

**Thermo Scientific AquaSensors™
AnalogPlus™ Differential
pH Sensors
User Guide**



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The specifications, descriptions, drawings, ordering information and part numbers within this document are subject to change without notice.

This publication supersedes all previous publications on this subject.

Preface

This instruction manual serves to explain the use of the Thermo Scientific AquaSensors AnalogPlus pH sensors 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 pH sensors 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 a Thermo Scientific AquaSensors AnalogPlus Differential pH 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.
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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 pH sensor is designed to continuously measure pH 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 pH 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

AnalogPlus pH sensors should be installed and operated only by personnel familiar with the sensor and qualified for such work.



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

No modifications to AnalogPlus pH sensors 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

Thermo Scientific AquaSensors AnalogPlus pH sensors use a differential measurement technique to maximize lifetime in continuous industrial applications.

- The ground rod and encapsulated preamplifier construction reduce the effects of ground loops and allow the pH signals to be transmitted up to 3,000 feet. Titanium is the standard ground rod material. For special applications, 316 stainless steel and Hastelloy C are also available.
- A replaceable heavy-duty salt bridge makes it simple to refurbish the sensor when necessary. The salt bridge is offered in PEEK® and CPVC materials and can be configured to protect the glass electrode or it can be configured with a flat face seal to minimize sensor body exposure to the process.
- A reference reservoir filled with buffered solution minimizes the effects of dilution and extends the life of the reference electrode.
- Temperature elements are embedded in all pH sensors and are used to compensate the pH measurement. There are three different choices of temperature element depending on which pH analyzer/controller electronics the sensor is to be used with.
- The standard cable lengths are 10, 20 and 30 feet. It is recommended that for longer cable runs that a junction box be used with an extension cable.

The AnalogPlus pH sensor comes in a variety of 1.0-inch and 1.5-inch diameter body styles. NPT threaded sensors are used for standard pipe tees and immersion mount applications. Smooth body sensors and sensors with Teflon wipers are used for insertion applications. Sensors with 2-inch and 2.5-inch Triclamp flange fittings can be installed in sanitary style mounting applications.



Standard 1.0-inch Sensor Body

PEEK® Body with NPT threads for immersion and insertion applications.

Standard 1.5-inch Sensor Body

CPVC Body with NPT threads for immersion and insertion applications.

Insertion Sensor Bodies for 2" Valves

Left: Peek® material with Teflon wiper
Right: CPVC material with smooth body.

Sanitary Style - 2.5" Triclamp

316 Stainless Steel Flange with CPVC sensor body.

2.2. Compatible Analyzers and Controllers

All AnalogPlus pH sensors use the differential measurement technique to insure longer life and less signal interference. Differential pH sensors also make it possible to have long cable runs. Sensor cables have either 5 or 6 wires, depending on the type of analyzer that the sensor is to be used with. The wires are designed for terminal block connection and each wire must be individually connected. All analyzers are rated NEMA 4X for outdoor use as long as proper mounting and conduit practices are used.

AV88 Universal Analyzer

Thermo Fisher Scientific offers the AV88 Universal Analyzer. The analyzer can be configured to measure with any AnalogPlus sensor. With the pH personality module installed, AnalogPlus pH sensors with a temperature hookup code of “9” in the part number can be used (EG: FP21A-9-D10). These sensors have 6 conductor cables while other versions of the sensor have 5 conductors. The analyzer has a very intuitive menu system that makes it easy to navigate through measurement, calibration, configuration and diagnostic display options. Two current outputs, two relays, PID control, and optional digital host communications are provided. Host communications make it possible to integrate all sensor functions remotely with any computer system while allowing local control through the AV88 keypad. Supported host communications protocols include Modbus RTU, DeviceNet, Modbus TCP, Ethernet/IP, CANopen and Profibus. The AV88 enclosure is rated for outdoor use and can be mounted to a wall, a panel or a pipe. Input power options of 24 VDC and Line Power (90 VAC to 240 VAC) are available with this Analyzer.



Figure 2.1: AV88 Universal Analyzer

P99 pH/ORP Analyzer

Thermo Fisher Scientific offers the P99 pH/ORP Analyzer which is compatible with all AnalogPlus pH and ORP sensors with a temperature/hookup code of “8” in the part number (EG: FP21A-8-D10). It provides a large LCD display, password protected menu access, 2 current outputs and 3 relays. It is compatible with GLI/HACH P63/P53/P33/P3 analyzers and transmitters. The P99 enclosure is rated for outdoor use and can be mounted to a wall, a panel or a pipe.



Figure 2.2: P99 pH/ORP Analyzer

Third Party Analyzers

AnalogPlus pH sensors with a temperature/hookup code of “7” (EG: FP21A-7-D10) are compatible with AquaMetrix differential pH analyzers. AnalogPlus pH sensors with a temperature/hookup code of “8” work with our P99 analyzer or GLI/HACH P63/P53/P33/P3 analyzers and transmitters.

Thermo Scientific AquaSensors AV88 and P99 analyzers have a number of options to provide the right features at the right price for an application. Common part numbers are shown in the table below.

Analyzers	Description	Part Number
AV88 Universal Analyzer	2 outputs, 2 relays, PID. AC power. ¼ DIN. 2 outputs, PID, Modbus. 24VDC. ¼ DIN.	AV88AB0C2 AV88AB4A1
P99 pH/ORP Analyzer	2 outputs, 3 relays. AC power. ½ DIN.	P99


2.3. Specifications


All AnalogPlus pH sensors are rated for continuous use in industrial and municipal process applications. Construction variables of electrode type, ground rod material, sensor body material, temperature element and cable length are described in Sections 6 and 7 of this manual. Specifications shown here are general in nature and assume that the proper materials have been chosen for the application.

Measuring Range..... 0 to 14 pH
Resolution..... 0.01 pH

	PEEK® Sensor	CPVC Sensor
Operating Temperature.....	-5°C to 95°C	-5°C to 75°C
Maximum Pressure.....	100 PSIG @ 95°C	85 PSIG @ 75°C
Maximum Flow Rate.....	10 ft/second	10 ft/second

Standard Sensor Cable Lengths..... 10 ft, 20 ft and 30 ft
Maximum Transmission Distance..... 3,000 ft (914 m)

	<p>The sensor will arrive with a protective cap that keeps the sensor hydrated.</p> <p>For short-term storage, put several drops of Thermo Scientific AquaSensors storage solution on the absorbent material in the protective cap and replace the cap on the sensor. This keeps the process electrode and salt bridge moist.</p> <p>For extended storage, repeat the above short-term storage procedure every 2 to 4 weeks, depending on the surrounding environmental conditions.</p>
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	<p>Make sure all wetted materials are compatible with process chemicals at operating temperatures and pressures.</p>
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3. Installation

Standard AnalogPlus pH sensors have NPT threads on the front and on the back of the sensor body. 1.5-inch diameter sensors can be threaded into standard 1.5 inch pipe extensions and tees. 1.0-inch diameter sensors can be threaded into standard 1.0 inch pipe extensions and tees. These standard NPT threads are used for a majority of immersion and insertion applications.

