIRE GROUNDING.
2. MANUFACTURER'S INSTALLATION INSTRUCTIONS SUPPLIED WITH THE PROTECTIVE BARRIER AND THE CEC [FOR CSA] OR THE NEC AND ANSI/ISA RP 12.06.01 [FOR FM] MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. BARRIER MUST BE CSA CERTIFIED FOR CANADIAN INSTALLATIONS & FM APPROVED FOR U.S. INSTALLATION.
3. CONTROL EQUIPMENT CONNECTED TO PROTECTIVE BARRIERS MUST NOT USE OR GENERATE MORE THAN 250 VDC OR VRMS.
4. NRTL LISTED DUST-TIGHT SEALS MUST BE USED WHEN TRANSMITTER IS INSTALLED IN CLASS II & III ENVIRONMENTS.
5. NO REVISIONS TO THIS DRAWING WITHOUT CSA AND FM APPROVAL.
6. FOR CSA: EXIA INTRINSICALLY SAFE/SECURITE INTRINSEQUE.
7. FOR CSA: WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABLITY FOR HAZARDOUS LOCATIONS.
8. FOR SUPPLY CONNECTIONS, USE WIRE SUITABLE FOR THE OPERATING TEMPERATURE. FOR 71º C AMBIENT, USE WIRE WITH A MINIMUM TEMPERATURE RATING OF 75º C.
9. THE TRANSMITTER CAN ALSO BE INSTALLED IN:
   *CLASS I, DIVISION 2, GROUPS A, B, C & D*
   *CLASS II, DIVISION 2, GROUPS F & G* (F & G ONLY FOR FM) (G ONLY FOR CSA)
   *CLASS III, DIVISION 2*, And HAZARDOUS LOCATIONS AND DOES NOT REQUIRE CONNECTION TO A PROTECTIVE BARRIER WHEN INSTALLED PER THE CEC (FOR CSA) OR THE NEC (FOR FMRC) AND WHEN CONNECTED TO A POWER SOURCE NOT EXCEEDING 30 VDC.
10. FOR CSA CERTIFICATIONS: CAUTION-FLEXIBLE CONDUIT MUST BE USED FOR PLASTIC HOUSING VERSIONS 70X-5XXX-13X
11. FOR CSA CERTIFICATION: CSA CERTIFIED BARRIERS WITH LINEAR OUTPUT CHARACTERISTICS **MUST BE USED**. REFER TO THE TABLE FOR PROPER BARRIER SELECTION.NONLINEAR BARRIERS **MUST NOT BE USED**. THEIR Voc & La VALUES ARE TYPICALLY MUCH LESS THAN VALUES GIVEN IN THE TABLE BELOW.

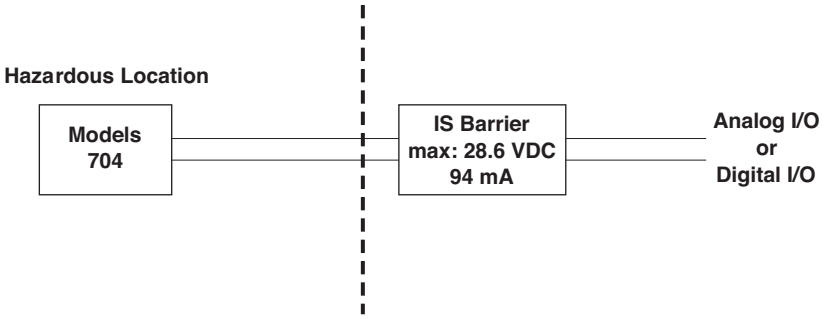
| BARRIER OUTPUT CURRENT (ISC) | TYPICAL LINEAR TYPE BARRIER OUTPUT | | |
|---|---|---|---|
| | VOC | Ca | La MINIMUM |
| 80mA | 30 V | 0.12µF | 4.0 mH |
| 100mA | 28 V | 0.13µF | 3.0 mH |
| 120mA | 26 V | 0.17µF | 2.3 mH |
| 140mA | 24 V | 0.21µF | 1.7 mH |

