

Preface

This instruction manual serves to explain the use of the Thermo Scientific AquaSensors AnalogPlus 1.0 inch Contacting Conductivity sensor and is written to cover as many applications as possible. Please do not hesitate to contact Thermo Fisher Scientific or an authorized representative with questions or concerns.

The information presented in this instruction manual is subject to change without notice as improvements are made, and does not represent any commitment whatsoever on the part of Thermo Fisher Scientific.

Thermo Fisher Scientific cannot accept any responsibility for damage or malfunction of the sensor due to improper use.

Contact Information

To contact Thermo Scientific AquaSensors Technical Support:

Within the United States call 1.800.225.1480 or fax 978-232-6015.

Outside the United States call 978.232.6000 or fax 978.232.6031.

In Europe, the Middle East and Africa, contact your local authorized dealer.

Visit us on the web at www.thermo.com/processwater

Safety Information



The Thermo Scientific AquaSensors AnalogPlus 1.0 inch Contacting Conductivity sensor shall be installed and operated only in the manner specified. Only a skilled, trained or authorized person should carry out installation, setup and operation of the sensor system.

Before using the sensor, make sure that the sensor cable is connected as specified. Failure to do so may result in permanent damage to the sensor or controller.

Protection against electric shock will be achieved only by observance of the corresponding installation rules.

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1. INTRODUCTION



1.1. General Information

Thank you for purchasing the Thermo Scientific AquaSensors AnalogPlus Contacting Conductivity Sensor. This industrial sensor has many enhanced features that offer superior performance in process applications.

The product is designed for continuous use in industrial process applications and complies with safety regulations currently in force. Improper use could lead to hazards for the user or a third-party, and/or adverse effects to the plant or other equipment.

Thermo Fisher Scientific does not accept any liability for damage that may arise if information in this manual is not followed. Therefore, the operating instructions and specifications must be read and understood by all persons involved in installation and operation of this equipment.

This manual identifies safety instructions and additional information by means of the following symbols:

	This symbol draws attention to safety instructions and warnings of potential danger, which if neglected, could result in injury to persons and/or damage to property.
	This symbol identifies additional information and instructions, which if neglected, could lead to inefficient operation and possible loss of production.

It is recommended that this manual be made accessible to everyone who may need it as a reference. Please contact Thermo Fisher Scientific or an authorized representative with any questions.

1.2. Intended use

The Thermo Scientific AquaSensors AnalogPlus 1.0 inch Contacting Conductivity sensor is designed to continuously measure Conductivity/Resistivity and temperature in aqueous solutions in accordance with the technical product specifications in Section 2.2 of this manual.

Any other use, or use not mentioned here, that is incompatible with the technical specifications is deemed inappropriate. The operator is solely responsible for any damage arising from such use.

Other prerequisites for appropriate use include:

- Observing the instructions, notes and requirements set out in this instruction manual.
- Observing all local safety regulations.
- Observing all warnings and cautions in the documentation regarding all products used in this measurement system, including the Conductivity sensor, mounting hardware, analyzer electronics and cabling.
- Observing the prescribed environmental and operational conditions.
- Observing chemical compatibility with all wetted materials.

1.3. Safety Instructions



The AnalogPlus 1.0 inch Contacting Conductivity sensor should be installed and operated only by personnel familiar with the sensor and qualified for such work.

A defective sensor should be returned to Thermo Fisher Scientific for repair or replacement. Contact Thermo Fisher Scientific to obtain a Return Material Authorization (RMA) number.

No modifications to the AnalogPlus 1.0 inch Contacting Conductivity sensor are allowed. The manufacturer/supplier accepts no responsibility for damage caused by unauthorized modifications. The risk is borne entirely by the user.

1.4. Removal from Service / Correct Disposal of the Sensor

Removal from Service

- Disconnect the cable wiring from the controller terminal block.
- Remove the sensor from the mounting hardware.

Correct Disposal of Unit

- When the sensor is taken out of service, observe the local environmental regulations for correct disposal.

2. PRODUCT DESCRIPTION

2.1. Sensor Description

The Thermo Scientific AquaSensors 1.0 inch Contacting Conductivity sensor is available in different cell constants to accurately measure your continuous industrial application. The wires in the sensor cable are color coded to allow for quick and easy installation into the Model C99 controller.



The wires in the sensor cable are color coded to match the terminal strip connection within the Model C99 Controller.

