

# TUpH™ pH/ORP Sensors

For additional information, please visit our website  
at [www.emersonprocess.com/rainhome/liquid/](http://www.emersonprocess.com/rainhome/liquid/).

**SPECIFICATIONS**

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

**Wetted Materials:**

Model 396: polypropylene, 316 stainless steel, glass, EP

Model 398: Tefzel; titanium; glass; and choice of Kalrez, Viton or EPDM o-rings

**Interconnecting Cable:** 15 ft (4.6 m), for use with remote preamplifier

**Temperature Rating:** 0 to 100° C (32 to 212° F)

**Pressure Range:**

Model 396:

Hemi bulb: 100 - 1136 kPa (abs) (0 - 150 psig)

Flat bulb: 100 - 790 kPa (abs) (0 - 100 psig)

Model 398:

Hemi bulb: 100 - 1825 kPa (abs) (0 - 250 psig)

Flat bulb: 100 - 790 kPa (abs) (0 - 100 psig)



**Minimum Conductivity:** 75 μS/cm, nominal 100 μS/cm

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

**Process Connections:** None: must use 1 in. MNPT process connector PN 23166-00 or 23166-01

*PERCENT LINEARITY		
pH range	hemi bulb GPHT	flat bulb GPLR
0-2	94%	93%
2-12	99%	98%
12-13	97%	95%
13-14	92%	—

 <b>CAUTION</b>
<b>SENSOR/PROCESS APPLICATION COMPATIBILITY</b>
The wetted sensor materials may not be compatible with process composition and operating conditions. Application compatibility is entirely the responsibility of the user.

 <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!

 <b>WARNING</b>
Glass electrode must be wetted at all times (in storage and in line) to maximize sensor life.

 <b>DANGER</b>
Do not connect sensor to power lines. Serious injury may result.

<b>ATEX DIRECTIVE</b>
<b>Special Conditions for safe use</b>
<ol style="list-style-type: none"> <li>All pH/ORP sensors have a plastic enclosure which must only be cleaned with a damp cloth to avoid the danger due to a build up of an electrostatic charge.</li> <li>All pH/ORP sensor Models are intended to be in contact with the process fluid and may not meet the 500V r.m.s. a.c. test to earth. This must be taken into consideration at installation.</li> </ol>

## STORAGE

1. It is recommended that electrodes be stored in their original shipping containers until needed.
2. Do not store at temperatures below  $-5^{\circ}\text{C}$  ( $23^{\circ}\text{F}$ ).
3. Electrodes should be stored with a protective cap containing KCl solution (PN 9210342).
4. For overnight storage, immerse the sensor in tap water or 4 pH buffer solution.
5. A pH glass electrode does have a limited shelf life of one year.

## ELECTRODE PREPARATION

1. Remove electrode from shipping container.
2. Remove the protective boot covering the electrode bulb.
3. For pH electrode, rinse away salt film with clean water, then shake the electrode so that the internal solution fills the bulb, thus removing any air trapped there.

### CAUTION

The buffer in the protective boot may cause skin or eye irritation.

## INSTALLATION

For sensor dimensions, see Figure 1.

For sensor orientation, see Figures 2 and 3.

For wiring, see Figures 4 - 18.

## TWO POINT BUFFER CALIBRATION

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 buffer solution reads a mV value of approx. zero, and pH buffers read approximately  $\pm 59.1$  mV for each pH unit above or below pH 7. 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 sensor in the first buffer solution. Allow sensor to equilibrate to the buffer temperature (to avoid errors due to temperature differences between the buffer solution and sensor temperature) and wait for reading to stabilize. Value of buffer can now be acknowledged by 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.
3. Repeat steps 1 & 2 using the second buffer solution.
4. The theoretical slope value, according to the Nernst equation for calculating pH, is approximately 59.17 mV/pH. Over time the sensor will age, both in the process and in storage, and will result in reduced slope values. To ensure accurate readings, it is recommended that the electrode be replaced when the slope value falls below 47 to 49 mV/pH.

## RECOMMENDED pH SENSOR STANDARDIZATION

For maximum accuracy, the sensor can be standardized on-line 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.

## MAINTENANCE FOR pH ELECTRODE

Electrodes should respond rapidly. Sluggishness, offsets, and erratic readings are indicators that the electrodes may need cleaning or replacement.

1. To remove oil deposit, clean the electrode with a mild non-abrasive detergent.
2. To remove scale deposits, soak electrodes for 30 to 60 minutes in a 5% hydrochloric acid solution.
3. Temperature effect on life expectancy: If glass electrode life expectancy is 100% @  $25^{\circ}\text{C}$  ( $77^{\circ}\text{F}$ ), then it will be approximately 25% @  $80^{\circ}\text{C}$  ( $176^{\circ}\text{F}$ ).

## ORP CALIBRATION

1. After making an electrical connection between the sensor and the instrument, obtain a standard solution of saturated quinhydrone. This 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 only a few crystals will be required.
2. Immerse the sensor in the standard solution. Allow 1-2 minutes for the ORP sensor to stabilize.
3. Adjust the standardize control of the instrument to the solution value shown in the table below. The resulting potentials, measured with a clean platinum electrode and saturated KCl/AgCl reference electrode, should be within +/- 20 millivolts of the value shown in the table below. 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 up fresh each time they are used.
4. Remove the sensor from the buffer, rinse, and install in the process.

