

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

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

To secure and maintain an intrinsically safe installation, an appropriate transmitter/ safety barrier/sensor combination must be used. The installation system must be in accordance 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 389 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	2/01	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	1/02	Revised wiring diagram on page 7.
B	5/02	Updated drawings on pages 5, 6, & 13.
C	8/02	Added drawing 40105552, rev.D.
D	6/02	Revised drawing on page 7.
E	3/04	Updated drawings on pages 4, 15, 16; added new wiring drawing on page 18.
G	10/05	Updated registration marks of Tefzel and Viton on page 1; PN9330022 is replaced with new PN9320057 on Figure 2-2, page 5.

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>



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Process Management

MODEL 389 COMBINATION pH/ORP SENSOR

TABLE OF CONTENTS

Section	Title	Page
1.0	DESCRIPTION AND SPECIFICATIONS	1
1.1	Features and Applications.....	1
1.2	Performance and Physical Specification.....	1
1.3	Ordering Information	2
2.0	INSTALLATION	3
2.1	Unpacking and Inspection.....	3
2.2	Mounting	3
2.3	Electrical Installation	4
3.0	START UP AND CALIBRATION	19
3.1	Sensor Preparation	19
3.2	Model 389 pH Calibration	19
3.3	Model 389 ORP	20
4.0	MAINTENANCE	21
4.1	Electrode Cleaning.....	21
4.2	Automatic Temperature Compensator	21
4.3	Model 389 ORP	22
5.0	TROUBLESHOOTING	23
5.1	Troubleshooting	23
6.0	RETURN OF MATERIAL.....	25

TABLE OF CONTENTS CONT'D

LIST OF TABLES

Number	Title	Page
3-1	ORP of Saturated Quinhydrone Solution (In Millivolts).....	20
4-1	R_0 and R_1 Values for Temperature Compensation Elements	21
4-2	Temperature vs Resistance of Auto T.C. Elements	21
5-1	Troubleshooting.....	23
5-2	Model 389 Replacement Parts and Accessories	24

LIST OF FIGURES

Number	Title	Page
1-1	Pressure /Temperature Limitations.....	2
2-1	Dimensional Drawing	4
2-2	Submersion Installations	5
2-3	Flow Through and Insertion Installations.....	6
2-4	Model 389 with Insertion Mounting Adapter PN 23242-02	6
2-5	Wiring Details Model 389-01-54 With and Without J-Box PN 22719-02	7
2-6	Wiring Model 389-02-54 to Models 1054ApH/ORP-54 and 2054pH-54.....	8
2-7	Wiring Model 389-02-54 to Models 2081pH-05 and 1054pH/ORP-54	9
2-8	Wiring Details Model 389-02-54 For Use With J-Box (PN 23309-04) For Remote Preamp (PN 22698-03)	10
2-9	Wiring Details Model 389-02-50/51 For Use With J-Box (PN 23309-03) For Remote Preamp (3K TC)	10
2-10	Wiring Details Model 389-01-54 For Use With Models 1054ApH/ORP-07, 1054BpH/ORP-07, and 2054pH-07	11
2-11	Wiring Model 389-02-()-54-62 to Model 1055-01-10-22-32.....	11
2-12	Wiring Details Model 389-01-50/51 For Use With and Without J-Box (PN 22719-02)	12
2-13	Wiring Model 389-02-54-62 to Model 1055-22-32.....	13
2-14	Wiring Model 389-02-54-62 to Model 1055-22-32 Through Remote Junction Box ..	13
2-15	Wiring Details Model 389-02-50 For Use With Model 1181pH/ORP-43/44	14
2-16	Wiring Details Model 389-02-54 For Use With Models 54/54e, 81, 3081, 4081, and 5081 Analyzers/Transmitters	15
2-17	Wiring Details Model 389-02-54 (Pt 100 RTD) For Use With J-Box and Remote Preamp (PN 23555-00) to Models 54/54e, 81, 3081, 4081, and 5081 Analyzers/Transmitters	16
2-18	Wiring Details Model 389-02-54 (Pt 100 RTD) For Use With Remote Preamp (PN 23054-03).....	17
2-19	Wiring Model 389-02-54-62 to Model Xmt-P-HT-10	18

SECTION 1.0

DESCRIPTION AND SPECIFICATIONS

- **DISPOSABLE DESIGN** for convenience and economic advantage where minimal troubleshooting and maintenance downtime are of prime importance.
- **RUGGED TEFZEL®¹ BODY** for maximum chemical resistance; completely sealed to eliminate process intrusion.
- **TRIPLE JUNCTION REFERENCE CELL** for longer sensor life in process solutions containing poisoning ions.
- **INTEGRAL PREAMPLIFIER** for noise free, long distance transmission of the high impedance pH signal.

1.1 FEATURES AND APPLICATIONS

The Rosemount Model 389 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 pH/ORP applications where a low cost, high performance, disposable sensor is required. The combination electrode features a peripheral ceramic junction. The triple junction reference cell provides longer life in process solutions containing ammonia, chlorine, cyanides, sulfides, or other poisoning ions.

The sensor is housed in a molded, chemically resistant Tefzel®¹ body with Viton®¹ and EPDM O-rings. Complete encapsulation eliminates process intrusion. The simplified construction, designed with user convenience in mind, does not require electrolyte replenishment or any component replacement.

The Rosemount method features an integral preamplifier that converts the high impedance signal into a stable, noise-free signal. This method has become the industry standard for measurement reliability.

Installation is easily achieved through the wide variety of mounting configurations. The Model 389 features 1 in. (MNPT) front and rear facing process connections for insertion, submersion, or flow through applications.

1.2 PERFORMANCE & PHYSICAL SPECIFICATIONS

Measured Ranges: pH: ACCUGLASS™² 0-14

Percent Linearity Over pH Range		
	Option 10	Option 11
0-2 pH	94%	94%
2-12 pH	99%	97%
12-13 pH	97%	98%
13-14 pH	92%	98%

ORP: -1500 to +1500 mV

Wetted Materials:

pH: Tefzel®¹, glass, ceramic, Viton®¹

ORP: Tefzel®¹, glass, ceramic, Viton®¹, Platinum

Accessories: Kynar™³, PEEK, PVC, CPVC, 304

S.S.

Process Connections: 1 in. MNPT

Integral Cable:

Option 01: 25 ft, with integral preamplifier

Option 02: 15 ft, for use with remote preamplifier

Temperature Compensation:

Automatic 0 to 85°C (32° to 185°F)

Temperature compensation is not required for 389 ORP when used with Models 1060, 1023 or 1181 ORP

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

Maximum Pressure: 790 kPa abs (100 psig) at 65°C

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

¹ Tefzel and Viton are registered trademarks of DuPont Performance Elastomers.

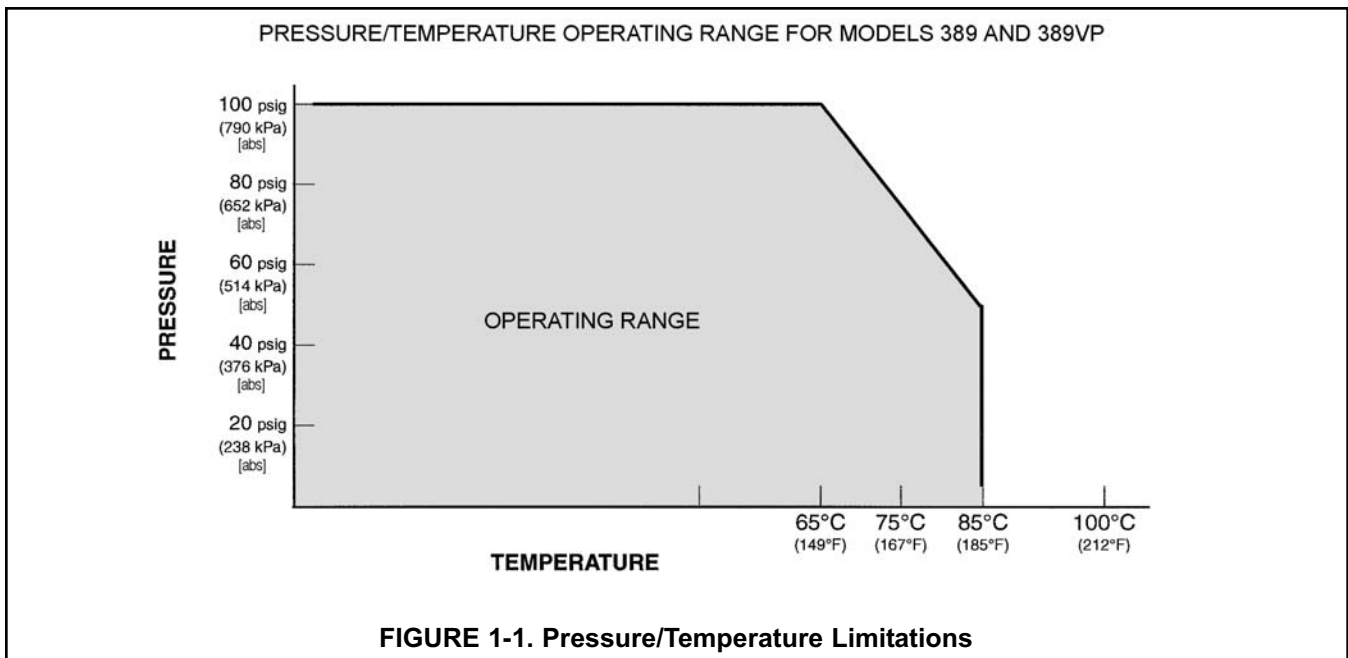
² ACCUGLASS is a trademark of Rosemount Analytical.

³ Kynar is a trademark of Pennwalt Inc.

1.3 ORDERING INFORMATION

The **Model 389 pH/ORP Sensor** is 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 pH or high pH electrode or a platinum ORP electrode with a triple junction gel filled reference cell. The Model 389 pH is available with or without an integral preamplifier. The Model 389 ORP is available only with an integral preamplifier. Automatic temperature compensation is standard with the Model 389 pH. Temperature measurement is provided with the Model 389 ORP-54.

MODEL 389 pH/ORP SENSOR	
CODE	PREAMPLIFIER/CABLE (Required Selection)
01	With Integral preamplifier, 25 ft cable (for use with Models 1181, 1054A/B, and 2081 only)
02	For use with remote preamplifier, 15 ft cable
CODE	COMBINATION ELECTRODE (Required Selection)
10	General Purpose Low Resistivity, GPLR
11	High pH
12	ORP
CODE	ANALYZER/TC COMPATIBILITY (Required Selection)
50	For Models 1181 (3K TC)
54	For Models 1054A/B, 54, 54e, 1055, 81, 2081, 3081, 4081, 5081, and Xmt; Code 02 only (Pt 100 TC)
CODE	OPTIONS
62	Cable prepped w/o BNC for wiring to Models 54e, 81, 1055, 2081, 3081, 4081, 5081, Xmt (only available w/combination of -02 & -54 options)
389	01 10 54 EXAMPLE



SECTION 2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION. Inspect the outside of the carton for any damage. If damage is detected, contact the carrier immediately. Inspect the hardware. Make sure all the items in the packing list are present and in good condition. Notify the factory if any part is missing. If the instrument appears to be in satisfactory condition, proceed to Section 2.2, Mounting.

NOTE

Save the original packing cartons and materials as most carriers require proof of damage due to mishandling, etc. Also, if it is necessary to return the instrument to the factory, you must pack the instrument in the same manner as it was received. Refer to Section 6 for return instructions. If the sensor is to be stored, the vinyl boot should be filled with pH buffer solution and replaced on sensor tip until ready for use.

CAUTION

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

WARNING

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 Caution label regarding this matter is attached to the sensor with the cable. Please do not remove the label. See Figure 2-1.

CAUTION

Internal electrolyte fill 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 on the horizontal. The sensor must be 10° off the horizontal to ensure accuracy.
3. Do not install the sensor upside down.
4. With the standard recessed electrode, air bubbles may become trapped in the sensor end. 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 ± 0.2 pH may be obtained. To obtain greater accuracy or to verify proper operation, the sensor must be calibrated as a loop with its compatible analyzer or transmitter.

2.2.1 Submersion Mounting. The Model 389 Sensor has a 1 in. MNPT process connection at the back of the sensor. Utilizing a standard 1 in. union, the sensor may be mounted to a 1 in. SCH 80 CPVC or PVDF standpipe. Tapered pipe threads in plastic tend to loosen after installation. It is therefore recommended that Teflon¹ tape be used on the threads and that the tightness of the connection be checked frequently to assure that no loosening has occurred. To prevent rain water or condensation from running into the sensor, a weatherproof junction box is recommended (See Figure 2-2). 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.

