Instruction

MI 611-210
February 2016

EP459A
Fluoride Sensor Assembly

Foxboro®

by Schneider Electric

Contents

Figures

1. Introduction

General

This instruction describes the assembly and calibration procedures for a sensor assembly specifically designed to measure fluoride.

Warnings and Cautions

⚠ WARNING

When performing calibration or maintenance, wear appropriate protective clothing including safety goggles. Chemicals escaping under pressure can cause severe injury including blindness.

⚠ WARNING

Use care when connecting and disconnecting any high pressure service connection. To avoid severe injury to personnel or damage to equipment, use proper gloves and follow the recommended procedure.

⚠ WARNING

When processing hazardous liquids, follow the recommended procedures. Failure to do so could result in injury to personnel and damage to equipment.

⚠ WARNING

Use only recommended spare parts. Substitution parts could result in injury to personnel and/or damage to the process or equipment.

⚠ CAUTION

Use care when handling and assembling sensor components (for example, fluoride electrode, O-rings) to prevent damage.

⚠ CAUTION

Mount the sensor out of direct sunlight. Prevent the formation of condensation inside the sensor assembly.

Reference Documents

DP 611-210	Dimensional Print - EP459A Fluoride Sensor Assembly
MI 611-190:	*873DPX Series Electrochemical Analyzers for Dual pH, ORP, or ISE Measurement*
MI 611-211:	*870ITPH Intelligent Electrochemical Transmitter for pH, ORP, or ISE Measurement*
MI 611-225	875PH Intelligent Electrochemical Analyzer for pH, ORP, or Ion Selective Electrode (ISE) Measurement
PL 611-210	Parts List - EP459A Fluoride Sensor Assembly

Measurement Specifications

Fluoride Measurement Range	Saturation to 0.02 ppm
Operative Temperature Range	0 to +60°C
Sample pH Range	pH 4 to pH 10
Temperature Measurement	2-wire, 100 ohm RTD
Min/Max Flow Range	5 to 30 gallons/hour (see note)
Maximum Operating Pressure	100 psi (see note)
Bottom Chamber Internal Volume	Approximately 100 mL
Cable Length	20 feet
Process Wetted Materials	PVC, 316 ss, epoxy electrode, EPM O-rings, LaF_3 Fluoride Crystal, Ceramic Reference Junction
Electrical Safety	FM approved intrinsically safe Class I, II, III, Division 1, Groups A, B, C, D, E, F, and G; nonincendive Class I, II, III, Division 2, Groups A, B, C, D, F, and G, hazardous locations when connected to 870ITPH Series Transmitter per TI 005-101.

NOTE

For drinking water applications, regulate the pressure and flow through the sensor assembly such that the inlet pressure is constant at about 10 psi and the outlet pressure is at atmospheric pressure.

2. Installation

Assembly Instructions

The fluoride sensor assembly is partially assembled. The final assembly is performed by the user. Installation consists of a few steps:

1. Mounting the sensor assembly to either a panel or 2-inch pipe.
2. Installing the fluoride and reference electrodes into the sensor assembly.
3. Wiring the sensor assembly to the analyzer or transmitter.
4. Calibrating the fluoride sensor along with the analyzer or transmitter.

Careful attention to the details of these steps ensures a trouble free startup and accurate fluoride measurements.

Mounting of the Fluoride Sensor Assembly

The fluoride sensor assembly is supplied with mounting hardware that allows it to be mounted to either a panel or a 2-inch pipe (see Figure 1 and Figure 3 respectively). The installer can select either mounting option.

Most process streams have some level of entrained or dissolved air. Under certain conditions the air forms bubbles that can collect in the flow cell section of the sensor assembly. When a bubble forms on the surface of either electrode, the signal is interrupted. The following suggested steps can be taken at the time of installation to minimize or prevent the impact of bubble formation. The amount of air in the process water and the tendency for bubble formation dictates the use of these suggestions.

Therefore, **these installation suggestions can be used in any combination or not at all.**

1. Install the sensor assembly at a 45° angle with the process inlet down and the outlet up. The inlet should be the process connection port that is closest to the electrodes (see Figure 2). The upward slope of the flow path encourages any bubbles that form to be swept up and out by water flow.

NOTE

Doing this requires removing the assembly from its mounting for calibration so that it can be calibrated with its base horizontal.

2. Provide flow adjustment capability before the inlet to the sensor assembly. By adjusting the flow, bubbles that do form, are swept away before they collect on the surface of the electrodes.
3. Bubble traps are available from other suppliers and some of our fluoride sensor users have reported success using bubble traps. This suggestion has not been tested.
4. Regulate the pressure and flow through the sensor assembly such that the inlet pressure is constant at about 10 psi and the outlet pressure is at atmospheric pressure.

