Instruction Manual
LIQ-MAN-385+
Rev. J
March 2017

Rosemount™ 385+

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)

About This Document

This manual contains instructions for installation and operation of the Rosemount 385+ pH/ORP Sensors.

The following list provides concerning all revisions of this document.

Rev. Level	Date	Notes
A	02/01	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.
B	05/02	Drawings updated throughout
C	05/03	Drawing 40385+02 updated to rev. C; added drawing 41055119 — both on page 9.
D	09/04	Updated wiring diagrams and Table 5-2
E	10/04	Added 1055 single input wiring diagram.
F	03/05	ORP info revision.
G	05/05	Fixed LED font mis-print on page 16.
H	03/06	Added a note on page 6.
I	05/09	Updated for SMART sensors.
J	03/17	Reformatted to reflect the latest Emerson documentation style and updated the ordering information, EC Declaration of conformity, FM Installation drawing, and Accessories.

Contents

Section 1: Description and Specifications

- SMART enabled
- Retractable version allows removal and replacement under pressure without process shut-down.
- Long-life, triple junction reference electrode provides longer service life in applications where poisoning ions are present.
- Disposable tefzel and titanium design provides maximum chemical resistance and economical advantage where minimum troubleshooting and maintenance downtime are of prime importance.

1.1 Features and Applications

The Rosemount 385+ Sensor measures the pH or ORP (Oxidation Reduction Potential) of aqueous solutions in pipelines, open tanks, or ponds. It is suitable for applications where a low cost, industrial, disposable sensor is required. The combination electrode features a peripheral ceramic junction. The triple junction reference cell provides longer life in processes containing sugar, ammonia, chlorides, sulfides or other poisoning ions. The Rosemount 385+ body is constructed of molded, chemically resistant Tefzel in two standard body versions.

The retraction version is housed in a titanium tube, with a plug-in style surface mount preamplifier in a weatherproof junction box. It is designed for use with a standard 1-1/2 in. ball valve assembly for process mounting where a separate sample stream is difficult or impossible to provide. The entire installation process is accomplished without line depressurization and minimal process fluid loss. Upon sensor removal, from the ball valve, maintenance and replacement is easy.

The insertion/submersion version has two body configurations: 25 ft (7.6 m) integral cable and preamplifier; 15 ft (4.5) integral cable for use with remote preamplifier.

1.2 Performance and Specifications

Table 1-1: Percent linearity over pH

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%

Table 1-2: Rosemount 385+ 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 (ball valve version)	
542 KPa abs (64 psig)	
Maximum Process Pressure and Temperature	
790 KPa abs (100 psig) at 100 °C (212 °F)	
Temperature Compensation	
(pH only) 0 to 100°C (32 to 212°F)	
Wetted Materials	
Tefzel, titanium, EPDM, 316 SS and Teflon (Code 02), Viton, glass, ceramic and (ORP only) platinum.	
Weight/Shipping Weight	
Submersion/insertion	1.6 lb/2.8 lb (0.7 kg/1.25 kg)
Retraction	6 lb/11 lb (2.7 kg/5.0 kg)
Ball Valve	5 lb/10 lb (2.25 kg/4.5 kg)
Process Connections	
With ball valve	1-1/2 in.
Without ball valve	1 in.
Cable Length	
Code 02	Requires interconnecting cable P/N 9200273 (Unprepped) or P/N 23646-01 (Prepped)
Code 03	25 ft. Integral Cable
Code 04	15 ft. Integral Cable

1.3 Ordering Information

Table 1-3: Rosemount 385+ ordering information

Model	Sensor type
385+	pH/ORP Sensor
Body Configuration	
02	Retractable with Sensor Head Junction Box, Preamplifier, and Process Connector (1)
03	Insertion/Submersion with Integral Preamplifier and 25 ft. (7.6m) Cable (1) (2)
04	Insertion/Submersion for use with Remote Preamplifier and 15 ft. (2)
Combination Electrode	
10	pH - GPLR Glass
11	High pH Glass
12	Platinum ORP
Typical Model Number: 385+-03-10	

1. *Preamplifier is SMART for pH options only. A standard preamplifier is used with ORP sensors.*
2. *First time installations require a 1 x 1 inch NPT Process Connector (see accessories).*

1.4 Product Certifications

Please see online certificates for further details.

IECEx

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

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

Sensors with standard preamp (ORP only) – Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +80°C) or Ex ia IIC T5 Ga (-20°C ≤ Ta ≤ +40°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 (pH only) – Ⓔx II 1 G Ex ia IIC T4 Ga (-20 ˚C ≤ Ta ≤ +60 °C)

Sensors with standard preamp (ORP only) – II 1 G Ex ia IIC T4 Ga (-20 ˚C ≤ Ta ≤ +80 ˚C) or Ⓔx II 1 G Ex ia IIC T5 Ga (-20 ˚C ≤ Ta ≤ +40 ˚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:

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

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

Section 2: 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 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.

NOTICE

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.

2.2 Mechanical Installation

The Rosemount 385+ is available in two versions, the retraction version (Code 02) and the insertion/submersion version (Code 03, & 04). Please refer to the appropriate section below.

2.2.1 Retraction Option (Code option 02)

The Rosemount 385+ sensor may be installed through a weldalet or in a pipe tee or "Y", as shown in Figure 2-1, 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.

The sensor can also be inserted directly into the process without the use of a ball valve for applications not requiring continuous operation during sensor maintenance (Figure 2-2).

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, thus keeping air bubbles out of the pH sensitive glass bulb. Bubbles settled in the glass bulb disrupt the electrical continuity between the pH sensitive glass and the silver/silver chloride measuring element.

If the retraction version is to be installed without a ball valve follow the installation procedure for insertion service (Section 2.2.2). Perform the following steps for sensor installation through a 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 (Figure 4-1, item A).

⚠ CAUTION

Buffer solution, in the vinyl 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.

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. (See Figure 4-2.)

⚠ 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.

2.2.2 Submersion/Insertion Option

Code Option -03 & -04). Figure 2-3 and Figure 2-4. The Rosemount 385+ may be installed through a weldalet or a pipe tee or "Y" when used with a process connector (P/N 23166-00-01). For submersion service, a process connector (P/N 23166-00-01 or 9510066) may be used with a water tight 1 in. schedule 80 CPVC or PVDF standpipe conduit. Refer to Figure 2-5. Tapered threads in plastic tend to loosen after installation. It is therefore recommended that TEFLON tape be used on the threads and that the tightness of the connection be checked frequently to assure that no loosening has occurred. The sensor should be installed within 80° of vertical, with the electrode facing down.

Figure 2-1: Typical Mounting Details-Retraction Version

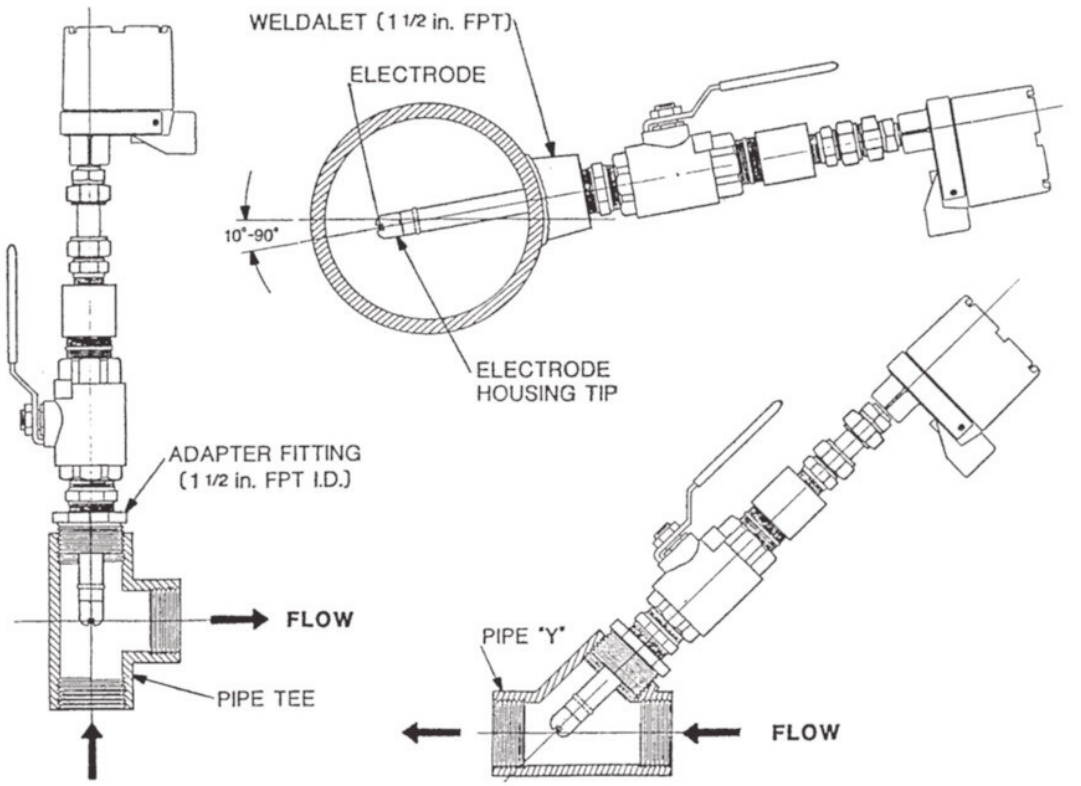


Figure 2-2: Dimensional Drawing Retraction Version (Code 02)

