Instruction Manual
LIQ-MAN-398R-398RVP
Rev. H
March 2017

Rosemount™ 398R/398RVP

pH/ORP Sensors

EMERSON™

Essential Instructions
Read this page before proceeding!

Emerson designs, manufactures and tests its products to meet many national and international standards. Because these sensors 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 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 sensor; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, contact your Emerson 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 Emerson. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, and VOID YOUR WARRANTY. Third-party 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.

The information contained in this document is subject to change without notice.

⚠ 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 combi nation 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 transmitter instruc tion manual for details.

Proper installation, operation and servicing of this sensor in a Hazardous Area Instal lation 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.

⚠ WARNING

Retractable sensors must not be inserted nor retracted when process pressures are in excess of 64 psig (542kPa) for option 21 or 35 psig (343 kPa) for option 25.

⚠ CAUTION

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.

About This Document

This manual contains instructions for installation and operation of the Rosemount 398R and 398RVP pH/ORP Sensors.

The following list provides concerning all revisions of this document.

Rev. Level	Date	Notes
0	01/99	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	07/02	Revised multiple drawings.
B	08/02	Added drawing #40105549, rev. D.
C	10/02	Revised drawing on page 10.
D	08/03	Added Silcore information.
E	06/04	Updated ordering info and added/revised wiring drawings.
F	10/05	Delete obsolete options.
G	01/11	Miscellaneous revisions.
H	03/17	Updated the Ordering Information, Specifications, Product Certifications, and Emerson logo and Address.

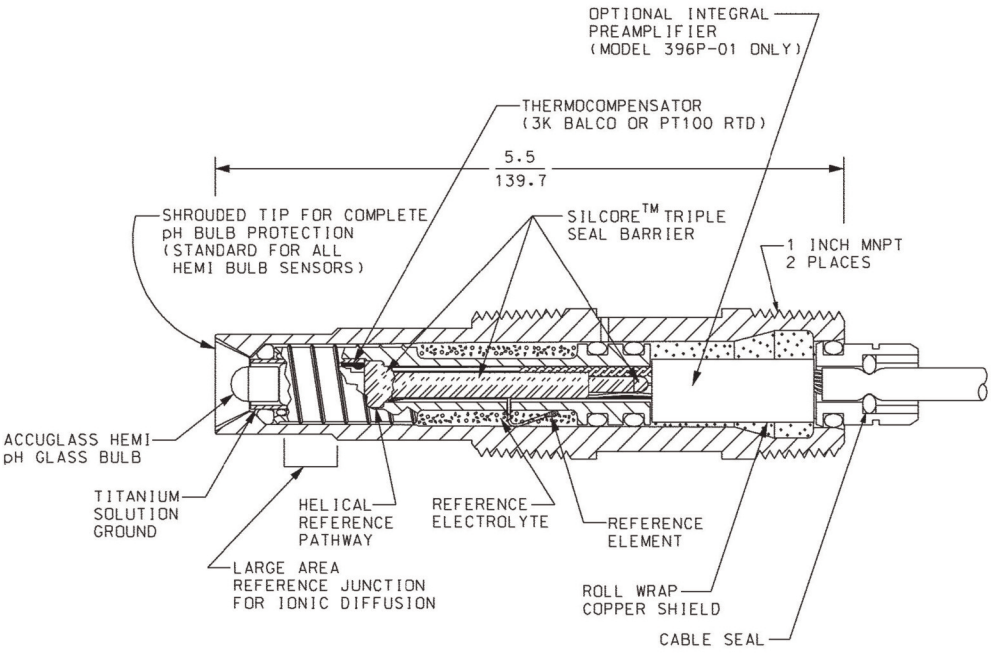
Contents

Section 1: Description and Specifications

1.1 Features and Applications

Rosemount 398R and 398RVP sensors feature a chemical resistant construction of Tefzel, titanium, and a TUpH reference junction which is ideal for measuring pH in harsh process liquids. These sensors can be used to measure pH in sour water strippers, in pulp bleaching towards that use chlorine dioxide, and in process streams containing a variety of organic solvents. These sensors are designed for use with a 1-1/4 inch or 1-1/2 inch ball valve.

Figure 1-1: Cross Section Diagram of the TUpH Reference Technology



All TUpH sensors are designed with a large area reference junction, helical reference pathway, and an AccuGlass pH glass bulb. This sensor technology ensures superior performance while only requiring minimal maintenance.

1.2 Specifications

Table 1-1: Percent linearity over pH

pH Range	Hemi Bulb
0-2 pH	94%
2-12 pH	99%
12-13 pH	97%
13-14 pH	92%

Table 1-2: Rosemount 398R-398RVP sensor specifications

Measured Range	
pH range	0 to 14 pH, GPHT ACCUGLASS
ORP range	-1500 mV to 1500 mV
Maximum Pressure at Retraction or Insertion	
64 psig (524 kPa abs) Code 21	
35 psig (343 kPa abs) Code 25	
Minimum Conductivity	
75 µS/cm, nominal 100 µS/cm	
Maximum Process Pressure and Temperature	
Hemi bulb: 250 psig (1825 kPa abs) at 212°F (100°C)	
Flat bulb: 100 psig (790 kPa abs) at 212°F (100°C)	
Wetted Materials	
Titanium, Tefzel®, glass, platinum (ORP only), and choice of Viton® or Kalrez®	
Reference	
Permeable Tefzel with secondary helical pathway	
Weight/Shipping Weight	
Sensor	Code 21; 2.0 lb/3.0 lb (.9kg/1.40kg)
	Code 25; 3.0 lb/4.0 lb (1.40 kg/1.80kg)
Process Connections	
With ball valve	1-1/2 in.
Without ball valve	1 in.
Cable Length	
Rosemount 398R	Standard 15 ft. Integral Cable; Optional 9.5 inch Cable for wiring to Sensor Head Junction Boxes
Rosemount 398RVP	Must use VP interconnect cable (sold separately)

1.3 Product Certifications

Please see online certificates for further details.

IECEx

Sensors with no preamp (pH and ORP) – Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +60 °C)

Sensors with SMART preamp (398RVP pH only) – Ex ia IIC T4 Ga (-20 °C ≤ Ta ≤ +60 °C)

Per standards IEC60079-0 : 2011, IEC 60079-11 : 2011

ATEX

Sensors without preamp (pH and ORP) – Ⓔx II 1 G Ex ia IIC T4 Ga (-20 °C ≤ Ta ≤ +60 °C)

Sensors with SMART preamp (398RVP pH only) – Ⓔx II 1 G Ex ia IIC T4 Ga (-20 ˚C ≤ Ta ≤ +60 °C)

Per standards EN 60079-0: 2012+A11:2013, EN 60079-11:2012

FM

See online FM Certificate of Compliance for applicable sensor options:

Intrinsically Safe for use in Class I, II, and III, Division 1, Groups A, B, C, D, E, F, and G; Temperature Class T6 Ta = -20 °C to +60 °C

Intrinsically Safe for use in Class I, Zone 0, AEx ia IIC T6 Ta = -20 °C to +60 °C

Nonincendive for use in Class I, Division 2, Groups A, B, C, and D; Temperature Class T6 Ta = -20 °C to +60 °C

Suitable for use in Class II and III, Division 2, Groups E, F, and G; Temperature Class T6 Ta = -20 °C to +60 °C Hazardous (Classified) Locations

IS/I,II,III/1/ABCDEFG/T6 Ta = 60°C - 1400332; Entity; I/0/AEx ia IIC/T6 Ta = 60 °C - 1400332; Entity; NI/I/2/ABCD/T6 Ta = 60 °C; S/II,III/2/EFG/T6 Ta = 60 °C

Per standards 3600:1998, 3610:2010, 3611:2004, 3810:2005

CSA

See online CSA Certificate of Compliance for applicable sensor options:

Sensors with preamp – Intrinsically Safe:

Class I, Division 1, Groups ABCD; Class II, Division 1, Groups EFG; Class III; Class I, Division 2, Groups ABCD; Ambient temperature rating -20 °C to +60 °C; Ex ia IIC; T6

Sensors without preamp – Intrinsically Safe and Non-Incendive:

Class I, Division 1, Groups ABCD; Class II, Division 1, Groups EFG; Class III; Class I, Division 2, Groups ABCD; Ex ia IIC; T6; Ambient temperature rating -20 °C to +60 °C: (Simple Apparatus)

Per standards C22.2 No. 0-10, C22.2 No. 0.4-M2004, C22.2 No. 94-M1991, C22.2 No. 142 – M1987, C22.2 No 157 – M1992, CAN/CSA E60079-0:07, CAN/CSA E60079- 11:02, UL50 11th Ed, UL508 17th Ed, UL913 7th Ed, UL 60079-0: 2005, UL 60079-11: 2002

1.4 Ordering Information

Table 1-4: Rosemount 398R ordering information

Model	Sensor type
398R	pH/ORP Sensor
Measuring Electrode Type	
10	pH - GPHT Glass
12	ORP
13	pH - GPHT Flat Glass
Sensor Length	
21	21 Inch Titanium Tube
25	36 Inch Titanium Tube
O-ring Material	
30	EPDM
31	Viton
32	Kalrez
Transmitter/TC Compatibility	
54	Pt-100
Cable Options	
_	No Selection
60	9.5 Inch Cable with BNC (1)
61	9.5 Inch Cable without BNC (1)
62	15 ft (4.6 m) Cable without BNC (2)
Typical Model Number: 398R-10-21-30-54-62	

1. *For use with sensor-head junction boxes.*
2. *For use with Rosemount 1056, 1057, 1066, 56, and 56 Transmitters.*

Table 1-5: Rosemount 398RVP ordering information

Model	Sensor type
398RVP	pH/ORP Sensor
Measuring Electrode Type	
10	pH - GPHT Glass
12	ORP
13	pH - GPHR Flat Glass
Sensor Length	
21	21 Inch Titanium Tube
25	36 Inch Titanium Tube
O-ring Material	
30	EPDM
31	Viton
32	Kalrez
Transmitter/TC Compatibility	
50	3K TC (1)
54	Pt-100
55	Pt-100 for SMART Preamplifier (2)
Preamplifier Options	
_	No Selection
70	SMART Preamplifier (3)
Typical Model Number: 398RVP-10-25-31-55-70	

1. *For use with legacy transmitter model 1181. If selected with ORP, the sensor comes without a 3K TC.*
2. *For use with Rosemount 1056, 1057, 1066, 56, and 5081 transmitters. Must be selected with option 70.*
3. *Only available with option 55.*

Section 2: Installation

2.1 First Time Installation

For first time installations, using the following guide is recommended:

Variopol Mating Connector Cables (Required for Rosemount 398RVP only)

Choose one:

PN 24281-00, 15 ft cable with mating VP connector

PN 24281-06, 10 ft cable with mating VP connector

Retractable Mounting

A. Choose one (required for all first time installations without ball valves or with 1-1/2 in. ball valve):

PN 23166-00, 1 in. MNPT process connector, Stainless Steel w/EPDM O-ring

PN 23166-01, 1 in. NPT process connector, Titanium w/EPDM O-ring

B. Choose one (Optional; Process Connector O-rings):

PN 9550220, O-ring, Kalrez®, 2-214

PN 9550099, O-ring, Viton®, 2-214

C. Choose one:

PN 23240-00, 1-1/2 in. ball valve assembly, 316 SST (process connector required)

PN 23765-00, 1-1/4 in. ball valve assembly, 316 SST, with graphite packed adapter

Junction Boxes (Optional; Choose either Sensor Head or Remote)

A. Sensor Head Junction Boxes (used with 9.5 in. cable length sensor) - Choose one:

PN 23709-00; includes preamplifier

B. Remote Junction Boxes (used with 15 ft cable length sensor or Rosemount 398RVP) Choose one:

PN 23555-00; includes preamplifier

Extension Cables - Choose one:

PN 23646-01, 11 conductor, shielded, prepped

PN 9200273, 11 conductor, shielded, unprepped

2.2 Unpacking and Inspection

Inspect the outside of the carton for any damage. If damage is detected, contact the carrier immediately. Inspect the instrument and hardware. Make sure all items in the packing list are present and in good condition. Notify the factory if any part is missing.

Note: If the sensor is to be stored, the protective boot should be filled with either KCl electrolyte solution or pH 4.0 buffer solution and replaced on sensor tip until ready to use.

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 6.0 for instructions.

⚠ WARNING

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

2.3 Mechanical Installation

Both models may be installed through a weldalet or in a pipe tee or "Y", as shown in Figure 2-2, when used with a ball valve. Insert the end of the sensor to a depth sufficient to ensure that the glass bulb is continuously wetted by the process fluid. Each model can also be inserted directly into the process without the use of a ball valve for appli cations not requiring continuous operation during sensor maintenance.

⚠ CAUTION

Allow sufficient room for safe retraction and insertion of the sensor. Personnel should have room for stable footing while performing removal or insertion of the sensor.

The sensor must be mounted within 10-90 degrees of the horizontal with the tip pointed downward. This ensures that the inside surface of the pH-sensitive glass bulb is completely wetted and that there is a good electrical connection between the bulb and the internal silver/silver chloride reference electrode. If the retraction version is to be installed without a ball valve follow the installation procedure for insertion service (Section 2.3.2). Perform the following steps for sensor installation through a ball valve:

2.3.1 Installation Through Ball Valve

1. Carefully remove the liquid filled rubber boot which protects the glass electrode and keeps the liquid junction wet during shipping and storage. Discard the liquid and boot. Make sure the lubricated O-ring is in place in the groove inside the male connector on the sensor body.

⚠ CAUTION

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

2. With the male connector on the sensor's body, insert the sensor into the ball valve until it gently touches the closed valve. The molded electrode guard will protect the glass bulb from breakage. (extra caution should be taken when inserting the flat glass sensor into the valve because it does not have an electrode guard).

3. Thread the male connector body tightly into the ball valve assembly. DO NOT tighten the hex nut on the male connector body; doing so would not allow the sensor to be inserted through the ball valve.

4. Pull back hard on the sensor assembly, as if trying to remove the sensor, to be certain that the sensor cannot come free of the ball valve assembly. The built-in retraction stop will butt against the shoulder of the male connector if properly installed.

⚠ CAUTION

The sensor must be captured by the valve assembly and the male connector so that it cannot be blown free by process pressure if mishandled during insertion or retraction.

5. After confirming that the sensor assembly is properly secured by the valve assembly, the valve may be opened and the sensor positioned into the process at the desired depth and orientation.

6. While holding the sensor in position, tighten the hex nut of the male connector to firmly secure the sensor in place. When the hex nut is tightened, the Teflon ferrule inside the compression fitting clamps the sensor tube.