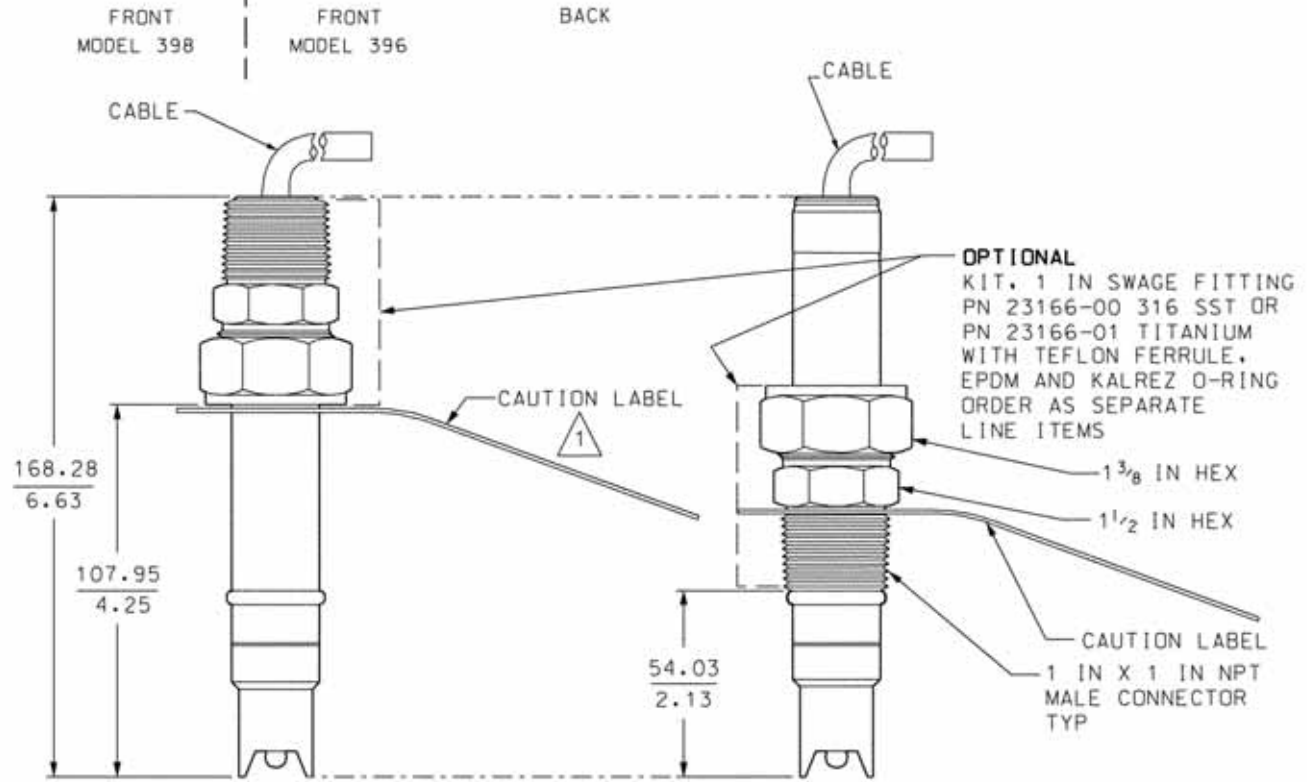
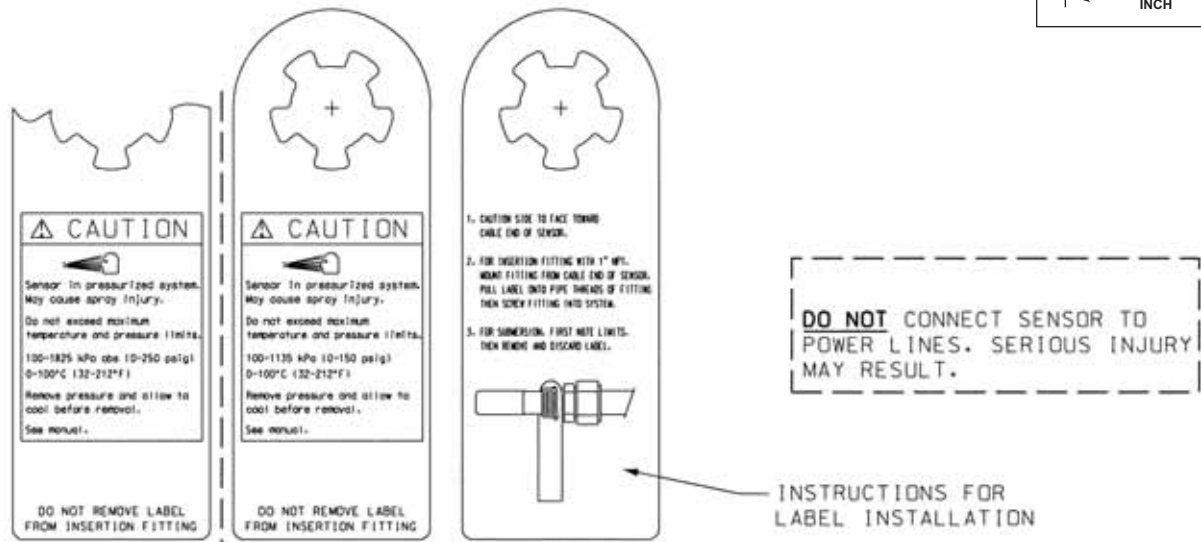
## MAINTENANCE FOR ORP ELECTRODE

Electrodes should respond rapidly. Sluggishness, offsets, and erratic readings are indicators that the electrodes may need cleaning or replacement.

1. To remove oil deposit, clean the electrode with a mild non-abrasive detergent.
2. To remove scale deposits, soak electrodes for 30 to 60 minutes in a 5% hydrochloric acid solution.
3. ORP (metallic) electrodes should be polished with moistened baking soda.

### ORP of Saturated Quinhydrone Solution (millivolts)

	pH 4 Solution			pH 7 Solution		
Temp °C	20	25	30	20	25	30
mV Potential	268	264	260	94	87	80

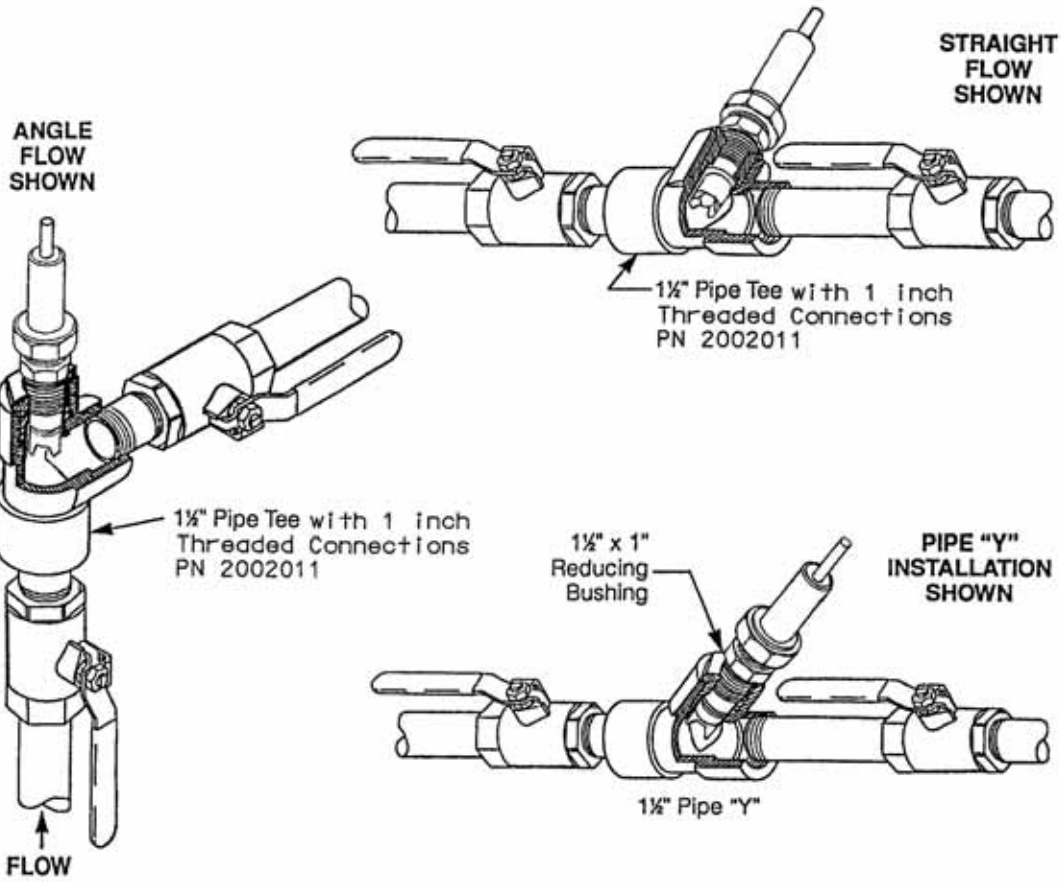


NOTE: FOR SUBMERSION APPLICATIONS NOTE LIMITS AND REMOVE LABEL

NOTE: INSTALL CAUTION LABEL AS SHOWN ON INSERTION FITTING FOR ALL INSERTION APPLICATIONS LABEL MUST BE VISIBLE AT ALL TIMES

