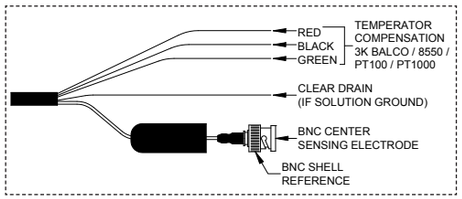
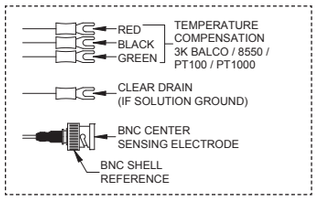
WIRING TERMINATION EXAMPLES

The wiring diagrams below depict the most common termination options for Barben pH/ORP sensors. For connection diagrams for specific analyzers and transmitters please consult **www.BarbenAnalytical.com/wiring.html** for the latest information.

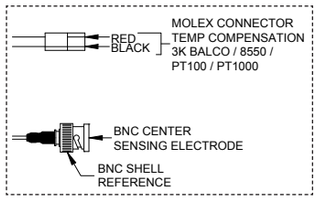
"CBT" Tinned Lead Terminations



"CBL" Lugged Terminations

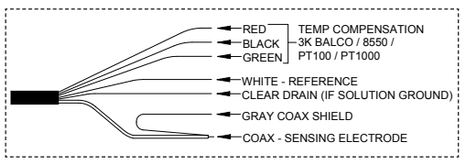


"CB2" Molex Terminations

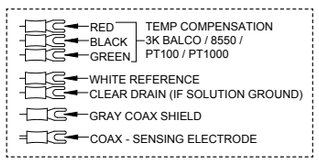


Wiring connections using BNC coaxial connector are commonly specified when using separate pH extension cables to connect to the analyzer. The pH measurement and reference signal are carried on the BNC connector. External wires are used for temperature compensation. If the sensor is ordered without temperature compensation then no temperature compensation wires will be present.

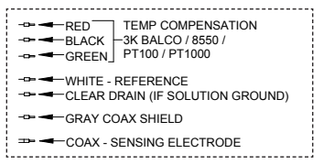
"ETT" Tinned Lead Terminations



"ELL" Lugged Terminations



"EPP" Pinned Terminations



Conventional wiring is specified when the sensor is directly connected to the analyzer. The addition of a shield on the coaxial cable helps to prevent noise on the pH sensing electrode. Barben offers standard tinned leads or the option for spade lugs or pinned leads for compatibility with most pH analyzer wiring terminals. If the sensor is ordered without temperature compensation then no temperature compensation wires will be present.

MEASUREMENT ELECTRODE RANGES & APPLICATIONS

Code	Glass Type	Suggested Applications	Recommended Measurement Range	Recommended Temperature Range	Maximum Temperature Range	Typical Impedance @ 25˚C (77˚F)
R CR	Industrial High Temp (Hemi) Industrial High Temp Coat Resist (Hemi)	Best choice for hi/low pH & high pressure. Coat resistant excels in NaOH. Hemispherical glass.	0 to 14 pH	15 to 100°C 59 to 212°F	15 to 130°C 59 to 266°F	375 MΩ
FG CF	Flat Industrial Glass Flat Industrial Glass Coat Resist	Best choice for in-line slurries. Consult if rapid pressure changes are present.	0 to 14 pH	20 to 85°C 68 to 185°F	20 to 130°C 68 to 266°F	1200 MΩ
PX	Redox (ORP)	Flat Platinum (Pt) Billet. Non-glass. Easy to clean.	0 to ±1500mV	0 to 130°C 32 to 266°F	0 to 130°C 32 to 266°F	1 KΩ
E CE	General Purpose General Purpose Coating Resist	Light to medium duty pH electrode for low temperature applications. Not for high pH.	2 to 11 pH	-10 to 40°C 14 to 104°F	-20 to 50°C -4 to 122°F	25 MΩ
FA	Antimony (Sb) Non-glass Electrode	Antimony (metal) pH electrode for abrasives or HF acid or low temperature applications.	3 to 11 pH	-20 to 80°C -4 to 176°F	-20 to 80°C -4 to 176°F	1 KΩ
FR	Fluoride / HF Acid (Hemi)	Resistant to etching by HF and other strong acids. Hemispherical pH glass.	1 to 14 pH	15 to 100°C 59 to 212°F	15 to 130°C 59 to 266°F	375 MΩ
HR	Silica Resistant High Temp (Hemi)	Best choice for extreme pH where silica may coat traditional electrodes. Hemispherical glass.	1 to 14 pH	15 to 100°C 59 to 212°F	15 to 130°C 59 to 266°F	375 MΩ
FH	Silica Resistant Flat Glass	Best choice for slurries and heavy fouling where silica may coat traditional glass electrodes.	1 to 14 pH	15 to 85°C 59 to 185°F	15 to 130°C 59 to 266°F	1200 MΩ

551 SERIES OPTIONAL ACCESSORIES

IN-LINE 1" NPT NUT-LOCK MOUNTING ACCESSORIES
B4953-0001 CPVC Body Delrin Hand Nut, 150 PSIG Max
B4953-0015 Kynar Body SS316 Hex Nut, 150 PSIG Max
B4954-0006 SS316 Body & Hex Nut, 300 PSIG Max
B4954-0036 Titanium Body SS316 Hex Nut, 300 PSIG Max

IN-LINE 1" NPT FLOWCELL FOR NUT-LOCK ADAPTERS
B4951-0022 SS316, 150 PSIG Max
B4951-0045 CPVC Sch. 80, 100 PSIG Max
B4951-0046 Kynar Sch. 80, 200 PSIG Max

For other accessories **www.BarbenAnalytical.com**

ANSI 150# FLANGE NUT-LOCK ADAPTERS
B4951-0118 1" Kynar with SS316 Hex Nut

FLOWCELLS
B4992-1009 SS316 with 1/2" FNPT Ports
B4992-0020 SS316 with 1/4 Tubing Ports

BARBEN ANALYTICAL

AMETEK®

551 SERIES pH/ORP SENSOR QUICK START MANUAL

IMPORTANT: READ THIS PAGE BEFORE PROCEEDING!