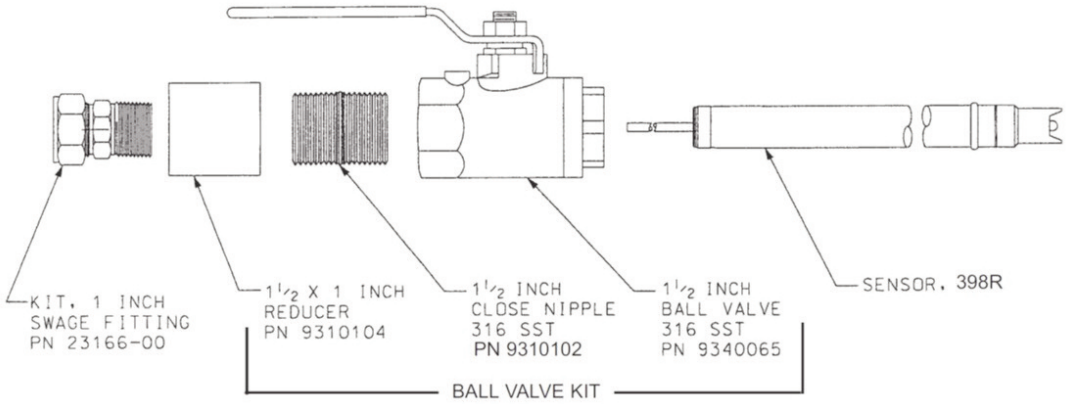
⚠ CAUTION

Over tightening the hex nut may damage the ferrule.

NOTICE

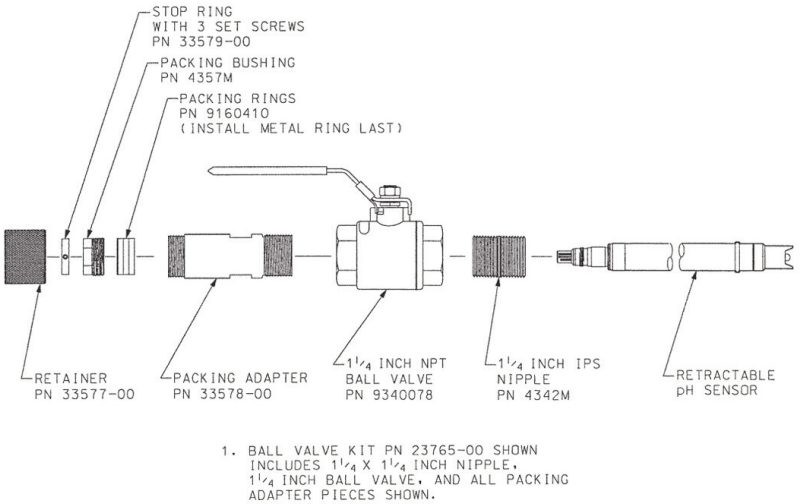
A stainless steel ferrule is available if the Teflon ferrule does not inadequately grip. When using the metallic ferrule, care must be taken to avoid over tightening and damaging the sensor tube. If the male connector leaks during insertion or retraction, replace the O-ring in the male connector.

Figure 2-1: Exploded View of Ball Valve Kit PN 23240-00 used with process connector PN 23166-00 (or PN 23166-01)



Ball Valve Kit includes 1-1/2 in. x 1 in. reducer, 1-1/2 in. close nipple, and 1-1/2 in. ball valve]

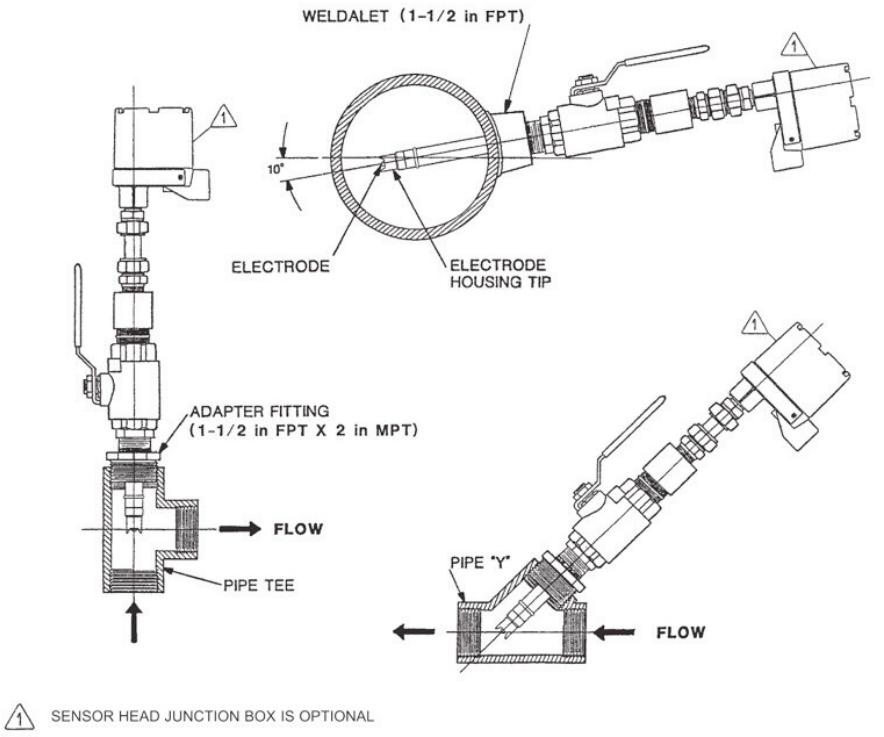
Figure 2-2: Exploded View of Ball Valve Kit PN 23765-00



2.3.2 Installation Without Ball Valve

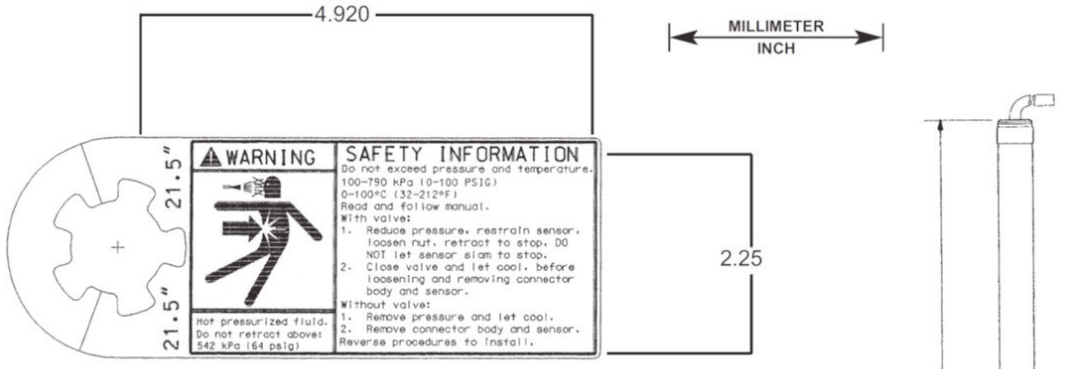
Rosemount 398R and 398RVP Sensors may be installed through a weldalet or pipe tee or "Y" when used with a process connector (PN 23166-00 or 23166-01). The sensor should be installed within 80° of vertical, with the electrode facing down.

Figure 2-3: Typical Mounting Details-Retraction Version



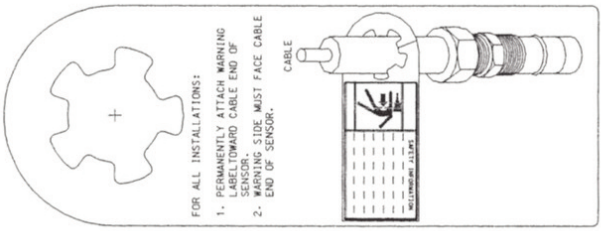
Note: Sensor must be mounted at an angle between 10° and 90° above the horizontal.
Pipe tees and weldalets provided by customer.
Only Rosemount 398R should be used with a sensor head junction box.

Figure 2-4: Dimensional Warning Label and Sensor Diagram

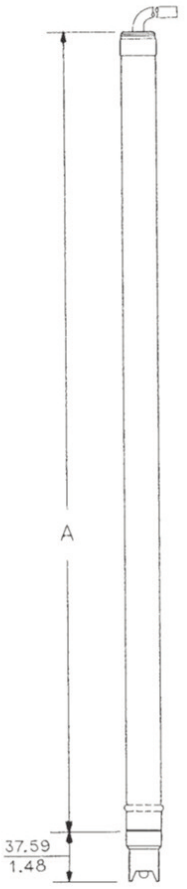


Front Side 398R-21

Note: Retraction and max. operating pressure for 21 in. tube with flat glass is shown on this label. Retraction and max. operating pressure for the 21 in. and the 36 in. sensors are shown in the tables below.



Back Side 398R

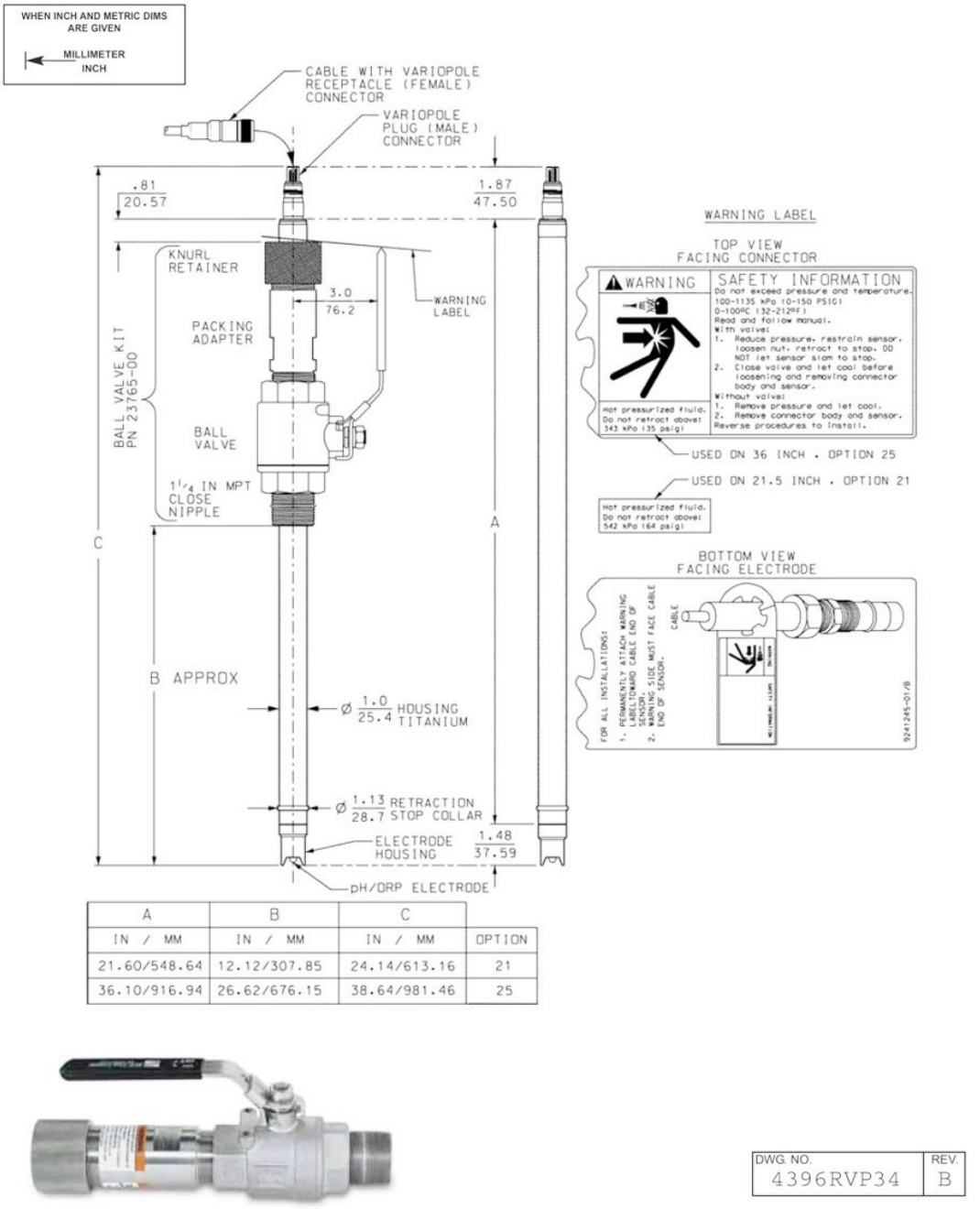


A		
MM / IN	Sensor Tube Length	Retraction Pressure
548.64 / 21.60	21 inches	64 psig (542 kPa)
916.94 / 36.10	36 inches	35 psig (343 kPa)

MAXIMUM OPERATING PRESSURE
Flat bulb — 100 psig
Hemi bulb — 250 psig

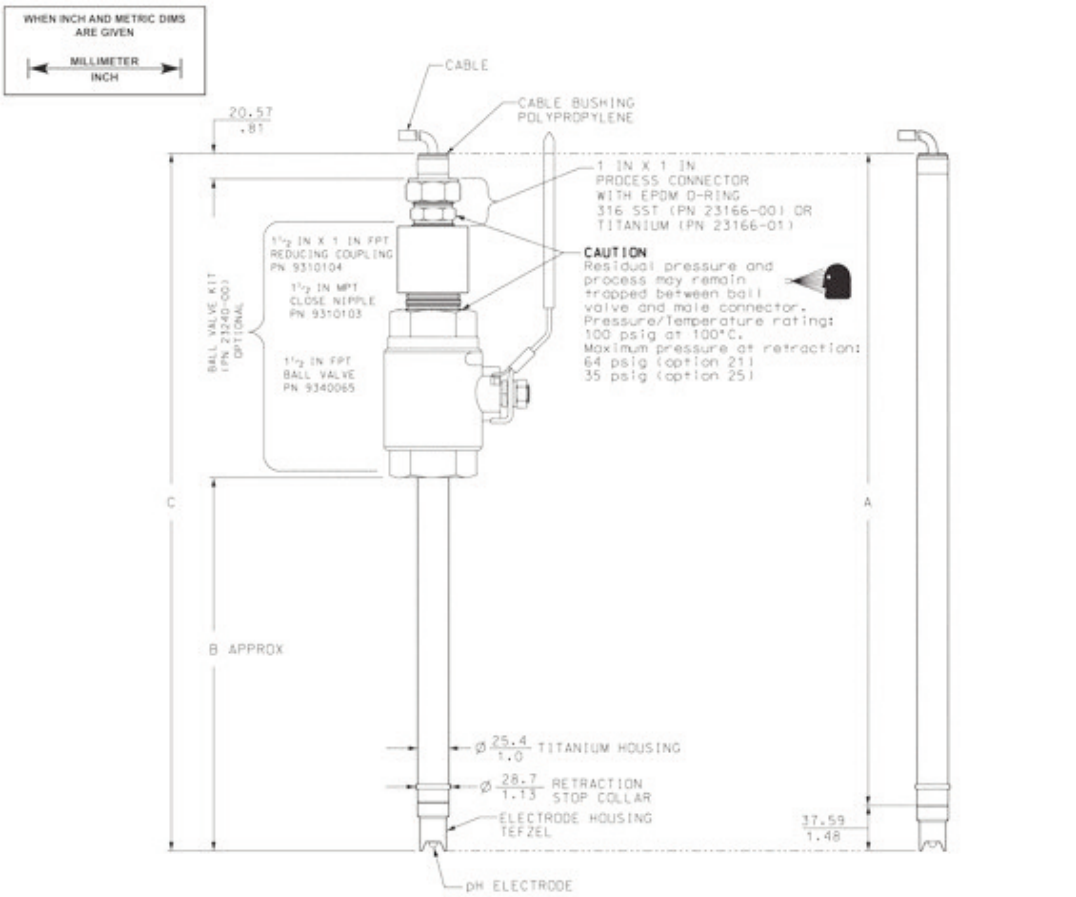
Note: For Rosemount 398RVP, the overall dimensional length increases by 1.9 inches (48 mm).