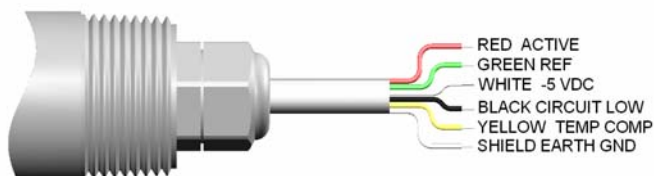


Figure 2.2: Conductivity sensor hook-up

The sensor body has 1 inch NPT threads for the following mounting options:

- Standard 1 inch NPT pipe tee insertion.
- Thermo Scientific AquaSensors immersion mounting assembly.
- Thermo Scientific AquaSensors pipe adapter for union

2.2. Specifications

Wetted Materials.....	Sensor Body – CPVC, PEEK or 316 Stainless Steel Electrodes - Titanium O-Ring Seals - Viton® (Consult factory for customized material construction)
Operating Temperature.....	-4°F to 257°F (-20°C to 125°C)
Maximum Pressure.....	300 psi @ 212°F (2,068 Pa @ 100°C)
Maximum Flow Rate.....	10 ft/sec (3 m/sec)
Measuring Range.....	0 to 5000 µS/cm
Resolution.....	4.5 significant digits
Standard Sensor Cable Length.....	10 ft (3 m)
Cable Wire Colors.....	White Wire (-5V) Black Wire (Ground) Red Wire (Active Electrode) Green Wire (Reference Electrode) Yellow Wire (Temperature/RTD) Drain/Shield (Earth)
Maximum Transmission Distance.....	3,000 ft (914 m)



The sensor will arrive with a protective cap. Remove when in process or calibrating.
Replace the cap on the sensor when placed in storage.



Make sure all wetted materials are compatible with process chemicals at operating temperatures and pressures.

3. INSTALLATION

3.1. Wiring

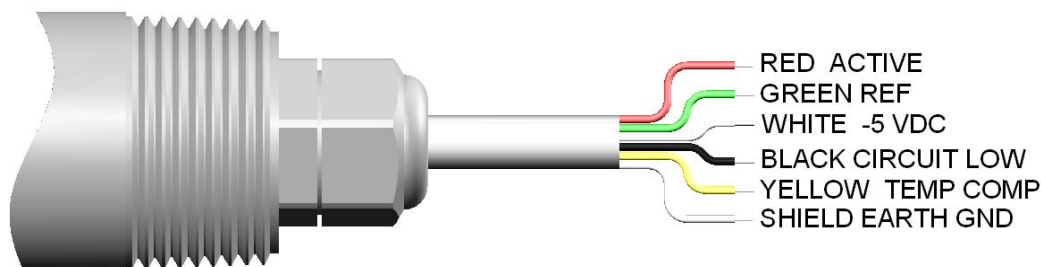


Figure 3.1: Conductivity Sensor Hook-Up

There are two different methods for electrical connection between the sensor and the conductivity controller: either direct or through a junction box.

3.1.1. Direct Connection

1. Insert the sensor cable through a watertight cord grip into the Model C99 Controller. Conduit holes are found on the bottom of the C99 controller for this purpose.
2. Connect the sensor wires to the C99 controller as outlined in the controller manual.

3.1.2. Indirect Connection (Using a Junction Box)

1. Insert the sensor cable and the interconnect cable through a watertight cord grip into the junction box that has a terminal strip designed to make the proper connections.
2. Connect both the sensor cable wires and the interconnect wires to the terminal strip.
3. Insert the interconnect cable through a watertight cord grip into the Model C99 Controller. Conduit holes are found on the bottom of the C99 controller for this purpose.
4. Connect the sensor wires to the C99 controller as outlined in the controller manual.



Be sure that the wire colors of the sensor cable match those of the interconnect cable on either side of the terminal strip.



Route the interconnect cable through metal conduit to minimize electrical noise that may interfere with the sensor signal.

3.2. Mounting Hardware

The Thermo Scientific AquaSensors 1.0 inch Contacting Conductivity sensor can be installed in standard plastic and metal 1-inch full bore tees, union mount tees, immersion mounts and sanitary mounts.