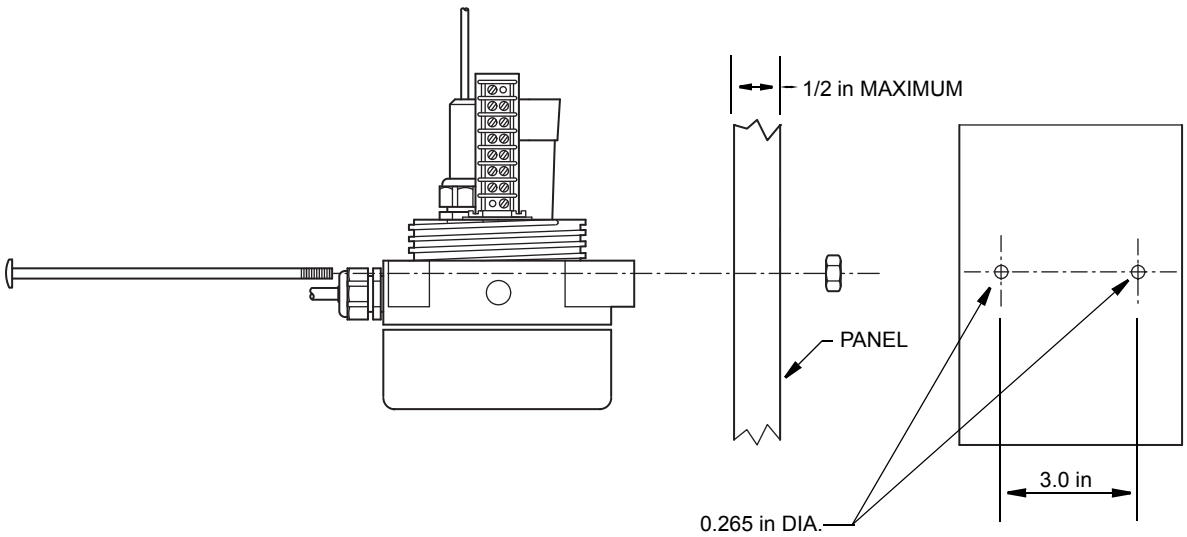


Figure 1. Panel-Mounted Fluoride Sensor Assembly

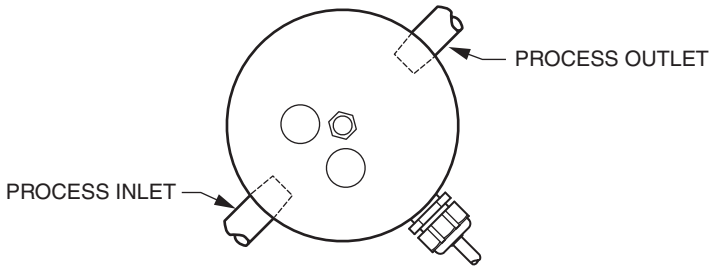


Figure 2. Bottom View, Electrode Assembly

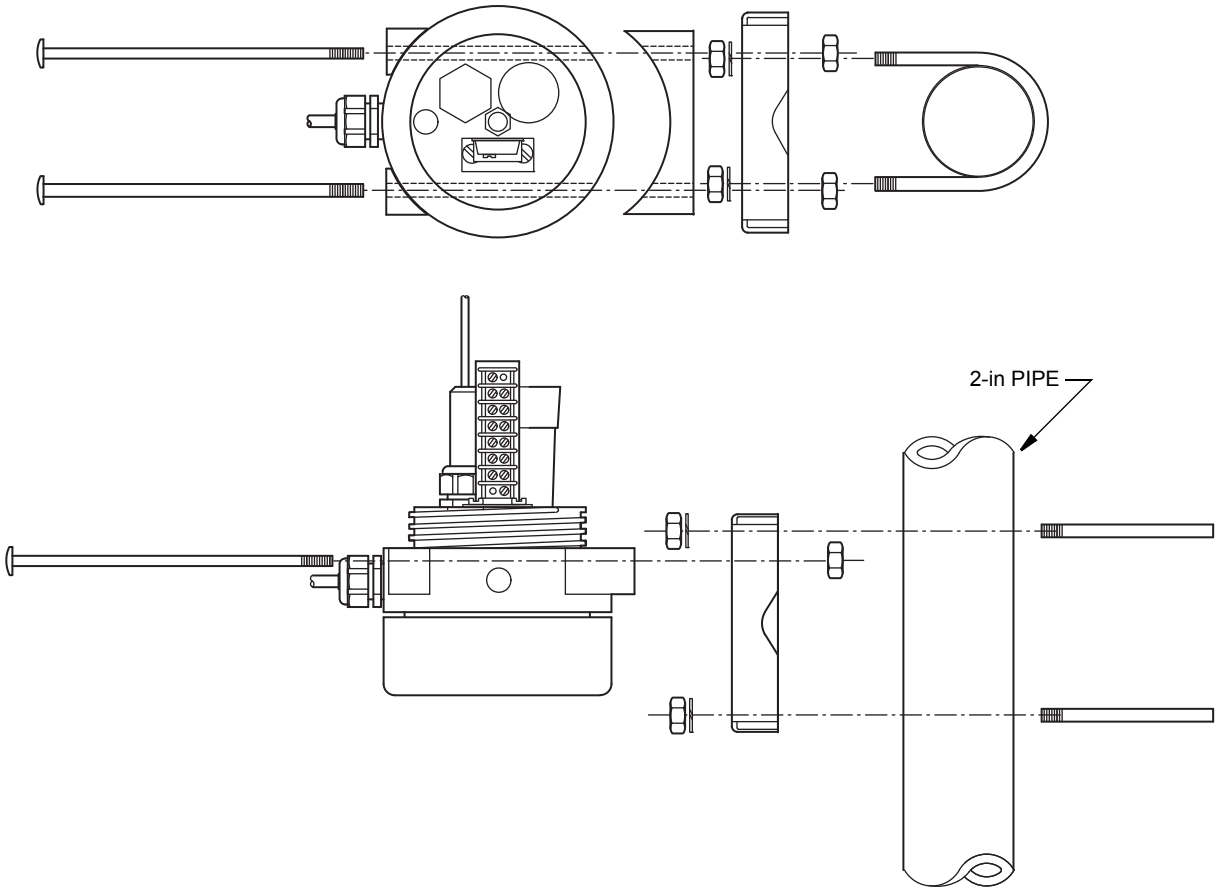


Figure 3. Pipe-Mounted Fluoride Sensor Assembly

Final Assembly

1. Remove the clear plastic cover to complete the remainder of the assembly.
2. Install the fluoride electrode:
   a. Remove the fluoride electrode from the box. Remove the protective end cap.
   b. Refer to Figure 5. The bushing/cap has three internal parts that must be in place to seal the fluoride electrode. The bushing/cap is shipped with these parts installed. If the bushing/cap has been disassembled, confirm that the parts are in place before installing the fluoride electrode. From top to bottom, the three internal parts are a metal washer, a plastic washer, and an O-ring.
   c. Slide the fluoride electrode through the bushing in the assembly. With the fluoride electrode fully installed into the bushing, tighten the bushing/cap (clockwise) 1/2 turn past hand-tight. The fluoride electrode should be firmly seated.