2.2.2 Flow Through and Insertion Mounting. The Model 389 Sensor also has a 1 in. MNPT process connection at the front of the sensor for mounting into a 1-1/4 in. tee or the process. See Figure 2-3 for installation configurations. Also see Figure 2-4.

NOTE

LARGE PIPE WRENCHES MUST NOT BE USED TO TIGHTEN THE SENSOR INTO A FLANGE OR OTHER TYPE OF MOUNTING.

¹ Teflon is a registered trademark of E.I. duPont de Nemours & Co.

2.3 ELECTRICAL INSTALLATION.

Figures 2-5 thru 2-19 provide the guidelines for wiring the 389 sensor to various Analyzer/Transmitter instruments. To determine which wiring guideline to use, locate the code number of the sensor to be installed. This number is stamped in the body of the sensor.

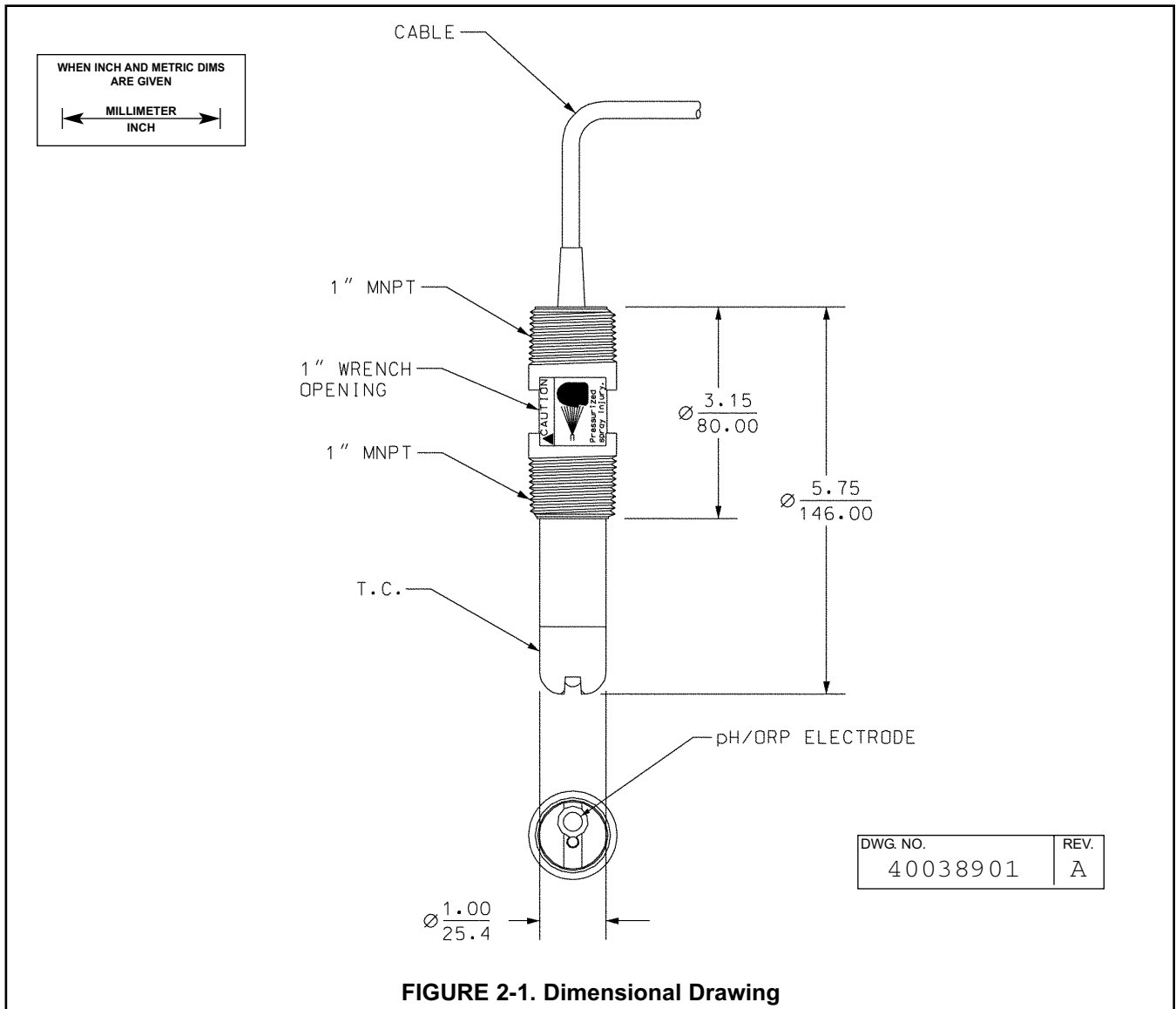
The corresponding wiring guideline selection is identified by the Preamplifier/Cable code (01/02) and the Analyzer/TC compatibility code (50/51/54).

1. If the cable needs to be extended, use a high quality four conductor shielded instrument cable available from Rosemount Analytical. Refer to Figures 2-5, 2-8, 2-9, 2-10, 2-11 and 2-14 for the appropriate junction box to use and the corresponding wiring details.

NOTE

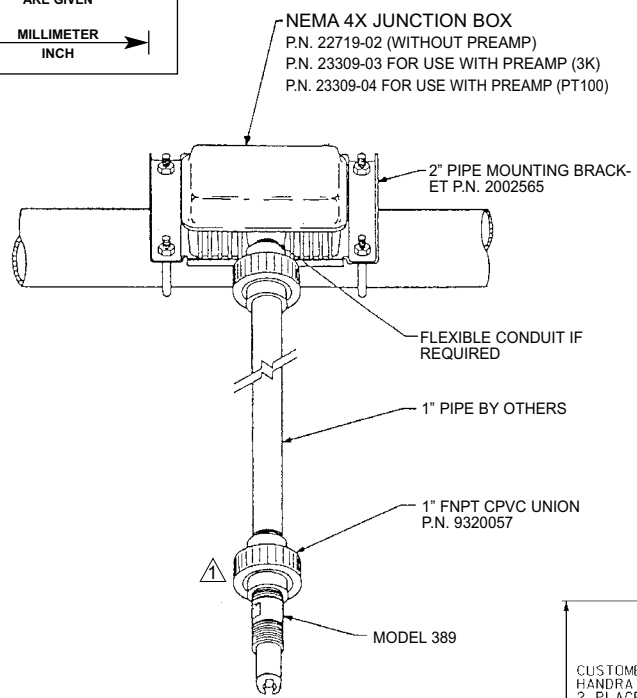
If the cable is too long, loop up the excess cable. If the cable has to be shortened, splice and terminate each conductor neatly and **make sure that the overall (outermost) drain wire is not shorted out with either of the two inner drain wires (shields).**

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. For your convenience, a spade lug kit is furnished (in a plastic bag wrapped around the cable).