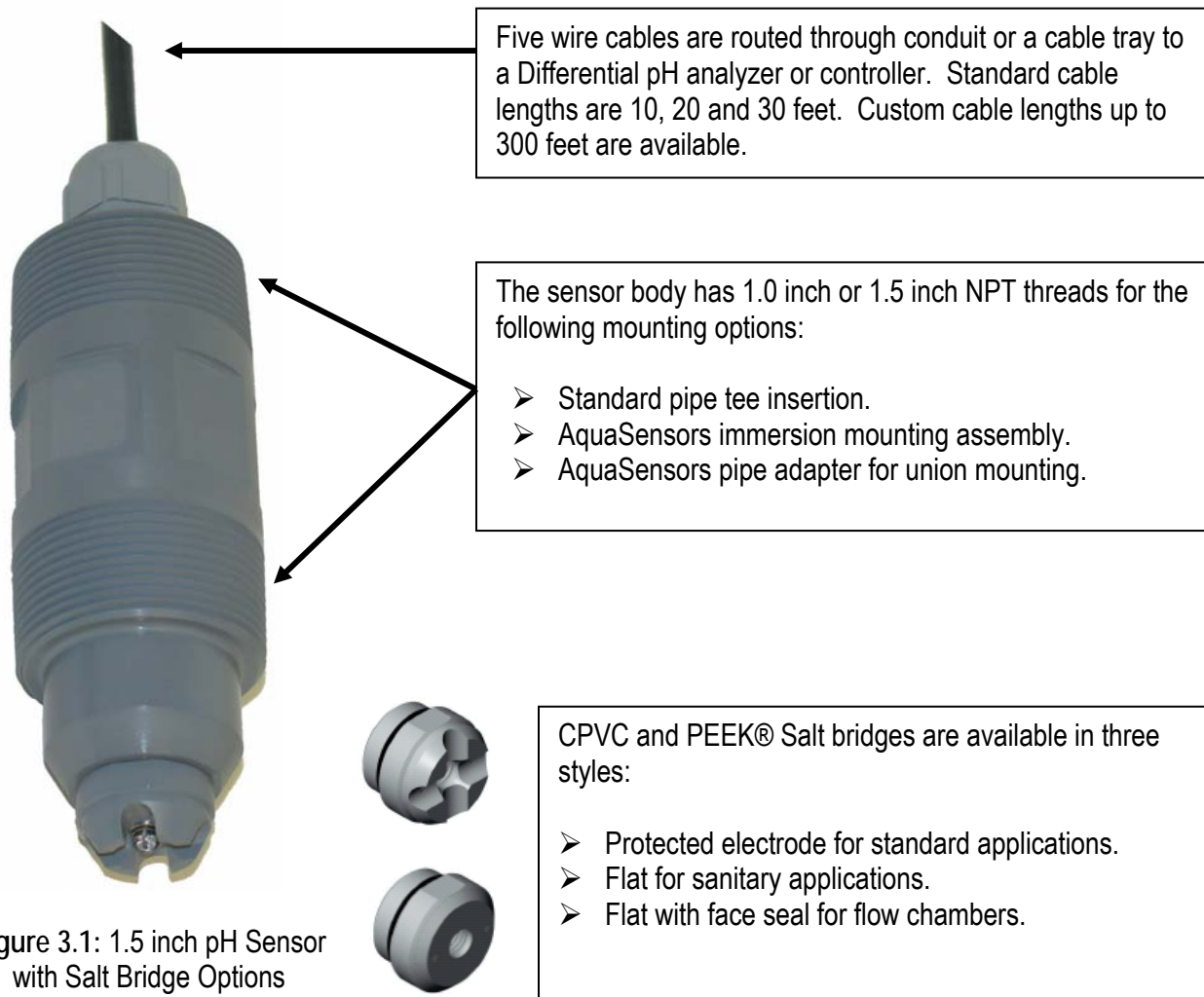


Figure 3.1: 1.5 inch pH Sensor with Salt Bridge Options

When ball valve and sanitary mounting are needed sensors can be provided with smooth bodies and sanitary flanges.

PEEK® pH Sensor with removable Teflon Wiper for 2-Inch ball valves.



Smooth CPVC 1.5 Inch Body for 2 inch Ball Valve insertion.



CPVC pH Sensor with 2.5-inch Tri-clamp flange.

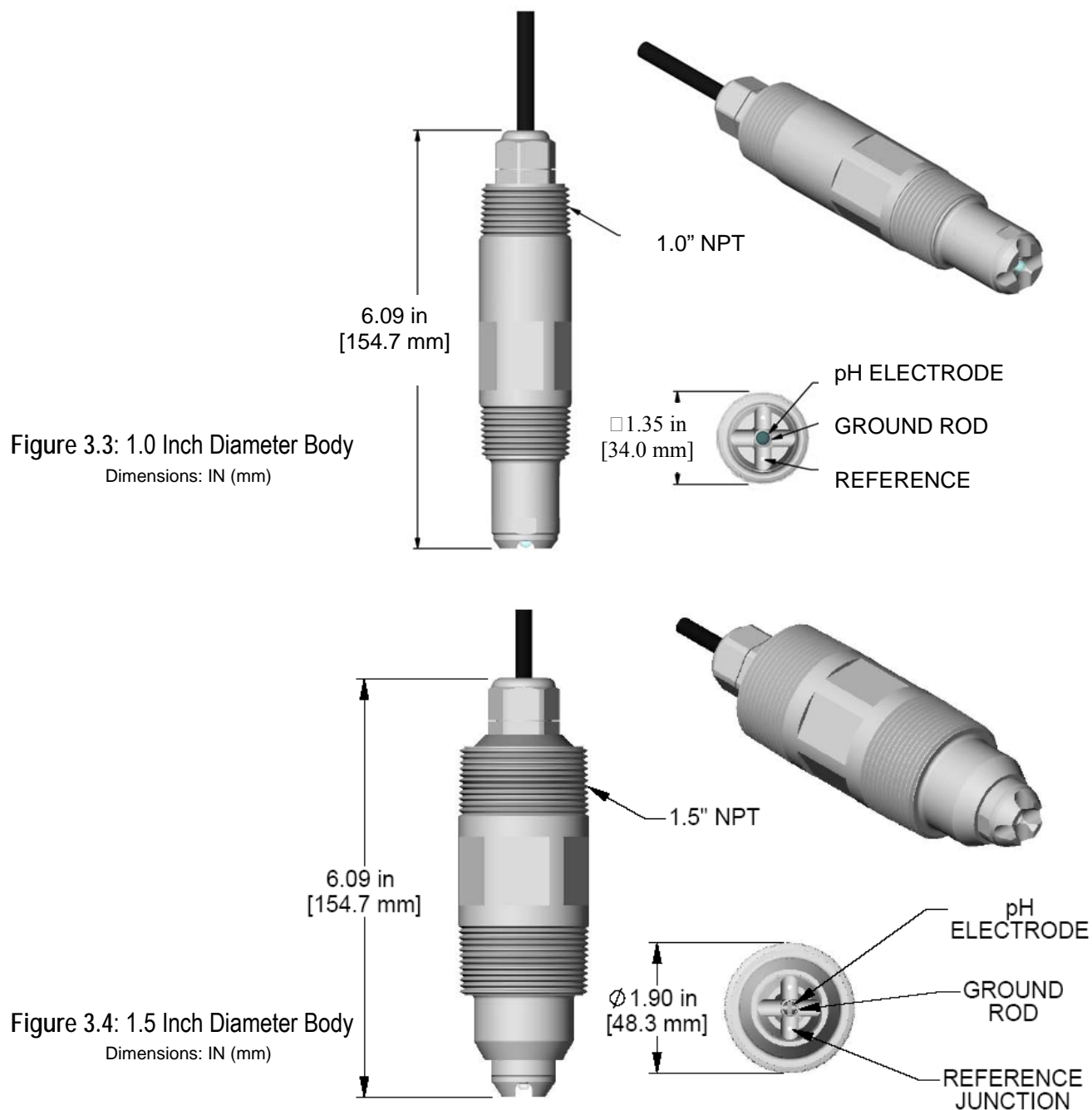


Figure 3.2: Body Variations for pH Sensors

3.1. Sensor Body Dimensions


Thermo Fisher Scientific offers two distinct body types for AnalogPlus pH sensor line. The 1.0-inch diameter sensor body (Fig 3.4) and the 1.5-inch diameter sensor body (Fig 3.5).