   d. When the fluoride electrode is fully seated, the sensing end of the electrode should protrude into the flow cell by about 0.15 ± 0.03 inches. Refer to Figure 4.

      If the electrode is not properly located, calibration and measurement inaccuracies may result. If the electrode is not protruding far enough, loosen the bushing/cap and attempt to insert the electrode further into the cap and retighten the cap.

      If the electrode is protruding too far, loosen the bushing/cap and pull the electrode out until the electrode protrudes the proper amount, and retighten the cap.
   e. Refer to Figure 6. Attach the black wire from the fluoride electrode to the terminal opposite the cable wire, number 3A. Attach the clear jacketed wire from the fluoride electrode to the terminal opposite the cable wire, number 3.

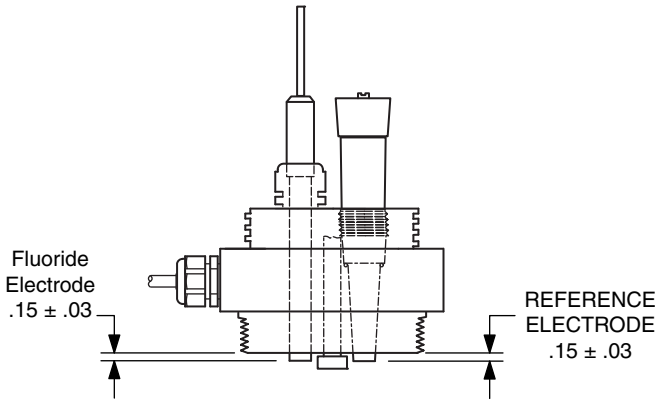


Figure 4. Electrode Depth

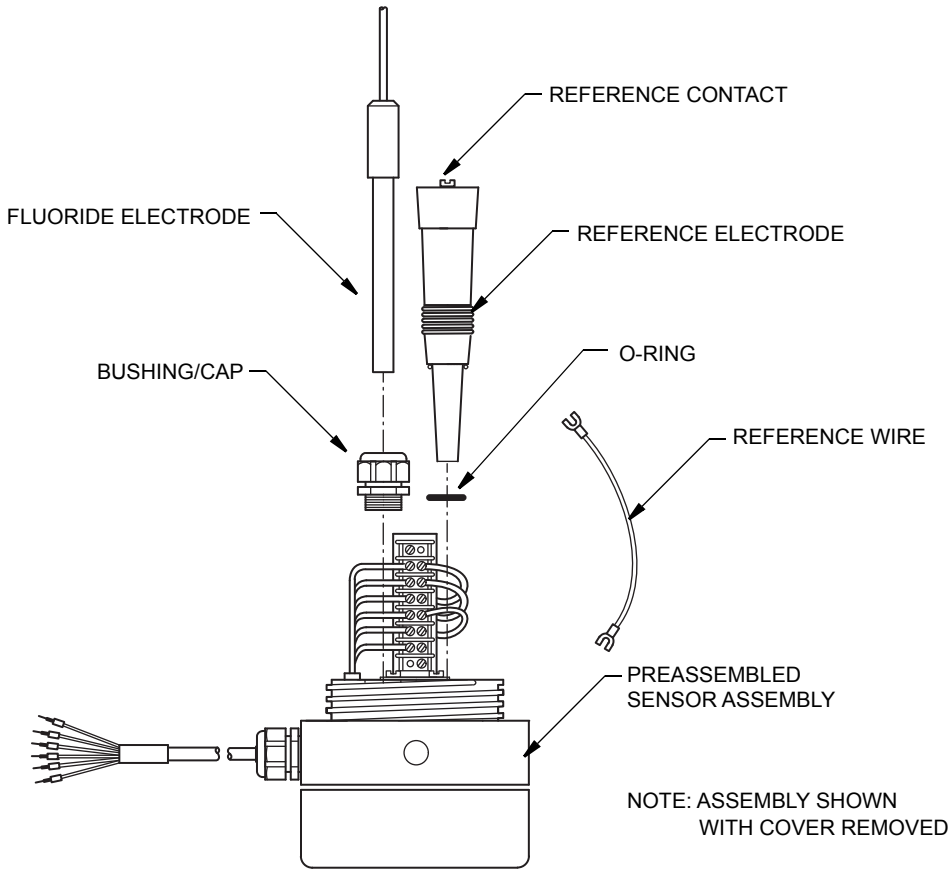
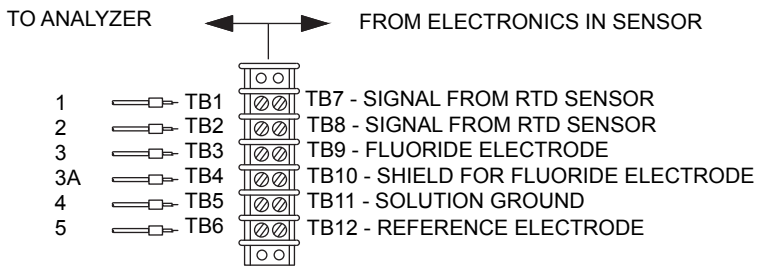