099-5060-D

SHEET 2 OF 2

**Caution:** In Explosion Proof installations, Grounding (+) will cause faulty operation but not permanent damage.

### 3.4.2 Agency Specifications – Intrinsically Safe Installation (ATEX)



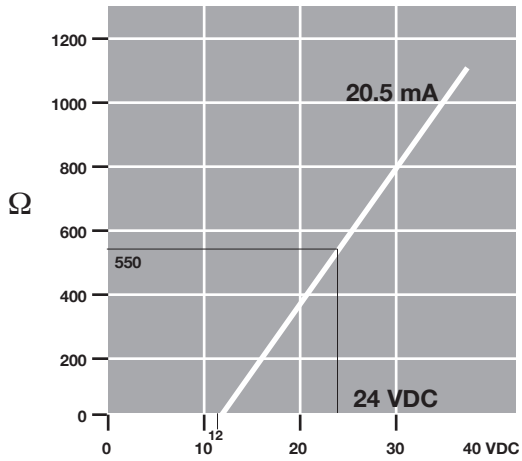

## 3.5 Specifications

### 3.5.1 Functional

| | | |
|---|---|---|
| **System Design** | | |
| Measurement Principle | | Guided time-of-flight via time domain reflectometry |
| **Input** | | |
| Measured Variable | | Level, determined by the time-of-flight of a guided radar pulse from transmitter to product surface and back |
| Zero and Span | | 6 to 192 inches (15 cm to 488 cm) |
| **Output** | | |
| Type | Analog | 4 to 20 mA with optional HART digital signal |
| Range | Analog | 3.8 to 20.5 mA useable |
| | Digital | 0 to 192 inches (0 to 488 cm) |
| Resolution | Analog | 0.01 mA |
| | Digital | 0.1" or 0.1 cm |
| Loop Resistance | | GP/IS/XP- 550 Ω @ 24 VDC (20.5 mA) |
| Diagnostic Alarm ① | | Adjustable 3.6 mA, 22 mA, HOLD |
| Damping | | 0-10 seconds |
| **User Interface** | | |
| Keypad | | 3-button menu-driven data entry |
| Indication | | 2-line x 8-character display |
| Digital Communication ② | | HART Version 5.x compatible |
| **Power (**Measured at instrument terminals) | | |
| General Purpose/Intrinsically Safe (FM/CSA) | | 12 to 28.6 VDC |
| General Purpose/Intrinsically Safe (ATEX) | | 12 to 28.6 VDC Pi = 0.67W, Ii = 94 mA |
| Explosion Proof FM/CSA | | 12 to 28.6 VDC |
| **Housing** | | |
| Material | | Aluminum A356T6 (< 0.2% copper) |
| Cable Entry | | ¾" NPT, M20 |

① 3.6 mA diagnostic alarm only valid without HART *or* display option.

② HART communicator Magnetrol P/N 89-5213-XXX sold separately.




GENERAL PURPOSE (GP)
INTRINSICALLY SAFE (IS)
EXPLOSION PROOF (XP)

| | | | |
|---|---|---|---|
| **Environment** | | | |
| Operating Temperature: | Alum. Housing | -40 to +175 °F | (-40 to +80 °C) |
| | | -40 to +160 °F | (-40 to +70 °C) ATEX EExia |
| | Valox Housing | -40 to +160 °F | (-40 to +70 °C) |
| Display Function Operating Temperature | | -5 to +160 °F | (-20 to +70 °C) |
| Storage Temperature | | -50 to +175 °F | (-40 to +80 °C) |
| Humidity | | 0-99%, non-condensing | |
| Electromagnetic Compatibility | | Meets CE Requirements: EN 61000-6-2/2001, EN 61000-6-4/2001 | |
| | | (Twin Rod must be used in metallic vessel or stillwell to maintain | |
| | | CE requirement). | |
| Mounting Affects: | Twin Rod | Active rod must be mounted at least 1" (25 mm) from any surface or | |
| | | obstruction. Minimum stillwell diameter for Twin Rod probe is 3". | |
| Shock Class | | ANSI/ISA-S71.03 Class SA1 | |
| Vibration Class | | ANSI/ISA-S71.03 Class VC2 | |