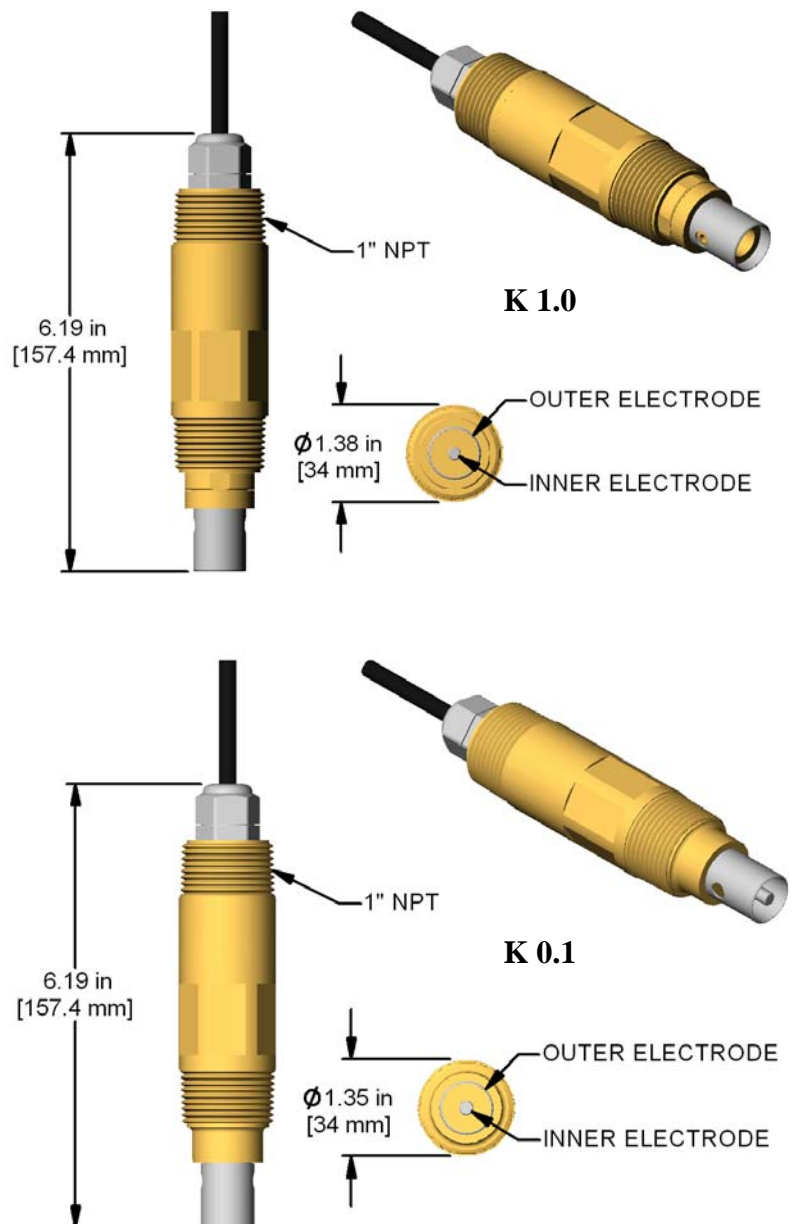
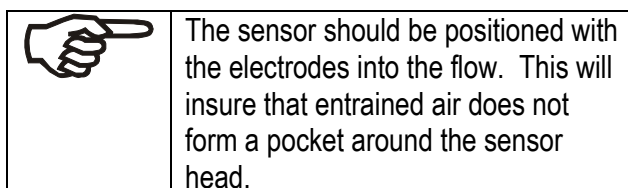
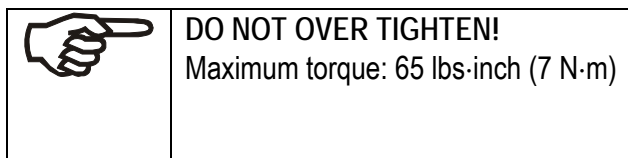
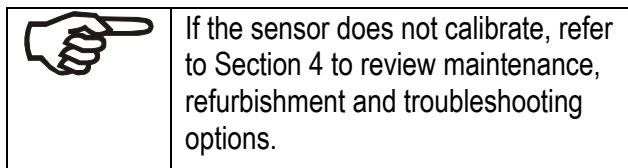
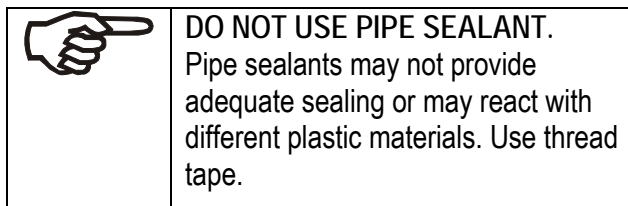
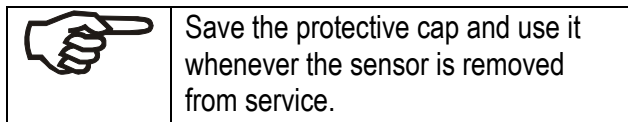
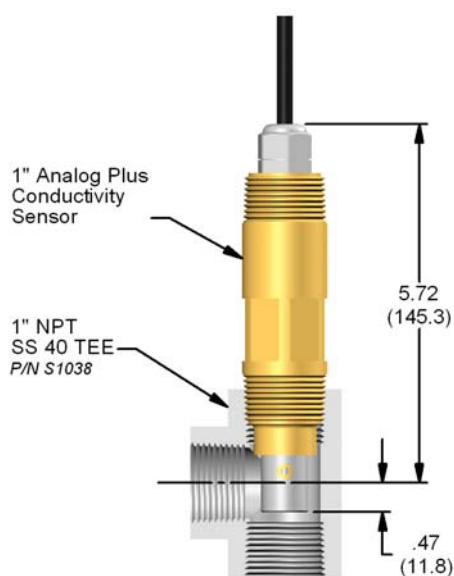


Figure 3.2: 1 Inch Sensor Body

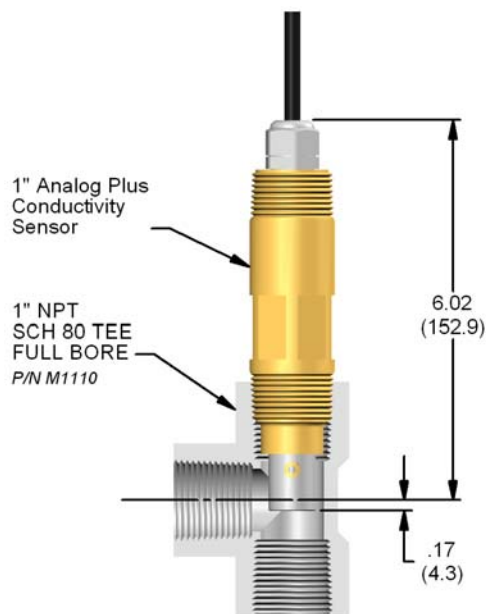
3.2.1. Pipe Tee Mounting

Normally available pipe tees vary widely in construction dimensions. CPVC pipe tees are most generally available with schedule 80 walls. Stainless steel tees have thinner walls that change the final position of the sensor. Common mounting arrangements are shown.