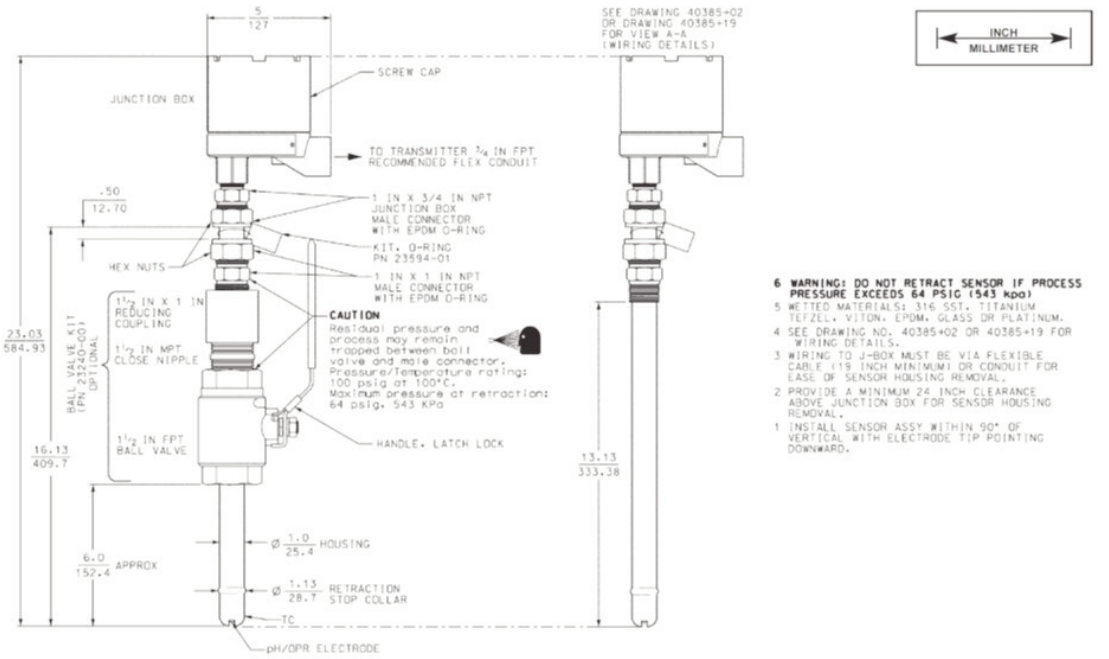


Figure 2-3: Dimensional Drawing Submersion/Insertion Version (Code -03, -04)

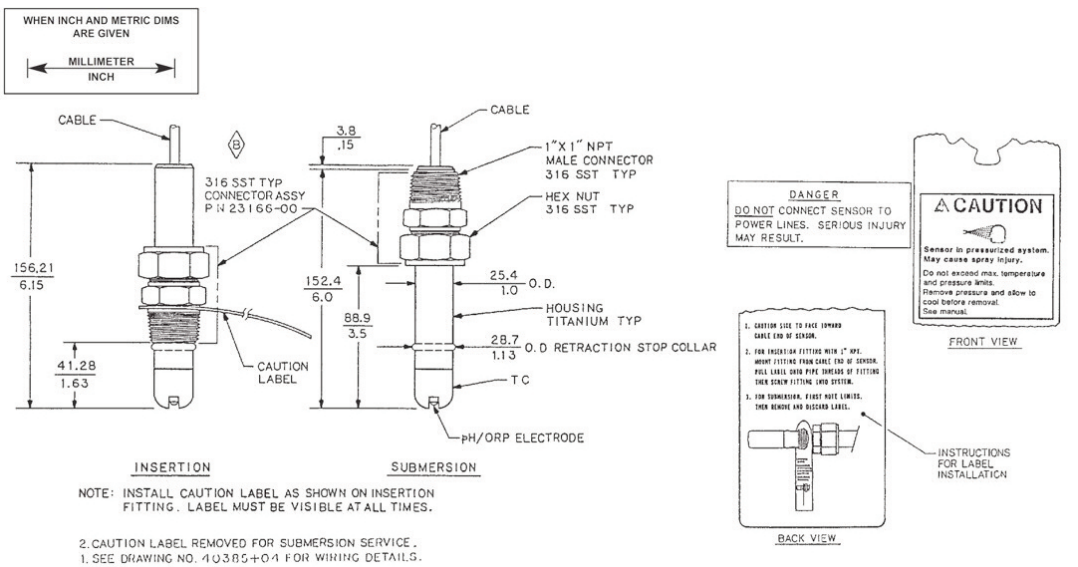


Figure 2-4: Submersion Accessory (Code 03, 04)

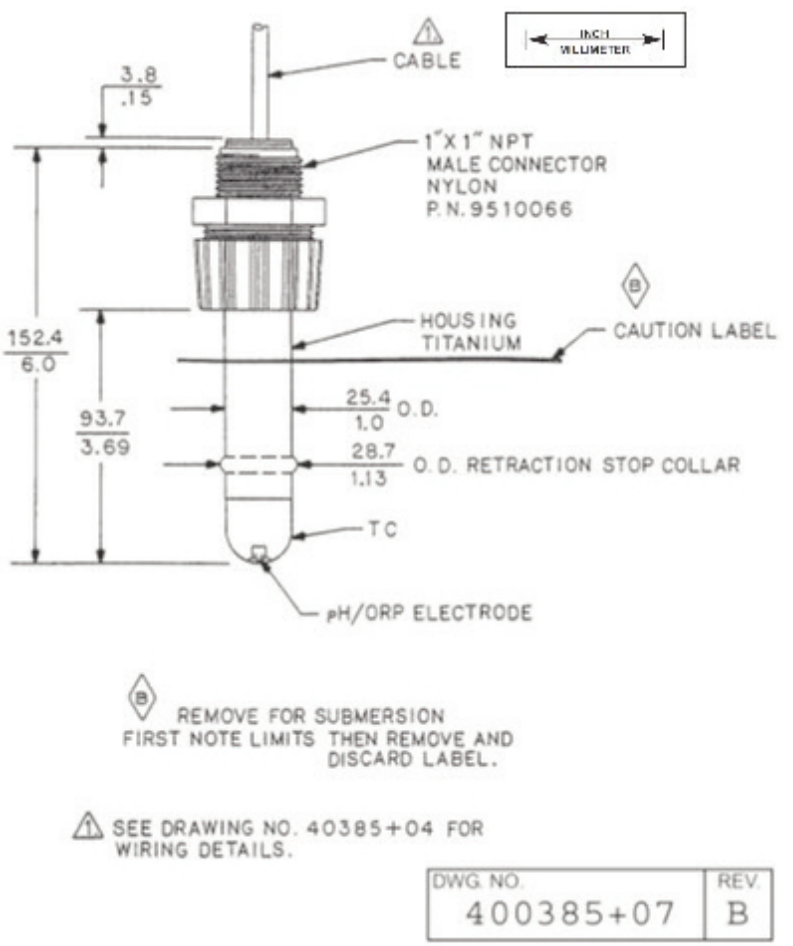
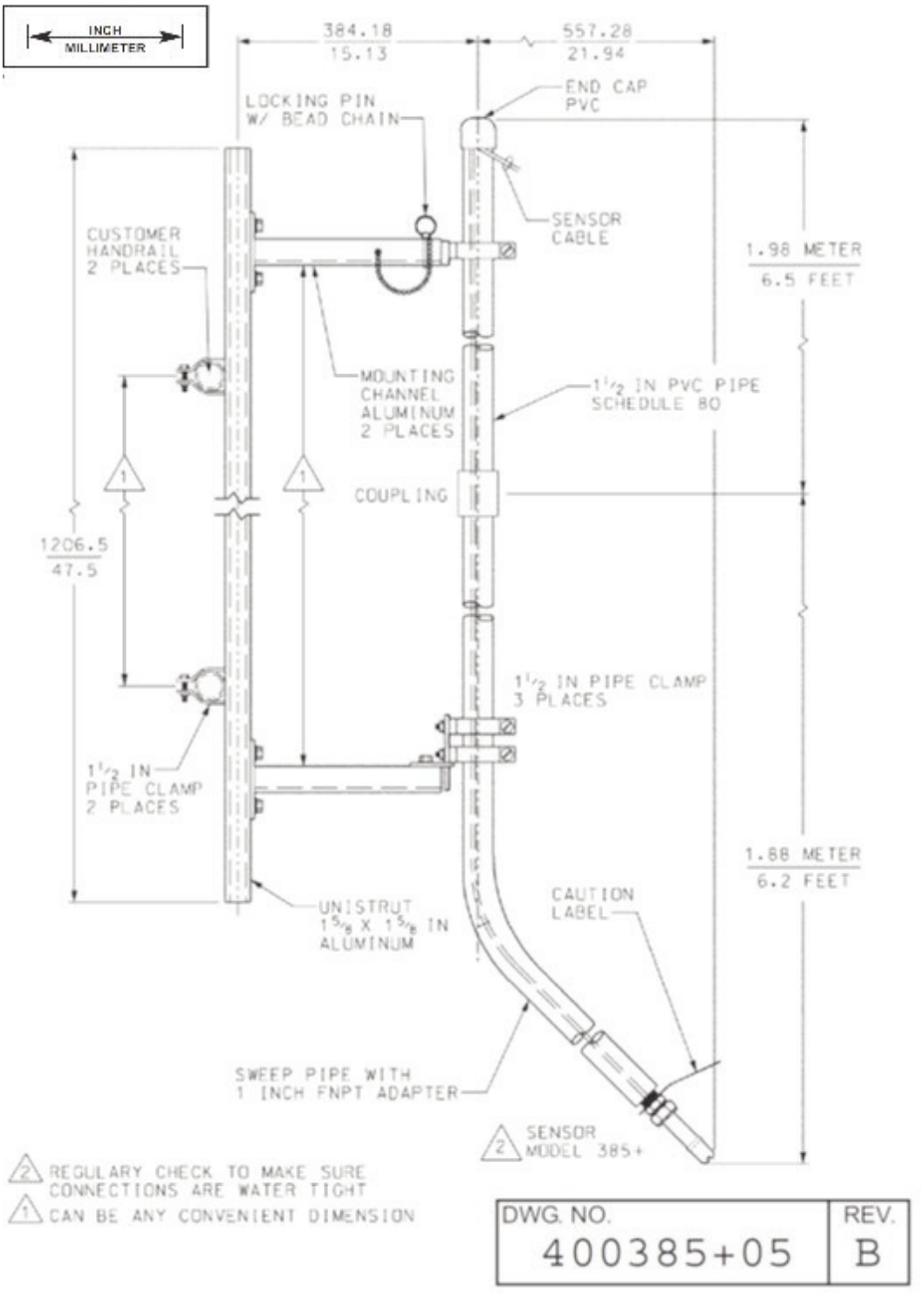


