

# Combination pH/ORP Sensor



## ESSENTIAL INSTRUCTIONS

### READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product. If this Instruction Manual is not the correct manual, telephone 1-800-654-7768 and the requested manual will be provided. Save this Instruction Manual for future reference.
- If you do not understand any of the instructions, contact your Rosemount representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

## DANGER HAZARDOUS AREA INSTALLATION

Installations near flammable liquids or in hazardous area locations must be carefully evaluated by qualified on site safety personnel. This sensor is not Intrinsically Safe or Explosion Proof.

To secure and maintain an intrinsically safe installation, the certified safety barrier, transmitter, and sensor combination must be used. The installation system must comply with the governing approval agency (FM, CSA or BASEEFA/CENELEC) hazardous area classification requirements. Consult your analyzer/transmitter instruction manual for details.

Proper installation, operation and servicing of this sensor in a Hazardous Area Installation is entirely the responsibility of the user.

## CAUTION SENSOR/PROCESS APPLICATION COMPATIBILITY

**The wetted sensor materials may not be compatible with process composition and operating conditions. Application compatibility is entirely the responsibility of the user.**

## About This Document

This manual contains instructions for installation and operation of the Model 399VP Combination pH/ORP Sensor. The following list provides notes concerning all revisions of this document.

<u>Rev. Level</u>	<u>Date</u>	<u>Notes</u>
0	10/00	This is the initial release of the product manual. The manual has been reformatted to reflect the Emerson documentation style and updated to reflect any changes in the product offering.
A	7/02	Added 1055 wiring diagrams.
B	1/05	Updated flow cell info on pages 2 & 6.
C	10/05	Replaced PN 9330022 with PN 9320057 in page 2, on Figure 2-6, page 8, and Figure 2-8, page 9.

### Emerson Process Management

#### Rosemount Analytical Inc.

2400 Barranca Parkway  
Irvine, CA 92606 USA  
Tel: (949) 757-8500  
Fax: (949) 474-7250

<http://www.raihome.com>



**EMERSON**  
Process Management

# MODEL 399VP pH/ORP SENSOR

## TABLE OF CONTENTS

SECTION	TITLE	PAGE
<b>1.0</b>	<b>DESCRIPTION AND SPECIFICATIONS .....</b>	<b>1</b>
1.1	Features and Applications .....	1
1.2	Physical Specifications .....	1
1.3	Ordering Information .....	2
<b>2.0</b>	<b>INSTALLATION .....</b>	<b>3</b>
2.1	Unpacking and Inspection .....	3
2.2	Mounting .....	3
2.3	Flow-Through Installation .....	5
2.4	Insertion Installations .....	6
2.5	Submersion Installations .....	7
<b>3.0</b>	<b>WIRING.....</b>	<b>10</b>
<b>4.0</b>	<b>START-UP AND CALIBRATION .....</b>	<b>19</b>
4.1	Sensor Preparation .....	19
4.2	pH Calibration .....	19
4.3	ORP Calibration .....	20
<b>5.0</b>	<b>MAINTENANCE.....</b>	<b>21</b>
5.1	General .....	21
5.2	Automatic Temperature Compensator .....	21
5.3	pH Electrode Cleaning .....	22
5.4	ORP Platinum Electrode Check .....	22
<b>6.0</b>	<b>TROUBLESHOOTING.....</b>	<b>23</b>
<b>7.0</b>	<b>RETURN OF MATERIAL.....</b>	<b>24</b>

# MODEL 399VP pH/ORP SENSOR

## LIST OF FIGURES

Figure No.	Title	Page
2-1	Sensor Dimensions .....	4
2-2	Model 399VP Shown in Various Flow-Through Installations .....	5
2-3	Model 399VP Shown in Low Flow Cell Assembly .....	6
2-4	Model 399VP Shown in Various Insertion Installations .....	6
2-5	Model 399VP With Insertion Adapter .....	7
2-6	Sensor Shown in Handrail Mounting Assembly .....	8
2-7	Jet Spray Cleaner Used With Model 399VP .....	9
2-8	Junction Box and Pipe Mounting Accessory .....	9
3-1	Wire and Connector Pin Functions .....	11
3-2	Model 81 Wiring .....	11
3-3	Model 1181 Wiring .....	11
3-4	Model 54 Wiring Through a Remote Junction Box.....	11
3-5	Model 54 Wiring .....	12
3-6	Model 2081 Wiring .....	12
3-7	Model 1181, 1050/1060, 1003/1023 Wiring Through a Remote Junction Box..	12
3-8	Model 2081 Wiring Through a Remote Junction Box.....	12
3-9	Model 81 Wiring Through a Remote Junction Box.....	13
3-10	Model 3081 and 4081 Wiring Through a Remote Junction Box.....	13
3-11	Model 1055-22-32 Wiring .....	13
3-12	Model 3081 and 4081 Wiring .....	13
3-13	Model 1054 Wiring .....	14
3-14	Model 1054A/B and 2054 Wiring .....	14
3-15	Model 1054 Wiring Through a Remote Junction Box.....	14
3-16	Model 1054A/B and 2054 Wiring Through a Remote Junction Box.....	14
3-17	Model SCL-(P/Q) Wiring .....	15
3-18	Model 2700 Wiring .....	15
3-19	Model 54epH Wiring.....	15
3-20	Model 1055-22-32 Wiring Through Remote Junction Boxes .....	15
3-21	Wiring Model 399VP-09 to Model 1055 (Pipe/Wall Mount).....	16
3-22	Wiring Model 399VP-09 to Model 1055 (Panel Mount).....	17
3-23	Preparation of Raw Connecting Cable.....	18

## LIST OF TABLES

Table No.	Title	Page
3-1	Remote Junction Box and Extension Cable Part Numbers.....	10
4-1	ORP of Saturated Quinhydrone Solutions (in Millivolts).....	20
5-1	R <sub>O</sub> & R <sub>1</sub> Values for Temperature Compensation Elements .....	21
5-2	Temperature vs. Resistance of Auto TC Element.....	21

# SECTION 1.0. DESCRIPTION AND SPECIFICATIONS

- 1.1 FEATURES AND APPLICATIONS
- 1.2 PHYSICAL SPECIFICATIONS
- 1.3 ORDERING INFORMATION

## 1.1 FEATURES AND APPLICATIONS

The Rosemount Analytical Model 399VP Sensor measures the pH or the Oxidation Reduction Potential (ORP) of aqueous solutions in pipelines, open tanks, or ponds. It is suitable for virtually all applications where a low cost sensor is required. The combination electrode features a ceramic junction constructed in an annular design around the pH/ORP sensitive membrane. The double or triple junction reference cell configuration is resistant to process solutions containing ammonia, chlorine, cyanides, sulfides, or other poisoning ions.

The glass electrode is housed in a molded Tefzel body and sealed with Viton<sup>1</sup> O-rings to guard against process leakage. The cable end of the sensor is also sealed, eliminating cable shorts caused by exposure to moisture. This construction makes for a highly chemical resistant disposable sensor and does not require electrolyte replenishment.

The custom glass electrode is available with either a standard hemi bulb or an optional flat bulb to best meet your application needs. Flat glass is advantageous in abrasive or coating applications that etch or build up on the glass respectively. In coating applications, such as slurries, the flat surface allows the process flow to act as a scrubbing agent to reduce coating and maintenance whereas in abrasive applications pitting from silicates and other similar materials is minimized by the flat surface to provide longer life. The hemi bulb is ideal for general purpose use and for those processes requiring greater accuracy over the entire pH range

Installation is easily achieved through the wide variety of mounting configurations. The Model 399VP features 1 in. (MNPT) front and rear facing connections for insertion, submersion or flow through pH and ORP applications.

## 1.2 PHYSICAL SPECIFICATIONS

**Materials of Construction:** Tefzel, glass, ceramic and Viton (also, Platinum for ORP sensor)

**Process Connections:** 1 in. MNPT

**Interconnecting Cable:** None - must use mating VP cable

**Measured Range:** pH: 0-14\*

ORP: -1500 -+1500mV

\*Percent Linearity over pH range:

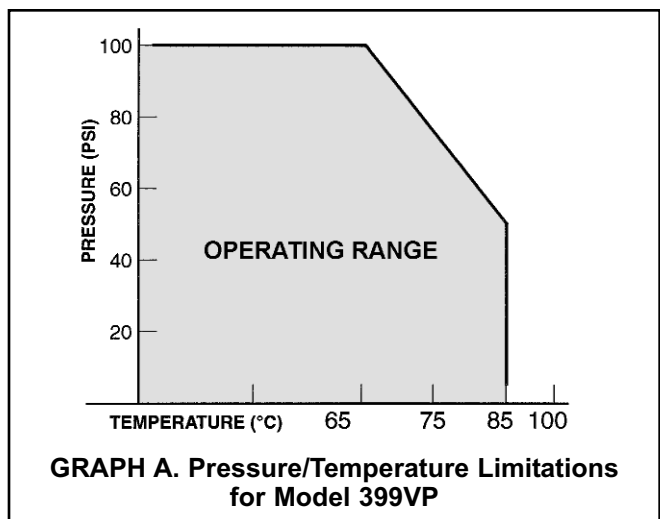
	Hemi Bulb	Flat Bulb
1-2 pH	94%	93%
2-12 pH	99%	98%
12-13 pH	97%	95%

**Temperature Compensation:** Automatic 0 to 85°C (32° to 185°F) (Temperature compensation is not required for 399 ORP when used with Models 1060, 1023 or 1181 ORP)

**Maximum Pressure:** 790 kPa abs (100 psig) at 65°C (Refer to Graph A below)

**Weight/Shipping Weight:** 0.45 kg/0.9 kg (1 lb/2 lb)

<sup>1</sup>Registered trademarks of E. I. du Pont de Nemours and Company.



### 1.3 ORDERING INFORMATION

The Model 399VP pH/ORP Sensor is available with custom glass electrodes housed in a molded Tefzel body with 1 in. MNPT threads suitable for insertion, submersion or flow through installation. The sensor includes a general purpose hemi bulb pH electrode (flat bulb optional) or a platinum ORP electrode and a double or triple junction gel filled reference electrode. Automatic temperature compensation is standard with the Model 399VP pH, but is not required on the Model 399VP ORP (except when used with the Model 1054A ORP Microprocessor Analyzer). The 399VP is offered with the Variopol (VP) connector and uses a mating VP cable (purchased separately). A remote preamplifier must be used with this sensor.

MODEL 399VP	pH/ORP SENSOR
Code	399VP pH (GPLR hemi bulb) Preamplifier/Cable (Required Selection)
02	3K ohm TC (Models 1181, 1050, and 1003)
09	Pt100 TC (Models 54pH, 1054A/B, 1055, 2054, 2081 pH, 81, 3081, and 4081)
Code	Glass Type (optional - choose one; not valid with special application codes)
11	High pH
15	HF Resistant
71	GPLR Flat bulb
Code	Special Applications - valid with only standard hemi glass (optional - choose one)
301	Low ionic strength water
302	Heavy reference poisoning ions (triple reference junction)
303	High temperature spikes or Low temperature storage
33	ORP sensor
PN	Mating VP Connector Cable (required for all new installations)
23645-06	15 ft cable with mating VP connector, prepped with BNC on analyzer end
23645-07	15 ft cable with mating VP connector, prepped without BNC on analyzer end

#### FOR FIRST TIME 399VP\* INSTALLATIONS, WE RECOMMEND USING THE FOLLOWING GUIDE:

##### 1. Mounting Accessories (optional)

- Choose one: PN 23242-02, Mounting adapter kit, 1/2 in. MNPT process connection, 1 in. x 3/4 in. sensor adapter  
 PN 915240-03, PVC flow through tee, 3/4 in. NPT process connection  
 PN 915240-04, PVC flow through tee, 1 in. NPT process connection  
 PN 915240-05, PVC flow through tee, 1-1/2 in. NPT process connection  
 PN 24091-00, Acrylic low flow cell  
 PN 2002011, 1-1/2 in. CPVC tee with 1-in. FNPT connection  
 PN 9320057, Pipe mount union, 1 in. x 1 in. PVC  
 PN 11275-01, Sensor handrail assembly  
 PN 1000857, Handrail mounting kit (pipe and sensor coupling supplied by others)

##### 2. Junction Boxes (optional)

**Remote Junction Boxes** (to extend sensor to analyzer distances)

- Choose one: PN 23555-00, includes preamplifier for Models 54, 81, 3081, 4081; NEMA 4X  
 PN 22719-02, Weatherproof junction box for cable extension  
 PN 23309-03, use with 1181 and 1050 compatible preamplifier  
 PN 23309-04, use with 1054/A/B, 2054, 2081 compatible preamplifier

##### 3. Preamplifiers (used to amplify signal when mounting sensor further than 15 ft from the analyzer)

- Choose one: PN 22698-02, Plug in preamplifier, 1181/1050 compatible (use with junction box PN 23309-03)  
 PN 22698-03, Plug in preamplifier, 1054/1054A/1054B/2054/ 2081 compatible (use with junction box PN 23309-04)

##### 4. Extension cables (used with remote junction boxes)

- Choose one: PN 23646-01, 11 conductor cable, shielded, prepped  
 PN 9200000, 4 conductor cable, shielded, unprepped

##### 5. Other optional accessories

- Choose one: PN 12707-00, Jet spray cleaner  
 PN 2001492, Stainless steel tag, specify marking (formerly Code -11)  
 PN 9210012, Buffer solution, 16 oz, 4.01 pH  
 PN 9210013, Buffer solution, 16 oz, 6.86 pH  
 PN 9210014, Buffer solution, 16 oz, 9.18 pH  
 PN 22698-00, Plug-in preamplifier, 1003 compatible

\* Also requires mating VP cable — see 399VP Ordering Information above.

