

## Instruction Sheet

PN 51A-399/rev.N

January 2011

Model 399

# General Purpose pH/ORP Sensor

For additional information, please visit our website at

[www.emersonprocess.com/raihome/liquid/](http://www.emersonprocess.com/raihome/liquid/).

## SPECIFICATIONS

**Sensor Type:** General purpose 399

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

ORP: -1500 to +1500 mV

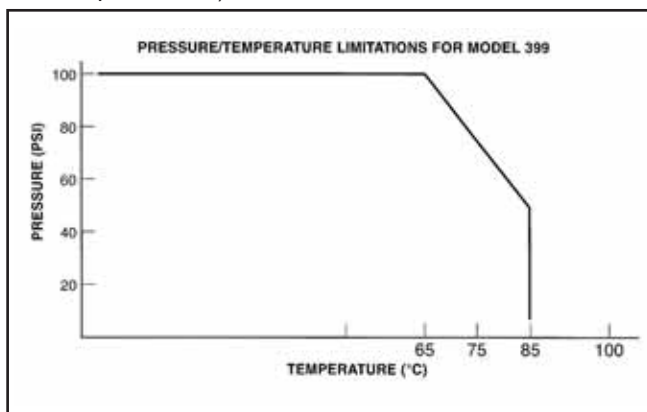
**Percent Linearity Over pH Range:**

	GPLR Hemi Bulb	Flat Bulb
1-2 pH	94%	93%
2-12 pH	99%	98%
12-13 pH	97%	95%
13-14 pH	92%	—

**Operating Temperature:** 0° to 85°C (32° to 185°F)

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

**Maximum Pressure:** 790 kPa [abs] (100 psig) at 65°C (see Graph 1 below)



**Flow Rate:** up to 2 ft/sec

**Materials of Construction:** Tefzel, glass, ceramic, & Viton

**Materials of ORP:** Platinum

**Process Connections:** 1 in. MNPT, 2 places

**Integral Cable:** 10 or 32 ft cable with integral SMART preamp  
10 ft cable without preamp sensor

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

- High pH glass provides greater accuracy over 12.5 pH
- HF glass provides improved resistance to hydrofluoric acid up to 300 ppm



**MODEL 399**

Insertion/Submersion  
Sensor with integral cable

## 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.

## WARNING



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!

## CAUTION

The solution used during calibration 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.

## ATEX DIRECTIVE

### Special Conditions for safe use

1. 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.
2. 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.

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## 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 has 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. 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.

### NOTE

Do not allow lubricant to coat electrode bulb or reference junction. If it does, wipe it clean before installation.

## INSTALLATION

For sensor orientation, see Figure 1.

For sensor dimensions, see Figure 2.

For wiring, see Figure 3 - 29.

## 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 and 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% @  $80^{\circ}\text{C}$  ( $176^{\circ}\text{F}$ ), and approximately 5% @  $120^{\circ}\text{C}$  ( $248^{\circ}\text{F}$ ).

**CAUTION**

Hydrofluoric acid and the mixture of Hydrochloric acid and thiourea is toxic and highly corrosive. Avoid skin contact, wear protective gloves. Use only in a well ventilated area. Do not inhale fumes. In case of an accident, consult a doctor immediately.

**ORP CALIBRATION**

1. After making an electrical connection between the sensor and the instrument, obtain a standard solution of saturated quinhydrone (PN R508-8OZ). 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.

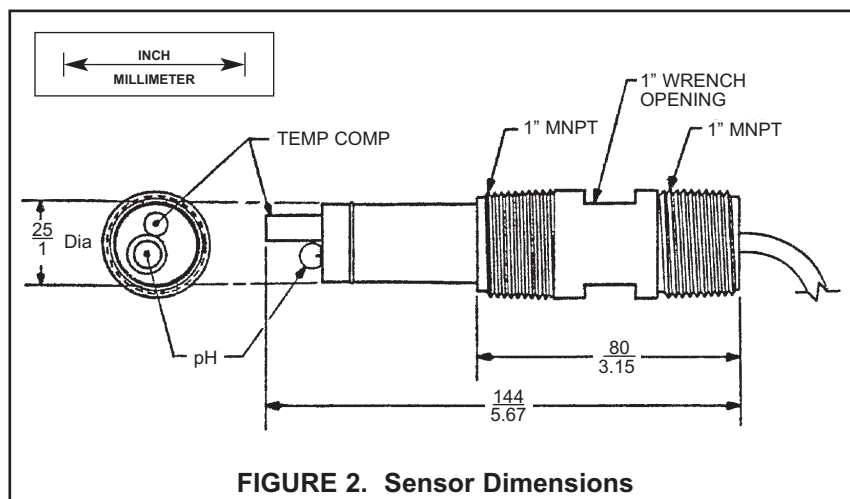
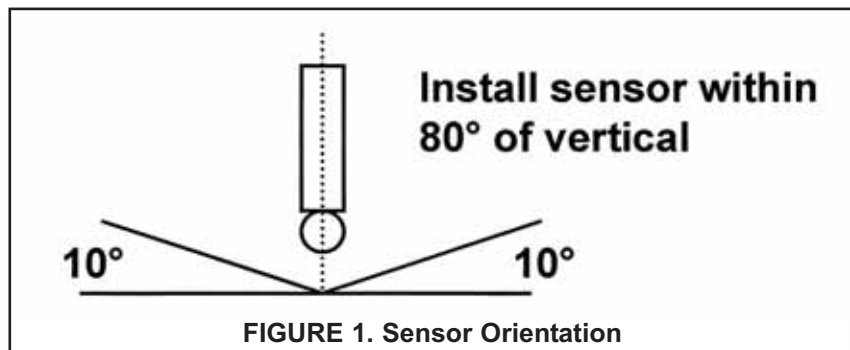
**MAINTENANCE FOR ORP ELECTRODE**

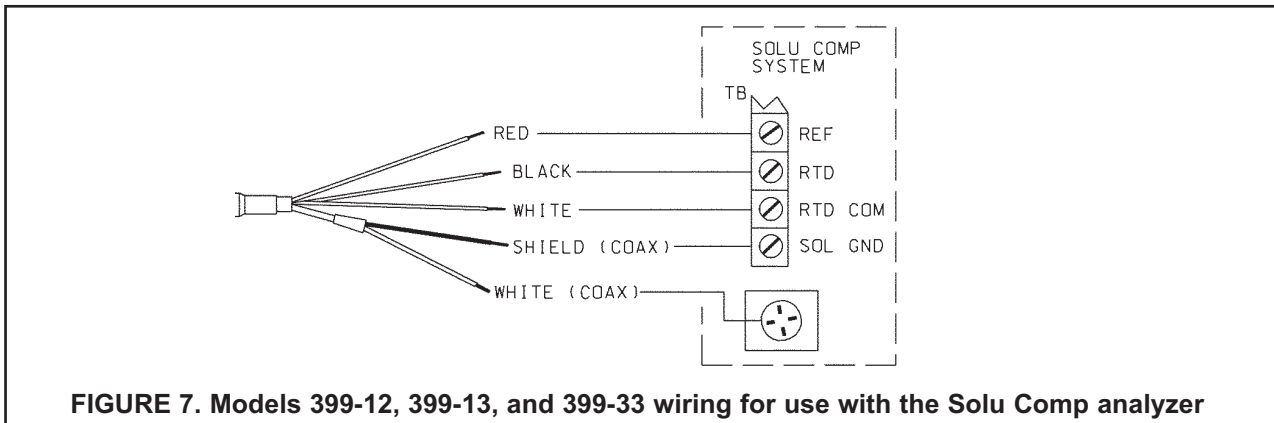
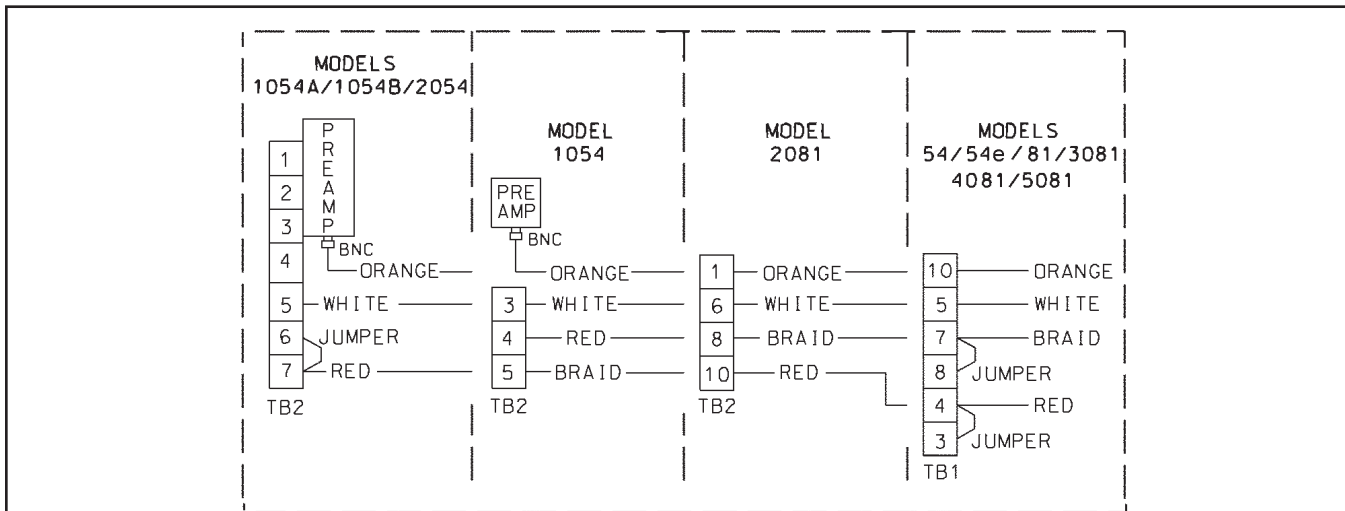
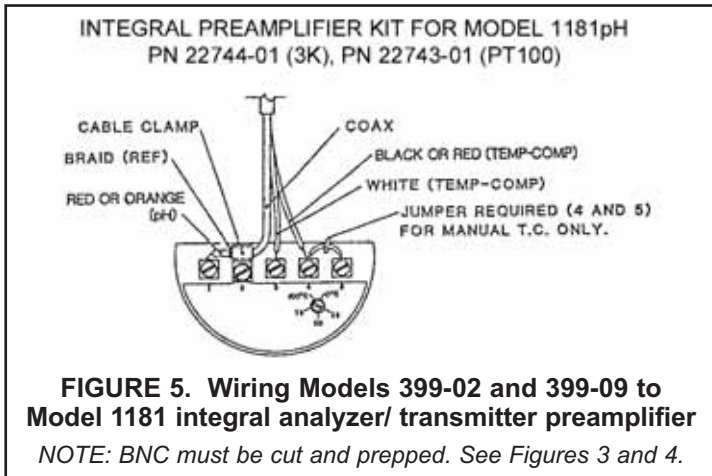
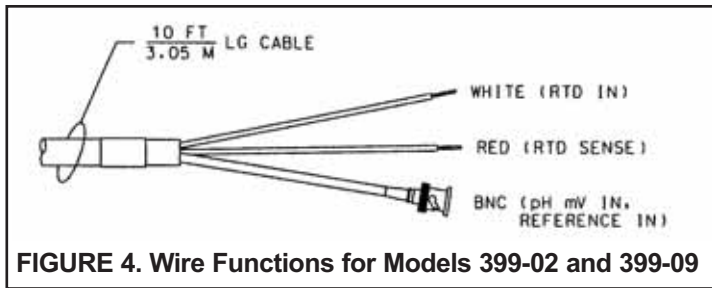
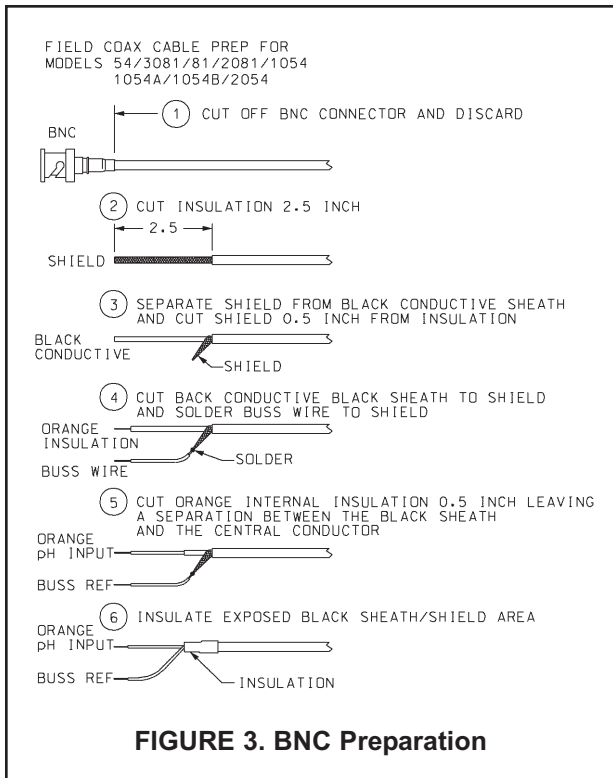
Electrodes should respond rapidly. Sluggishness, off-sets, and erratic readings are indicators that the electrodes may need cleaning or replacement.