Figure 2-5: Dimensional Drawing for Ball Valve Kit PN 23765-00 (shown with Rosemount 398RVP sensor)



A	B	C	
IN / MM	IN / MM	IN / MM	OPTION
21.60/548.64	12.12/307.85	24.14/613.16	21
36.10/916.94	26.62/676.15	38.64/981.46	25

Figure 2-6: Dimensional Drawing for Ball Valve Kit PN 23240-00 (shown with Rosemount 398R).

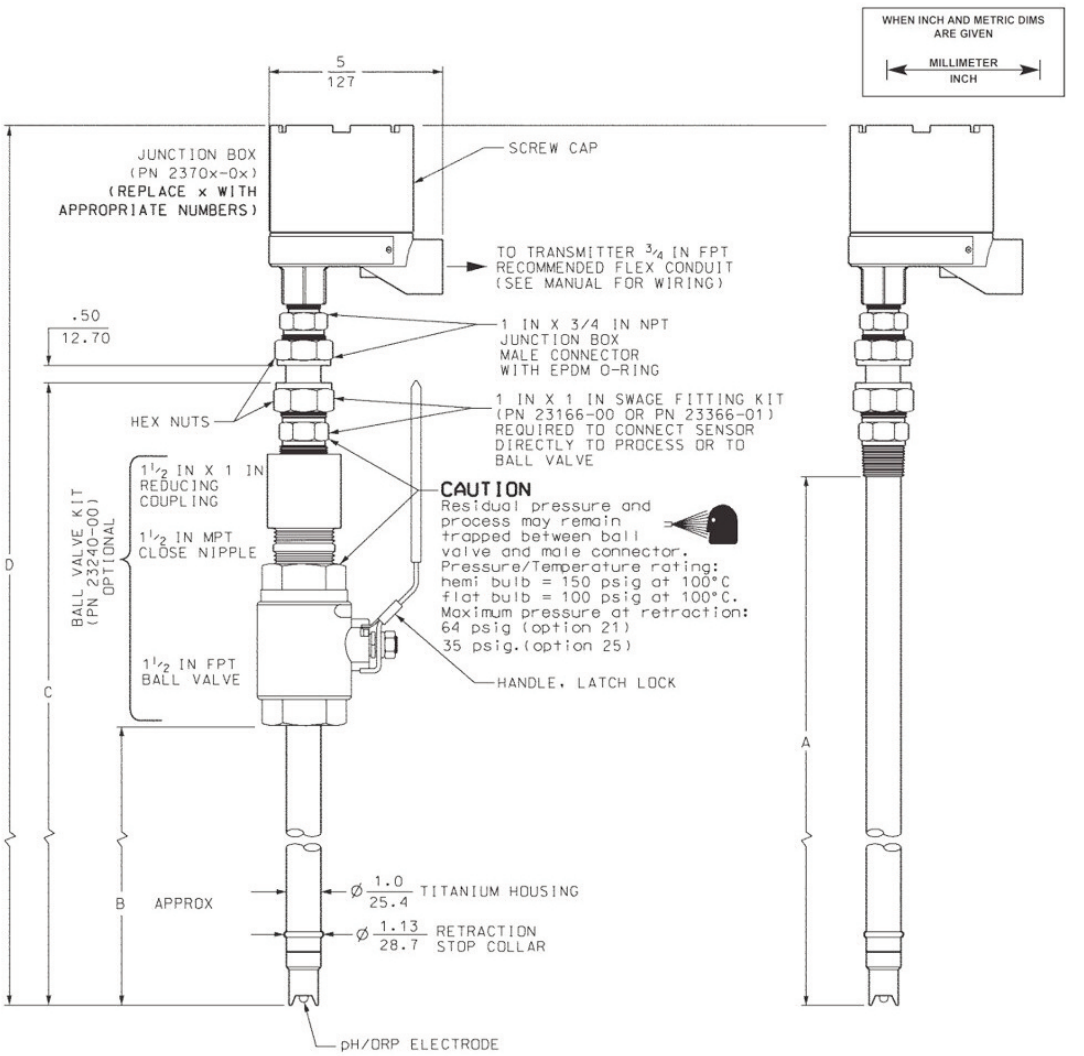


Ball Valve Kit (PN 23240-00)

A process connector (PN 23166-00 or -01) must be used to connect the sensor to Ball Valve Kit 23240-00. Process connector can be purchased separately.

Note: For Rosemount 398RVP, the overall dimensional length increases by 1.9 inches (48 mm).

Figure 2-7: Dimensional Drawing of Rosemount 398R shown with Sensor Head Junction Box, with and without 1-1/2 in. Ball Valve PN 23240-00



DWG. NO.	REV.
40396R03	G

TABLE 1

398R	A		B		C		D	
OPTION	MM	IN	MM	IN	MM	IN	MM	IN
-21	477.77	18.81	304.8	12.0	538.23	21.19	689.36	27.14
-25	846.07	33.31	673.1	26.5	906.53	35.69	1064.26	41.90

Note: For the installations shown, the 1 in. x 1 in. process connector (PN 23166-00 or 23166-01), sensor head junction boxes (various part numbers; see page 3), and ball valve kit (PN 23240-00) must be purchased separately.

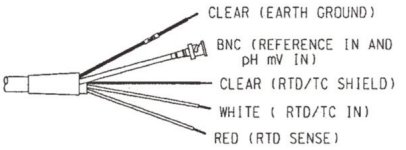
Note: Sensor head junction boxes should be used with Rosemount 398R sensor

Section 3: Wiring the Rosemount 398R/398RVP Sensor

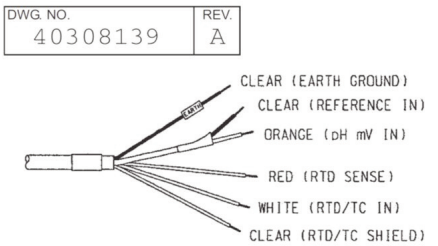
3.1 Wiring for Rosemount 398R/398RVP

For wiring diagrams not shown below, please refer to the Liquid Wiring Diagrams.

Figure 3-1: Wire Configurations



Wire Configuration for Code -60 and Standard Cable Options



Wire Configuration for Code -61 and -62 Cable Options

Figure 3-2: Wiring for Rosemount 398R-54-62 to 3081, 4081, and 5081 Transmitters.

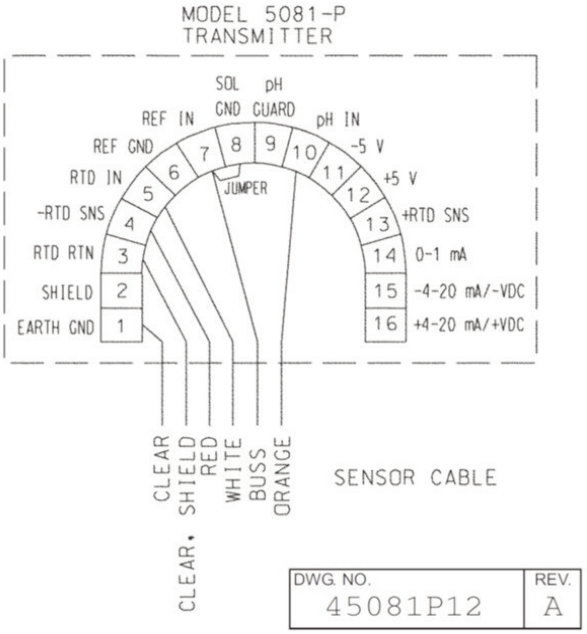
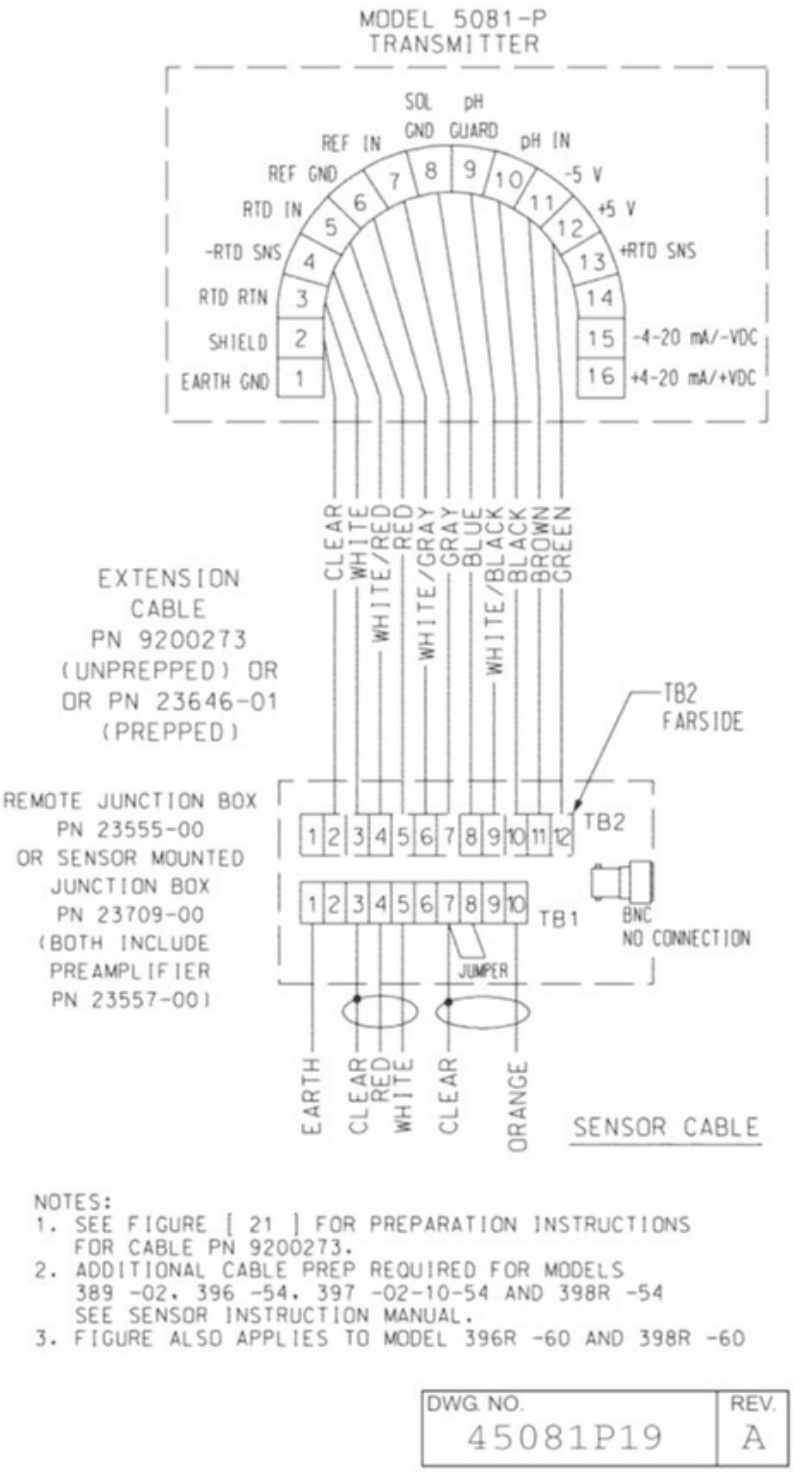


Figure 3-3: Wiring for 398R-54-62 Through Remote Junction Box PN 23555-00



Note: Sensor Model 398R-54 or 398R-54-60 can also be wired as shown above, but customer must prepare the BNC as shown in Figure 3-4. For preparing wires on end of extension cable, use Figure 3-5.