## SECTION 2.0. INSTALLATION

- 2.1 UNPACKING AND INSPECTION
- 2.2 MOUNTING
- 2.3 FLOW-THROUGH INSTALLATIONS
- 2.4 INSERTION INSTALLATIONS
- 2.5 SUBMERSION INSTALLATIONS

### 2.1 UNPACKING AND INSPECTION.

Inspect the carton for any damage. If damage is detected, contact the carrier immediately. Inspect the hardware. Make sure all the items on the packing list are present and in good condition. Notify the factory if any part is missing. If the sensor is in satisfactory condition, proceed to Section 2.2, Mounting.

#### NOTE

Save the packing cartons and materials as most carriers require proof of damage due to mishandling, etc. Also, if it is necessary to return the sensor to the factory, you must pack the sensor in the same manner as it was received. Refer to Section 7.0 for instructions. If storing the sensor, the vinyl boot should be filled with pH buffer solution (pH 4 buffer recommended) and replaced on sensor tip until ready to use.

#### CAUTION

Buffer solution in the vinyl boot may cause skin or eye irritation.

#### NOTE

Glass electrode must be wetted at all times (in storage and in line) to maximize sensor life.

### 2.2 MOUNTING.

The sensor has been designed to be located in industrial process environments. Temperature and pressure limitations must not be exceeded at any time. A pertinent caution label is attached to the sensor. Please do not remove the label. See Figure 2-1.

#### CAUTION

Internal electrolyte fill solution may cause skin or eye irritation.

#### Mounting Guidelines:

1. Shake down the sensor to remove any air bubbles that may be present inside the tip of the pH glass.
2. Do not install the sensor horizontally. The sensor must be at a minimum of 10° off the horizontal (sensor glass bulb pointing down) to ensure accuracy.
3. Do not install the sensor upside down.
4. Air bubbles may become trapped on the sensor glass bulb. This problem is most commonly encountered in areas of low flow or during calibration. Shake the probe while immersed in solution to remove bubbles.

In most cases, the pH sensor can simply be installed as shipped, and readings with an accuracy of  $\pm 0.6$  pH may be obtained. To obtain greater accuracy or to verify proper operation, the sensor must be calibrated together with its compatible analyzer or transmitter.

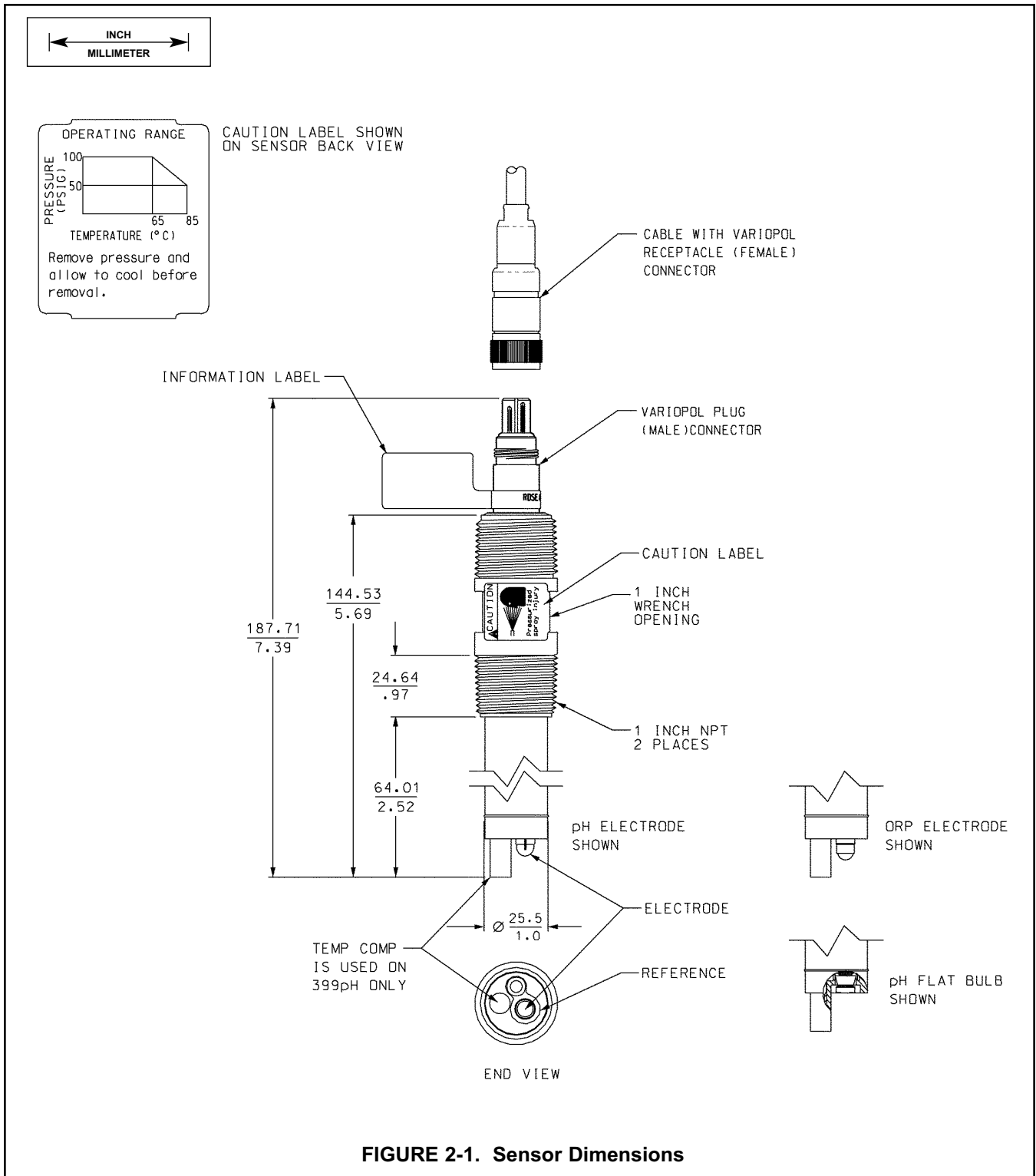


FIGURE 2-1. Sensor Dimensions



### 2.3 FLOW-THROUGH INSTALLATIONS.

The Model 399VP Sensor has a 1 in. MNPT process connection at the front and back end of the sensor for mounting directly into a 1 in. or 1½ in. tee. See Figure 2-2 for installation configurations. It is recommended that shut-off valves be provided for sensor removal and service.

**NOTE**

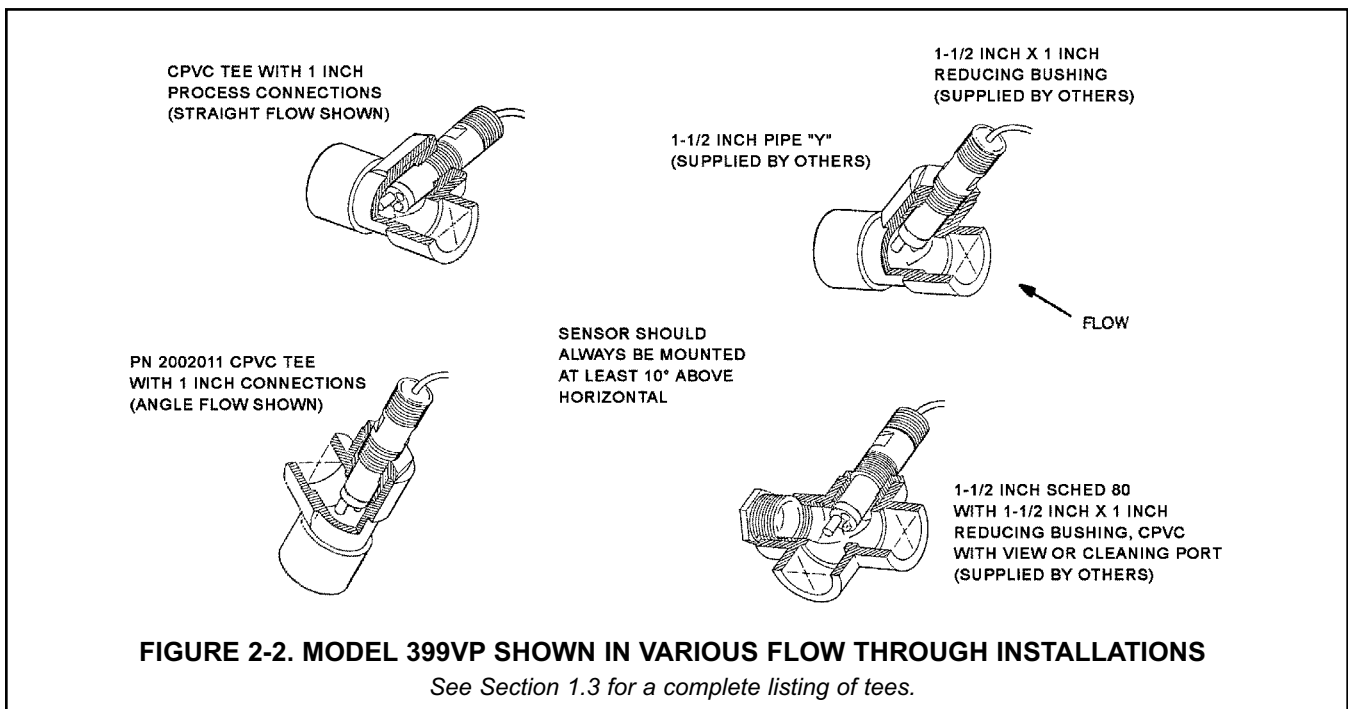
**Large pipe wrenches must not be used to tighten the sensor into a flange or other type of mounting.**



**Model 399VP shown in Tee PN 915240-03, -04, or -05. Tee is available with 3/4 in., 1 in., or 1-1/2 in. NPT process connection threads.**



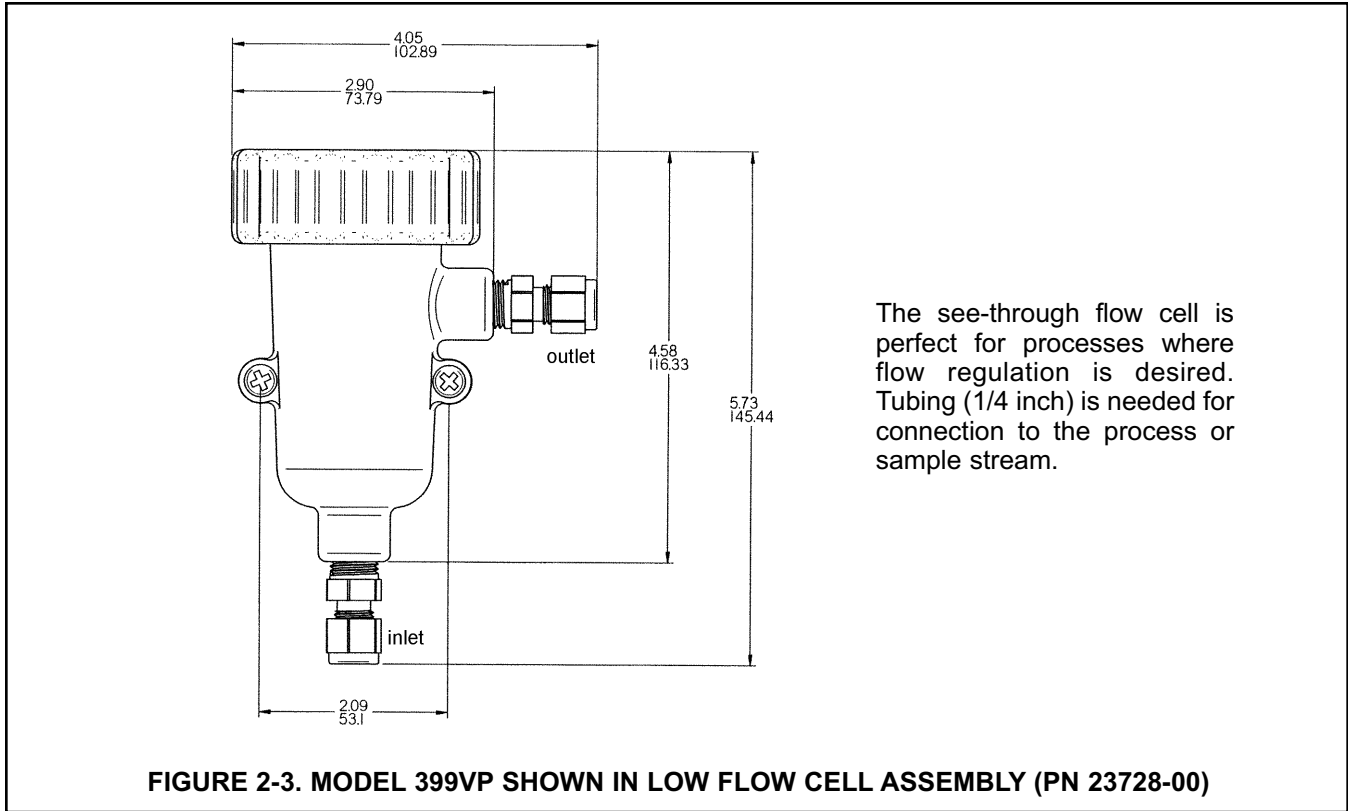
**Side view of Tee PN 915240-03, -04, or -05 with Model 399VP shown in middle of process flow.**