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





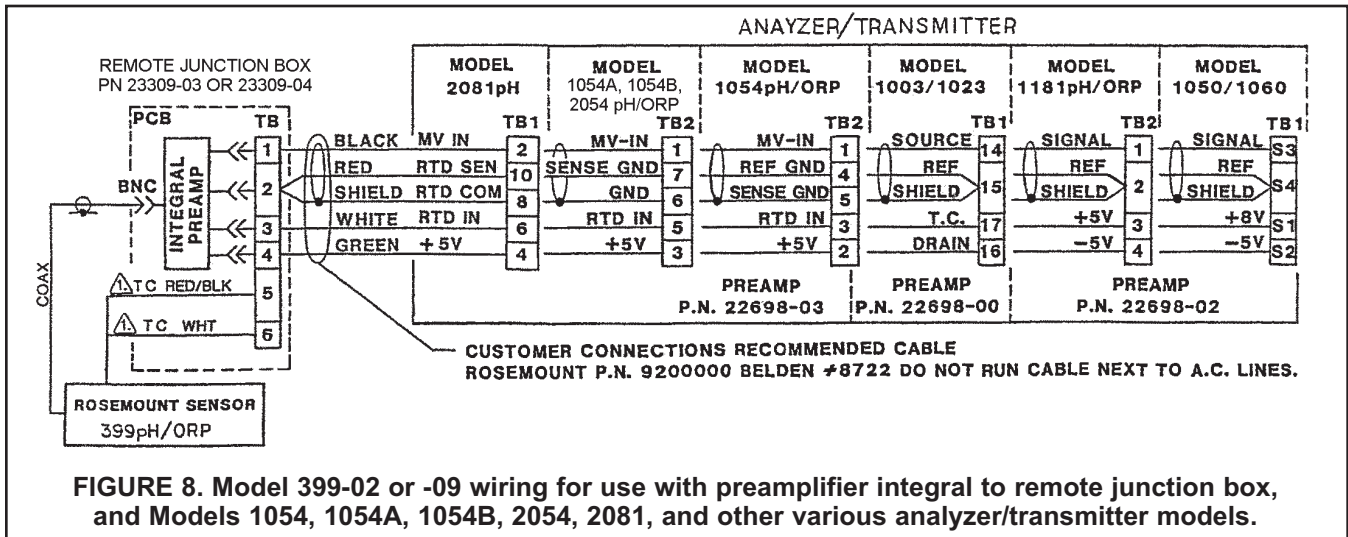


FIGURE 8. Model 399-02 or -09 wiring for use with preamplifier integral to remote junction box, and Models 1054, 1054A, 1054B, 2054, 2081, and other various analyzer/transmitter models.

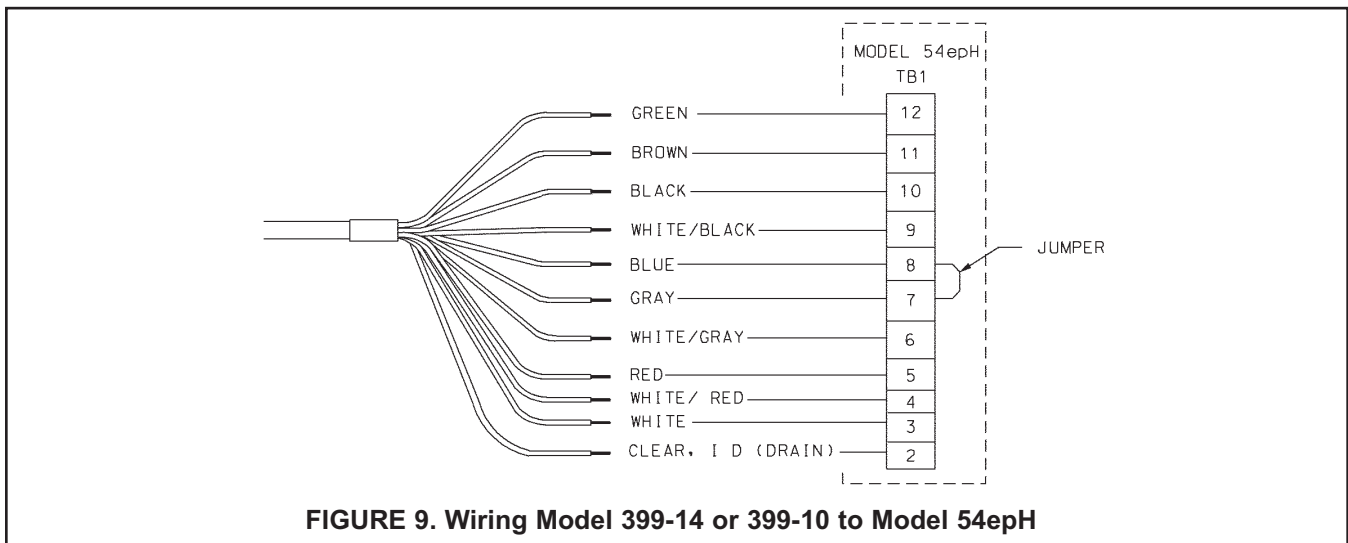


FIGURE 9. Wiring Model 399-14 or 399-10 to Model 54epH

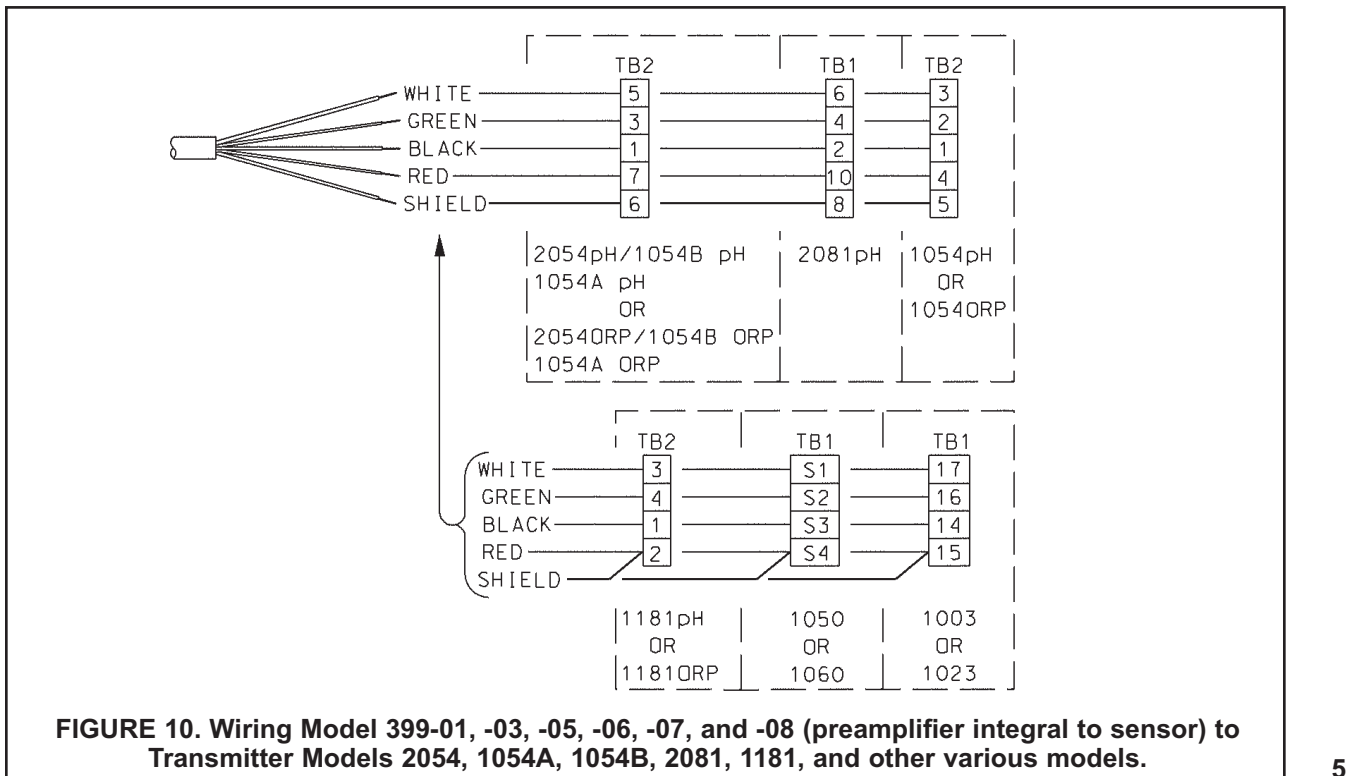


FIGURE 10. Wiring Model 399-01, -03, -05, -06, -07, and -08 (preamplifier integral to sensor) to Transmitter Models 2054, 1054A, 1054B, 2081, 1181, and other various models.

