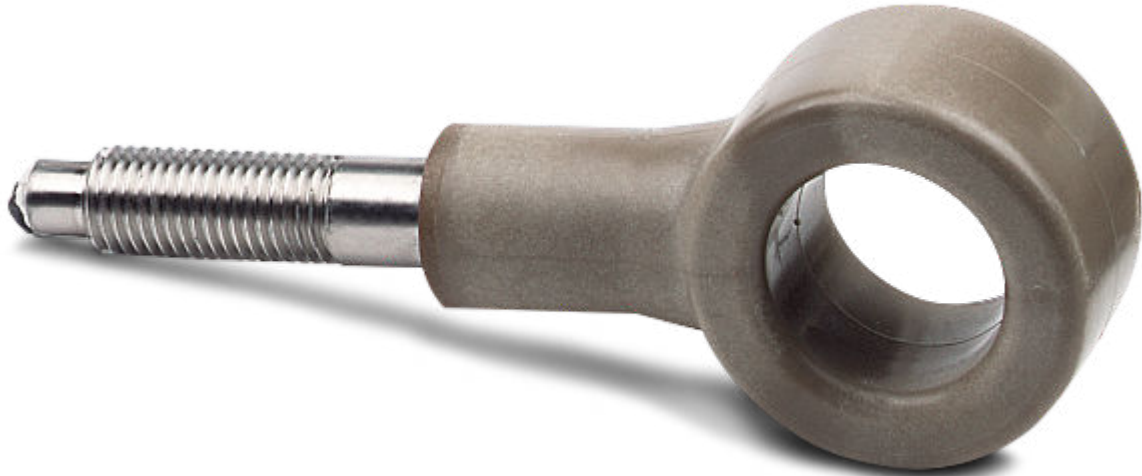


# Rosemount™ 226

Toroidal Conductivity Sensors





## Safety Information

### **⚠ WARNING**

#### HIGH PRESSURE AND TEMPERATURE HAZARD

Before removing the sensor, reduce the process pressure to 0 psig and cool down the process temperature.

Failure to reduce the pressure and temperature may cause serious injury to personnel.

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### **⚠ CAUTION**

#### EQUIPMENT DAMAGE

The wetted sensor materials may not be compatible with process composition and operating conditions. Application compatibility is entirely your responsibility.

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# 1 Description and specifications

## 1.1 Overview

The Rosemount 226 sensor is a toroidal (inductive) conductivity sensor. These sensors work well for measuring in highly conductive liquids up to 2 S/cm (2,000,000  $\mu$ S/cm). Unlike metal electrode based conductivity sensors, toroidal conductivity sensors, like the Rosemount 226, are resistant to fouling, coating, and chemical attack.

Sensors are molded with highly corrosion-resistant glass-filled PEEK (polyetheretherketone). The sensors include an integral Pt-100 RTD for temperature compensation. With a large bore hole opening, the Rosemount 226 greatly resists plugging when used in liquids containing high amounts of suspended solids. PEEK is not recommended for greater than 50% concentrations (at 77 °F (25 °C) ) of H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, and H<sub>3</sub>PO<sub>4</sub>. PEEK is not recommended for use with HF at all.

## 1.2 Specifications

**Table 1-1: Rosemount 226 Toroidal Conductivity Sensor Specifications**

Description	Material and Units
Conductivity Range	Refer to transmitter product data sheet
Wetted Materials	Glass-filled PEEK, EPDM Gasket
Operating Temperature	32 to 248 °F (0 to 120 °C)
Maximum Pressure	295 psig (2135 kPa [abs])
Cable Length	20 ft. (6.1 m)
Maximum Cable Length	Up to 200 ft. maximum
Process Connections	7/8 in. 9 UNC threads for flange mounting and 1 in. MNPT (with -80 option); see dimensional drawings for more details.
Weight/Shipping Weight	2 lbs/3 lbs (1.0 kg/1.5 kg)

## 1.3 Unpacking and inspection

Complete the following steps when you unpack your instrument.

### Procedure

1. Inspect the shipping container. If there is damage, contact the shipper immediately for instructions.
2. If there is no apparent damage, unpack the container and remove the sensor.
3. Ensure that all items shown on the packing list are present. If items are missing, if items are missing, contact your local Customer Care representative
4. Save the shipping container and packaging.

They can be used to return the sensor to the factory in case of damage.

## 1.4 Ordering information

**Table 1-2: Rosemount 226 Toroidal Conductivity Sensor ordering information**

Model	Sensor type
226	Toroidal Conductivity Sensor
Materials of Construction	
02	Glass-filled PEEK <sup>(1)</sup>
Transmitter Compatibility <sup>(2)</sup>	
54	Standard Cable <sup>(3)</sup>
56	EMI/RFI Shielded Cable <sup>(4)</sup>
Mounting Kit	
80	Submersion <sup>(5)</sup>
81	Insertion Through User-Supplied Flange <sup>(6)</sup>
82	No Kit Required <sup>(7)</sup>
Typical Model Number: 226-02-56-80	

- (1) The sensor is supplied with an EPDM gasket (a Viton gasket PN 33151-01 is also available; see accessories).
- (2) Cables may be extended using the remote junction box PN 23550-00 (sold separately) and extension cables (see accessories).
- (3) Recommended for use with Rosemount legacy transmitter models 1054 and 2054.
- (4) Recommended for use with Rosemount transmitter models 54C, 54eC, 81T, 2081T, 3081T, 4081T, XMT, 56, 1056, 1066, 5081, and 56.
- (5) Includes a 1-in. MNPT PEEK adapter
- (6) Includes spacer and nut
- (7) This option does not include any mounting kit and is for replacement sensors only.