**Model 399VP shown in Tee PN 2002011. Tee is available with 1 in. process connection threads.**



**Side view of Tee PN 2002011 with Model 399VP shown in middle of process flow.**

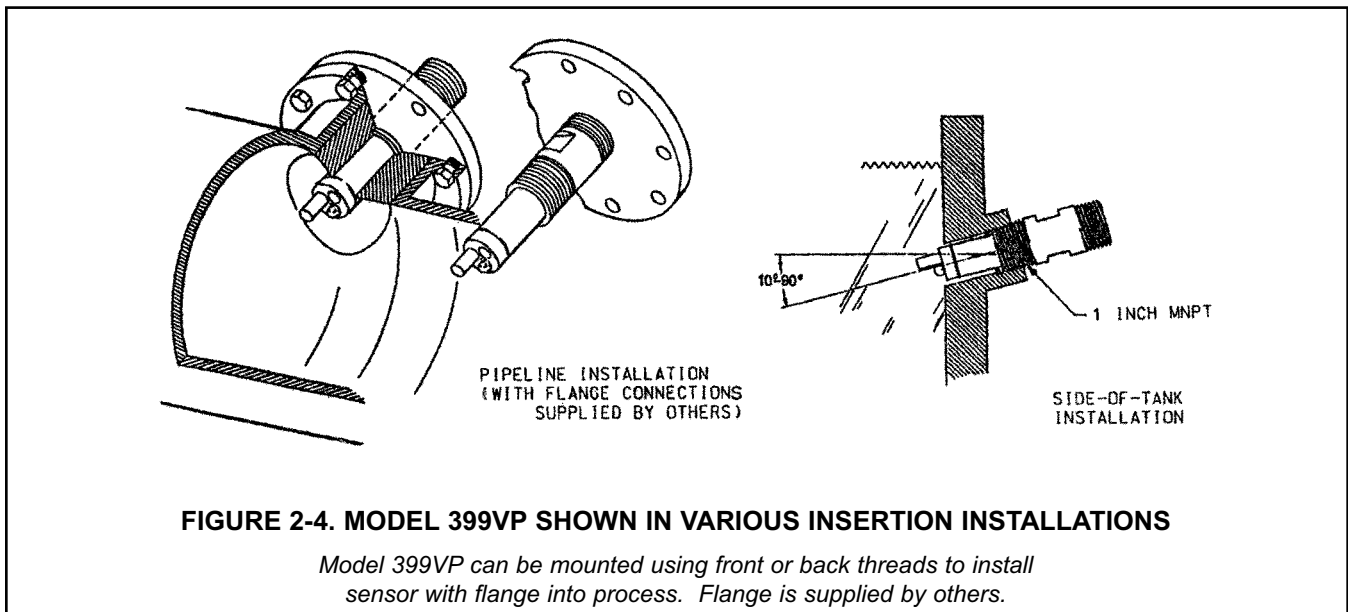


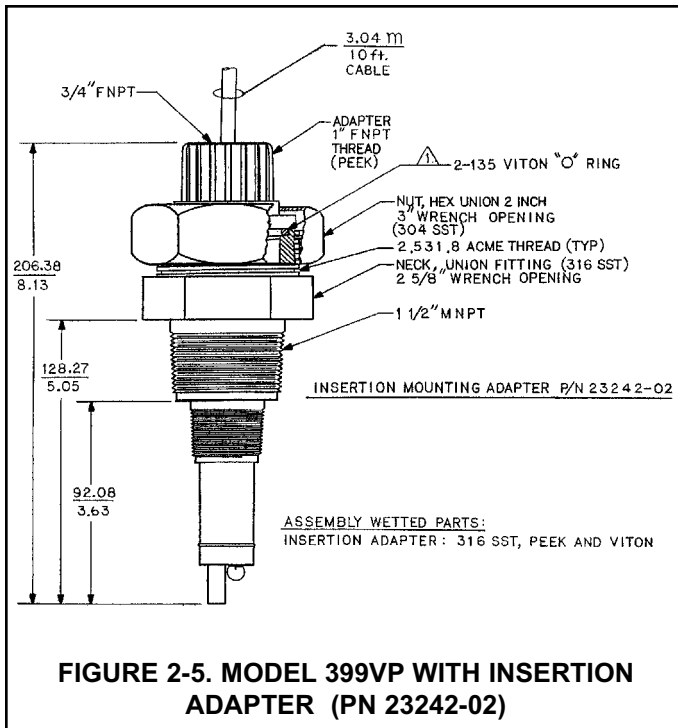
**2.4 INSERTION INSTALLATIONS.**

The Model 399VP sensor has forward and rear facing 1 in. MNPT process connections for pipeline installations (see Figure 2-4 or 2-5) and flange connections. The Model 399VP is also suitable for side-of-tank installation. The Model 399VP must be mounted at least 10° above the horizontal (see Figure 2-4).

**NOTE**

Large pipe wrenches must not be used to tighten the sensor into a flange or other type of mounting.





The Insertion Adapter mounts Model 399VP into a 1-1/2 inch NPT process pipe. Unscrewing the hex nut allows easy sensor removal without twisting the sensor cable.

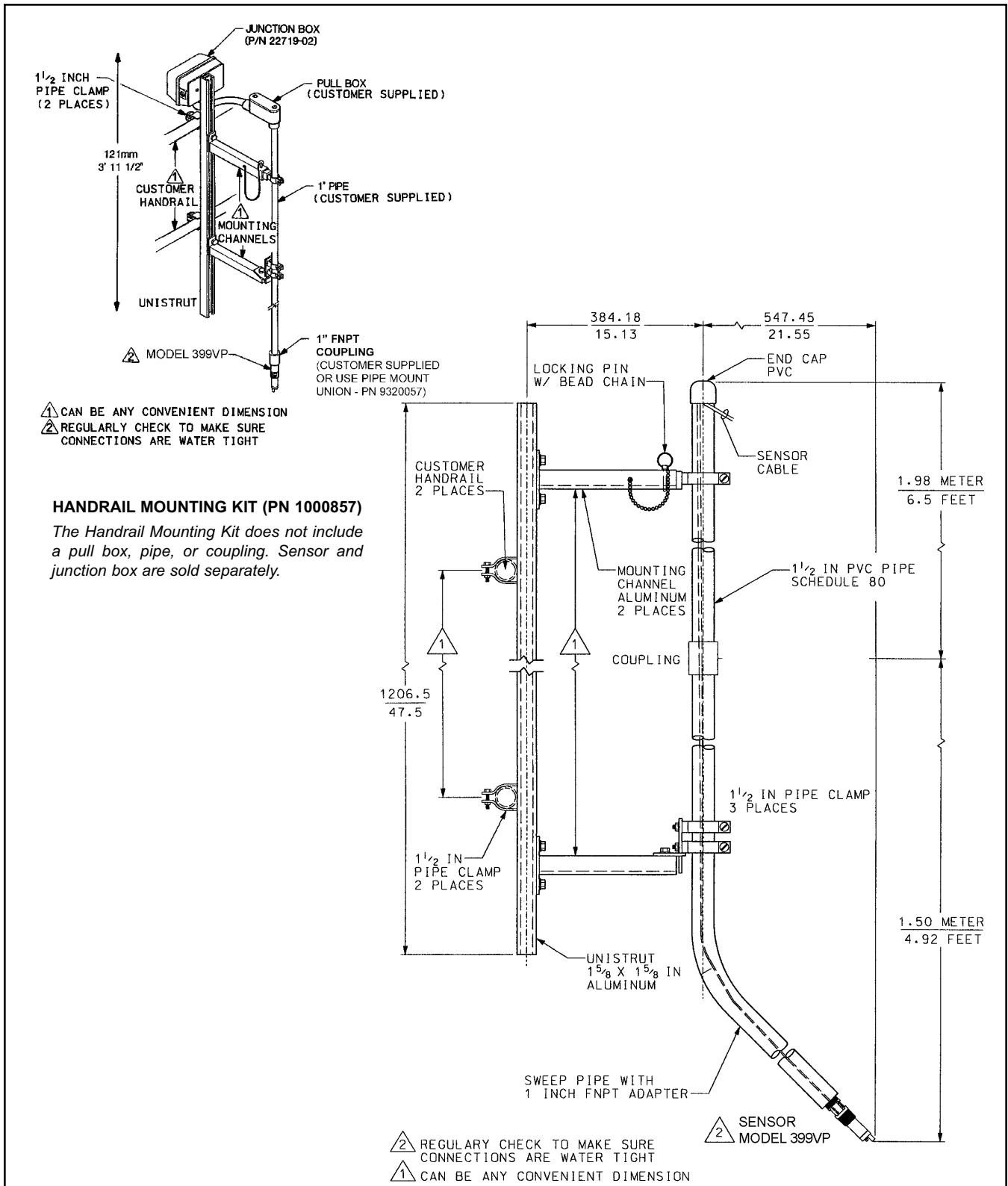
## 2.5 SUBMERSION INSTALLATIONS.

The Model 399VP Sensor has a 1 in. MNPT process connection at the back of the sensor (see Figure 2-1). Utilizing a standard 1 in. union (such as PN 9330022), the sensor may be mounted to a 1 in. SCH 80 CPVC or PVDF standpipe. The sensor can also be mounted in the Handrail Mounting Assembly (PN 11275-01; see Figure 2-6). Tapered pipe threads in plastic tend to loosen after installation. It is therefore recommended that the tightness of the connection be checked frequently to ensure that no loosening has occurred. To prevent rain water or condensation from running into the sensor, a weatherproof junction box is recommended (Rosemount Analytical PN 22719-02; see Figure 2-8). The sensor cable must be run through a protective conduit for isolation from electrical interference or physical abuse from the process. The sensor should be installed within 80° of vertical, with the electrode facing down. The sensor's cable should not be run with power or control wiring.

### NOTE

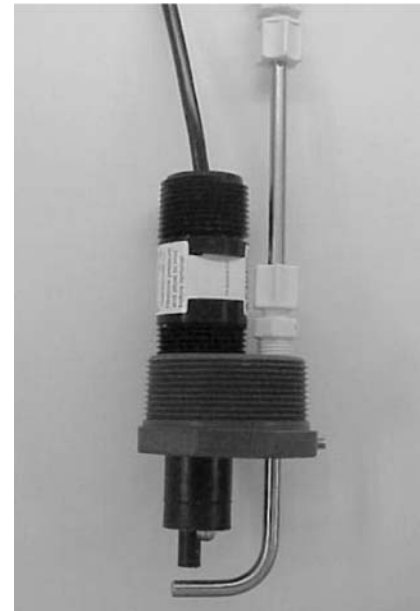
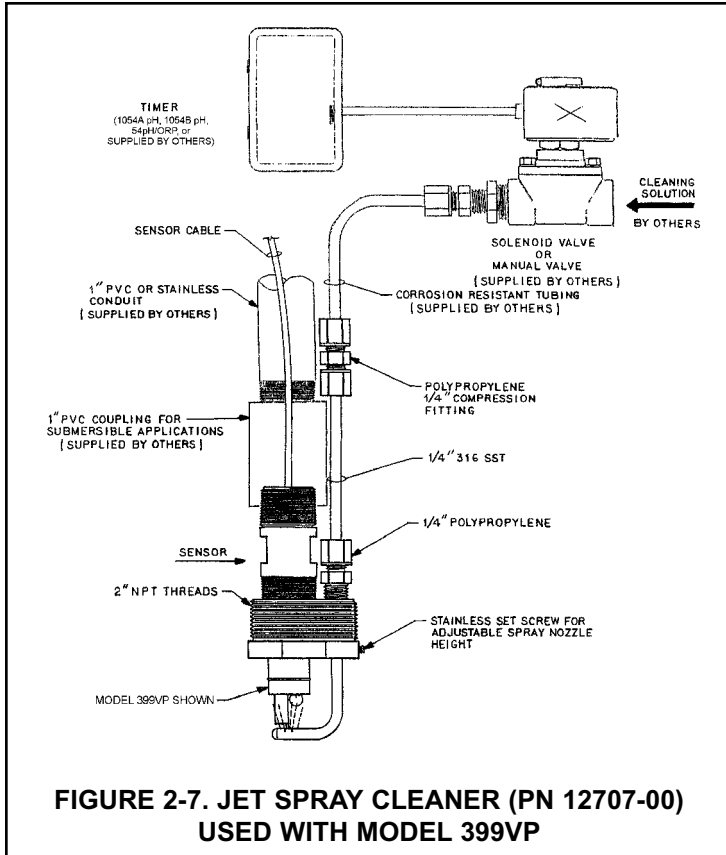
LARGE PIPE WRENCHES MUST NOT BE USED TO TIGHTEN THE SENSOR INTO MOUNTING ACCESSORIES.

When the Model 399VP is installed using a 1 in. standpipe, the sensor can be cleaned while still submersed in the process by using a jet spray cleaner. The jet spray cleaner (PN 12707-00; see Figure 2-7) can spray water or air directly onto the sensor.