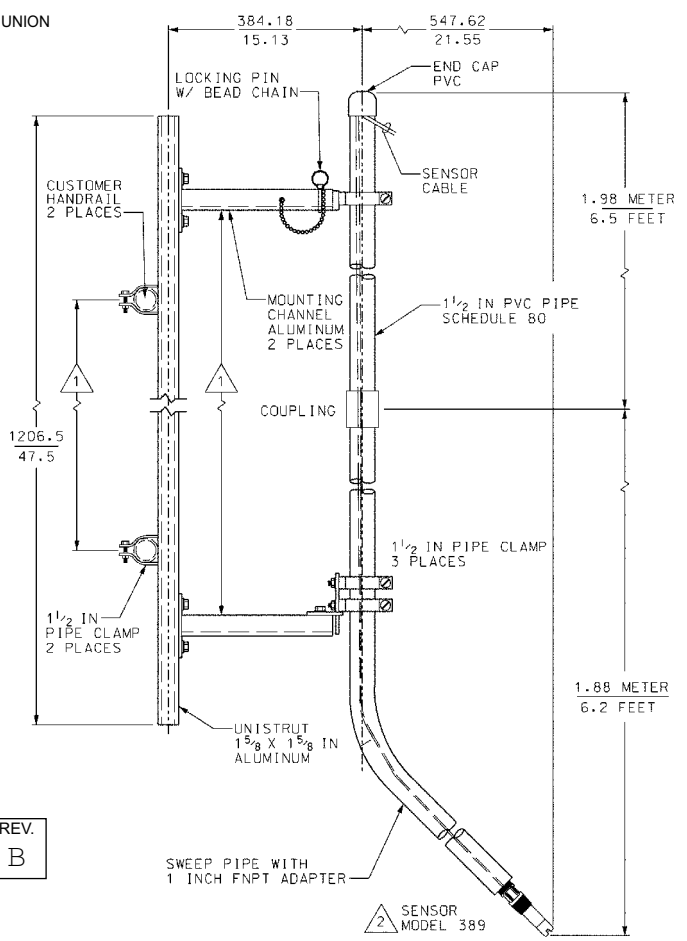
WHEN INCH AND METRIC DIMS
ARE GIVEN

MILLIMETER
INCH



⚠ REGULARLY CHECK TO MAKE SURE
CONNECTIONS ARE WATER TIGHT.
NOTES: UNLESS OTHERWISE SPECIFIED

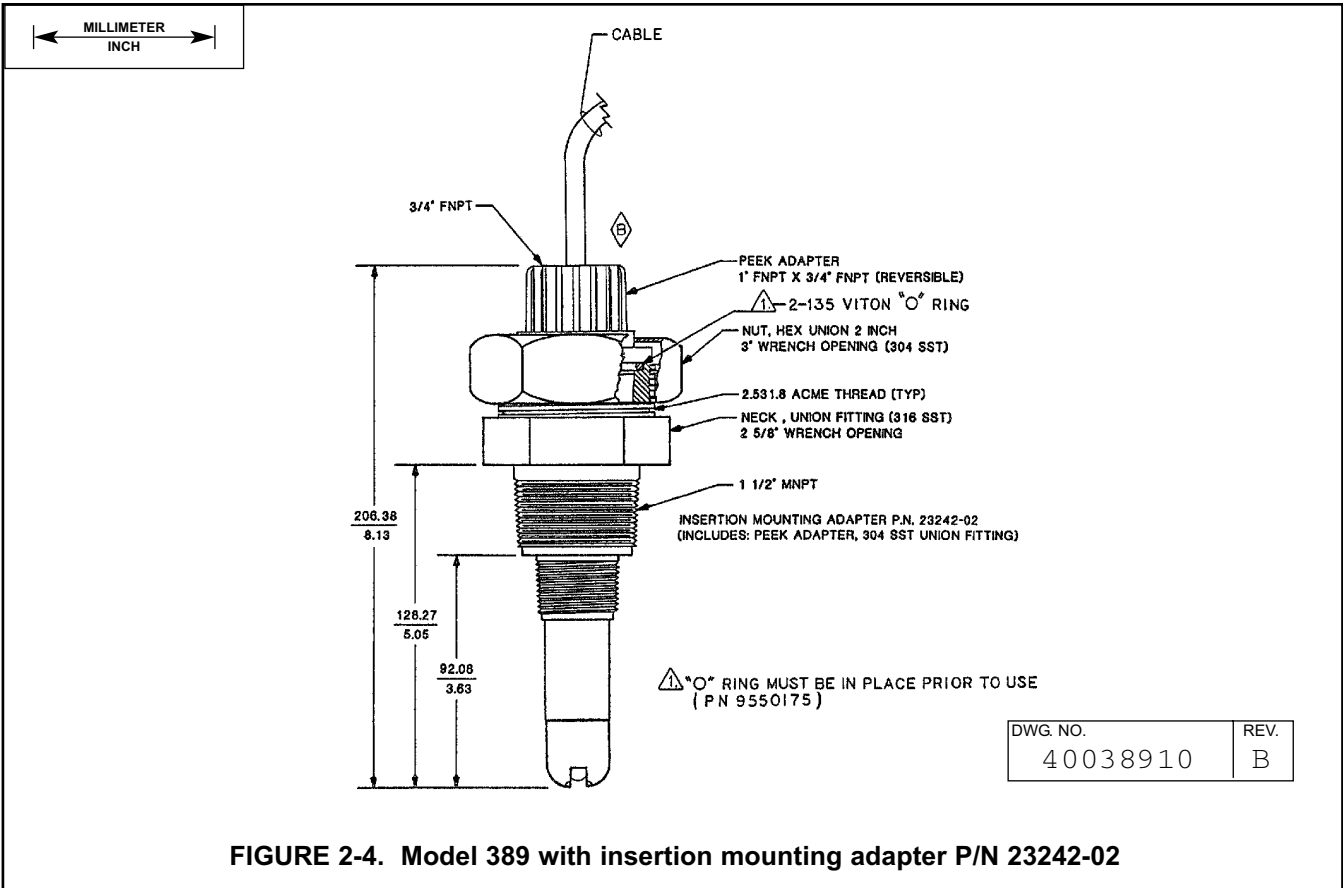
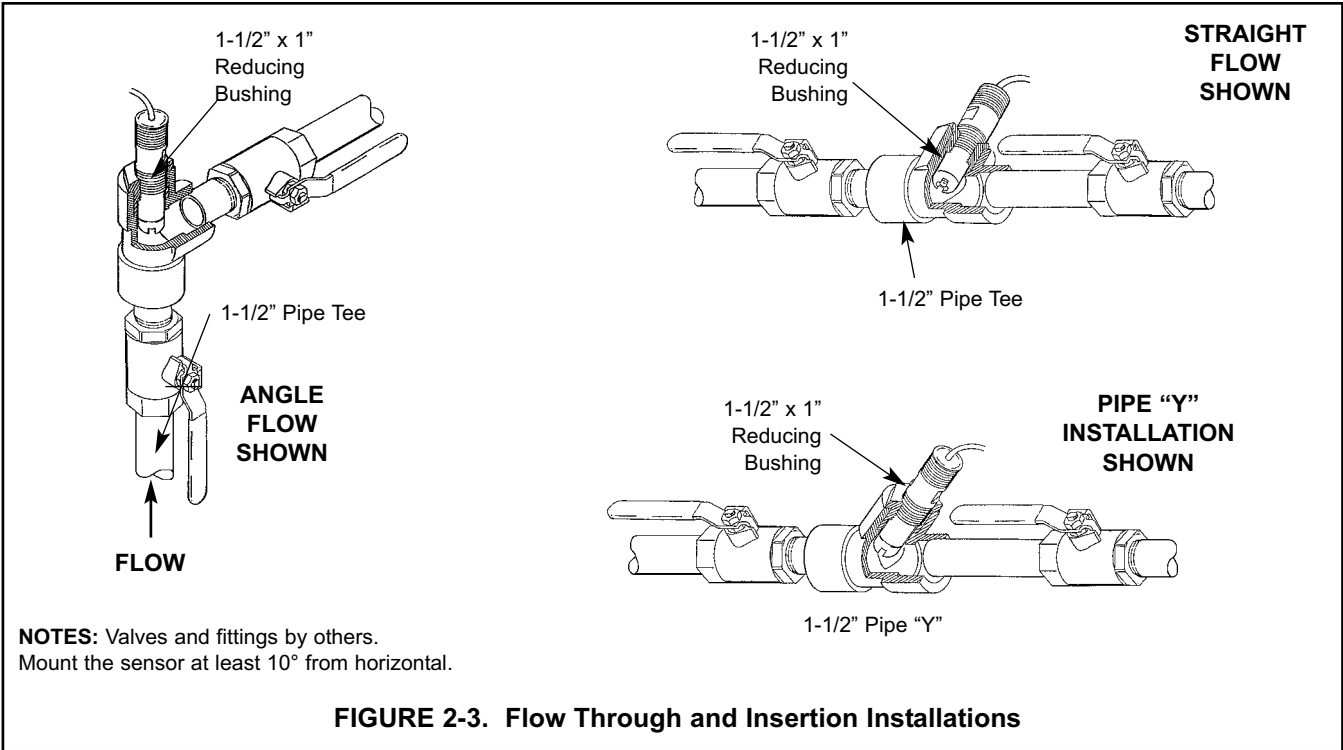
DWG. NO. 40038912	REV. A
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DWG. NO. 40038911	REV. B
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⚠ REGULARY CHECK TO MAKE SURE
CONNECTIONS ARE WATER TIGHT
⚠ CAN BE ANY CONVENIENT DIMENSION

FIGURE 2-2. Submersion Installations



2.3.1 Wiring. The Model 389 has a built-in preamplifier (except option 02) and comes standard with a seven conductor, shielded 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. Please refer to Figures 2-5, 2-10, and 2-12 or your analyzer/transmitter instruction manual for electrical connections.

The Model 389 pH/ORP-02 is for use with a remote preamplifier. It comes with a special 15 ft low noise coax cable. Please refer to Figures 2-6, 2-7, 2-8, 2-9, 2-11, 2-13, 2-14, 2-15, 2-16, 2-17, and 2-18 for wiring information.

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

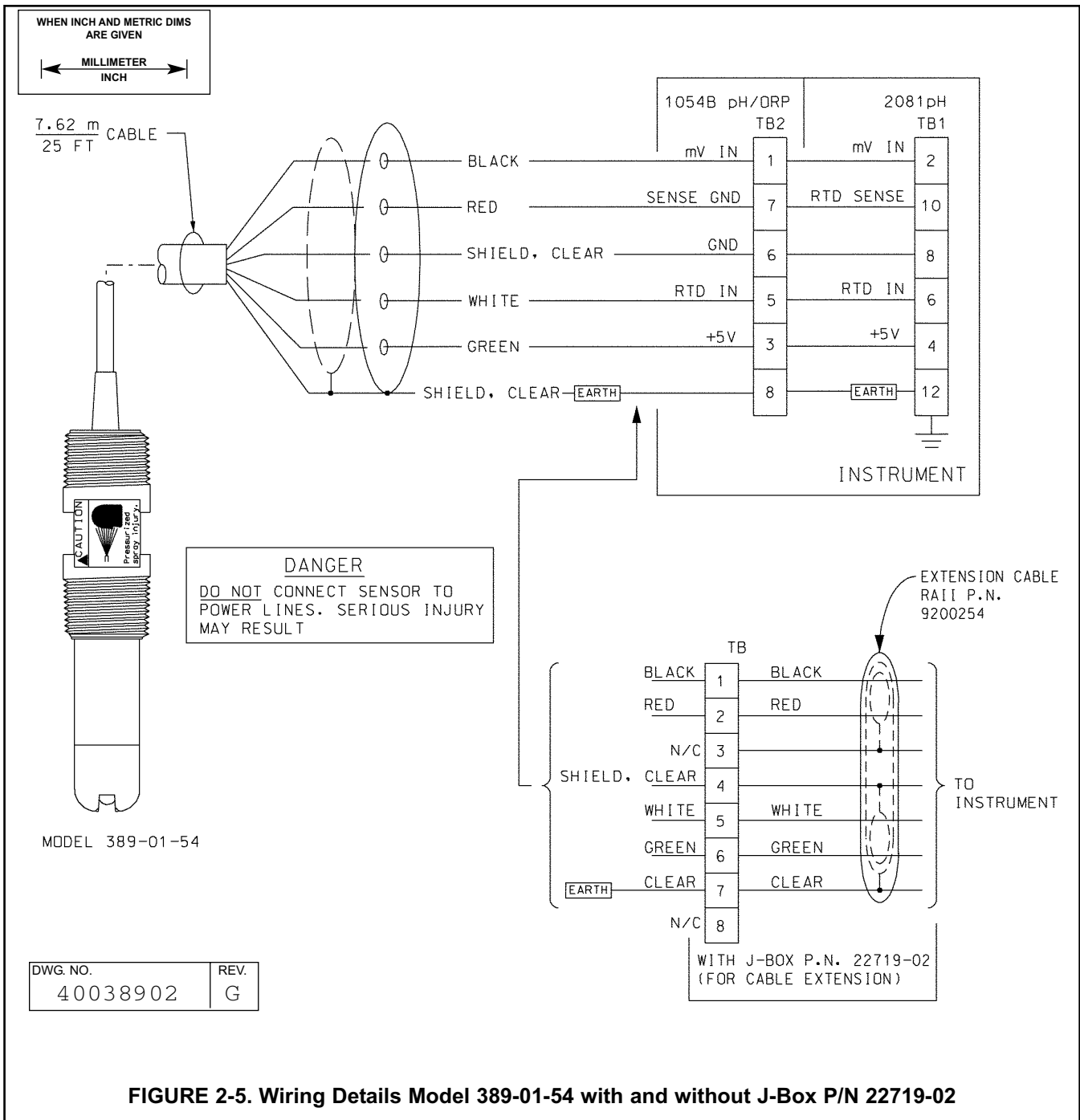
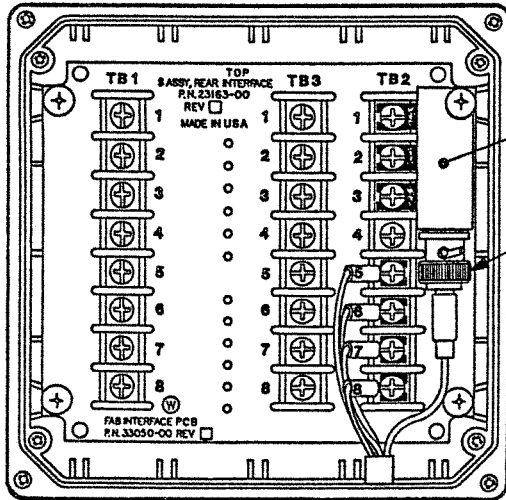


FIGURE 2-5. Wiring Details Model 389-01-54 with and without J-Box P/N 22719-02

MODELS 1054A-54, 1054B-54
AND 2054-54

BACK VIEW COVER OMITTED



INTEGRAL PREAMP
P. N. 23363-00

BNC CONNECTOR

- ← TB2-5, RTD IN (WHITE)
- ← TB2-6, REF GND (CLEAR SHIELD)
- ← TB2-7, SENSE GND (RED)
- ← TB2-8, EARTH GND (CLEAR)*"EARTH" WIRE MARKER

SENSOR CABLE $\frac{4.57 \text{ M}}{15 \text{ FT.}}$

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

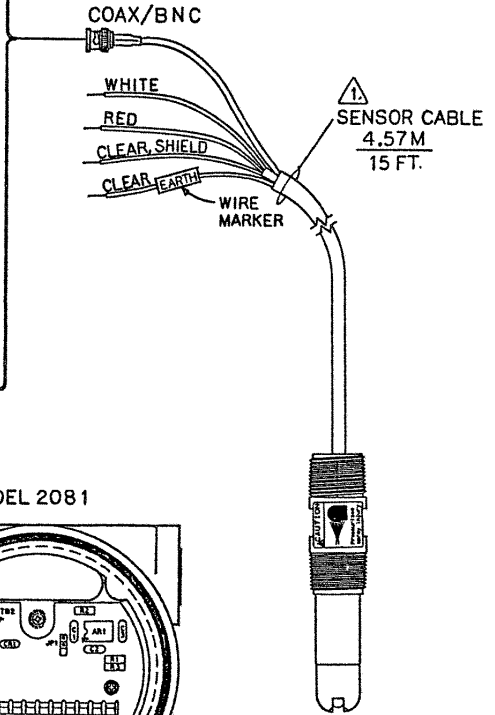
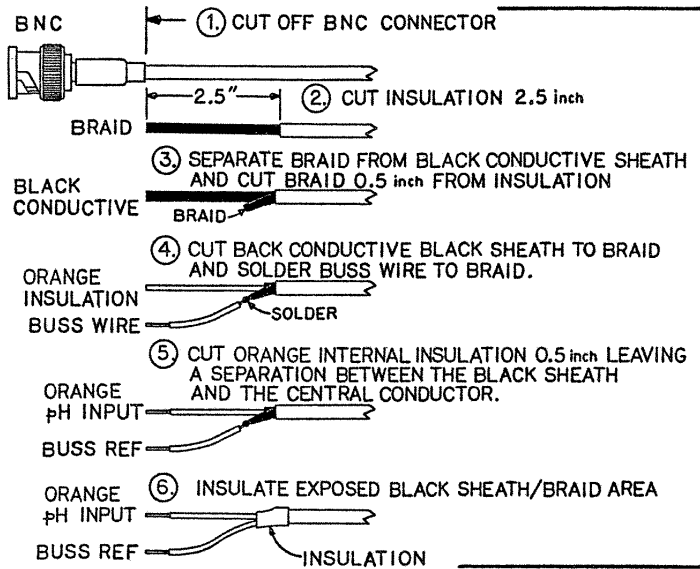
MODEL 389-02-54