### 3.5.2 Performance

| | | |
|---|---|---|
| Reference Conditions ③ | Reflection from liquid of selected dielectric at +70 °F (+20 °C) | |
| | with 72" coaxial probe (Model 704 with CFD threshold) | |
| Linearity ④ Coaxial | ±0.25" | |
| Twin Rod | ±0.50" | |
| Resolution | ±0.15 inch | |
| Repeatability | < 0.15 inch | |
| Hysteresis | < 0.15 inch | |
| Response Time | < 1 second | |
| Warm-up Time | < 5 seconds | |
| Operating Temp. Range | -40 to +175 °F (-40 to +80 °C) | |
| LCD Temp. Range | -5 to +160 °F (-20 to +70 °C) | |
| Ambient Temp. Effect | Approximately +0.03% of probe length/ °C | |
| Process Dielectric Effect | < .5 inch within selected range | |
| Humidity | 0-99%, non-condensing | |
| Electromagnetic Compatibility | Meets CE requirements (EN 61000-6-2/2001, EN 61000-6-4/2001) | |
| | (Twin Rod probes must be used in metallic vessel or | |
| | stillwell to maintain CE requirement) | |

③ Specifications will degrade with Model 7XB probe and fixed threshold configuration.

④ Top 24 inches of Model 7XB probe: 0.75 inches

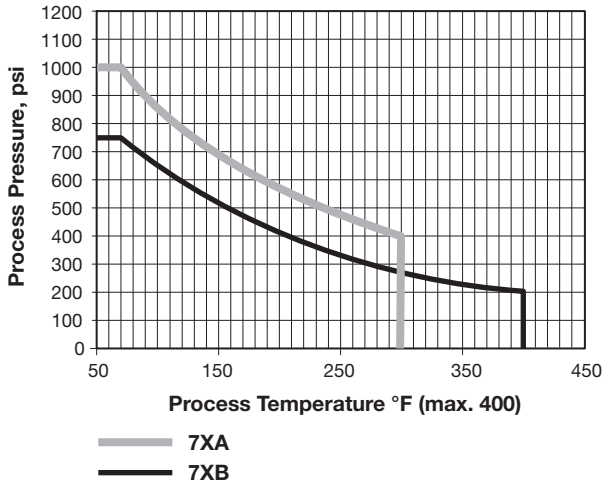
### 3.5.3 Materials of Construction

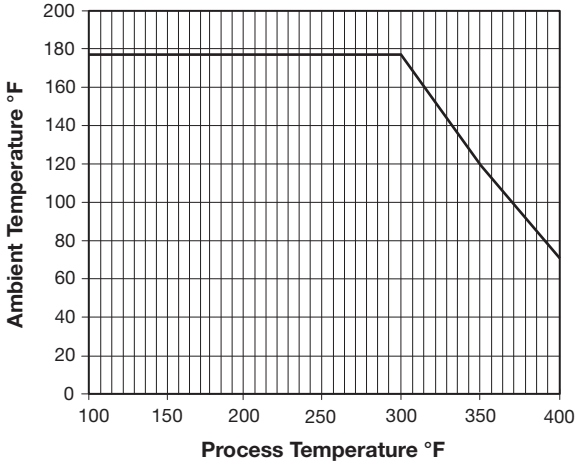
| Model | Coaxial (7XA, 7XR) | Rigid Twin Rod (7XB) |
|---|---|---|
| **Materials** | 316/616L stainless steel (Hastelloy C and Monel opt.)<br>TFE spacers, Viton® O-rings | |
| **Diameter** | .3125" (8mm) ø rod<br>.875" (10mm) ø tube | Two, .5" (13 mm) ø rods,<br>.375" clearance between rods |
| **Process Connection** | ¾" NPT, 1" BSP<br>ANSI or DIN flanges | 2" NPT<br>ANSI or DIN flanges |
| **Transition Zone (Top)** | 1" (25 mm)@ $\varepsilon_r$ = 2.0<br>6"(150 mm)@ $\varepsilon_r$ = 80.0 | 1" (25 mm) (+4" inactive) $\varepsilon_r$ > 10<br>7" (178 mm) (+4" inactive) $\varepsilon_r$ < 10 |
| **Transition Zone (Bottom)** | 6" (150 mm) @ $\varepsilon_r$ = 2.0<br>1" (25 mm) @ $\varepsilon_r$ = 80.0 | |

