

Rosemount™ 410VP

Four-Electrode Conductivity Sensor



Essential Instructions

Read this page before proceeding!

Emerson designs, manufactures and tests its products to meet many national and international standards. Because these sensors are sophisticated technical products, you **MUST** properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions **MUST** be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount products. Failure to follow the proper instructions may cause any one of the following situations to occur: loss of life; personal injury; property damage; damage to this sensor; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, contact your Emerson representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Quick Start Guide and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, and **VOID YOUR WARRANTY**. Third-party substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

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

CAUTION

Sensor/Process Application Compatibility

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

WARNING

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!

WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

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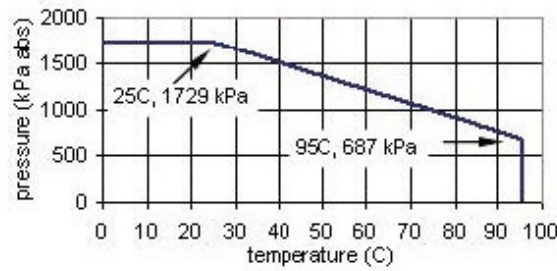
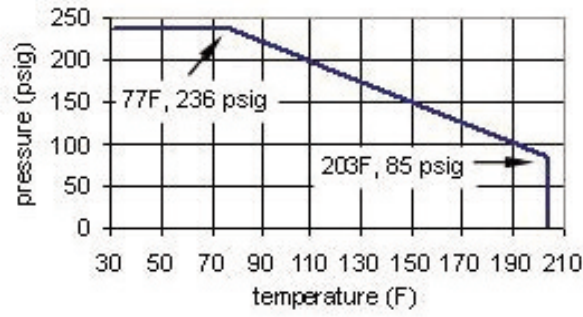
Section 1: Specifications

1.1 Specifications

Table 1-1: Rosemount 410VP sensor specifications

Wetted Materials	
Electrodes	316L stainless steel
Sensor body	unfilled PEEK; compliant with 21CFR177.2415
O-ring (option -22 only)	EP; compliant with 21CFR177.2600
Conformance to 3-A Sanitary Standards	
Sensors with option -20 and -21 meet 3-A sanitary standards for sensors and sensor fittings and connections used on milk and milk products equipment (74-06)	
Surface Finish	
All wetted surfaces except electrodes have 16 micro in. (0.4 micrometer) Ra surface finish.	
Cable	
VP8 connector cable (sold separately)	
Maximum Cable Length	
100 ft (30.5 m)	
Range	
1 μ S/cm to 1400 mS/cm	
Accuracy	
Within \pm 4% of the expected conductivity	
Steam Sterilization	
Tolerates SIP to 284 °F (140 °C)	
Weight/Shipping Weight	
1lb (0.5kg) / 1lb (0.5kg) Weight and shipping weight are rounded up to the nearest 1lb or 0.5kg.	

Figure 1-1: Temperature and pressure



Section 2: Installation

2.1 Unpacking and Inspection

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

2.2 Installation

The Rosemount 410VP sensor is available with four process connections: 1½ in. Tri-Clamp, 2-in. Tri-Clamp, G 1¼, and Varivent N². Gaskets and clamps for the Tri-Clamp and Varivent connections must be supplied by the user.

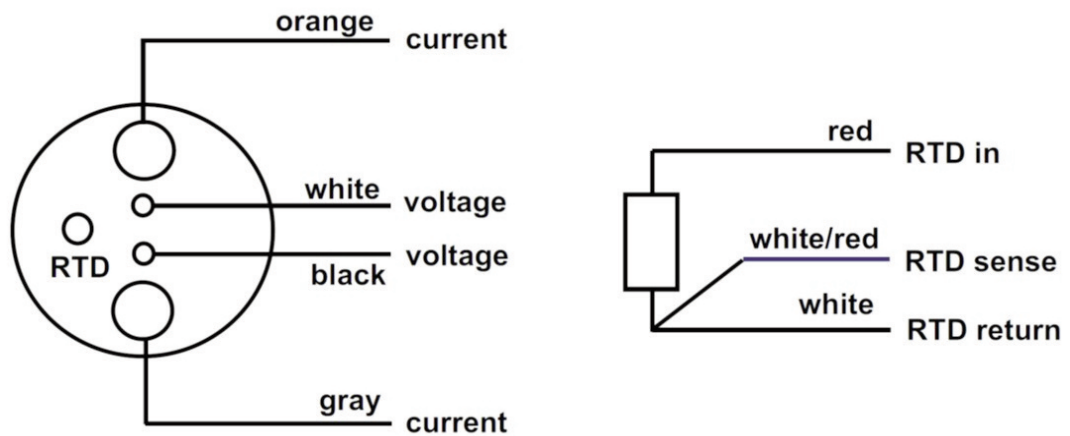
1. Install the sensor so that the electrodes are completely immersed in the process liquid.
2. Avoid installing the sensor in places where air bubbles are likely to get trapped or sediment is likely to accumulate on the electrodes.
3. Generally, mounting the sensor in a vertical pipe run is best. If the sensor must be installed in a horizontal pipe, place the sensor in the 3 o'clock position.
4. Keep at least 1.0 in. (25 mm) clearance between the end of the sensor and the opposite pipe wall.
5. To keep response time as fast as possible, do not install the sensor in dead legs or areas where circulation is poor.