## 2 Install

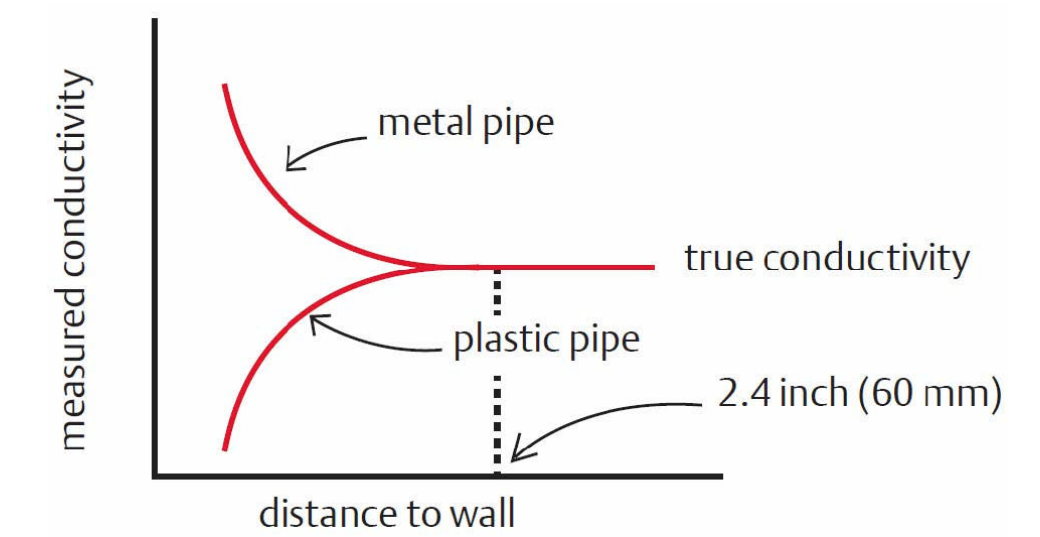
### 2.1 Installing the Sensor

To ensure accurate readings, it is recommended the sensor be installed so that there is at least 2.4 inches of clearance between the sensor and tank or pipe walls. If installed too closely to the walls, an error in readings will be induced by wall effects. Wall effects arise from the interaction between the current induced in the sample by the sensor and nearby pipe or vessel walls.

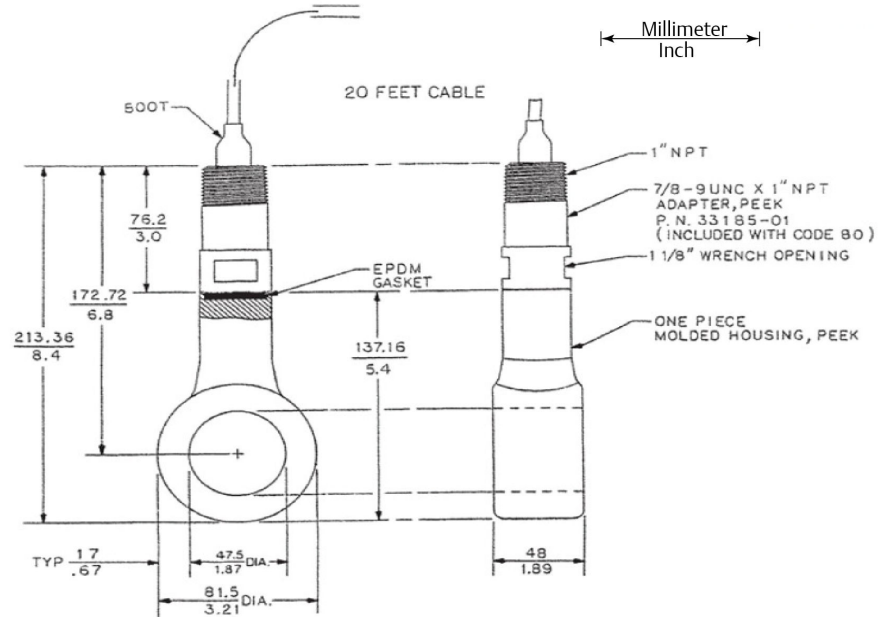
As [Figure 2-1](#) shows, the measured conductivity can either increase or decrease depending on the wall material. This effect can be seen by watching the conductivity readings change as the sensor is moved closer to the sides of the pipe, tank, or beaker.

Ensure that the sensor is completely submerged in the process liquid. Mounting the sensor in a vertical pipe run with flow running from bottom to top is recommended. If the sensor must be installed in a horizontal pipe run, mount the sensor in the 3 o'clock or 9 o'clock position.