Dimensions: IN (mm)

Figure 3.4: Schedule 40 PVC Tee



Dimensions: IN (mm)

Figure 3.5: Schedule 80 PVC Tee

Detailed Pipe Tee Installation Instructions

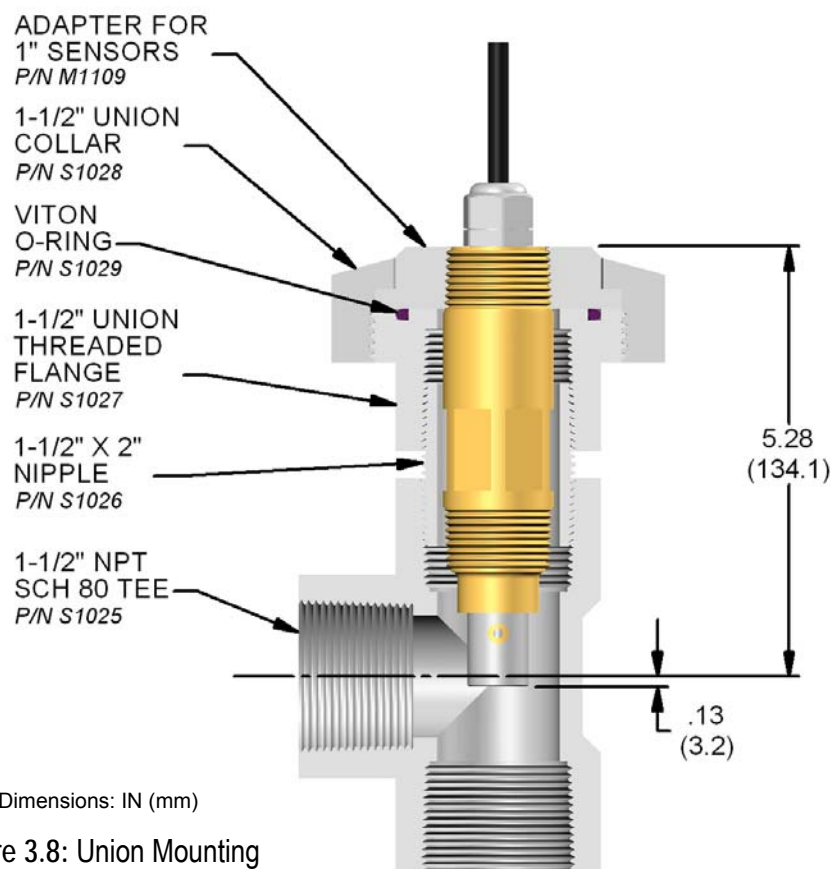
1. Wiring:
 - a. Route the cable either through conduit or on a cable tray.
 - b. Insert the sensor cable into the Model C99 controller through a watertight cord grip. Conduit holes are provided for the cord grip on the bottom of the C99 controller.
 - c. Connect the sensor wires into the C99 sensor terminal block as shown in the C99 manual.
2. Calibrate:
 - a. Power the C99 controller.
 - b. Remove the protective cap from the sensor head. Connect and calibrate the Conductivity sensor as explained in the C99 manual. Subsequent calibrations should be scheduled based on process demands.
 - c. If measurement response time is slow or if the sensor will not calibrate, refer to Section 4 for maintenance, refurbishment and troubleshooting suggestions.
3. Mount:
 - a. Apply Teflon® tape to the sensor body threads.
 - b. Insert the sensor into the tee and slowly turn clockwise until secure. Tighten the sensor with a wrench until snug to prevent leaking. Be sure the pipe remains full when the sensors are installed.

3.2.2. Union Mounting

Union mount hardware makes it easy to remove and insert the sensor for applications where calibration and/or cleaning is frequent.

Union Mount Advantages

- ✓ Optimal positioning of sensing surface.
- ✓ Trouble-free installation.
- ✓ Quick disconnect.
- ✓ No cable twisting during installation or removal.
- ✓ Easy maintenance.