Section 3: Wiring

3.1 Wiring for Rosemount 410VP

For other wiring diagrams not shown below, please refer to the [Liquid Transmitter Wiring Diagrams](#).

Figure 3-1: Wire color and functions



Note: Current is injected through the gray and orange wires. Voltage is measured across the white and black wires.

Figure 3-2: Rosemount 410VP Sensor Wiring to Rosemount 1056, 56, and 1057 Transmitters

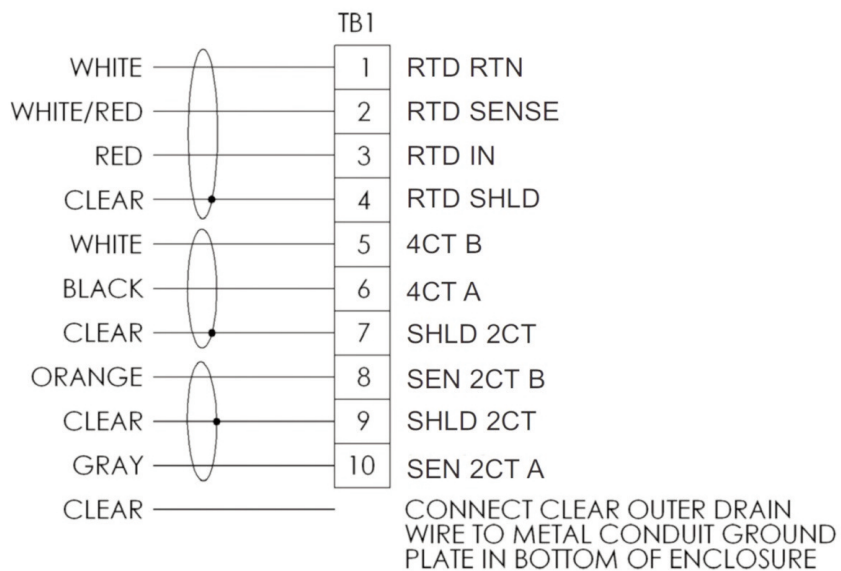


Figure 3-3: Rosemount 410VP Sensor Wiring to Rosemount 1066 Transmitter



* CONNECT CLEAR DRAIN WIRE TO GREEN SCREW AT BOTTOM OF ENCLOSURE.

Note: The terminal end of the sensor is keyed to ensure proper mating with the cable receptacle. Once the key has slid into the mating slot, tighten the connection by turning the knurled ring clockwise.

Section 4: Setup and Calibration

4.1 Calibrating the sensor

The sensor is calibrated at the factory and does not require initial user-calibration. Simply configure the transmitter to accept a four-electrode sensor and enter the cell constant and calibration factor printed on the label. After a period of service, the sensor may require calibration. The sensor can be calibrated against a solution having known conductivity or against a referee meter and sensor. If using a standard solution, choose one having conductivity greater than 500 $\mu\text{S}/\text{cm}$. Do not use standard solutions having conductivity less than 100 $\mu\text{S}/\text{cm}$. They are susceptible to contamination by atmospheric carbon dioxide, which can alter the conductivity by a variable amount as great as 1.2 $\mu\text{S}/\text{cm}$ (at 25 °C). Calibration changes the cell constant only, not the calibration factor. If you wish to change the calibration factor, consult the factory. For more information about calibrating contacting conductivity sensors refer to [Application Data Sheet](#).

4.1.1 Calibrating using a standard solution

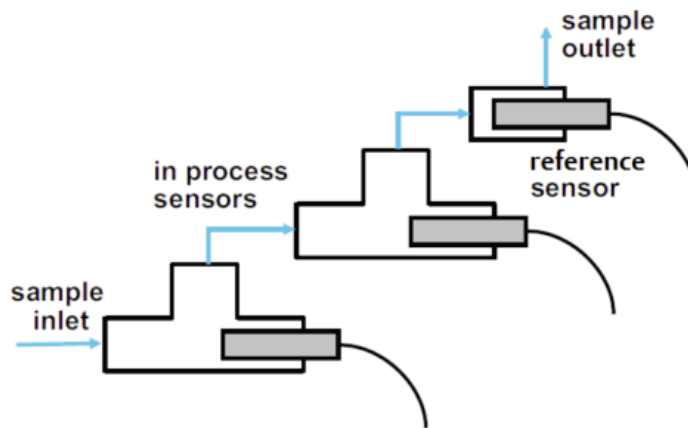
If using a standard solution, choose one having conductivity in the recommended operating range for the sensor cell constant.