Figure 3-4: BNC Preparation Instructions

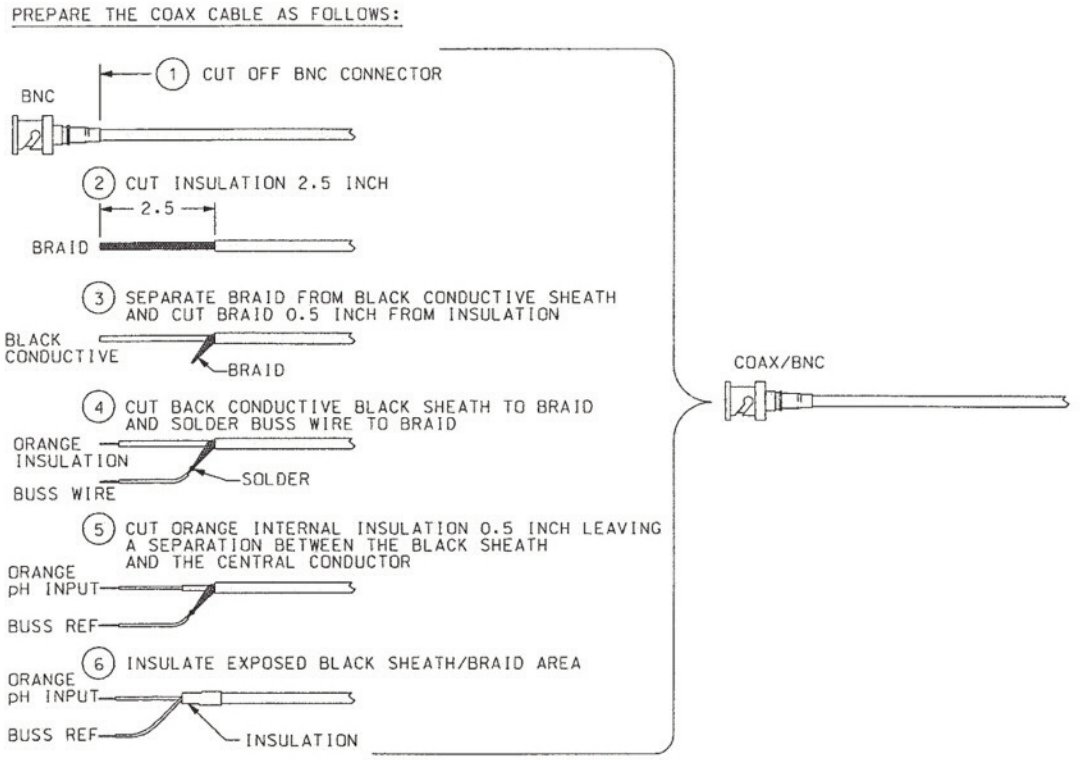


Figure 3-5: Extension Cable Preparation

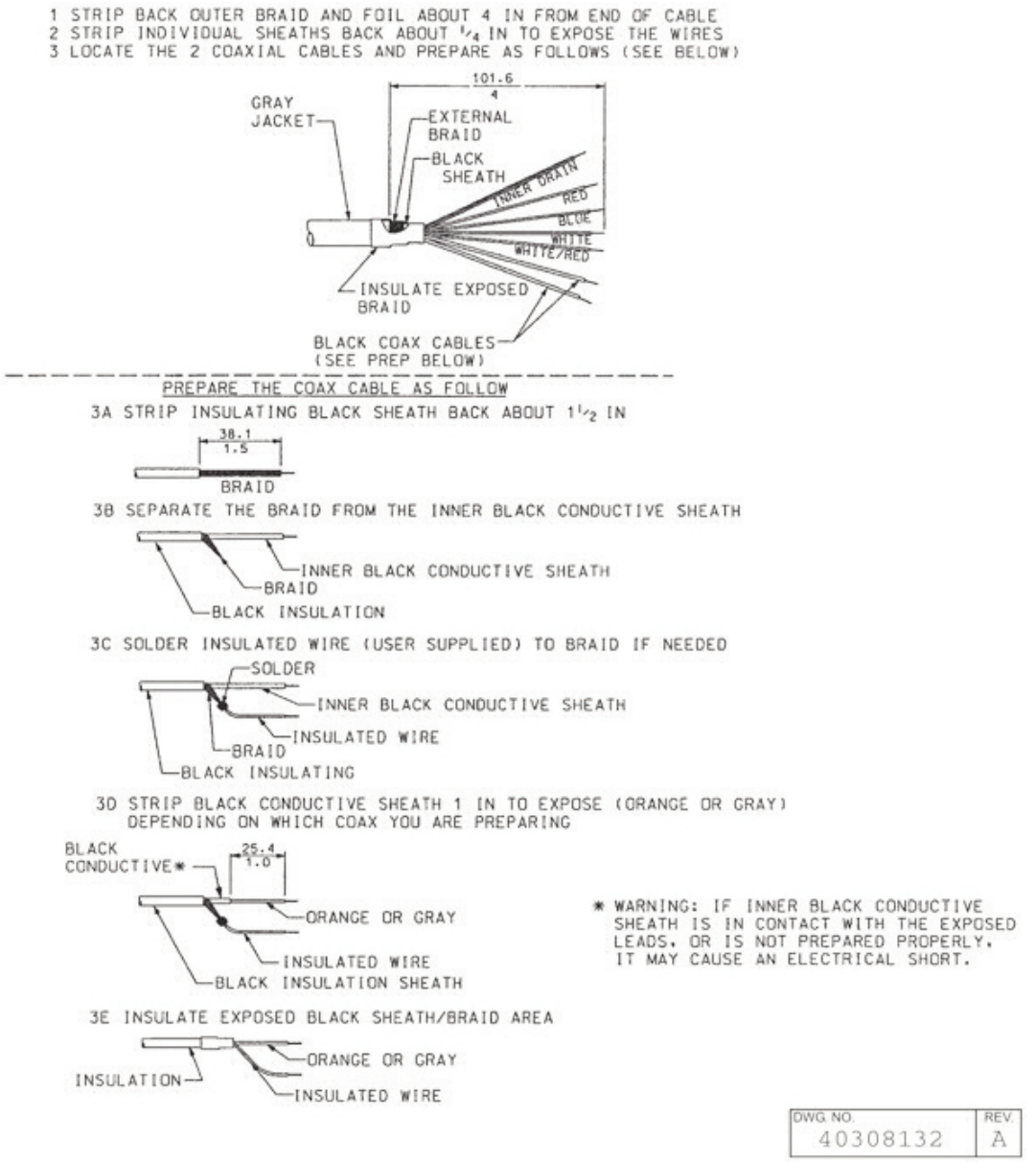


Figure 3-6: Rosemount 398R-54-61 Wiring to Rosemount 1056/56 Transmitters

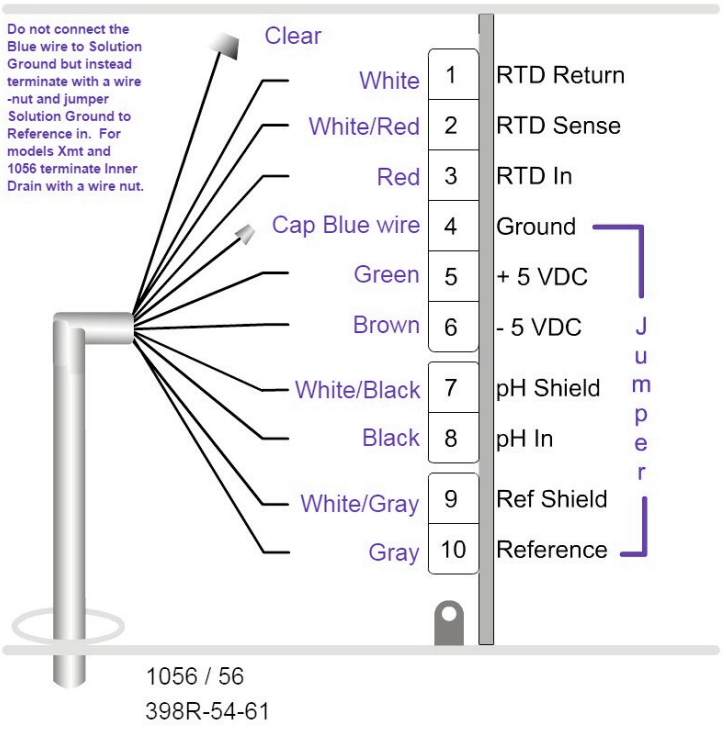


Figure 3-7: Rosemount 398R-54-61 Wiring to Rosemount 1057 Transmitter

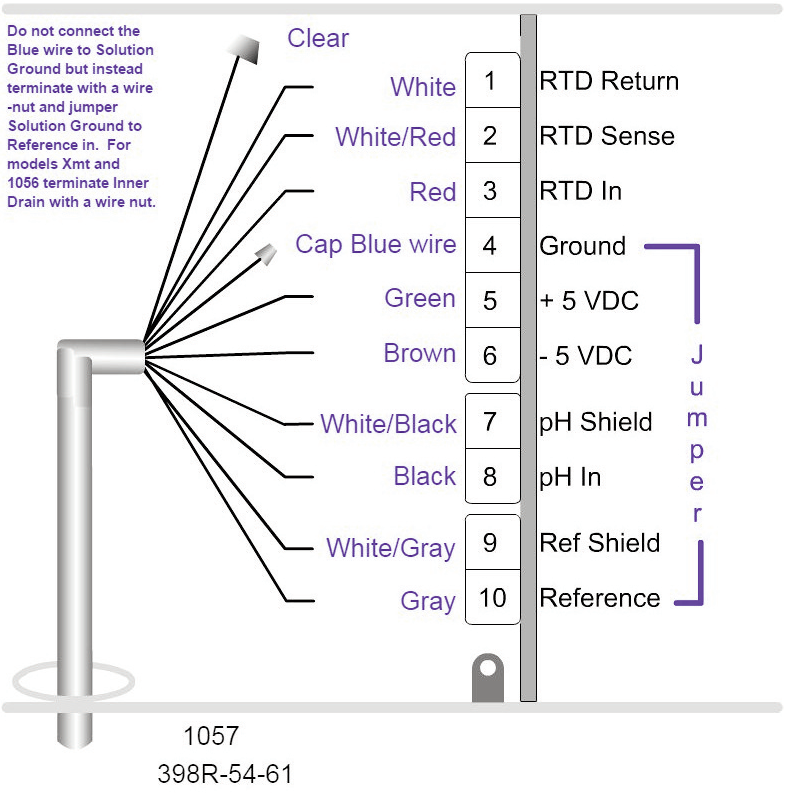


Figure 3-8: Rosemount 398R-54-61 Wiring to Rosemount 1066 Transmitter

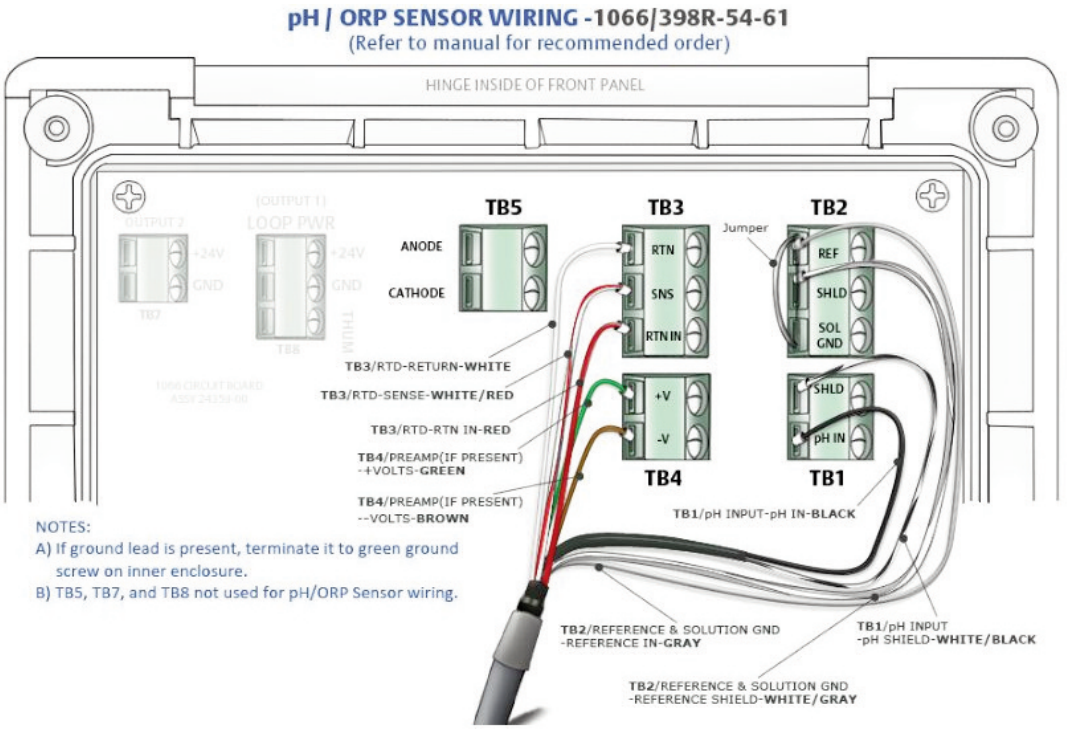


Figure 3-9: Rosemount 398R-54-61 Wiring to Rosemount 5081

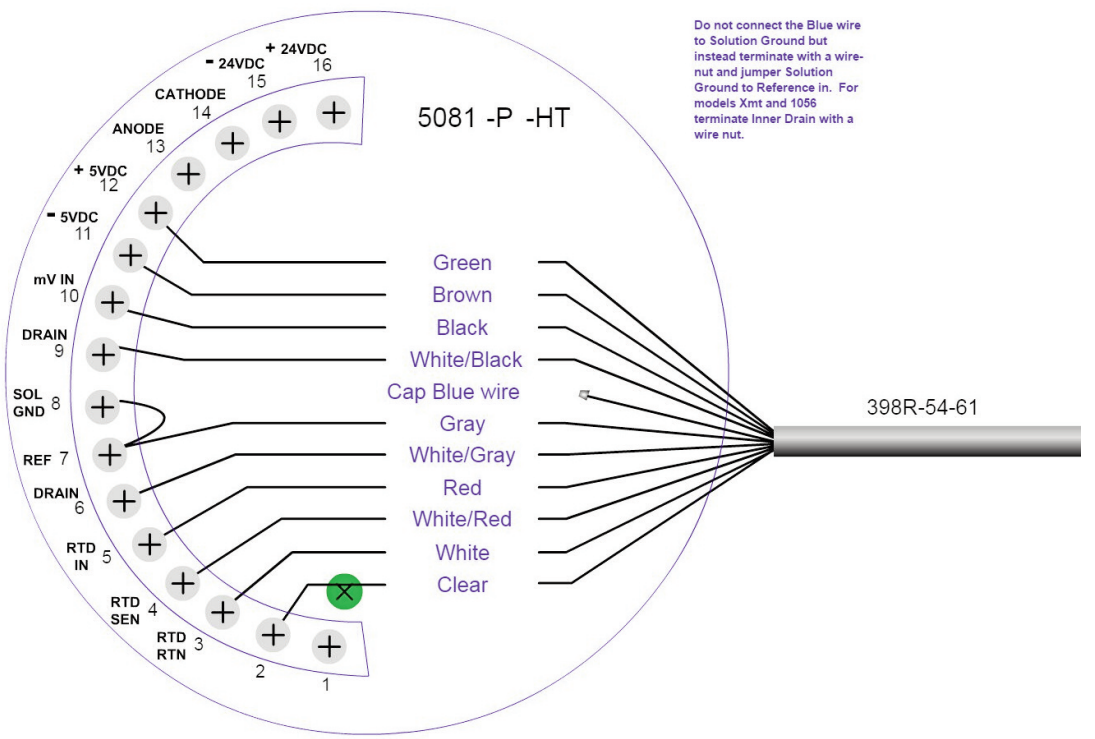


Figure 3-10: Rosemount 398R-xx-xx-54-62 Wiring to Rosemount 1056/56/1057 Transmitters