Detailed Union Mount Installation Instructions

1. Wiring:
 - a. Apply Teflon® tape to the rear sensor body threads and pass the cable through the adapter. Thread the adapter onto the sensor clockwise until it is secure.
 - b. Pass the union collar over the cable and onto the adapter with the threads facing the sensor.
 - c. Route the cable either through conduit or on a cable tray.
 - d. Insert the sensor cable into the Model C99 controller through a watertight cord grip. Conduit holes are provided for the cord grip on the bottom of the C99 controller.
 - e. Connect the sensor wires into the C99 sensor terminal block as shown in the C99 manual.
2. Calibrate:
 - a. Power the C99 controller.
 - b. Remove the protective cap from the sensor head. Connect and calibrate the Conductivity sensor as explained in the C99 manual. Subsequent calibrations should be scheduled based on process demands.
 - c. If measurement response time is slow or if the sensor will not calibrate, refer to Section 4 for maintenance, refurbishment and troubleshooting suggestions.
3. Mount:
 - a. Assemble the lower portion of the mounting hardware by threading the pipe nipple into the threaded flange and the tee. Apply Teflon® tape to the threads.
 - b. Inspect the O-ring on the union-mounting threaded flange for imperfections or particles of dirt that may prevent the O-ring seal from seating properly.
 - c. Carefully insert the sensor into the Thermo Scientific AquaSensors union-mounting tee. Turning the retaining collar clockwise and hand tighten until snug. Be sure the pipe remains full when the sensor is installed.

3.2.3. Immersion Mounting

For immersion mounting applications the sensor is connected to a 1 inch to 1.5 inch reducing coupling. A 1.5 inch extension pipe is added to protect the cable from damage.

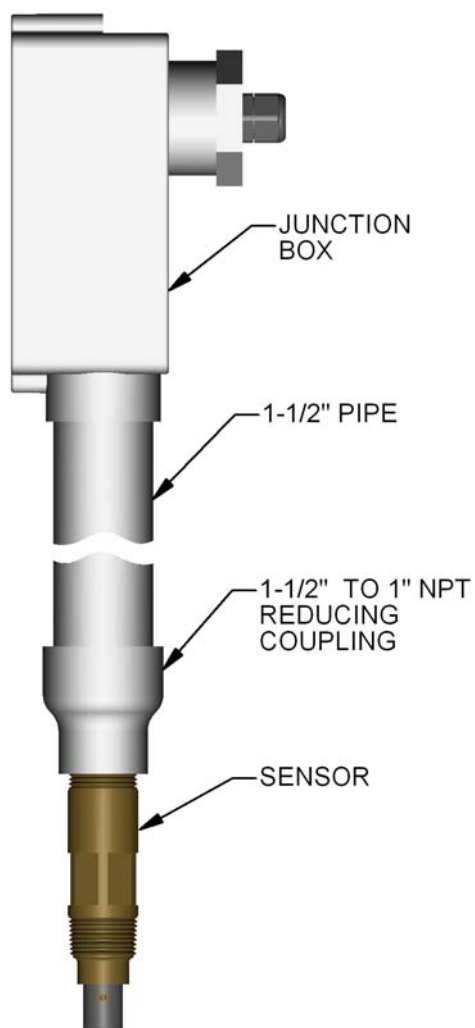


Figure 3.9: Immersion mounting assembly

Detailed Insertion Mount Installation Instructions

1. Wiring:
 - a. Route the sensor cable through the 1.5 inch extension pipe.
 - b. Apply Teflon® tape to the sensor threads.
 - c. Attach the sensor to the 1.0 inch NPT reducing coupling by turning the sensor in a clockwise direction until secure.
 - d. Either route the cable directly to the C99 or splice the wires in a junction box and use an extension cable.
 - e. Insert the cable into the Model C99 controller through a watertight cord grip. Conduit holes are provided for the cord grip on the bottom of the C99 controller.
 - f. Connect the sensor wires into the C99 sensor terminal block as shown in the C99 manual.
2. Calibrate:
 - a. Power the C99 controller.
 - b. Remove the protective cap from the sensor head. Connect and calibrate the Conductivity sensor as explained in the C99 manual. Subsequent calibrations should be scheduled based on process demands.
 - c. If measurement response time is slow or if the sensor will not calibrate, refer to Section 4 for maintenance, refurbishment and troubleshooting suggestions.
3. Mount:
 - a. Secure the pipe assembly so that the sensor is fully immersed in the process. Handrail mounting hardware can be ordered from Thermo Fisher Scientific.



Be sure that the wire colors of the sensor cable match those of the interconnect cable on either side of the terminal strip.



Do not route the interconnect cable conduit where there are AC or DC power cables which create electrical noise that may interfere with the sensor signal.



Route the interconnect cable through metal conduit to minimize electrical noise that may interfere with the sensor signal.

3.2.4. Sanitary Mounting

For sanitary mounting applications the sensor is connected to an adapter with a retaining collar and clamped into a short-branch sanitary tee.