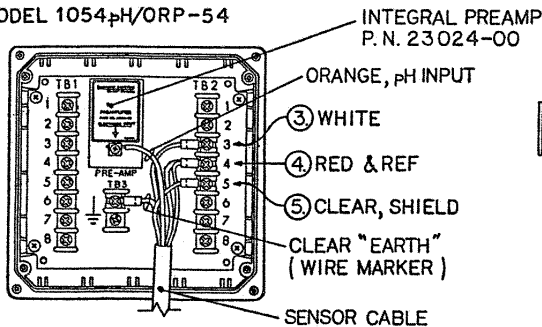
DWG. NO.	REV.
40038903	C

FIGURE 2-6. Wiring Details Model 389-02-54 for use with Models 1054ApH/ORP-54, 1054BpH/ORP-54, and 2054pH-54

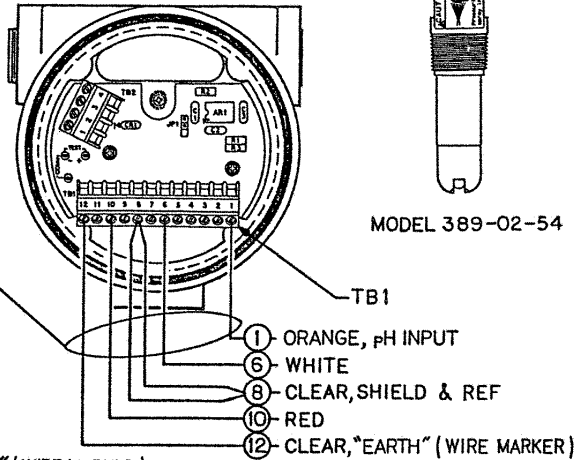
PREPARE THE COAX CABLE AS FOLLOWS:



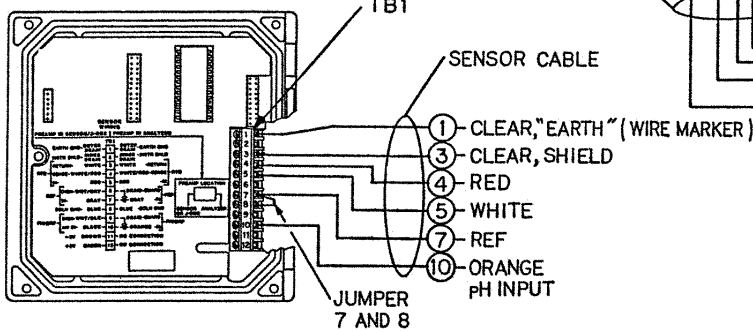
MODEL 1054 pH/ORP-54



MODEL 2081



MODEL 54 pH/ORP

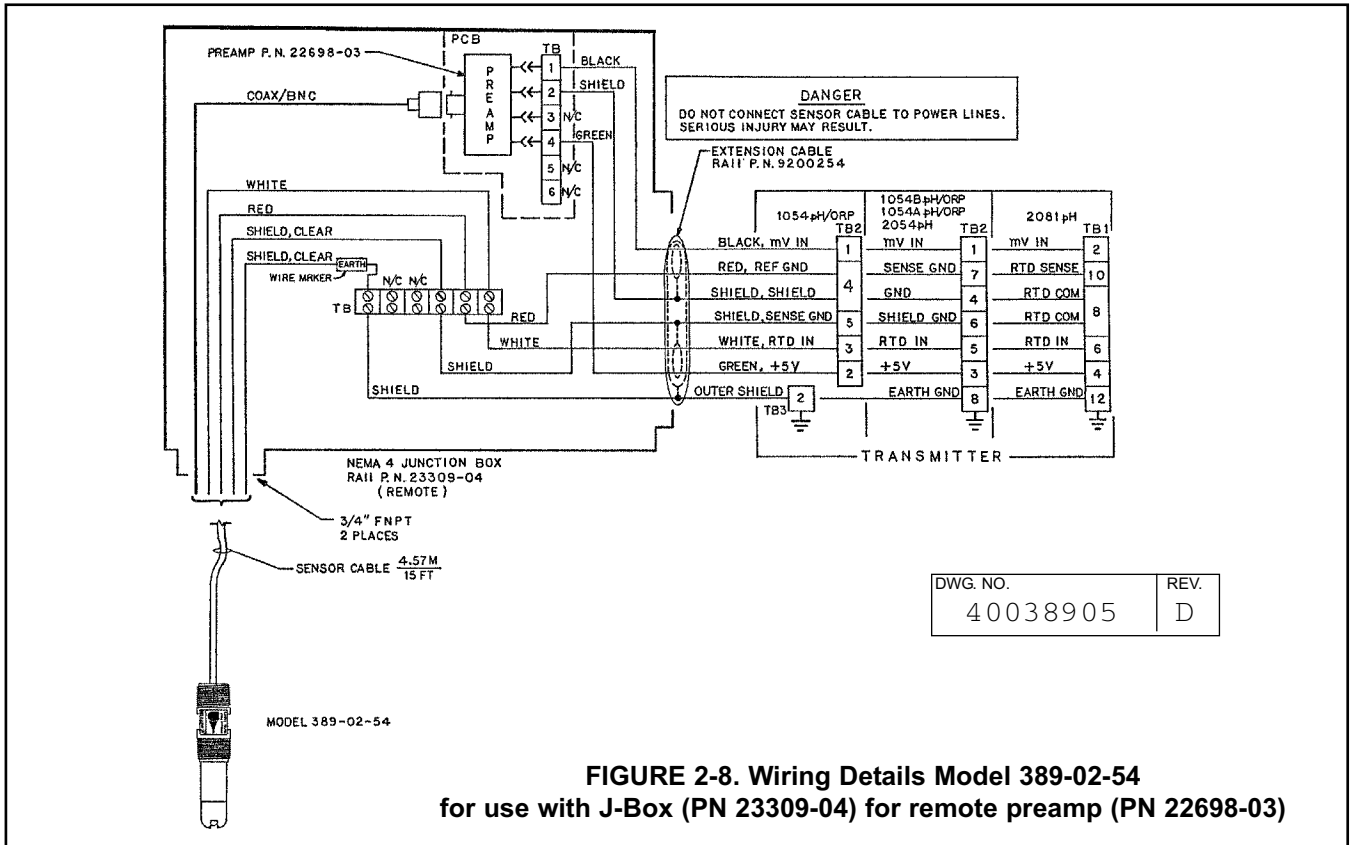


DANGER
DO NOT CONNECT SENSOR CABLE TO POWER LINES. SERIOUS INJURY MAY RESULT.

⚠ SPADE LUG KIT SHIPPED LOOSE WITH SENSOR FOR USE WITH MODEL 1054 pH/ORP-54

DWG. NO.	REV.
40038904	E

FIGURE 2-7. Wiring Details Model 389-02-54 for use with Models 2081pH-05 and 1054pH/ORP-54



**FIGURE 2-8. Wiring Details Model 389-02-54
for use with J-Box (PN 23309-04) for remote preamp (PN 22698-03)**

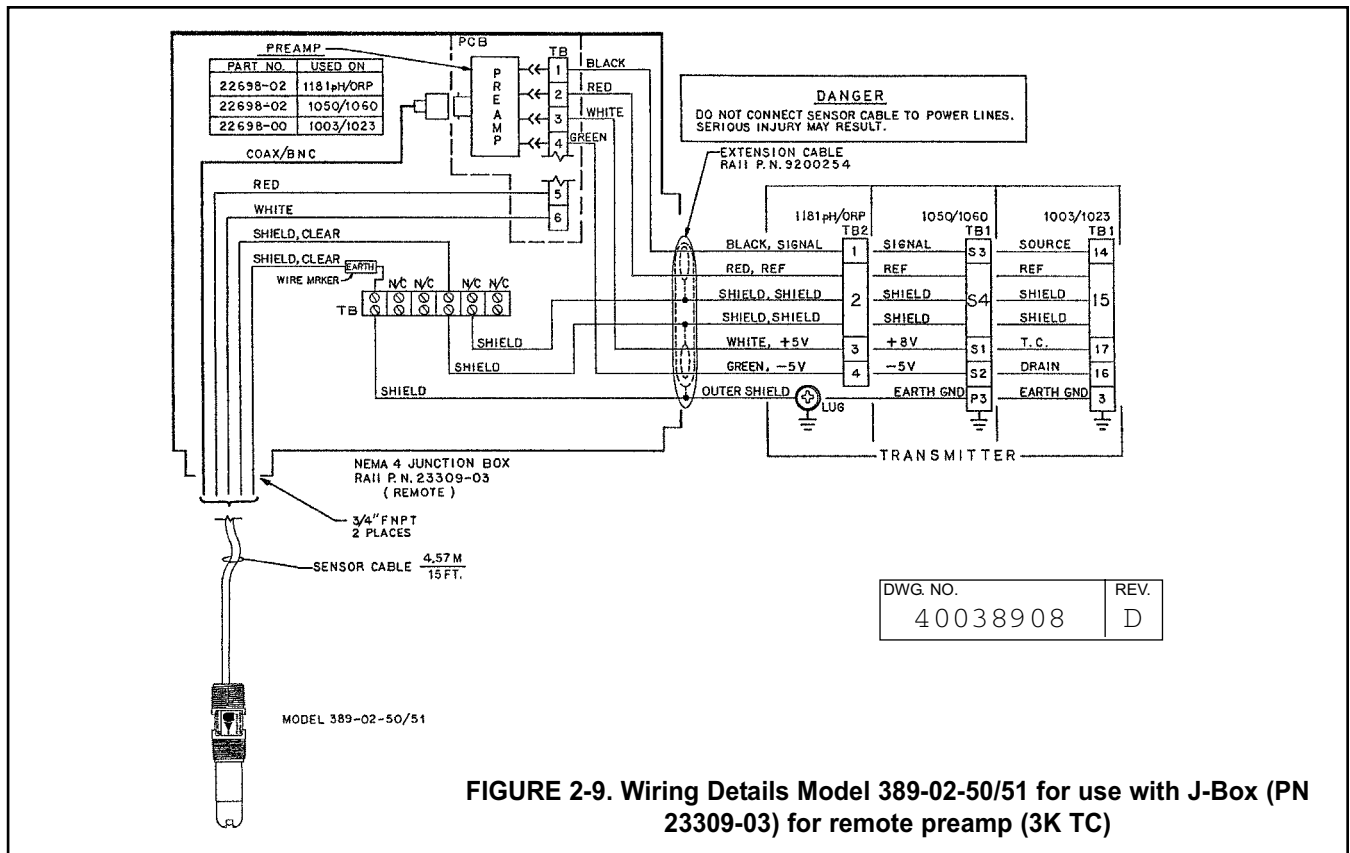
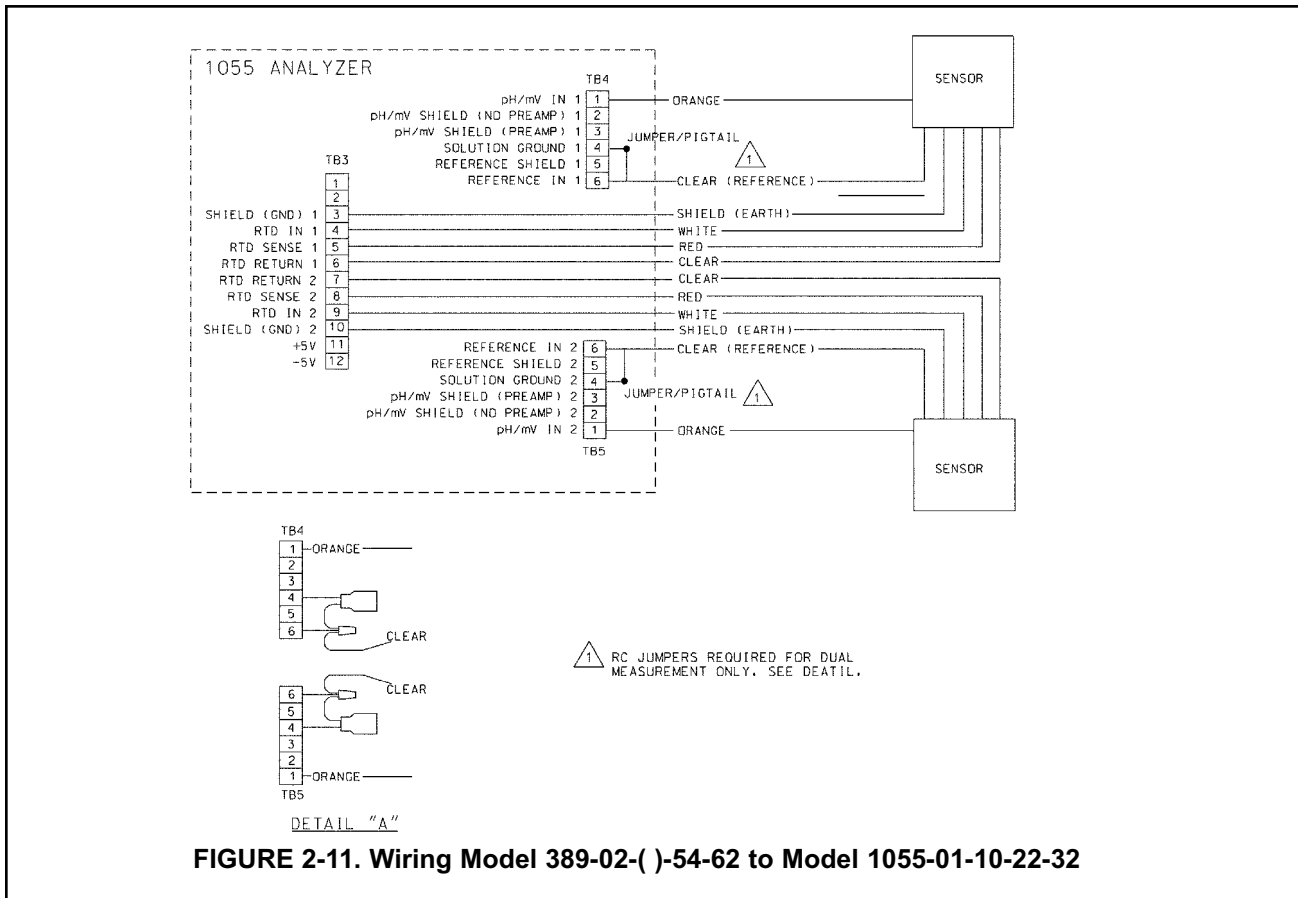
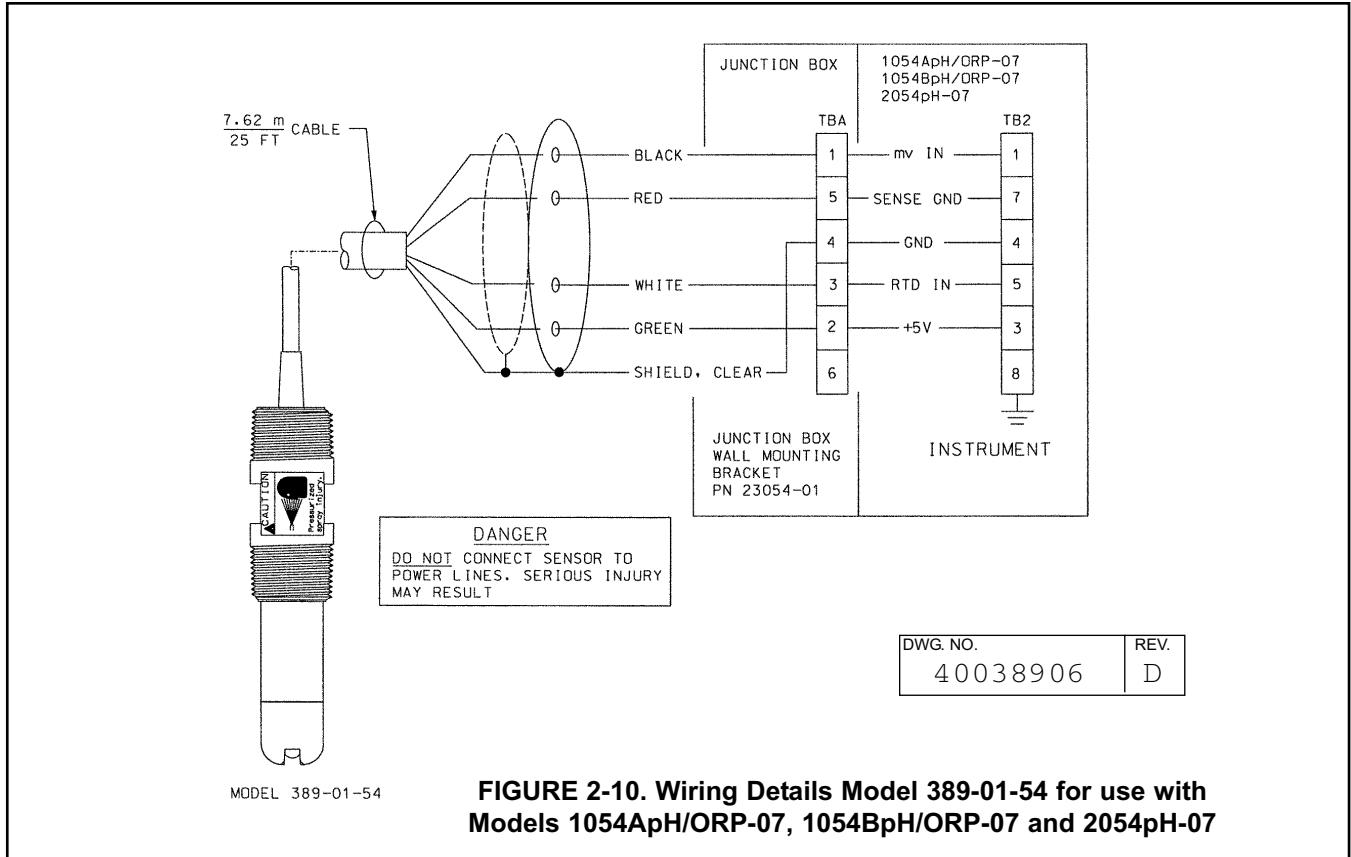