The 1.5-inch diameter body is intended for use where 1.5 inch NPT compatible hardware is installed.





3.2. Important Points to Remember During Installation


To insure accurate measurements when installing a new pH sensor it is important to remember a few simple steps to avoid damage and to keep the pH measurement reliable.


	Save the protective cap and use it to keep electrodes moist whenever the sensor is removed from service.
---	--

	When taking a sensor out of storage, soak the sensor in a pH 7 buffer solution for 30 minutes before calibration.
---	---

	DO NOT USE PIPE SEALANT. Pipe sealants may not provide adequate sealing or may react with different plastic materials. Use Teflon thread tape.
---	--

	DO NOT OVER TIGHTEN! Maximum torque: 65 lbs·in (7 N·m)
---	--

	The sensor should be positioned at least 15° up from horizontal. This will insure that entrained air does not form a pocket around the sensor head.
---	---

	If the sensor does not calibrate, refer to Section 4 to review maintenance, refurbishment and troubleshooting options.
---	--

3.3. Wiring Overview

There are two different methods for electrical connection between the sensor and a pH controller: either direct or through a junction box. For ease of maintenance it is recommended that any cable run over 30 feet employ an indirect connection with a junction box and an extension cable.

3.1.1. Direct Connection

1. Insert the sensor cable through a watertight cord grip or conduit into the AV88 or P99 Controller. It is recommended that conduit holes on the bottom side of the controller be used for this purpose.
2. Connect the sensor wires to the controller terminal block 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 or conduit 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 or conduit into the controller.
4. Connect the sensor wires to the controller terminal block as outlined in the controller manual.



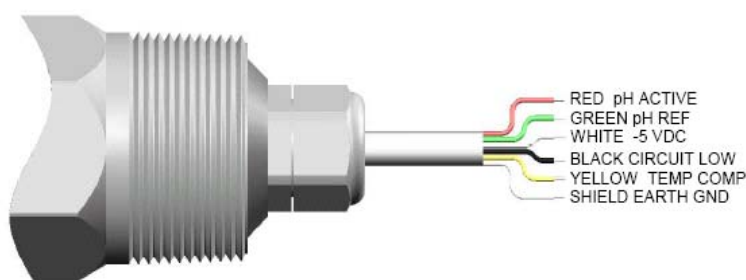
Be sure that the wire colors of the sensor cable match those of the interconnect cable on either side of the terminal strip.



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

3.3.1. Connections for AV88 Controllers

Sensors that are constructed to operate with the AV88 Controller have 6 wires and a shield. Part numbers are located on a cable label and will have a 9 in the part number as shown: FP21A-9-D10.

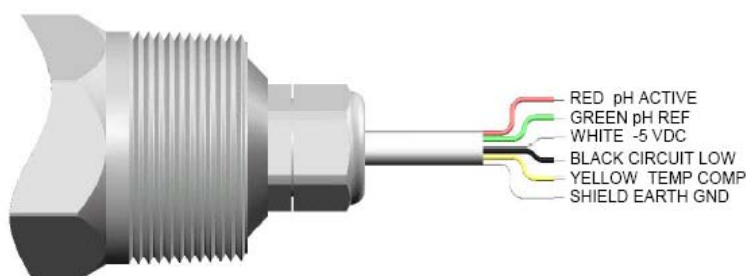


Wire	Function
Red	pH Active Electrode
Green	pH Reference Electrode
Blue	+ V
White	- V
Black	Ground
Yellow	Temperature
Shield	Earth Ground

Figure 3.5: pH sensor hook-up for AV88 Controllers

3.3.2. Connections for P99 Controllers

Sensors that are constructed to operate with the P99 or with third party analyzers like the GLI/Hach P63/P53/P33/P3 have 5 wires and a shield. Part numbers are located on a cable label and will have a 7 or 8 in the part number as show: FP21A-7-D10 or FP21A-8-D10.



Wire	Function
Red	pH Active Electrode
Green	pH Reference Electrode
White	-5 VDC
Black	Ground
Yellow	Temperature
Shield	Earth Ground

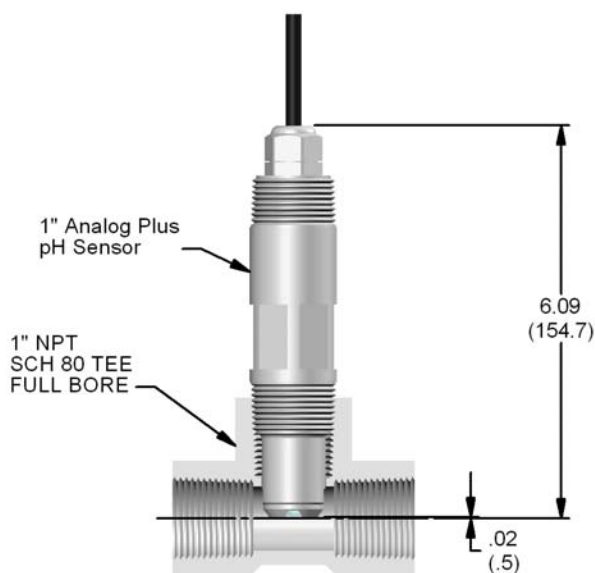
Figure 3.6: pH sensor hook-up for P99 and GLI/Hach Controllers

3.4. Sensor Mounting

3.4.1. *Pipe Tee Mounting*

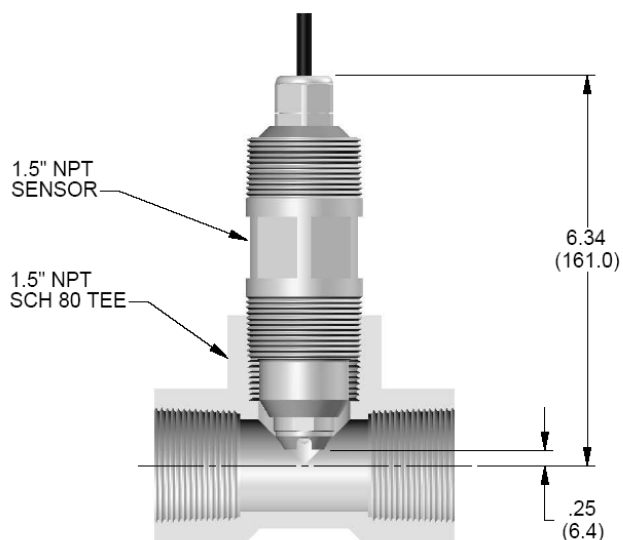
Thermo Scientific AquaSensors 1.0 inch and 1.5 inch diameter bodies are threaded into standard pipe tees. Normally available pipe tees vary widely in construction dimensions. CPVC pipe tees are most generally available with schedule 80 walls and AnalogPlus sensors generally fit as shown here. Pipe tees made of stainless steel with schedule 40 walls will sit lower in the pipe.

Recommended Tee Mounting Configurations



Dimensions: IN (mm)

Figure 3.7: 1.0 Inch Sensor Mounted in Schedule 80 PVC Tee



Dimensions: IN (mm)

Figure 3.8: 1.5 Inch Sensor Mounted in 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 controller through a watertight cord grip or conduit fitting.
 - c. Connect the sensor wires into the controller terminal block as shown in the controller manual.