**FIGURE 2-6. SENSOR SHOWN IN HANDRAIL MOUNTING ASSEMBLY (PN 11275-01)**

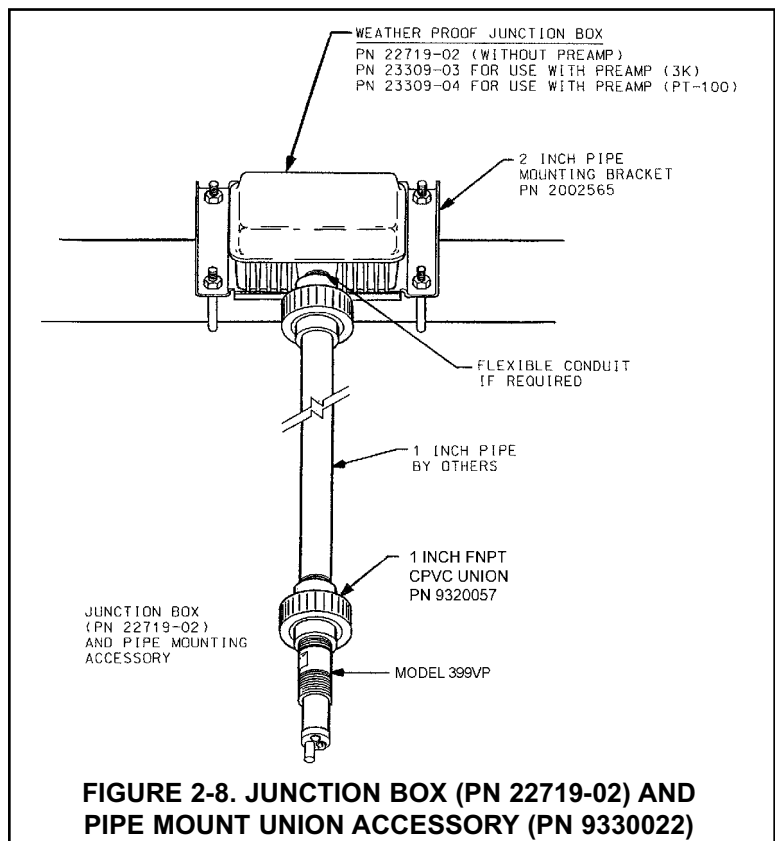
The Handrail Mounting Assembly can be used in applications where Model 399VP needs to be placed in a pond, tank, aeration basin, or open channel. Handrail Mounting Assembly includes all parts seen in drawing; sensor is sold separately.



The Jet Spray Cleaner eliminates routine manual sensor maintenance by cleaning Model 399VP with water or compressed air. Flow through the cleaner can be controlled by a solenoid valve. (Model 399 with integral cable shown)



The Pipe Mount Union Accessory (PN 9330022) is ideal for connecting Model 399VP to a pipe for insertion into a pond, tank, aeration basin, or open channel.



## SECTION 3.0. WIRING

Figures 3-2 thru 3-23 provide the diagrams for wiring the 399VP sensor to various analyzer/transmitters.

1. If the cable needs to be extended, use a high quality cable available from Rosemount Analytical. Refer to Figures 3-2 through 3-23 for the appropriate junction box part number and the corresponding wiring details.

### NOTE

If the extension cable is too long, either loop up the excess cable or cut and terminate each conductor neatly. **Make sure that the overall (outermost) drain wire is not shorted out with either of the two inner drain wires (shields).**

2. Signal cable should be run in a dedicated conduit (preferably an earth grounded metallic conduit) and should be kept away from AC power lines.

### NOTE

When extending the mV signal from the sensor through a remote junction box to the analyzer, the outer braid of the extension cable to the instrument must be terminated at earth ground or by using an appropriate metal cable gland fitting that provides a secure connection to the instrument cable.

The Model 399VP is used with a Variopol coax cable. The cable should be handled carefully and kept dry and free of corrosive chemicals at all times. Extreme care should be used to prevent it from being twisted, damaged or scraped by rough, sharp edges or surfaces.

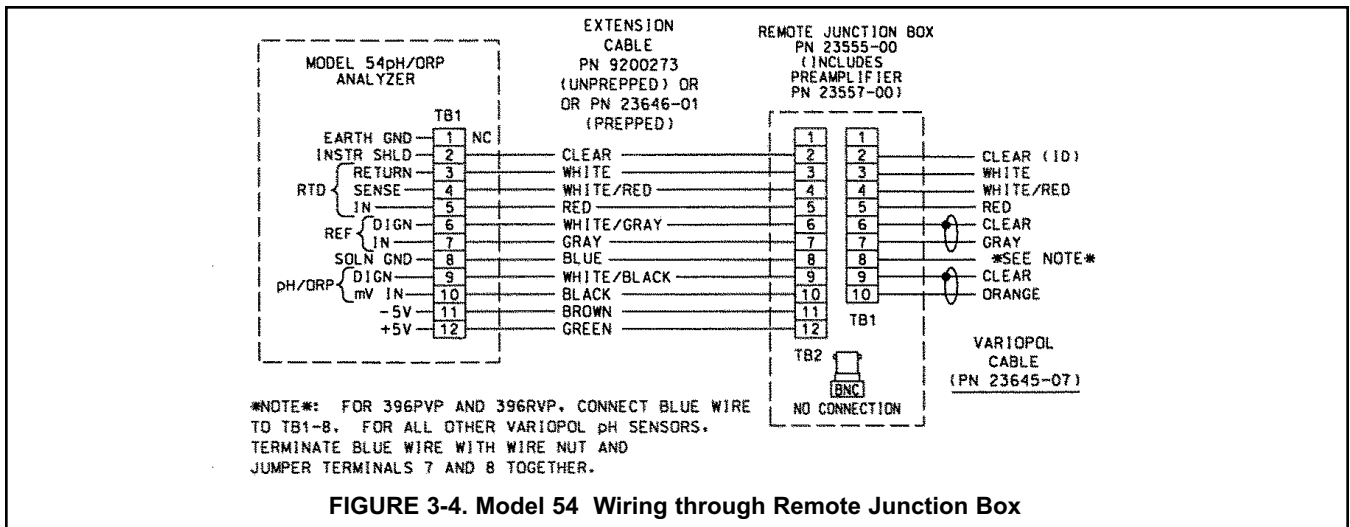
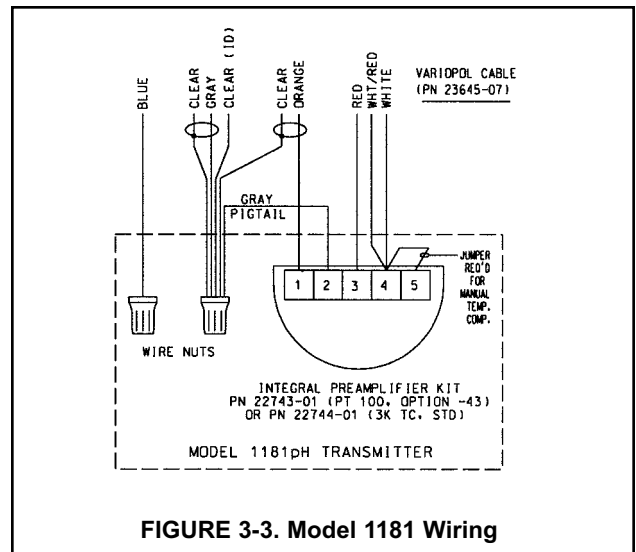
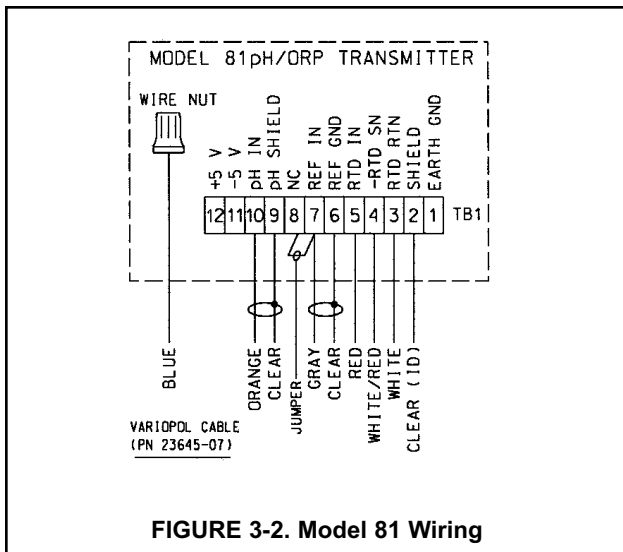
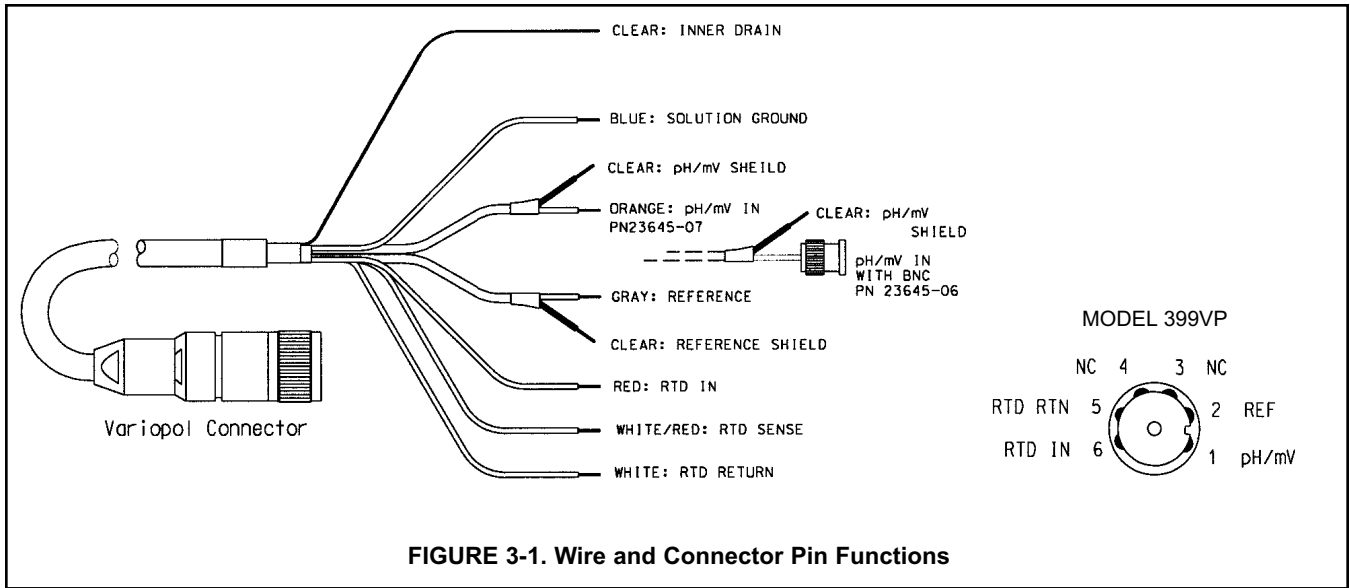
### DANGER

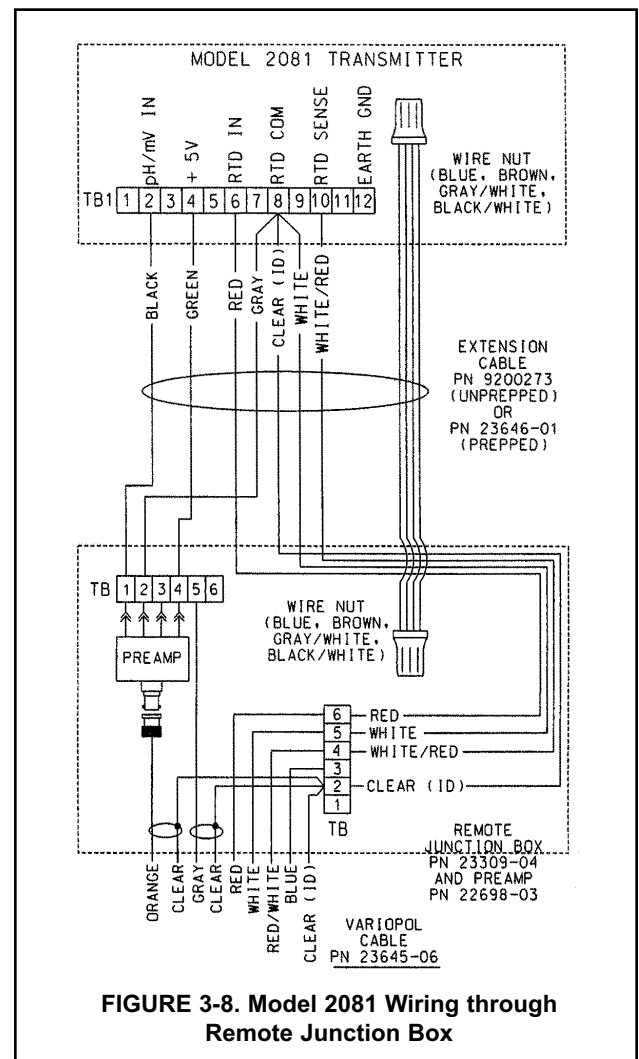
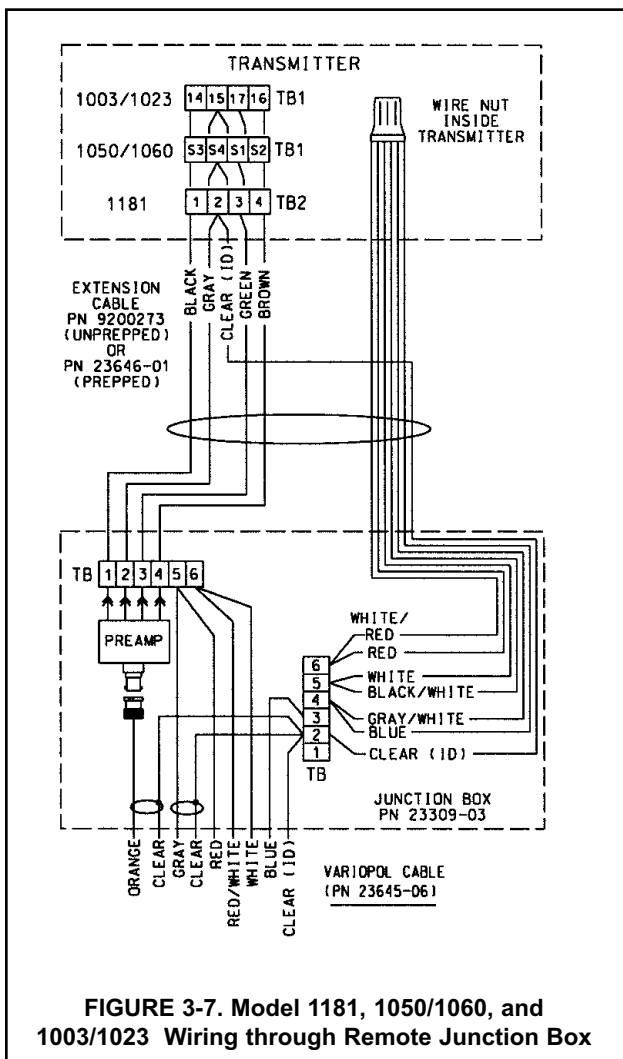
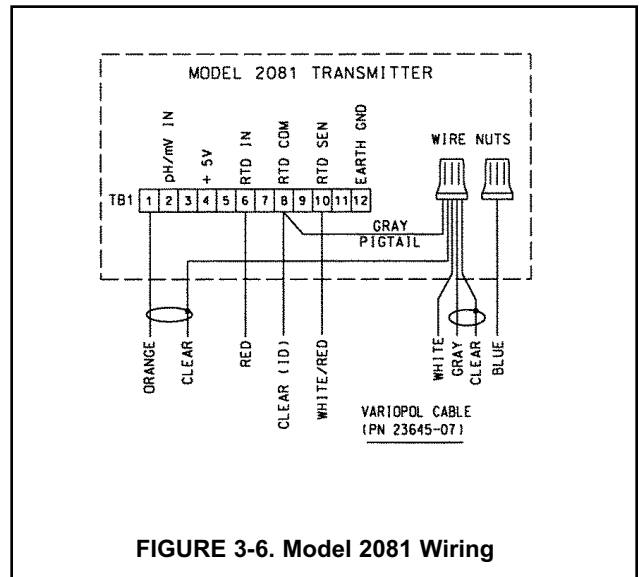
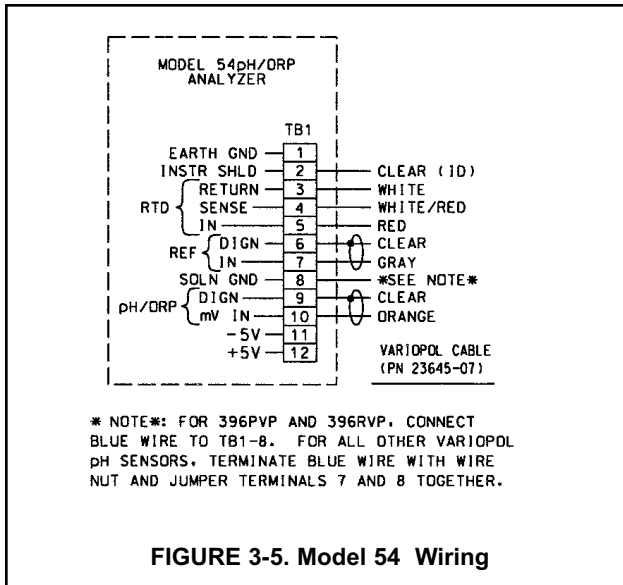
**DO NOT CONNECT SENSOR CABLE TO POWER LINES. SERIOUS INJURY MAY RESULT.**