FIGURE 2-9. Wiring Details Model 389-02-50/51 for use with J-Box (PN 23309-03) for remote preamp (3K TC)



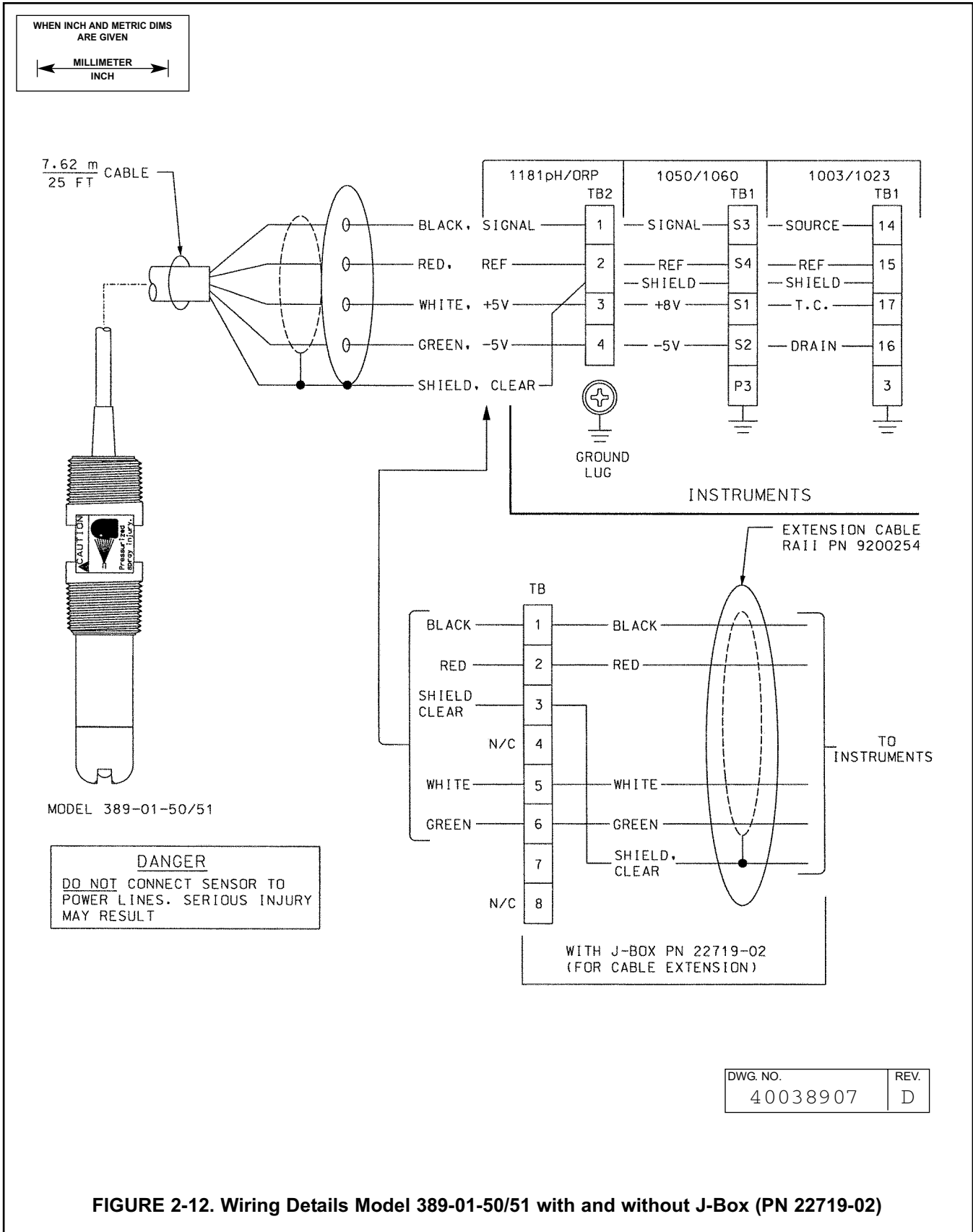


FIGURE 2-12. Wiring Details Model 389-01-50/51 with and without J-Box (PN 22719-02)