2. Calibrate:
 - a. Apply power to the controller and allow the sensor to warm up for approximately ½ hour before calibrating the measurement.
 - b. Remove the protective cap from the sensor head and make sure moisture is present and that the salt bridge has not dried out. If the protective cap is dry, the sensor should be hydrated in tap water for at least 1 hour prior to calibration.
 - c. Calibrate the pH sensor as explained in the controller manual. It is recommended to use a 2-point buffer calibration upon installation of the sensor. 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.

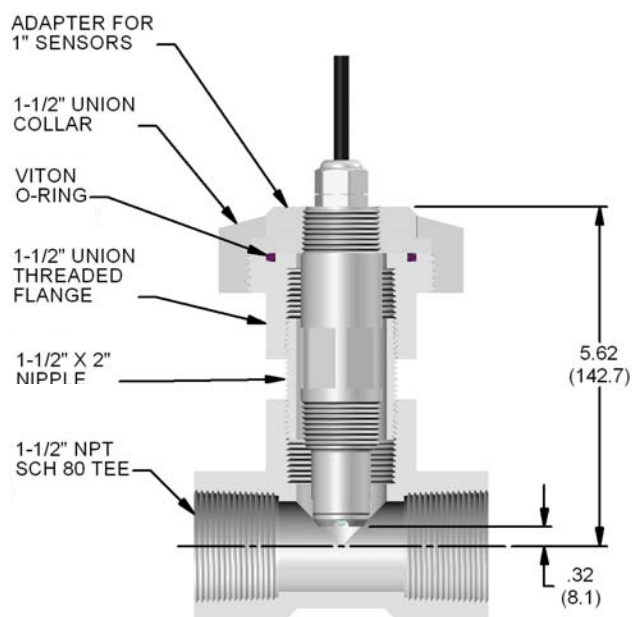
3. Mount:
 - a. Apply Teflon® tape to the sensor body threads.
 - b. Either remove the cable from the analyzer or if there is enough slack, reverse twist the cable (counter-clockwise) by 4 turns so that the cable is not over stress when threading it into the tee.
 - c. Insert the sensor into the tee 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.

3.4.2. Union Mounting

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

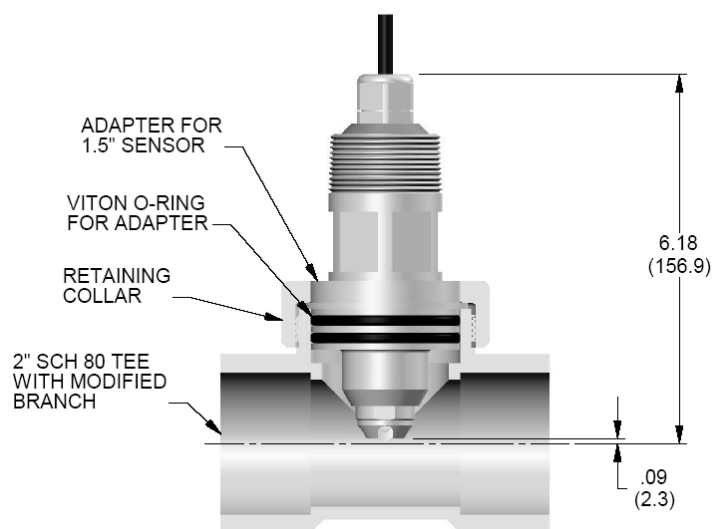
Union Mount Advantages

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



Dimensions: IN (mm)

Figure 3.9: Union Mounting
1.0 Inch Sensor Body



Dimensions: IN (mm)

Figure 3.10: Union Mounting
1.5 Inch Sensor Body

Detailed Union Mount Installation Instructions

1. Wiring:
 - a. Apply Teflon® tape to the front sensor body threads and pass the cable through the adapter. Thread the adapter onto the sensor clockwise until it is secure.
 - b. Pass the retaining 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 controller through a watertight cord grip or a conduit.
 - e. Connect the sensor wires into the controller terminal block as shown in the controller manual.

2. Calibrate:
 - a. Apply power to the controller and allow the sensor to warm up for approximately ½ hour before calibrating the measurement.
 - a. Remove the protective cap from the sensor head and make sure moisture is present and that the salt bridge has not dried out. If the protective cap is dry, the sensor should be hydrated in tap water for at least 1 hour prior to calibration.
 - b. Calibrate the pH sensor as explained in the controller manual. It is recommended to use a 2-point buffer calibration on installation of the sensor. 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. 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.
 - b. 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.

3.4.3. Immersion Mounting

For immersion mounting applications the sensor is threaded on to the end of a pipe and wired into a junction box at the other end. An extension cable is then wired from the junction box to the controller. The standard pipe length is 7 feet and the assembly is often mounted onto a hand rail assembly for easy repositioning of the sensor in a pond or tank.

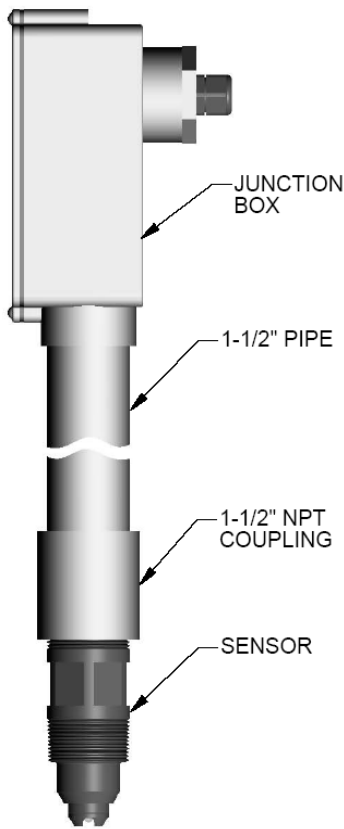


Figure 3.11: Immersion Mount Assembly
1.5 Inch Sensor Body

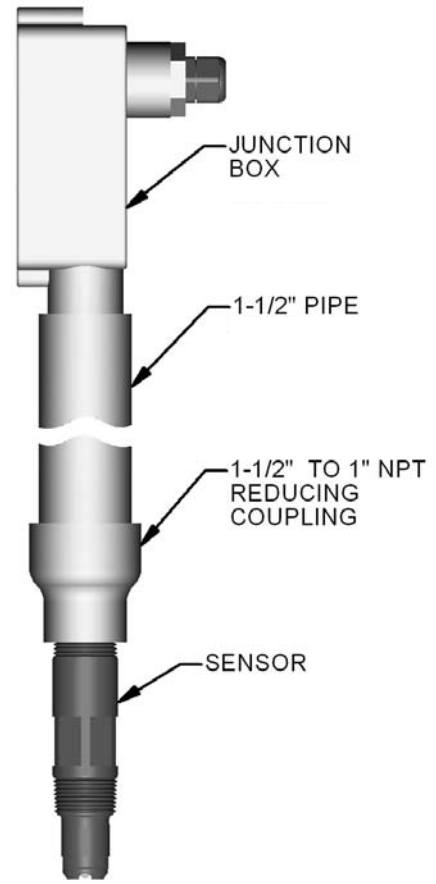


Figure 3.12: Immersion Mount Assembly
1.0 Inch Sensor Body

This immersion mount assembly can be ordered by itself, with a hand rail mounting assembly or with a ball float that keeps the sensor as a fixed distance below the surface of the water.

Part numbers for the three assemblies is shown in the following table.