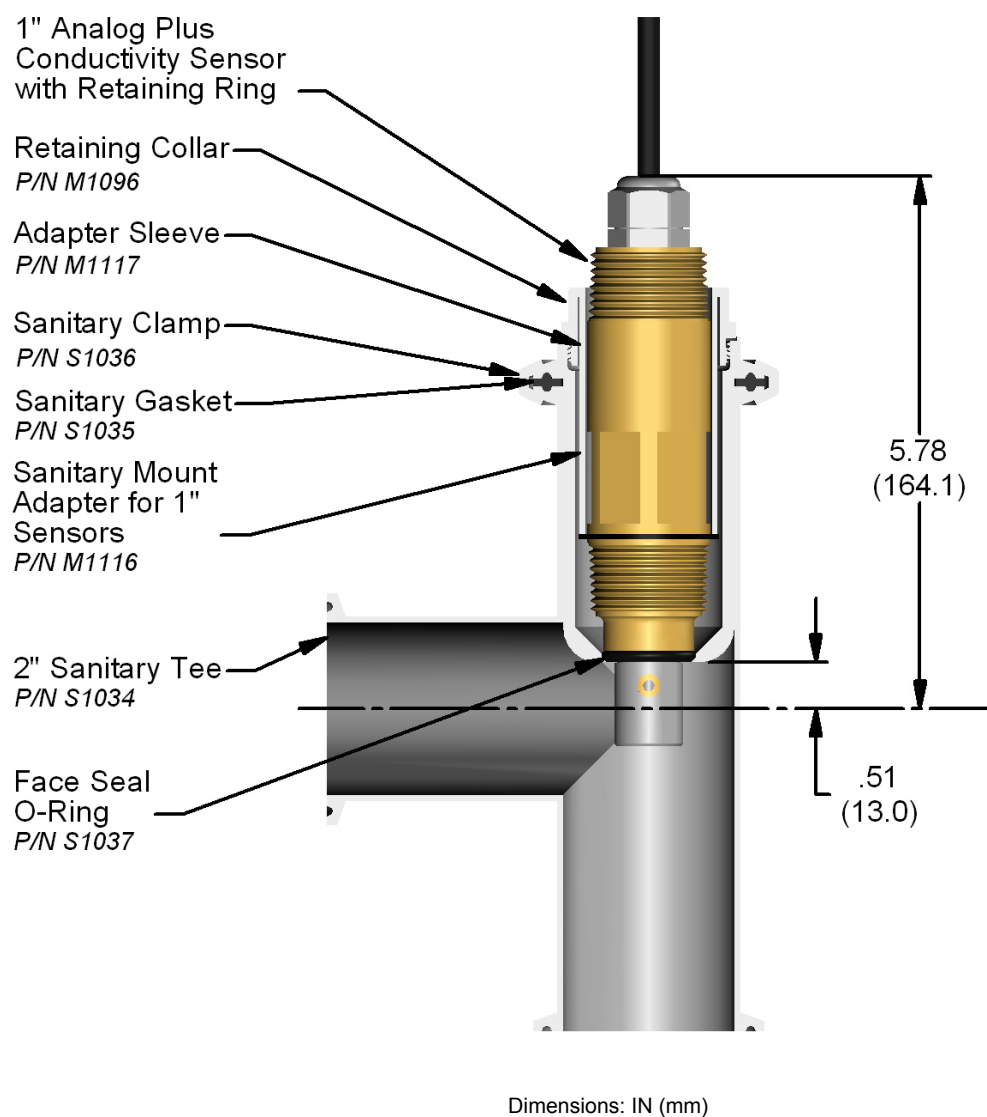


Figure 3.10: Sanitary mounting assembly

Detailed Sanitary Mount Installation Instructions

1. Wiring:
 - a. Thread the retaining collar over the cable and onto the sensor with the threads facing the front of the sensor.
 - b. Route the cable either through conduit or on a cable tray.
 - c. Insert the sensor cable into the Model C99 controller through a watertight cord grip. Conduit holes are provided for the cord grip on the bottom of the C99 controller.
 - d. Connect the sensor wires into the C99 sensor terminal block as shown in the C99 manual.
2. Calibrate:
 - a. Power the C99 controller.
 - b. Remove the protective cap from the sensor head.
 - c. Calibrate the Conductivity sensor as explained in the C99 manual. Subsequent calibrations should be scheduled based on process demands.
 - d. If measurement response time is slow or if the sensor will not calibrate, refer to Section 4 for maintenance, refurbishment and troubleshooting suggestions.
3. Mount:
 - a. Insert the sensor into the adapter making sure the front o-ring on the sensor is seated.
 - b. Thread the retaining collar into the adapter and tighten with a wrench until the face of the sensor head is flush with the adapter and the o-ring forms a seal.
 - c. Place a sanitary gasket on the branch flange.
 - d. Insert the sensor with the adapter into the branch of the tee; be sure the pipe remains full while installing to minimize trapped air.
 - e. Install and tighten the sanitary clamp to retain the sensor and adapter in the tee.



Route the interconnect cable through metal conduit to minimize electrical noise that may interfere with the sensor signal.



Do not route the interconnect cable conduit where there are AC or DC power cables which create electrical noise that may interfere with the sensor signal.