**1** CAUTION LABEL REMOVED FOR SUBMERSION SERVICE

**FIGURE 1. Sensor Dimensions**

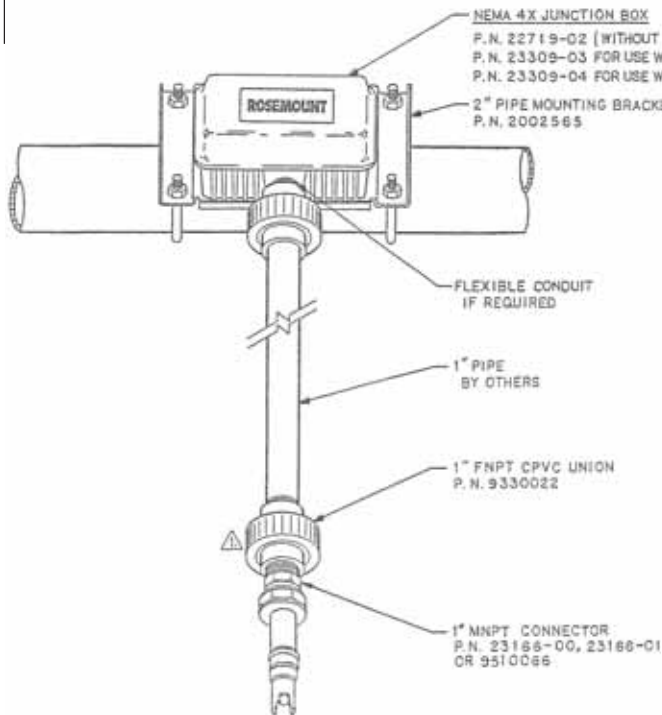


NOTES: VALVES AND FITTINGS BY OTHERS,  
MOUNT THE SENSOR AT LEAST 10° FROM  
HORIZONTAL .

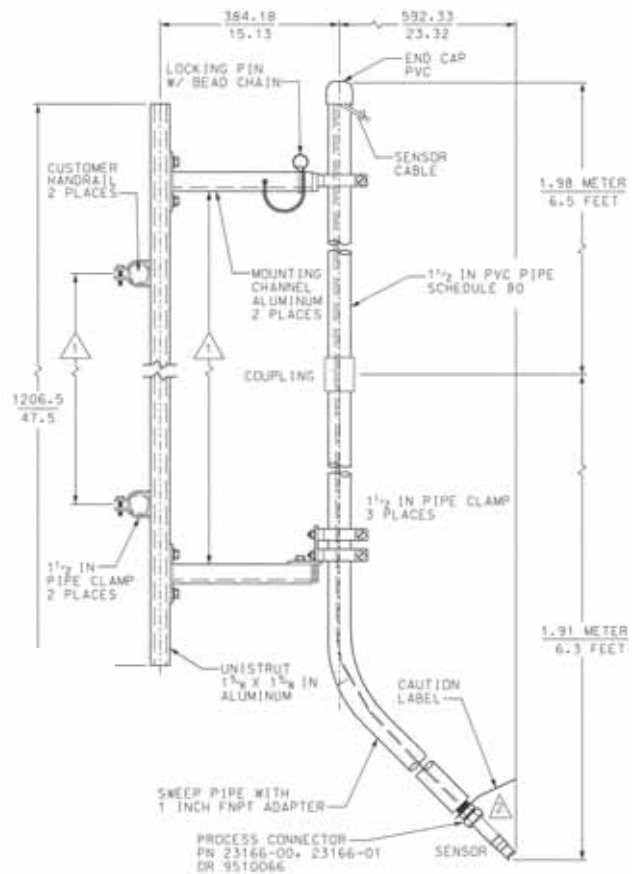
**FIGURE 2. Flow Through and Insertion Installation For Models 396 and 398**

*1-1/2 inch Pipe Tee (PN 2002011) with 1 inch threaded connections.*

*NOTE: The sensor must be mounted at least 10° above the horizon.*



⚠ REGULARLY CHECK TO MAKE SURE CONNECTIONS ARE WATER TIGHT.



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 ⚠ CAN BE ANY CONVENIENT DIMENSION