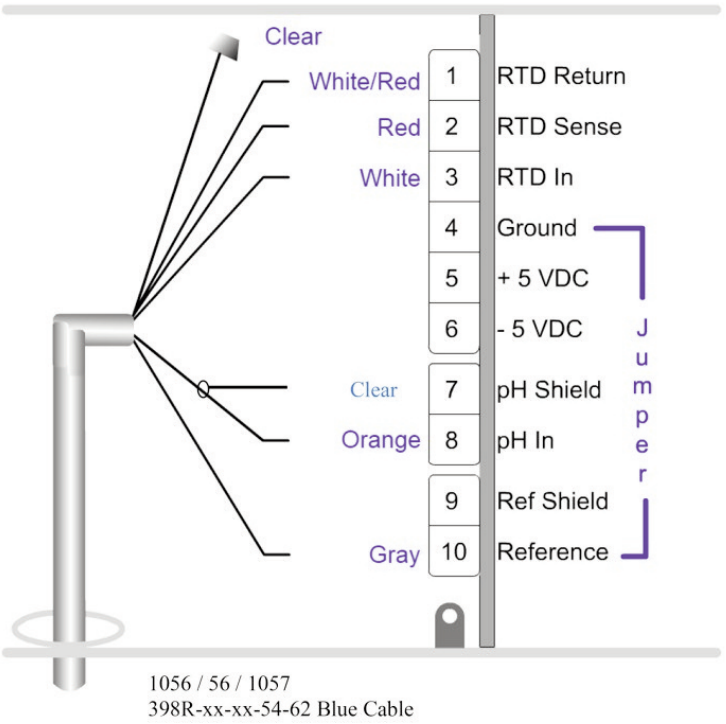


Figure 3-11: Rosemount 398R-xx-xx-54-62 Wiring to Rosemount 1066 Transmitter

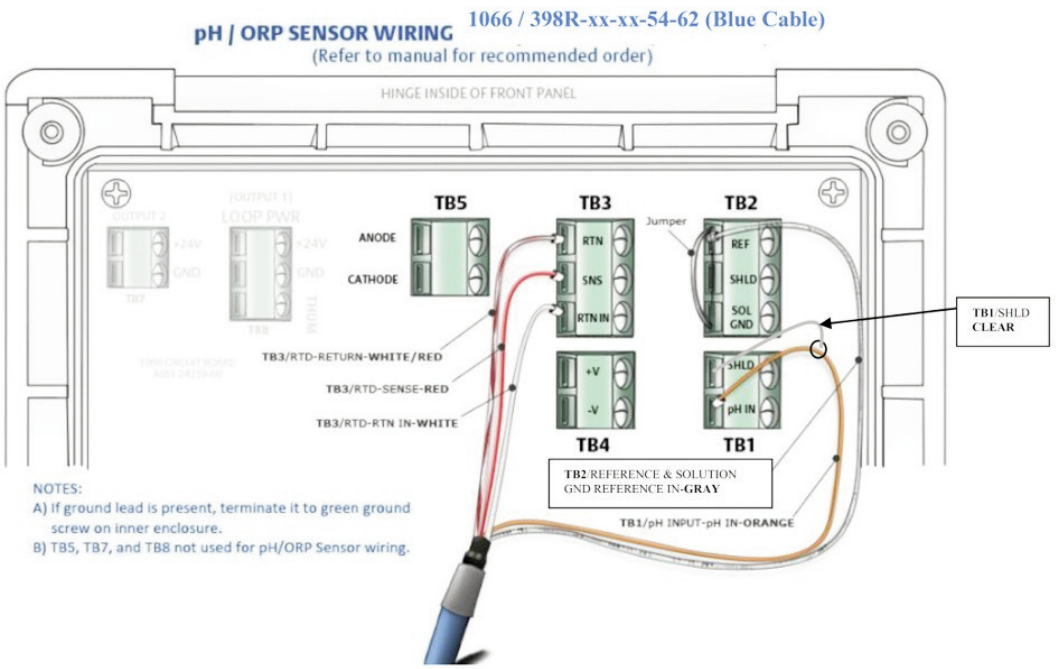


Figure 3-12: Rosemount 398R-xx-xx-54-62 Wiring to Rosemount 5081 Transmitter

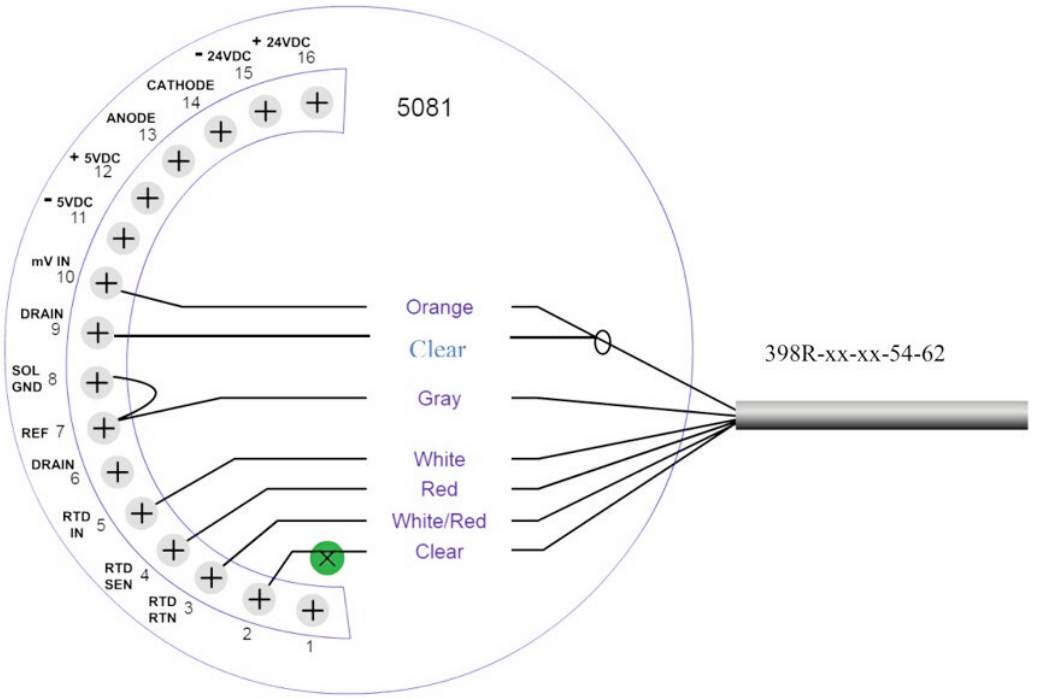


Figure 3-13: Rosemount 398RVP Wiring to Rosemount 1056/56 Transmitters

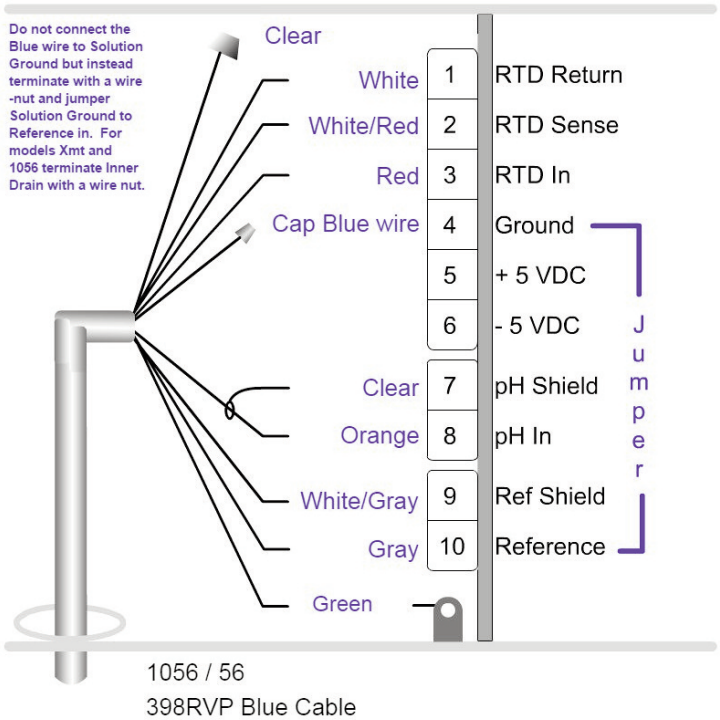


Figure 3-14: Rosemount 398RVP Wiring to Rosemount 1057 Transmitter

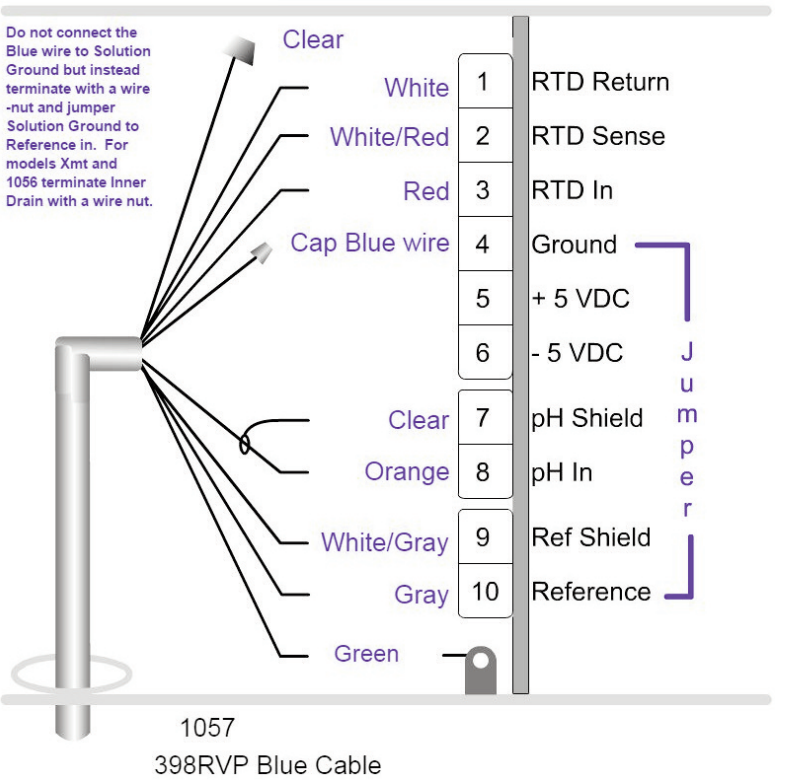


Figure 3-15: Rosemount 398RVP Wiring to Rosemount 1066 Transmitter

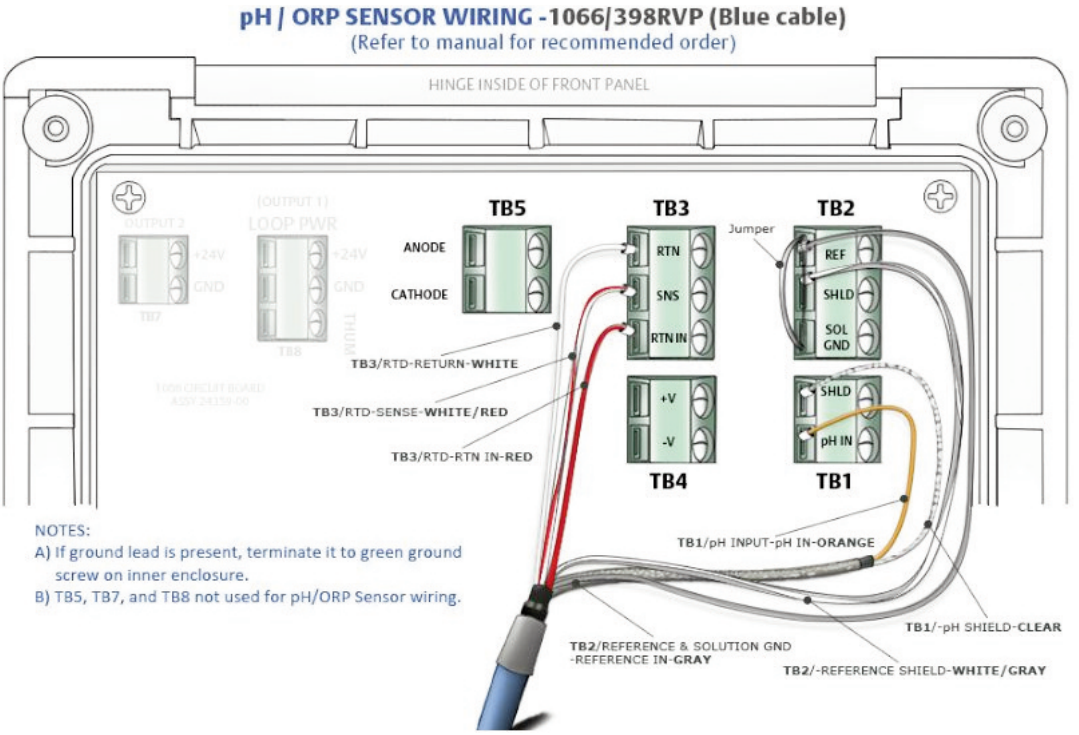


Figure 3-16: Rosemount 398RVP Wiring to Rosemount 5081 Transmitter

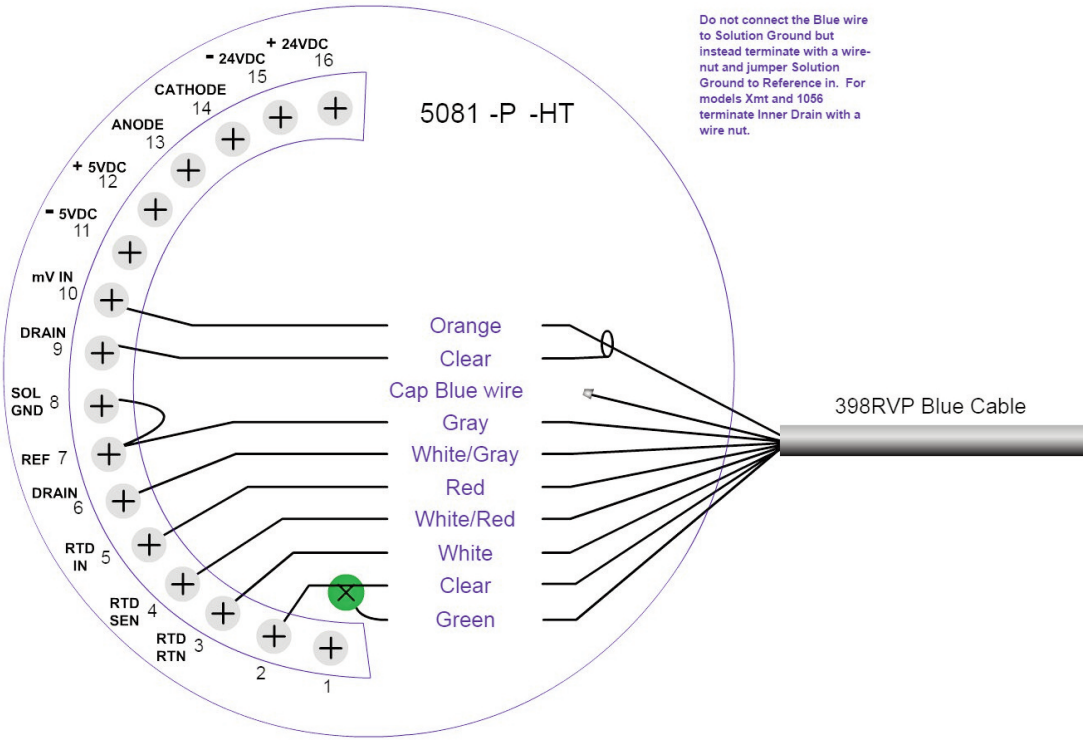


Figure 3-17: Rosemount 398RVP-70 Wiring to Rosemount 1056/56/1057 Transmitters

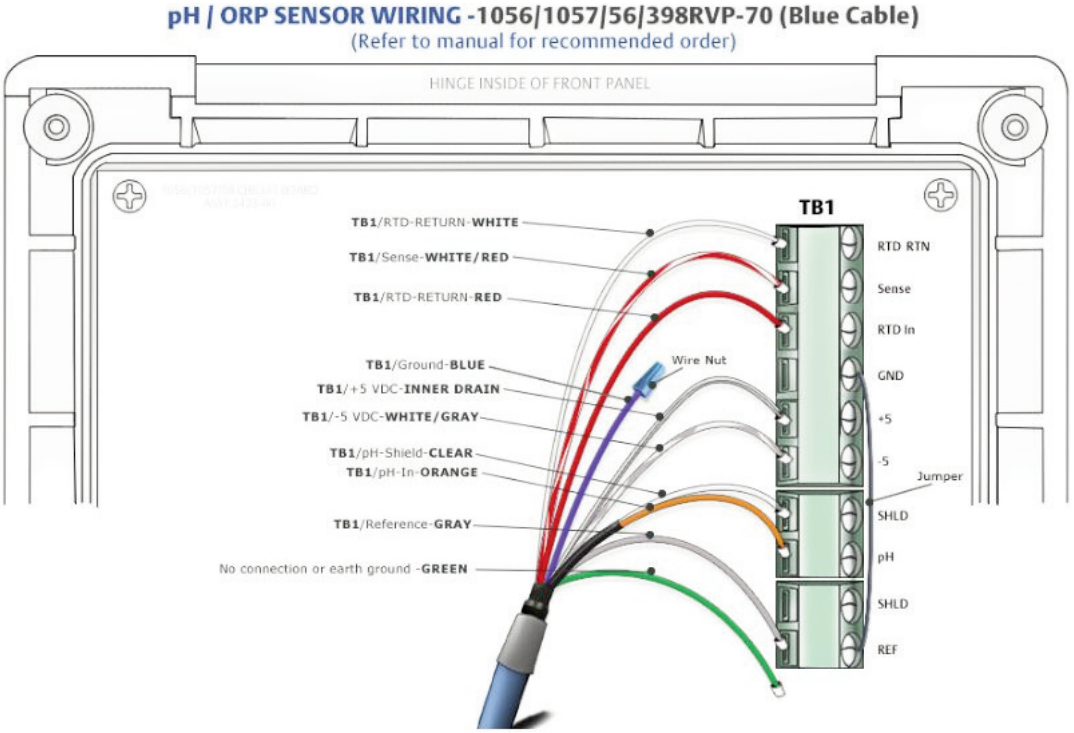


Figure 3-18: Rosemount 398RVP-70 Wiring to Rosemount 1066 Transmitter

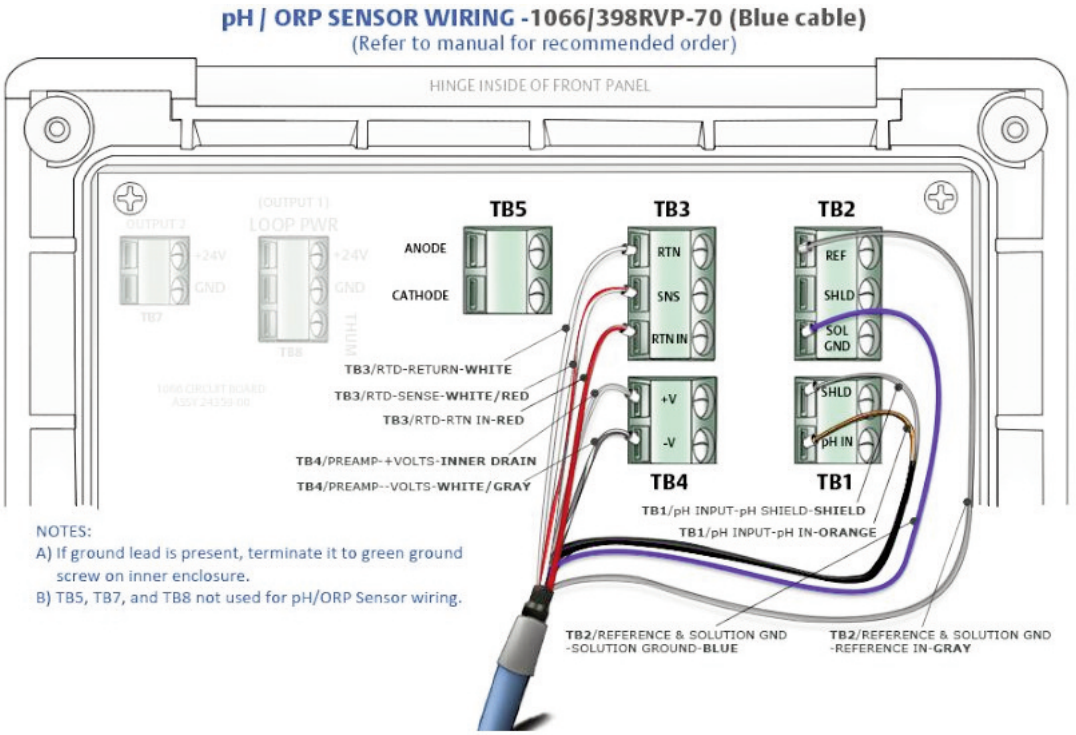
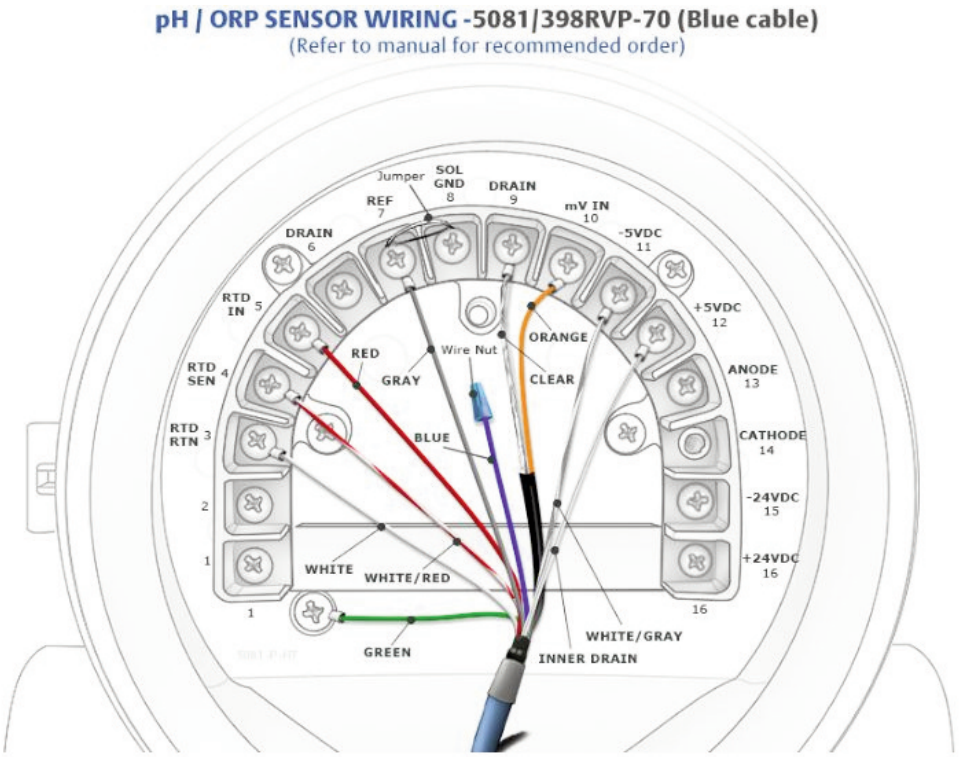


Figure 3-19: Rosemount 398RVP-70 Wiring to Rosemount 5081 Transmitter



Section 5: Calibration

5.1 General Information

1. New sensors must be calibrated before use.
2. Regular recalibration is also necessary and is determined by the user.
3. The use of a two-point buffer calibration is always recommended.
4. Refer to the transmitter instruction manual for more specific calibration procedures.

5.2 Use of Calibration Buffers (Standards)

1. Good buffers lead to good calibrations: A pH measurement is only as good as the calibration, and the calibration is only as good as the buffers used. A careful buffer calibration is the first step in making an accurate pH measurement.
2. Use appropriate buffers: Calibrate with buffers having pH values that bracket the pH of the process. For example, if the pH is between 8 and 9, calibrate with pH 7 and 10 buffers. Commercial buffers for intermediate range pH are readily available.
3. Sensor and buffers must be at the same temperature: Allow time for the sensor and buffers to reach the same temperature. If the sensor was just removed from a process having a temperature more than 10°C different from the buffer, allow at least 20 minutes.
4. Buffers must be at process temperature: For best results, calibrate with buffers having the same temperature as the process. If the buffer and process temperature differ by more than about 15°C an error as great as 0.1pH may result.
5. Be careful using buffers at very high temperatures: Protect the solution from evaporation. Evaporation changes the concentration of the buffer and its pH. Be sure the pH of the buffer is defined at high temperatures. The pH of many buffers is undefined above 60°C. Finally, no matter what the temperature is, allow the entire measurement cell, sensor and solution, to reach constant temperature before calibrating.
6. The pH of a buffer changes with temperature: The pH of a buffer is a function of temperature. The pH of alkaline buffers depends more strongly on temperature than the pH of acidic or neutral buffers. Most process pH instruments, including those manufactured by Rosemount, have an auto calibration feature. The instrument recognizes the buffer being used and automatically corrects for the change in buffer pH with temperature. If the instrument does not perform the correction, the user must enter the appropriate value. Buffer manufacturers usually list the temperature dependence of the buffer on the label.
7. Buffers have limited shelf lives: Do not use a buffer if the expiration date has passed. Store buffers at controlled room temperature.
8. Do not reuse buffers: Do not return used buffer to the stock bottle. Discard it.
9. Protect buffers from excessive exposure to air: Atmospheric carbon dioxide lowers the pH of alkaline buffers. Other trace gases commonly found in industrial environments, for example, ammonia and hydrogen chloride, also affect the pH of buffers. Molds, from airborne spores, grow readily in neutral and slightly acidic buffers. Mold growth can substantially alter the pH of a buffer.

5.3 Two Point Buffer Calibration

1. Remove the protective vinyl cap from the sensor tip.
2. Rinse the sensor and immerse it in the first buffer. Ensure that the glass bulb and the temperature element are completely submerged by keeping the sensor tip about 3 inches below the liquid level. Swirl the sensor to dislodge trapped air bubbles. Do not allow the weight of the sensor to rest on the glass bulb.
3. Once the reading is stable, enter the buffer value in the analyzer. If the analyzer does not correct for changes in buffer pH with temperature, be sure to enter the temperature-corrected value.
4. Remove the sensor from the first buffer. Rinse the sensor and place it in the second buffer. Follow the same precautions given in step 2.
5. Once the reading is stable, enter the buffer value in the analyzer. If the analyzer does not correct for changes in buffer pH with temperature, be sure to enter the temperature-corrected value.
6. After calibration, note the sensor slope. Slope has units of mV per unit change in pH. An ideal sensor has a slope of 59 mV/pH at 25°C. Slope decreases as the sensor ages. Once the slope drops to between 47 and 49 mV/pH, the sensor should be replaced.