TABLE 3-1. Remote Junction Box and Extension Cable Part Numbers

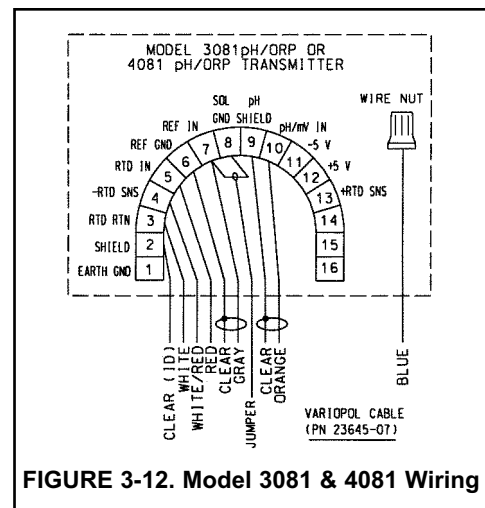
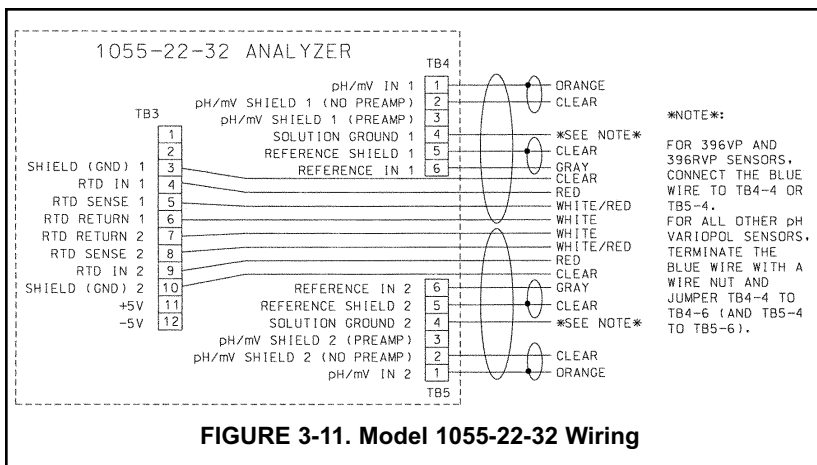
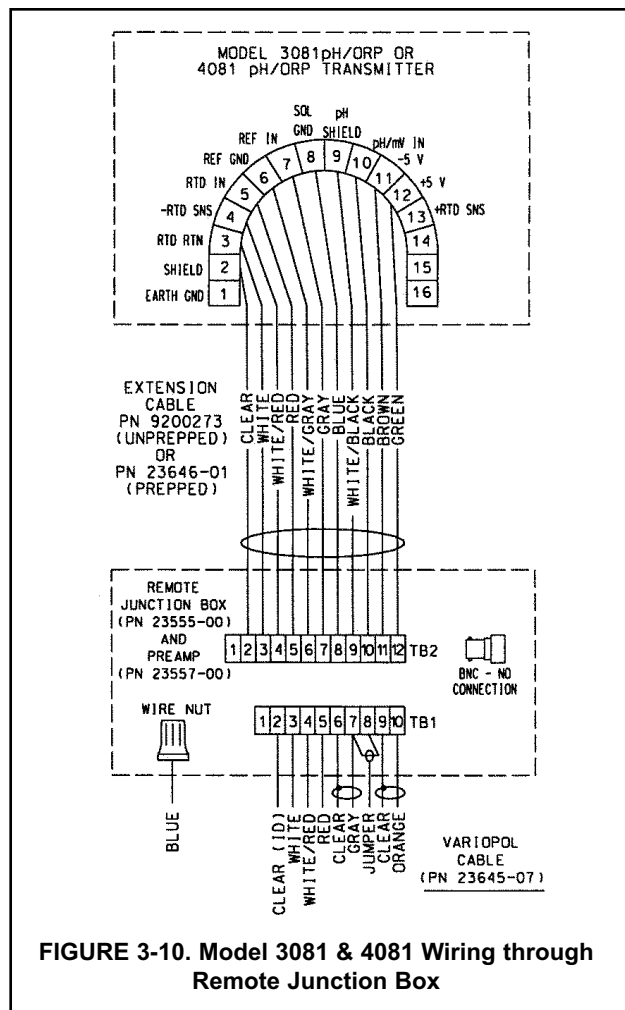
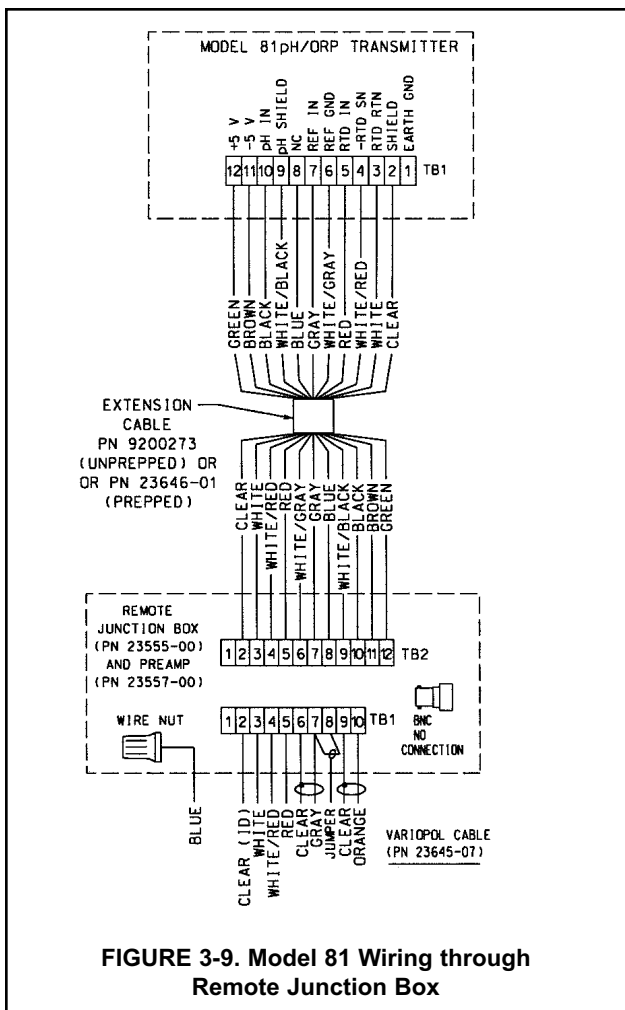
Model	Remote Junction Box PN	Extension Cable PN
54	23555-00	9200273*
81	23555-00	9200273*
1003/1023	23309-03	9200000
1050/1060	23309-03	9200000
1054	23309-04	9200273*
1054A/B	23309-04	9200273*
1055	23555-00	9200273*
1181	23309-03	9200273*
2054	23309-04	9200273*
2081	23309-04	9200273*
3081/4081	23555-00	9200273*
SCL	—	—
2700	—	—

\* Note that PN 9200273 is a raw cable. It can also be purchased with wires already prepared (PN 23646-01) for quicker installation.