1. Immerse the rinsed sensor in the standard solution and adjust the transmitter reading to match the conductivity of the standard.
2. For an accurate calibration:
 - a. Choose a calibration standard near the midpoint of the recommended conductivity range for the sensor.
 - b. Do not use calibration standards having conductivity less than 100 $\mu\text{S}/\text{cm}$.
 - c. Turn off automatic temperature compensation in the transmitter.
 - d. Use a standard for which the conductivity as a function of temperature is known.
 - e. Use a good quality calibrated thermometer with an error rate less than ± 0.1 °C to measure the temperature of the standard.
 - f. Follow good laboratory practice. Rinse the beaker and sensor at least twice with standard. Be sure the rinse solution reaches between the inner and outer electrodes by tapping and swirling the sensor while it is immersed in the standard.
 - g. Be sure air bubbles are not trapped between the electrodes. Place the sensor in the standard and tap and swirl to release bubbles. Note the reading and repeat. If readings agree, no trapped bubbles are present. Repeat until two subsequent readings agree.

4.1.2 Calibrating using a reference meter and sensor

1. Connect the process sensors and reference sensor in series and allow the process liquid to flow through all sensors.
2. Calibrate the process sensor by adjusting the process transmitter reading to match the conductivity measured by the reference meter. See [Figure 4-1](#) for the calibration setup.

Figure 4-1 In process calibration setup



NOTICE

The above figure shows two process sensors connected in series with a reference sensor. The horizontal sensor orientation ensures good circulation of the process liquid past the electrodes. The staircase orientation provides an escape path for bubbles.

3. The method is ideal for calibrating the sensors used in low conductivity water (0.01/cm cell constants) because the calibration system is closed and cannot be contaminated by atmospheric carbon dioxide.

Following precautions are necessary for successful calibration:

1. If the normal conductivity of the process liquid is less than about 1.0 $\mu\text{S}/\text{cm}$, adjust the conductivity so that it is near the upper end of the operating range.

The difference between the conductivity measured by the process and reference meter usually has both a fixed (constant error) and relative (proportional error) component. Because the cell constant calibration assumes the error is proportional only, calibration at low conductivity allows the fixed component to have an outsized influence on the result.

For example, assume the only difference between reference meter and process sensor is fixed and the process sensor always reads 0.002 $\mu\text{S}/\text{cm}$ high. If the process sensor is calibrated at 0.100 $\mu\text{S}/\text{cm}$, the new cell constant will be changed by 0.100/0.102 or 2%. If the sensor is calibrated at 0.500 $\mu\text{S}/\text{cm}$, the change will be only 0.500/0.502 or 0.4%.

Calibration at higher conductivity produces a better result because it minimizes the effect of the offset.

2. Orient the sensors so that air bubbles always have an easy escape path and cannot get trapped between the electrodes.
3. Turn off automatic temperature compensation in the transmitter.

Almost all process conductivity transmitter feature automatic temperature compensation in which the transmitter applies one of several temperature correction algorithms to convert the measured conductivity to the value at a reference temperature, typically 25 °C.

Although temperature correction algorithms are useful for routine measurements, they should not be used during calibration.

There are two following reasons:

- a. No temperature correction is perfect. If the assumptions behind the algorithm do not perfectly fit the solution being measured, the temperature-corrected conductivity will be in error.
- b. If the temperature measurement itself is in error, the corrected conductivity will be in error.

The purpose of calibrating the sensor is to determine the cell constant. To minimize the error in the cell constant, all sources of avoidable error, e.g., temperature compensation should be eliminated.

4. Keep tubing runs between the sensors short and adjust the sample flow as high as possible. Short tubing runs and high flow ensure the temperature of the liquid does not change as it flows from one sensor to another.

If the process temperature is appreciably different from ambient, high flow may not be enough to keep the temperature constant. In this case, pumping sample at room temperature from a reservoir through the sensors might be necessary. Because such a system is likely to be open to atmosphere, saturate the liquid with air to prevent drift caused by absorption of atmospheric carbon dioxide.

5. To prevent contamination of low conductivity (<1 $\mu\text{S}/\text{cm}$) process liquids, use clean tubing to connect the sensors. To prevent drift caused desorption of ionic contaminants from tube walls, keep the sample flow greater than 6 ft/sec (1.8 m/sec).