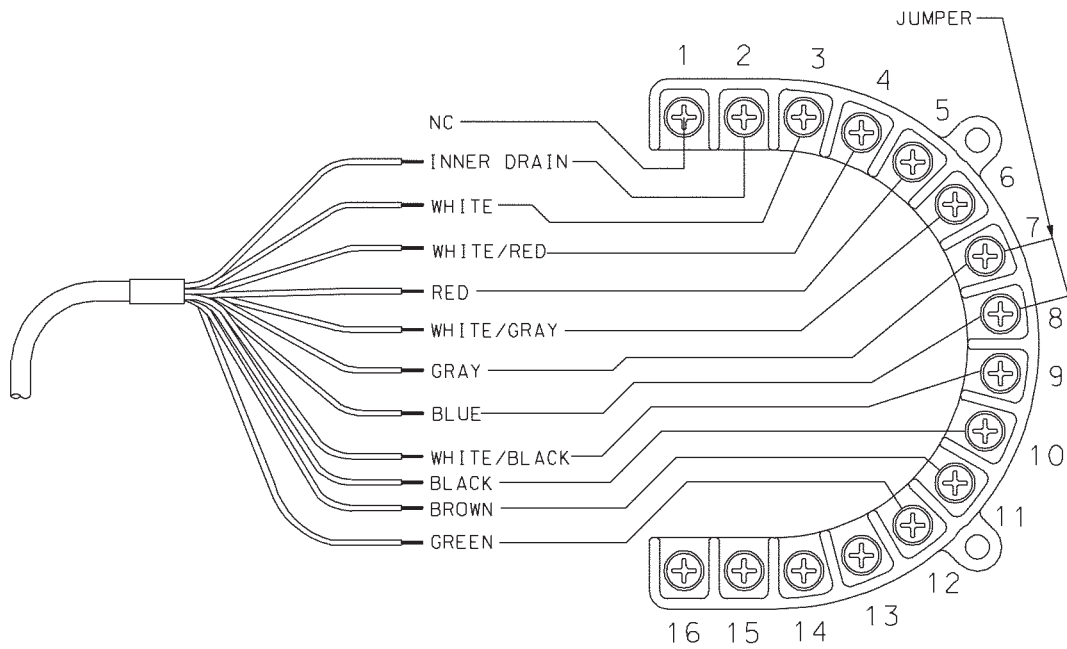
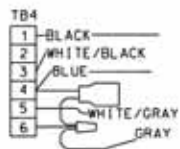
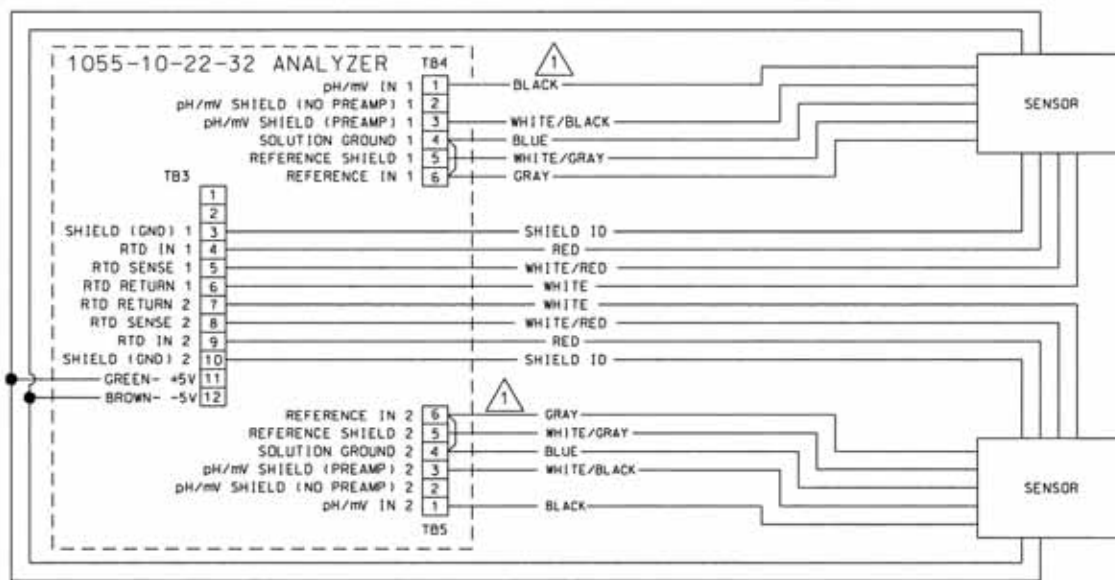


FIGURE 11. Wiring Model 399-14, 399-10, or 399-34 to Models 3081, 4081, and 5081-P



⚠ RC JUMPERS REQUIRED FOR DUAL MEASUREMENT ONLY. SEE DETAIL.

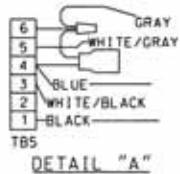
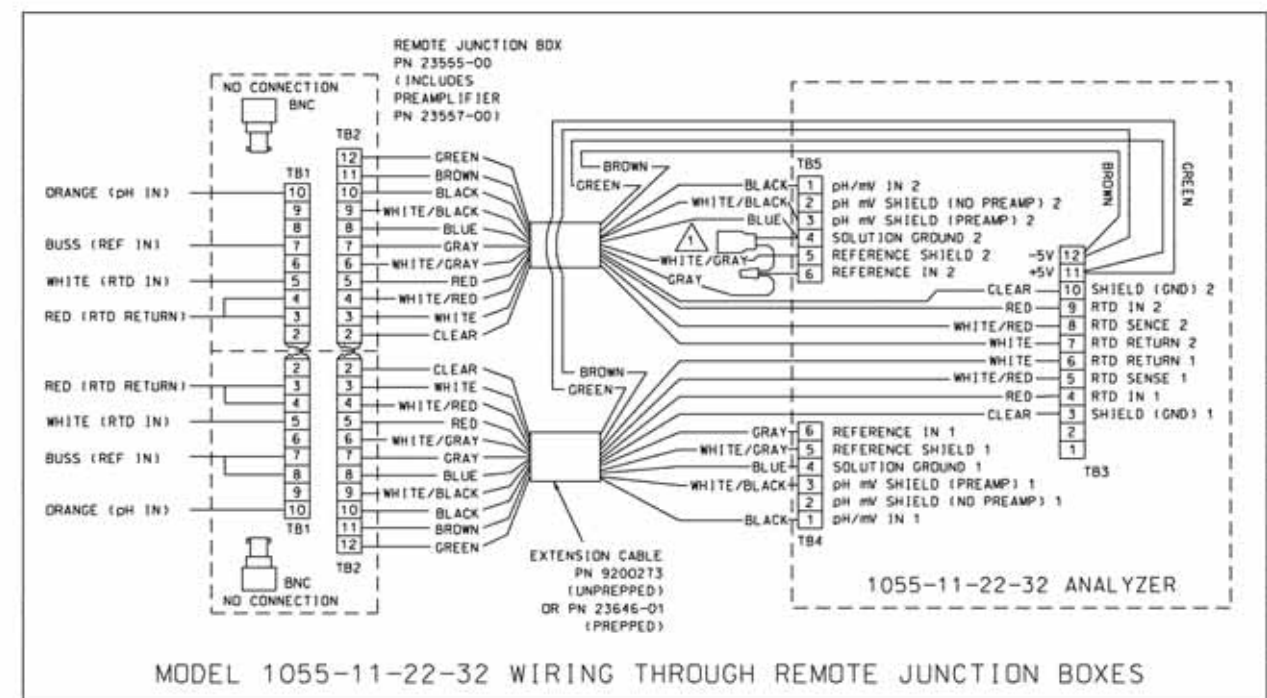
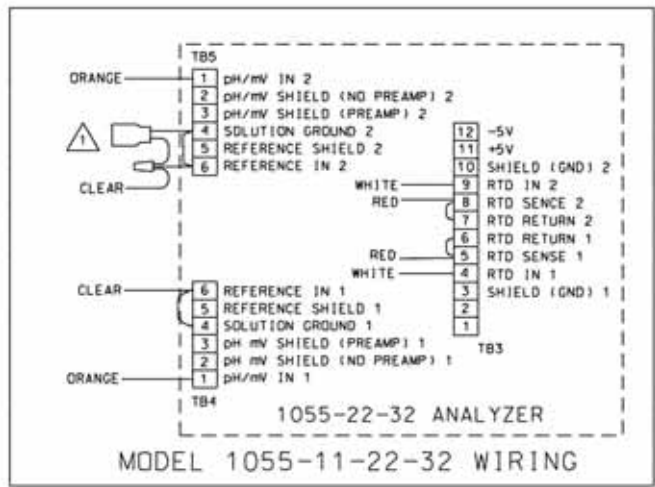
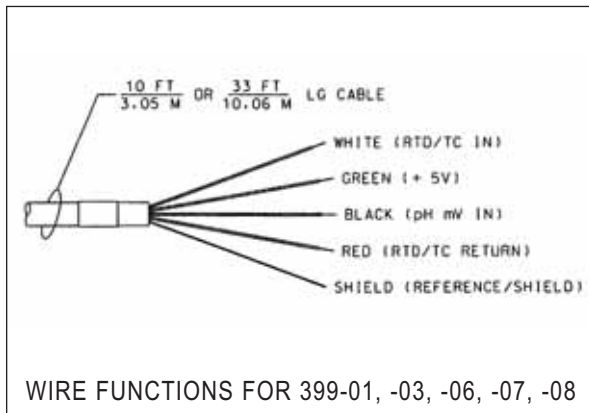
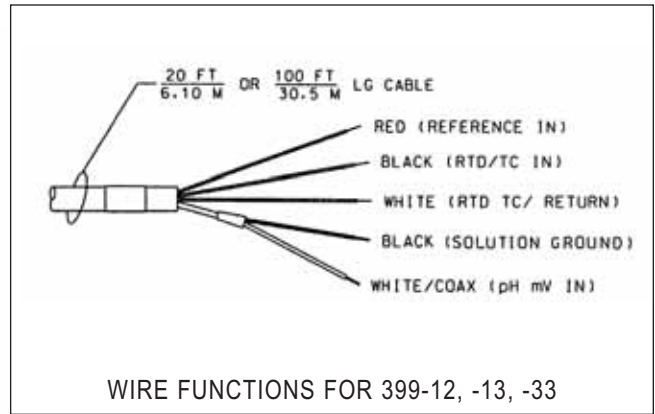
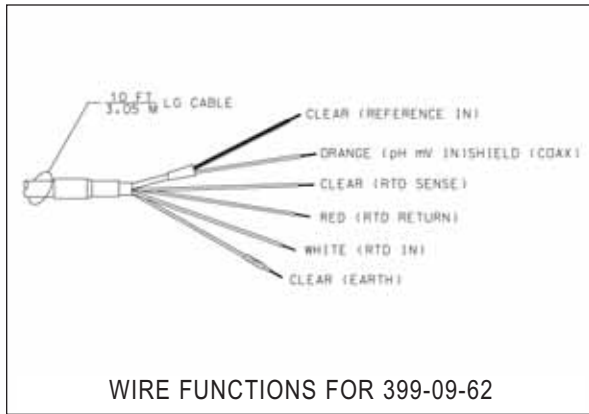


FIGURE 12. Wiring Model 399-14, 399-10, or 399-34 to Model 1055-22-32



RC JUMPER REQUIRED FOR DUAL MEASUREMENT ONLY.