Figure 5. Sensor Assembly

3. Install the reference electrode:
   a. Remove the reference electrode from the box. Remove the yellow tape from the top, saving the O-ring.
   b. Refer to Figure 5. Install the O-ring in the remaining tapped hole. Ensure that the O-ring is lying flat in the bottom of the hole.
   c. Remove the protective end cap from the reference electrode. Save the cap for future storage of the electrode if desired. Thread the reference electrode into the mating hole and tighten 1/4 turn past hand-tight.
   d. When the reference electrode is properly installed, the sensing end of the electrode should protrude into the flow cell by about 0.15± 0.03 inches. Refer to Figure 4.



Analyzer	Sensor Cable		Sensor Connections			
Terminal	Terminal	Color	Terminal Block Position		Function	Color
1	1	Black	TB1	TB7	Signal from RTD Sensor	Orange
2	2	White (Thin)	TB2	TB8	Signal from RTD Sensor	Orange
3	3	White (Thick)	TB3	TB9	Fluoride Electrode	Natural
3A	3A	Clear	TB4	TB10	Shield for Fluoride Electrode	Black
4	4	Clear	TB5	TB11	Solution Ground	Green
5	5	Red	TB6	TB12	Reference Electrode	Red

Figure 6. Electrical Connections

4. Refer to Figure 5 and Figure 6. Install the reference wire by attaching the end of the reference wire (from TB12) to the reference contact on top of the reference electrode.
5. With all wires tucked inside, screw the clear plastic cover onto the sensor assembly, tightening firmly by hand.
6. Attach process inlet and outlet plumbing as required to satisfy the application. Attach process inlet and outlet plumbing using the ½-inch FNPT ports in accordance with Mounting Instructions and Figure 2.
7. Wire the cable from the sensor assembly to an 875PH Analyzer, 873DPX Analyzer, or to 870ITPH Transmitter. The numbering of the terminal strip is the same in each instrument and the leads of the sensor assembly are numbered to match the terminal strip in the analyzer (transmitter). Refer to Figure 6.