Note: Transition Zone is dielectric dependent; $\varepsilon_r$ = dielectric permittivity. The transmitter still operates but level reading may become nonlinear in Transition Zone.

### 3.5.4 Process Conditions

| Model | Coaxial (7XA, 7XR) | Twin Rod (7XB) |
|---|---|---|
| **Maximum Process Temperature** | +400° F @ 270 psig<br>(+200° C @ 13 bar) | +400° F @ 200 psig<br>(+200° C @ 13 bar) |
| **Maximum Process Pressure** | 1000 psig @ +70 °F<br>(70 bar @ +20 °C) | 750 psig @ +70 °F<br>(50 bar @ +20 °C) |
| **Maximum Viscosity** | 500 cp | 1500 cp |
| **Dielectric Range** | ≥ 1.7 | ≥ 2.5 |
| **Hermeticity** | N/A | N/A |

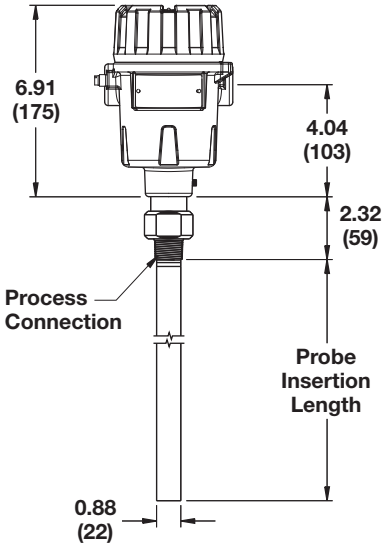


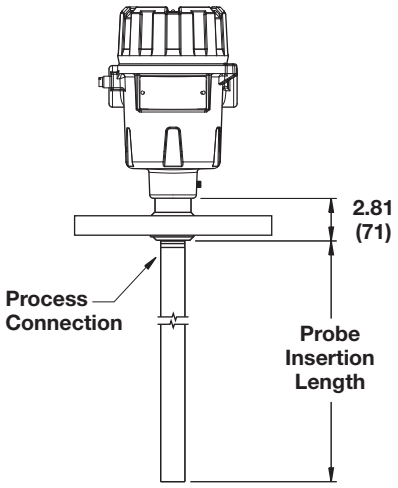

**Ambient Temperature vs Process Temperature - 7XA & 7XB**

## 3.5.5 Physical

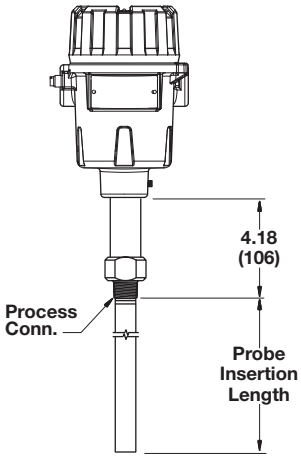
**inches (mm)**




**Horizon Model 7XA Probe**
**NPT Threaded Connection**



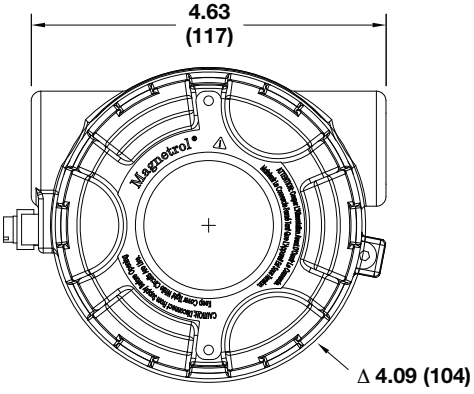