FIGURE 13. Wiring Model 399-09-62 to Model 1055-22-32 through Remote Junction Boxes

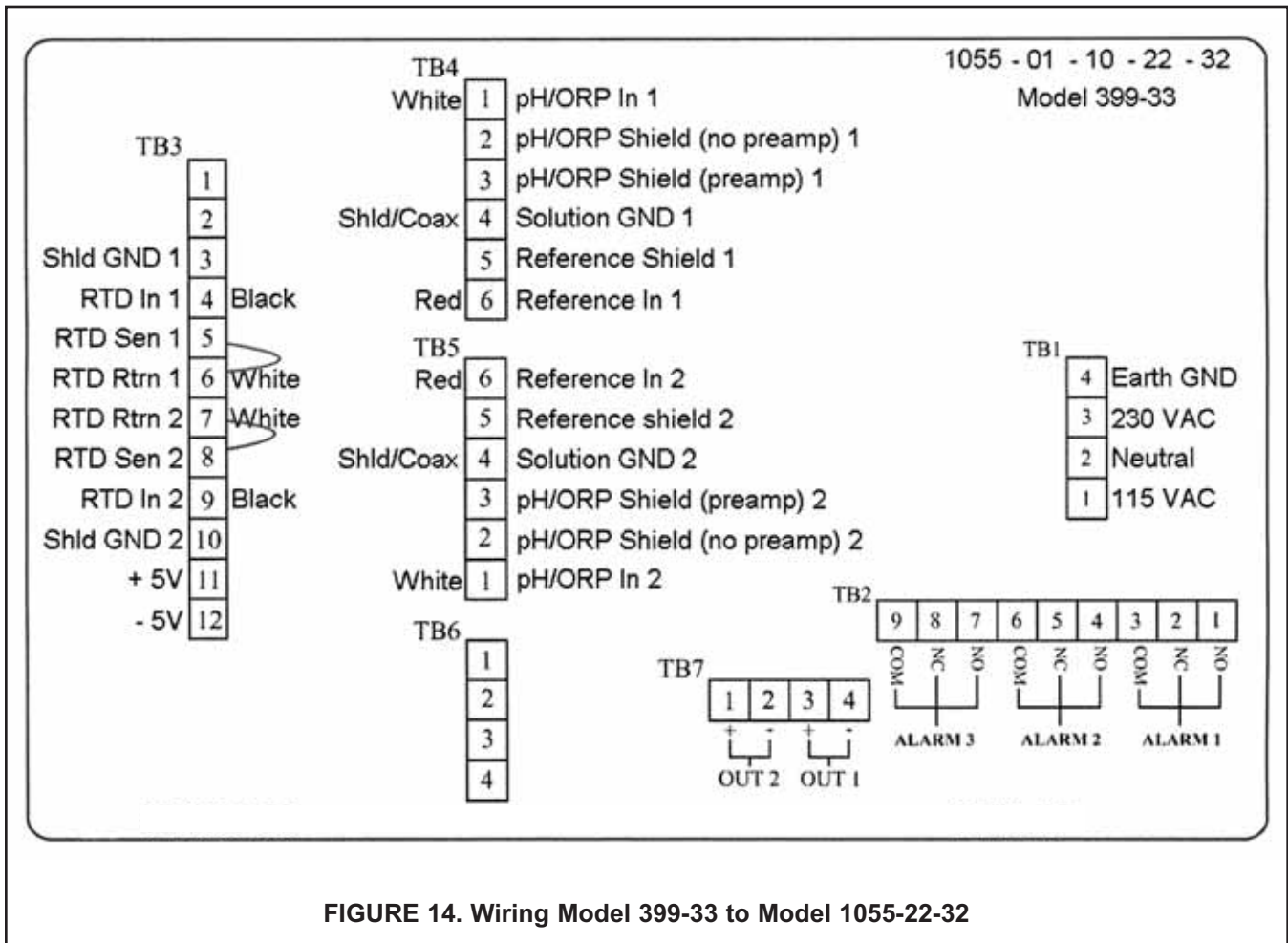


FIGURE 14. Wiring Model 399-33 to Model 1055-22-32



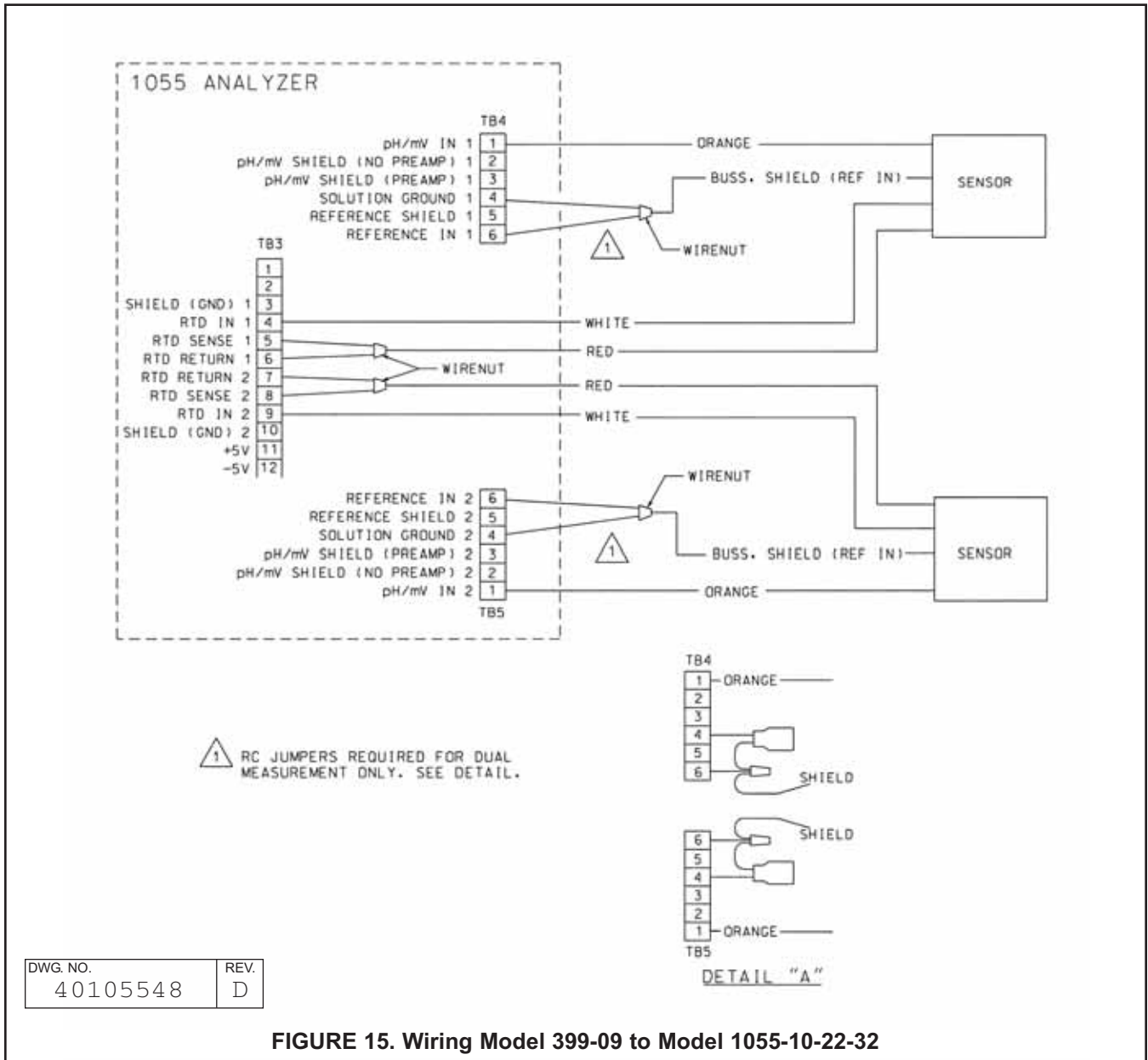
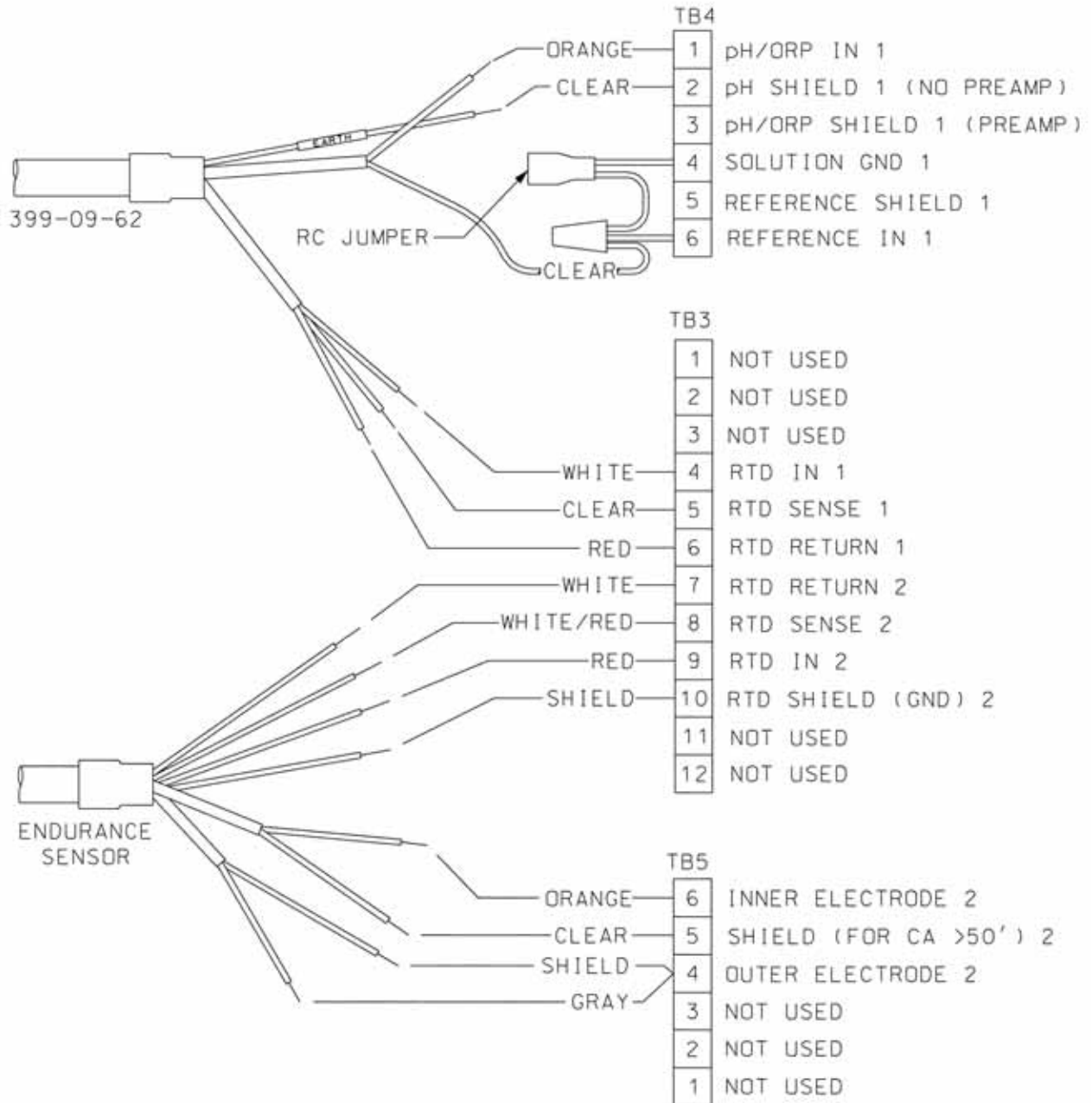
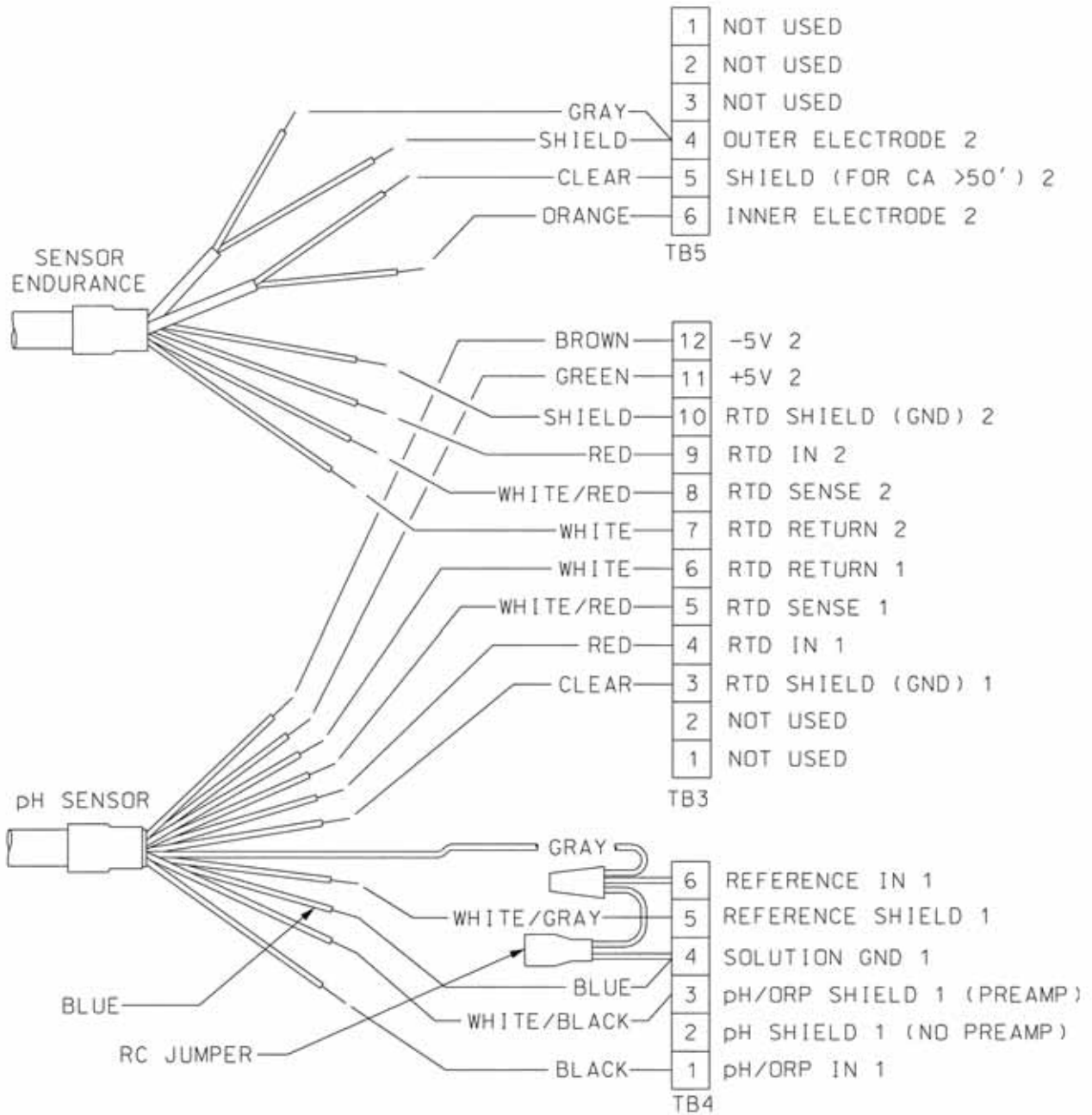