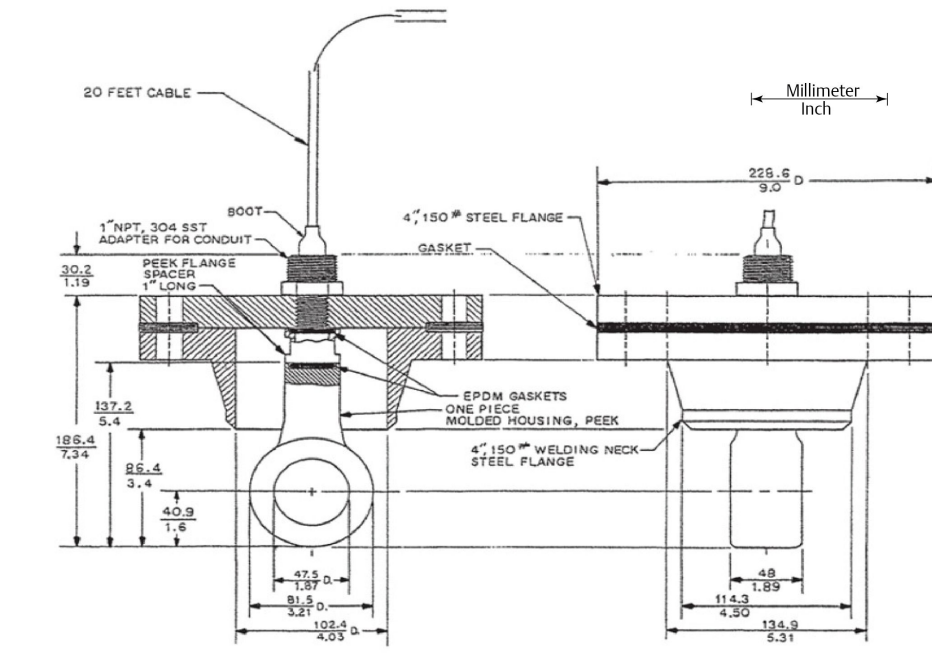
**Figure 2-1: Measured conductivity as a function of clearance between sensor and walls**



**Figure 2-2: Rosemount 226 with 1 in. MNPT process connection mounting adapter (-80 option) dimensional drawing**



**Figure 2-3: Rosemount 226 with 7/8 in. 9 UNC thread and insertion through flange mounting adapter (-81 option) dimensional drawing**



## 2.1.1 Submersion Mounting

The sensor must be mounted in conduit or stand pipe to protect the back end from process leakage. Use Teflon tape for a good seal.

## 2.1.2 Insertion Mounting

The sensor is designed to be mounted through any user-supplied flange. The user is responsible for cutting a hole through the flange to fit the sensor. The flange may be drilled and tapped for the sensor's 7/8 in. 9 UNC thread. Alternatively, a simple 15/16 in. (2.4 cm) drilled hole will accommodate the 7/8-in. 9 UNC thread.

## 2.1.3 Sensor Cable

### **⚠ CAUTION**

#### ELECTRICAL HAZARD

Do not run sensor cable in same conduit as the AC power wiring or near heavy electrical equipment.

Cables run in the same conduit with power wiring or near heavy electrical equipment may cause measurement errors and damage the sensor.

### **⚠ CAUTION**

#### MOISTURE DAMAGE

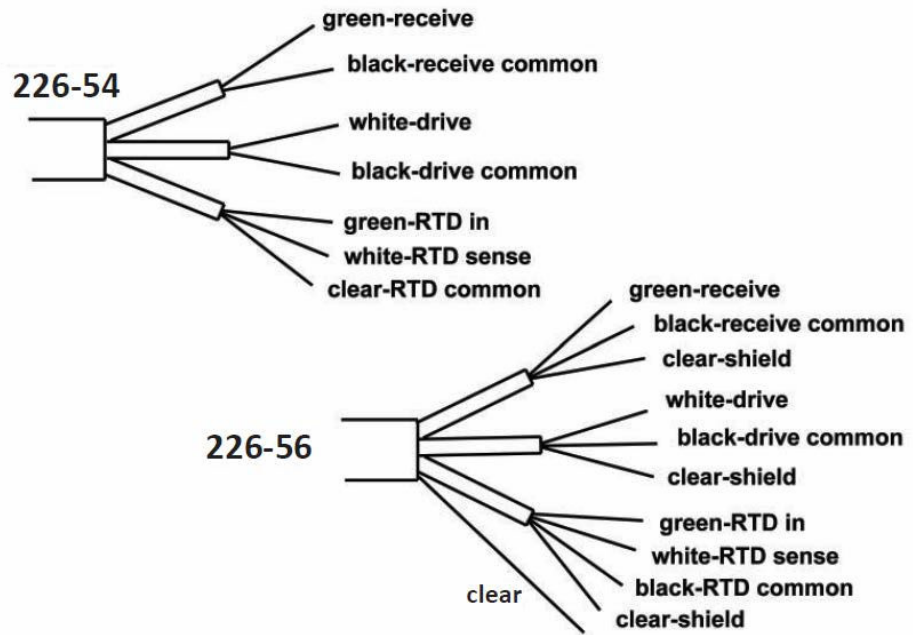
Sensor cables routed in conduit must be sealed or plugged with sealing compound.