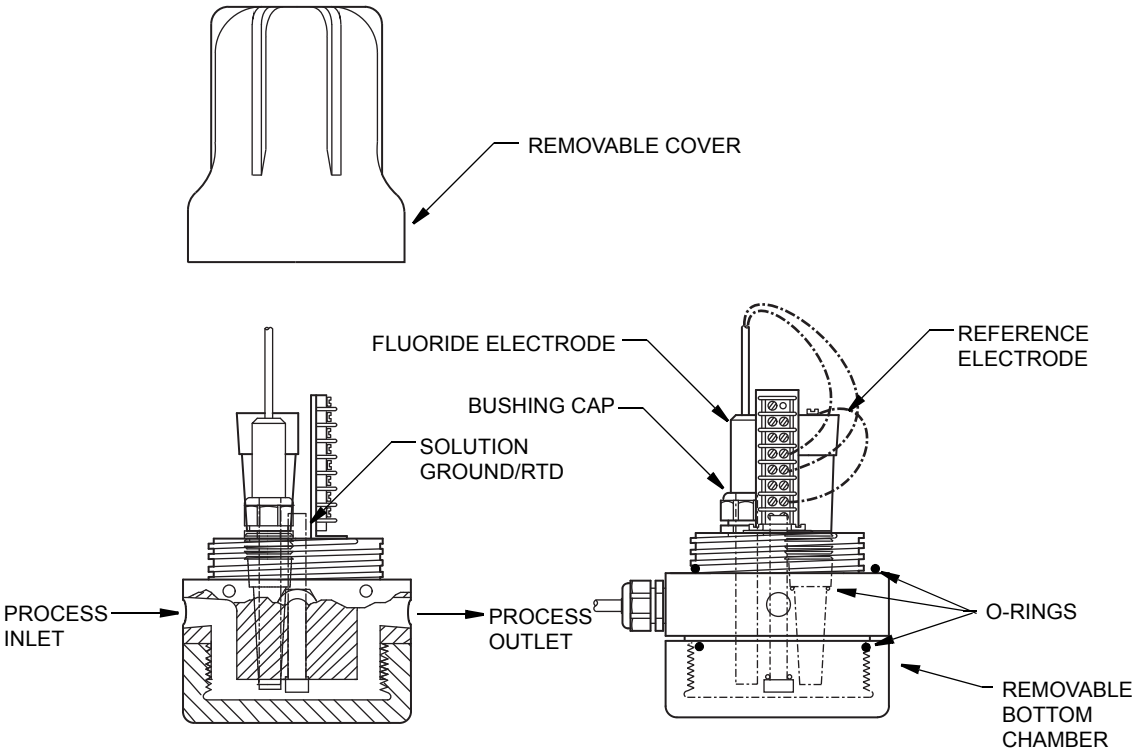


Figure 7. Sensor Assembly

3. Configuration/Calibration

Calibration and Measurement Guidelines

- Never use 0 ppm fluoride, deionized (DI) water for a calibration point. Effective calibration requires a known amount of fluoride present in the calibration solution.
- Before the unit is calibrated, the displayed ppm values have little significance.
- To validate the measuring capability of the sensor, use the expected mV values for the standard fluoride solutions and the slope that results from a 2-point calibration.
- Some typical mV values for new sensors are

1 ppm	118 mV
2 ppm	100 mV
10 ppm	59 mV
100 ppm	0 mV

- Other mV values can be determined by the following formula:

  Typical mV = (-59)log(expected F^- in ppm) + 118mV

  For example, for 10 ppm, the typical mV value is: (-59)log(10) + 118 = 59 mV
- Acceptable slope from a 2-point calibration falls between -54 and -60 mV/decade of concentration.
- As the electrodes age, the slope is expected to decrease and the typical voltage to change.
- Cleaning the surface of the fluoride electrode with toothpaste and cleaning the white ceramic of the reference electrode with 0.1 to 1.0 Normal hydrochloric acid may add life to the sensor. Do not use acid on the fluoride electrode. Stronger concentrations of acid may damage the reference ceramic.
- Replace electrodes when successful calibration is no longer possible.

Measurements Using 875PH Series Analyzers

Analyzer Configuration

The 875PH Analyzer is a versatile analyzer, configurable to measure pH, or ORP, or fluoride ISE. Configure the analyzer for ISE operation per MI 611-225.

Specifically check the following parameters:

- In the Measurement menu, set:
  Units = ppm (ISE)
  Scale = 999.9 ppm, adjust as needed
  Chemical Comp = Standard
  Damping = 120 Seconds, adjusted as needed
- In the Sensor menu, set:
  Electrode = Negative
  Valence = Monovalent
  Isopotential = 0 mV
  Temp Type = RTD
  RTD Type = 2 Wire 100 Ω
  Temp Mode = Automatic
- All other configuration parameters should be set as appropriate for the application.

Fluoride Electrode Calibration

A 2-point calibration must be performed when you first install the fluoride sensor assembly. For highest measurement accuracy, a 2-point slope calibration procedure using standard fluoride solutions is recommended. This procedure establishes the slope of the installed electrodes. Then use a periodic grab sample calibration to set the offset of the electrodes.

The following procedure specifically applies to measurement of 1 ppm nominal fluoride in potable water using the 875PH. For other samples refer to MI 611-225.

Two-Point Slope Calibration Procedure

1. Prepare 100 mL each of 1 ppm and 2 ppm fluoride standards.

   Required Solutions:
   TISAB, available from Fisher Scientific, Part Number 13-641-874
   Fluoride, 100 ppm Stock Solution, available from us, Part Number Q0105AX

   1 ppm Fluoride Solution:
   To 100 mL graduated cylinder, add 5 mL of TISAB solution. Use a Class A pipet to add 1 mL of 100 ppm fluoride standard and fill the cylinder to the 100 mL mark with deionized water. Transfer this solution to a clean beaker, labeled 1 ppm.

   2 ppm Fluoride Solution:
   To 100 mL graduated cylinder, add 5 mL of TISAB solution. Use a Class A pipet to add 2 mL of 100 ppm fluoride standard and fill the cylinder to the 100 mL mark with deionized water. Transfer this solution to a clean beaker, labeled 2 ppm.

— NOTE

When calibrating electrodes for the first time or when electrodes have been allowed to dry, the electrodes may need a conditioning period of up to several hours. To condition the electrodes, soak the sensing surface in process water that contains the typical level of fluoride.

2. Stop the process flow, disconnect the process inlet and outlet ports, and flush the process from the sensor assembly.

— NOTE

If the assembly is mounted so that the base is not horizontal, it must be removed from its mounting for calibration in the horizontal position.