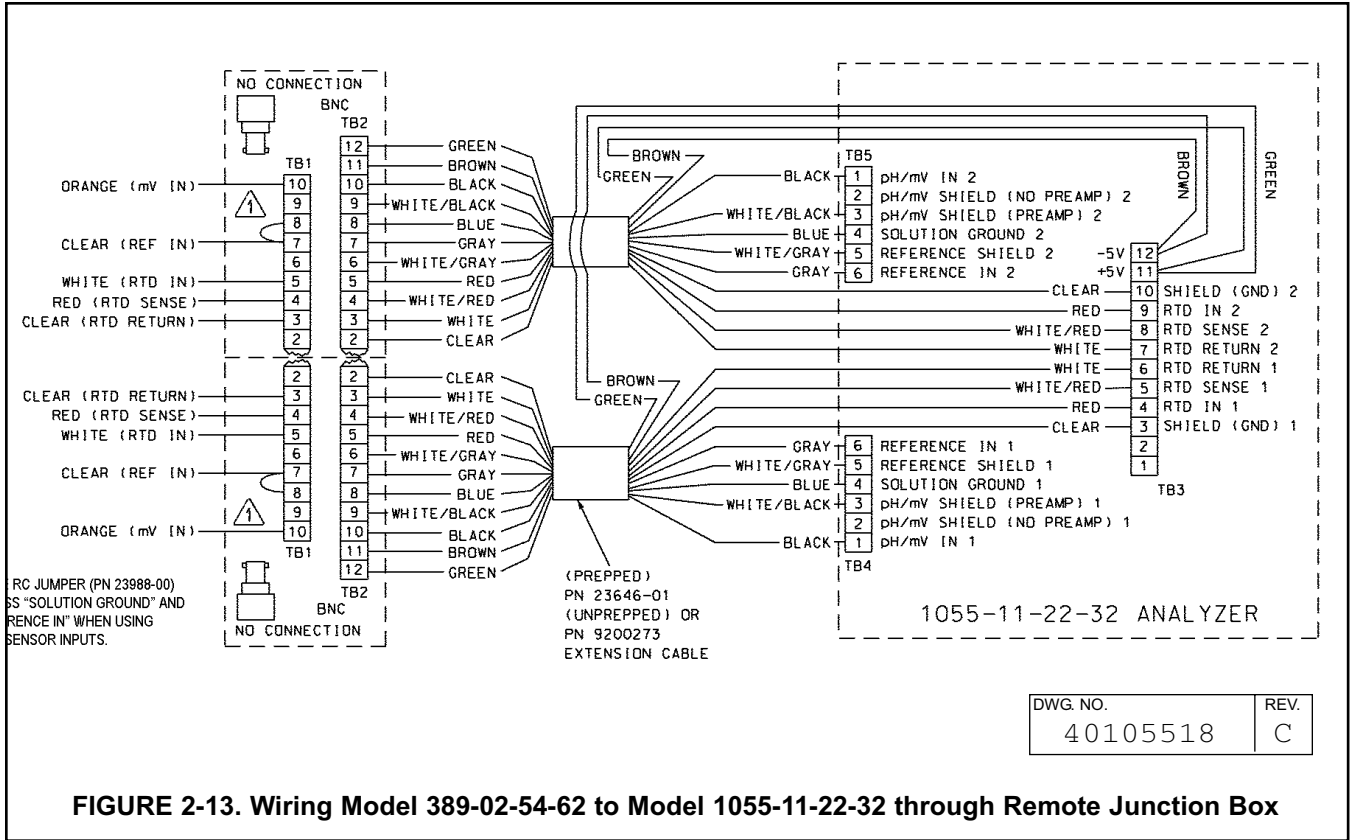
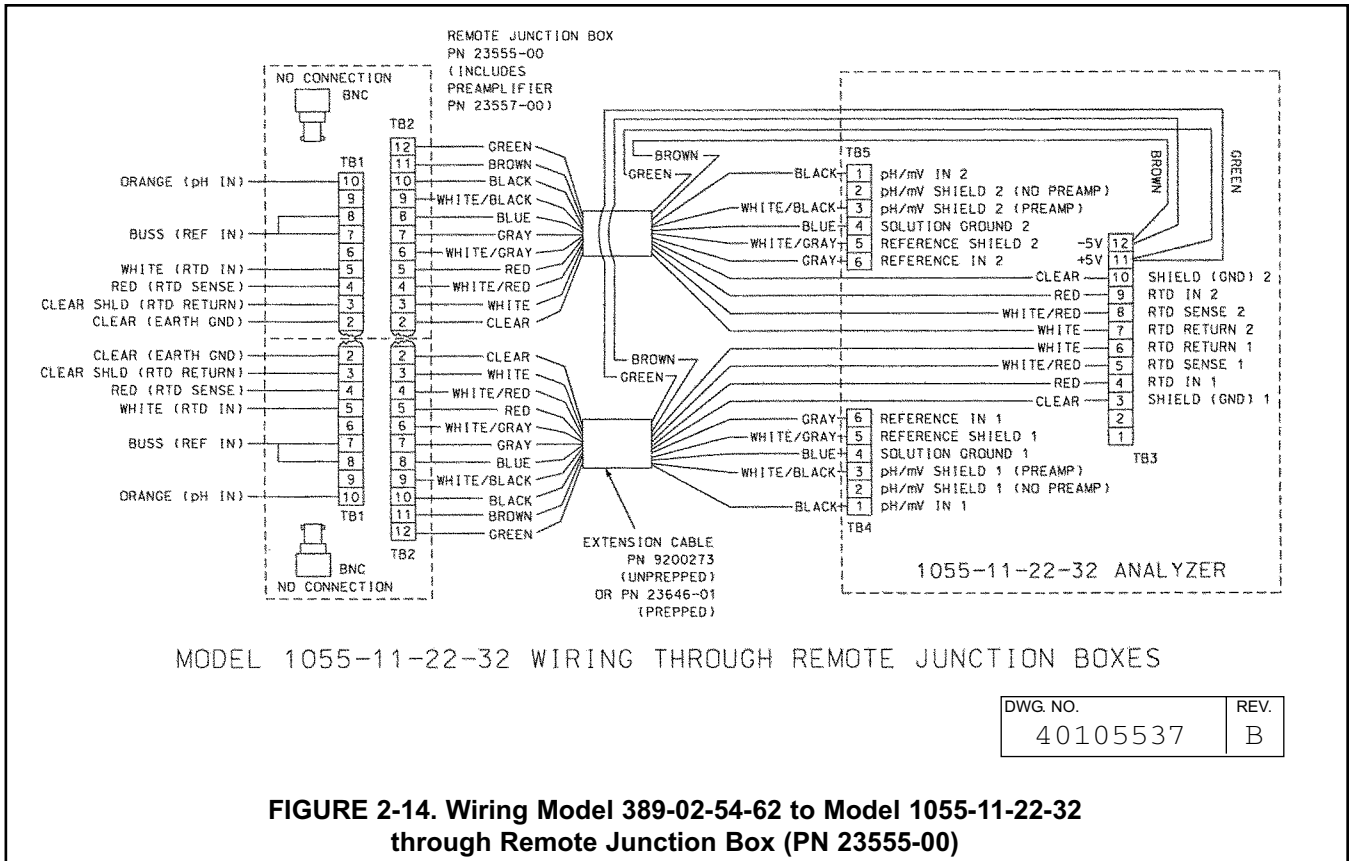
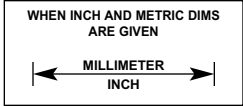


FIGURE 2-13. Wiring Model 389-02-54-62 to Model 1055-11-22-32 through Remote Junction Box

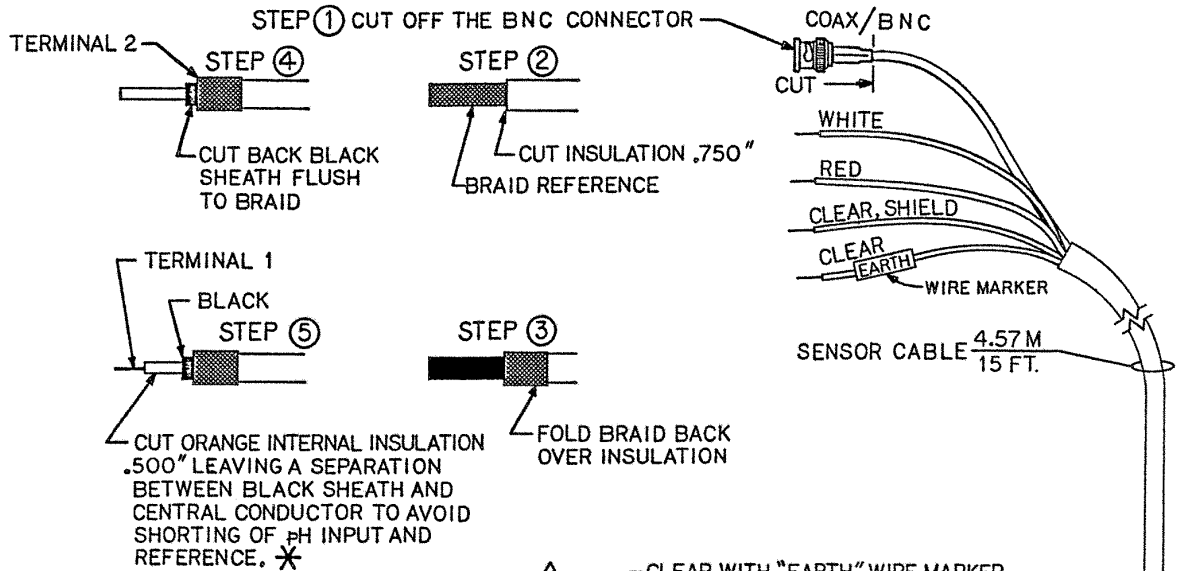


MODEL 1055-11-22-32 WIRING THROUGH REMOTE JUNCTION BOXES

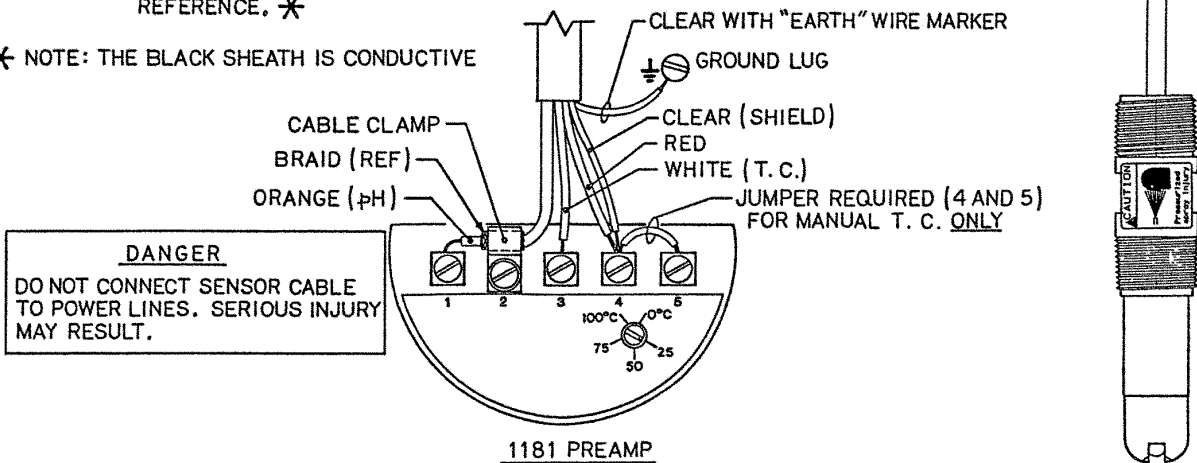
FIGURE 2-14. Wiring Model 389-02-54-62 to Model 1055-11-22-32 through Remote Junction Box (PN 2355-00)



PREPARE THE COAX CABLE AS FOLLOWS:



* NOTE: THE BLACK SHEATH IS CONDUCTIVE



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

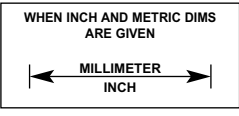
1181 PREAMP

P. N. 22743-01 (PT100 TC)
P. N. 22744-01 (3K TC)

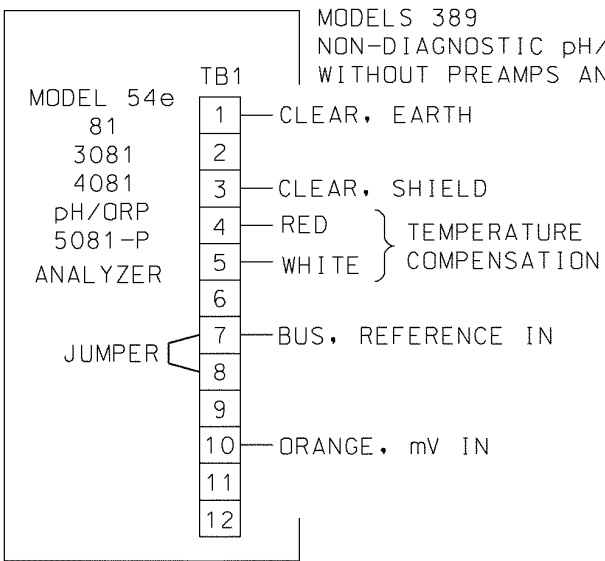
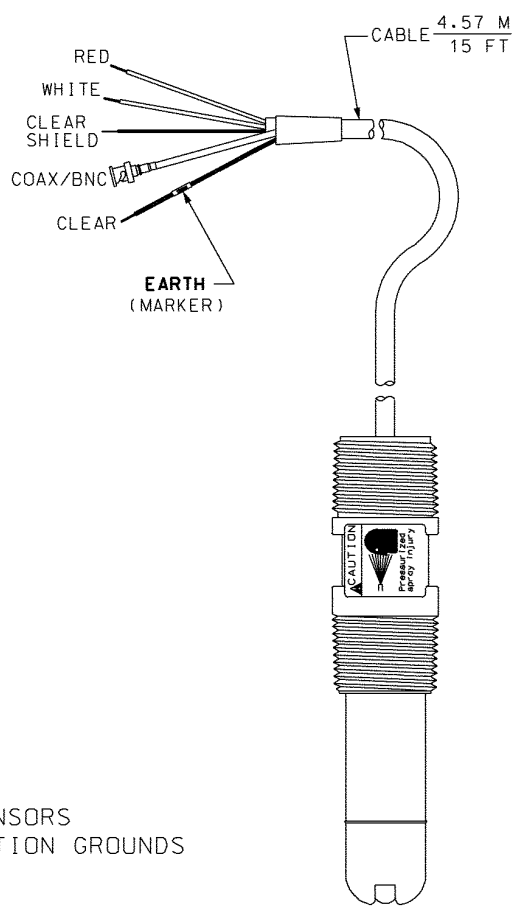
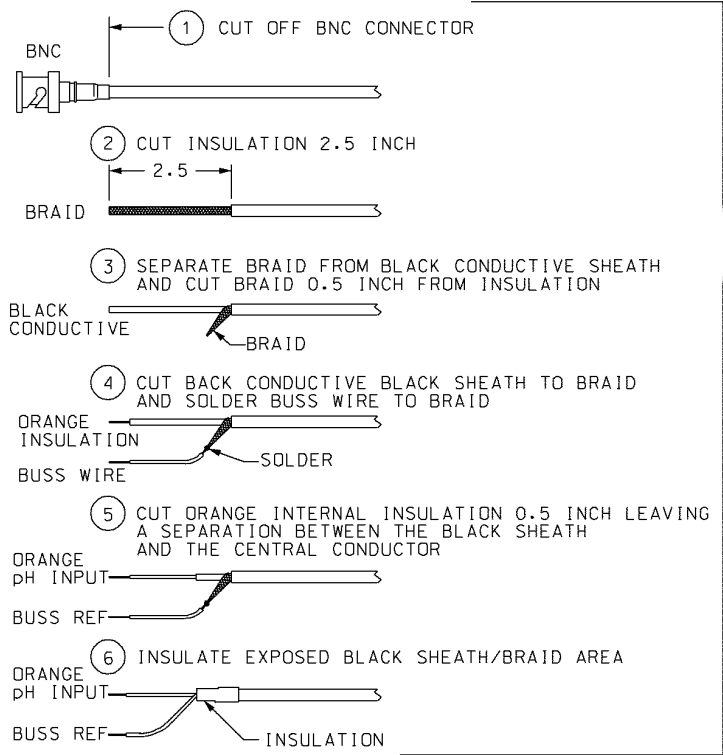
MODEL 389-02-50