**Horizon Model 7XA Probe**
**Flanged Connection**



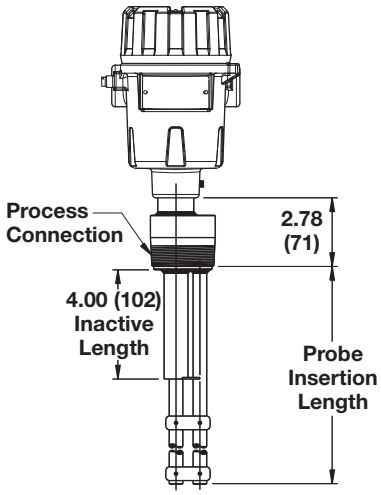

**Horizon Model 7XP Probe**
**NPT Threaded Connection**

**COAXIAL PROBES**

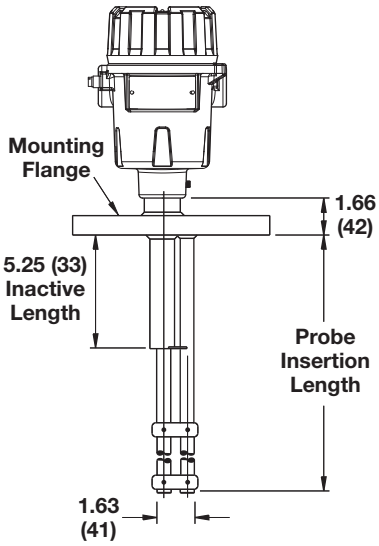
| Probe | H Dimension-NPT | H Dimension-Flanged |
|---|---|---|
| 7XA | 2.32 (59) | 2.91 (71) |
| 7XR | 5.89 (150) | 6.57 (167) |
| 7XP | 4.189 (106) | 6.54 (166) |




**Horizon Top View**



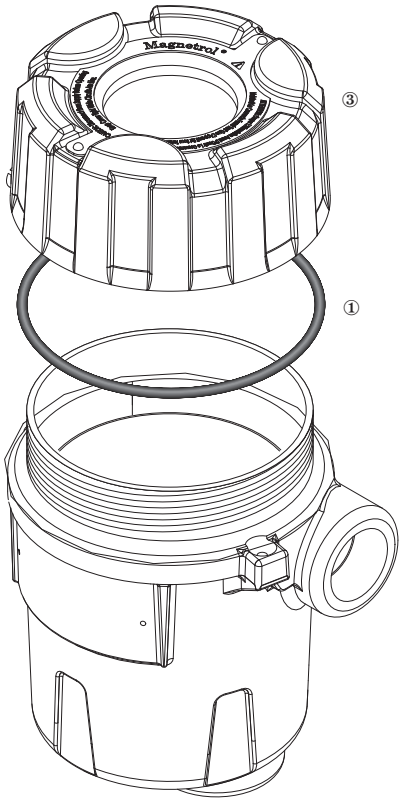

**Horizon Model 7XB Twin Rod Probe**
**NPT Threaded Connection**




**Horizon Model 7XB Twin Rod Probe**
**Flanged Connection**

## 3.6 Replacement Parts

| Item | Description | | Part Number |
|---|---|---|---|
| ① | O-ring (neoprene)<br>(Consult Factory for alternative O-ring materials) | | 012-2201-237 |
| ② | Housing cover without glass | Aluminum<br>Valox | 004-9193-003<br>003-1226-001 |
| ③ | Housing cover with glass | Aluminum IS<br>Aluminum XP<br>Valox | 036-4410-001<br>036-4410-005<br>036-4410-001 |