Assembly	1.5 Inch Sensor Part Number	1.0 Inch Sensor Part Number
Immersion Assembly	MH2083	MH3083
Immersion Assembly w/Swivel Rail Mounting	MH2242	MH1242
Immersion Assembly w/Swivel and Ball Float	MH2252	MH1252




Detailed Immersion 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 NPT coupling by turning the sensor in a clockwise direction until secure.
 - d. Either route the cable directly to the controller or splice the wires in a junction box and use an extension cable.
 - e. Insert the cable into the controller through a watertight cord grip or a conduit fitting.
 - f. Connect the sensor wires into the controller terminal block as shown in the controller manual.

2. Calibrate:
 - a. Apply power to the controller and allow the sensor to warm up for approximately ½ hour before calibrating the measurement.
 - b. Remove the protective cap from the sensor head and make sure moisture is present and that the salt bridge has not dried out. If the protective cap is dry, the sensor should be hydrated in tap water for at least 1 hour prior to calibration.
 - c. Calibrate the pH sensor as explained in the controller manual. It is recommended to use a 2-point buffer calibration on installation of the sensor. 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:

Secure the pipe assembly so that the sensor is fully immersed in the process. Handrail mounting hardware and ball float assemblies 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.

3.4.4. Tri-clamp Mounting

AnalogPlus sensors fitted with a 316 Stainless Steel 2.5 inch Tri-clamp flange can be mounted in a standard 2.5 inch Tri-clamp tee. In this setup the Branches of the tee are equal in length to the run. In the case of the 2.5 inch tri-clamp mounting hardware, the length is 7 inches and the insertion branch is 3.5 inches. Thermo Fisher Scientific can provide the gasket, the clamp and the tee when the mounting hardware package is ordered.

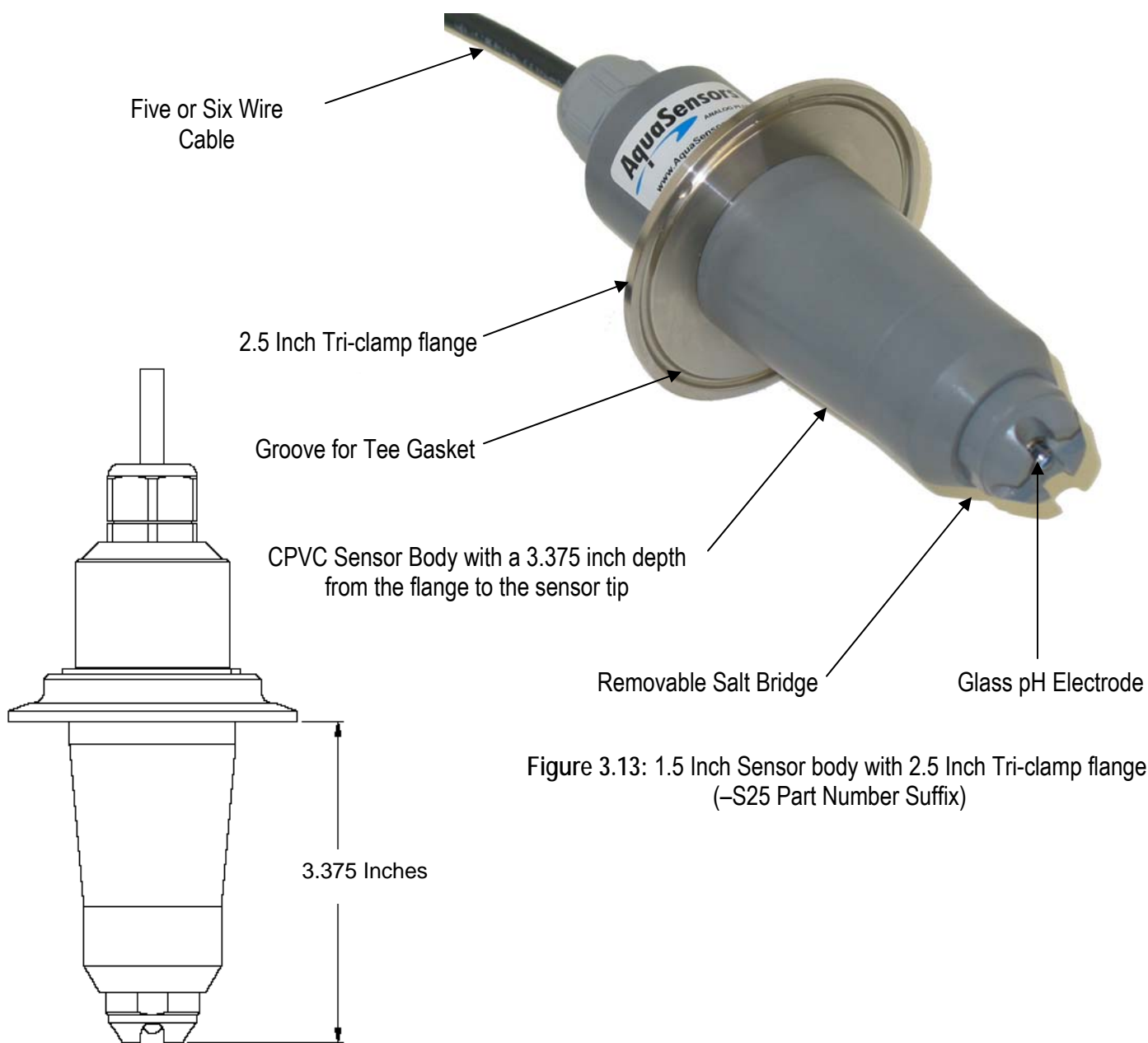


Figure 3.13: 1.5 Inch Sensor body with 2.5 Inch Tri-clamp flange. (-S25 Part Number Suffix)

3.4.5. Ball Valve Mounting

1.0 Inch Sensors: Standard AnalogPlus pH sensors with 1.0 Inch NPT threads can be installed in 1.5 inch and 2 inch ball valve assemblies. The threads on the back of the sensor mate with threads on the end of an o-ring sealed pipe inside the ball valve assembly.

1.5 Inch Sensors: For 2 inch ball valve mounting the 1.5 Inch diameter AnalogPlus pH sensors must have the -INS or -INSW extension in the part number. These sensors thread onto 1/2 inch external NPT threads at the end of a 2 inch ball valve extension rod.

The sensor with an “-INS” suffix in the part number is pictured here with a smooth CPVC body.

The sensor with a “-INSW” suffix in the part number is pictured here with a Teflon wiper to assist with insertion and retraction. The Teflon wiper is usually used with PEEK® sensors in tough chemical applications. 2-inch ball valve assemblies used with 1.5 inch diameter sensor bodies have a “-FP” suffix at the end of the part number.