7. Remove the sensor from buffer 2 and return it to the process liquid.

5.4 pH Standardization

Standardization means making the process instrument match the reading from a second pH meter. The second pH reading is usually made on a grab sample.

1. Take the sample from a point as close as possible to the process sensor. To avoid starving the process sensor, use a downstream sample point.
2. Wait until the process pH is constant or, at worst, slowly drifting before taking the grab sample.
3. To ensure that measured pH is truly the pH of the process liquid, determine the pH of the grab sample immediately. pH is a function of temperature. If the temperature of the process differs from ambient, measure the pH of the grab sample before its temperature changes. Some process liquids are poorly buffered. The pH of the sample may change significantly upon exposure to air or to the sample container. To avoid deterioration of the sample, measure the pH immediately.
4. Following the instructions in the instrument manual, adjust the process reading to the value measured on the grab sample.

5.5 ORP Standardization

There are relatively few ORP calibration standards available. The most popular one is a solution containing 0.1 M iron (II) and 0.1 M iron (III) in 1 M sulfuric acid. The standard is available from Rosemount as PN R508- 16OZ. The poten-tial of the solution measured against a silver-silver chloride reference electrode is 475 ±20 mV at 25 °C.

1. Rinse the sensor with deionized water and place it in the ORP standard along with a reliable thermometer. Submerge the sensor tip at least three inches below the surface of the liquid. Swirl the sensor to dislodge trapped bubbles. Adjust the temperature of the standard to 25 ±5 °C.
2. Wait until temperature and ORP readings are stable.
3. Following the instructions in the instrument analyzer, store ORP value (475 mV) in memory.
4. Remove the sensor from the ORP standard, rinse it, and return it to the process fluid.

Section 6: Maintenance

6.1 Maintenance

The frequency at which a sensor should be inspected, cleaned, and calibrated can be determined only by experience. Generally, the greater the tendency of the process liquid to coat or foul the sensor, the more frequently maintenance should be done. Rosemount 398R and 398RVP sensors are fouling resistant and, they usually require maintenance less often than other pH (or ORP) sensors. Sensors exposed to extreme pH values or to high temperature require more frequent inspection than sensors installed in less severe environments. The best way to evaluate a sensor is to check its performance in buffers. If the sensor cannot be calibrated or has low slope, it is dirty or has failed. Refer to the troubleshooting guide in this manual for assistance.

6.2 Sensor Removal

Please refer to the appropriate paragraph for instructions regarding removal of the sensor for periodic maintenance.

6.2.1 Retractable Version

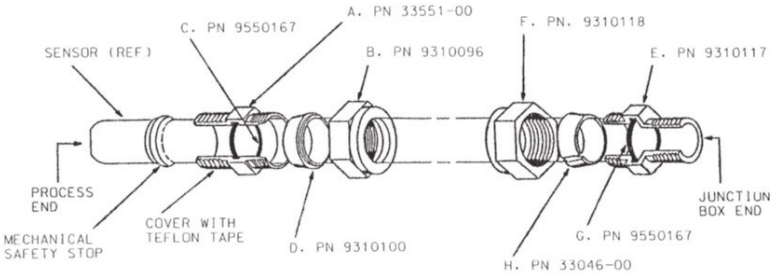
WARNING

System pressure may cause the sensor to blow out with great force unless care is taken during removal. Make sure the following steps are adhered to.

A. Rosemount 398R-21 and 398RVP-21 (21” tube)

1. Be certain system pressure at the sensor is below 64 psig before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figure 6-1. Push in on the cable end or the top of the junction box and slowly loosen the hex nut (B) of the process end male connector (A).

Figure 6-1: Example of Sensor Tube Replacement



PROCESS END (A,B,C, & D SOLD TOGETHER AS SST. PROCESS CONNECTOR KIT PN 23166-00 OR TITANIUM PROCESS CONNECTOR KIT PN23166-01)

A. MALE CONNECTOR BODY
B. HEX NUT
C. O-RING
D. TEFLON FERRULE (SST. FERRULE AVAILABLE AS PN 9310094)

JUNCTION BOX END (E, F, G, & H SOLD TOGETHER AS SENSOR HEAD JUNCTION BOX FITTING KIT PN 23472-00)

E. MALE CONNECTOR BODY
F. HEX NUT
G. O-RING
H. SST. SPLIT FERRULE

B. Rosemount 398R-25 and 398RVP-25 (36” tube)

2. Be certain that pressure at the sensor is below 35 psig before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figure 6-1. Push in on the cable end or the top of the junction box and slowly loosen the hex nut (B) of the process end male connector (A).

⚠ CAUTION

Do not remove nut at this time.

3. When the hex nut is loose enough, slowly ease the sensor back completely until the retraction stop collar (mechanical safety stop) is reached.

⚠ CAUTION

Failure to withdraw the sensor completely may result in damage to the sensor when the valve is closed.

4. Close the ball valve slowly. If there is resistance, the valve may be hitting the sensor. Double check that the sensor has been retracted to the retraction stop collar.

⚠ WARNING

Before removing the sensor from the ball valve, be absolutely certain that the ball valve is fully closed. Leakage from the male connector threads may indicate that the male connector is still under pressure. Leakage through a partially open valve could be hazardous, however with the ball valve closed, some residual process fluid may leak from the connector's pipe threads.

5. The Male Connector Body (A) may now be completely unthreaded from the reducing coupling and the sensor removed for servicing.

