

**Electrodeless Conductivity  
System Calibration Examples**



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# 1. Introduction

This document provides step-by-step examples of calibration procedures for 875EC Analyzers, 870ITEC Transmitters, and 873EC Analyzers used with 871FT and 871EC Sensors.

— **NOTE** —

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A Bench Calibration (using a Foxboro calibration plug or a decade resistance box) provides a typically more reliable, more consistent, and far easier calibration than a Solution Calibration. A solution calibration can inherently introduce variables which can demonstrably affect the measurement obtained; for example, temperature of the solution affecting actual conductivity and any contamination).

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## 2. 875EC Analyzer with 871FT Industrial Sensor

Calibrate an 875EC Analyzer with an 871FT-4E3D3C-3C Sensor. The sensor in this example is an industrial sensor with a 1 inch bore, no RTD and with an extended length low smoke cable.

### Bench Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 on page 65).

#### Preparation

1. Prepare your 871FT industrial sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring % caustic).
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

#### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.

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#### — NOTE

For a maximum sensitivity sensor calibration, use an 871FT-9 sensor and calibrate as follows: At the prompt, **Suspend in Air**, connect a low value (nonzero), high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

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6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, connect the Foxboro calibration plug (EP485A Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.

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— **NOTE** —

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For a maximum sensitivity sensor calibration with an 871FT-9 sensor:

At the prompt, **Connect Loop Resistor**, connect a high value, high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

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8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Bench Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cables are part numbered BS807BD.

### Preparation

1. Prepare your 871FT industrial sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring caustic).
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.

5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter** (see Note 3 on page 65). If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, connect the Foxboro calibration cable between the RTD port connection on the sensor and a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. (see Note 4 on page 65) Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871FT industrial sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.

7. At the prompt, **Connect Loop Resistor**, loop the user-supplied calibration wire through the sensor bore and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value (see Note 4 on page 65). Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Solution Calibration

### Preparation

1. Remove your 871FT industrial sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.
3. Prepare your calibration solution (see Note 5 on page 65).

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Solution** and press **Enter** again.
5. At the prompt, **Put Sensor in Solution 1**, suspend the sensor in air and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Pt 1** (and if the reading is not correct), use the arrow keys to adjust the (low) reading to the correct value. Press **Enter**.
7. At the prompt, **Put Sensor in Solution 2**, fill the sensor with your solution sample (see Note 9 on page 67) and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Pt 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.

9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.



# 3. 875EC Analyzer with 871FT Sanitary Sensor

Calibrate an 875EC Analyzer with an 871FT-2G1A1T-C Sensor. The sensor in this example is a sanitary sensor with a 2-inch bore, and a 100  $\Omega$  RTD.

## Bench Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 on page 65).

### Preparation

1. Prepare your 871FT sanitary sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution. It is not necessary to stop the process flow to calibrate an 871FT Sanitary Sensor.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
6. At the prompt, **Suspend in Air** (zero measurement), press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.

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#### — NOTE —

For a maximum sensitivity sensor calibration, use an 871FT-8 sensor and calibrate as follows: At the prompt, **Suspend in Air**, connect a low value (nonzero), high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

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7. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
8. Reconnect the grounding strap disconnected in Step 5.
9. At the prompt, **Connect Loop Resistor**, connect the Foxboro calibration plug (EP485A Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.

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— **NOTE** —

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For a maximum sensitivity sensor calibration with an 871FT-8 sensor:

At the prompt, **Connect Loop Resistor**, connect a high value, high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

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10. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value (if this is the full scale value, the value noted on the calibration plug label). Press **Enter**.
11. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Bench Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cable is part numbered BS807BD.

### Preparation

1. Prepare your 871FT sanitary sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution. It is not necessary to stop the process flow to calibrate a 871FT Sanitary Sensor.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.



5. Disconnect one end of the grounding strap between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
6. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter** (see Note 3 on page 65). If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
7. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
8. Reconnect the grounding strap disconnected in Step 5.
9. At the prompt, **Connect Loop Resistor**, connect the Foxboro calibration cable between the RTD connection on the sensor and a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
10. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value (see Note 4 on page 65). Press **Enter**.
11. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871FT sanitary sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter** (see Note 3 on page 65). If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is

- configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
  7. At the prompt, **Connect Loop Resistor**, loop the user-supplied calibration wire through the sensor bore and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
  8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value (see Note 4 on page 65). Press **Enter**.
  9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Solution Calibration

### Preparation

1. Remove your 871FT sanitary sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.
3. Prepare your calibration solution (see Note 5 on page 65).

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Solution** and press **Enter** again.
5. Disconnect one end of the grounding strap between the Tri-Clamp fittings by disconnecting its wing nut.
6. At the prompt, **Put Sensor in Solution 1**, suspend the sensor in air and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
7. At the prompt, **Adjust Pt 1** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.

8. At the prompt, **Put Sensor in Solution 2**, fill the sensor with your solution sample (see Note 9 on page 67) and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
9. At the prompt, **Adjust Pt 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
10. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.
11. Reconnect the grounding strap disconnected in Step 5.



# 4. 875EC Analyzer with 871EC Sensor

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871EC invasive sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, loop the user-supplied calibration wire through the sensor bore (see Note 8 on page 67) and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value (see Note 4 on page 65). Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

# Bench Calibration (Using a Foxboro Calibration Plug)

## Preparation

1. Remove your sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

## Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, loop the wire of the Foxboro calibration plug through the sensor bore (EP485Q Series - see Note 2 on page 65 and Note 8 on page 67). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value (see Note 4 on page 65). Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

# Solution Calibration

## Preparation

1. Remove your sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.
3. Prepare your calibration solution (see Note 5 on page 65).

## Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Solution** and press **Enter** again.
5. At the prompt, **Put Sensor in Solution 1**, suspend the sensor in air and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Pt 1** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
7. At the prompt, **Put Sensor in Solution 2**, immerse the sensor in your solution (see Note 6 on page 65) and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Pt 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.





# 5. 870ITEC Transmitter with 871FT Industrial Sensor

Calibrate an 870ITEC Transmitter with an 871FT-4E3D3C-3NC Sensor. The sensor in this example is an industrial sensor with a 1 inch bore, no RTD, and with an extended length low smoke cable.

## Bench Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 on page 65).

### Preparation

1. Prepare your 871FT industrial sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring % caustic).
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

### Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

— **NOTE** —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**.