1-Inch Sensor Body



1.5-Inch Sensor Body with
-INS
Part Number Suffix



1.5-Inch Sensor Body with
-INSW
Part Number Suffix

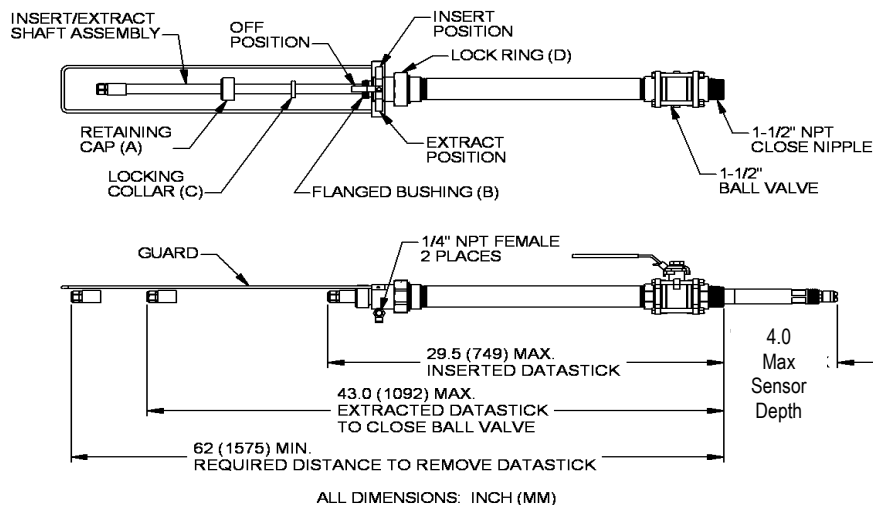


Figure 3.14: pH Sensors for Ball Valve Applications

1.5 Inch Ball Valve Assembly shown with 1 inch diameter sensor body in the retracted and extended positions.

3.4.6. Flow Chamber Mounting

Thermo Scientific AquaSensors Flow chambers are compatible with 1 inch diameter pH sensors that are configured with a flat salt bridge with a face seal. These salt bridges can be retrofitted to any Thermo Scientific AquaSensors pH sensor. The flow chamber is mounted at a minimum of 15° above horizontal with the inlet at the bottom and the outlet at the top. The sensor is inserted into the chamber so that the salt bridge face seal seats. A retaining ring is used to lock the sensor in place.

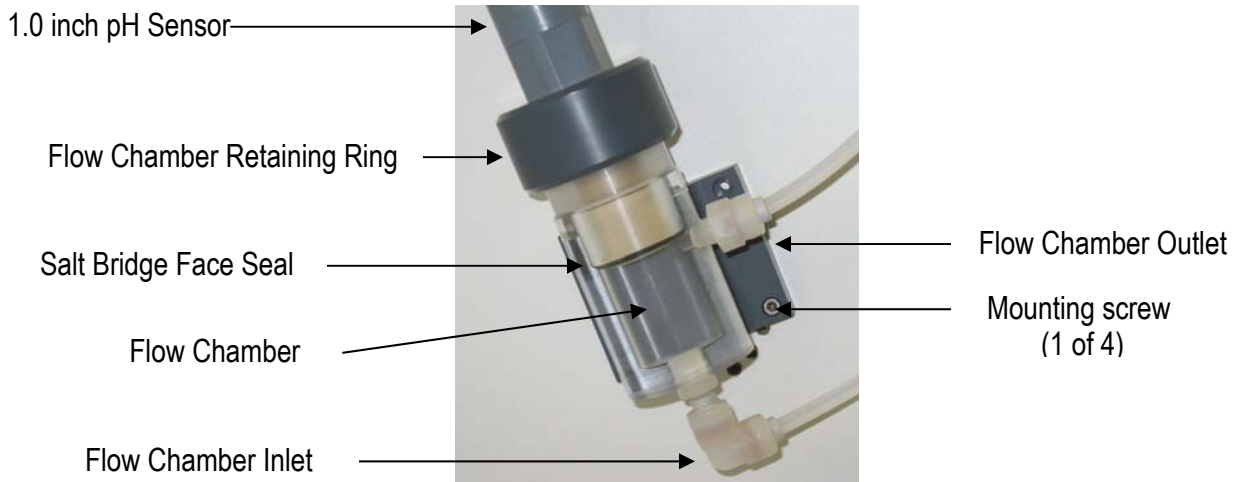


Figure 3.15: pH Sensor with Face Seal Mounted in a Flow Chamber.

3.4.7. Wash Head Accessory

In application where the sensor head is quickly fouled with sediment, a wash head assembly can be attached. The head slips on the body of the sensor and the wash nozzle is aligned with the glass pH electrode. A single screw is tightened to secure the wash head to the sensor. A hose is connected from the wash head to an air compressor or water source valve that is controlled by an AV88 wash relay that is programmed with a wash interval and duration.

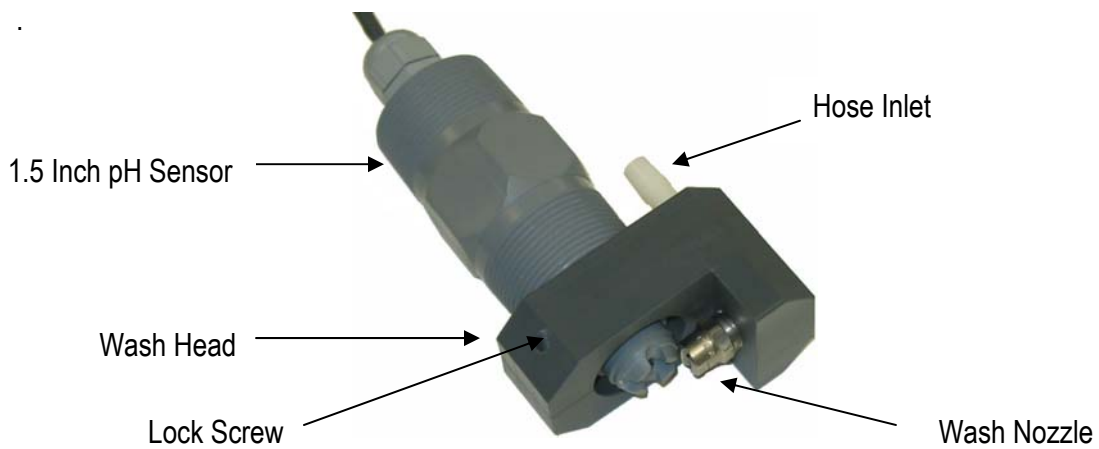


Figure 3.16: pH Sensor with Wash Head Attached

4. pH Sensor Maintenance

4.1. Cleaning the pH Sensor

4.1.1. In order to maintain an accurate measurement value, the sensor will need occasional cleaning and 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 glass electrode. 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, being careful not to scratch or break the glass electrode.

4.1.2.4. Rinse the electrode end with clean warm water.

4.1.2.5. If deposits are still present on the glass electrode repeat the cleaning procedure. 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 or buffer at ambient temperature for about an hour to stabilize the pH electrode and the salt bridge.

4.1.4. After cleaning the sensor, calibrate sensor per instructions in the controller manual.

4.1.5. Reinstall sensor in process.


4.2. pH Sensor Refurbishment - Replacing the Salt Bridge and Reference Solution

4.2.1. If the sensor head has been cleaned (see section 4.1.2) and calibration cannot be achieved, replace the salt bridge and reference solution.


4.2.2. Hold the sensor firmly with the electrode tip facing upwards. Remove the existing salt bridge by using a 15/16 wrench (24mm) and turning it counterclockwise. Dispose of the salt bridge using an approved method.

4.2.3. Pour out the old reference solution. Rinse the reservoir with distilled or de-ionized water.


4.2.4. Slowly fill the reservoir with 7pH Standard Cell Solution so the solution just covers the reference O-ring.

	Do not overfill. Overfilling will lead to excessive pressures that will affect the junction potentials of the reference.
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4.2.5. Slowly screw the new salt bridge clockwise onto the sensor head until secure. Tighten the salt bridge with a 15/16 wrench (24mm) until snug.

	Do not over tighten. Maximum torque: 10 lbs-in (1.13 N·m)
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4.2.6. After replacing the salt bridge and reference solution, calibrate the sensor according to the instructions in the controller manual.