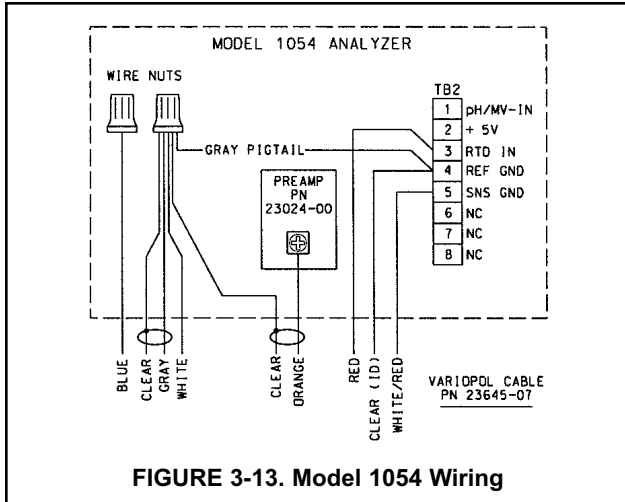


FIGURE 3-13. Model 1054 Wiring

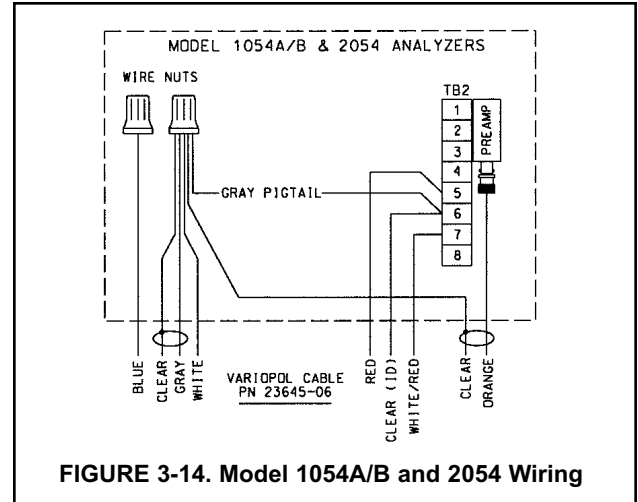


FIGURE 3-14. Model 1054A/B and 2054 Wiring

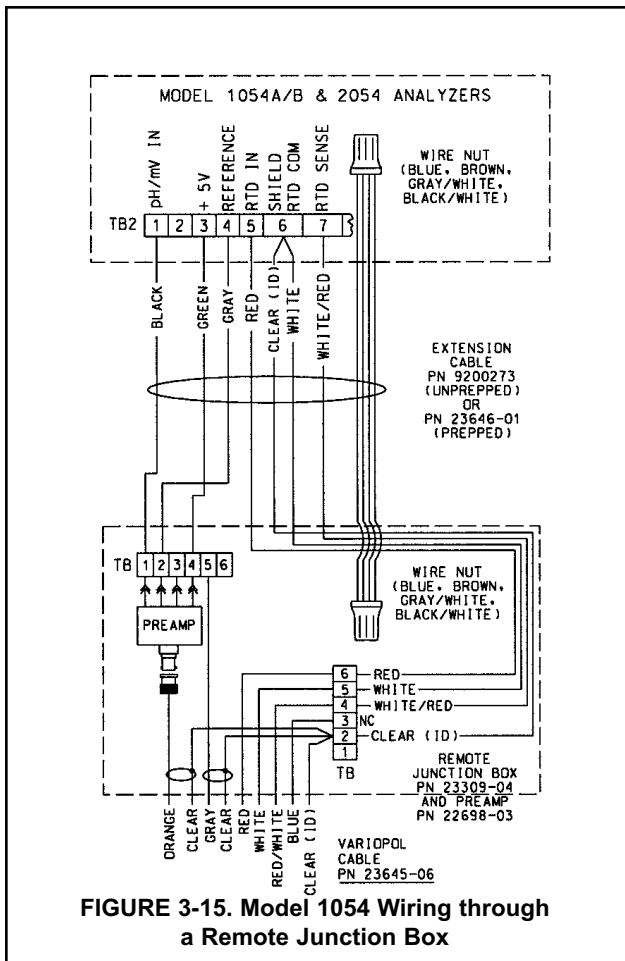


FIGURE 3-15. Model 1054 Wiring through a Remote Junction Box

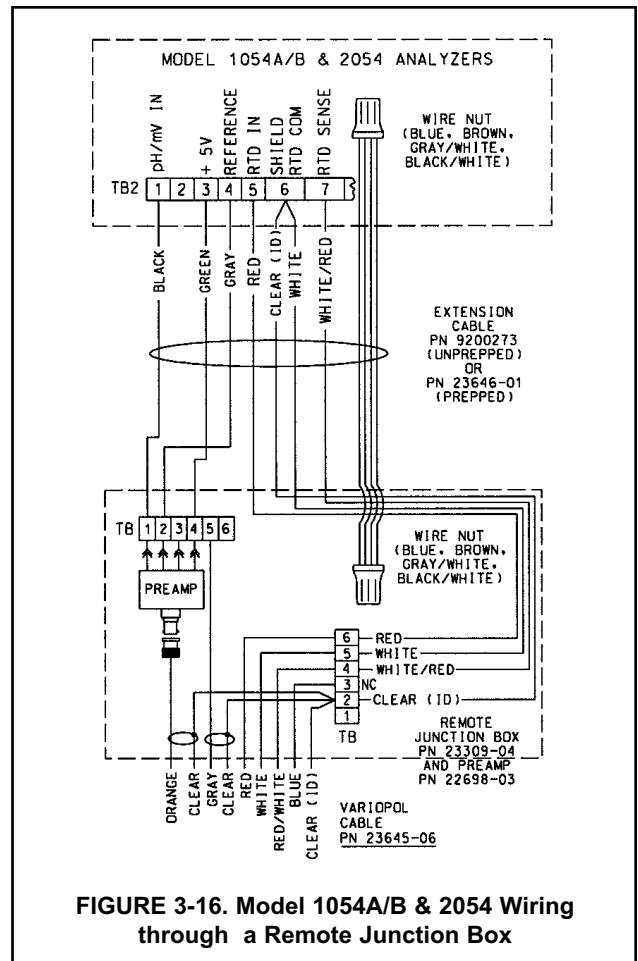


FIGURE 3-16. Model 1054A/B & 2054 Wiring through a Remote Junction Box

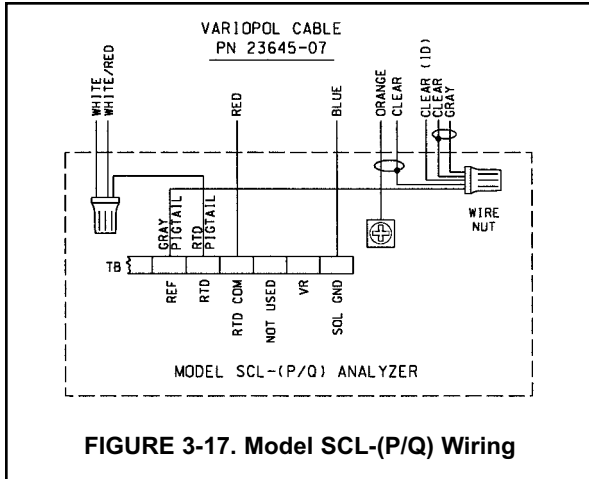


FIGURE 3-17. Model SCL-(P/Q) Wiring

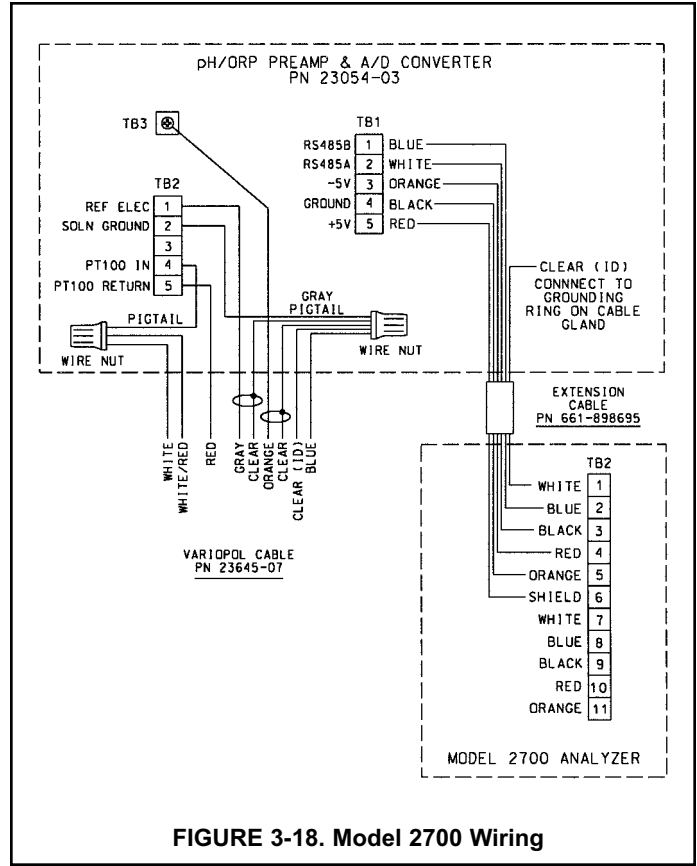


FIGURE 3-18. Model 2700 Wiring

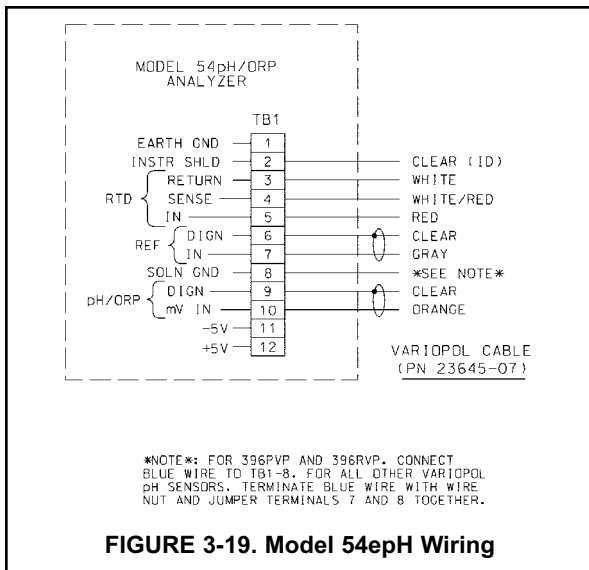


FIGURE 3-19. Model 54epH Wiring

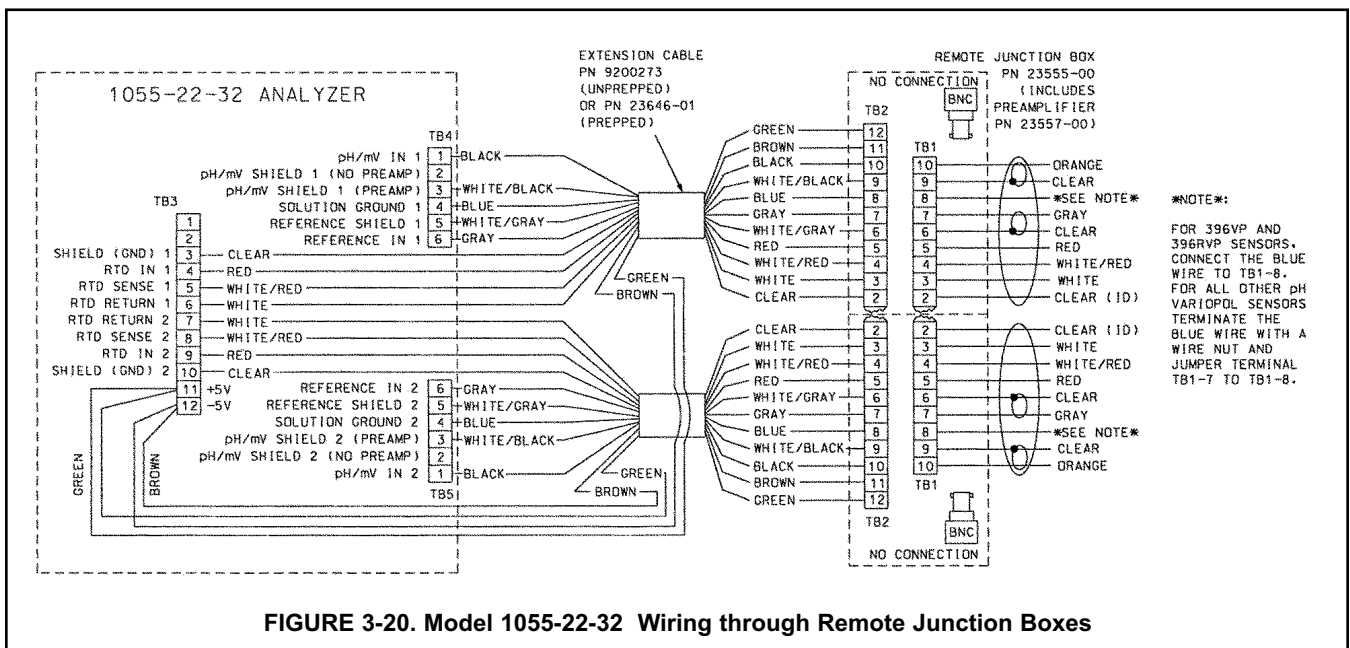
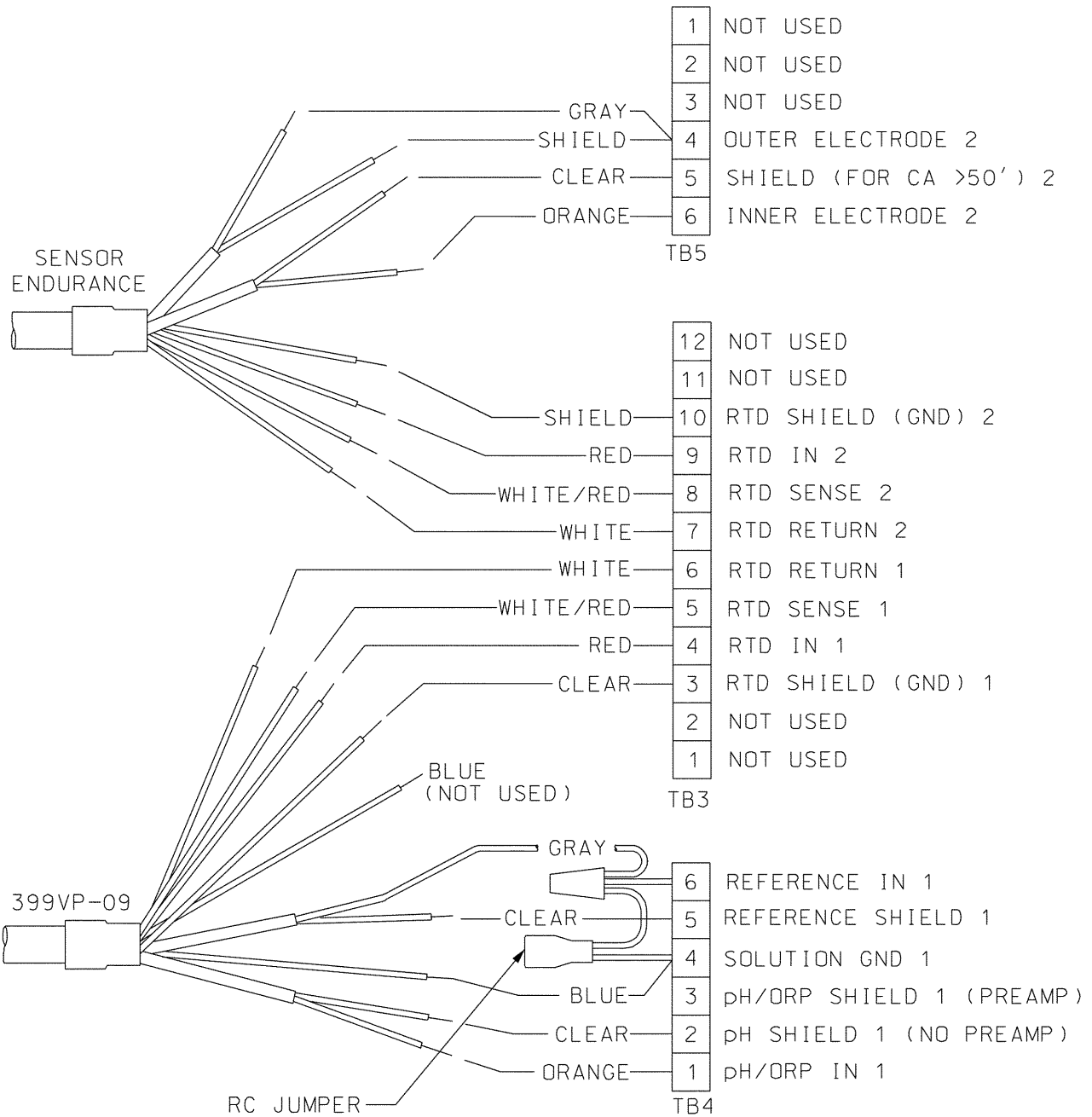
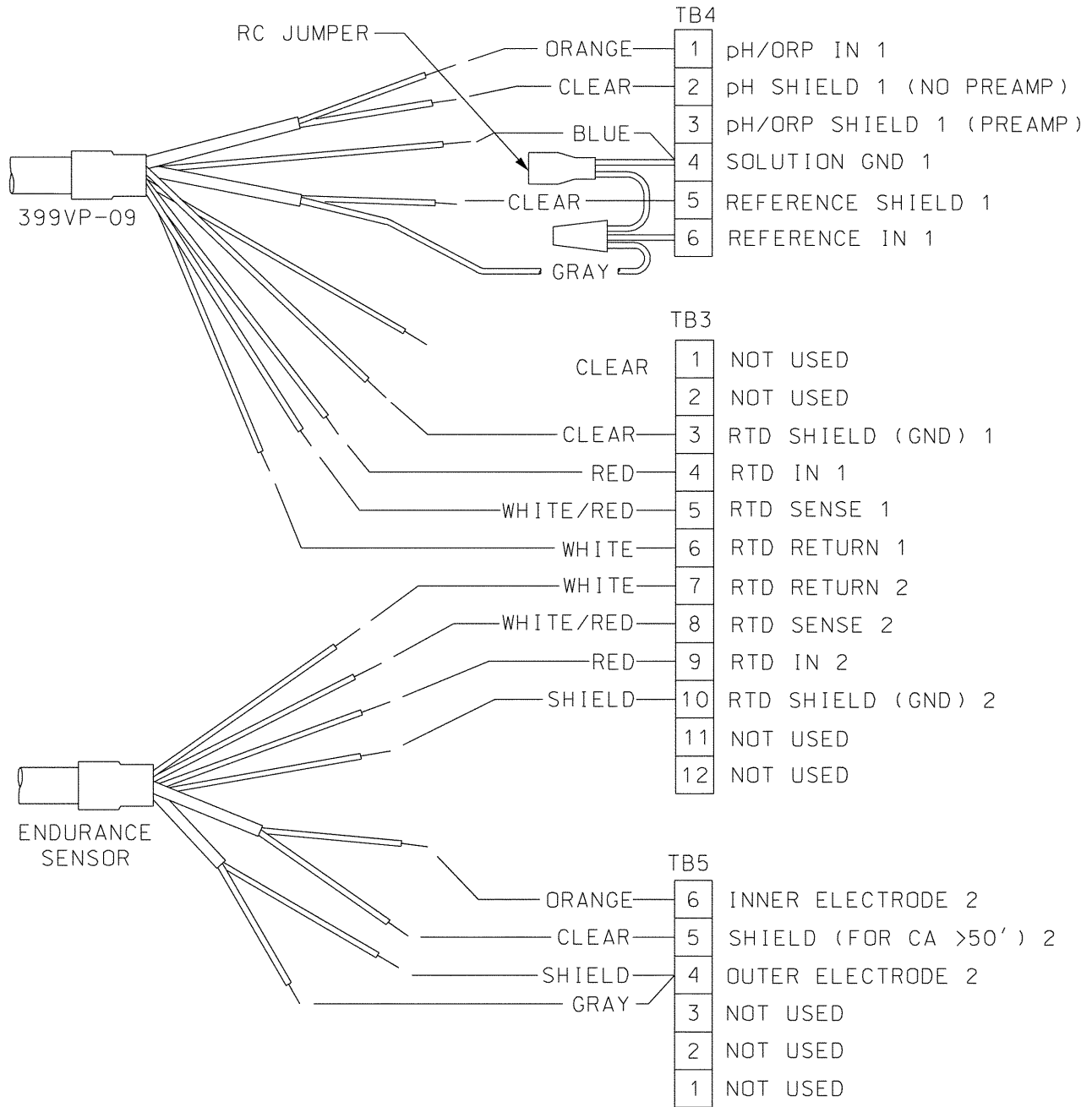