Failure to properly seal the conduit may allow accumulated moisture in the transmitter housing and damage the sensor and the transmitter.

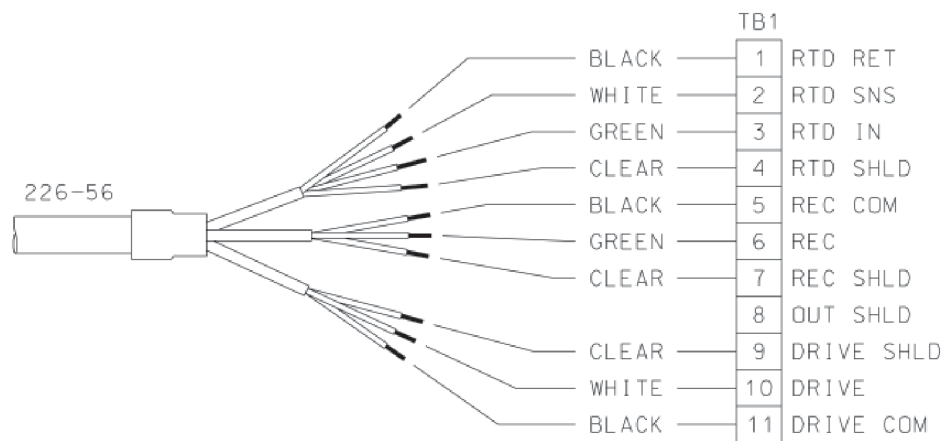
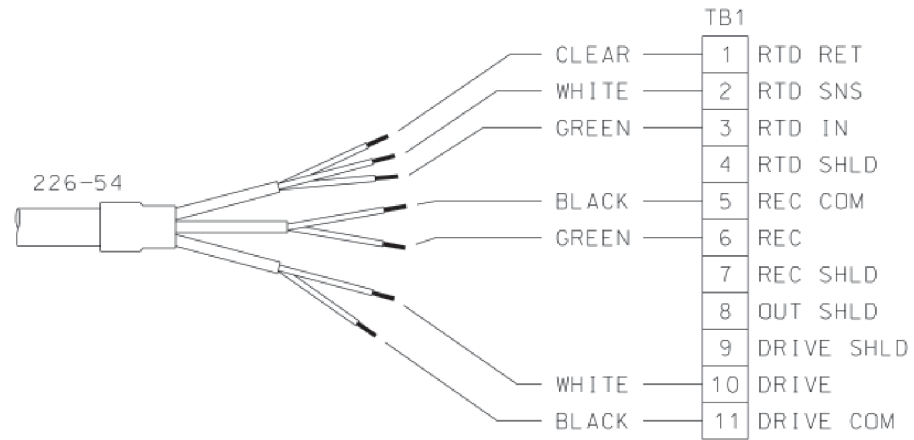
## 2.2 Wiring the Sensor

For additional wiring information on this product, including sensor combinations not shown here, please refer to the [Transmitter Wiring Diagrams](#).