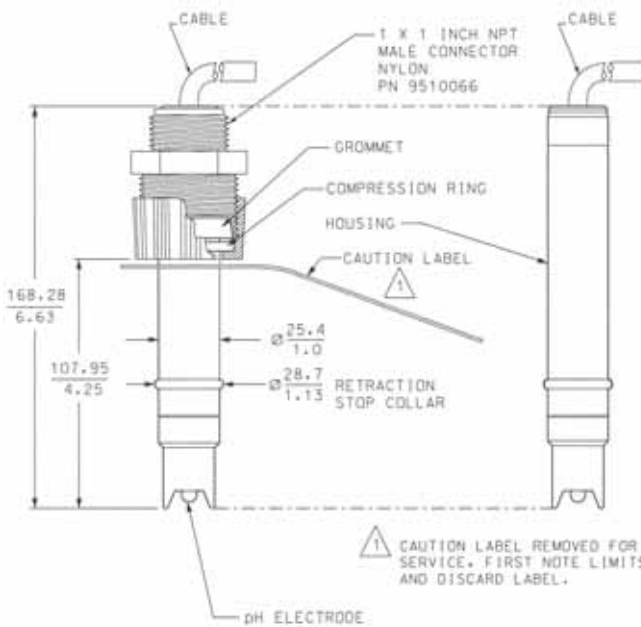
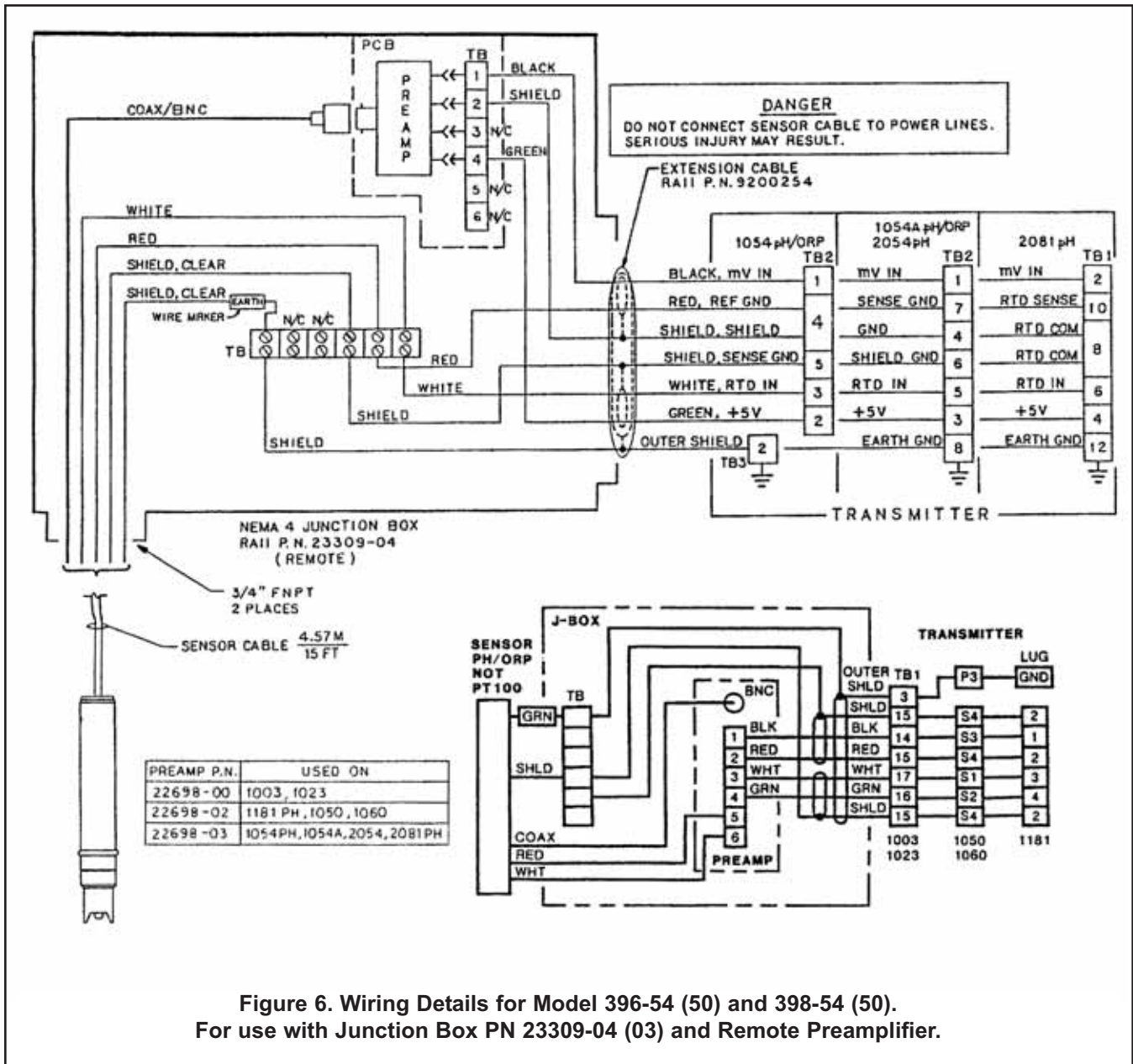
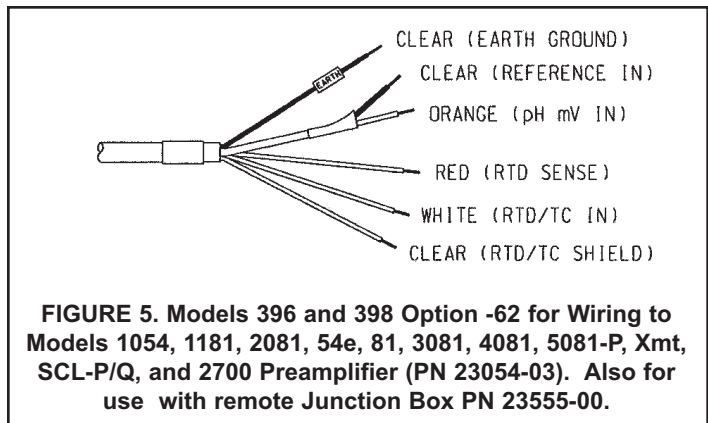
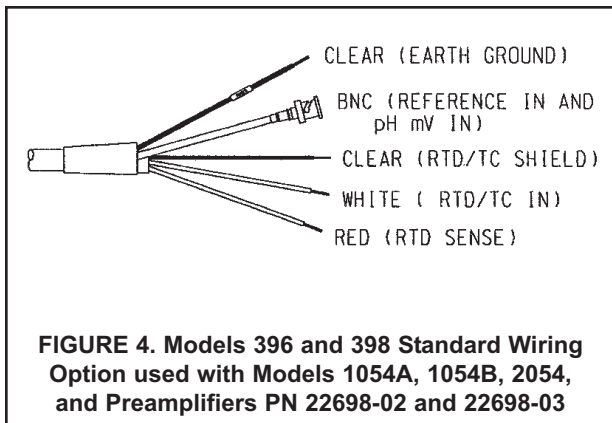