	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 representative or call Thermo Fisher Scientific Customer Service.
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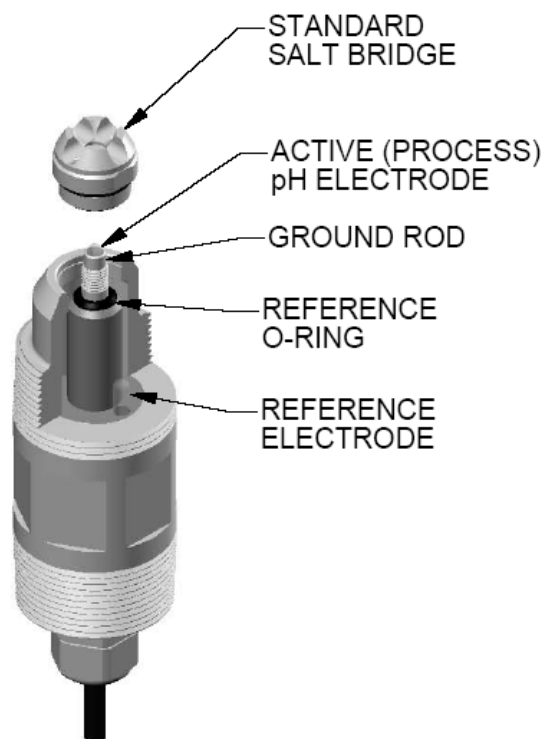


Figure 4.1: Replacing the salt bridge and reference solution

4.3. pH Sensor Troubleshooting

General Inspection

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

1. Inspect the integrity of the glass electrodes. If the electrode is broken, replace the sensor.
2. Inspect the integrity of the salt bridge junctions. Be sure that they are clean and moist. If the salt bridge has been allowed to dry out it may be necessary to replace the salt bridge and filling solution.
3. Inspect the sensor cable for damage to the outer jacket. Any cuts or kinks may damage signal connections.
4. Inspect terminal block connections to be sure wires are not corroded or loose.
5. 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.
6. The sensor electrodes should be immersed in a solution of known pH.
7. Establish that the analyzer electronics are working correctly by verifying operation with another sensor.



Note: Any new sensor that has been in storage for more than a few days should be soaked in tap water or a solution of known pH for at least 30 minutes before reviewing measurement performance.



Note: The salt bridge of any pH sensor in storage must be kept moist at all times. Protective caps should be filled with Thermo Scientific AquaSensors storage solution for best performance. The protective cap should be placed securely over the sensor head.

If the sensor passes the general inspection, there are four basic tests that can verify the temperature measurement, the pH offset, the pH span and the pH span on sensor power. If the sensor passes these tests it should be ready for service.

Temperature Span (For Sensors that Connect to the P99 or GLI/Hach Analyzers)

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	630 Ω	430 Ω	300 Ω	215 Ω	155 Ω

If the measured resistance is within 10 to 20 ohms of the expected value, the element should be satisfactory. If not, please consult the factory.

pH Offset Test

1. Disconnect the RED and GREEN sensor wires from the analyzer terminal block while leaving the other wires connected. Connect the (+) lead of a millivolt meter to the RED wire and the (-) lead of the millivolt meter to the GREEN wire.
2. Place the sensor in 7 pH buffer. Stir the sensor for 10 to 15 seconds and then allow the sensor to stabilize in solution for about 2 minutes. The meter should read 0.0mV +/- 50 mV. If the reading is higher or lower than specified, replace the salt bridge and filling solution and try again. If on the second attempt the offset does not meet specification, replace the sensor.

pH Span Test

If the RED and GREEN wires have already been disconnected to run the offset test, skip step 1.

1. Disconnect the RED and GREEN sensor wires from the analyzer terminal block while leaving the other wires connected. Connect the (+) lead of a millivolt meter to the RED wire and the (-) lead of the millivolt meter to the GREEN wire.
2. Rinse the sensor in clean water. Put the sensor in 4 pH buffer. Stir the sensor for 10 to 15 seconds and then allow the sensor to stabilize in solution for about 2 minutes. The meter should read a change of at least -150mV from the offset reading. For example, if the offset is +20mV the reading in 4 pH buffer should be at least -130mV.

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

Sensor Power Test (For Sensors that Connect to the P99 or GLI/Hach Analyzers)

If the sensor does not respond with any reasonable millivolt signal in the offset and span tests, 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 is within 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, offset, span and power tests but the analyzer is not displaying the correct values, the analyzer may be defective.

5. AnalogPlus Differential pH Sensors and Hardware for 1.0-Inch Bodies

Model Number SP Differential pH Sensor in 1-inch body. Cable connects to any AV88 Universal Analyzer, P99 Analyzer or compatible differential pH analyzers. Integral ground rod, temperature, replaceable salt bridge and reference solution. Standard 1-inch NPT mounting. Options for tri-clamp and ball valve mounting.	
Body Material 2 CPVC (Low Cost, All-Purpose) 3 PEEK® (Food Grade, Chemically Resistant)	
Measurement Electrode 1 General Purpose Glass (Standard) 2 HF Glass (recommended for hydrofluoric acid applications) 3 Low Temperature Glass (recommended for temperatures below 5°C) 4 Pure Water Glass (recommended for conductivity below 10µS/cm) 5 High Temperature Glass (recommended for temperatures above 85°C)	
Sensor Tip A Protected Electrode (Standard) B Process Flat (reduce protrusions)	
Temperature Element and Hookup 7 PT1000 for AquaMetrix Analyzer Hookup 8 NTC300 for P99 & GLI/Hach Analyzer Hookup 9 PT1000 for AV88 Universal Analyzer Hookup	
Ground Rod D 316 Stainless Steel (for HF or customer specified applications) E Titanium (standard configuration) F Hastelloy C (for heavy industrial applications)	
Cable Length 10 10 Feet 20 20 Feet 30 30 Feet xx Where xx = Number of Feet	

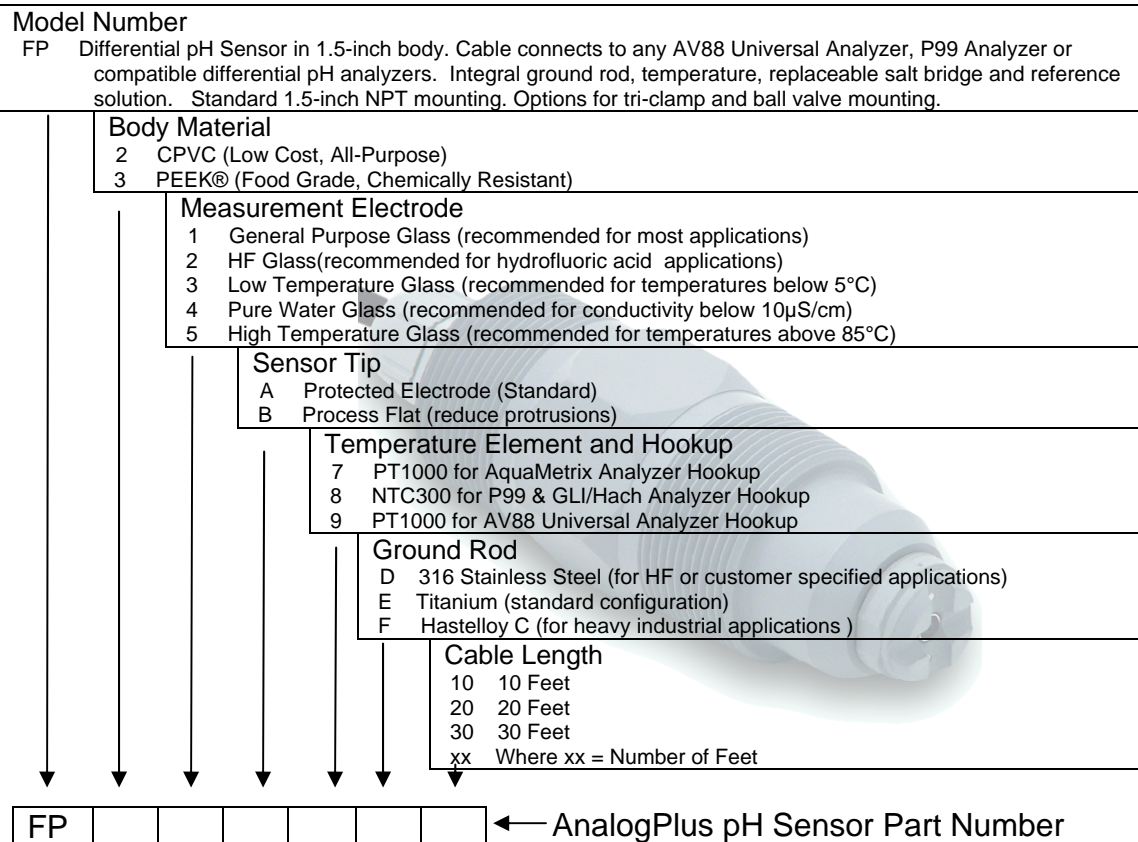
SP [] [] [] [] [] [] ← AnalogPlus pH Sensor Part Number