FIGURE 15. Wiring Model 399-09 to Model 1055-10-22-32



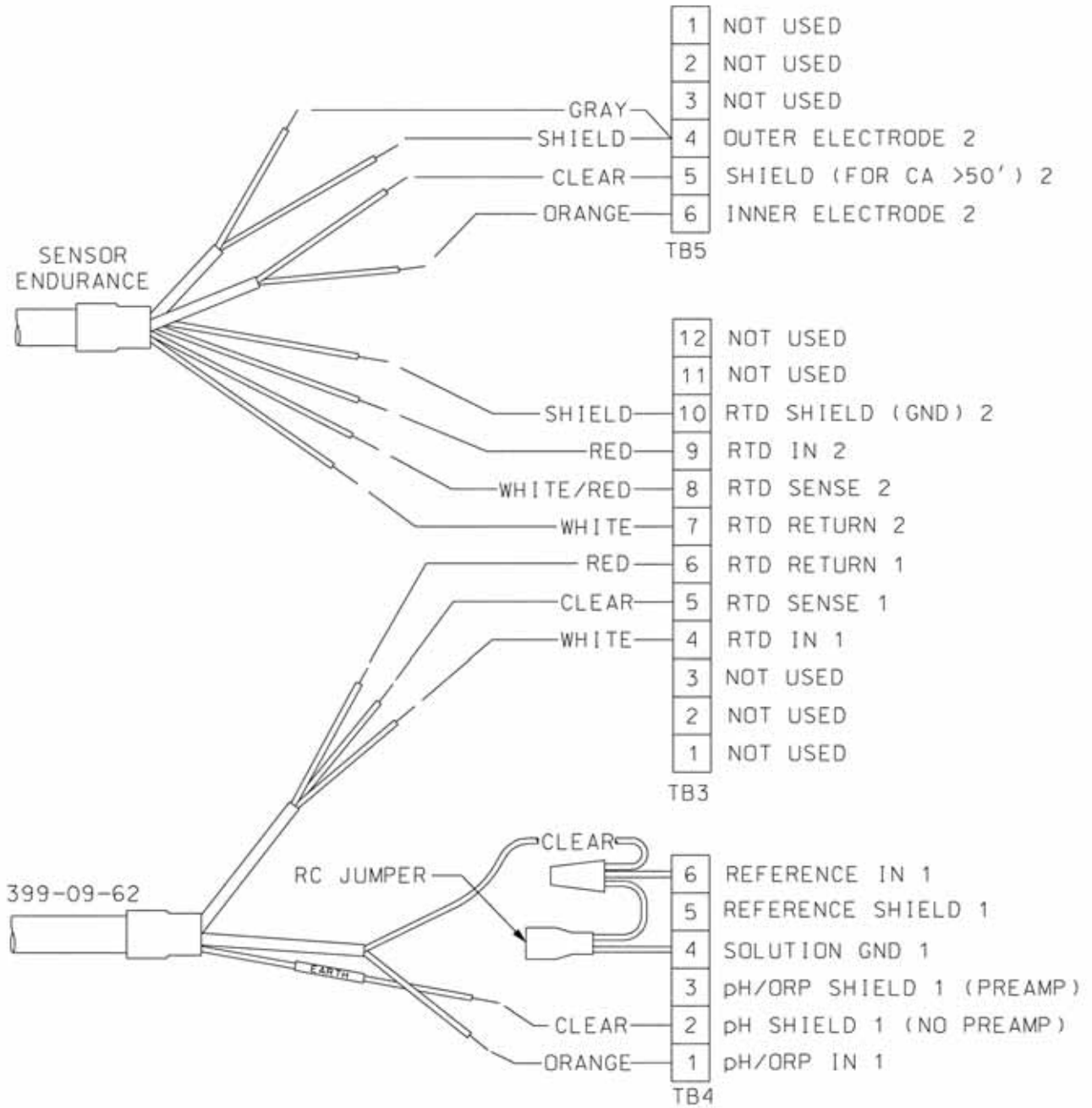
DWG. NO. 41055105	REV. C
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**FIGURE 16. Wiring Model 399-09-62, 400, 401, 402, 403, and 404 to Model 1055 (Panel Mount)**