FIGURE 3. Submersion Installations For Models 396 and 398



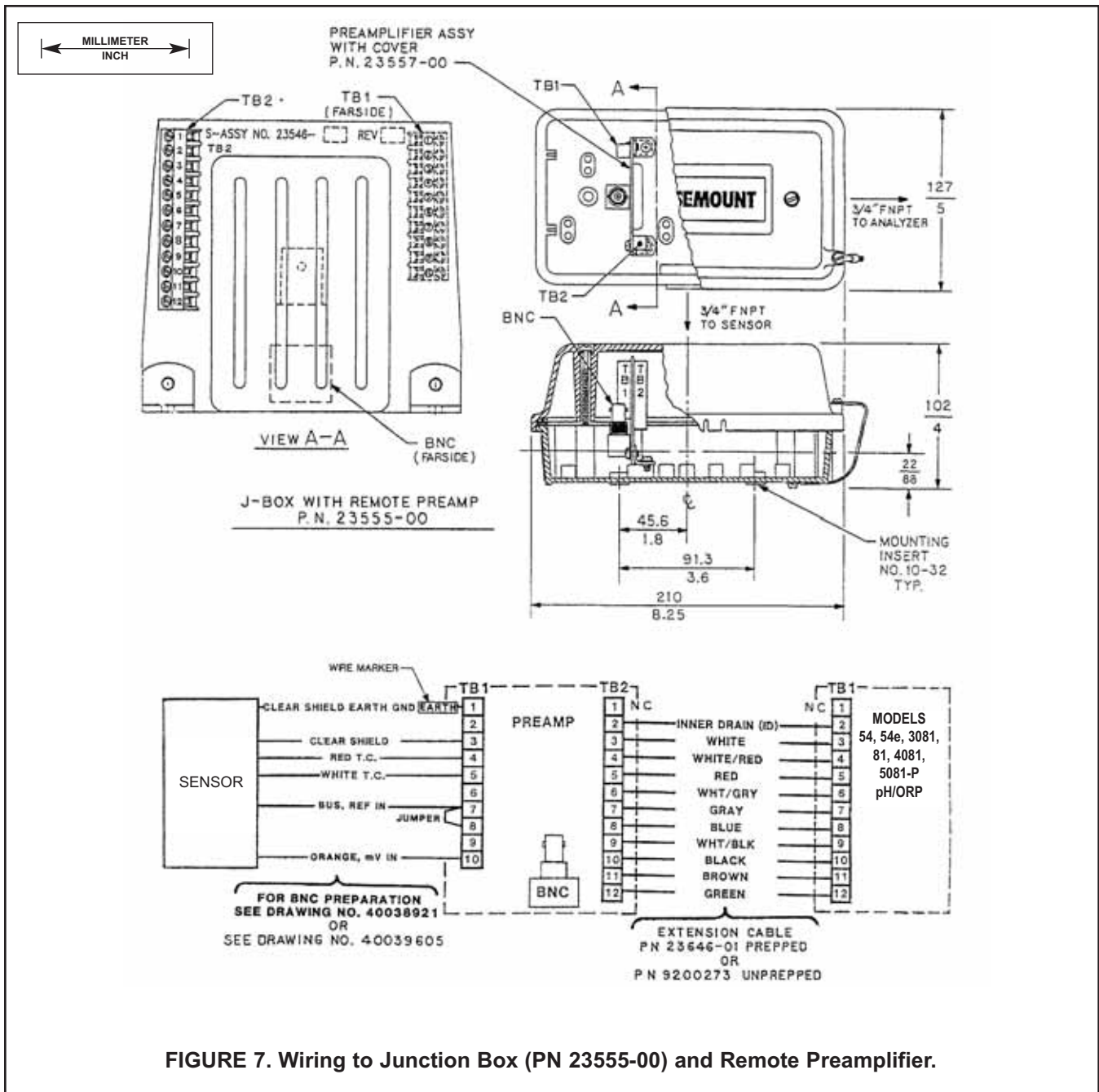
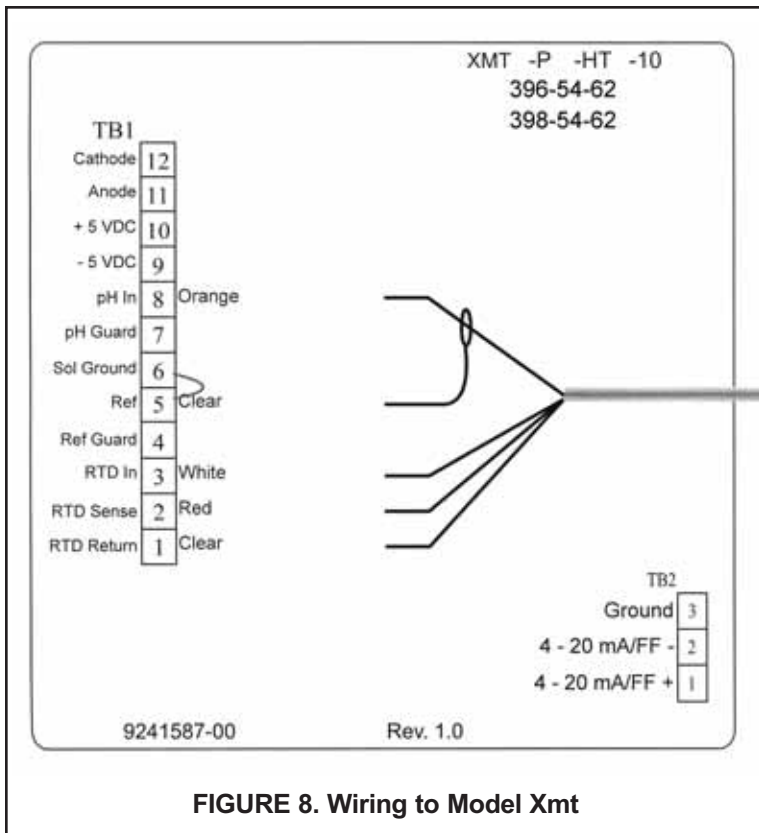
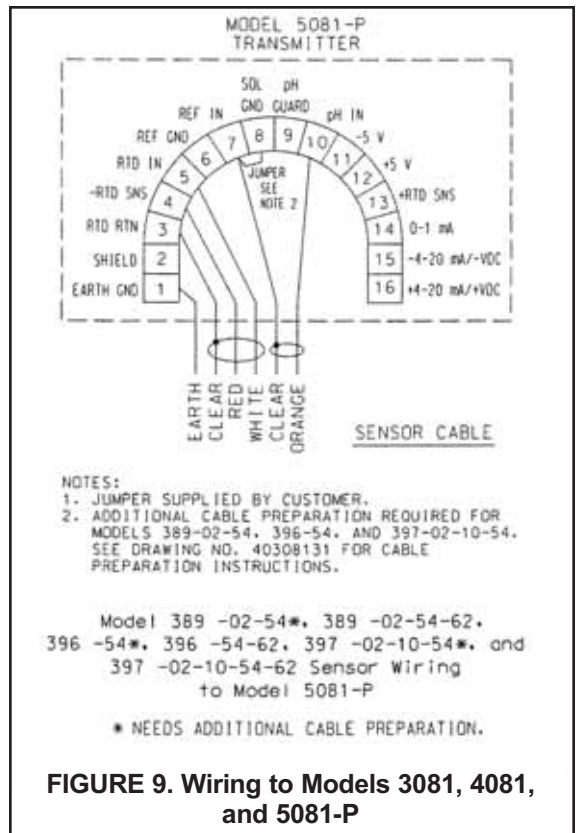


FIGURE 7. Wiring to Junction Box (PN 23555-00) and Remote Preamplifier.