FIGURE 3-20. Model 1055-22-32 Wiring through Remote Junction Boxes



DWG. NO. 41055107	REV. C
----------------------	-----------

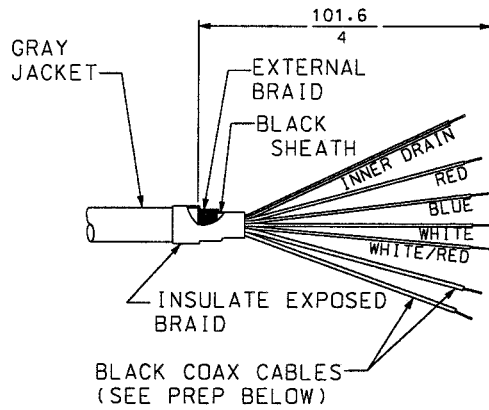
FIGURE 3-21. Wiring Model 399VP-09, 400, 401, 402, 403, and 404 to Model 1055 (Pipe/Wall Mount).



DWG. NO.	REV.
41055108	C

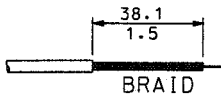
FIGURE 3-22. Wiring Model 399VP-09, 400, 401, 402, 403, and 404 to Model 1055 (Panel Mount).

- 1 STRIP BACK OUTER BRAID AND FOIL ABOUT 4 IN FROM END OF CABLE
- 2 STRIP INDIVIDUAL SHEATHS BACK ABOUT 1/4 IN TO EXPOSE THE WIRES
- 3 LOCATE THE 2 COAXIAL CABLES AND PREPARE AS FOLLOWS (SEE BELOW)

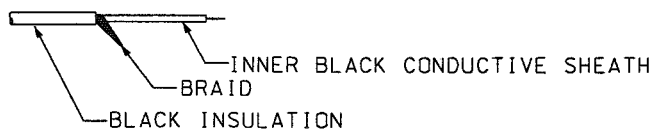


PREPARE THE COAX CABLE AS FOLLOWS

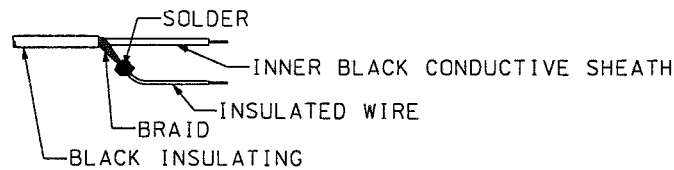
- 3A STRIP INSULATING BLACK SHEATH BACK ABOUT 1 1/2 IN



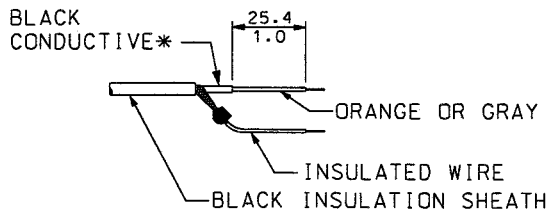
- 3B SEPARATE THE BRAID FROM THE INNER BLACK CONDUCTIVE SHEATH



- 3C SOLDER INSULATED WIRE (USER SUPPLIED) TO BRAID IF NEEDED

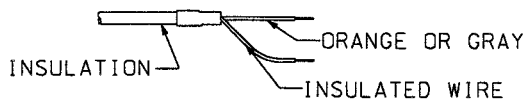


- 3D STRIP BLACK CONDUCTIVE SHEATH 1 IN TO EXPOSE (ORANGE OR GRAY) DEPENDING ON WHICH COAX YOU ARE PREPARING



\* WARNING: IF INNER BLACK CONDUCTIVE SHEATH IS IN CONTACT WITH THE EXPOSED LEADS, OR IS NOT PREPARED PROPERLY, IT MAY CAUSE AN ELECTRICAL SHORT.

- 3E INSULATE EXPOSED BLACK SHEATH/BRAID AREA



**FIGURE 3-23. Preparation of Extension Cable (PN 9200273)**

*This cable is shipped as a raw cable. Cable must be prepared, as shown above, before installation. To avoid preparing raw cable, PN 23646-01 can be used. PN 23646-01 cable offers the wires already prepared for installation.*

## SECTION 4.0. START-UP AND CALIBRATION

- 4.1 SENSOR PREPARATION
- 4.2 pH CALIBRATION
- 4.3 ORP CALIBRATION

### 4.1 SENSOR PREPARATION

Shake down the sensor to remove any air bubbles that may be present in the tip of the pH glass bulb. In most cases, the pH sensor can simply be installed as shipped, and readings with an accuracy of  $\pm 0.6$  pH may be obtained. To obtain greater accuracy or to verify proper operation, the sensor must be calibrated together with its compatible analyzer or transmitter.

### 4.2 pH CALIBRATION

After a temporary connection is established between the sensor and the instrument, a buffer calibration may be performed. Consult the appropriate pH/ORP analyzer or transmitter instruction manual for specific calibration and standardization procedures, or see below for recommended two-point buffer calibration procedure.

#### **Recommended two-point buffer calibration procedure:**

Select two stable buffer solutions, preferably pH 4.0 and 10.0 (pH buffers other than pH 4.0 and pH 10.0 can be used as long as the pH values are at least two pH units apart).

#### **NOTE**

A pH 7.0 buffer solution reads a mV value of approximately zero, and pH buffers read approximately 59.1 mV for each pH unit above or below pH 7.0. Check the pH buffer manufacturer specifications for millivolt values at various temperatures, since it may affect the actual value of the buffer solution mV/pH value.

1. Immerse the sensor in the first buffer solution. Allow the sensor to adjust to the buffer temperature (to avoid errors due to temperature differences between the buffer solution and sensor temperature) and wait for the reading to stabilize. The value of the buffer can now be acknowledged by the analyzer/transmitter.
2. Once the first buffer has been acknowledged by the analyzer/transmitter, rinse the buffer solution off of the sensor with distilled or deionized water and/or a small quantity of the next buffer solution.
3. Repeat steps 1 and 2 using the second buffer solution.
4. Once the analyzer/transmitter has acknowledged both buffer solutions, a sensor slope (mV/pH) is established (the slope value can be found within the analyzer/transmitter).
5. The slope value should read about 59.1 mV/pH for a new sensor and will decrease over time to approximately 47-49 mV/pH. Once the slope reads below the 47-49 mV/pH range, either clean the sensor and recalibrate for a better slope or install a new sensor to maintain accurate readings.

#### **Recommended pH Sensor Standardization:**

For maximum accuracy, the sensor can be standardized online or with a process grab sample after a buffer calibration has been performed and the sensor has been conditioned to the process. Standardization accounts for the sensor junction potential and other interferences. Standardization will not change the sensor's slope but will simply adjust the analyzer's reading to match that of the known process pH.

1. While obtaining a process solution sample (it is recommended that the sample be taken close to the sensor), record the pH value that is shown on the analyzer/transmitter display.
2. Measure and record the pH of the process solution sample with another temperature compensated, calibrated pH instrument. For best results, standardization should be performed at the process temperature.
3. Adjust the analyzer/transmitter value to the standardized value.

### 4.3 ORP CALIBRATION

Most industrial applications have a number of ORP reactions occurring in sequence or simultaneously. There can be several components that are oxidized or reduced by the reagents that are used. Theoretically, the ORP potential is absolute because it is the result of the oxidation-reduction equilibrium. However, the actual measured potential is dependent on many factors, including the condition of the surface of the ORP platinum electrode. Therefore, the sensor should be allowed 1-2 hours to become "conditioned" to the stream when first set up or after being cleaned.

#### CAUTION

The solution used during the following check is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper protective equipment. Do not let the solution come in contact with skin or clothing. If contact with skin is made, immediately rinse with clean water.

1. Make a temporary electrical connection between the sensor and the instrument.
2. Obtain an ORP standard solution (PN R508-16OZ). A standard solution can also be made quite simply by adding a few crystals of quinhydrone to either pH 4 or pH 7 buffer. Quinhydrone is only slightly soluble therefore a few crystals will be required.
3. Immerse the sensor in the standard solution. Allow 1-2 minutes for the ORP sensor to stabilize.
4. Adjust the standardize control of the instrument to the solution value shown on the label of the PN R508-16OZ standard solution or, if using a quinhydrone solution, in Table 4-1. The resulting potentials, measured with a clean platinum electrode and saturated KCl/AgCl reference electrode, should be within  $\pm 20$  millivolts of the value. Solution temperature must be noted to ensure accurate interpretation of results. The ORP value of saturated quinhydrone solution is not stable over long periods of time. Therefore, these standards should be made fresh each time they are used.
5. Remove the sensor from the buffer, rinse, and install in the process.

**TABLE 4-1. ORP of Saturated Quinhydrone Solution (In Millivolts)**

	pH 4 Solution			pH 7 Solution		
<b>Temp °C</b>	20	25	30	20	25	30
<b>Millivolt Potential</b>	268	264	260	94	87	80




## SECTION 5.0. MAINTENANCE

- 5.1 GENERAL
- 5.2 AUTOMATIC TEMPERATURE COMPENSATOR
- 5.3 pH ELECTRODE CLEANING
- 5.4 ORP PLATINUM ELECTRODE CHECK

### 5.1 GENERAL

The Model 399VP sensor is a disposable type sensor and therefore requires minimum maintenance. The sensor should be kept clean and free of debris and sediment at all times. The frequency of cleaning, by wiping or brushing with a soft cloth or brush, is determined by the nature of the solution being measured. The sensor should be removed from the process periodically and checked in buffer solutions.

<b>WARNING</b>
BEFORE REMOVING THE SENSOR, be absolutely certain that the process pressure is reduced to 0 psig and the process temperature is lowered to a safe level! 

If the sensor will not calibrate, refer to your analyzer/ transmitter instruction manual for proper test procedures. If it is then determined that the sensor has failed, it should be discarded and replaced.

### 5.2 AUTOMATIC TEMPERATURE COMPENSATOR

The temperature compensator element is temperature sensitive and can be checked with an ohmmeter. Resistance increases with temperature.