## 3.7 Model Numbers

### 3.7.1 Transmitter

**BASIC MODEL NUMBER**

| | |
|---|---|
| 704 | Horizon GWR Level Transmitter for use with probe models 7XA, 7XB, 7XR and 7EP |

**POWER**

| | |
|---|---|
| 5 | 24 VDC, two-wire |

**SIGNAL OUTPUT**

| | |
|---|---|
| 1 | 4-20 mA with HART (HART communicator Magnetrol P/N 89-5213-XXX sold separately) |

**MENU LANGUAGE**

| | |
|---|---|
| 1 | English |

**ACCESSORIES**

| | |
|---|---|
| A | Digital display and keypad |

**MOUNTING/CLASSIFICATION**

| | |
|---|---|
| 1 | Integral, General Purpose & Intrinsically Safe (FM & CSA), Non-Incendive (Class I, Div. 2) |
| 5 | Integral, Explosion Proof (FM & CSA) |
| A | Integral, General Purpose & Intrinsically Safe (ATEX EEx ia IIC T4) |

**HOUSING**

| | |
|---|---|
| 3 | Valox, single compartment |
| 4 | Cast aluminum, single compartment |

**CONDUIT CONNECTION**

| | |
|---|---|
| 0 | ¾" NPT |
| 1 | M20 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 0 | 4 | — | 5 | 1 | 1 | A | — | | |

### 3.7.2 Probe

**BASIC MODEL NUMBER**

| | |
|---|---|
| 7E | Horizon GWR probe, English unit of measure |
| 7M | Horizon GWR probe, Metric unit of measure |

**CONFIGURATION/STYLE**

| | | |
|---|---|---|
| A | Coaxial, ¾" process connection or larger | (Dielectric range ≥ 1.7) |
| B | Twin Rod, 2" NPT or 3" flanged process connection or larger | (Dielectric range ≥ 2.5) |
| P | Coaxial High Pressure, ¾" process connection or larger | (Dielectric range ≥ 1.7) |
| R | Coaxial Overfill, ¾" process connection or larger | (Dielectric range ≥ 1.7) |

**MATERIAL OF CONSTRUCTION**

| | |
|---|---|
| A | 316/316L stainless steel |
| B | Hastelloy C |
| C | Monel |

**PROCESS CONNECTION SIZE/TYPE**

Refer to next page for selections

**O-RINGS**

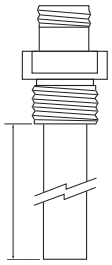
| | |
|---|---|
| 0 | Viton® GFLT |
| 1 | EPDM (Ethylene Propylene Rubber) |
| 2 | Kalrez 4079 |
| 8 | Aegis PF128 |
| N | None (Use with probes 7XP) |

**LENGTH**

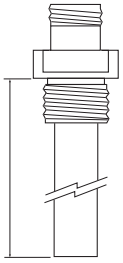
24 to 192 inches (60 cm to 488 cm)
(unit of measure is determined by second digit of Model Number)

Examples: 24 inches = 024; 60 centimeters = 060

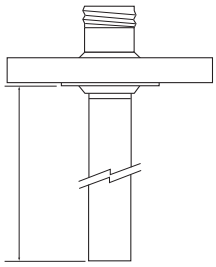
### 3.7.2 Probe



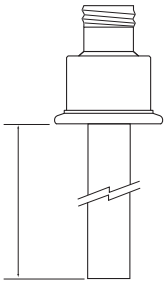
**Insertion Length**
**NPT Process Connection**



**Insertion Length**
**BSP Process Connection**



**Insertion Length**
**ANSI or DIN Welded Flange**



**Insertion Length**
**Hygienic Flange**

**PROCESS CONNECTION SIZE/TYPE**
**THREADED CONNECTIONS**

| | |
|---|---|
| 11 | ¾" NPT Thread ① |
| 22 | 1" BSP Thread ① |
| 41 | 2" NPT Thread ② |
| 42 | 2" BSP Thread ② |