---

**— NOTE**

---

For a maximum sensitivity sensor calibration, use an 871FT-9 sensor and calibrate as follows: At the prompt, **Suspend in Air**, connect a low value (nonzero), high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

---

6. Adjust **Zero** (if the reading is not 0000). Press **Enter**.

---

**— NOTE**

---

For a maximum sensitivity sensor calibration with an 871FT-9 sensor:  
At the prompt, **Zero**, (if the reading is not correct) adjust the reading to the value indicated on the calibration plug label. Press **Enter**.

---

7. At the prompt, **Connect Loop Resistor**, connect the Invensys Foxboro calibration plug (EP485A Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

---

**— NOTE**

---

For a maximum sensitivity sensor calibration with an 871FT-9 sensor:  
At the prompt, **Connect Loop Resistor**, connect a high value, high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

---

8. Adjust **Value** (if the reading is not correct) to the value indicated on the calibration plug label. Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

## Bench Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cable is part numbered BS807BD.

### Preparation

1. Prepare your 871FT industrial sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring caustic).

2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure Mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

### — NOTE —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**.
6. Adjust **Zero** (if the reading is not 0000). Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, connect the Foxboro calibration cable between the RTD port connection on the sensor and a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**.
8. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871FT industrial sensor from the process line. Clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.

3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

### — NOTE —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**.
6. Adjust **Zero** (if the reading is not 0000). Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, loop the user-supplied calibration cable through the sensor bore and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**.
8. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

## Solution Calibration

### Preparation

1. Remove your 871FT industrial sensor from the process line. Clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Prepare your calibration solution (see Note 5 on page 65).
4. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

— **NOTE**

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **CALx Solution**, then the Right arrow key to go to **Solution Singlept**, and the Down arrow key to go to **Solution Two Pt** and press **Enter**.
5. At the prompt, **Immerse in Solution 1**, suspend the sensor in air and press **Enter**.
6. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
7. At the prompt, **Value 1** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
8. At the prompt, **Immerse in Solution 2**, fill the sensor with your solution sample (see Note 9 on page 67) and press **Enter**.
9. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
10. At the prompt, **Value 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
11. When the Help Message advises **Cal Completed**, press **Enter** to return to **Solution**.
12. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
13. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
14. Press the **Measure** key to return to Measure mode.



# 6. 870ITEC Transmitter with 871EC Sensor

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871EC invasive sensor from the process line and clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

### Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

— **NOTE** —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**.
6. Adjust **Zero** (if the reading is not 0000). Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, loop the user-supplied calibration wire through the sensor bore (see Note 8 on page 65) and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**.
8. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

# Bench Calibration (Using a Foxboro Calibration Plug)

## Preparation

1. Remove your 871EC invasive sensor from the process line and clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

### — NOTE —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typical zero measurement), press **Enter**.
6. Adjust **Zero** (if the reading is not 0000). Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, loop the loop the wire of the Foxboro calibration plug through the sensor bore (EP485Q Series - see Note 2 on page 65 and Note 8 on page 67). Press **Enter**.
8. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.



# Solution Calibration

## Preparation

1. Remove your 871EC invasive sensor from the process line. Clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Prepare your calibration solution (see Note 5 on page 65).
4. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

**— NOTE —**

---

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **CALx Solution**, then the Right arrow key to go to **Solution Singlept**, and the Down arrow key to go to **Solution Two Pt** and press **Enter**.
5. At the prompt, **Immerse in Solution 1**, suspend the sensor in air and press **Enter**.
6. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
7. At the prompt, **Value 1** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
8. At the prompt, **Immerse in Solution 2**, immerse the sensor in your solution sample (see Note 6 on page 65) and press **Enter**.
9. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
10. At the prompt, **Value 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
11. When the Help Message advises **Cal Completed**, press **Enter** to return to **Solution**.

12. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
13. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
14. Press the **Measure** key to return to Measure mode.

# 7. 870ITEC Transmitter with 871FT Sanitary Sensor

Calibrate an 870ITEC Transmitter with an 871FT-2G1A1T-C Sensor. The sensor in this example is a sanitary sensor with a 2 inch bore and a 100  $\Omega$  RTD.

## Bench Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 on page 65).

### Preparation

1. Prepare your 871FT sanitary sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution. It is not necessary to stop the process flow to calibrate an 871FT Sanitary Sensor.
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

### Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

— **NOTE** —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
6. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**.

---

**— NOTE**

---

For a maximum sensitivity sensor calibration, use an 871FT-8 sensor and calibrate as follows: At the prompt, **Suspend in Air**, connect a low value (nonzero), high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

---

7. Adjust **Zero** (if the reading is not 0000). Press **Enter**.

---

**— NOTE**

---

For a maximum sensitivity sensor calibration with an 871FT-8 sensor:  
At the prompt, **Zero**, (if the reading is not correct) adjust the reading to the value indicated on the calibration plug label. Press **Enter**.

---

8. Reconnect the grounding strap disconnected in Step 5.
9. At the prompt, **Connect Loop Resistor**, connect the Invensys Foxboro calibration plug (EP485A Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

---

**— NOTE**

---

For a maximum sensitivity sensor calibration with an 871FT-8 sensor:  
At the prompt, **Connect Loop Resistor**, connect a high value, high-precision Foxboro calibration plug (EP485N Series - see Note 2 on page 65) to the RTD port connection on the sensor. Press **Enter**.

---

10. Adjust **Value** (if the reading is not correct) to the value indicated on the calibration plug. Press **Enter**.
11. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
12. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
13. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
14. Press the **Measure** key to return to Measure mode.

## Bench Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cable is part numbered BS807BD.

### Preparation

1. Prepare your 871FT sanitary sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring caustic).

2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure Mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

### — NOTE

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
6. At the prompt, **Suspend in Air** (typically zero measurement), press **Enter**.
7. Adjust **Zero** (if the reading is not 0000). Press **Enter**.
8. Reconnect the grounding strap disconnected in Step 5.
9. At the prompt, **Connect Loop Resistor**, connect the Invensys Foxboro calibration cable between the RTD port connection on the sensor and a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**.
10. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
11. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
12. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
13. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
14. Press the **Measure** key to return to Measure mode.

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871FT sanitary sensor from the process line. Clean and dry it.