Resistance varies with temperature for a 3K and Pt100 element and can be determined according to Table 5-2 or with the following formula:

$$R_T = R_0 [1 + R_1 (T - 20)]$$

Where  $R_T$  = Resistance

T = Temperature in °C

Refer to Table 5-1 for  $R_0$  and  $R_1$  values

**TABLE 5-1.  $R_0$  and  $R_1$  VALUES FOR  
TEMPERATURE COMPENSATION ELEMENTS**

Temperature Compensation Element	$R_0$	$R_1$
3K	2934	.0045
Pt100	107.7	.00385

**TABLE 5-2. TEMPERATURE vs RESISTANCE  
OF AUTO T.C. ELEMENTS**

Temperature °C	Resistance (Ohms) ±1%	
	3K	Pt100
0	2670	100.0
10	2802	103.9
20	2934	107.8
25	3000	109.7
30	3066	111.7
40	3198	115.5
50	3330	119.4
60	3462	123.2
70	3594	127.1
80	3726	130.9
90	3858	134.7
100	3990	138.5

### 5.3 pH ELECTRODE CLEANING

If the electrode is coated or dirty, clean as follows:

1. Remove the sensor from process.
2. Wipe the glass bulb with a soft, clean, lint free cloth or tissue. If this does not remove the dirt or coating, go to Step 3 (detergents clean oil and grease; acids remove scale).
3. Wash the glass bulb in a mild detergent solution and rinse it in clean water. If this does not clean the glass bulb, go to Step 4.

#### CAUTION

The solution used during the following check is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper protective equipment. Do not let the solution come in contact with skin or clothing. If contact with skin is made, immediately rinse with clean water.

4. Wash the glass bulb in a dilute 5% hydrochloric acid solution and rinse with clean water. Soaking the sensor overnight in the acid solution can improve cleaning action.

#### NOTE

Erroneous pH results may result immediately after acid soak, due to reference junction potential build-up. Replace the sensor if cleaning does not restore sensor operation.

### 5.4 ORP PLATINUM ELECTRODE CHECK

The platinum electrode may be checked as follows: there are two types of standard solutions that may be used to check the ORP electrode/transmitter system.

**Type 1:** A prepared ORP standard solution (Ferrous/ferric ammonia sulfate standard PN R508-16OZ)

OR

An ORP standard solution can be prepared from the following formula: Dissolve 39.2 grams of reagent grade ferrous ammonium sulfate,  $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  and 48.2 grams of reagent grade ferric ammonium sulfate,  $\text{FeNH}_4(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ , in approximately 700 milliliters of water (distilled water is preferred, but tap water is acceptable). Slowly and carefully add 56.2 milliliters of concentrated sulfuric acid. Add sufficient water to bring the total solution volume up to 1000 ml. This standard ORP solution, although not as simple to prepare as the quinhydrone formula, is much more stable and will maintain its millivolt value for approximately one year when stored in glass containers. This solution (ferric/ferrous ammonium sulfate) will produce a nominal ORP of 476 +20 mV at 25°C when used with a saturated KCl/AgCl reference electrode and platinum measuring electrode. Some tolerance in mV values is to be expected due to the rather large liquid reference junction potentials that can arise when measuring this strongly acidic and concentrated solution. However, if the measuring electrodes are kept clean and in good operating condition, consistently repeatable calibrations can be carried out using this standard solution.

**Type 2:** Another type of commonly used ORP standard solution is the saturated quinhydrone solution. Refer to Section 4.3.

#### CAUTION

The solution used during the following check is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper protective equipment. If contact with skin or clothing is made, immediately rinse with plenty of clean water.

**Cleaning a Platinum Electrode.** The electrode can be restored to normal operation by simply cleaning the platinum electrode with baking soda. Polish it by rubbing it with a damp paper towel and baking soda until a bright, shiny appearance is attained.

## SECTION 6.0. TROUBLESHOOTING

**TROUBLESHOOTING.** The table below lists common problems, causes and remedies typically encountered in process measurement.

Problem	Probable Cause	Remedy
Meter reads off scale (display reads overrange).	T.C. element shorted.	Check T.C. element as instructed in Section 5.2 and replace sensor if defective.
	Sensor not in process. Sample stream is low or air bubbles are present.	Make sure sensor is in process with sufficient sample stream (refer to Section 2.0 for installation details).
	Open glass electrode.	Replace sensor.
	Reference element open - no contact.	Replace sensor.
Display reads between 3 and 6 pH, regardless of actual pH of solution or sample.	Electrode cracked.	Replace sensor.
Meter or display indication swings or jumps widely in AUTO T.C. Mode.	T.C. element shorted.	Check T.C. element as instructed in Section 5.2 and replace sensor if defective.
Span between buffers extremely short in AUTO T.C. Mode.	T.C. element open.	Check T.C. element as instructed in Section 5.2 and replace sensor if defective.
Sluggish or slow meter indication for real changes in pH level.	Electrode coated.	Clean sensor as instructed in Section 5.3. Replace sensor if cracked.
	Electrode defective.	Replace sensor.
Transmitter cannot be standardized.	Electrode coated or cracked.	Clean sensor as instructed in Section 5.3. Replace sensor if cracked.
Transmitter short spans between two different buffer values.	Aged glass electrode or high temperature exposure.	Replace sensor.
	Electrode coated .	Clean sensor as instructed in Section 5.3. Replace sensor if cracked.

## SECTION 7.0 RETURN OF MATERIAL

### 7.1 GENERAL.

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Before returning a product for repair, call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

### 7.2 WARRANTY REPAIR.

The following is the procedure for returning instruments still under warranty:

1. Call Rosemount Analytical for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number. In the case of individual parts or sub-assemblies, the serial number on the unit must be supplied.
3. Carefully package the materials and enclose your "Letter of Transmittal" (see Warranty). If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

Rosemount Analytical Inc., Uniloc Division  
Uniloc Division  
2400 Barranca Parkway  
Irvine, CA 92606

Attn: Factory Repair

RMA No. \_\_\_\_\_

Mark the package: Returned for Repair

Model No. \_\_\_\_\_

### 7.3 NON-WARRANTY REPAIR.

The following is the procedure for returning for repair instruments that are no longer under warranty:

1. Call Rosemount Analytical for authorization.
2. Supply the purchase order number, and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do Steps 3 and 4 of Section 7.2.

#### NOTE

Consult the factory for additional information regarding service or repair.

# RETURN OF MATERIALS REQUEST

**•IMPORTANT!**  
This form must be completed to ensure expedient factory service.

<b>CUSTOMER</b>	<b>FROM:</b>	<b>RETURN</b>	<b>BILL TO:</b>
	_____	_____	_____
	_____	_____	_____

**NOTICE TO SENDER** **CUSTOMER/USER MUST SUBMIT MATERIAL SAFETY SHEET (MSDS) OR COMPLETE STREAM COMPOSITION, AND/OR LETTER CERTIFYING THE MATERIALS HAVE BEEN DISINFECTED AND/OR DETOXIFIED WHEN RETURNING ANY PRODUCT, SAMPLE OR MATERIAL THAT HAVE BEEN EXPOSED TO OR USED IN AN ENVIRONMENT OR PROCESS THAT CONTAINS A HAZARDOUS MATERIAL ANY OF THE ABOVE THAT IS SUBMITTED TO ROSEMOUNT ANALYTICAL WITHOUT THE MSDS WILL BE RETURNED TO SENDER C.O.D. FOR THE SAFETY AND HEALTH OF OUR EMPLOYEES. WE THANK YOU IN ADVANCE FOR COMPLIANCE TO THIS SUBJECT.**

**SENSOR OR CIRCUIT BOARD ONLY:**  
(Please reference where from in MODEL / SER. NO. Column)

1. PART NO. _____	1. MODEL _____	1. SER. NO. _____
2. PART NO. _____	2. MODEL _____	2. SER. NO. _____
3. PART NO. _____	3. MODEL _____	3. SER. NO. _____
4. PART NO. _____	4. MODEL _____	4. SER. NO. _____

**REASON FOR RETURN** **PLEASE CHECK ONE:**

REPAIR AND CALIBRATE
  DEMO EQUIPMENT NO. \_\_\_\_\_  
 EVALUATION
  OTHER (EXPLAIN) \_\_\_\_\_  
 REPLACEMENT REQUIRED?  YES  NO

DESCRIPTION OF MALFUNCTION:

\_\_\_\_\_

\_\_\_\_\_

**REPAIR STATUS** **WARRANTY REPAIR REQUESTED:**

YES-REFERENCE ORIGINAL ROSEMOUNT ANALYTICAL ORDER NO. \_\_\_\_\_  
 CUSTOMER PURCHASE ORDER NO. \_\_\_\_\_  
 NO-PROCEED WITH REPAIRS-INVOICE AGAINST P.O. NO. \_\_\_\_\_  
 NO-CONTACT WITH ESTIMATE OF REPAIR CHARGES: LETTER  \_\_\_\_\_  
 PHONE  \_\_\_\_\_

NAME \_\_\_\_\_ PHONE \_\_\_\_\_

ADDRESS \_\_\_\_\_

\_\_\_\_\_ ZIP \_\_\_\_\_

**RETURN AUTHORITY FOR CREDIT ADJUSTMENT [Please check appropriate box(s)]**

WRONG PART RECEIVED
  REPLACEMENT RECEIVED  
 DUPLICATE SHIPMENT
 REFERENCE ROSEMOUNT ANALYTICAL SALES ORDER NO. \_\_\_\_\_  
 RETURN FOR CREDIT
 **RETURN AUTHORIZED BY:** \_\_\_\_\_  
 WARRANTY DEFECT \_\_\_\_\_  
 \_\_\_\_\_

24-6047

**Emerson Process Management**

**Rosemount Analytical Inc.**

2400 Barranca Parkway  
Irvine, CA 92606 USA  
Tel: (949) 757-8500  
Fax: (949) 474-7250

<http://www.raihome.com>

© Rosemount Analytical Inc. 2005





The right people, the right answers, right now.

## Immediate, Reliable Analytical Support

Now there's a way to quickly get the right answers for your liquid analytical instrumentation questions: the Analytical Customer Support Center.

Our staff of trained professionals is ready to provide the information you need. If you are placing an order, verifying delivery, requesting application information, or just want to contact a Rosemount Analytical representative, a call to the Customer Support Center will provide you with the right people, the right answers, right now.

## A Worldwide Network of Sales and Service

Emerson Process Management's field sales offices are your source for more information on the full line of Rosemount Analytical products. Field sales personnel will work closely with you to supply technical data and application information.

For more information, please contact your nearest Emerson Process Management sales office.

### THE AMERICAS - HEADQUARTERS

Rosemount Analytical Inc.  
Liquid Division  
2400 Barranca Parkway  
Irvine, CA 92606  
Phone: 949-757-8500  
Toll Free: 800-854-8257  
Fax: 949-474-7250

### ASIA-PACIFIC

Fisher-Rosemount  
Singapore Private Ltd.  
1 Pandan Crescent  
Singapore 0512  
Republic of Singapore  
Phone: 65-777-8211  
Fax: 65-777-0947

### EUROPE, MIDDLE EAST, AND AFRICA

Fisher-Rosemount Ltd.  
Heath Place  
Bognor Regis  
West Sussex PO22 9SH  
England  
Phone: 44-1243-863121  
Fax: 44-1243-845354

### ADDITIONAL SALES OFFICES IN:

Argentina	India	Romania
Australia	Indonesia	Russia
Austria	Ireland	Saudi Arabia
Azerbaijan	Israel	Singapore
Bahrain	Italy	Slovak Republic
Belgium	Jamaica	South Africa
Bolivia	Japan	Spain
Brazil	Jordan	Sweden
Brunei	Kazakhstan	Switzerland
Bulgaria	Korea	Syria
Canada	Kuwait	Taiwan
Chile	Malaysia	Thailand
China	Mexico	Tobago
Colombia	Netherlands	Trinidad
Costa Rica	New Zealand	Tunisia
Croatia	Nigeria	Turkey
Czech Republic	Norway	Ukraine
Denmark	Oman	United Arab Emirates
Egypt	Pakistan	United Kingdom
Ecuador	Paraguay	Uruguay
Finland	Peru	Uzbekistan
France	Philippines	Venezuela
Germany	Poland	Yemen
Greece	Portugal	
Hong Kong	Puerto Rico	
Hungary	Qatar	

VISIT OUR WEBSITE AT  
[www.raihome.com](http://www.raihome.com)

## WARRANTY

Seller warrants that the firmware will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. **Consumables, such as glass electrodes, membranes, liquid junctions, electrolyte, o-rings, catalytic beads, etc., and Services are warranted for a period of 90 days from the date of shipment or provision.**

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

## RETURN OF MATERIAL

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

**Emerson Process Management  
Liquid Division  
2400 Barranca Parkway  
Irvine, CA 92606**

The shipping container should be marked:

Return for Repair

Model \_\_\_\_\_

The returned material should be accompanied by a letter of transmittal which should include the following information (make a copy of the "Return of Materials Request" found on the last page of the Manual and provide the following thereon):

1. Location type of service, and length of time of service of the device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name and telephone number of the person to contact if there are questions about the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device.

If the material is returned for out-of-warranty repairs, a purchase order for repairs should be enclosed.



*The right people,  
the right answers,  
right now.*

ROSEMOUNT ANALYTICAL  
CUSTOMER SUPPORT CENTER  
1-800-854-8257



ON-LINE ORDERING NOW AVAILABLE ON OUR WEB SITE  
<http://www.raihome.com>

*Specifications subject to change without notice.*



Credit Cards for U.S. Purchases Only.



**Emerson Process Management**

**Liquid Division**

2400 Barranca Parkway  
Irvine, CA 92606 USA  
Tel: (949) 757-8500  
Fax: (949) 474-7250

<http://www.raihome.com>