Figure 2-5: Submersion Installations, Handrail Mounting Assembly (P/N 11275-01)



2.3 Electrical Installation

Make electrical connections as shown on Figures 2-6 through 2-14 using the following guidelines:

1. Pay particular attention to the analyzer or transmitter model number when following details on the wiring diagrams to ensure that the connections are made to the proper terminals.
2. Use Rosemount custom cable PN 9200273.
3. The maximum distance from the sensor to the analyzer is 15 ft without an integral preamplifier.
4. Signal cable should be run in a dedicated conduit and should be kept away from AC power lines.

For additional wiring information on this product, including sensor combinations not shown here, please refer to the Liquid Transmitter Wiring Diagrams.

Figure 2-6: Rosemount 385+-02 Sensor Wiring to Rosemount 5081 Transmitter

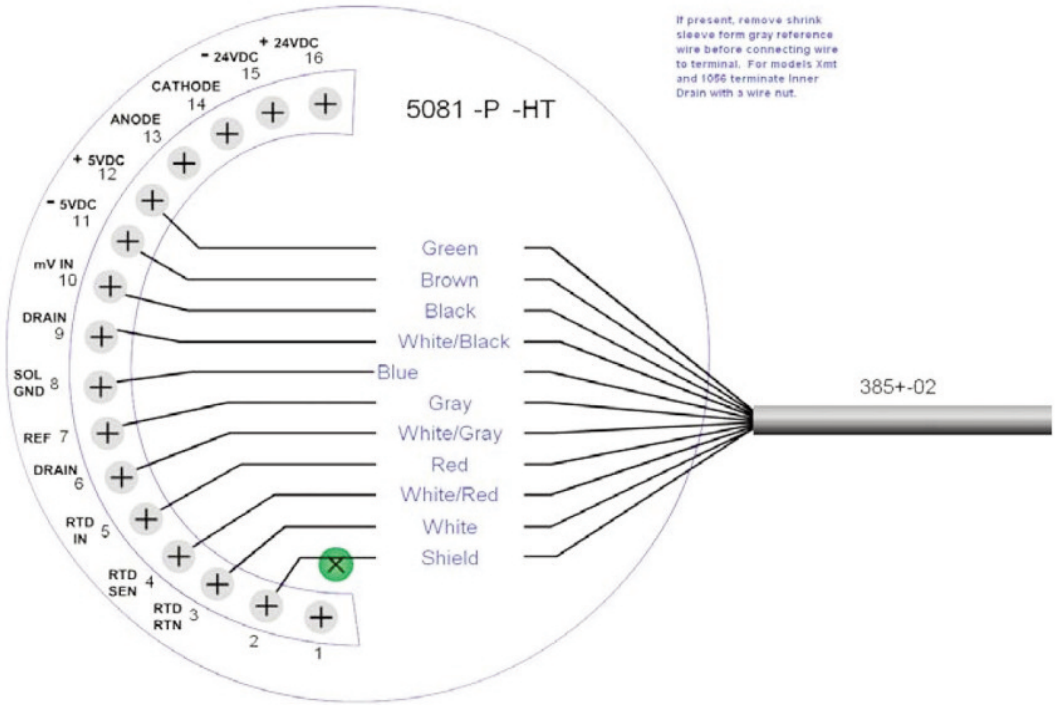


Figure 2-7: Rosemount 385+-03 Sensor Wiring to Rosemount 5081 Transmitter

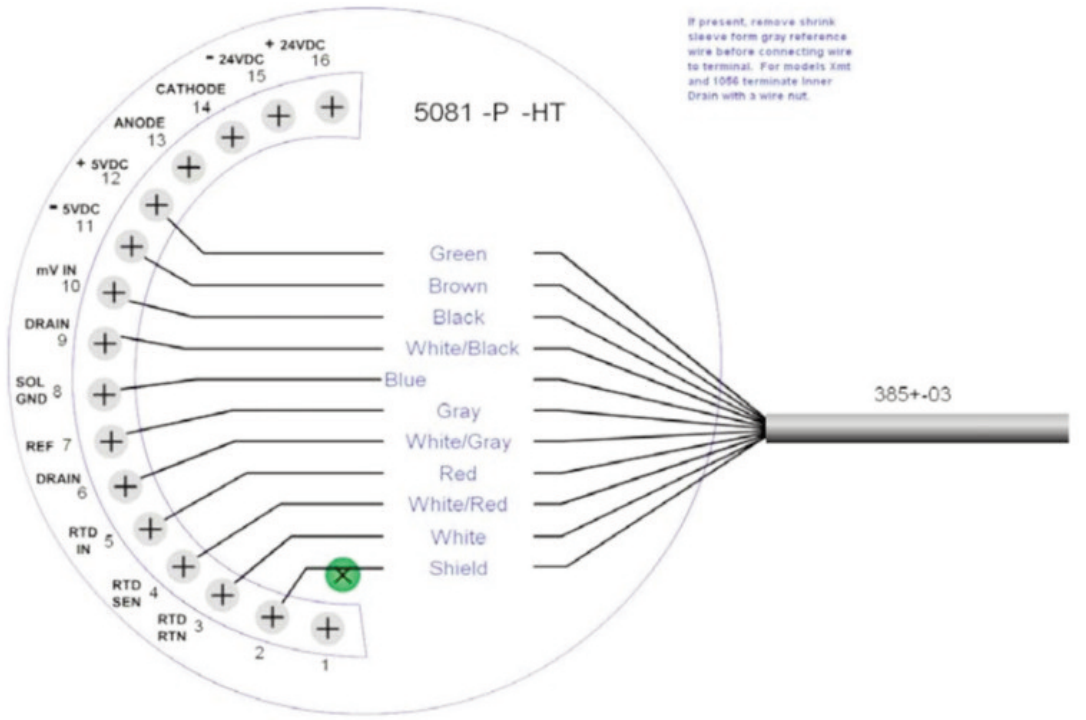


Figure 2-8: Rosemount 385+-04 Sensor Wiring to Rosemount 5081 Transmitter

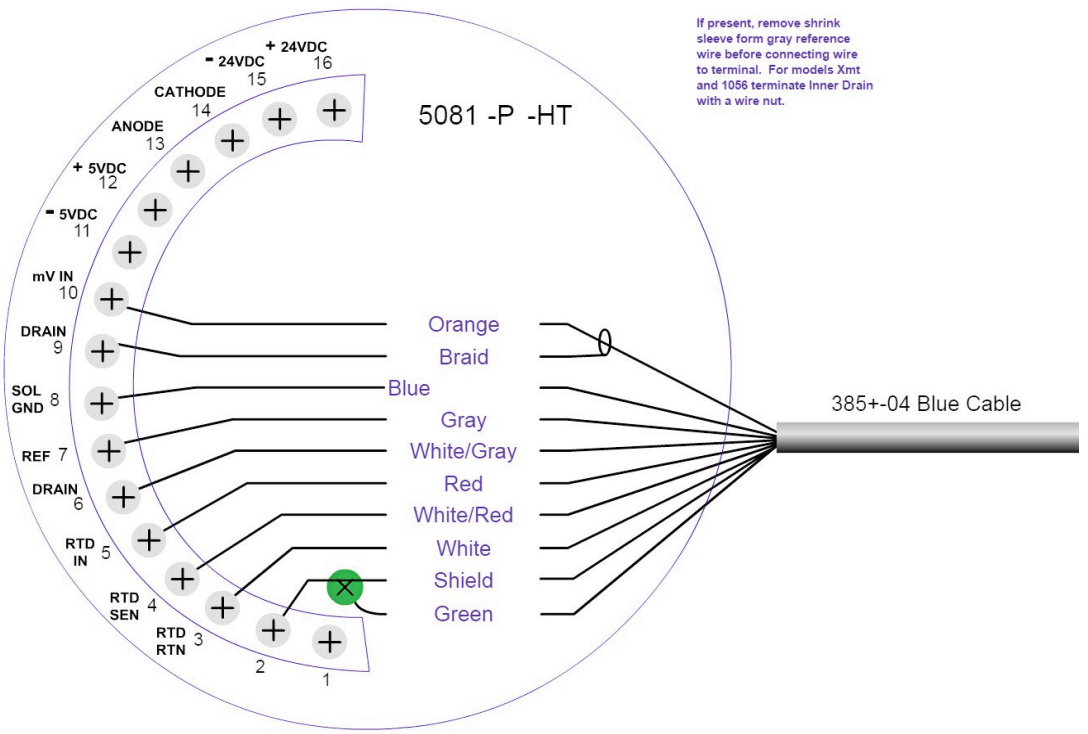


Figure 2-9: Rosemount 385+-02 sensor Wiring to Rosemount 1056/56/1057 Transmitters

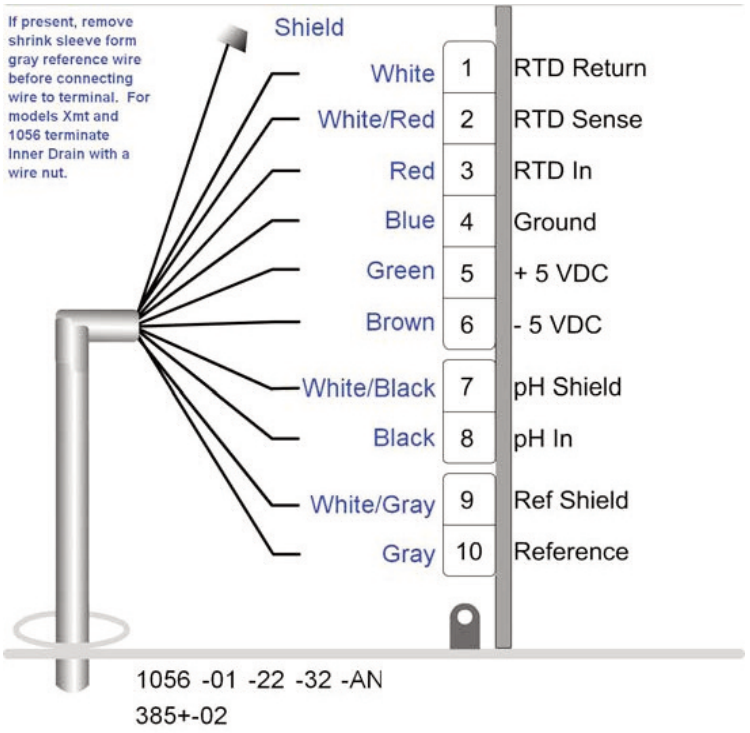


Figure 2-10: Rosemount 385+-03 Sensor Wiring to Rosemount 1056/56/1057 Transmitters

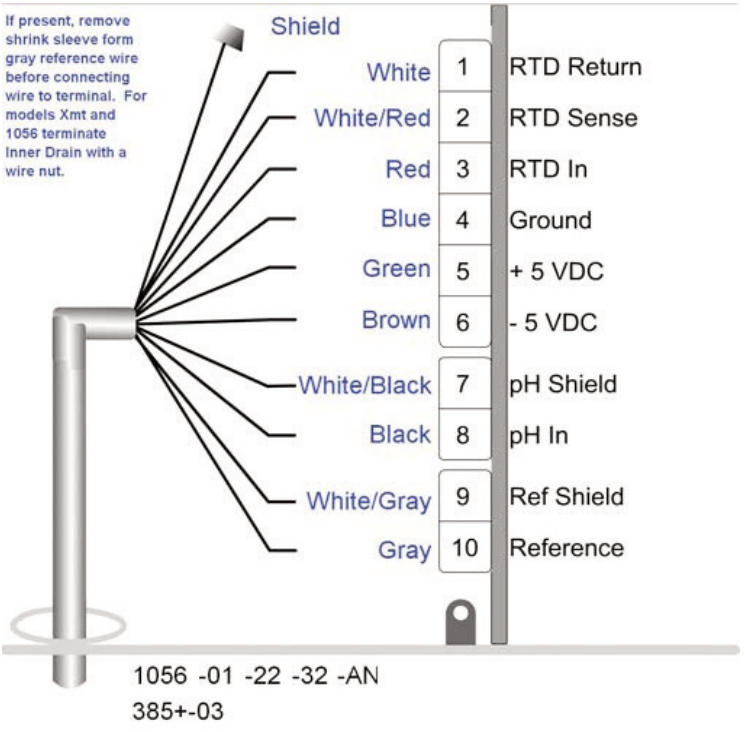


Figure 2-11: Rosemount 385+-04 Sensor Wiring to Rosemount 1056/56/1057 Transmitters

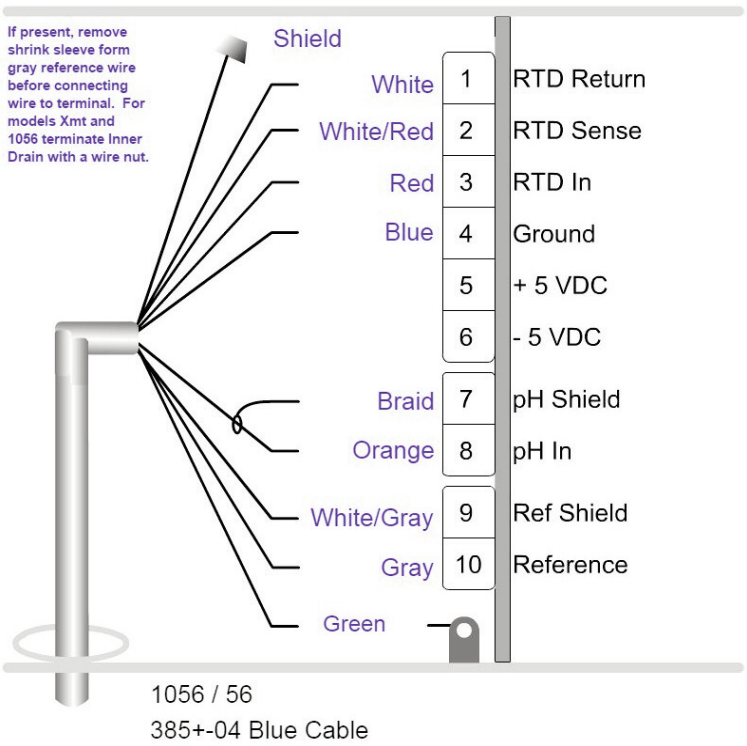


Figure 2-12: Wiring Details - Submersion/Insertion (Code 03 & 04)