3. Remove the bottom chamber by unthreading it from the sensor assembly. A strap wrench may be required.
4. Thoroughly rinse the exposed sensors with deionized water and blot dry.
5. Rinse the bottom chamber with deionized water, blot dry, and fill the chamber with the lower concentration fluoride standard (that is, 1 ppm). Overfill the chamber by a small amount to ensure that the electrode surfaces are completely wetted with the fluoride standard.

— NOTE

Always use the fluoride standard with the lower concentration first.
Reminder: Never use 0 ppm fluoride as a calibration point.

6. Remount the bottom chamber onto the sensor assembly.
7. Follow the procedure per MI 611-225 for Calibration mode, Solution Calibration, Manual 2-Point calibration.
8. Allow time for the fluoride reading to stabilize.
9. Repeat Steps 3, 4, and 5 when the analyzer prompts you to put the sensor into Solution 2.
10. Temperature calibration is usually not required but can be done if there is any reason to doubt temperature accuracy.
11. Check the slope parameters in the Status mode. Slope % should be about 90% to 100% and Slope mV should be about -54 to -60 mV.
12. Remove the bottom chamber. Rinse the wetted surfaces of the bottom chamber and the sensor assembly. Ensure that the large O-ring is properly seated. Replace bottom chamber and tighten firmly by hand.

— NOTE

It is recommended that the 2-point slope calibration procedure be repeated at monthly intervals to verify the operational status of the fluoride system and that the grab sample calibration procedure be conducted at weekly intervals to validate the final measurement accuracy of the system. Calibration intervals may be affected by individual process conditions. You should establish appropriate intervals for your application requirements.

Grab Sample Calibration

1. Record the current fluoride concentration, and extract a sample from the process line. Protect the sample from atmosphere and temperature changes.
2. Determine the fluoride concentration of the sample using a reliable laboratory method. This method should provide the required measurement precision and include accurate calibration of the measurement system. Follow Good Laboratory Practices (GLP) protocols.
3. Determine the difference (Correction Value) between the laboratory value (from Step 2) and the process fluoride concentration (from Step 1). For example:

Initial Process Fluoride Concentration (Step 1)	0.98 ppm
Laboratory Fluoride Concentration (Step 2)	1.18 ppm
Correction Value	1.18 – 0.98 = 0.20

4. Record the current process fluoride concentration.
5. Use this present reading to calculate the Calibration Point. For example:

Current Process Fluoride Concentration (Step 4)	0.99 ppm
Correction Value (Step 3)	0.20
Calibration Point (CAL LO)	0.99 + 0.20 = 1.19 ppm

6. Follow the procedure per MI 611-225 for Calibration mode, Solution Calibration, Manual 1-Point calibration. Make the displayed value for fluoride equal the value determined in Step 5.

Measurements Using 873DPX Series Analyzers

Analyzer Configuration

The 873DPX Analyzer is a versatile analyzer, configurable to measure pH, or ORP, or fluoride ISE. Configure the analyzer for ISE operation per Instruction Book 3456, which contains document number MI 611-190. Verify that all “configuration setup entries” and all “basic setup entries” are appropriate for the application.

Specifically check the following parameters:

- User-Defined Measurement Error, Codes UL 1, LL 1, UL 2, LL 2.
- Full Scale Values, Codes FSC 1, and FSC 2. For drinking water applications that never exceed 2 ppm fluoride concentration, select 2.00 ppm. You can select a higher FSC for applications that exceed 2.00 ppm. Select an FSC code that is higher than both the normal fluoride measurement and the highest calibration standard that is used.
- Compensation, Codes CO 1, and CO 2. Set compensation code(s) to 2010 for standard fluoride measurements.
- Isopotential, Codes ISO 1, and ISO 2. Set the isopotential code(s) to 0000.
- Offset Voltage, Code OF. Set the offset voltage code to the mV value that corresponds to the expected fluoride concentration for your application. For example, consider a

drinking water application that is expected to be normally at 1.0 ppm fluoride. The mV value for 1.0 ppm fluoride is about 118 mV. For this application then, set the OF code to equal "+118". Typical millivolt values for other fluoride concentrations can be determined by the following formula:

Typical mV = (-59)log(expected F^- in ppm) + 118mV

For example, for 10 ppm, the typical mV value is: (-59)log(10) + 118 = 59 mV

Fluoride Electrode Calibration

A 2-point calibration must be performed when you first install the fluoride sensor assembly. For highest measurement accuracy, a 2-point slope calibration procedure using standard fluoride solutions is recommended. This procedure establishes the slope of the installed electrodes. Then use a periodic grab sample calibration to set the offset of the electrodes.

The following procedure specifically applies to measurement of 1 ppm nominal fluoride in potable water using the 873DPX. For other samples refer to MI 611-190.

Two-Point Slope Calibration Procedure

1. Prepare 100 mL each of 1 ppm and 2 ppm fluoride standards.

   Required Solutions:
   TISAB, available from Fisher Scientific, Part Number 13-641-874
   Fluoride, 100 ppm Stock Solution, available from us, Part Number Q0105AX

   1 ppm Fluoride Solution:
   To 100 mL graduated cylinder, add 5 mL of TISAB solution. Use a Class A pipet to add 1 mL of 100 ppm fluoride standard and fill the cylinder to the 100 mL mark with deionized water. Transfer this solution to a clean beaker, labeled 1ppm.