2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

### — NOTE —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air** (typically zero measurement), and press **Enter**.
6. Adjust **Zero** (if the reading is not 0000). Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, loop the user-supplied calibration wire through the sensor bore and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65). Press **Enter**.
8. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

## Solution Calibration

### Preparation

1. Remove your 871FT sanitary sensor from the process line. Clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Prepare your calibration solution (see Note 5 on page 65).

4. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

### — NOTE —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **CALx Solution**, then the Right arrow key to go to **Solution Singlept**, and the Down arrow key to go to **Solution Two Pt** and press **Enter**.
5. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
6. At the prompt, **Immerse in Solution 1**, suspend the sensor in air and press **Enter**.
7. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
8. At the prompt, **Value 1** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
9. At the prompt, **Immerse in Solution 2**, fill the sensor with your solution sample (see Note 9 on page 67) and press **Enter**.
10. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
11. At the prompt, **Value 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
12. When the Help Message advises **Cal Completed**, press **Enter** to return to **Solution**.
13. Reconnect the grounding strap disconnected in Step 5.
14. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
15. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
16. Press the **Measure** key to return to Measure mode.





# 8. 873EC Analyzer with 871FT Industrial Sensor

Calibrate an 873EC Analyzer with an 871FT-4E3D3C-C Sensor. The sensor in this example is an industrial sensor with a 1 inch bore, no RTD.

## Bench Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 on page 65).

### Preparation

1. Prepare your 871FT industrial sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring % caustic).
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.

### Procedure

---

— **NOTE** —  
Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —  
The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again after a few seconds.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.

- b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**.  
If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 1. Press **Enter**.

Table 1. Ct Codes

English Sensors		
Line Size	High Range $\square=3$	Low Range $\square=4$
871FT- $\square$ C (1/2 in)	7	9
871FT- $\square$ E (1 in)	15	1
871FT- $\square$ F (1-1/2 in)	14	11
871FT- $\square$ G (2 in)	14	11
871FT- $\square$ H (3 in)	3	12
871FT- $\square$ J (4 in)	16	12

7. In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

**— NOTE —**


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If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

8. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
9. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
10. Connect the Foxboro calibration plug (EP485A Series - see Note 2 on page 65) to the RTD port connection on the sensor.
11. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to get the conductivity value indicated on the calibration plug label. Press **Enter**.
12. Remove power from the analyzer.
13. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
14. Reinstall the sensor in the process line (if it was removed).
15. Apply power to the analyzer.
16. Reset the **Cd** code for appropriate compensation and damping.

17. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
18. Lock the analyzer. See MI 611-167.

## Bench Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cable is part numbered BS807BD.

### Preparation

1. Prepare your 871FT industrial sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring % caustic).
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.

### Procedure

---

— **NOTE** —  
Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —  
The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

5. Verify the temperature circuit calibration

- a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 1. Press **Enter**.

Table 2. Ct Codes

English Sensors		
Line Size	High Range $\square=3$	Low Range $\square=4$
871FT- $\square$ C (1/2 in)	7	9
871FT- $\square$ E (1 in)	15	1
871FT- $\square$ F (1-1/2 in)	14	11
871FT- $\square$ G (2 in)	14	11
871FT- $\square$ H (3 in)	3	12
871FT- $\square$ J (4 in)	16	12

7. In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

— **NOTE** —

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

8. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
9. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
10. Connect the Foxboro calibration cable between the RTD connection on the sensor and a decade box. Dial in the full scale resistance value (see note 7 on page 65).
11. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to get the desired reading. Press **Enter**.
12. Remove power from the analyzer.
13. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
14. Reinstall the sensor in the process line (if it was removed).
15. Apply power to the analyzer.
16. Reset the **Cd** code for appropriate compensation and damping.

17. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
18. Lock the analyzer. See MI 611-167.

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871FT industrial sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.

### Procedure

---

— **NOTE** —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.

6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 1. Press **Enter**.

*Table 3. Ct Codes*

English Sensors		
Line Size	High Range $\square=3$	Low Range $\square=4$
871FT- $\square$ C (1/2 in)	7	9
871FT- $\square$ E (1 in)	15	1
871FT- $\square$ F (1-1/2 in)	14	11
871FT- $\square$ G (2 in)	14	11
871FT- $\square$ H (3 in)	3	12
871FT- $\square$ J (4 in)	16	12

7. In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

— **NOTE** —

---

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

8. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
9. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
10. Loop the user-supplied calibration wire through the sensor bore and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65).
11. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to get the desired reading. Press **Enter**.
12. Remove power from the analyzer.
13. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
14. Reinstall the sensor in the process line.
15. Apply power to the analyzer.
16. Reset the **Cd** code for appropriate compensation and damping.
17. Verify that the temperature reading is appropriate.
- Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - Reset **tCF1** to the appropriate temperature if necessary.
  - Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.

18. Lock the analyzer. See MI 611-167.

## Standardization Using a Known Solution

Standardization is a procedure used to set the analyzer/sensor system to agree with the accepted value of a standard solution. If deemed necessary, standardization should be considered:

- ◆ after a bench/dry calibration as a final check before operation, if deemed necessary
- ◆ as dictated by historical need
- ◆ whenever the measurement value is in doubt.

Normally, a standardization procedure is not necessary before operation of the system.

### Preparation

1. Remove your 871FT industrial sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.
3. Prepare your calibration solution (see Note 5 on page 65).

### Procedure

---

— **NOTE** —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

2. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.
3. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
4. With the sensor dry and in air, press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.  
OR  
Fill the sensor with a known solution of low conductivity at the reference temperature

- (see Note 9 on page 67), press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to obtain a reading of the solution conductivity. Press **Enter**.
5. Remove the solution from the sensor and rinse the sensor with distilled water.
  6. Fill the sensor with a known solution of higher conductivity value at the reference temperature (see Note 9 on page 67), press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to obtain a reading of the solution conductivity. Press **Enter**.
  7. Remove the solution from the sensor and rinse the sensor with distilled water.
  8. Reinstall the sensor in the process line.
  9. Reset the **Cd** code for appropriate compensation and damping.
  10. Verify that the temperature reading is appropriate.
    - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
    - b. Reset **tCF1** to the appropriate temperature if necessary.
    - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
  11. Lock the analyzer. See MI 611-167.