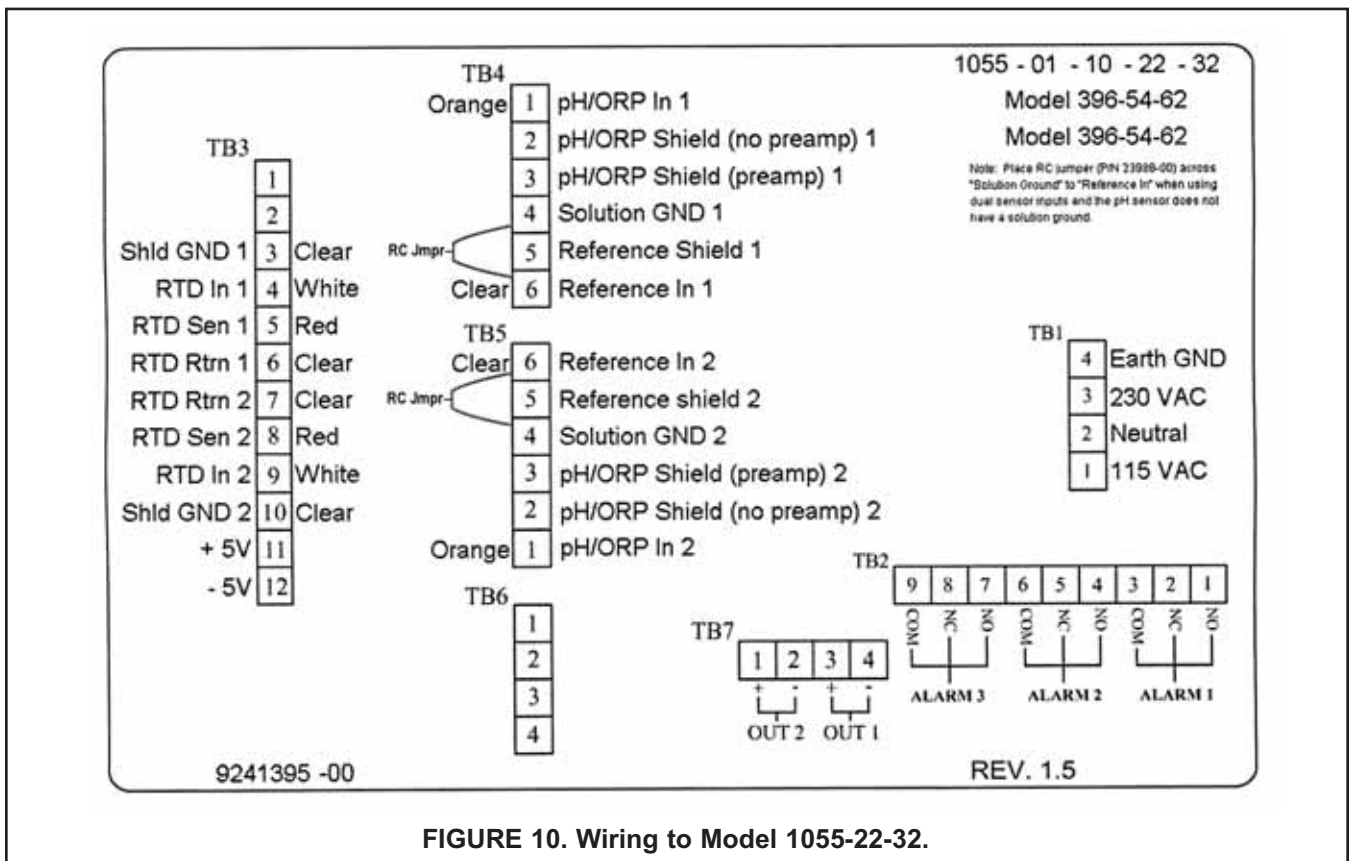




**FIGURE 8. Wiring to Model Xmt**



**FIGURE 9. Wiring to Models 3081, 4081, and 5081-P**



**FIGURE 10. Wiring to Model 1055-22-32.**

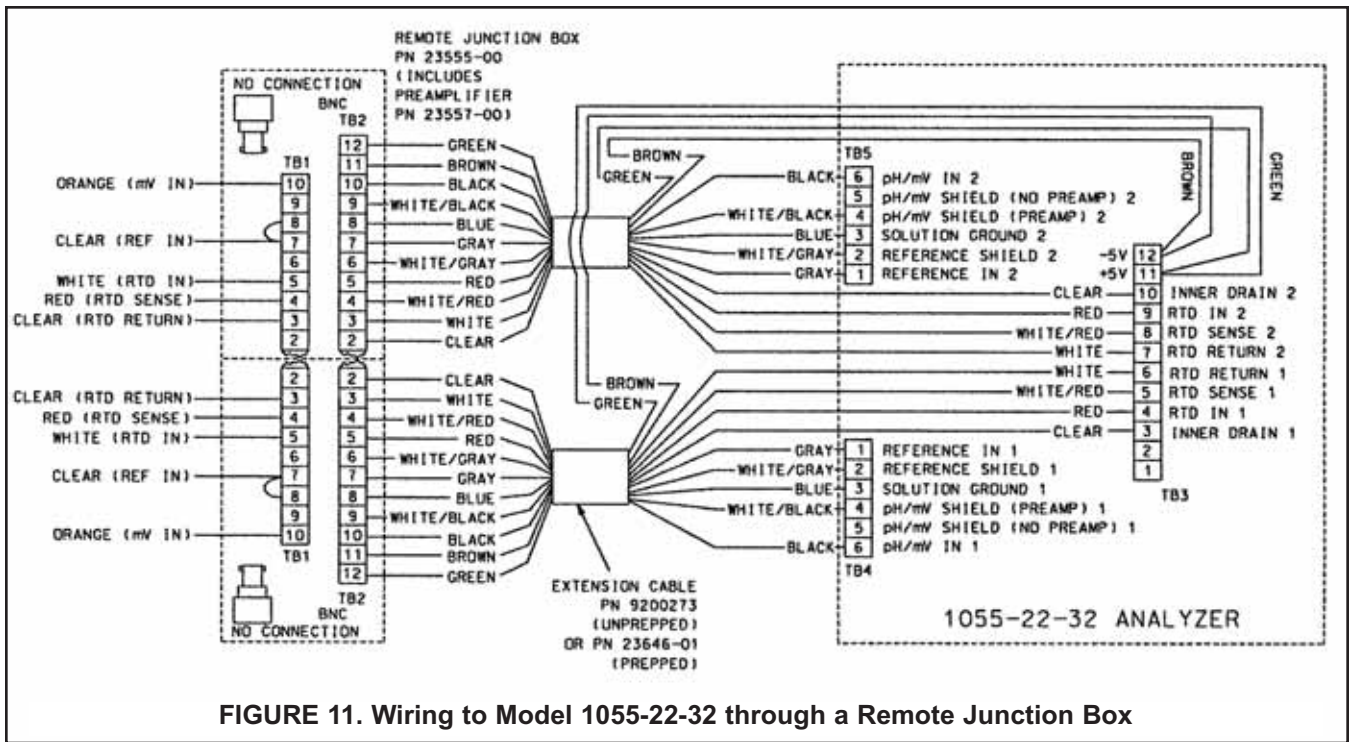