   2 ppm Fluoride Solution:
   To 100 mL graduated cylinder, add 5 mL of TISAB solution. Use a Class A pipet to add 2 mL of 100 ppm fluoride standard and fill the cylinder to the 100 mL mark with deionized water. Transfer this solution to a clean beaker, labeled 2 ppm.

NOTE

When calibrating electrodes for the first time or when electrodes have been allowed to dry, the electrodes may need a conditioning period of up to several hours. To condition the electrodes, soak the sensing surface in process water that contains the typical level of fluoride.

2. Stop the process flow, disconnect the process inlet and outlet ports, and flush the process from the sensor assembly.

NOTE

If the assembly is mounted so that the base is not horizontal, it must be removed from its mounting for calibration in the horizontal position.

3. Remove the bottom chamber by unthreading it from the sensor assembly. A strap wrench may be required.
4. Thoroughly rinse the exposed sensors with deionized water and blot dry.

5. Rinse the bottom chamber with deionized water, blot dry, and fill the chamber with the lower concentration fluoride standard (that is, 1 ppm). Overfill the chamber by a small amount to ensure that the electrode surfaces are completely wetted with the fluoride standard.

NOTE

Cal Lo point must be performed first. Reminder: Never use 0 ppm fluoride as a calibration point

6. Remount the bottom chamber onto the sensor assembly.
7. Wait for the sensor to reach a stable reading. Check the mV value on the analyzer by pressing the `mV` key while pressing and holding the `Shift` key. Release both keys. Compare the observed mV to the expected mV for a new sensor in this standard solution. If the observed mV is within ±10 mV of the expected value then proceed with the calibration. For example, 1 ppm fluoride yields approximately 118 mV ±10 mV. If the mV reading is unstable or outside the expected range, start over, verifying each step. For a used sensor, the acceptable mV range can be broadened.
8. Press and hold the `Shift` key while pressing the `Cal Lo` key. Release both keys.
9. Enter the fluoride concentration of the first standard by pressing the `Next` and `Arrow` keys. Press `Enter`.
10. Repeat Steps 3 through 7, filling the chamber with the second fluoride standard (that is, 2 ppm).
11. Press and hold the `Shift` key while pressing the `Cal Hi` key. Release both keys.
12. Enter the fluoride concentration of the second standard by pressing the `Next` and `Arrow` keys. Press `Enter`.
13. Press `Shift` and `Slope` keys. Slope should be between 54 to 60 mV/dec.
14. Remove the bottom chamber. Rinse the wetted surfaces of the bottom chamber and the sensor assembly. Ensure that the large O-ring is properly seated. Replace bottom chamber and tighten firmly by hand.

NOTE

It is recommended that the 2-point slope calibration procedure be repeated at monthly intervals to verify the operational status of the fluoride system and that the grab sample calibration procedure be conducted at weekly intervals to validate the final measurement accuracy of the system. Calibration intervals may be affected by individual process conditions. You should establish appropriate intervals for your application requirements.

Grab Sample Calibration

1. Record the current fluoride concentration, and extract a sample from the process line. Protect the sample from atmosphere and temperature changes.
2. Determine the fluoride concentration of the sample using a reliable laboratory method. This method should provide the required measurement precision and include accurate calibration of the measurement system. Follow Good Laboratory Practices (GLP) protocols.
3. Determine the difference (Correction Value) between the laboratory value (from Step 2) and the process fluoride concentration (from Step 1). For example:

Initial Process Fluoride Concentration (Step 1)	0.98 ppm
Laboratory Fluoride Concentration (Step 2)	1.18 ppm
Correction Value	1.18 – 0.98 = 0.20

4. Record the current process fluoride concentration.
5. Use this present reading to calculate the Calibration Point. For example:

Current Process Fluoride Concentration (Step 4)	0.99 ppm
Correction Value (Step 3)	0.20
Calibration Point (CAL LO)	0.99 + 0.20 = 1.19 ppm

6. Press and hold the `Shift` key while pressing the `Cal Lo` key. Release both keys.
7. Use the `Next` and `Arrow` keys to enter the Calibration Point from Step 5.
8. Press `Enter`.

Measurements Using 870ITPH Series Transmitters

Analyzer Configuration

Model 870ITPH is a versatile transmitter, configurable to measure pH, or ORP, or fluoride ISE. Configure the transmitter for ISE operation per MI 611-211. Verify that all "configuration" parameters are appropriate for the application.

Specifically check the following parameters:

- In the Config Display menu, set Primary Sensor = ISE
- In the Config Electrode menu, set Electrode = Negative.
- In the Config Temp menu, set
  Temp Mode = Auto
  Temp Type = RTD
  RTD = 2 Wire
  2 Wire = 100 Ohm
- In the Config Diags menu, set Diags Glass = Disable
  Other diagnostics can be enabled at your choice.

Fluoride Electrode Calibration

A 2-point calibration must be performed when you first install the fluoride sensor assembly. For highest measurement accuracy, a 2-point slope calibration procedure using standard fluoride solutions is recommended. This procedure establishes the slope of the installed electrodes. Then use a periodic grab sample calibration to set the offset of the electrodes.