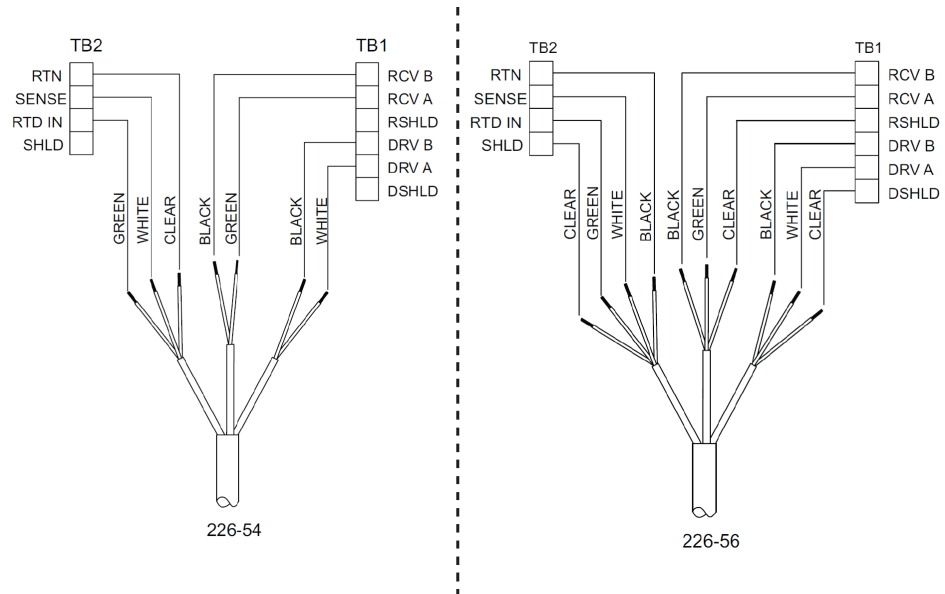
Figure 2-4: Wire functions



**Figure 2-5: Wiring for Rosemount 226-54 and Rosemount 226-56 sensors to 1056 and 56 transmitters**



**Figure 2-6: Wiring for Rosemount 226-54 and Rosemount 226-56 sensors to 1066 transmitter**



**Figure 2-7: Wiring for Rosemount 226-54 and Rosemount 226-56 sensors to 5081-T transmitter**

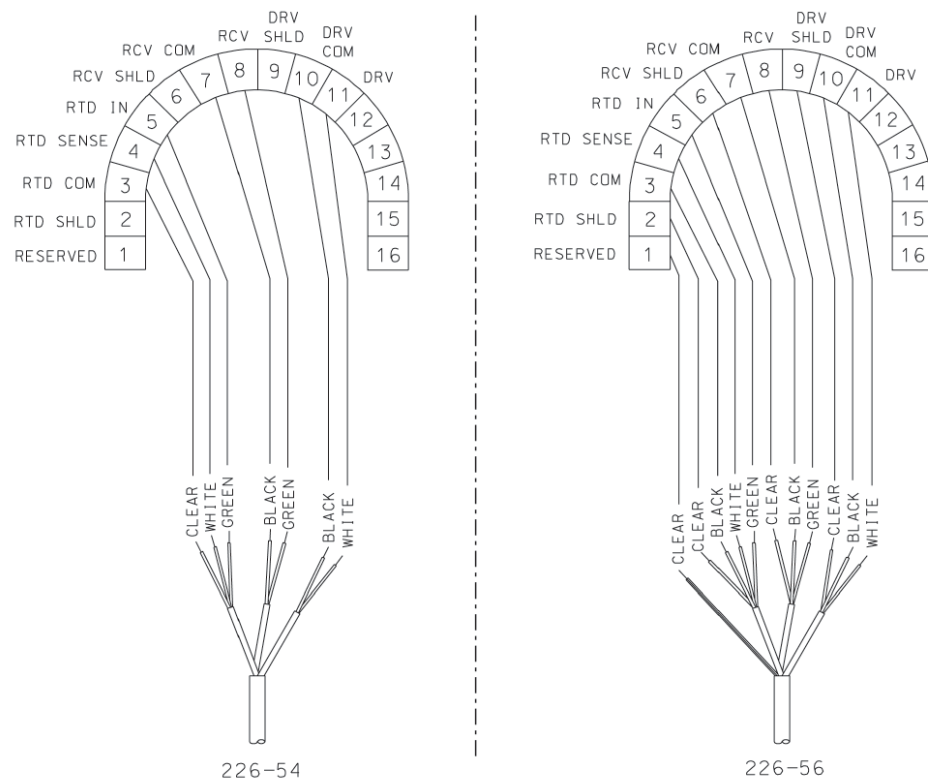
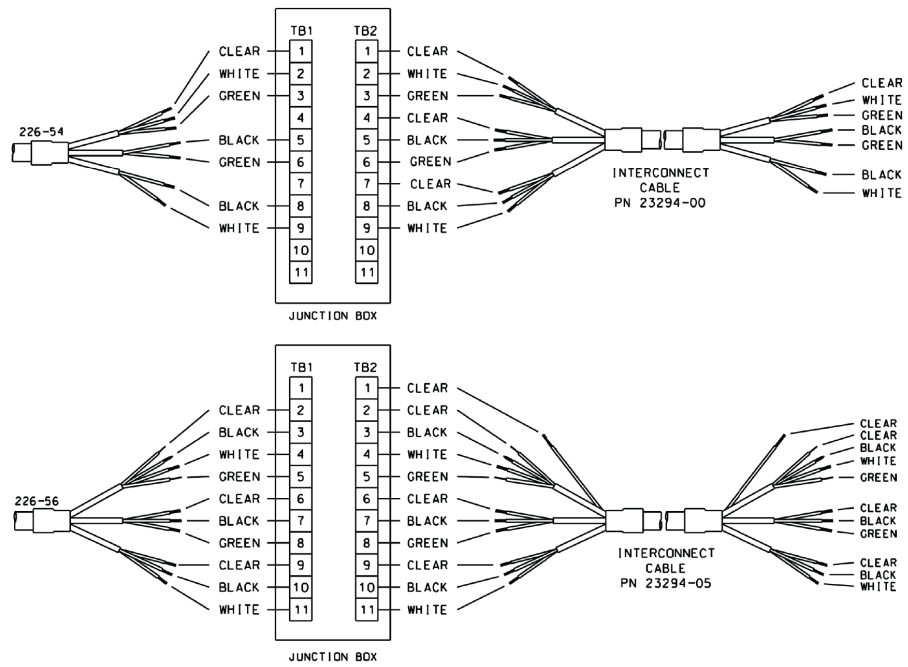


Figure 2-8: Wiring sensors through a remote junction box







## 3 Calibration

### 3.1 Sensor Calibration

The nominal cell constant of the Rosemount 226 sensor is 1.2/cm. The error in cell constant is about  $\pm 10\%$ , so conductivity readings made using the nominal cell constant will have an error of at least  $\pm 10\%$ .

Wall effects as shown in [Figure 2-1](#) will likely make the error greater.

There are two basic ways to calibrate a toroidal sensor: against a standard solution or against a referee meter and sensor. A referee meter and sensor is an instrument that has been previously calibrated and is known to be accurate and reliable.