# 9. 873EC Analyzer with 871FT Sanitary Sensor

Calibrate an 875EC Analyzer with an 871FT-2G1A1T-C Sensor. The sensor in this example is a sanitary sensor with a 2-inch bore, and a 100  $\Omega$  RTD.

## Bench Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 on page 65).

### Preparation

1. Prepare your 871FT sanitary sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution. It is not necessary to stop the process flow to calibrate an 871FT Sanitary Sensor.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.

### Procedure

---

— **NOTE** —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.

- b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**.  
If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 4. Press **Enter**.

Table 4. Ct Codes

English Sensors		
Line Size	High Range $\square=3$	Low Range $\square=4$
871FT- $\square$ C (1/2 in)	7	9
871FT- $\square$ E (1 in)	15	1
871FT- $\square$ F (1-1/2 in)	14	11
871FT- $\square$ G (2 in)	14	11
871FT- $\square$ H (3 in)	3	12
871FT- $\square$ J (4 in)	16	12

7. In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

— **NOTE** —

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

8. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
9. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
10. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
11. Reconnect the grounding strap disconnected in Step 5.
12. Connect the Foxboro calibration plug (EP485A Series - see Note 2 on page 65) to the RTD port connection on the sensor.
13. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to adjust the reading to the correct value (that is, the value noted on the calibration plug label). Press **Enter**.
14. Remove power from the analyzer.
15. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
16. Reinstall the sensor in the process line (if it was removed).
17. Apply power to the analyzer.

18. Reset the **Cd** code for appropriate compensation and damping.
19. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
20. Lock the analyzer. See MI 611-167.

## Bench Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cable is part numbered BS807BD.

### Preparation

1. Prepare your 871FT sanitary sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and cleaning and drying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution. It is not necessary to stop process flow.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.

### Procedure

---

— **NOTE** —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C

- or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
- b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**.  
If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 4. Press **Enter**.

Table 5. Ct Codes

English Sensors		
Line Size	High Range $\square=3$	Low Range $\square=4$
871FT- $\square$ C (1/2 in)	7	9
871FT- $\square$ E (1 in)	15	1
871FT- $\square$ F (1-1/2 in)	14	11
871FT- $\square$ G (2 in)	14	11
871FT- $\square$ H (3 in)	3	12
871FT- $\square$ J (4 in)	16	12

7. In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

— **NOTE** —

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

8. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
9. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
10. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
11. Reconnect the grounding strap disconnected in Step 5.
12. Connect the Foxboro calibration cable between the RTD connection on the sensor and a decade box. Dial in the full scale resistance value (see Note 3 and Note 7 on page 65).
13. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys adjust the reading to the correct value (that is, the value noted on the calibration plug label). Press **Enter**.
14. Remove power from the analyzer.
15. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
16. Reinstall the sensor in the process line (if it was removed).

17. Apply power to the analyzer.
18. Reset the **Cd** code for appropriate compensation and damping.
19. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
20. Lock the analyzer. See MI 611-167.

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871FT sanitary sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.

### Procedure

---

— **NOTE** —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again after a few seconds.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.

- c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**.  
If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 4. Press **Enter**.

Table 6. Ct Codes

English Sensors		
Line Size	High Range $\square=3$	Low Range $\square=4$
871FT- $\square$ C (1/2 in)	7	9
871FT- $\square$ E (1 in)	15	1
871FT- $\square$ F (1-1/2 in)	14	11
871FT- $\square$ G (2 in)	14	11
871FT- $\square$ H (3 in)	3	12
871FT- $\square$ J (4 in)	16	12

7. In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

**NOTE**


---

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

8. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
9. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
10. Loop the user-supplied calibration wire through the sensor bore and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65).
11. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to get the desired reading. Press **Enter**.
12. Remove power from the analyzer.
13. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
14. Reinstall the sensor in the process line.
15. Apply power to the analyzer.
16. Reset the **Cd** code for appropriate compensation and damping.
17. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.

- c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
18. Lock the analyzer. See MI 611-167.

## Standardization Using a Known Solution

Standardization is a procedure used to set the analyzer/sensor system to agree with the accepted value of a standard solution. If deemed necessary, standardization should be considered:

- ◆ after a bench/dry calibration as a final check before operation
- ◆ as dictated by historical need
- ◆ whenever the measurement value is in doubt

Normally, a standardization procedure is not necessary before operation of the system.

## Preparation

1. Remove your 871FT sanitary sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.
3. Prepare your calibration solution (see Note 5 on page 65).

## Procedure

---

### — NOTE —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

### — NOTE —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

2. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.
3. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.

4. Disconnect one end of the grounding strap (braided cable) between the Tri-Clamp fittings by disconnecting its wing nut. Do **not** loosen the Tri-Clamp connections.
5. With the sensor dry and in air, press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.  
OR  
Fill the sensor with a known solution of low conductivity at the reference temperature (see Note 9 on page 67), press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to obtain a reading of the solution conductivity. Press **Enter**.
6. Remove the solution from the sensor and rinse the sensor with distilled water.
7. Fill the sensor with a known solution of higher conductivity value at the reference temperature (see Note 9 on page 67), press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  key to obtain a reading of the solution conductivity. Press **Enter**.
8. Remove the solution from the sensor and rinse the sensor with distilled water.
9. Reconnect the grounding strap disconnected in Step 4.
10. Reinstall the sensor in the process line.
11. Reset the **Cd** code for appropriate compensation and damping.
12. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
13. Lock the analyzer. See MI 611-167.



# 10. 873EC Analyzer with 871EC Sensor

## Bench Calibration (Using a User-Supplied Wire)

### Preparation

1. Remove your 871EC invasive sensor from the process line and clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 5 in the following procedure

### Procedure

---

— **NOTE** —

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the Basic Setup Entries (**bL**). See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 7. Press **Enter**.

Table 7. Ct Codes

871EC Type	Ct Code	871EC Type	Ct Code
UT/LB	1	EP307B	7
RE/BW/EV	2	EP436E	4
AB	3	EP307G	7
SP/HP/PP/PT	4		
TF	5		
NL	6		
PN/PX	7		

In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

— **NOTE**

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

7. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
8. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
9. Loop the user-supplied calibration wire through the sensor bore (see Note 8 on page 67) and connect it to a decade box. Dial in the full scale resistance value (see Note 7 on page 65).
10. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to get the desired reading. Press **Enter**.
11. Remove power from the analyzer.
12. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
13. Reinstall the sensor in the process line.
14. Apply power to the analyzer.
15. Reset the **Cd** code for appropriate compensation and damping.
16. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
17. Lock the analyzer. See MI 611-167.