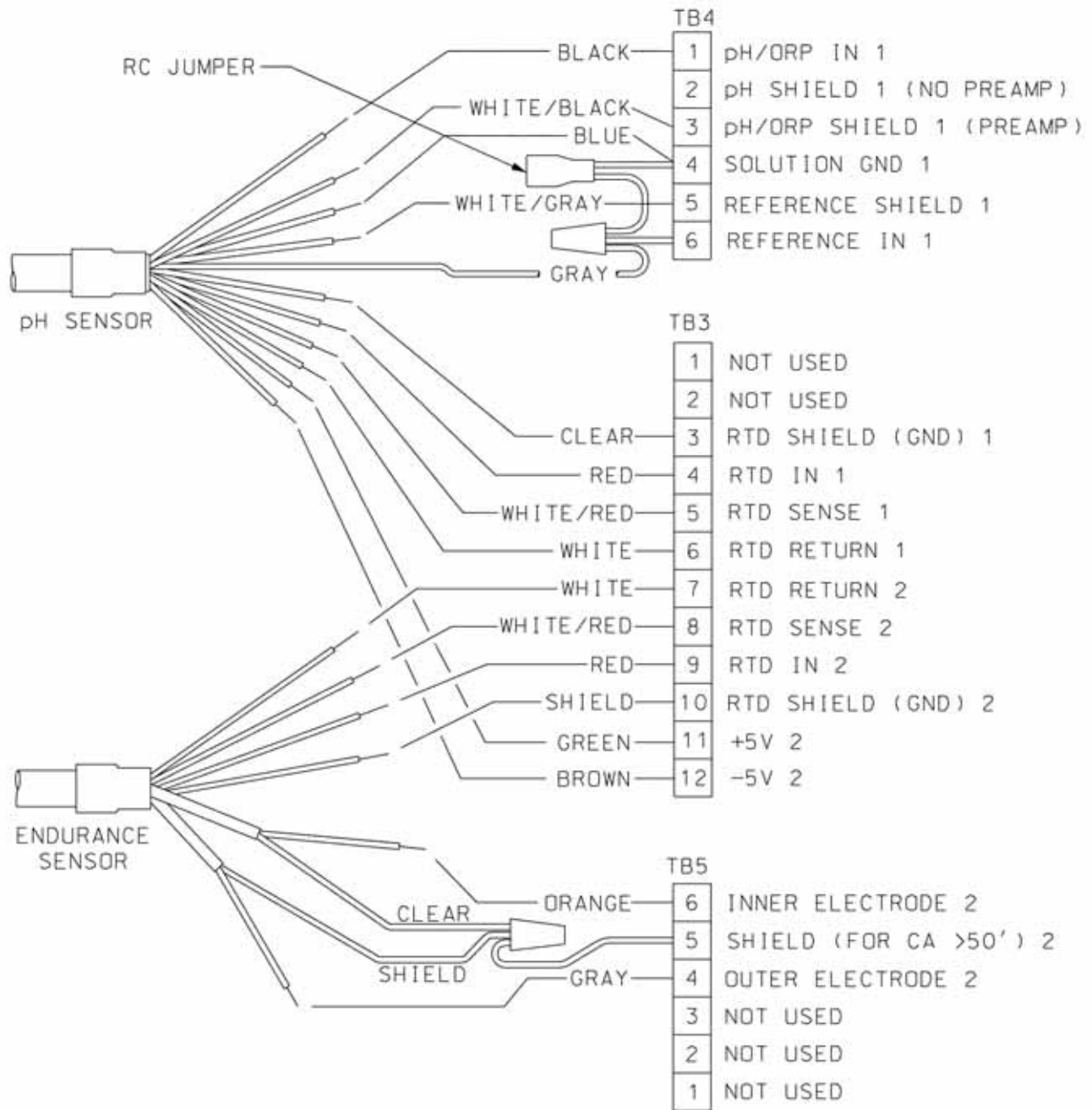
DWG. NO. 41055106	REV. C
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FIGURE 17. Wiring Model 399-14, 399-10, or 399-34 and 400, 401, 402, 403, or 404 to Model 1055 (Pipe/Wall Mount)



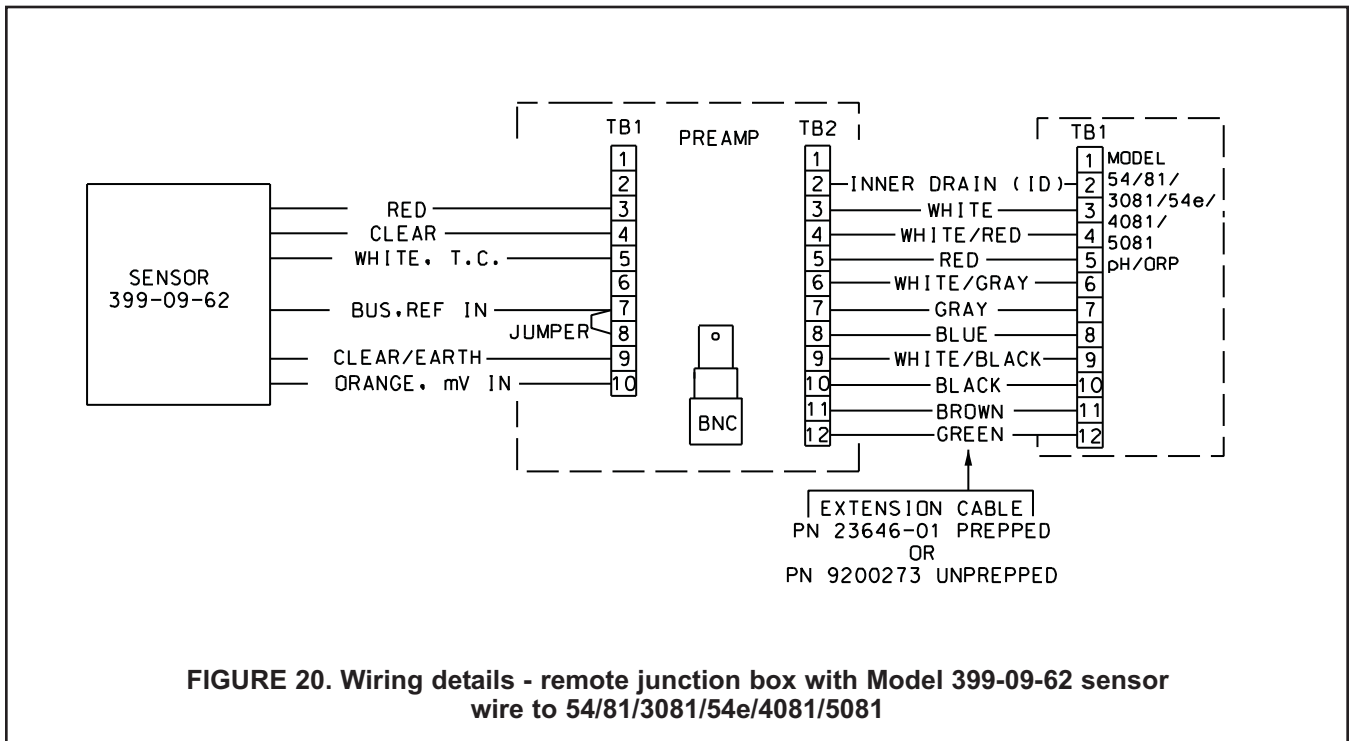
DWG. NO. 41055109	REV. C
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FIGURE 18. Wiring Model 399-09-62 and 400, 401, 402, 403, or 404 to Model 1055 (Pipe/Wall Mount)