The referee instrument can be used to perform either an in-process or a grab sample calibration. Regardless of the calibration method used, the connected transmitter automatically calculates the cell constant once the known conductivity is entered.

For more detailed information on calibration methods, please refer to Application Data Sheet ([ADS 43-025](#)).

### 3.2 Calibrating against a Standard Solution

Calibration against a standard solution requires removing the sensor from process piping. This calibration method is practical only if wall effects are absent or if the sensor can be calibrated in a container identical to the process piping. Ideally, the conductivity of the standard used should be close to the middle of the range that the sensor will be used in. Generally, toroidal conductivity sensors have good linearity and so standards greater than 5000  $\mu\text{S}/\text{cm}$  at 25°C may also be used.

#### Prerequisites

#### **⚠ CAUTION**

Before removing the sensor, be absolutely certain that the process pressure is reduced to 0 psig and the process temperature is lowered to a safe level!

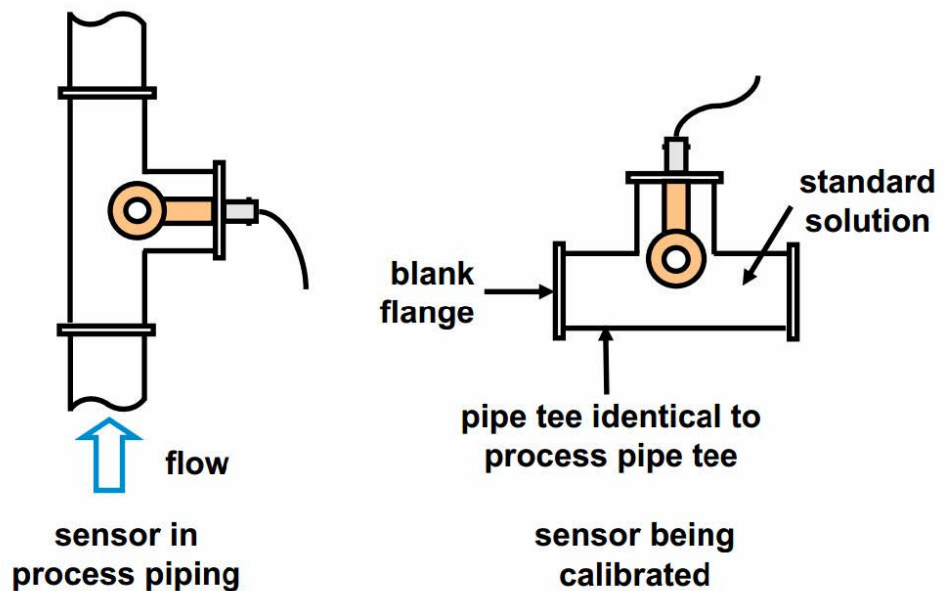
Immerse the rinsed sensor in the standard solution and adjust the transmitter reading to match the conductivity of the standard. For an accurate calibration several precautions are necessary:

#### Procedure

1. If wall effects are absent in the process installation, use a sufficiently large container for calibration to ensure that wall effects are absent.
2. To check for wall effects, fill the container with solution and place the sensor in the center submerged at least  $\frac{3}{4}$  of the way up the stem.
3. Note the reading. Then move the sensor small distances from the center and note the reading in each position.  
The readings should not change.

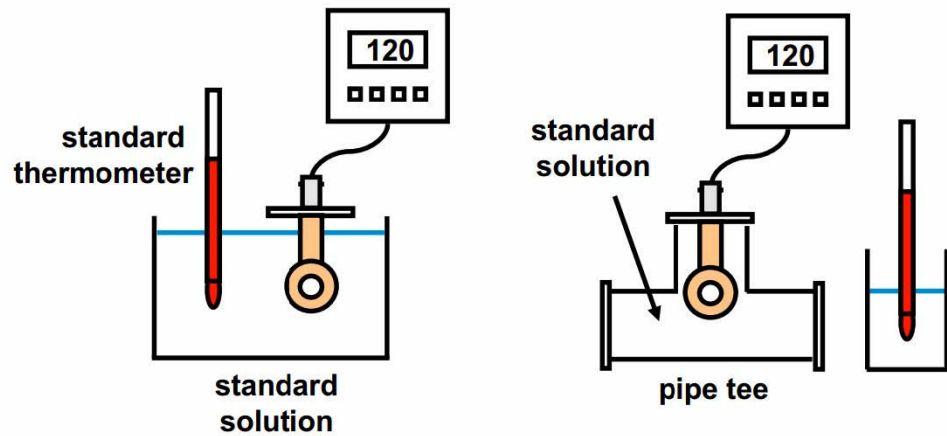
4. If wall effects are present, be sure the vessel used for calibration has exactly the same dimensions as the process piping.
5. Also, ensure that the orientation of the sensor with respect to the piping is exactly the same in the process and calibration vessels.