4. CONDUCTIVITY SENSOR MAINTENANCE

4.1. Cleaning the Contacting Conductivity Sensor Head

- 4.1.1. In order to maintain an accurate measurement value, the sensor will need occasional maintenance. The maintenance interval will be dictated by the process in which it is installed. The harsher the process, the more often the sensor will require maintenance. Regular maintenance will yield a longer sensor life.
- 4.1.2. The sensor cleaning procedure is as follows:
 - 4.1.2.1. Remove sensor from service and rinse or spray it with warm water to remove heavy deposits.
 - 4.1.2.2. Soak the sensor in a container of hot detergent water for one hour. Do not use detergents that contain oily skin softeners like aloe or lanolin that can coat the electrodes. Alconox® and Dawn™ dishwashing liquid work well.
 - 4.1.2.3. Use a soft-bristled brush, such as a soft toothbrush, and hot detergent water to scrub the entire electrode end of the sensor.
 - 4.1.2.4. Rinse the electrode end with clean warm water.
 - 4.1.2.5. If deposits are still present on the electrode repeat steps 2 and 3. In the case of lime or other mineral deposits a weak solution (about 0.1 M) of hydrochloric acid may be used. In some cases, a dilute solution (about 10:1) of water and chlorine bleach or a solution of water and EDTA may also work. Stubborn oil or grease deposits may require cleaning with a solvent such as acetone or alcohol. Protein deposits may be cleaned with a pepsin-based cleaning solution. Bacterial or mold growth may be removed with dilute chlorine bleach.



Caution: Ensure that dangerous chemical reactions will not occur between process deposits and cleaning solutions. Compounds of cyanide and hydrochloric acid will react and pose health risks. Cyanide is often used in electroplating and in gold refining. If in doubt about potential chemical reactions, check with a chemist before cleaning.

- 4.1.3. Before returning the sensor to service, allow it to soak in water at ambient temperature for about an hour to restabilize the Conductivity electrode.
- 4.1.4. After cleaning the sensor, calibrate sensor per instructions in the Model C99 controller manual.
- 4.1.5. Reinstall sensor in process.

4.2. Contacting Conductivity Sensor Troubleshooting

General Inspection

If the sensor is not providing reasonable signals to the analyzer, check the following:

1. Inspect the integrity of the electrodes. If the electrode is broken, replace the sensor.
2. Inspect the sensor cable for damage to the outer jacket. Any cuts or kinks may damage signal connections.
3. Inspect terminal block connections to be sure wires are not corroded or loose.
4. Make sure all sensor wires are connected to the correct places on the analyzer terminal block. Depending on the analyzer, some terminal block jumpers may be required and it is common to put those jumpers in the wrong place.
5. The sensor electrodes should be immersed in a solution of known conductivity solution.
6. Establish that the analyzer electronics are working correctly by verifying operation with another sensor.

If the sensor passes the general inspection, there are four basic tests that can verify the Temperature Measurement, the Conductivity Short Test, the Conductivity Span Test and the Sensor Power Test. If the sensor passes these tests it should be ready for service.

Temperature Span

Disconnect the BLACK and YELLOW sensor wires from the analyzer. Use an ohmmeter to measure the resistance between the BLACK and YELLOW wires. The meter should measure a resistance corresponding to the sensor temperature as outlined in the following table.

Sensor Temperature	5°C	15°C	25°C	35°C	45°C
Thermistor Resistance	1020 Ω	1058 Ω	1097 Ω	1136 Ω	1175 Ω

If the measured resistance is within 20 to 40 ohms of the expected value, the element should be satisfactory. If not, please consult the factory.



If after cleaning and refurbishment sensors still have slow responses, low measurement slopes or are seriously abraded or scratched, they must be replaced. Contact your local distributor or call Thermo Fisher Scientific Customer Service.

Conductivity Short Test

1. Disconnect the RED and GREEN sensor wires from the analyzer terminal block while leaving the other wires connected. Connect the (+) lead of an ohmmeter to the RED wire and the (-) lead of the ohmmeter to the GREEN wire.
2. The ohmmeter should read open.

After testing, the RED and GREEN wires should be reconnected to the analyzer terminal block.

Conductivity Span Test

1. The sensor can be tested by substituting a resistor (or resistance decade box) for the process to determine if the system is reading correctly.
2. Sensors are available in both 0.1 and 1.0 cell constants. To obtain the equivalent resistance for any conductivity, divided the conductivity in Siemens by the cell constant. The equivalent resistances for some cell constants and process conductivities are shown in the table below:

Cell Constant = 0.1

Process Conductivity	-	1k μ S	100 μ S	10 μ S	1 μ S
Nominal Resistance	-	100 Ω	1k Ω	10k Ω	100k Ω

Cell Constant = 1.0

Process Conductivity	10k μ S	1k μ S	100 μ S	10 μ S	1 μ S
Nominal Resistance	100 Ω	1k Ω	10k Ω	100k Ω	1M Ω

3. Connect the leads from the resistor (or properly adjusted decade box) to the electrodes. If the reading is not correct continue to the power test.

Sensor Power Test

If the sensor does not respond with any reasonable signal in the span test, it may be worthwhile to verify that power is being supplied to the sensor from the analyzer. To do this, connect a voltmeter from the BLACK lead to the WHITE lead (It is not necessary to disconnect the wires from the terminal block). The meter should read -5 VDC +/- 0.3 VDC. If the voltage is low, disconnect the white wire from the terminal block and measure the voltage on the terminal block. If the voltage comes back into specification there is a defect in the sensor that is loading down the analyzer. If the voltage remains low then the analyzer may be defective.

If the sensor passes the temperature, short, span and power tests but the analyzer is not displaying the correct values, the analyzer may be defective.