DWG. NO. 40038909	REV. C
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FIGURE 2-15. Wiring Details Model 389-02-50 for use with Model 1181pH/ORP



PREPARE THE COAX CABLE AS FOLLOWS:



MODEL 389-02-54
pH/ORP SENSOR

DWG. NO.	REV.
40038921	D

FIGURE 2-16. Wiring Details Model 389-02-54 for use with
Models 54/54e, 81, 3081, 4081, and 5081 Analyzers/Transmitters

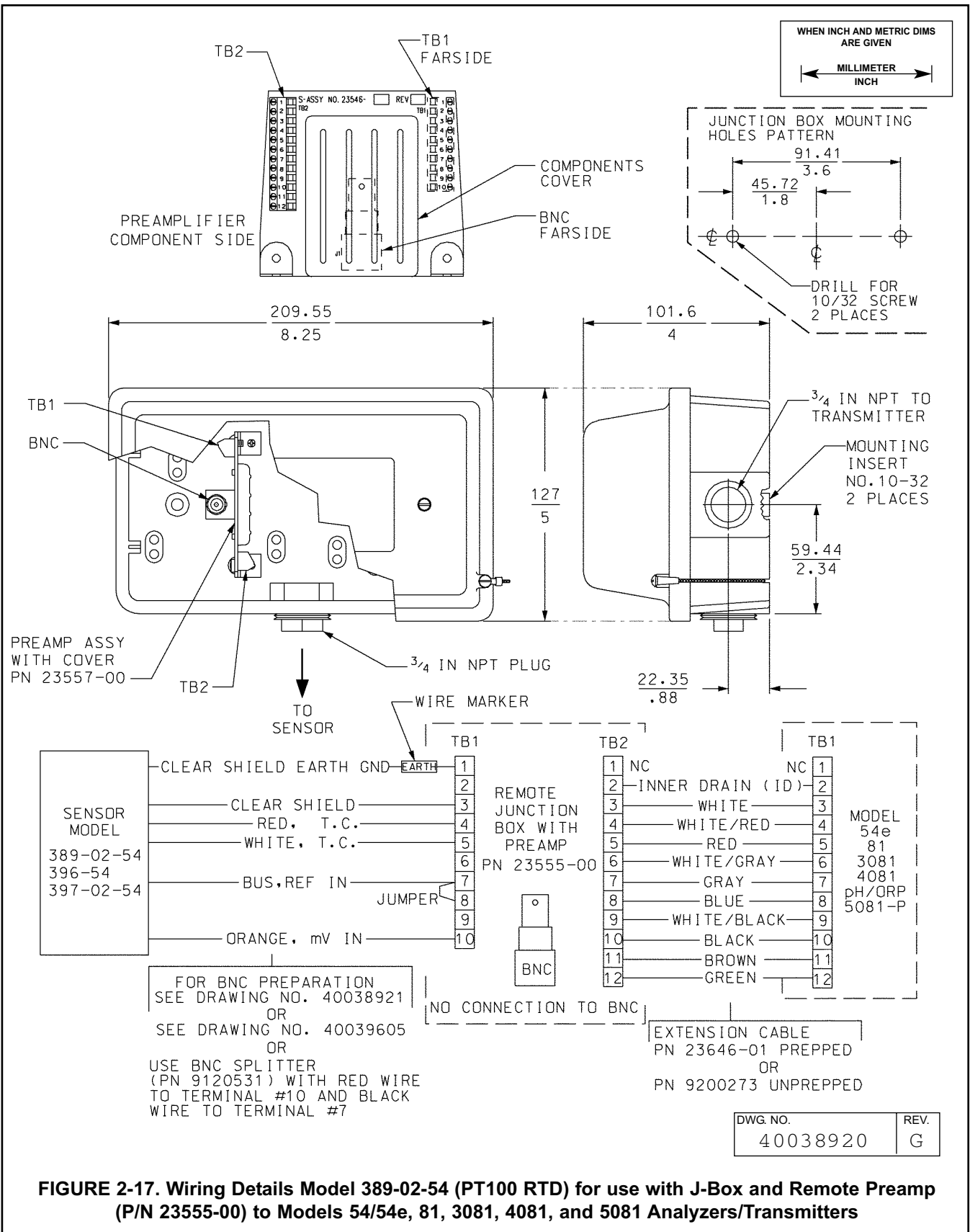
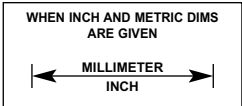
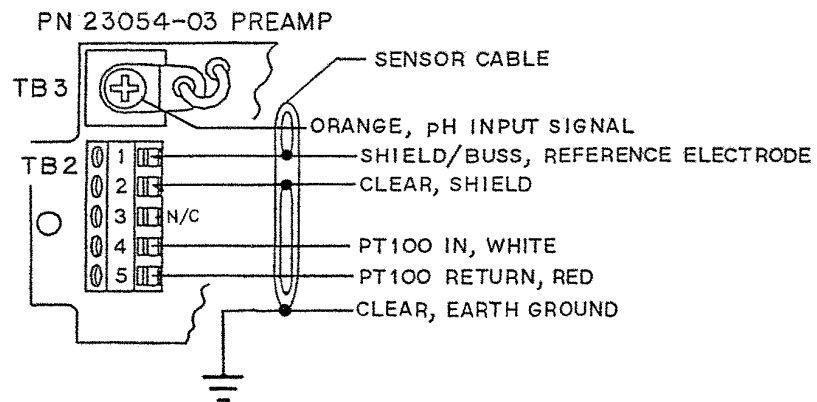
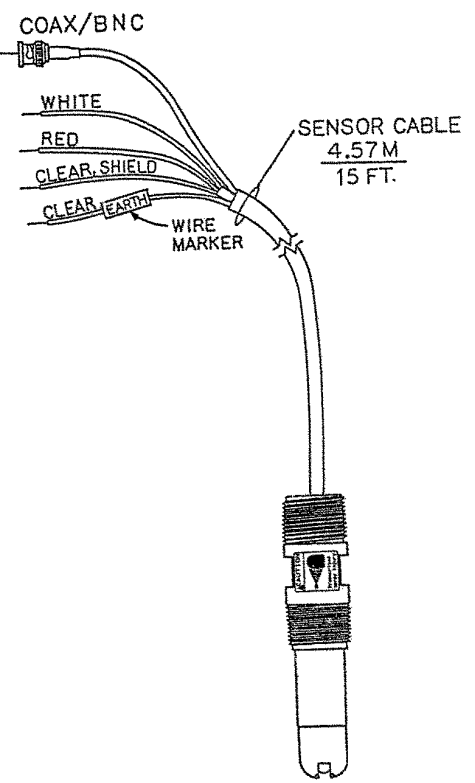
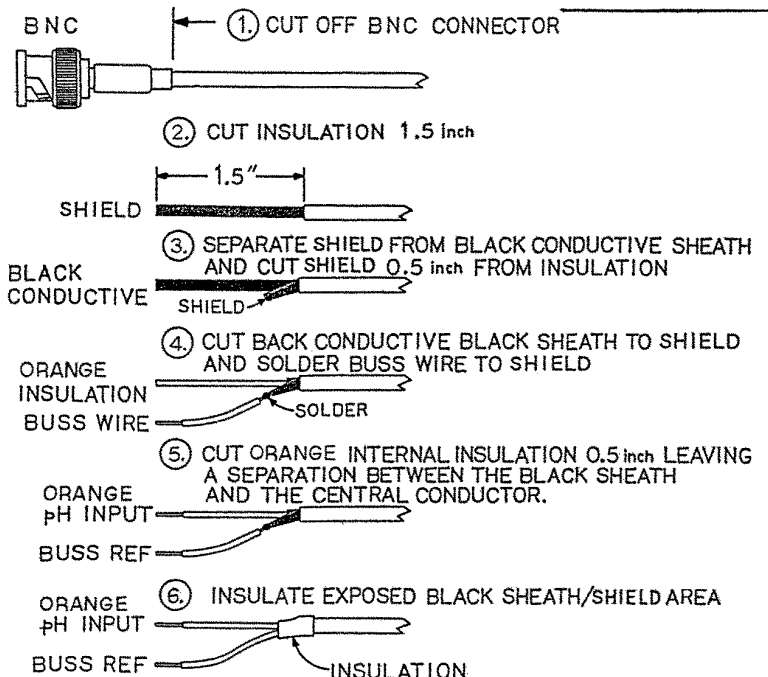


FIGURE 2-17. Wiring Details Model 389-02-54 (PT100 RTD) for use with J-Box and Remote Preamp (P/N 23555-00) to Models 54/54e, 81, 3081, 4081, and 5081 Analyzers/Transmitters



PREPARE THE COAX CABLE AS FOLLOWS:



1. BETWEEN PREAMP AND MODEL 2700 ANALYZER
GROUND SHIELD OF CABLE (P N 661-898695)
TO SECOND GROUNDING RING/QUICK CONNECT LUG
ON INSIDE OF PREAMP BOX.

DWG. NO.	REV.
40038924	D

FIGURE 2-18. Wiring Details Model 389-02-54 (PT100 RTD)
for use with Remote Preamp (P/N 23054-03)

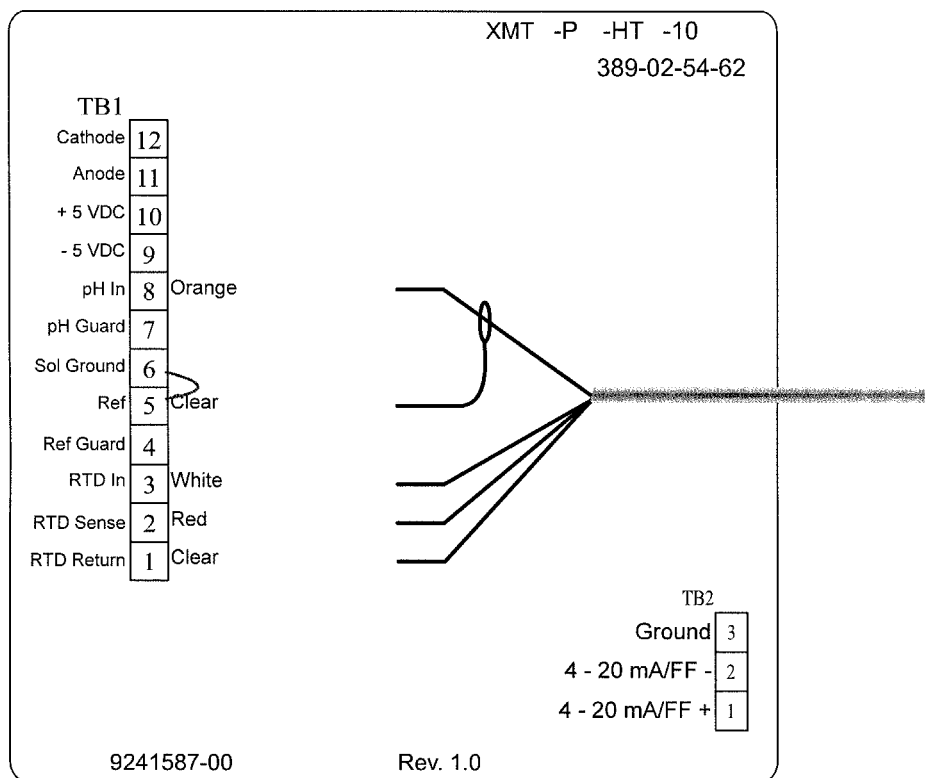


FIGURE 2-19. Wiring Model 389-02-54-62 to Model Xmt-P-HT-10

SECTION 3.0

START UP AND CALIBRATION

3.1 SENSOR PREPARATION. Shake down the sensor to remove any air bubbles that may be present at 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 ± 0.2 pH may be obtained. To obtain greater accuracy or to verify proper operation, the sensor must be calibrated as a loop with its compatible analyzer or transmitter.