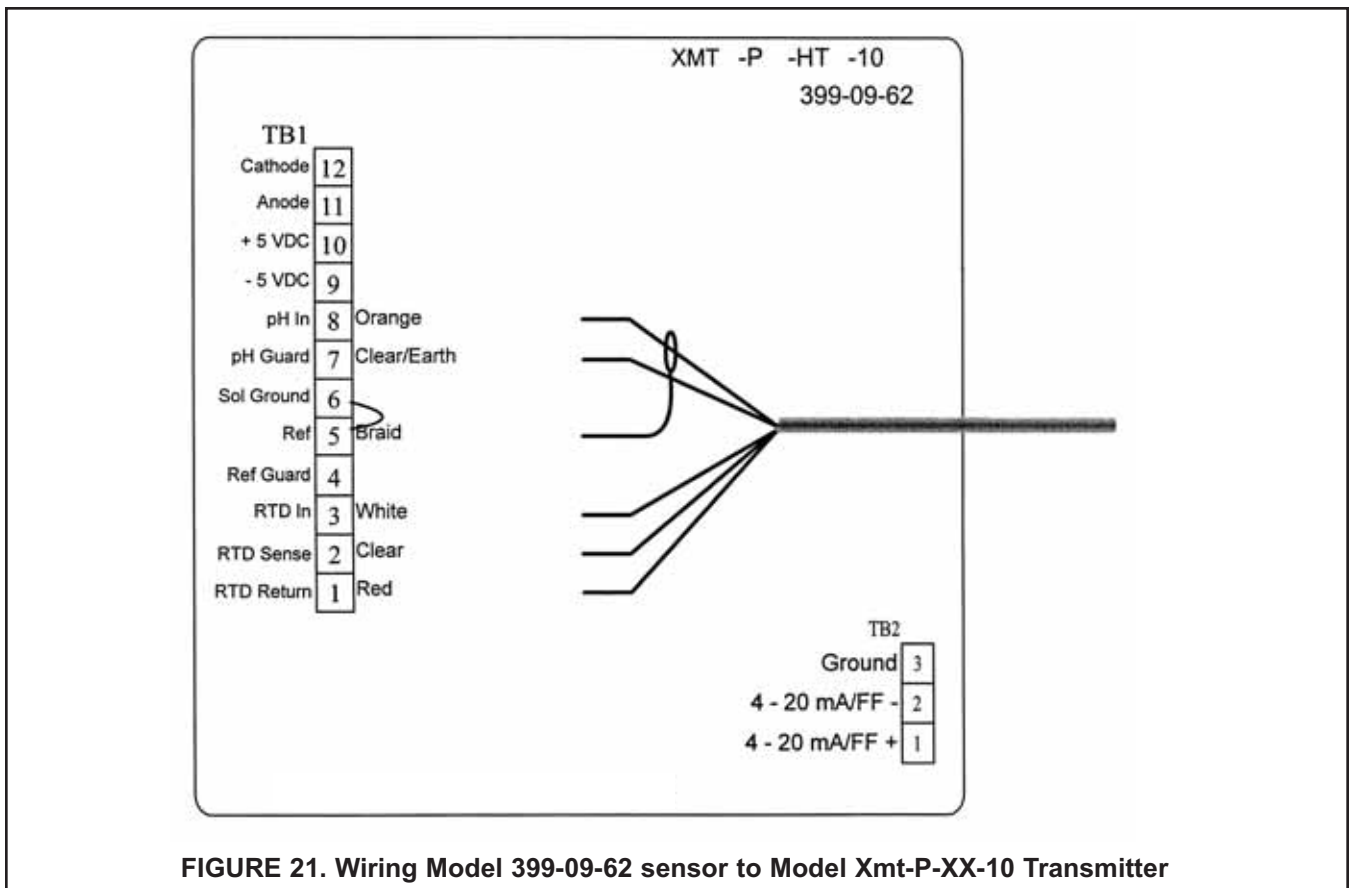


DWG. NO.	REV.
41055110	D

**FIGURE 19. Wiring Model 399-14, 399-10, or 399-34 and 400, 401, 402, 403, or 404 to Model 1055 (Panel Mount)**



**FIGURE 20. Wiring details - remote junction box with Model 399-09-62 sensor wire to 54/81/3081/54e/4081/5081**



**FIGURE 21. Wiring Model 399-09-62 sensor to Model Xmt-P-XX-10 Transmitter**

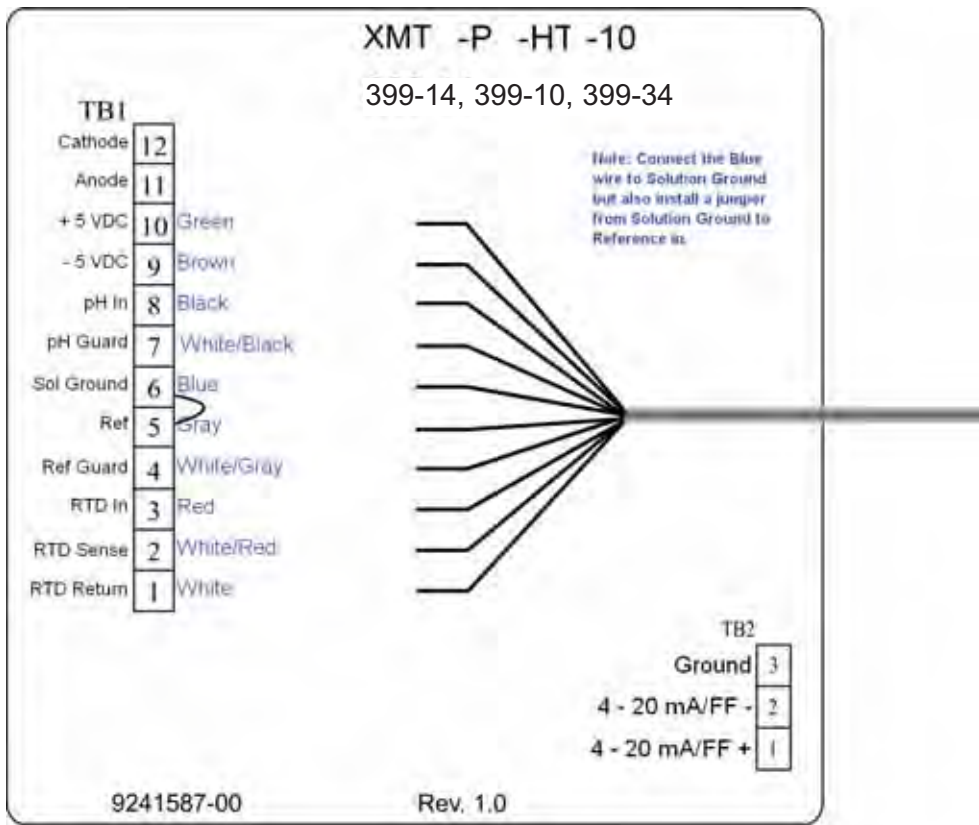


FIGURE 22. Wiring Model 399-14, 399-10, or 399-34 sensor to Model Xmt-P-XX-10 Transmitter