The following procedure specifically applies to measurement of 1 ppm nominal fluoride in potable water using the 870ITPH. For other samples refer to MI 611-211.

2-Point Standard Calibration

1. Prepare 100 mL each of 1 ppm and 2 ppm fluoride standards.

   Required Solutions:
   TISAB, available from Fisher Scientific, Part Number 13-641-874
   Fluoride, 100 ppm Stock Solution, available from us, Part Number Q0105AX

   1 ppm Fluoride Solution:
   To 100 mL graduated cylinder, add 5 mL of TISAB solution. Use a Class A pipet to add 1 mL of 100 ppm fluoride standard and fill the cylinder to the 100 mL mark with deionized water. Transfer this solution to a clean beaker, labeled 1 ppm.

   2 ppm Fluoride Solution:
   To 100 mL graduated cylinder, add 5 mL of TISAB solution. Use a Class A pipet to add 2 mL of 100 ppm fluoride standard and fill the cylinder to the 100 mL mark with deionized water. Transfer this solution to a clean beaker, labeled 2 ppm.

— NOTE

When calibrating electrodes for the first time or when electrodes have been allowed to dry, the electrodes may need a conditioning period of up to several hours. To condition the electrodes, soak the sensing surface in process water that contains the typical level of fluoride.

2. Stop the process flow, disconnect the process inlet and outlet ports, and flush the process from the sensor.

— NOTE

If the assembly is mounted so that the base is not horizontal, it must be removed from its mounting for calibration in the horizontal position.

3. Remove the bottom chamber by unthreading it from the sensor assembly. A strap wrench may be required.
4. Thoroughly rinse the exposed sensors with deionized water and blot dry.
5. Rinse the bottom chamber with deionized water, blot dry, and fill the chamber with the lower concentration fluoride standard (that is, 1 ppm).

— NOTE

SOL 1 procedure must be performed first. Reminder: never use 0 ppm fluoride as a calibration point.

6. Remount the bottom chamber onto the sensor assembly.
7. Wait for the sensor to reach a stable reading. Check the mV value on the transmitter by pressing the `Status` key. Use the down arrow to select "Absolute" and read the mV value. Compare the observed mV to the expected mV for a new sensor in this standard solution. If the observed mV is within ±10 mV of the expected value, proceed with the calibration. For example, 1 ppm fluoride yields approximately 118 mV ±10 mV. If the mV reading is unstable or outside the expected range, start over, verifying each step. For a used sensor, the acceptable mV range can be broadened.
8. Press the `Cal` key.
9. When display reads CAL MANUAL, press `Enter`.
10. Select MANUAL TWO PT calibration.
11. Press `Enter` at the IMMERSE IN SOL 1 prompt.
12. Wait for the reading to stabilize or the ENTER TO EDIT prompt. Press `Enter`.
13. Enter the fluoride concentration of the first standard at the VALUE 1 prompt. Press `Enter`.
14. Repeat Steps 3 through 6, filling the chamber with the second fluoride standard (that is, 2 ppm).
15. To enter the value of the second standard, repeat Steps 11 through 13 for SOL 2.
16. When the calibration is complete, press `Measure` to return to Measurement mode.
17. Remove the bottom chamber. Rinse the wetted surfaces of the bottom chamber and the sensor assembly. Ensure that the large O-ring is properly seated. Replace bottom chamber and tighten firmly by hand.

NOTE

It is recommended that the 2-point slope calibration procedure be repeated at monthly intervals to verify operational status of the fluoride system and that the Grab Sample Calibration procedure be conducted at weekly intervals to validate the final measurement accuracy of the system. Calibration intervals may be affected by individual process conditions. You should establish appropriate intervals for your application requirements.

Grab Sample Calibration

1. Record the current fluoride concentration, and extract a sample from the process line. Protect the sample from atmosphere and temperature changes.
2. Determine the fluoride concentration of the sample using a reliable laboratory method. This method should provide the required measurement precision and include accurate calibration of the measurement system. Follow Good Laboratory Practices (GLP) protocols.
3. Determine the difference (Correction Value) between the laboratory value (from Step 2) and the process fluoride concentration (from Step 1). For example:

Initial Process Fluoride Concentration (Step 1)	0.98 ppm
Laboratory Fluoride Concentration (Step 2)	1.18 ppm
Correction Value	1.18 – 0.98 = 0.20

4. Record the current process fluoride concentration.
5. Use this present reading to calculate the Calibration Point. For example:

Current Process Fluoride Concentration (Step 4)	0.99 ppm
Correction Value (Step 3)	0.20
Calibration Point	0.99 + 0.20 = 1.19 ppm

6. Press the `Cal` key.
7. When display reads CAL MANUAL press `Enter`.
8. Select SINGLEPT calibration.
9. Press `Enter` at the IMMERSE IN SOL 1 prompt.
10. Wait for the reading to stabilize or the ENTER TO EDIT prompt. Press `Enter`.
11. Enter the Calibration Point as determined in Step 5 at the VALUE 1 prompt. Press `Enter`.
12. At the CAL COMPLETE prompt, press `Measure` to return to Measurement mode.

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