# Bench Calibration (Using a Foxboro Calibration Plug)

## Preparation

1. Remove your 871EC invasive sensor from the process line and clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 5 in the following procedure

## Procedure

---

### — NOTE

Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

1. Remove power from the analyzer.
2. Disconnect leads from Terminals 6 and 7 on TB2 and connect a 110  $\Omega$  resistor across these terminals
3. Apply power to the analyzer.
4. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

### — NOTE

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

5. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.
6. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 7. Press **Enter**.

Table 8. Ct Codes

871EC Type	Ct Code	871EC Type	Ct Code
UT/LB	1	EP307B	7
RE/BW/EV	2	EP436E	4
AB	3	EP307G	7
SP/HP/PP/PT	4		
TF	5		
NL	6		
PN/PX	7		

In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

---

— **NOTE** —

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

7. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
8. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
9. Loop the wire of the Foxboro calibration plug through the sensor bore (EP485Q Series - see Note 2 on page 65 and Note 8 on page 67).
10. Press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to get the desired reading. Press **Enter**.
11. Remove power from the analyzer.
12. Remove the resistor installed in Step 2 and reconnect the leads to Terminals 6 and 7.
13. Reinstall the sensor in the process line.
14. Apply power to the analyzer.
15. Reset the **Cd** code for appropriate compensation and damping.
16. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
17. Lock the analyzer. See MI 611-167.

# Solution Calibration

## Preparation

1. Remove your 871EC invasive sensor from the process line. Clean and dry it.
2. With your analyzer in Configuration mode, enter the cell type, full scale range, and any other applicable parameters. Refer to MI 611-167.
3. Prepare your calibration solution (see Note 5 on page 65).
4. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 2 in the following procedure

## Procedure

1. Unlock the **Basic Setup Entries (bL)**. See MI 611-167.

---

— **NOTE** —

The unit remains unlocked only as long as any of the Basic Setup Entries are being accessed. If the analyzer defaults to the current measurement value, this level of security locks again.

---

2. Verify the temperature circuit calibration
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode (no decimal should be visible after the C or F legend). If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. In **Shift-Setup**, press the **Next** key until **tCF1** appears. Then use the  $\Delta$  key, to reset **tCF1** to 25.00 (the theoretical temperature transducer value). Press **Enter**.
  - c. Press the **Temp** key. The display should read approximately **25.C** or **77.F**. If it does not, reset the temperature electronics.

---

— **NOTE** —

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

3. In **Shift-Setup**, press the **Next** key until **Ct** appears. Then use the  $\Delta$  key to enter the appropriate **Ct** code. See Table 7. Press **Enter**.

*Table 9. Ct Codes*

871EC Type	Ct Code	871EC Type	Ct Code
UT/LB	1	EP307B	7
RE/BW/EV	2	EP436E	4
AB	3	EP307G	7
SP/HP/PP/PT	4		
TF	5		
NL	6		
PN/PX	7		

In **Shift-Setup**, press the **Next** key until **FSC** appears. Then use the  $\Delta$  key, to enter the full scale value of the analyzer. Press **Enter**. Refer to “Selecting a Full Scale Range” in MI 611-167.

— **NOTE** —

---

If the existing full scale value is the desired value, it is important to re-enter the same value. When the **FSC** value is entered, Error Code **ER4** may begin to flash on the display.

---

4. In **Shift-Setup**, press the **Next** key until **Cd** appears. Then use the  $\Delta$  key to enter a **Cd** code of 0000.
5. Press and hold the **Shift** key while pressing the **Cal Lo** key. Use the **Next** and  $\Delta$  keys to get a 0.00 reading. Press **Enter**.
6. Place the sensor in a known solution (see Note 6 on page 65) of higher conductivity value (at the reference temperature), press and hold the **Shift** key while pressing the **Cal Hi** key. Use the **Next** and  $\Delta$  keys to obtain a reading of the solution conductivity. Press **Enter**.
7. Remove the solution from the sensor and wash the sensor with distilled water.
8. Reinstall the sensor in the process line (see Note 6 on page 65).
9. Reset the **Cd** code for appropriate compensation and damping.
10. Verify that the temperature reading is appropriate.
  - a. Press the **Temp** key. The unit should be in Automatic Temperature mode; no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it by pressing the  $\Delta$  key and then **Enter**.
  - b. Reset **tCF1** to the appropriate temperature if necessary.
  - c. Press the **Temp** key. The display should read this value. If it does not, reset the temperature electronics.
11. Lock the analyzer. See MI 611-167.

# 11. 875EC Analyzer with FT10 Sensor

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## — NOTE —

Installation should be completed before calibrating your electrodeless conductivity system.

---

Calibrate an 875EC Analyzer with an FT10-LC04F1C Sensor. The sensor in this example is a low conductivity sensor for a 1/4 inch line size and with a standard size flare end connection.

## Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 in Appendix A).

### Preparation

1. Prepare your FT10 sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and emptying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring % caustic).
2. With your analyzer in Configuration mode, enter the sensor type, RTD type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

---

## — NOTE —

If using an 875EC Analyzer with firmware version earlier than 2.15, contact Invensys Foxboro to request a firmware upgrade or enter the sensor type as **Other** and then enter appropriate electronic cell factor  $C_{f(\text{elec})}$  for the sensor being used.

---

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 in Appendix A) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air**, connect a low value (nonzero), high-precision Foxboro calibration plug (EP485F Series - see Note 2 in Appendix A) to the RTD

- port on the sensor. Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the value indicated on the calibration plug label. Press **Enter**.
  7. At the prompt, **Connect Loop Resistor**, connect a high value, high-precision Foxboro calibration plug (EP485F Series - see Note 2 in Appendix A) to the RTD port connection on the sensor. Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
  8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the value indicated on the calibration plug label. Press **Enter**.
  9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

## Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cables are part numbered BS807BD.