**ANSI RAISED FACE FLANGE CONNECTIONS**

| | | |
|---|---|---|
| 23 | 1" 150# | ANSI Raised Face Flange ① |
| 24 | 1" 300# | ANSI Raised Face Flange ① |
| 33 | 1½" 150# | ANSI Raised Face Flange ① |
| 34 | 1½" 300# | ANSI Raised Face Flange ① |
| 43 | 2" 150# | ANSI Raised Face Flange ① |
| 44 | 2" 300# | ANSI Raised Face Flange ① |
| 53 | 3" 150# | ANSI Raised Face Flange |
| 54 | 3" 300# | ANSI Raised Face Flange |
| 63 | 4" 150# | ANSI Raised Face Flange |
| 64 | 4" 300# | ANSI Raised Face Flange |

**HYGIENIC FLANGE CONNECTIONS**

| | |
|---|---|
| 4P | 2" Triclover® type, 16 AMP Hygienic Flange |
| 5P | 3" Triclover type, 16 AMP Hygienic Flange |
| 6P | 4" Triclover type, 16 AMP Hygienic Flange |

**DIN FLANGE CONNECTIONS**

| | | | |
|---|---|---|---|
| BA | DN 25, | PN 16 | DIN 2527 Form B Flange ① |
| BB | DN 25, | PN 25/40 | DIN 2527 Form B Flange ① |
| CA | DN 40, | PN 16 | DIN 2527 Form B Flange ① |
| CB | DN 40, | PN 25/40 | DIN 2527 Form B Flange ① |
| DA | DN 50, | PN 16 | DIN 2527 Form B Flange |
| DB | DN 50, | PN 25/40 | DIN 2527 Form B Flange |
| EA | DN 80, | PN 16 | DIN 2527 Form B Flange |
| EB | DN 80, | PN 25/40 | DIN 2527 Form B Flange |
| FA | DN 100, | PN 16 | DIN 2527 Form B Flange |
| FB | DN 100, | PN 25/40 | DIN 2527 Form B Flange |

① Configuration/Style Code A only.
② Configuration/Style Code B only.

| 7 | | | — | | | | | — | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

# Model 704 Horizon
# Guided Wave Radar Transmitter
## Configuration Data Sheet

Copy blank page and store calibration data for future reference and troubleshooting.

| Item | Value | Value | Value | TROUBLESHOOTING | |
|---|---|---|---|---|---|
| Vessel Name | | | | | |
| Vessel # | | | | | |
| Media & Dielectric | | | | | |
| Tag # | | | | | |
| Electronics Serial # | | | | | |
| Probe Serial # | | | | **Correct Value** | **Incorrect Value** |
| Level | | | | | |
| Units | | | | | |
| Probe Mount | | | | | |
| Probe Length | | | | | |
| Offset | | | | | |
| Level Trim | | | | | |
| Dielectric/Sensitivity | | | | | |
| 4mA point | | | | | |
| 20mA point | | | | | |
| Damping | | | | | |
| Fault Choice | | | | | |
| Deadband | | | | | |
| HART Poll Address | | | | | |
| Trim 4mA | | | | | |
| Trim 20mA | | | | | |
| Loop Test | | | | | |
| Fiducial Tick | | | | | |
| Conversion Factor | | | | | |
| Scale Offset | | | | | |
| # of Ticks | | | | | |
| Threshold | | | | | |
| Software Version | | | | | |
| | | | | | |
| **Name** | | | | | |
| **Date** | | | | | |
| **Time** | | | | | |

## Notes

**Service Policy**

Owners of MAGNETROL may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. MAGNETROL will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

**Return Material Procedure**

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory prior to the material's return. This is available through MAGNETROL local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

MAGNETROL®

**705 Enterprise Street • Aurora, Illinois 60504-8149 • 630.969.4000**
**info@magnetrol.com • magnetrol.com**



**BULLETIN: 57-603.2**
**EFFECTIVE: May 2019**
**SUPERSEDES: April 2008**