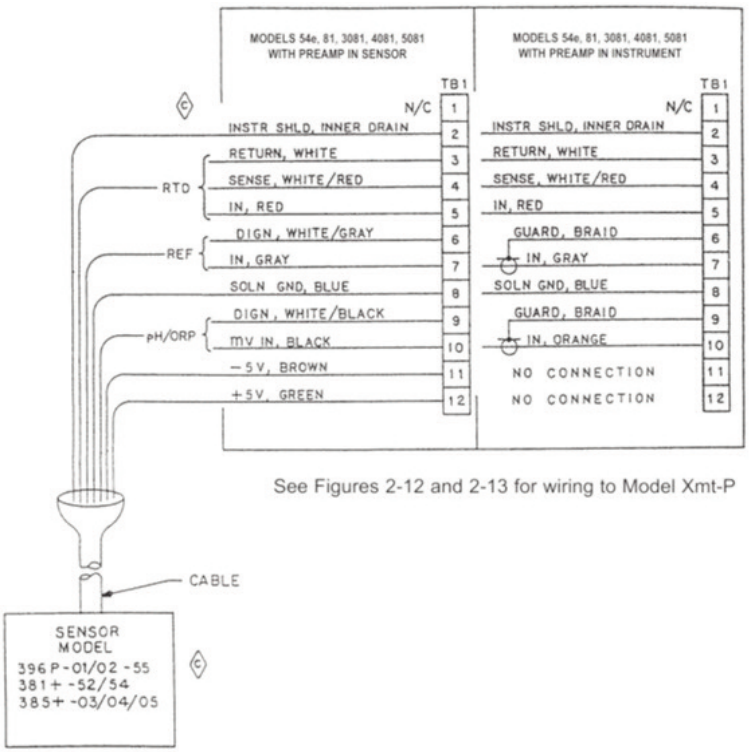


Figure 2-13: Wiring Rosemount 385+-02 Sensor to Rosemount 1055-11-22-32 through Remote Junction Box

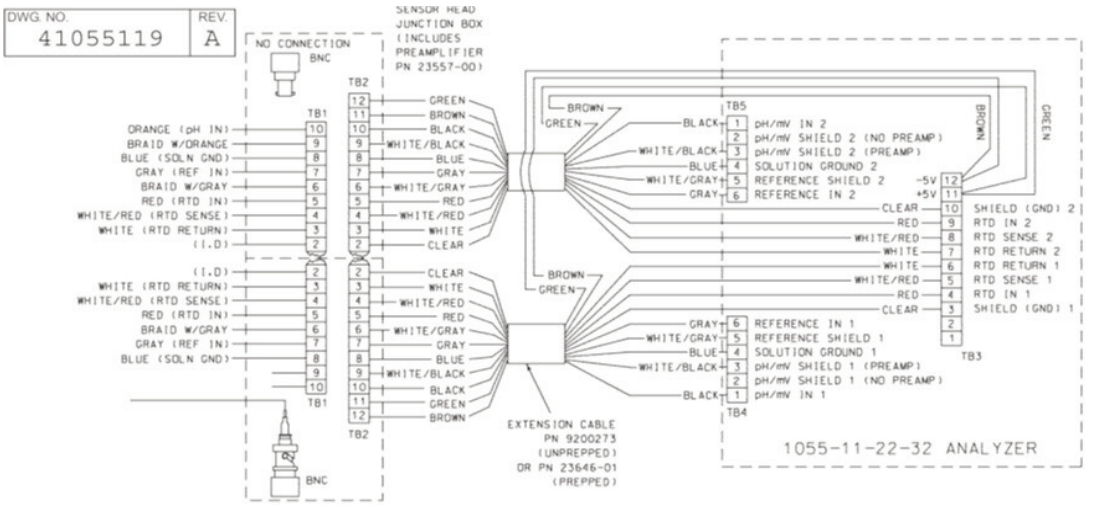


Figure 2-14: Wiring Retraction Version (Code-02)