### Preparation

1. Prepare your FT10 sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and emptying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring caustic).
2. With your transmitter in Configuration mode, enter the sensor type, RTD type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

---

#### — NOTE —

If using an 875EC Analyzer with firmware version earlier than 2.15, contact Invensys Foxboro to request a firmware upgrade or enter the sensor type as **Other** and then enter appropriate electronic cell factor  $C_{f(elec)}$  for the sensor being used.

---

### Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 in Appendix A) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.



4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air**, connect the Foxboro calibration cable between the RTD port connection on the sensor and a decade box. Dial in the low end resistance value (see Note 10 in Appendix A). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.

---

— **NOTE** —

At high conductivities, you may do a low end calibration at 0.0  $\mu\text{S}/\text{cm}$ , 0.0  $\text{mS}/\text{cm}$  or 0.0  $\text{S}/\text{cm}$  with the calibration cable not connected to the decade resistance box.

---

6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, dial in the full scale resistance value (see Note 7 in Appendix A). Press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

---

— **NOTE** —

The resistance in the calibration cable may introduce a zero shift in your calibration. Therefore at low conductivity, Foxboro recommends that you proceed to perform a one-point low value solution calibration at 0.0  $\mu\text{S}/\text{cm}$ , 0.0  $\text{mS}/\text{cm}$  or 0.0  $\text{S}/\text{cm}$ , depending on the desired range (or at a nonzero low value, if desired).

---

## Solution Calibration

### Preparation

1. Remove your FT10 sensor from the process line. Clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type, RTD type, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-224.

---

— **NOTE** —

If using an 875EC Analyzer with firmware version earlier than 2.15, contact Invensys Foxboro to request a firmware upgrade or enter the sensor type as **Other** and then enter appropriate electronic cell factor  $C_{f(\text{elec})}$  for the sensor being used.

---

3. Prepare your calibration solution (see Note 5 on page 65).

## Procedure

1. On your analyzer, press the **Mode** key until the **Cal** indicator is illuminated. Then press the **Enter** key.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Enter the calibrator's name and press **Enter**.
4. In the Calibrate menu, select **Sensor** and press **Enter**. In the next menu, select **Solution** and press **Enter** again. In the next menu, select **2 Point** and press **Enter** again.
5. At the prompt, **Put Sensor in Solution 1**, suspend the sensor in air and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
6. At the prompt, **Adjust Pt 1** (and if the reading is not correct), use the arrow keys to adjust the (low) reading to the correct value. Press **Enter**.
7. At the prompt, **Put Sensor in Solution 2**, fill the sensor with your solution sample (see Note 9 on page 67) and press **Enter**. If **Meas Stability** is configured **On**, the display reads **Stabilizing** until stability is achieved. When the message disappears, press **Enter**. If **Meas Stability** is configured **Off**, the display reads **Stability Off**. Watch for the measurement to stabilize before proceeding to press **Enter**.
8. At the prompt, **Adjust Pt 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
9. When the Help Message advises **Calibration Completed**, press the **Mode** key to return to **Measure** mode.

# 12. 870ITEC Transmitter with FT10 Sensor

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**— NOTE**

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Installation should be completed before calibrating your electrodeless conductivity system.

---

Calibrate an 870ITEC Transmitter with an FT10-LC04F1C Sensor. The sensor in this example is a low conductivity sensor for a 1/4 inch line size and with a standard size flare end connection.

## Calibration (Using a Foxboro Calibration Plug)

Invensys Foxboro calibration plugs are identified as EP485 Series (see Note 2 in Appendix A).

### Preparation

1. Prepare your FT10 sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and emptying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring % caustic).
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

### Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 in Appendix A) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

**— NOTE**

---

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.

5. At the prompt, **Suspend in Air** connect a low value (nonzero), high-precision Foxboro calibration plug (EP485F Series - see Note 2 in Appendix A) to the RTD port connection on the sensor. Press **Enter**.
6. At the prompt, **Adjust Reading** (and if the reading is not correct), use the arrow keys to adjust the reading to the value indicated on the calibration plug label. Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, connect a high value, high precision Foxboro calibration plug (EP485F Series - see Note 2 in Appendix A) to the RTD port connection on the sensor. Press **Enter**.
8. Adjust **Value** (if the reading is not correct) to the value indicated on the calibration plug label. Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

## Calibration (Using a Foxboro Calibration Cable)

Invensys Foxboro calibration cable is part numbered BS807BD.

### Preparation

1. Prepare your FT10 sensor for calibration by doing one of the following:
  - ◆ Removing it from the process line and emptying it
  - ◆ Leaving it in an empty line
  - ◆ Leaving it in a line filled with a solution having a conductivity 1000-fold less than the full scale range for which the system will be calibrated (for example, water if measuring caustic).
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Check that the temperature on the secondary display in the Measure Mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

### Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 in Appendix A) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

**— NOTE**


---

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

---

4. Using the Up/Down arrow keys, select **Bench** and press **Enter** again.
5. At the prompt, **Suspend in Air**, connect the Foxboro calibration cable between the RTD port connection on the sensor and a decade box. Dial in the low end resistance value (see Note 10 in Appendix A). Press **Enter**.

**— NOTE**


---

At high conductivities, you may do a low end calibration at 0.0  $\mu\text{S}/\text{cm}$ , 0.0  $\text{mS}/\text{cm}$  or 0.0  $\text{S}/\text{cm}$  with the calibration cable not connected to the decade resistance box.

---

6. Adjust **Zero** (if the reading is not correct). Press **Enter**.
7. At the prompt, **Connect Loop Resistor**, dial in the high end resistance value (see Note 7 in Appendix A). Press **Enter**.
8. Adjust **Value 2** (if the reading is not correct). Press **Enter**.
9. When the Help Message advises **Cal Completed**, press **Enter** to return to **Bench**.
10. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
11. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
12. Press the **Measure** key to return to Measure mode.

**— NOTE**


---

The resistance in the calibration cable may introduce a zero shift in your calibration. Therefore at low conductivity, Foxboro recommends that you proceed to perform a one-point low value solution calibration at 0.0  $\mu\text{S}/\text{cm}$ , 0.0  $\text{mS}/\text{cm}$  or 0.0  $\text{S}/\text{cm}$ , depending on the desired range (or at a nonzero low value, if desired).