⚠ CAUTION

If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550167) in the male connector A.

6.3 Cleaning Procedures - pH Sensors

To remove the sensor from the process piping, follow the instructions in Section 6.2.

⚠ CAUTION

Only persons thoroughly familiar with the procedure for diluting concentrated hydrochloric acid should prepare the solution. Dilute the acid in a fume hood or in a well-ventilated area. Point the acid bottle away from people when opening it. Wear appropriate safety equipment, including chemical goggles and gloves. Do not let acid touch the skin or clothing. If acid solutions contact the skin or eyes, rinse thoroughly with water. Seek medical assistance.

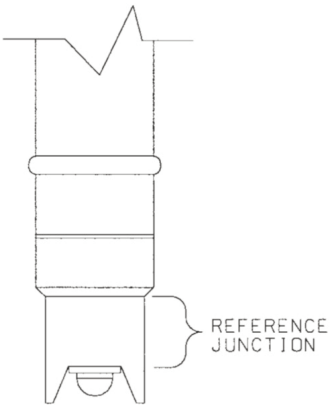
Problem	Cleaning Suggestions
Loose scale or debris	Use a stream of water from a wash bottle to rinse away solids from the tip of the sensor. If water does not work, gently wipe the glass bulb and liquid junction with a soft cloth, tissue, cotton-tipped swab, or a soft bristle brush.
Oil and grease	Wash the glass bulb with mild detergent solution and rinse thoroughly with water.
Hard scale (carbonate and sulfate scales and corrosion products)	If wiping the sensor tip with a tissue or cotton swab does not remove the scale, soak the the glass bulb ONLY in a solution of 5% hydrochloric acid. To prepare the acid solution, add 15 mL of concentrated hydrochloric acid to 85 mL of water with continuous stirring. See CAUTION below. Keep the acid away from the liquid junction. Rinse the sensor thoroughly with deionized water. Some scales (for example, calcium sulfate) cannot be removed easily with acid. Soaking the glass bulb in a 2% solution of disodium EDTA for 20 minutes may be helpful.

When using acid or alkaline solvents, be careful to keep the solvent away from the liquid junction. See Figure 6-2. If the cleaning solvent contacts the junction, hydrogen ions (acid solvent) or hydroxide ions (alkaline solvent) will diffuse into the junction. Because hydrogen and hydroxide ions have much greater mobility than other ions, they produce a large junction potential.

When the electrode goes back in service, the hydrogen or hydroxide ions slowly diffuse out of the junction, causing the liquid junction potential and the pH reading to drift. It may take hours or days for the reading to stabilize.

Always recalibrate the sensor after cleaning. If the sensor was cleaned with detergent or acid, soak the sensor in pH 4 or pH 7 buffer for at least an hour before calibrating.

Figure 6-2: Tip of Rosemount 398R pH Sensor



The figure shows the tip of the Rosemount 398R pH sensor. The bottom of the liquid junction is about even with the top of the wings that form the slotted tip. Keep acidic and alkaline solvents away from the liquid junction. If acids or bases get into the junction, subsequent pH readings may drift for several hours.

6.4 Cleaning Procedures - ORP Sensors

Clean platinum ORP electrodes by using a tissue to rub the metal surface with a paste of baking soda (sodium bicarbonate). A clean platinum electrode is bright and shiny.

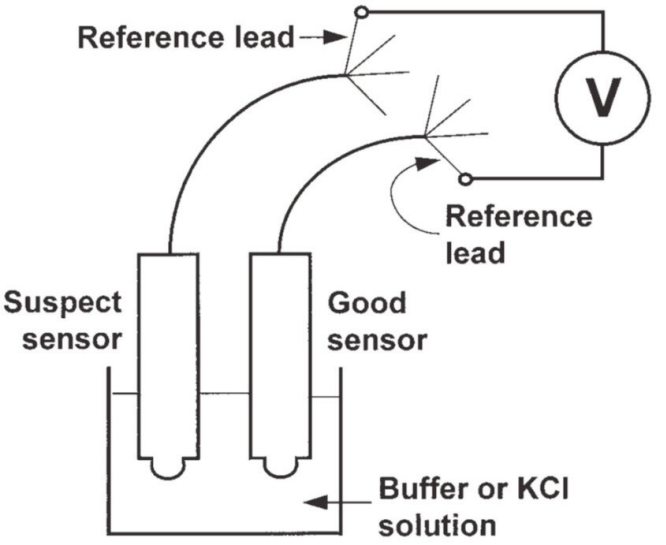
6.5 Checking the Reference Electrode

Some processes contain substances, for example, sulfides, that poison the reference electrode. Poisoning alters the electrode potential. For example, sulfide poisoning converts the reference electrode from a silver/silver chloride electrode into a silver/silver sulfide electrode, causing a shift in potential of several hundred millivolts.

A good way to check for poisoning is to compare the voltage of the reference electrode with a silver/silver chloride electrode that is known to be good. The reference electrode from a new sensor is the best choice. To check the suspect electrode, place both sensors in a beaker containing buffer or a solution of potassium chloride. Connect the reference leads to a voltmeter and measure the potential difference. If the suspect electrode is good, the difference should be no more than about 20 mV.

Refer to Figure 6-3. A poisoned reference electrode usually requires replacement. A laboratory silver/silver chloride reference electrode can be used in place of the second sensor. All Rosemount pH sensors have a silver/silver chloride reference, and most sensors use gelled saturated potassium chloride for the fill. The potentials of a good sensor reference electrode and a saturated silver/ silver chloride laboratory electrode will agree within about 20 mV.

Figure 6-3: Checking the Potential of the Reference Electrode



6.6 Rejuvenating Reference Electrodes

Occasionally, a poisoned or plugged reference electrode can be reconditioned. Although the electrode seldom recovers completely, the procedure might extend the life of the sensor by a few weeks.

a. Clean the sensor as thoroughly as possible.

b. Soak the sensor for several hours in a hot (NOT BOILING) 3% potassium chloride solution. Prepare the solution by dissolving 3 g of potassium chloride in 100 mL of water.

c. Soak the sensor in pH 4 buffer at room temperature overnight.

d. Calibrate the sensor in buffers and retest it in the process liquid.

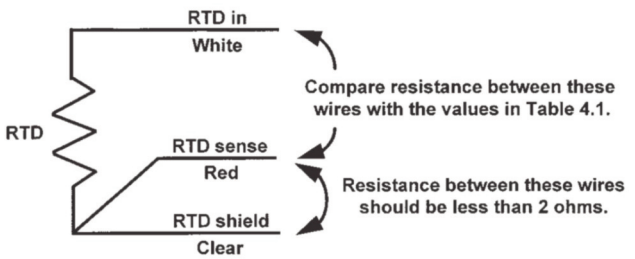
Table 6-1: Resistance as a Function of Temperature for Selected RTDs.

Temperature °C	Resistance (Ohms) ±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

6.7 Temperature Element

Rosemount 398R/398RVP pH sensors produce a voltage which the instrument converts to pH using a temperature-dependent factor. A Pt 100 or a Balco 3K RTD built into the sensor measures temperature. To permit cor-rection for changes in lead resistance with temperature, a three-wire configuration (Figure 6-4) is used. To check the RTD, disconnect the leads and measure the resistances shown. The measured resistance should agree with the value in the table to within about ±1%. If the measured resistance is appreciably dif-ferent (between 1 and 5%), the discrepancy can be calibrated out. See the instrument instruction manual.

Figure 6-4: Three-wire RTD circuit



Consult Table 6.1 (above) for temperature-resistance data. Lead resistance is about 0.05 ohm/ft at 25°C. Therefore, 15 ft of cable increases the resistance by about 1.5 ohm. The resistance between the RTD return and RTD sense leads should be less than 2 ohms. If a connection is open or shorted and should not be, replace the sensor. If the measured resistance is greatly in error, replace the sensor.

6.8 Sensor Tube Replacement When Used With A Sensor Head Junction Box

Replace ment of the retraction versions sensor tube assembly involves the removal and installation of two sets of male connectors: One at the process end of the sensor, and the other at the junction box end (See Figure 6-1 and Figure 6-5). Refer to Section 6.2 for proper removal of the sensor from process.

1. Remove sensor from process before proceeding. The junction box with attached male connector must be recovered from the old sensor for reuse. Unscrew the junction box cover and set aside. Disconnect electrical connections from printed circuit board inside junction box. Disconnect BNC connector to preamp. Unscrew hex nut (F) from male connector body (E). Separate junction box from used sensor. Set aside.

2. Pry off split ferrule from sensor and set aside for reuse. Remove hex nut (F) and set aside for reuse. Check that the internal O-ring is in place in the male connector body (E) attached to the junction box.

3. Remove hex nut (B) from male connector body (A) at process end of sensor and set aside. Slide the Teflon ferrule and the male connector off sensor in the direction of junction box and set.

Note: If stainless steel ferrule was used, male connector body (A) will have to be dis carded with the sensor tube.

4. Discard used O-ring from male connector body (A). Coat new O-ring with a thin film of the O-ring lubricant provided. Position it in the machined O-ring groove in place of the discarded O-ring.

⚠ CAUTION

Make sure lubricant does not contact any part of the sensor tip particularly the glass bulb.

5. Cover the 1" MNPT pipe threads of the male connector body (A) with Teflon tape (not provided) to protect them from galling during reinstallation.

6. Pass the wires from the new sensor through the process end male connector (A). Make sure that the beveled edge of the ferrule faces the process end of the sensor. Snug the hex nut (B) to keep it in place. Do not tighten down fully on the hex nut at this time.

7. Pass the wires from the new sensor through the hex nut (F), the split ferrule (from the old sensor), male connector body (E), O-ring, and through the junction box from the “neck” opening and out to the printed circuit board in the junction box. Butt the ferrule’s beveled edge and the sensor tube against the junction male connector (E).

8. Screw the hex nut (F) by hand until the tube is “locked” into the male connector body.

9. Make sure that the male connector body (E) is sufficiently tightened.

10. The sensor will “click” into place by pulling the sensor tube away from the junction box, but will not move from side to side or pull clear of the male connector.

11. If the sensor tube is correctly attached to the junction box, wrench tighten hex nut (F) on male connector body (E). See Figure 6-1.

12. Do not put the sensor tube in a vise or use a pipe wrench to tighten the hardware as these will damage the sensor. If sensor tube is not correctly attached to the junction box, loosen hex nut (F) and repeat.

13. Connect the sensor wires to the terminals on the printed circuit board in the junction box in the manner recommended on the junction box cover,and reattach the BNC connector to the preamp.

14. Screw on the cover of the junction box aside. Discard sensor tube.

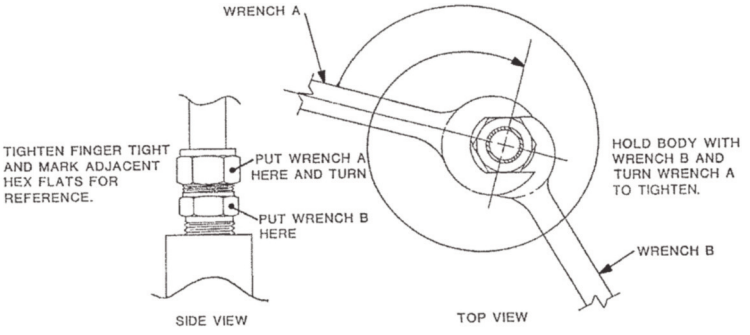
15. Insert the sensor in the process fitting. Stop it against the closed ball valve. Slide the process-end male connector down the sensor tube to mate with the process fitting. Tighten the male connector into the process fitting.

16. Pull back hard on the sensor assembly, as if trying to remove the sensor, to be certain that the sensor cannot come free from the valve assembly and male connector. The built-in retraction stop collar at the end of the sensor will butt against the shoulder of the male connector.

17. Open ball valve and position the sensor at the desired insertion depth and orientation. Using a crescent or open end wrench, tighten the hex nut (B) to secure the sensor in place. See Figure 6-5.

Note: A stainless steel ferrule is available if the Teflon ferrule does not adequately grip. Be careful and avoid over tightening. This can damage the sensor tube.

Figure 6-5: Male Connector Tightening Diagram



⚠ CAUTION

If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550167) in the male connector A.

If the sensor is to be stored, the rubber boot should be filled with 7pH buffer solution and replaced on sensor tip until ready to use.

Section 7: Troubleshooting

7.1 Troubleshooting

Table 7-1, below, lists common problems, causes and remedies typically encountered in process measurement. For more specific troubleshooting information, please refer to the appropriate transmitter manual.

Table 7-1: Troubleshooting

PROBLEM/SYMPTOM	PROBABLE CAUSE	REMEDY
pH value from sensor will not stabilize for calibration, even though sensor seemed to work okay in process stream	Dirty sensor	See Section 6.3, Cleaning Procedures.
	Broken wire	Check wire integrity at instrument end of the sensor cable.
	Miswired sensor	Check wiring diagrams for proper wiring to appropriate analyzer.
	Buffers are old or contaminated	Retry calibration with fresh buffers.
	Glass electrode failure	The glass may be cracked. Check the glass impedance value. If it is above 20 megohms, glass is not cracked.
	Air bubbles trapped on outside surface of glass	Gently swirl sensor to remove any air bubbles that may have formed when sensor was placed into calibration beaker.
pH value from new sensor will not stabilize for calibration	pH sensor bulb has dried out in storage	Soak sensor in pH 4 buffer for several hours. Then retry calibration.
	Miswired sensor	Check wiring diagrams for proper wiring to appropriate analyzer.
	Buffers are old or contaminated	Retry calibration with fresh buffers.
	Air bubbles inside glass bulb	Gently shake down sensor to remove any air bubbles that have formed inside the glass bulb measurement area.
	Air bubbles trapped on outside surface of glass	Gently swirl sensor to remove any air bubbles that may have formed when sensor was placed into calibration beaker.
After completing calibration procedures, slope is high (a high slope value is any value above 59.1 mV)	Buffers are old or contaminated	1. Retry calibration with fresh buffers. 2. Make sure that the temperature of the buffer solutions are the same temperature as the sensor. 3. Some 10 pH buffers are inaccurate (because of age or manufacturing procedures) and could cause high slope error. In this case, try another pH 10 buffer or buffer calibrate with another value of pH buffer.
	Calibration technique or procedure	1. Inaccurate procedure or technique. 2. Sensor must be cooled to same temperature as buffer solutions. 3. Sensor must continue to be immersed in buffer solution until reading has stabilized.

Note: For any repair or warranty inquiries please contact our Customer Care group.