**Figure 3-1: Calibration installation orientation**



6. Turn off automatic temperature compensation in the transmitter. This eliminates error in the cell constant.
7. Use a good quality calibrated thermometer to measure the temperature of the standard solution.  
The thermometer error should be less than  $\pm 0.1^\circ\text{C}$ .
8. Allow adequate time for the solution and sensor to reach thermal equilibrium.  
If the sensor is being calibrated in an open beaker, keep the thermometer far enough away from the sensor so it does not introduce wall effects.
9. If the sensor is being calibrated in a pipe tee or similar vessel, it will probably be impractical to place the thermometer in the standard solution.
10. Instead, put the thermometer in a beaker of water placed next to the calibration vessel.
11. Let both come to thermal equilibrium with the ambient air before continuing calibration.

Figure 3-2: Measuring standard temperature



12. Make sure that the air bubbles are not adhering to the sensor.  
An air bubble trapped in the toroid opening has a particularly severe effect on the reading.

### 3.3 Calibrating against a Referee – In Process

This method involves connecting the process and referee sensors in series and allowing the process liquid to flow through both sensors. The process sensor is calibrated by adjusting the process analyzer reading to match the conductivity measured by the referee instrument.

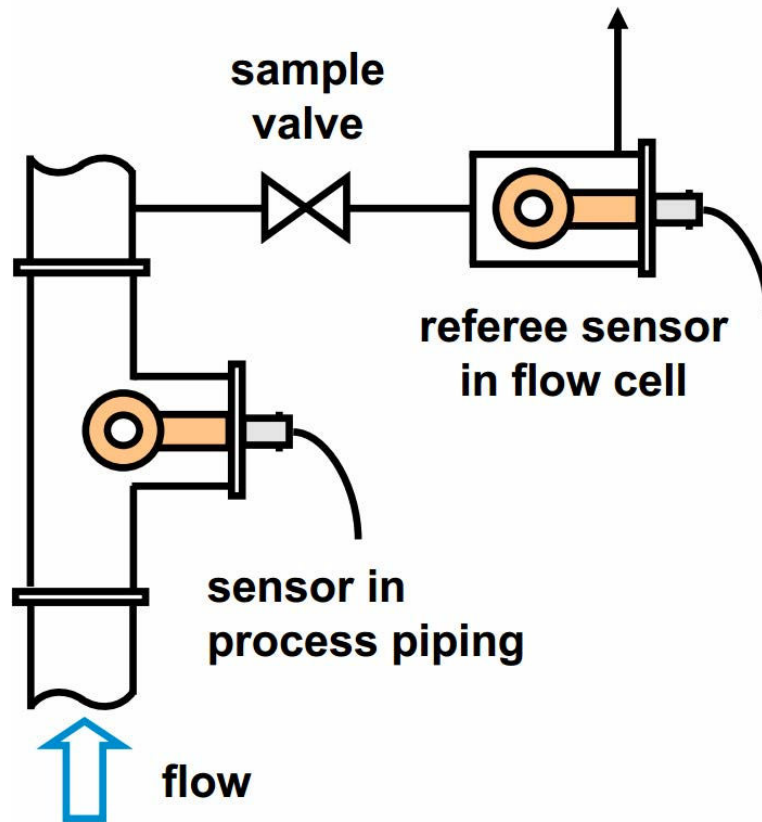
#### Prerequisites

For a successful calibration, several precautions are necessary:

#### Procedure

1. If possible, adjust the conductivity of the process liquid so that it is near the midpoint of the operating range.  
If this is not possible, adjust the conductivity so that it is at least 5000  $\mu\text{S}/\text{cm}$ .
2. Orient the referee sensor so that air bubbles always have an easy escape path and cannot get trapped.

Figure 3-3: Calibration with a referee instrument example



3. Tap and hold the flow cell in different positions to allow bubbles to escape.
4. Turn off automatic temperature compensation in the transmitter.  
This eliminates error in the cell constant.
5. Keep tubing runs between the sensors short and adjust the sample flow to as high a rate as possible.  
Short tubing runs and high flow ensure that the temperature of the liquid does not change as it flows from one sensor to another.
6. Wait for readings to stabilize before starting the calibration.

## 3.4 Calibrating against a Referee - Grab Sample

This method is useful when calibration against a standard is impractical or when in-process calibration is not feasible because the sample is hot, corrosive, or dirty, making handling the waste stream from the referee sensor difficult.

### Prerequisites

The method involves taking a sample of the process liquid, measuring its conductivity using a referee instrument, and adjusting the reading from the process analyzer to match the measured conductivity.

### Prerequisites

For a successful calibration, several precautions are necessary:

### Procedure

1. If possible, adjust the conductivity of the process liquid so that it is near the midpoint of the operating range.  
If this is not possible, adjust the conductivity so that it is at least 5000  $\mu\text{S}/\text{cm}$ .
2. Take the sample from a point as close to the process sensor as possible.  
Be sure the sample is representative of what the sensor is measuring.
3. Keep temperature compensation with the transmitter turned on.
4. Confirm that the temperature measurements in both the process and referee instruments are accurate, ideally to within  $\pm 0.5$  °C.
5. Wait until readings are stable before starting the calibration.



# 4 Troubleshooting

## 4.1 Maintaining the sensor

Generally, the only maintenance required is to keep the opening of the sensor clear of deposits. Cleaning frequency is best determined by experience.

**⚠ CAUTION**

Make sure that the sensor is cleaned of process liquid before handling.