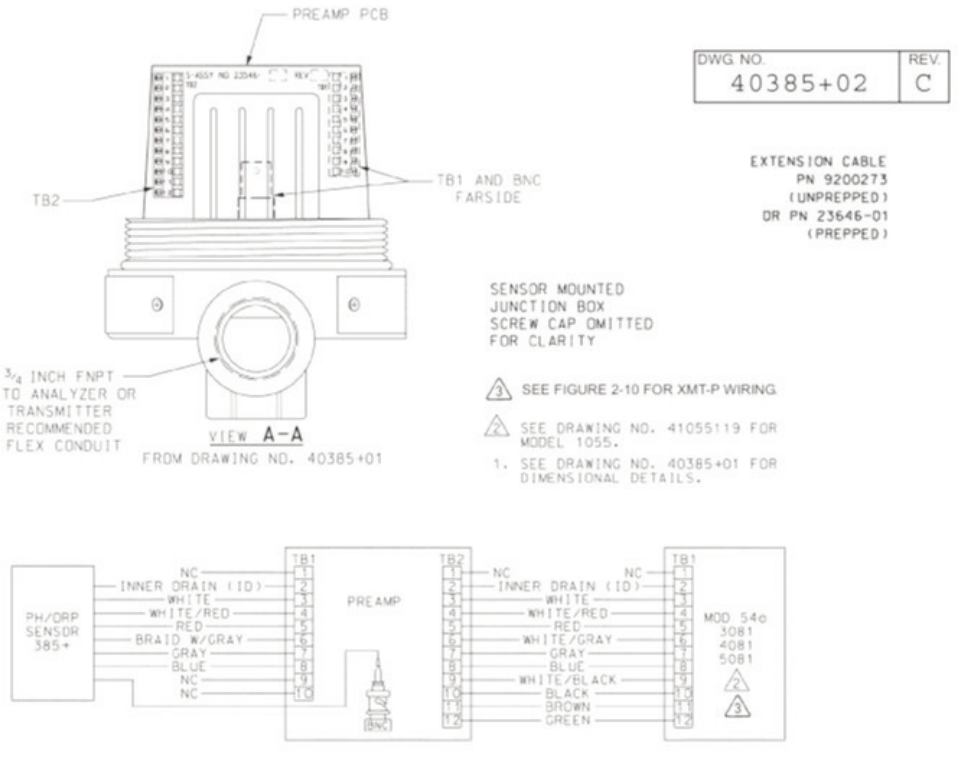


Figure 2-15: Wiring Details - Remote J-Box for Extension Cable

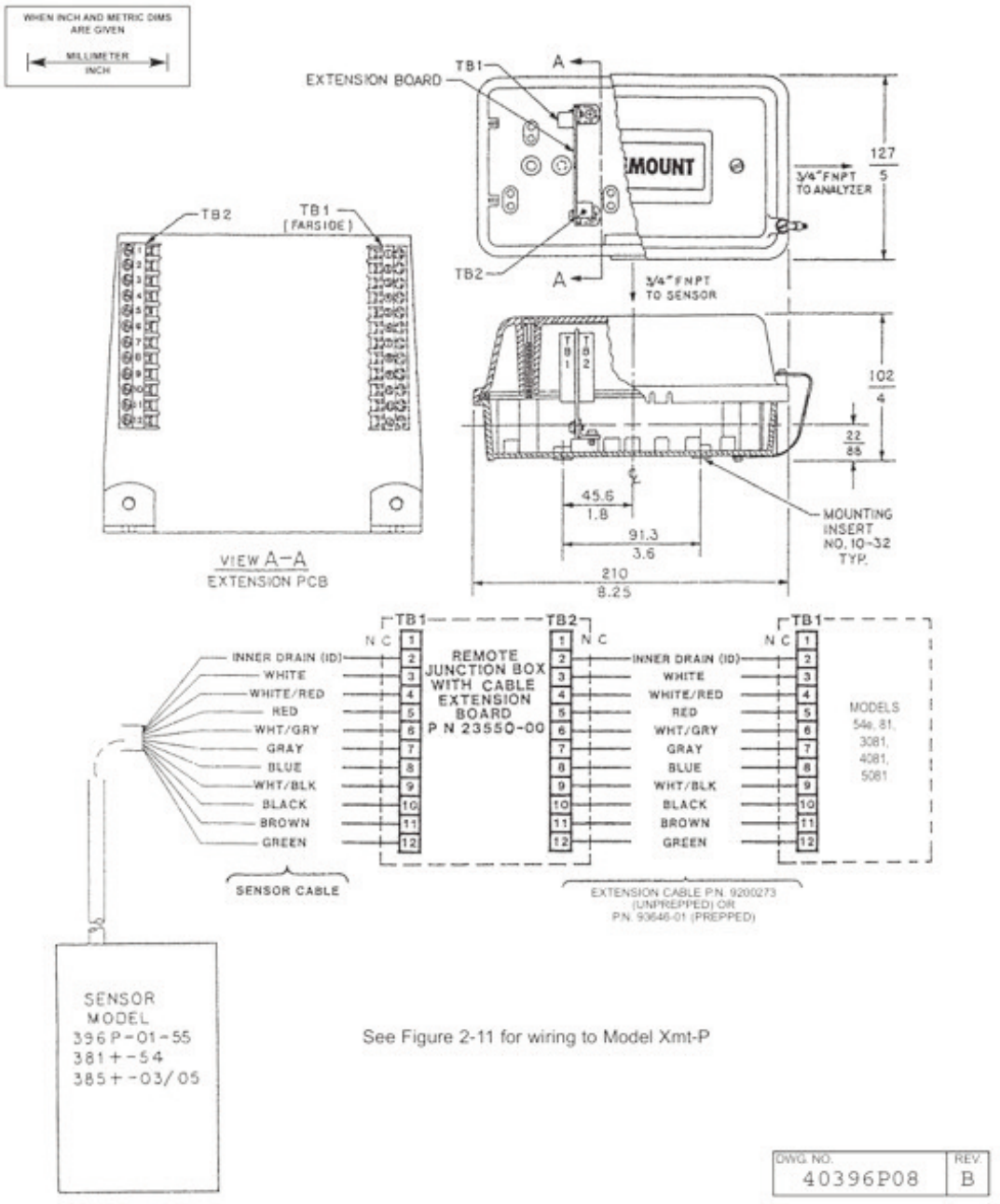
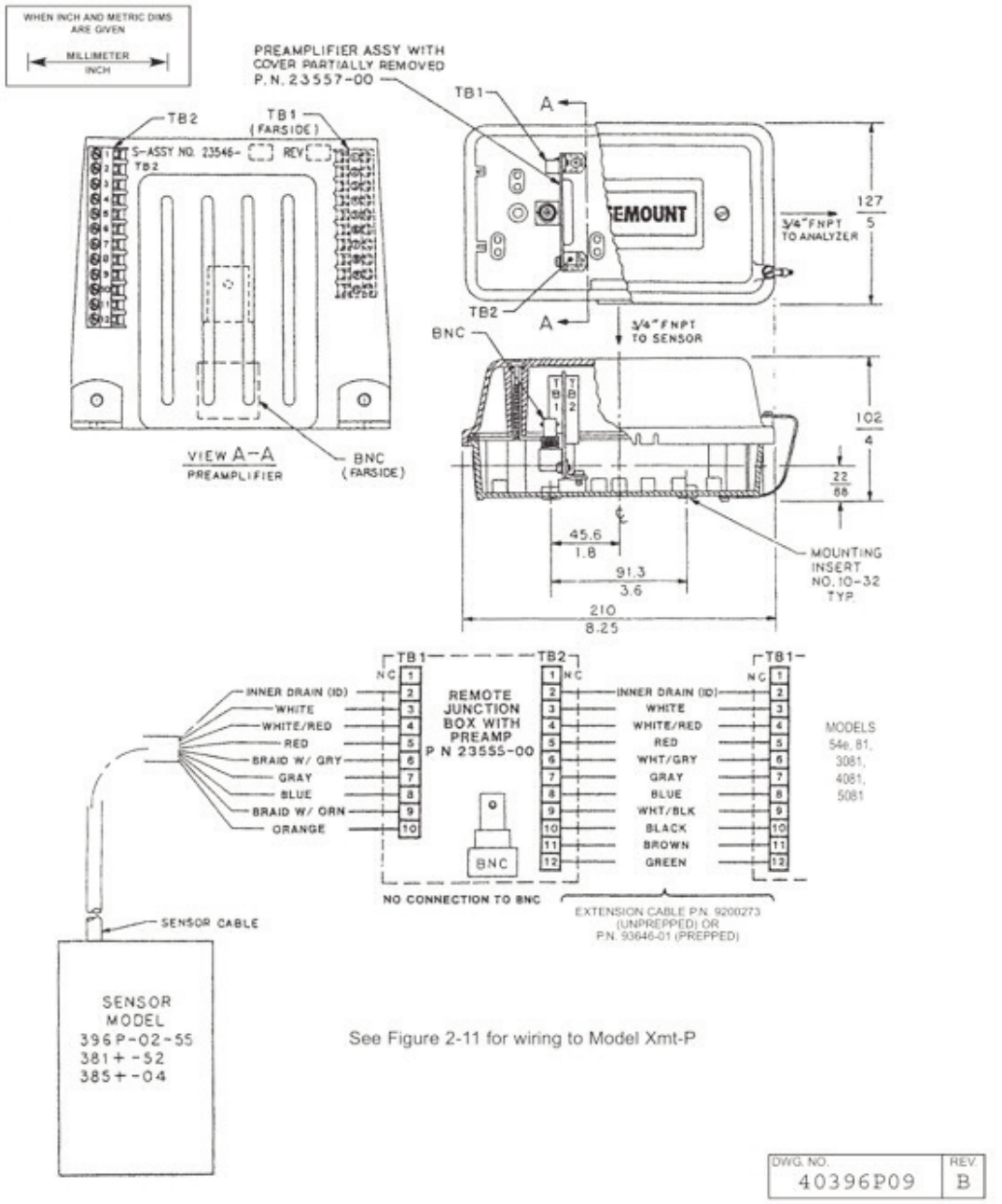


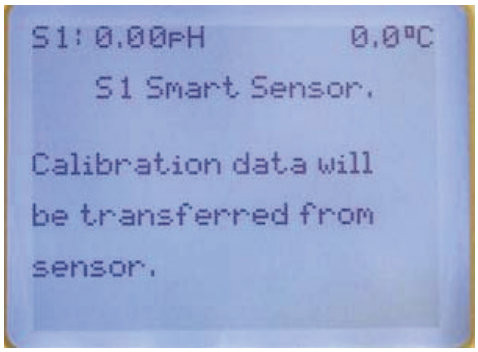
Figure 2-16: Wiring Details - Remote J-Box with Preamp



Section 3: Startup and Calibration

3.1 Startup

To obtain best accuracy, the sensor must be calibrated as a loop with the transmitter. Please refer to the transmitter manual for proper calibration and setup procedures. Example of 1056 start-up shown below.



3.2 pH Calibration Using Buffer Solutions or Grab Samples

The loop may be calibrated with the sensor's measuring tip submersed in standard pH buffer solutions (two point calibration) or with a process grab sample of a known pH value (one point standardization). Please refer to the corresponding transmitter manuals for proper procedures.

3.3 ORP Calibration

An ORP loop is best calibrated using an ORP standard solution.

3.3.1 Quinhydrone Solution

A commonly used ORP standard solution is a saturated quinhydrone solution. This can be made by simply adding a few quinhydrone crystals to either a 4 pH or a 7 pH buffer. Quinhydrone is only sightly soluble so only a few crystals will be required. The solution will have a yellow color. The resulting potentials should be within ±20 millivolts of the value shown in Table 3-1. The ORP value of saturated quinhydrone solution is not stable over long periods of time and therefore new solutions should be made each time they are used.

Table 3-1: ORP of Saturated Quinhydrone Solution

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

3.3.2 Ferric-Ferrous Ammonium Sulfate Solution

Although this solution is not as easy to prepare as the quinhydrone solution in Section 3.3.1, it offers a much more stable solution which will maintain its millivolt value for approximately one year when stored in a glass container.

⚠ CAUTION

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

To prepare solution, dissolve 39.2 grams of reagent grade ferrous ammonium sulfate [Fe(SO4) • (NH)2SO4 • 6H2O] and 48.2 grams of reagent grade ferric ammonium sulfate [FeNH4(SO4)2 • 12H2O] 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 1,000 milliliters. This solution (ferric-ferrous ammonium sulfate) will produce a nominal ORP of 476 ±20 mV at 25°C. Some tolerance in mV values is to be expected due to the rather large liquid reference junction potentials which can arise when measuring this strongly acidic and concentrated solution. However, if the measuring electrodes are kept clean and in good operating condition, consistent repeatable calibrations can be achieved.

NOTICE

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 to be measured when first setting up or after being cleaned.

Section 4: Maintenance

4.1 Maintenance

The Rosemount 385+ Sensor is a disposal type sensor and therefore requires only periodic cleaning and calibration. If the sensor has failed, it should be discarded and replaced.

4.2 Sensor Removal

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

4.2.1 Retractable Version (Code-02)

⚠ 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.

1. Be certain system pressure at the sensor is below 64 psig (442 kPa) before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figure 4-1.
2. Push in on the sensor using the top of the J-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 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.

⚠ 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 stop collar.

⚠ CAUTION

If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550099) in the male connector A.

4.2.2 Insertion/Submersion Version (Code -03 and -04)

⚠ 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!

Remove the sensor from process for cleaning, calibration or replacement.