5. CONTACTING CONDUCTIVITY SENSOR SPARE PARTS and ACCESSORIES

5.1 Replacements

Description	Part Number
Protective Cap	SBC01

5.2 Thermo Scientific AquaSensors Conductivity Standards

Description	Part Number
1000 $\mu\text{S/cm}$ Conductivity Std (500 ml)	CONSOL1000
2000 $\mu\text{S/cm}$ Conductivity Std (500 ml)	CONSOL2000
5000 $\mu\text{S/cm}$ Conductivity Std (500 ml)	CONSOL5000

5.3 Mounting Hardware Replacements

Union Mounting Assembly

Description	Part Number
Sensor adapter	M1109
Viton® O-ring for sensor adapter	S1029
Retaining collar	S1028
Schedule 80 CPVC tee	S1025
Threaded Union Flange	S1027
1.5" Close Nipple	S1026

Immersion Mounting Assembly

Description	Part Number
Junction box	M1114
1½" PVC pipe	M1115
1½" PVC NPT coupling	S1032

Sanitary Mounting Assembly

Description	Part Number
2" Sanitary Tee	S1034
Viton® O-ring for Face Seal	S1037
2" Sanitary Gasket	S1035
2" Sanitary Clamp	S1036
Sanitary Mounting Adapter for 1" Sensors	M1116
Retaining Collar	M1096

6. Limited Warranty

CONDUCTIVITY & RESISTIVITY SENSOR WARRANTY/REPLACEMENT PLAN

Thermo Fisher Scientific warrants its AnalogPlus 1.0 Inch Conductivity and Resistivity sensors against material and workmanship defect for a period of one year from the date of shipment.

In the event that a defect is discovered during the warranty period, Thermo Fisher Scientific agrees, at its option, to repair or replace the defective product. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products associated with this product including, but not limited to, chemical reagents and salt bridges.

Products may not be returned without authorization from Thermo Fisher Scientific. To obtain authorization, please call Thermo Fisher Scientific for a return material authorization number.

Limitations:

This warranty does not cover:

1. Damage caused by misuse, neglect (lack of appropriate maintenance), alteration, accident or improper application or installation.
2. Damage caused by any repair or attempted repair not authorized by Thermo Fisher Scientific.
3. Any product not used in accordance with the instructions furnished by Thermo Fisher Scientific.
4. Damage caused by acts of God, natural disaster, acts of war (declared or undeclared), acts of terrorism, work actions, or acts of any governmental jurisdiction.
5. Freight charges to return merchandise to Thermo Fisher Scientific.
6. Travel fees associated with on-site warranty repair.

This warranty is the sole expressed warranty made by Thermo Fisher Scientific in connection with its products. All other warranties, whether expressed or implied, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

The liability of Thermo Fisher Scientific shall be limited to the cost of the item giving rise to the claim. In no event shall Thermo Fisher Scientific be liable for incidental or consequential damages.

This warranty is the sole and complete warranty for Thermo Fisher Scientific. No person is authorized to make any warranties or representations on behalf of Thermo Fisher Scientific.

Thermo Fisher Scientific reserves the right to change or modify this warranty at any time.

Control Number: W1003 Rev: 12/04

7. Terms and Conditions

Terms and Conditions of Sale

The following terms and conditions will be presumed acceptable unless changes are made in writing and accepted by both parties in a reasonable amount of time.

Any standard or boilerplate terms and conditions supplied with a written purchase order will not be applicable unless accepted in writing by both parties.

Quotations: All quotations shall be in writing. Written quotations shall be valid for 30 days from the date issued. Verbal quotations or price lists are not valid.

Pricing: All pricing is in US Dollars. Thermo Fisher Scientific reserves the right to change pricing without notice.

Terms: Payment terms are net 30 days from the date of invoice with approved credit. Thermo Fisher Scientific reserves the right to deny credit or revoke previously extended credit. Past due accounts are subject to interest charges. Other acceptable payment terms are cash, certified check, money order, credit card or letter of credit confirmed by any United States of America bank. Other payment terms are not valid unless accepted in writing.

Sales taxes shall be included on the invoice unless a valid tax exemption certificate is supplied.

Return Material Authorization: Contact Thermo Fisher Scientific Customer Service for a Return Material Authorization (RMA) number. Items returned without an RMA number will be rejected.

All returned merchandise must be in unused, resalable condition, and must not be contaminated with hazardous materials.

Cancelled orders must be returned within 30 days of the date on the invoice and shall be subject to expenses incurred that may include, but are not limited to, inspection and restocking fees. Items returned within 60 days shall be subject to a restocking charge that is equal to 15% of the purchase price. Items returned after more than 60 days shall be subject to a restocking charge equal to 25% of the purchase price. Thermo Fisher Scientific reserves the right to reject any return that is not under warranty after 60 days. Non-stock items are normally not returnable.

Transportation: Orders are shipped FOB Thermo Fisher Scientific, or factory, by the most efficient means available. Appropriate charges, such as freight and insurance will be added to invoices. All shipments will be insured. Goods damaged in shipment must be reported by the recipient to the freight carrier for claims.