3.2 389 pH CALIBRATION.

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

3.2.1 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 buffer solution reads a mV value of approx. zero, and pH buffers read approx. +/- 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 adjust to the buffer temperature (to avoid errors due to temperature differences between the buffer solution and sensor temperature) and wait for reading to stabilize. The 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. 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, a new sensor should be installed to maintain accurate readings.

3.2.2 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 analyzers reading to match that of the known process pH.

1. While obtaining a process solution sample (it is recommended that the sample is 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 a 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.

3.3 MODEL 389 ORP. 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.**

3.3.1 Calibration

1. Make a temporary electrical connection between the sensor and the instrument.
2. Obtain a standard solution of saturated quinhydrone. This can be made quite simply by adding a few crystals of quinhydrone to either pH 4 or pH 7 buffer. Quinhydrone is only slightly soluble, but only a few crystals will be required (refer to Section 4.3.1 for an alternate ORP standard solution).
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 transmitter to the solution value shown in Table 3-1. 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 Table 3-1. 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.
5. Remove the sensor from the buffer, rinse, and install in the process.

TABLE 3-1.
ORP of Saturated Quinhydrone Solution
(In Millivolts)


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

SECTION 4.0 MAINTENANCE

4.0 Maintenance. The Model 389 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.

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!



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

4.1 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 strong 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.

Replace the sensor if it cannot be cleaned.

4.2 Automatic Temperature Compensator. The temperature compensator element is a temperature sensitive resistor and can be checked with an ohmmeter. Resistance increases with temperature.

The 3K element will read 3000 ohms \pm 1% at 25°C (77°F), and a Pt100 will read 110 ohms. Resistance varies with temperature for a 3K and Pt-100 element and can be determined according to Table 4-2 or the following formula:

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

Where R_t = Resistance

T = Temperature in °C

Refer to Table 4-1 for R_0 and R_1 values

TABLE 4-1
 **R_0 and R_1 VALUES FOR TEMPERATURE
COMPENSATION ELEMENTS**

Temperature Compensation Element	R_0	R_1
3K	2934	.0045
PT-100	107.7	.00385

TABLE 4-2
**TEMPERATURE vs RESISTANCE OF AUTO
T.C. ELEMENTS**

Temperature °C	Resistance (Ohms) \pm 1%	
	3K	PT-100
0	2670	100.0
10	2802	103.8
20	2934	107.7
25	3000	109.6
30	3066	111.5
40	3198	115.4
50	3330	119.2
60	3462	123.1
70	3594	126.9
80	3726	130.8
90	3858	134.6
100	3990	138.5

4.3 MODEL 389 ORP

4.3.1 Platinum Electrode Check. The platinum electrode may be checked as follows. There are two types of standard solutions which may be used to check the ORP electrode/transmitter system:

Type 1: One type of commonly used ORP standard solution is the saturated quinhydrone solution. Refer to Section 3.3.

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.

Type 2: A second ORP standard solution can be prepared from the following recipe: 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 recipe, 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.

4.3.2 Cleaning 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 5.0 TROUBLESHOOTING

TABLE 5-1. Troubleshooting

Trouble	Probable Cause	Remedy
Meter reads off scale (Display reads overrange).	Defective preamplifier.	Replace preamplifier (for code 02 sensors). For code 01, replace sensor.
	T.C. element shorted.	Check T.C. element as instructed in Section 4.2 and replace sensor if defective.
	Sensor not in process or sample stream is low.	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 4.2 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 4.2 and replace sensor if defective.
Sluggish or slow meter indication for real changes in pH level.	Electrode coated.	Clean sensor as instructed in Sections 4.1 or 4.3.2. Replace sensor if cracked.
	Electrode defective.	Replace sensor.
Transmitter cannot be standardized.	Electrode coated or cracked.	Clean Sensor as instructed in Sections 4.1 or 4.3.2 and, if cracked, replace sensor.
	Defective preamplifier.	Replace preamplifier.
Transmitter short spans between two different buffer values.	Old glass electrode or high temperature exposure.	Replace sensor.
	Coated glass.	Clean Sensor as instructed in Sections 4.1 or 4.3.2. Replace sensor if cracked.

TABLE 5.2. Model 389 pH/ORP Replacement Parts and Accessories

P/N	DESCRIPTION	QUANTITY
11275-01	Sensor Handrail Mounting Assembly	
2002011	Flow Cell, CPVC, 1 in. FNPT	
23242-02	Mounting Adapter, Insertion, 1-1/4 in. MNPT (304 S.S.) X 3/4 in. FNPT (PEEK)	
23309-03	Junction Box, for remote preamplifier Codes-50 and -51	
23309-04	Junction Box, for remote preamplifier Code-54	
23646-01	Cable, Extension (Prepped) for Model 54pH/ORP Only	
23555-00	Preamplifier and Junction Box (NEMA 4X) For Model 389-02-54 Sensor and Model 54pH/ORP Analyzer	
23557-00	Preamplifier (Remote) For Model 389-02-57 Sensor, J-Box and Model 54pH/ORP Analyzer	
22698-00	Preamplifier, Plug-in, 1003 Compatible (for Code 02-51)	1
22698-02	Preamplifier, Plug-in, 1181/1050 Compatible (for Code 02-50)	1
22698-03	Preamplifier, Plug-in, 1054, 1054A, 2081 Compatible (for Code 02-54)	1
22719-02	Junction Box, w/o Preamp	
33081-00	Adapter Insert, PEEK, 1 X 3/4 in., for 23242-02	
7901631	Shroud, PVC	
9200254	Cable, 4 conductor, 22AWG, 2 pairs shielded (unprepped)	
9200273	Cable, Extension (Unprepped) for Model 54pH/ORP Only	
9210012	Buffer Solution, 4.01pH, 16 oz	4
9210013	Buffer Solution, 6.86pH, 16 oz	4
9210014	Buffer Solution, 9.18pH, 16 oz	4
9322014	Union, Kynar	
9330022	Union, CPVC	
R508-160Z	ORP solution, 460 mV \pm 10 at 20°	

SECTION 6.0 RETURN OF MATERIAL

6.1 GENERAL. To expedite the repair and return of instruments, proper communication between the customer and the factory is important. The "Return of Materials Request" form is provided for you to copy and use in case the situation arises. The accuracy and completeness of this form will affect the processing time of your materials. Call Tel. No. 1-949-757-8500 for a Return Materials Authorization (RMA) number.

6.2 WARRANTY REPAIR. The following is the procedure for returning instruments still under warranty.

1. Contact the factory for authorization.
2. Complete a copy of the "Return of Materials Request" form as completely and accurately as possible.
3. 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.
4. Carefully package the materials and enclose your "Letter of Transmittal" and the completed copy of the "Return of Materials Request" form. If possible, pack the materials in the same manner as it was received.

IMPORTANT

Please see second section of "Return of Materials Request Form". Compliance to the OSHA requirements is mandatory for the safety of all personnel. MSDS forms and a certification that the instruments have been disinfected or detoxified are required.

5. Send the package prepaid to:

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

Attn: Factory Repair

RMA No. _____

Mark the package: Returned for Repair

Model No. _____

6.3 NON WARRANTY REPAIR.

1. Contact the factor for authorization.
2. Fill out a copy of the "Return of Materials Request" form as completely and accurately as possible.
3. Include a purchase order number and make sure to include the name and telephone number of the right individual to be contacted should additional information be needed.
4. Do Steps 4 and 5 of Section 6.2.

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.

C U S T O M E R R E Q U I R E D	FROM: _____ _____ _____	RETURN _____ _____ _____	BILL TO: _____ _____ _____												
N O T I C E T O S E N D E R	<p>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.</p>														
<p>SENSOR OR CIRCUIT BOARD ONLY: (Please reference where from in MODEL / SER. NO. Column)</p> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:33%;">1. PART NO. _____</td> <td style="width:33%;">1. MODEL _____</td> <td style="width:33%;">1. SER. NO. _____</td> </tr> <tr> <td>2. PART NO. _____</td> <td>2. MODEL _____</td> <td>2. SER. NO. _____</td> </tr> <tr> <td>3. PART NO. _____</td> <td>3. MODEL _____</td> <td>3. SER. NO. _____</td> </tr> <tr> <td>4. PART NO. _____</td> <td>4. MODEL _____</td> <td>4. SER. NO. _____</td> </tr> </table>				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. _____
1. PART NO. _____	1. MODEL _____	1. SER. NO. _____													
2. PART NO. _____	2. MODEL _____	2. SER. NO. _____													
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R E A S O N F O R R E T U R N	<p>PLEASE CHECK ONE:</p> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%;"><input type="checkbox"/> REPAIR AND CALIBRATE</td> <td style="width:50%;"><input type="checkbox"/> DEMO EQUIPMENT NO. _____</td> </tr> <tr> <td><input type="checkbox"/> EVALUATION</td> <td><input type="checkbox"/> OTHER (EXPLAIN) _____</td> </tr> <tr> <td colspan="2"><input type="checkbox"/> REPLACEMENT REQUIRED? <input type="checkbox"/> YES <input type="checkbox"/> NO</td> </tr> </table> <p>DESCRIPTION OF MALFUNCTION: _____ _____ _____</p>			<input type="checkbox"/> REPAIR AND CALIBRATE	<input type="checkbox"/> DEMO EQUIPMENT NO. _____	<input type="checkbox"/> EVALUATION	<input type="checkbox"/> OTHER (EXPLAIN) _____	<input type="checkbox"/> REPLACEMENT REQUIRED? <input type="checkbox"/> YES <input type="checkbox"/> NO							
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R E P A I R S T A T U S	<p>WARRANTY REPAIR REQUESTED:</p> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%;"><input type="checkbox"/> YES-REFERENCE ORIGINAL ROSEMOUNT ANALYTICAL ORDER NO. _____</td> <td style="width:50%;">CUSTOMER PURCHASE ORDER NO. _____</td> </tr> <tr> <td colspan="2"><input type="checkbox"/> NO-PROCEED WITH REPAIRS-INVOICE AGAINST P.O. NO. _____</td> </tr> <tr> <td colspan="2"><input type="checkbox"/> NO-CONTACT WITH ESTIMATE OF REPAIR CHARGES: LETTER <input type="checkbox"/> _____</td> </tr> <tr> <td colspan="2">PHONE <input type="checkbox"/> _____</td> </tr> </table>			<input type="checkbox"/> YES-REFERENCE ORIGINAL ROSEMOUNT ANALYTICAL ORDER NO. _____	CUSTOMER PURCHASE ORDER NO. _____	<input type="checkbox"/> NO-PROCEED WITH REPAIRS-INVOICE AGAINST P.O. NO. _____		<input type="checkbox"/> NO-CONTACT WITH ESTIMATE OF REPAIR CHARGES: LETTER <input type="checkbox"/> _____		PHONE <input type="checkbox"/> _____					
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<p>NAME _____ PHONE _____</p> <p>ADDRESS _____</p> <p>_____ ZIP _____</p>															
<p>RETURN AUTHORITY FOR CREDIT ADJUSTMENT [Please check appropriate box(s)]</p> <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%;"><input type="checkbox"/> WRONG PART RECEIVED</td> <td style="width:50%;"><input type="checkbox"/> REPLACEMENT RECEIVED</td> </tr> <tr> <td><input type="checkbox"/> DUPLICATE SHIPMENT</td> <td>REFERENCE ROSEMOUNT ANALYTICAL SALES ORDER NO. _____</td> </tr> <tr> <td><input type="checkbox"/> RETURN FOR CREDIT</td> <td>RETURN AUTHORIZED BY: _____</td> </tr> <tr> <td colspan="2">WARRANTY DEFECT _____</td> </tr> </table>				<input type="checkbox"/> WRONG PART RECEIVED	<input type="checkbox"/> REPLACEMENT RECEIVED	<input type="checkbox"/> DUPLICATE SHIPMENT	REFERENCE ROSEMOUNT ANALYTICAL SALES ORDER NO. _____	<input type="checkbox"/> RETURN FOR CREDIT	RETURN AUTHORIZED BY: _____	WARRANTY DEFECT _____					
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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.RAuniloc.com>

© Rosemount Analytical Inc. 2001



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.*

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CUSTOMER SUPPORT CENTER
1-800-854-8257



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