4.3 pH Electrode Cleaning

If the electrode is coated or dirty, it may be cleaned as follows:

1. Remove the sensor from process as instructed in Section 4.2.
2. Wipe the glass bulb with a soft, clean, lint free cloth or tissue. If this does not remove the dirt or coating, proceed to step 3. If the sensor appears to be clean, go to step 5.
3. Wash the glass bulb in a strong detergent solution and thoroughly rinse with tap water. If the bulb still appears to have a coating, proceed to step 4.

⚠ CAUTION

The solution used in the following step 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 the skin is made, immediately rinse with clean water.

4. Following the caution above, wash the glass bulb in dilute 5% hydrochloric acid solution and then rinse it thoroughly in tap water. Replace the sensor if it cannot be cleaned. If the glass bulb appears clean, proceed to step 5.
5. Buffer calibrate the sensor (Refer to Section 3.0). If the sensor appears to respond sluggishly to pH change, soaking it overnight in a weak acid solution (5% hydrochloric acid) may improve its response. Be sure to follow the CAUTION above and to rinse the sensor's tip thoroughly with tap water. If the sensor will not calibrate, it must be replaced.

4.4 Platinum Electrode Cleaning

Remove any film or dirt by wiping the electrodes platinum band with a clean, lint free, cloth. If needed, a strong detergent should be used to remove any remaining dirt or film.

Platinum electrodes can become poisoned by cyanide or sulfide compounds. However, processes involving these compounds (such as cyanide destruction) will destroy all the cyanides or sulfides before they can react with the platinum.

Should poisoning occur, the electrode can be restored to normal operation by polishing the platinum (metallic) surface with moistened baking soda (after a strong detergent wash to remove any film on the platinum surface).

4.5 Sensor Tube Replacement (Code -02)

Replacement 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. Refer to Section 4.2 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 (D) from male connector body (C). Separate junction box from used sensor. Set aside.

2. Pry off split ferrule from sensor and set aside for reuse. Remove hex nut (D) and set aside for reuse. Check that the internal O-ring is in place in the male connector body (C) 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 aside. Discard sensor tube.

NOTICE

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 1in. 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 (D), the split ferrule (from the old sensor), male connector body (C), 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 (C). Screw the hex nut (D) by hand until the tube is “locked” into the male connector body. Make sure that the male connector body (C) is sufficiently tightened. 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. If the sensor tube is correctly attached to the junction box, wrench tighten hex nut (D) on male connector body (C) (see Figure 4-1). 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 (D) and repeat.

8. 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, or see Figure 2-4. Reattach the BNC connector to the preamp. Screw on the cover of the junction box.

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

10. 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.

11. 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.

NOTICE

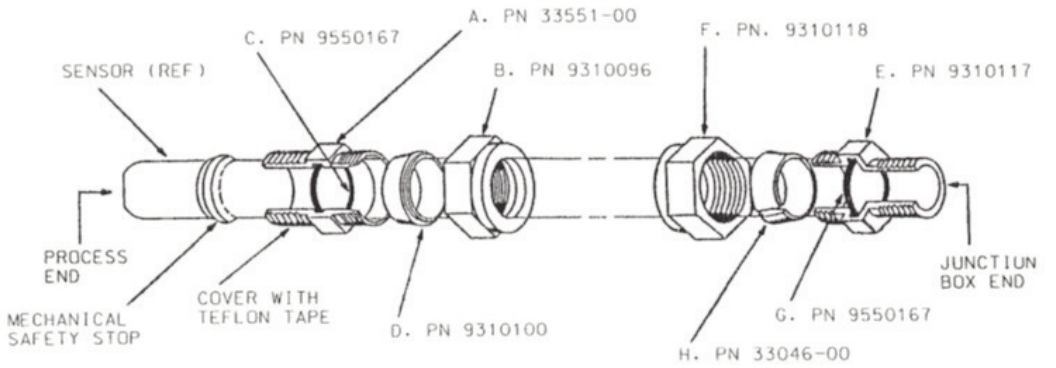
A stainless steel ferrule is available if the TEFLON ferrule does not adequately grip. When using the metallic ferrule, be careful and avoid over tightening. This can damage the sensor tube.

⚠ CAUTION

If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550099) in the male connector body (A).

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

Figure 4-1: Sensor Tube Replacement



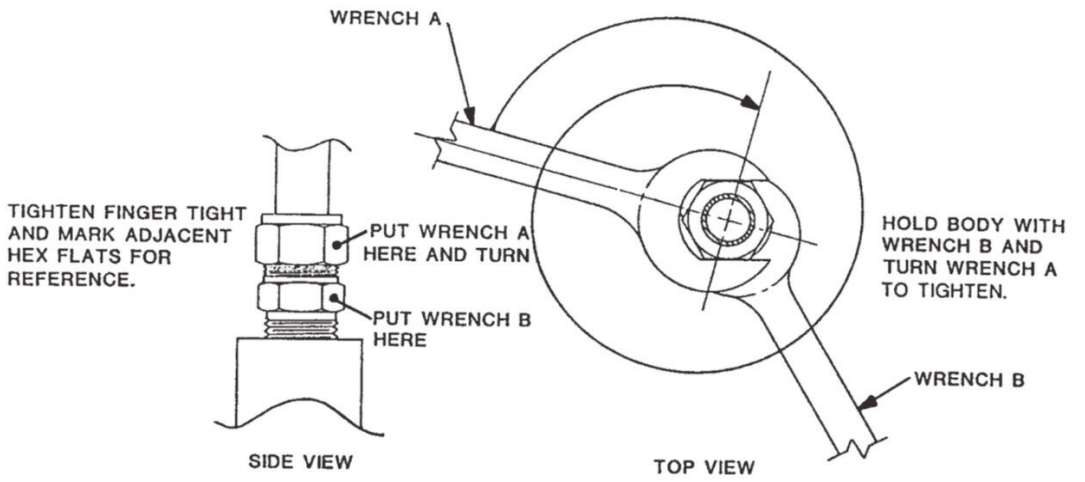
PROCESS END (A.B.C. & D SOLD TOGETHER AS
SST. PROCESS CONNECTOR KIT PN 23166-00 OR
TITANIUM PROCESS CONNECTOR KIT PN23166-01)

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

Figure 4-2: Male Connector Tightening Diagram



Section 5: Diagnostics and Troubleshooting

5.1 Model 54/3081 pH Diagnostics

The Models 54 and 54e Transmitters and Models 3081, 4081, and 5081 pH Transmitters automaically search for fault conditions that would cause an error in the measured pH value. Refer to the respective manual for a complete description of the transmitter's fault conditions.

5.2 Troubleshooting

Table 5-1, below, lists the diagnostic messages that indicate a possible sensor problem. A more complete description of the problem and a suggested remedy corresponding to each message is also listed.

Table 7-1: Troubleshooting

DIAGNOSTIC MESSAGE 54/54E 3081/4081/5081	DESCRIPTION OF PROBLEM	REMEDY
"Calibration Warning" CALIbrAtE	1. Aged glass. 2. Sensor not immersed.	1. Perform buffer calibration. 2. Be sure electrode measuring tip is in process.
"Cracked glass failure" 6LASS fAIL	Broken or cracked glass.	Replace Sensor.
"High reference imped" rEF fAIL or rEF WJArn	1. Liquid junction coated. 2. Reference Cell gel depleted. 3. Sensor not immersed.	1. Clean sensor; replace if necessary. 2. Replace sensor. 3. Be sure electrode measuring tip is in process.
"Input voltage high" "Input voltage low"	pH input shorted or sensor. miswired.	Check wiring. Replace sensor if necessary.
"Old glass warning" 6LaSS WJArn	1. Glass electrode worn out. 2. Sensor not immersed.	1. Replace sensor. 2. Be sure electrode measuring tip is in process.
"Reference offset err" (offline only) Std Err	Reference electrode poisoned.	Replace sensor.
"Ref voltage high" "Ref voltage low"	1. Reference shorted or sensor miswired. 2. Sensor not immersed.	Check wiring. Replace sensor if necessary.
"Sensor line open" LInE fAIL	1. Open wire between sensor and analyzer. 2. Interconnecting cable greater than 1000 ft.	1. Check sensor wiring. 2. Relocate analyzer.
"Sensor miswired"	1. Open wire between sensor and analyzer. 2. Bad preamplifier.	1. Check wiring. 2. Replace preamplifier.
"Temp error high" "Temp error low" tEMP HI tEMP LO	1. Open or shorted RTD. 2. Temperature out of range.	1. Replace sensor. 2. Check process temperature.