4.1.3 Calibrating using a grab sample

1. Use the grab sample method when it is impractical to remove the sensor for calibration or to connect a reference sensor to the process line.
2. Take a sample of the process liquid, measuring its conductivity using a reference instrument, and adjusting the reading from the process transmitter to match the measured conductivity.
3. Take the sample from a point as close to the process sensor as possible.
4. Keep temperature compensation turned on. There is likely to be a lag time between sampling and analysis, so temperature is likely to change.
5. Be sure the reference and process instruments are using the same temperature correction algorithm.

6. Grab sample calibration should be used only when the conductivity is fairly high.
 - a. The temperature compensation algorithm will most likely be linear slope.
 - b. Confirm that both instruments are using the same temperature coefficient in the linear slope calculation.
 - c. If the reference meter does not have automatic temperature correction, calculate the conductivity at 25 °C using the equation:

$$C_{25} = \frac{C_t}{1 + \alpha(t - 25)}$$

Where: C₂₅ = the conductivity at 25 °C

C_t = the conductivity at t °C

α = the temperature co-efficient expressed as a decimal fraction.

- d. Confirm the temperature measurements in both the process and reference instruments are accurate, ideally to within ±0.5 °C.
- e. Follow good laboratory practice when measuring the conductivity of the grab sample.
 - Rinse the beaker and sensor at least twice with sample. Be sure the rinse solution reaches between the inner and outer electrodes by tapping and swirling the sensor while it is immersed in the sample.
 - Be sure air bubbles are not trapped in the sensor. Place the sensor in the sample and tap and swirl to release bubbles. Note the reading. Then, remove the sensor and return it to the sample. Tap and swirl again and note the reading. If the two readings agree, trapped bubbles are absent. If they do not agree, bubbles are present. Continue the process until two subsequent readings agree.
 - While making the measurement, do not allow the sensor to touch the sides and, particularly, the bottom of the beaker. Keep at least 1/4 in. (6 mm) clearance.
- f. Be sure to compensate for process conductivity changes that might have occurred while the grab sample was being tested. Rosemount conductivity transmitters (Rosemount transmitter models 1056, 1066, and 56) do this automatically. They save the value of the process conductivity at the time the sample was taken and use that value to calculate the new cell constant when the user enters the result of the grab sample test. Older transmitters do not remember the process conductivity value. Therefore, the user must enter a value adjusted by an amount proportional to the change in the process conductivity. For example, suppose the process conductivity is 810 μS/cm when the sample is taken and 815 μS/cm when the test result is entered. If the grab sample conductivity is 819 μS/cm, the user should enter (815/810) × 819 or 824 μS/cm.

Section 5: Troubleshooting

5.1 Troubleshooting

Table 5-1: Troubleshooting

Trouble	Probable Cause	Remedy
Off-scale reading	Wiring is incorrect.	Verify wiring.
	RTD is open or shorted.	Check RTD for open connections or shorts. See Figure 3-1.
	Sensor is not in process stream.	Be sure sensor is completely submerged in process stream.
	Variopol cable is not properly seated.	Loosen connector and reseal.
Noisy reading	Sensor is improperly installed in process stream.	Be sure sensor is completely submerged in process stream.
	Variopol cable is not properly seated.	Loosen connector and reseal.
Reading seems wrong (lower or higher than expected)	Bubbles trapped on sensor.	Be sure sensor is installed so that air cannot become trapped against it.
	Wrong temperature correction algorithm.	Check that temperature correction algorithm is appropriate for the sample. See the transmitter manual for more information.
	Wrong cell constant. Wrong calibration factor.	Verify that the correct cell constant and calibration factor have been entered in the transmitter. See the transmitter manual for more information.
	Bottom of sensor is too close to pipe wall.	Maintain at least 1.0 in (25 mm) clearance between bottom of sensor and opposite pipe wall.
	Temperature reading in error	Disconnect red and white RTD wires. Measure resistance across leads, which should be about 1100 Ω at room temperature.
Sluggish response	Electrodes are fouled.	Clean electrodes.
	Sensor is installed in dead area in process piping	Move sensor to a location more representative of the process liquid.

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

Section 6: Accessories

6.1 Accessories

Table 6-1: Accessories for Rosemount 410VP Sensor

Part Number	Description
24287-00	10 ft VP8 connector cable for Rosemount 410VP sensor
24287-01	50 ft VP8 connector cable for Rosemount 410VP sensor
23550-00	Remote junction box, without preamplifier
24289-00	Interconnect cable for Rosemount 410VP sensor, prepped
9200334	Interconnect cable for Rosemount 410VP sensor, unprepped
9210004	Conductivity standard, 2000 $\mu\text{S}/\text{cm}$, 16 oz

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