Table 7-1: Troubleshooting (continued)

PROBLEM/SYMPTOM	PROBABLE CAUSE	REMEDY
After completing calibration procedures, slope is low (a low slope value is any value below 48 mV)	Aged glass electrode	Replace sensor if glass impedance is above 800 megohms.
	High temperature exposure	Replace sensor; high temperature has affected the sensor much like aging glass.
	Electrode is coated	See Section 6.3 for proper sensor cleaning. After cleaning, the glass impedance value will dramatically drop to a value between 20 and 800 megohms.
	Broken wire	Check integrity of wires at instrument end of the sensor cable.
	Miswired sensor	Check wiring diagrams for proper wiring to appropriate analyzer.
	Buffers are old or contaminated	Retry calibration with fresh buffers.
	Glass electrode is cracked	The glass may be cracked. Check the glass impedance value. If it is above 20 megohms, the glass is not cracked.
	Defective preamplifier	If it is a plug-in preamplifier in junction box or in instrument, replace preamplifier unit. If preamplifier is integral to sensor, replace entire sensor.
While sensor is in the process, the pH reading is sluggish or slow to change	Electrode is coated	See Section 6.3 for proper sensor cleaning. After cleaning, glass impedance value will dramatically drop to a value between 20 and 800 megohms.
	Glass electrode has hairline crack	The glass may be cracked. Check the glass impedance value. If it is above 20 megohms, glass is not cracked.
pH reading between 3 and 6 pH regardless of actual pH of solution or sample	Glass electrode is cracked	Replace sensor.
pH reading is off scale	Defective preamplifier	If it is a remote preamplifier, replace the preamplifier unit. If preamplifier is integral to sensor, replace entire sensor.
	T.C. element shorted	Check T.C. element (see Section 6.5) and replace sensor if defective.
	Sensor is 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).
	Glass electrode is cracked or reference element is shorted	Replace sensor
pH display on instrument jumps widely while in auto T.C. mode	T.C. element is shorted	Check T.C. element (see Section 6.5) and replace sensor if defective.
Span between buffers is extremely short in auto T.C. mode	T.C. element is open	Check T.C. element (see Section 6.5) and replace sensor if defective.

Table 7-1: Troubleshooting (continued)

PROBLEM/SYMPTOM	PROBABLE CAUSE	REMEDY
While pH sensor is in process, pH reading is not stable, fluctuates too much	Air bubbles trapped on glass bulb	Remount sensor in a part of the process stream where the flow is less turbulent.
	Sensor is mounted too close to pump	Remount sensor in a part of the process stream where the pumping effect is less burdensome on the sensor.
	Sensor is mounted too close to chemical addition, reaction is taking place at this point and pH is actually changing all the time	Remount sensor in a part of the process stream where the reaction has stabilized. Then the pH reading will not seem to fluctuate too much.
pH value of process sensor in buffer solution doesn't match the pH value stated on label of the buffer solutions	Temperature of the sensor is not the same as the pH buffers	Since the pH value of mixtures changes with temperature, the temperature of the pH sensor and the buffer solutions must be the same. Otherwise, pH value will not match buffer value.
pH value of process sensor in process grab sample doesn't match the grab sample pH value	Temperature of the process sensor is not the same as the temperature of the grab sample	Since the pH value of mixtures changes with temperature, the temperature of the pH sensor and the buffer solutions must be the same. Otherwise, pH value will not match buffer value.
Once sensor has been properly calibrated and placed in the process stream, pH value shifts 0.1 to 0.2 pH units or more within a short period of time.	Reference is becoming contaminated	Although an extremely rare case for any TUpH reference, the reference can become contaminated with certain substances. If this is the case, consult Rosemount Analytical for process stream evaluation.
	Process solution ground loop	If sensor has been verified to work in buffers, check for ground loops in the following manner: 1. Connect a heavy gauge wire to the process piping or in process tank. 2. Place loose end of wire into beaker with buffer solution and pH sensor. If buffer value changes the same way that is seen the the process, then a ground loop has been confirmed. If symptoms do not develop but problem still persists, a ground loop is not ruled out. Consult Rosemount Analytical for further help with ground loop problems.

Section 8: Accessories

8.1 Accessories

Table 8-1: Accessories for Rosemount 398R/398RVP

Part Number	Description
23557-00	Preamplifier for remote junction box (PN 23555-00),
23550-00	Remote Junction box with extension board
9550099	O-ring, Viton, for process connector
9550220	O-ring, Kalrez, for process connector
9210012	Buffer solution, 4.01 pH, 16 oz
9210013	Buffer solution, 6.86 pH, 16 oz
9210014	Buffer solution, 9.18 pH, 16 oz

EC Declaration of Conformity

Note: Please see website for most recent Declaration.

EMERSON

EU Declaration of Conformity

(No. 1700911)

CE

pH/ORP Sensors

This declaration is issued under the sole responsibility of the manufacturer:
Rosemount Inc., 8200 Market Blvd., Chanhassen, MN 55317 USA
The sensor models:

328A, 385, 385+ -04, 385+ -02/03, 385+-03-12, 389-01, 389-01-10/11-50, 389-01-10/11-54, 389-01-12-50, 389-01-12-54, 389-01-12-55, 389-02, 389VP, 389VP-70, 396, 396P-01-10/13-50, 396P-01-10/13-54, 396P-01-12-50, 396P-01-12-54, 396P-01-12-55, 396P-01-55, 396VP, 396VP-70, 396R, 396RVP, 396RVP-70, 396P-02, 396PVP, 396PVP-70, 397, 398, 398VP, 398R, 398RVP, 398RVP-70, 3200HP, 3300HT, 3300HT VP, 3300HTVP-70, 3400HT, 3400HT VP, 3400HTVP-70, 3500P-01, 3500P-01-12, 3500P-02, 3500VP-01, 3500VP-01-12, 3500VP-02, 3800, 3800VP, 3900-01, 3900-02, 3900VP-01, 3900VP-02

to which this declaration relates, are in conformity with relevant Union harmonization legislation:
(2014/34/EU) ATEX Directive
Intrinsically Safe, Examination Certificate: Baseefa10ATEX0156X
Provisions of the directive fulfilled by the equipment:
Equipment Group II, Category 1 G Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +60°C) exceptions noted below

Model 328A Steam sterilizable pH sensor with integral cable
Model 385 Retractable pH/ORP sensor with integral cable
Model 385+ -04 pH/ORP sensor with integral cable
Model 385+ -02/03 pH/ORP sensor with integral cable & Smart preamplifier
Model 385+ -03-12 ORP sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C), T5 (-20°C ≤ Ta ≤ +40°C)
Model 389-01 pH sensor with integral cable & Smart preamplifier
Model 389-01-10/11-50 pH sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C) or T5 (-20°C ≤ Ta ≤ +40°C)
Model 389-01-10/11-54 pH sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C) or T5 (-20°C ≤ Ta ≤ +40°C)
Model 389-01-12-50 ORP sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C)
Model 389-01-12-54 ORP sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C)
Model 389-01-12-55 ORP sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C)
Model 389-02 pH/ORP sensor with integral cable
Model 389VP-70 pH sensor with Variopol connector & Smart preamplifier
Model 389VP pH/ORP sensor with Variopol connector
Model 396 TUpH sensor with integral cable
Model 396P-01-10/13-50 polypropylene pH sensor with integral cable & preamp: T4 (-20°C ≤ Ta ≤ 80°C) or T5 (-20°C ≤ Ta ≤ 40°C)
Model 396P-01-10/13-54 polypropylene pH sensor with integral cable & preamp: T4 (-20°C ≤ Ta ≤ 80°C) or T5 (-20°C ≤ Ta ≤ 40°C)
Model 396P-01-12-50 ORP sensor with integral cable & preamp: T4 (-20°C ≤ Ta ≤ +80°C)
Model 396P-01-12-54 ORP sensor with integral cable & preamp: T4 (-20°C ≤ Ta ≤ +80°C)
Model 396P-01-12-55 ORP sensor with integral cable & preamp: T4 (-20°C ≤ Ta ≤ +80°C)
Model 396P-01-55 pH sensor with integral cable & Smart preamp
Model 396VP TUpH sensor with Variopol connector
Model 396VP-70 TUpH sensor with Variopol connector & Smart preamplifier
Model 396R TUpH Retractable pH/ORPsensor with integral cable
Model 396RVP TUpH Retractable pH/ORP sensor with Variopole connector
Model 396RVP-70 TUpH Retractable pH sensor with Variopole connector & Smart preamplifier
Model 396P-02 TUpH Polypropylene pH/ORP sensor with integral cable
Model 396PVP TUpH Polypropylene pH/ORP sensor with Variopole connector
Model 396PVP-70 TUpH Polypropylene pH sensor with Variopole connector & Smart preamplifier
Model 397 TUpH sensor with integral cable
Model 398 TUpH pH/ORP sensor with integral cable
Model 398VP TUpH pH/ORP sensor with Variopole connector
Model 398R TUpH Retractable pH/ORP sensor with integral cable
Model 398RVP TUpH Retractable pH/ORP sensor with Variopole connector
Model 398RVP-70 TUpH Retractable pH sensor with Variopole connector & Smart preamplifier
Model 3200HP Flowing junction pH sensor with Variopole connector
Model 3300HT Insertion/submersion pH sensor with integral cable
Model 3300HTVP Insertion/submersion pH sensor with Variopole connector
Model 3300HTVP-70 Insertion/submersion pH sensor with Variopole connector & Smart preamplifier
Model 3400HT Retractable pH sensor with integral cable
Model 3400HTVP Retractable pH sensor with Variopole connector
Model 3400HTVP-70 Retractable pH sensor with Variopole connector & Smart preamplifier
Model 3500P-01 High performance pH sensor with integral cable & Smart preamplifier
Model 3500P-01-12 PerpH-X ORP sensor with integral cable & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C)
Model 3500P-02 High performance pH sensor with integral cable
Model 3500VP-01 High performance pH sensor with Variopole connector & Smart preamplifier
Model 3500VP-01-12 PerpH-X ORP sensor with Variopole connector & preamplifier: T4 (-20°C ≤ Ta ≤ +80°C)
Model 3500VP-02 High performance pH sensor with Variopole connector
Model 3800 Steam sterilizable pH sensor with single pole Eurocap connector

Model 3800VP Steam sterilizable pH sensor with Variopole connector
Model 3900-01 pH/ORP sensor with integral cable & Smart preamplifier
Model 3900-02 pH/ORP sensor with integral cable
Model 3900VP-01 pH sensor with Variopole connector & Smart preamplifier
Model 3900VP-02 pH/ORP sensor with Variopole connector

Special conditions for safe use:

1) All pH/ORP sensor models with a plastic enclosure or exposed plastic parts may provide an electrostatic ignition hazard and must only be cleaned with a damp cloth to avoid the danger of ignition due to a build up of electrostatic charge.
2) All pH/ORP sensor models with a metallic enclosure may provide a risk of ignition by impact or friction. Care should be taken during installation to protect the sensor from this risk.
3) External connections to the sensor must be suitably terminated and provide a degree of protection of at least IP20.

All pH/ORP sensor models are intended to be in contact with the process fluid and may not meet the 500V r.m.s test to earth. This must be taken into consideration at installation.

ATEX Notified Body for EC Type Examination Certificate & Quality Assurance:
SGS Baseefa[Notified Body Number:1180], Rockhead Business Park, Staden Lane, Buxton SK17 9RZ UNITED KINGDOM

Assumption of conformity is based on the application of the harmonized standards:
EN 60079-0:2012+A11:2013 Explosive atmospheres. Equipment. General requirements
EN 60079-11:2012 Explosive atmospheres. Equipment protection by intrinsic safety "i"

K Freeman

(Signature)

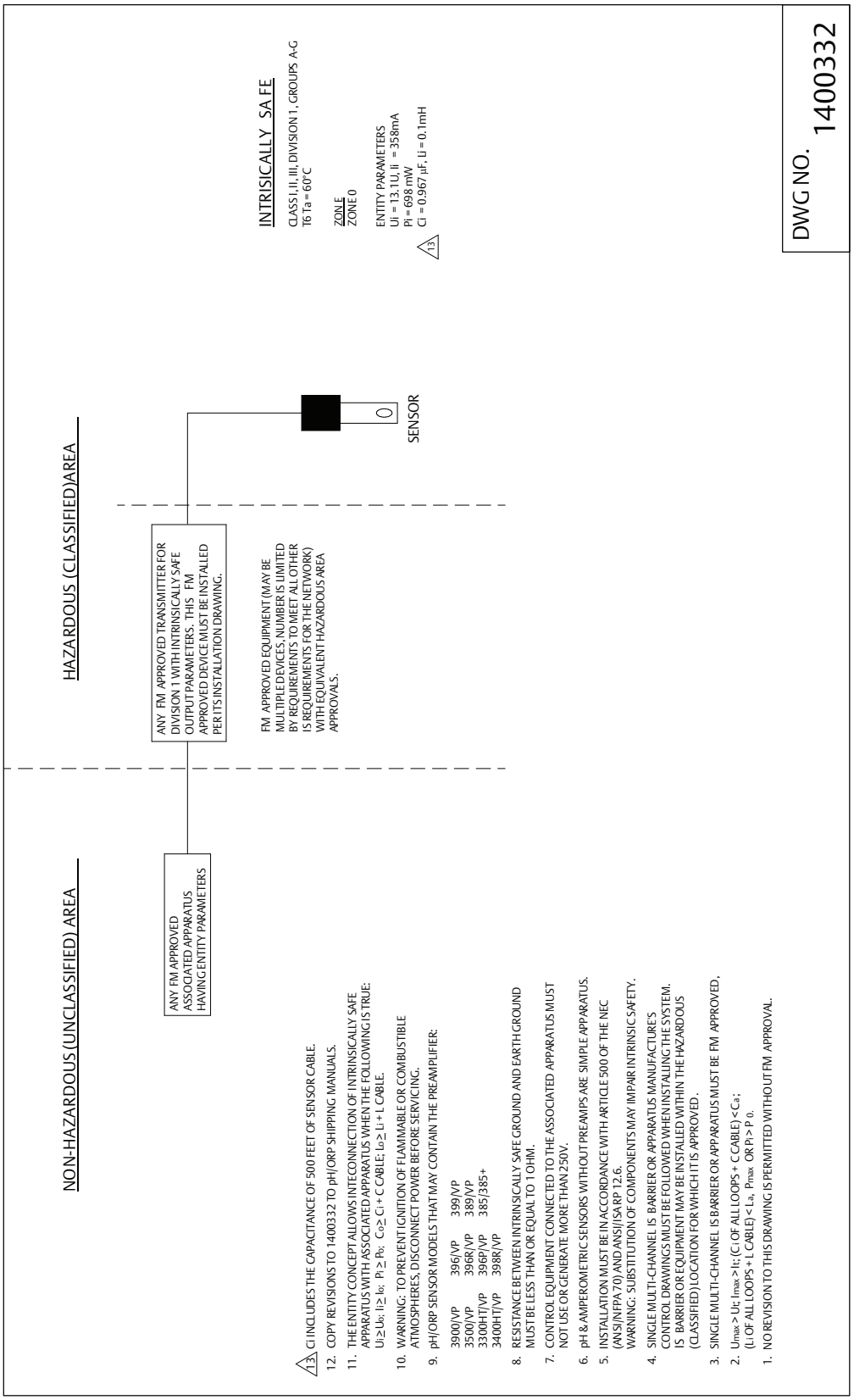
Kim Freeman
(Name printed)

Director of Global Quality
(Function name)

March 23, 2017
(Date of issue)

CE marking was first affixed to this product in 2011

Intrisicallly Safe Sensor Installation Drawing - FM



LIQ-MAN-398R-398RVP
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