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

5.3 Rosemount 1056/1057 SMART pH Diagnostics

Rosemount 1056 and 1057 transmitters automatically search for SMART sensors. Once the SMART sensor is detected, 385+ (-03), and communication is established the start-up, screen will appear, figure 5-1. Start-up and calibration of pH/ORP are described on page 16. Up to five (5) calibration data sets can be found under DIAG/sensorX/calibration history, see figure 5-2.

Figure 5-1: SMART start-up screen

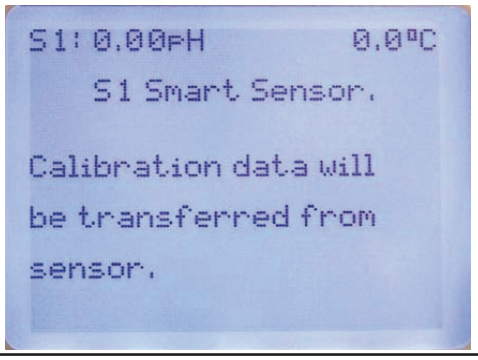
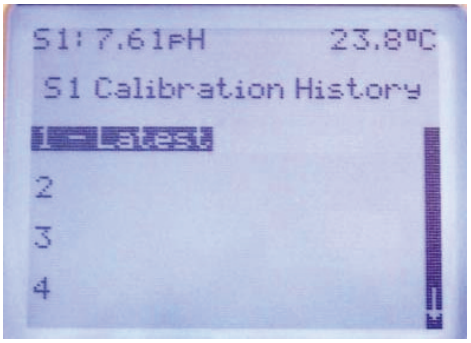
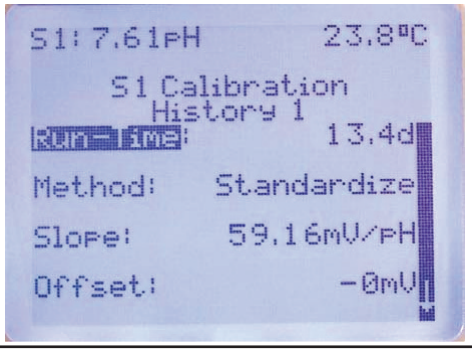


Figure 5-2: Calibration History menu on Rosemount 1056



The calibration data contain slope, offset, temperature, method of calibration (page 16), glass impedance, reference impedance and time stamp between the calibration, figure 5-3. Advanced diagnostic data can be used for preventive maintenance, replacement and timely troubleshoot.

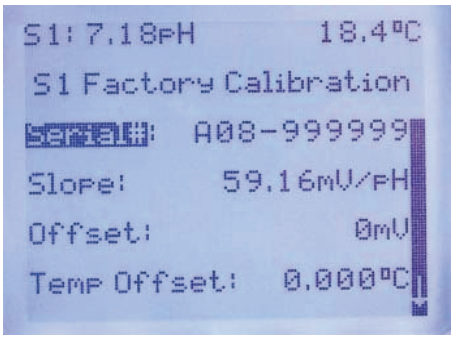
Figure 5-3: Calibration History screen



Please refer to the corresponding installment manual for detailed description.

The factory calibration data can be found on the bottom of Calibration History menu figure 5-2. Use key-pad to scroll down to the bottom, find Factory Cal. line and press enter. The factory calibration screen will appear, figure 5-4. It contains the serial number of the sensor, slope, offset, temperature offset, glass impedance and reference inductance value. It's possible to retore the calibration settings to factory default. Please, refer to corresponding instrument manual for correct procedure.

Figure 5-4: Factory Calibration



Section 6: Accessories

6.1 Accessories

Table 6-1: Accessories for Rosemount 385+ sensor

Part Number	Description
11275-01	Handrail mounting assembly (Code 03, 04 only)
23550-00	Remote J-Box without preamplifier (Code 02, 03 only)
23555-00	Remote J-Box with preamplifier, (Code 04 only)
23166-00	Process connector, 316SS, insertion/submersion 1 in. MNPT (Code 02, 03, 04)
23166-01	Process connector, titanium, insertion/submersion 1 in. MNPT (Code 02, 03, 04)
9510066	Process connector, Nylon, submersion only, 1 in. MNPT (Code 03, 04)
9210012	Buffer solution, 4.01 pH, 16 oz
9210013	Buffer solution, 6.86 pH, 16 oz
9210014	Buffer solution, 9.18 pH, 16 oz
12707-00	Jet Spray Cleaner for submersion service
23566-00	Sensor Tube, pH, Pt 100, Titanium, Low Resistance Glass
23566-01	Sensor Tube, pH, Pt 100, Titanium, High pH
23566-02	Sensor Tube, ORP, Pt 100, Titanium, General Purpose
23240-00	Ball Valve Assembly 316 Stainless Steel
23646-01	Cable, 12 Conductor, Shielded, Prepped
23557-00	Preamplifier, J-box
33046-00	Ferrule, 1 in. 316 SS, Split
9310096	Nut, Swage, 1 in. 316 SS
9310100	Ferrule, 1 in. TEFLON
9550099	O-ring, 2-214, VITON

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)

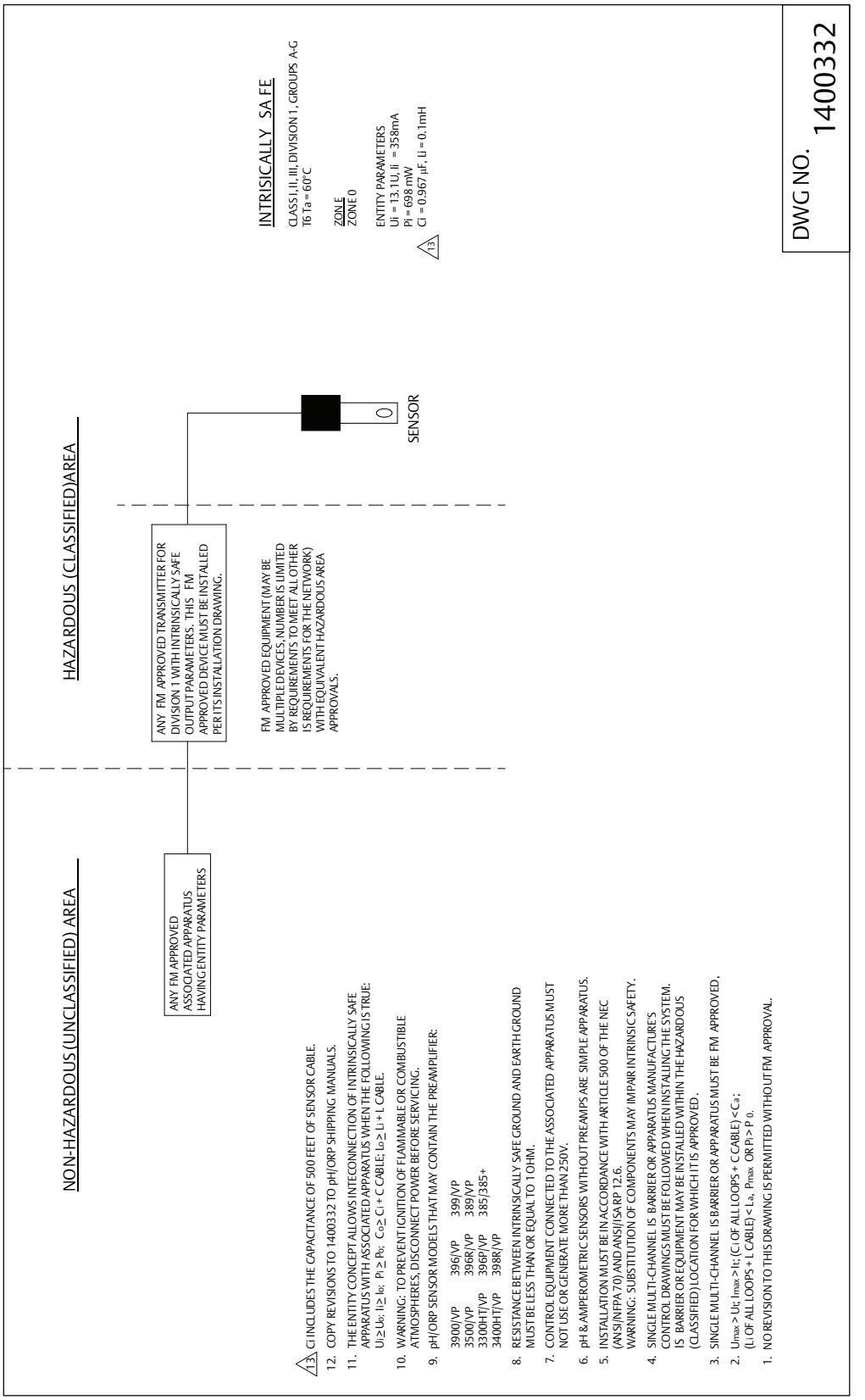
Kim Freeman
(Name printed)

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



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