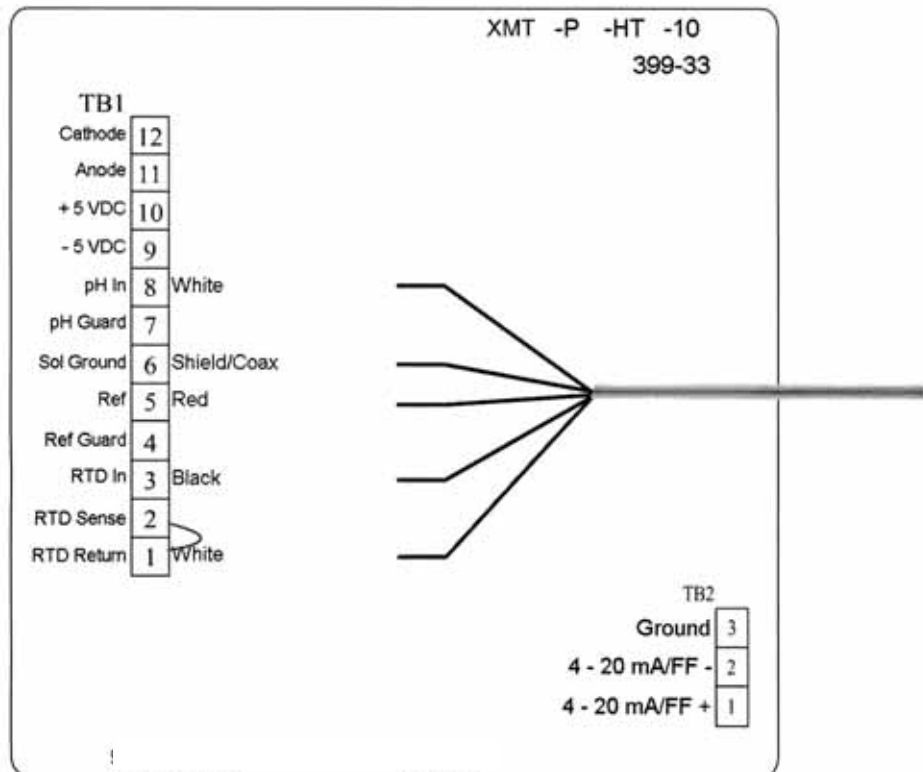


FIGURE 23. Wiring Model 399-33 sensor to Model Xmt-P-XX-10 Transmitter

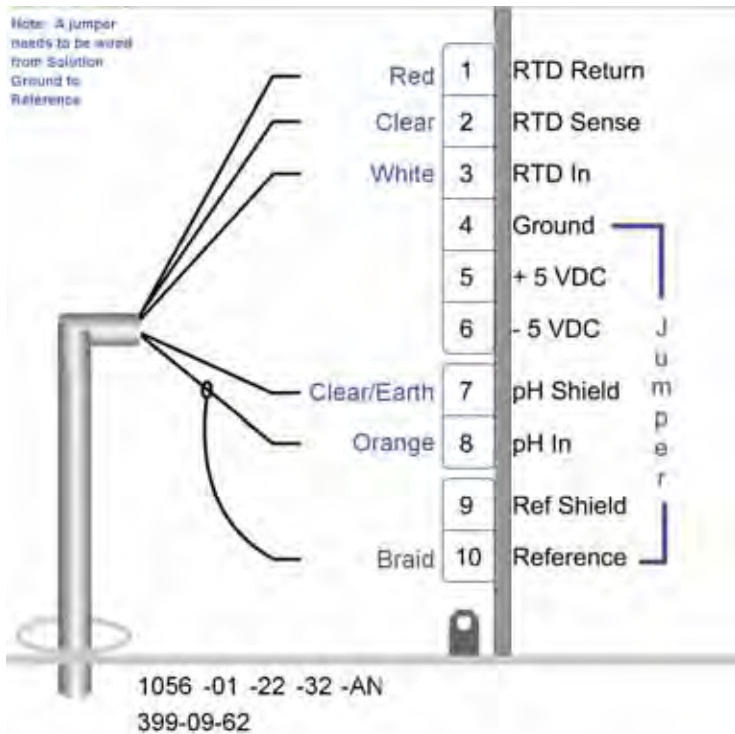


FIGURE 24. Wiring Model 399-09-62 sensor to 1056

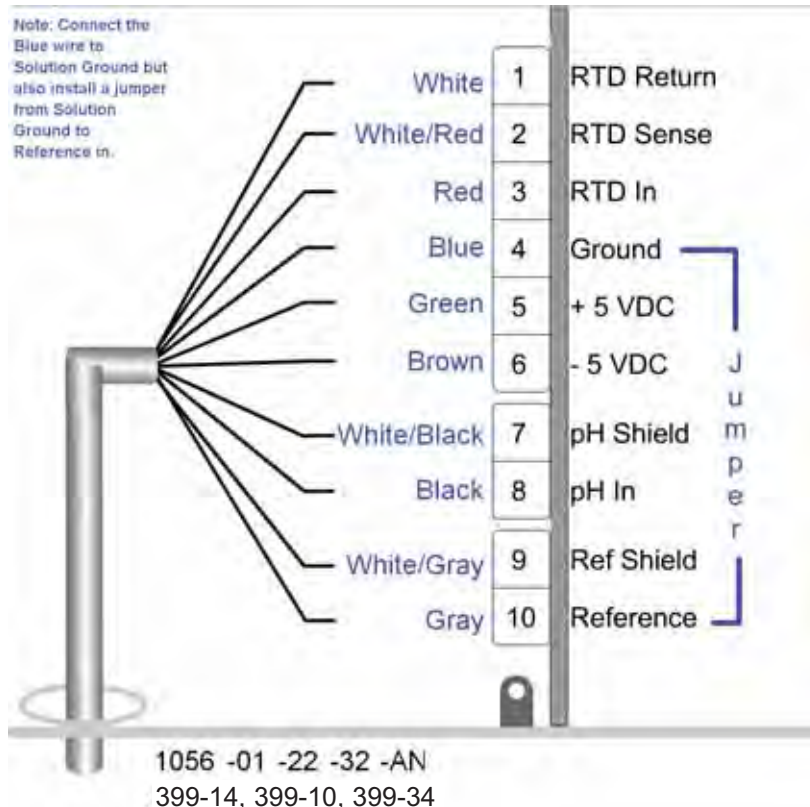


FIGURE 25. Wiring Models 399-14, 399-10, 399-34 (SMART sensors) to 1056



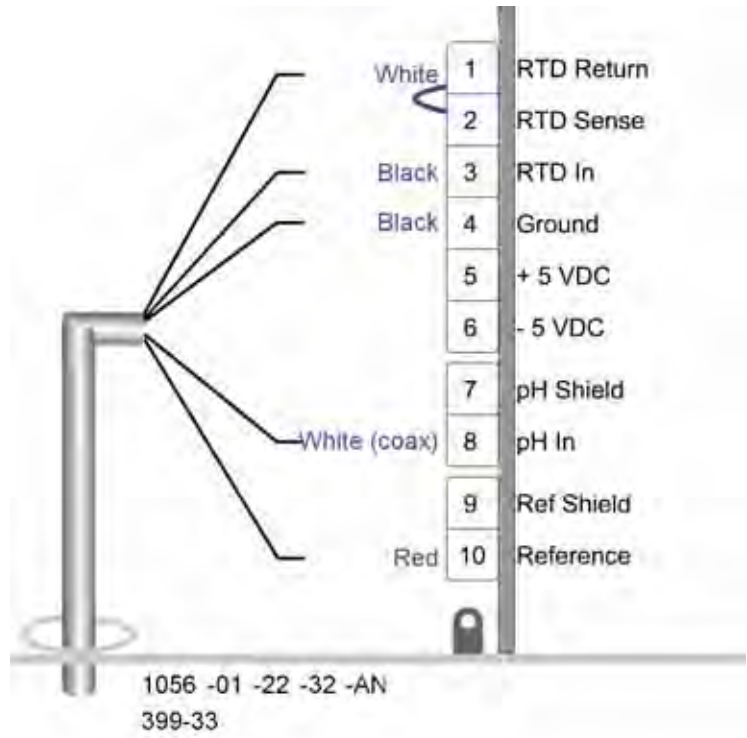


FIGURE 26. Wiring Model 399-33 sensor to 1056

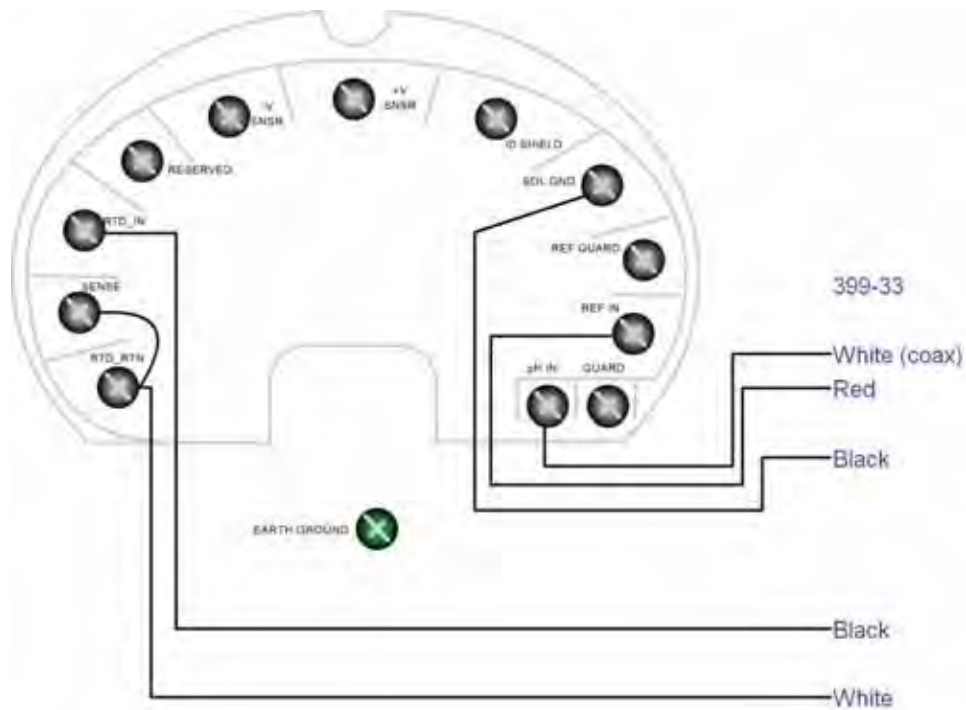
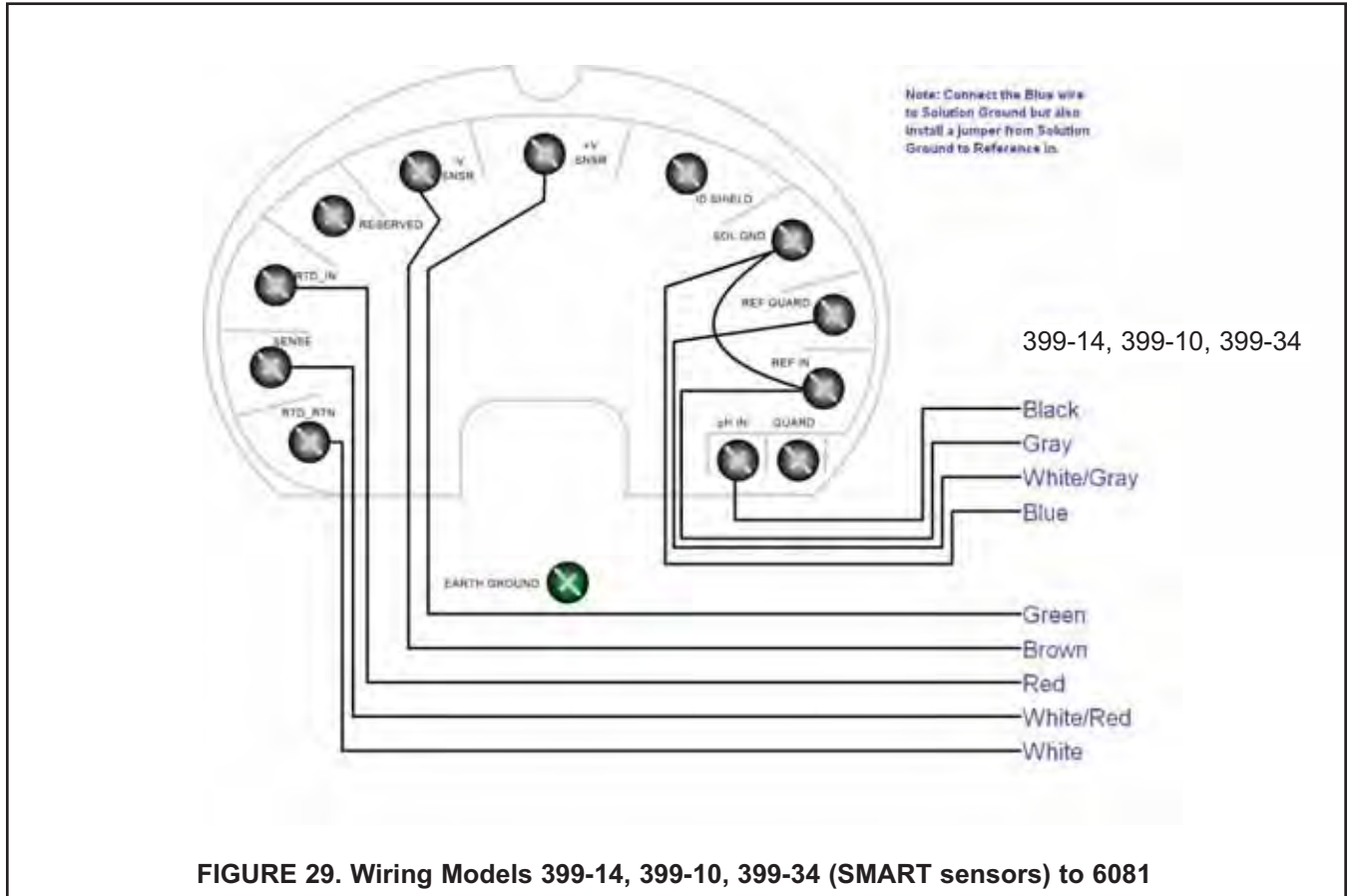
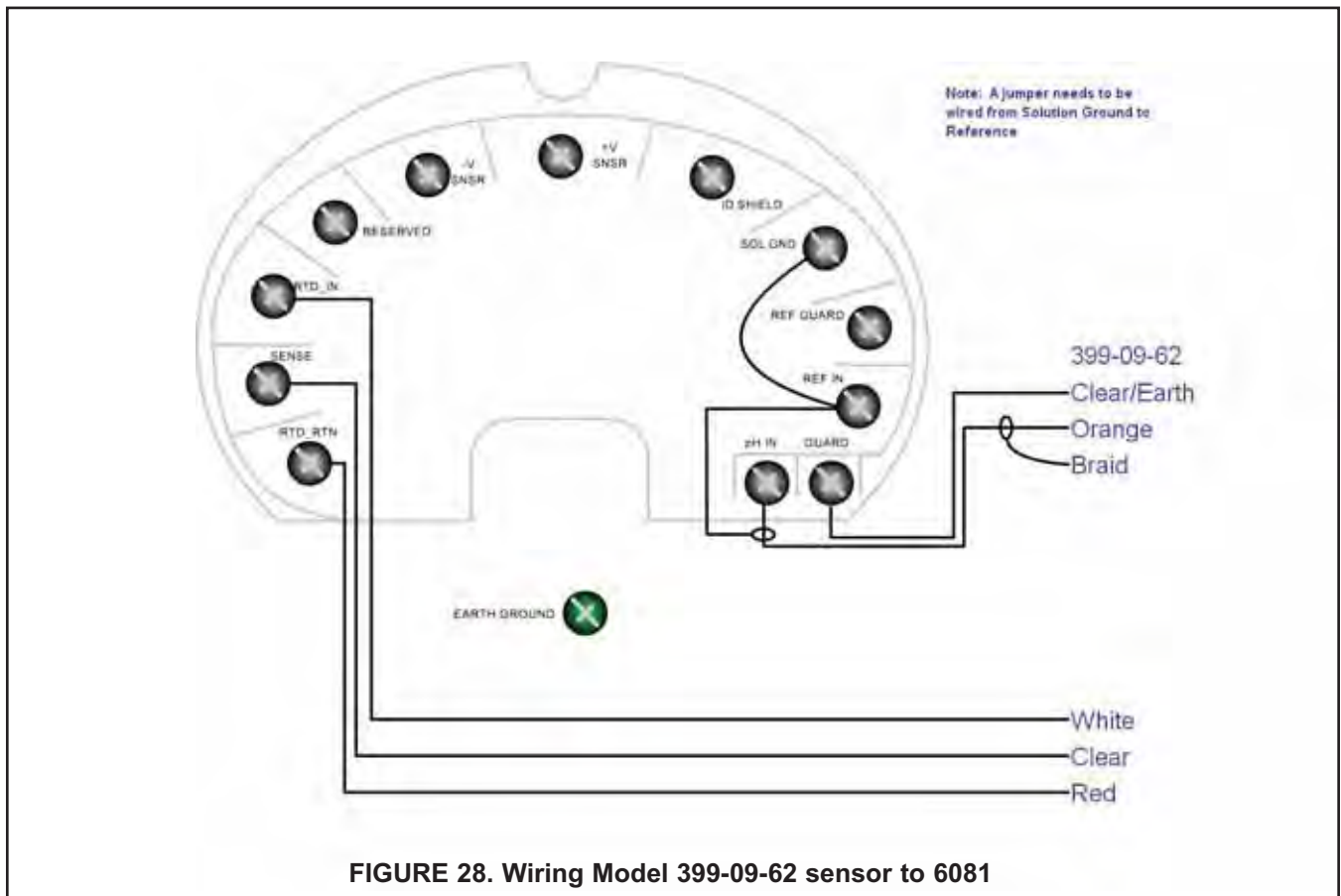


FIGURE 27. Wiring Models 399-33 to 6081



**ACCESSORIES**

<b>PART NUMBER</b>	<b>DESCRIPTION</b>
23645-06	15 ft cable with mating VP6 connector, prepped with BNC on analyzer end
23645-07	15 ft cable with mating VP6 connector, prepped without BNC on analyzer end
24281-00	15 ft. cable with mating VP8 connector
24281-01	25 ft. cable with mating VP8 connector
24281-02	2.5 ft. cable with mating VP8 connector
24281-03	50 ft. cable with mating VP8 connector
24281-04	100 ft. cable with mating VP8 connector
24281-05	4 ft. cable with mating VP8 connector
24281-06	10 ft. cable with mating VP8 connector
24281-07	20 ft. cable with mating VP8 connector
24281-08	30 ft. cable with mating VP8 connector
915240-03	Process tee with NPT connection threads
22719-02	Junction box
12707-00	Jet cleaner
23242-02	Insertion adapter
24091-00	Low flow cell



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