---

## Solution Calibration

### Preparation

1. Remove your FT10 sensor from the process line. Clean and dry it.
2. With your transmitter in Configuration mode, enter the sensor type (**Other**) and its electronic cell factor, measurement units, full scale conductivity value, and any other applicable parameters. Refer to MI 611-212.
3. Prepare your calibration solution (see Note 5 on page 65).
4. Check that the temperature on the secondary display in the Measure mode agrees with the actual temperature of the process. If there is a difference, perform Step 3 in the following procedure.

## Procedure

1. Press the **Cal** key on your transmitter.
2. At the prompt, enter the passcode (see Note 1 on page 65) and press **Enter**.
3. Using the Down arrow key, go to **CALx Temp** and then the Right arrow key to go to **Temp**. Enter the correct temperature and press **Enter**.

---

— **NOTE**

You may omit this step if the temperature on the secondary display in Measure mode agrees with the actual temperature of the process.

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4. Using the Up/Down arrow keys, select **CALx Solution**, then the Right arrow key to go to **Solution Singlept**, and the Down arrow key to go to **Solution Two Pt** and press **Enter**.
5. At the prompt, **Immerse in Solution 1**, suspend the sensor in air and press **Enter**.
6. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
7. At the prompt, **Value 1** (and if the reading is not correct), use the arrow keys to adjust the (low, typically zero) reading to the correct value. Press **Enter**.
8. At the prompt, **Immerse in Solution 2**, fill the sensor with your solution sample (see Note 9 on page 67) and press **Enter**.
9. If the measurement stability parameter is configured **On**, the display **Reading xxxxxxxx** flashes until the measurement is stable and then alternate with the message **Enter to Edit**. If the measurement stability parameter is configured **Off**, watch for the measurement to stabilize before proceeding. Press **Enter**.
10. At the prompt, **Value 2** (and if the reading is not correct), use the arrow keys to adjust the reading to the correct value. Press **Enter**.
11. When the Help Message advises **Cal Completed**, press **Enter** to return to **Solution**.
12. Using the Up/Down arrow keys, go to **CALx Date** and then the Right arrow key to go to **Date**. Enter the date and press **Enter**.
13. Using the Down arrow key, go to **CALx Person** and then the Right arrow key to go to **Person**. Enter the name of the calibrator (6 characters maximum) and press **Enter**.
14. Press the **Measure** key to return to Measure mode.

# Appendix A. Notes

1. 875EC Analyzers are shipped with a default passcode of 0800. You can change this passcode. Refer to MI 611-224 (875EC), MI 611-212 (870ITEC), or MI 611-167 (873EC) for instructions.
2. Invensys Foxboro offers calibration plugs to facilitate calibrating of 871FT and 871EC Sensors.
  - ◆ Plug EP485A with an 871FT-1, -2, -3, or -4 Sensor
  - ◆ Plug EP485N with an 871FT-8 or -9 Sensor (for maximum low range sensitivity)
  - ◆ Plug EP485F with an FT10 Sensor
  - ◆ Plug EP485Q with and 871EC Sensor

These calibration plugs are sensor model (for example, 871FT-4E) and range (for example, 100  $\mu\text{S}/\text{cm}$ ) specific. The plugs are manufactured using precision resistors for close tolerance accuracy and thus eliminate the need for a decade resistance box. They also offer the applicable temperature element resistance (for example, 100  $\Omega$  RTD).

3. Do **not** connect the calibration cable if/when setting the zero. The calibration cable does impart some resistance and this can create an unintentional offset that is especially noticeable at low full-scale measurements. For optimum conductivity results, perform the Bench Calibration with a user-supplied wire or a Foxboro Calibration Plug.
4. Doubling the resistance computed for a full-scale measurement will result in a half-scale measurement being displayed.
5. The actual conductivity of any solution varies with temperature. Fresh uncontaminated solutions prepared and labeled as a specific conductivity value at a specific temperature exhibit that conductivity only at the specific temperature on the label.
6. Electrodeless sensors have a minimum installation/vessel size which must be provided to avoid side wall effects and achieve maximum accuracy. For small-bore sensors, (for example 871EC-SP, -HP, -NL, -TF, -PN, -PP, and so forth), the minimum size is 3 inches. For large bore sensors (for example, 871EC-LB, -UT, -RE, -BW, and so forth), the minimum size is 6 inches. The sensor head must be a minimum of 1 1/2 in from any solid surface (for example, vessel side or bottom) when making a measurement. Center the sensor toroid head in the vessel.
7. Calculating (Full Scale) Resistance Values  
The resistance required to calibrate your system at full scale value is dependent upon:
  - ◆ If you are using a user-supplied calibration wire (with an 871FT or 871EC sensor)
  - ◆ If you are using a Foxboro calibration cable, when your 871FT sensor was manufactured.

The date of manufacture is determined from the last four digits of the Origin Date Code found on the sensor data plate. A code of 2B0149 means the sensor was manufactured in week 49 of 2001,

Use the following formula to calculate full scale loop resistance if using a Foxboro supplied calibration cable **and** your 871FT sensor has an Origin Date code of 2B9710 or later.

$$(Cf_{(\text{geom})} \cdot 1000 \cdot 25) / (\text{FS in mS/cm}) = \text{Loop R in ohms}$$

where

$Cf_{(\text{geom})}$  = geometric cell factor for the sensor being calibrated, found in Table 10.

FS = Full Scale conductivity value expressed in mS/cm

R = Resistance value, in ohms, to set on the decade resistance box.

Use the following formula to calculate full scale loop resistance if using a user-supplied calibration wire looped through an 871FT or 871EC sensor or if using a Foxboro calibration cable **and** your 871FT sensor has an Origin Date code earlier than 2B9710.

$$(Cf_{(\text{geom})} \cdot 1000 \cdot 1) / (\text{FS in mS/cm}) = \text{Loop R in ohms}$$

where

$Cf_{(\text{geom})}$  = geometric cell factor for the sensor being calibrated, found in Table 10.

FS = Full Scale conductivity value expressed in mS/cm

R = Resistance value, in ohms, to set on the decade resistance box.

### Example:

Calibrate an 871FT-1F English Sanitary Flow-Thru Sensor with Full Scale Conductivity = 500  $\mu\text{S/cm}$  using a Foxboro calibration cable.

From Table 10,  $Cf_{(\text{geom})} = 1.11 \text{ cm}^{-1}$ .