FIGURE 11. Wiring to Model 1055-22-32 through a Remote Junction Box

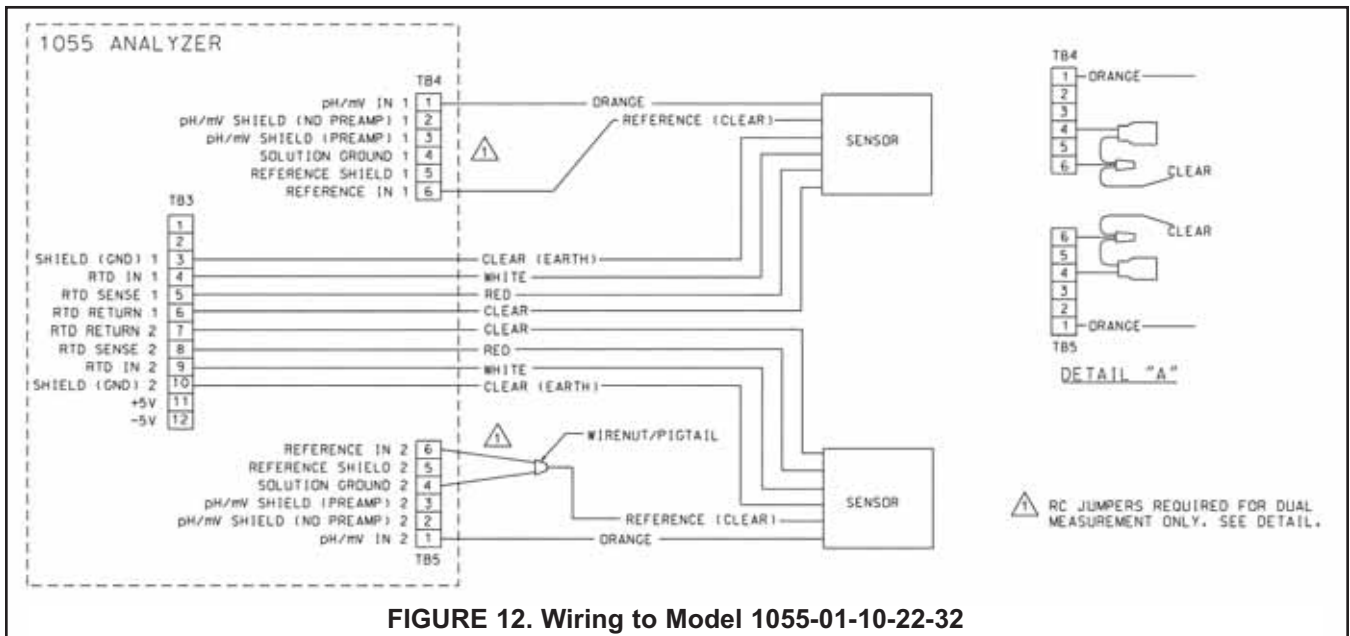
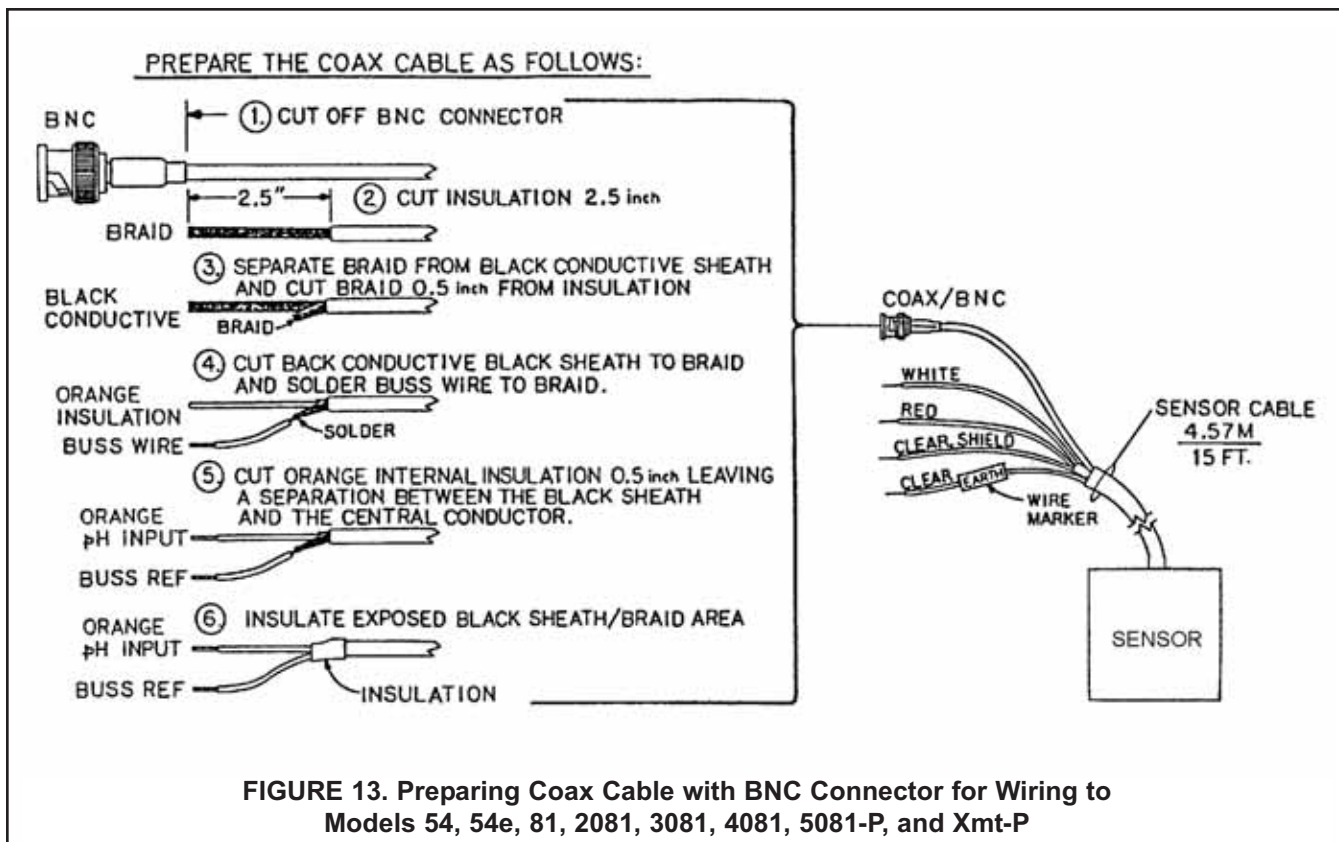
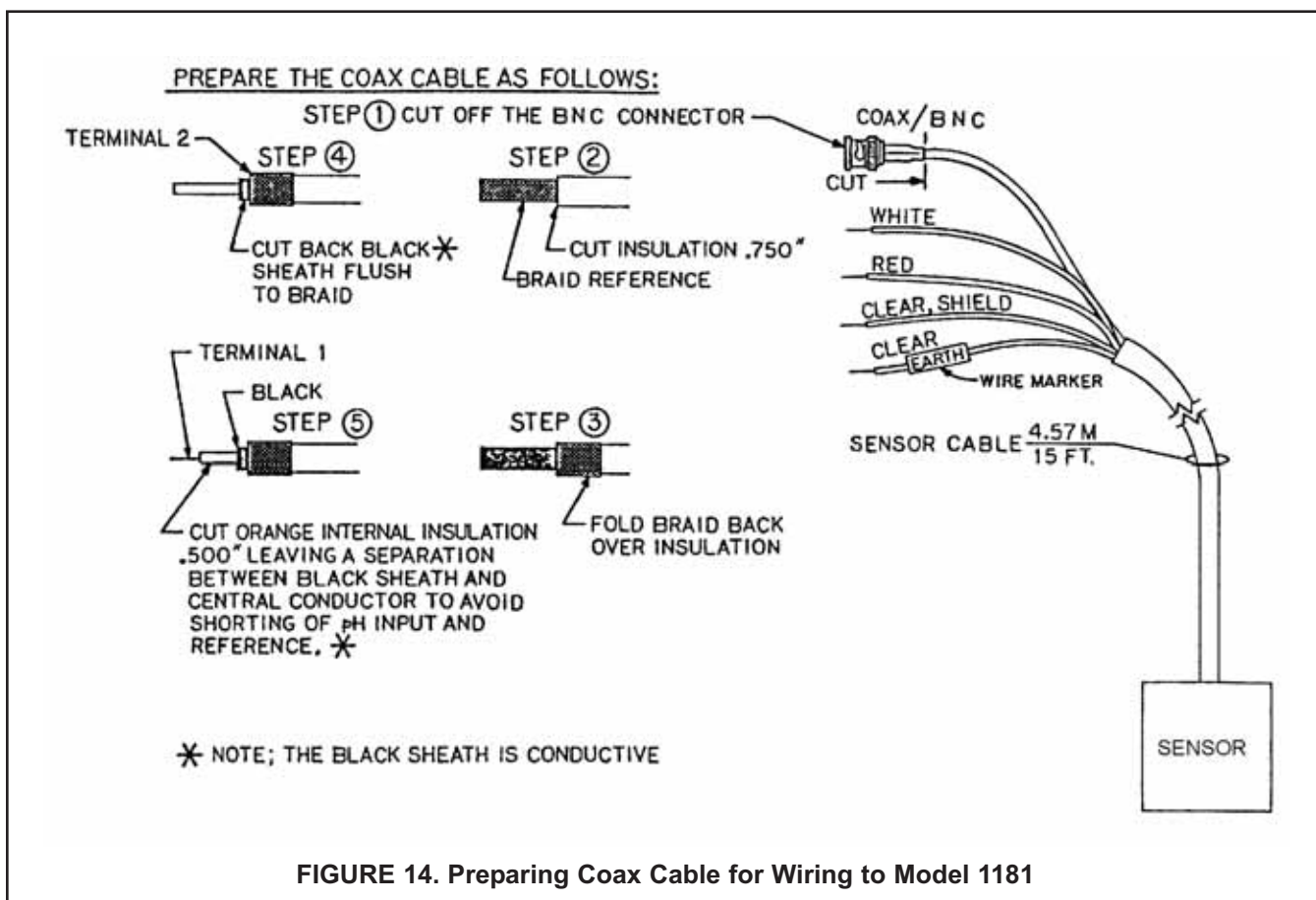