## 4.2 Troubleshooting

Table 4-1: Troubleshooting

Problem	Probable cause	Solution
Off-scale reading	Wiring is wrong.	Verify and correct wiring.
	RTD is open or shorted.	Check the RTD for open or short circuits. See <a href="#">Figure 4-1</a> .
	Sensor is not in process stream.	Confirm that the sensor is fully submerged in the process stream. See <a href="#">Installing the Sensor</a> .
	Sensor is damaged.	Perform isolation checks. See <a href="#">Figure 4-1</a> .
Noisy reading	Sensor is improperly installed in the process stream.	Confirm that the sensor is fully submerged in the process stream. See <a href="#">Installing the Sensor</a> .
	Sensor cable is run near high voltage process stream.	Move cable away from high voltage conductors.
	Sensor cable is moving.	Keep sensor cable stationary.
Reading seems wrong (lower or higher than expected)	Bubbles are trapped in the sensor, particularly in the toroid opening.	Install the sensor in a vertical pipe run with the flow against the toroidal opening. Increase flow if possible.
	Sensor is not completely submerged in the process stream.	Confirm that the sensor is fully submerged in the process stream. See <a href="#">Installing the Sensor</a> .
	Cell constant is wrong. Wall effects are present.	Calibrate the sensor in place in the process piping. See <a href="#">Sensor Calibration</a> .
	Wrong temperature correction algorithm is being used.	Check that the temperature correction is appropriate for the sample. See transmitter manual for more information.

**Table 4-1: Troubleshooting (continued)**

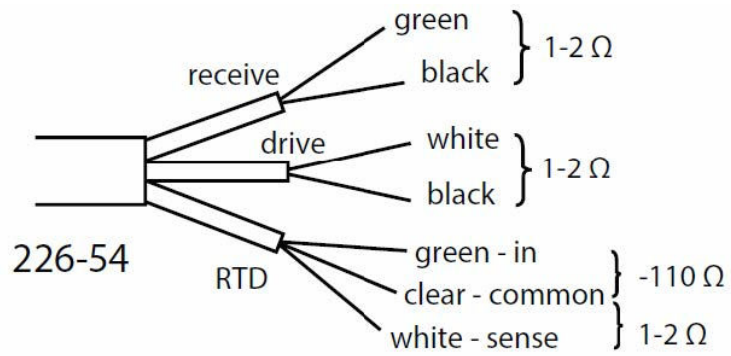
Problem	Probable cause	Solution
	Temperature reading is inaccurate.	Disconnect the RTD leads (Figure 4-1 ) and measure the resistance between the in and common leads. Resistance should be close to the value in Table 4-2.
	Slow temperature response to sudden changes in temperature.	Use an RTD in a metal thermowell for temperature compensation.
Sluggish response	Sensor is in a dead area in the piping.	Move sensor to a location more representative of the process liquid.
	Slow temperature response to sudden changes in temperature.	Use an RTD in a metal thermowell for temperature compensation.

**Table 4-2: Resistance vs. Temperature for Temperature Compensation (PT-100 RTD)**

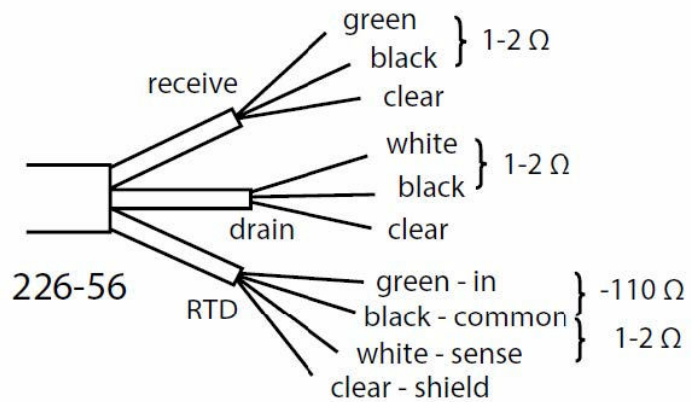
Temperature	Resistance
10 °C (50 °F)	103.9 Ω
20 °C (68 °F)	107.8 Ω
25 °C (77 °F)	109.7 Ω
30 °C (86 °F)	111.7 Ω
40 °C (104 °F)	115.5 Ω
50 °C (122 °F)	119.4 Ω



Figure 4-1: Sensor resistance check



Resistance between shield and any other wire: >40 M $\Omega$



Resistance between shield and any other wire: >40 M $\Omega$



## 5 Accessories

Part number	Description
2001492	Stainless steel tag (must specify marking)
23550-00	Remote junction box without preamplifier
23294-00	Interconnecting extension cable, unshielded (for use with remote junction box)
23294-05	Interconnecting extension cable, shielded (for use with remote junction box)
33151-00	EPDM gasket
33151-01	Viton gasket
33185-01	Submersion mounting adapter, 1 in. MNPT, 3 in. length, PEEK (spare for -80 option sensors)
33185-02	Flange insertion mounting adapter, 1 in. length, PEEK (spare for -81 option sensors)
33219-00	7/8 in. 9 UNC X 1 in. MNPT for conduit connection (spare for -81 option sensors)

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