$R = (1.11 \cdot 1000 \cdot 1) / (0.5) = 2220 \text{ ohms}$  for a sensor with a pre-2B9710 Origin Code.

$R = (1.11 \cdot 1000 \cdot 25) / (0.5) = 55,500 \text{ ohms}$  for a sensor with an Origin Code of 2B9710 or later.

The resistance value calculated in these formulas assume a Foxboro calibration cable assembly is used or a user supplied calibration wire is used with a single loop or turn through the sensor. When the value of the resistance calculated is very small (less than 10 ohms), the resistance of the wire could affect the accuracy of the calibration. To avoid this, use multiple loops of user-supplied calibration wire through the sensor. The resistance calculated is then multiplied by the square of the number of turns.

### Example:

Calibrate an 871FT-3G English Industrial Flow-Thru Sensor with a full scale conductivity = 500 mS/cm.



From Table 10,  $Cf_{(geom)} = 0.49 \text{ cm}^{-1}$ .

$R = (0.49 \cdot 1000 \cdot 1) / (500) = 0.98 \text{ ohms}$  for a sensor with a pre-2B9710 Origin Code.

$R = (0.49 \cdot 1000 \cdot 25) / (500) = 24.5 \text{ ohms}$  for a sensor with an Origin Code of 2B9710 or later.

The resistance calculated in the first formula is less than 10 ohms. Therefore, you may decide to use 10 turns of wire. With 10 turns of wire, multiply the resistance value by  $10^2$  or 100 and use a resistance of 98 ohms to calibrate the full scale value to 500 mS/cm.

8. Electrodeless conductivity sensors of a barrel geometry (for example, PN, PX and EP307B) require that the wire be run through the bottom hole and out one side of the lateral hole.
9. Performing a solution calibration of an 871FT sensor requires filling the sensor with solution. Do this by capping one end of the bore and filling the sensor to the other end of the bore. While calibrating an 871FT sanitary sensor, dip one end of the grounding strap into the solution to provide conductivity.
10. Calculating (Low Value) Resistance Values

The low end conductivity value used in calibrating an FT10 sensor is usually about 1% of the full scale value. Use the following formula to calculate low end resistance if using a Foxboro calibration cable with an FT10 sensor.

$$(Cf_{(geom)} \cdot 1000) / (LV \text{ in mS/cm}) = \text{Loop R in ohms}$$

where

$Cf_{(geom)}$  = geometric cell factor for the sensor being calibrated, found in Table 10.

LV = Low end conductivity value expressed in mS/cm

R = Resistance value, in ohms, to set on the decade resistance box.

### Example:

Calibrate an FT10-MT12 Sensor with range of 0 - 5 mS/cm using a Foxboro calibration cable.

Establish a low end conductivity value of 0.5 mS/cm

From the sensor data label,  $Cf_{(geom)} = 11.71 \text{ cm}^{-1}$ .

$R = (11.71 \cdot 1000) / (0.05) = 234200 \text{ ohms}$ .

Table 10. Cell Factors

871EC Sensor		871FT English Flow-Thru Sensor		871FT Metric Flow-Thru Sensor		Other Sensors	
Sensor Type	Geometric Cell Factor	Sensor Type	Geometric Cell Factor	Sensor Type	Geometric Cell Factor	Sensor Type	Geometric Cell Factor
-AB	0.588	-1C	11.60	-1C	9.54	EP307B	2.49
-BW	0.873	-2C	11.60	-2C	9.54	EP307G	2.49
-EV	0.45	-1D	4.14	-1D	4.61	EP451A	2.185
-HP	2.15	-2D	4.14	-2D	4.61	EP436E	2.185
-LB	0.873	-1E	2.67	-1E	3.05	FT10-MT08	38.68
-NL	2.35	-2E	2.67	-2E	3.05	FT10-MT12	11.71
-PN	2.45	-1F	1.11	-1F	1.14	FT10-MT16	8.08
-PX	2.45	-2F	1.11	-2F	1.14		
-RE	0.873	-1G	0.62	-1G	0.67		
-SP	2.15	-2G	0.62	-2G	0.67		
-TF	2.31	-1H	0.38	-1H	0.27		
-UT	0.873	-2H	0.38	-2H	0.27		
		-1J	0.21	-3E	0.80		
		-2J	0.21	-4E	0.80		
		-3C	3.02	-3F	0.62		
		-4C	3.02	-4F	0.62		
		-3E	1.06	-3G	0.44		
		-4E	1.06	-4G	0.44		
		-3F	0.49	-3H	0.19		
		-4F	0.49	-4H	0.19		
		-3G	0.49	-3J	0.11		
		-4G	0.49	-4J	0.11		
		-3H	0.25				
		-4H	0.25				
		-3J	0.15				
		-4J	0.15				

# Appendix B. Tools Required

The following tools are required for the various system calibrations shown.

*Table 11. Tools Required*

Type of System	Bench Calibration with Calibration Plug	Bench Calibration with Calibration Cable	Bench Calibration with User-Supplied Wire	Solution Calibration
875EC Analyzer with 871FT Industrial Sensor	EP485A Plug or EP485N Plug <sup>(a)</sup>	Decade Box Calibration Cable	Decade Box	Two Discrete Known Solutions
875EC Analyzer with 871FT Sanitary Sensor	EP485A Plug or EP485N Plug <sup>(b)</sup>			
875EC Analyzer with 871EC Sensor	EP485Q Plug			
870ITEC Transmitter with 871FT Industrial Sensor	EP485A Plug or EP485N Plug <sup>(a)</sup>			
870ITEC Transmitter with 871FT Sanitary Sensor	EP485A Plug or EP485N Plug <sup>(b)</sup>			
870ITEC Transmitter with 871EC Sensor	EP485Q Plug			
873EC Analyzer with 871FT Industrial Sensor	EP485A Plug			
873 Analyzer with 871FT Sanitary Sensor	EP485A Plug			
873 Analyzer with 871EC Sensor	EP485Q Plug			
875EC Analyzer with FT10 Sensor	EP485F Plug			
870ITEC Transmitter with FT10 Sensor	EP485F Plug			

(a) Plug EP485A with an 871FT-3 or -4 sensor; Plug EP 485N with an 871FT-9 sensor

(b) Plug EP485A with an 871FT-1 or -2 sensor; Plug EP 485N with an 871FT-8 sensor

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