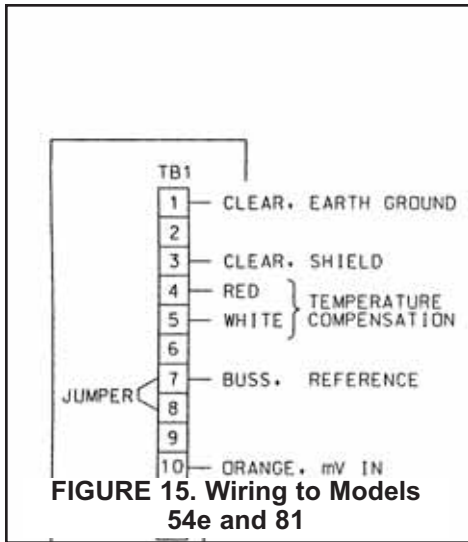
FIGURE 12. Wiring to Model 1055-01-10-22-32



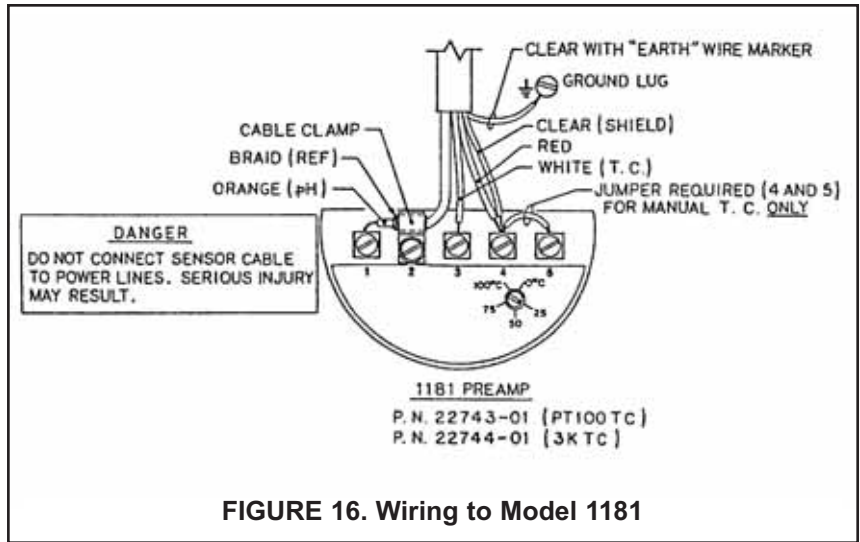
**FIGURE 13. Preparing Coax Cable with BNC Connector for Wiring to Models 54, 54e, 81, 2081, 3081, 4081, 5081-P, and Xmt-P**



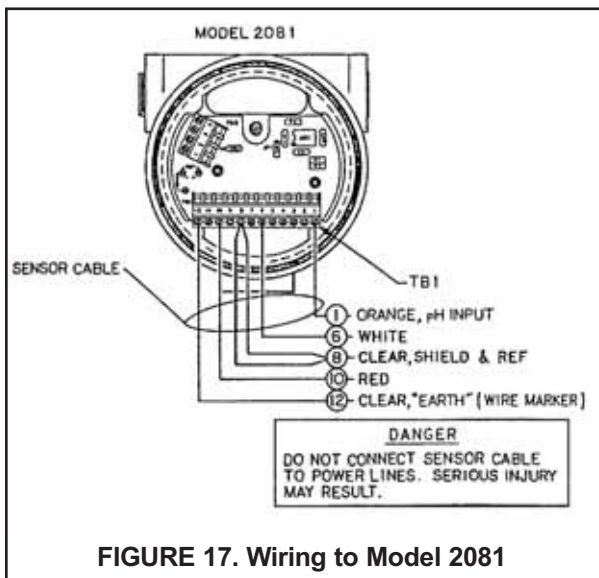
**FIGURE 14. Preparing Coax Cable for Wiring to Model 1181**



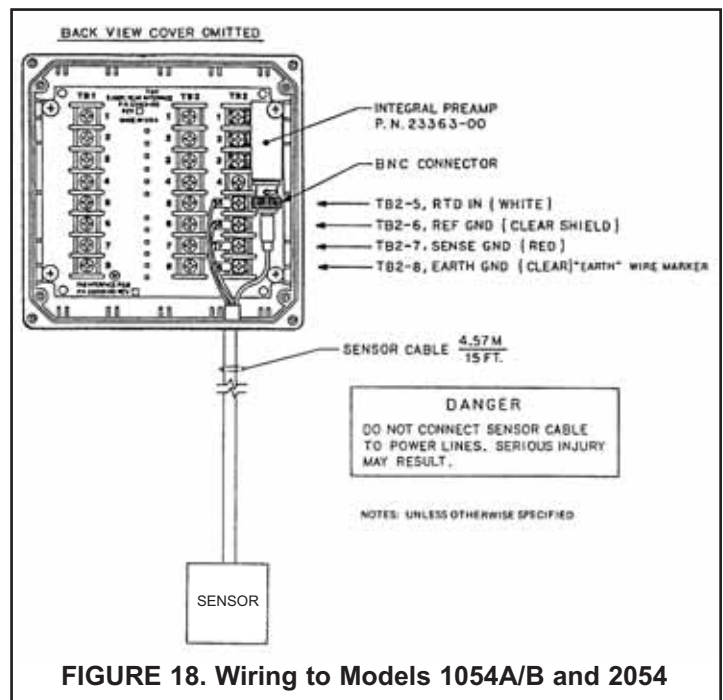
**FIGURE 15. Wiring to Models 54e and 81**



**FIGURE 16. Wiring to Model 1181**



**FIGURE 17. Wiring to Model 2081**



**FIGURE 18. Wiring to Models 1054A/B and 2054**

For more detailed instructions, see electronic file 51-396to398 on "Instruction Manuals" CD-rom.



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*Specifications subject to change without notice.*

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