Part Number Suffixes for Special Body Construction

-IN15	1.5-inch Ball Valve Insertion Mount (No front threads)	
-S20	Sanitary Style 2.0" Tri-clamp.	
-S25	Sanitary Style 2.5" Tri-clamp.	

Mounting Hardware	Description	Part Number
1.5" Union Mount Assembly	Tee with locking collar, 316 Stainless Steel Tee with locking collar, CPVC	MH3041 MH3042
1" Tee	Schedule 40, Stainless Steel Schedule 80, CPVC	MH3011 MH3022
Immersion Assembly	7 ft PVC extension with junction box – 1" Sensors	MH3083
Immersion Assembly w/Swivel Rail Mounting	7 ft PVC extension with junction box – 1" Sensors With swivel hand rail mount.	MH1242
Immersion Assembly w/Swivel and Ball Float	7 ft PVC extension with junction box – 1" Sensors With swivel hand rail mount and inflatable float.	MH1252
1.5" Ball Valve Assembly	Low Pressure, CPVC Low Pressure, Stainless Steel High Pressure, CPVC High Pressure, Stainless Steel	MH1112 MH1111 MH1122 MH1121
Tri-Clamp Tee Assembly	2" Tri-Clamp tee, gasket and clamp, Stainless Steel	MH1261
Junction box Extension Cable	For extension cables. Terminal strip included. AnalogPlus extension cable	JBOXX01 APECxx; xx=ft
Wash Hardware	Attach purge block to sensor body. Works with compressor & AV88 wash relay.	MH1132

6. AnalogPlus Differential pH Sensors and Mounting Hardware for 1.5-Inch Bodies



Part Number Suffixes for Special Body Construction

-INS	Insertion – smooth body. For 2" valve hardware.	
-INSW	Insertion with Teflon® wiper for MH1181-FP valve hardware.	
-S25	Sanitary Style 2.5" Triclamp.	

Mounting Hardware	Description	Part Number
2" Union Mount Assembly	Tee with locking collar, 316 Stainless Steel	MH2031
	Tee with locking collar, CPVC	MH2032
1.5" Tee	Schedule 40, Stainless Steel	MH2011
	Schedule 80, CPVC	MH2022
Immersion Assembly	7 ft PVC extension with junction box – 1.5" Sensors	MH2083
Immersion Assembly w/Swivel Rail Mounting	7 ft PVC extension with junction box – 1.5" Sensors With swivel hand rail mount.	MH2242
Immersion Assembly w/Swivel and Ball Float	7 ft PVC extension with junction box – 1.5" Sensors With swivel hand rail mount and inflatable float.	MH2252
2" Ball Valve Assembly	Low Pressure, CPVC	MH1172-FP
	Low Pressure, Stainless Steel	MH1171-FP
	High Pressure, CPVC	MH1182-FP
	High Pressure, Stainless Steel	MH1181-FP
Tri-Clamp Tee Assembly	2.5" Tri-Clamp tee, gasket and clamp, Stainless Steel	MH1271
Junction box	For extension cables. Terminal strip included. AnalogPlus Extension cable	JBOXX01
Extension Cable		APECxx; xxx=ft
Wash Hardware	Attach purge block to sensor body. Works with compressor & AV88 wash relay.	MH2132

7. pH Solutions and Salt Bridge Replacements

Product	Description	Part Number
Solutions		
4 pH buffer	For Calibration – 500ml bottle	PHSOL4
7 pH buffer	For Calibration – 500ml bottle	PHSOL7
10 pH buffer	For Calibration – 500ml bottle	PHSOL10
Standard Cell Solution – 60ml	For sensor reference chamber – 60ml bottle	RCS01
Standard Cell Solution – 500ml	For sensor reference chamber – 500ml bottle	RCS01-500
Reference Cell Solution	For sensor reference before serial number 2419 – 60ml bottle	RCS02
pH storage solution	Place in storage caps to keep glass electrode wet – 60ml bottle	RCS03
Salt Bridges		
PEEK, Protected Qty 1	For all pH and ORP sensors with PEEK bodies. Quantity 1	SBS01-1
PEEK, Protected Qty 3	For all pH and ORP sensors with PEEK bodies. Quantity 3	SBS01-3
PEEK, Protected Qty 10	For all pH and ORP sensors with PEEK bodies. Quantity 10	SBS01-10
PEEK, Process Flat Qty 1	For all pH and ORP sensors with PEEK bodies. Quantity 1	SBS02-1
PEEK, Process Flat Qty 3	For all pH and ORP sensors with PEEK bodies. Quantity 3	SBS02-3
PEEK, Process Flat Qty 10	For all pH and ORP sensors with PEEK bodies. Quantity 10	SBS02-10
PEEK, Face Seal Qty 1	For all pH and ORP sensors with PEEK bodies. Quantity 1	SBS08-1
PEEK, Face Seal Qty 3	For all pH and ORP sensors with PEEK bodies. Quantity 3	SBS08-3
PEEK, Face Seal Qty 10	For all pH and ORP sensors with PEEK bodies. Quantity 10	SBS08-10
CPVC, Protected Qty 1	For all pH and ORP sensors with CPVC bodies. Quantity 1	SBS03-1
CPVC, Protected Qty 3	For all pH and ORP sensors with CPVC bodies. Quantity 3	SBS03-3
CPVC, Protected Qty 10	For all pH and ORP sensors with CPVC bodies. Quantity 10	SBS03-10
CPVC, Process Flat Qty 1	For all pH and ORP sensors with CPVC bodies. Quantity 1	SBS04-1
CPVC, Process Flat Qty 3	For all pH and ORP sensors with CPVC bodies. Quantity 3	SBS04-3
CPVC, Process Flat Qty 10	For all pH and ORP sensors with CPVC bodies. Quantity 10	SBS04-10
Storage cover	Comes with sponge to keep stored sensor electrodes wet	SBC01

8. Limited Warranty

DIFFERENTIAL pH and ORP SENSOR WARRANTY/REPLACEMENT PLAN

Thermo Fisher Scientific warrants its Thermo Scientific AquaSensors AnalogPlus Differential pH and ORP sensors against material and workmanship defect for a period of two years from the date of shipment in accordance with the following prorated schedule:

0 to 12 months	Sensor repaired or replaced
12 to 18 months	Sensor repaired or replaced at one third of the current list price
18 to 24 months	Sensor repaired or replaced at two thirds of the current list price

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 according to the proration schedule listed in this limited warranty. 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.

9. 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 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.

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