Barben Analytical designs, manufactures, and tests its sensors to meet or exceed national and international standards. Because these products are of a technical nature, you must properly install, use, and maintain them to insure they continue to operate within normal specifications. The following drawings and instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Barben products. Failure to follow the proper instructions may cause any of the following conditions to occur: Loss of life; personal injury; property damage; damage to instrument; and voided warranty.

CAUTION: SENSOR/PROCESS APPLICATION COMPATIBILITY

Before installation verify that the wetted sensor materials are compatible with the process chemistry, operating pressure, and temperature. Application compatibility is entirely the responsibility of the user.

- Read and understand all drawings and instructions prior to installing, operating and servicing the product. Save this manual for future reference.
- If you do not understand the manual or instructions, contact your Barben Analytical 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.
- When replacement parts are required, please select authorized parts from Barben Analytical. Unauthorized parts and procedures can affect the product's performance and place the operation of your process and personnel at risk.

CAUTION: AVOID FREEZING, KEEP HYDRATED

pH sensors can be damaged by freezing during storage or shipment. Store in a warm, dry place. Keep the tip of the sensor hydrated with water or process liquid at all times to avoid shortened lifespan.

Looking for additional help? Please consult our website for the most up-to-date information. Additional contact information is listed below.

Website: www.BarbenAnalytical.com (Manuals, Datasheets, Wiring Diagrams, Application Notes)
Email: Sales.Barben@Ametek.com (Technical Support, Customer Service)
Phone: Toll Free +1(800)993-9309 Phone +1(775)883-2500
Fax: +1(775)297-4740

551 SERIES PRODUCT SPECIFICATIONS

STORAGE TEMPERATURE

41 to 122°F (5 to 50°C)

WETTED MATERIALS

Body: PVDF (Kynar) or PEEK (Polyether ether Ketone)
ORings: Viton or EPDM or FFKM (Kalrez)
Reference: Teflon, PVDF (Kynar)
Electrode: Glass (pH) or Platinum (ORP) or Antimony (pH)

OPERATING TEMPERATURE / PRESSURE

Installation & Electrode Dependent See Charts

Sensor Material	Quick Change Nut Lock Type		
	Threaded plastic or metal body with hand nut	Threaded metal body with metal hex nut	Plastic body with metal hex nut (flanged or threaded mounting)
Kynar *(White)*	150 PSIG @ 158°F (70°C) 40 PSIG @ 266°F (130°C)	300 PSIG @ 176°F (80°C) 40 PSIG @ 266°F (130°C)	150 PSIG @ 73°F (25°C) 25 PSIG @ 266°F (130°C)
PEEK *(tan)*	150 PSIG @ 158°F (70°C) 40 PSIG @ 266°F (130°C)	300 PSIG @ 176°F (80°C) 40 PSIG @ 266°F (130°C)	150 PSIG @ 73°F (25°C) 25 PSIG @ 266°F (130°C)

ISO 9001:2008 Cert. No. 43271

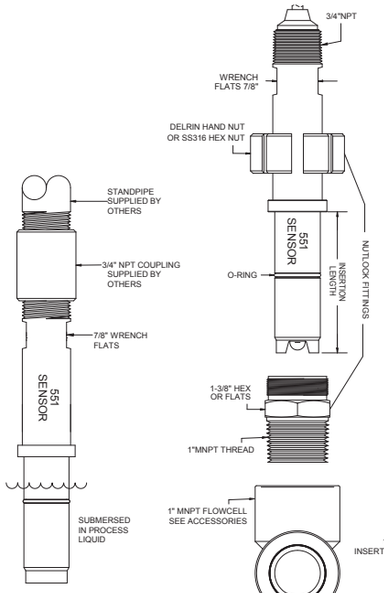
551 IN-LINE & SUBMERSIBLE INSTALLATION

INSERTION LENGTH		
1" NPT TEE	**PART #**	**551 LENGTH**
SS316 150#	B4951-0022	2.63" (std)
CPVC 100#	B4951-0045	3.0"
Kynar 200#	B4951-0046	3.0"

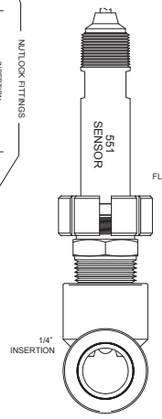
* For flowcells use 2.625" to 100mm Insertion Length

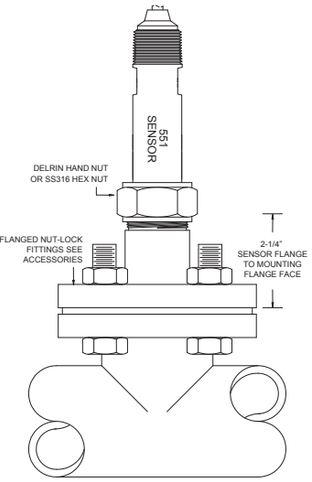
When installing the 551 sensor for the first time, mount the Nut-Lock Adapter into the process prior to inserting the sensor. This avoids possible sensor damage due to overtightening of the adapter. Lubrication of the o-ring on the sensor body will aid in installation. Dow Corning Silicone 111 or similar is recommended.

If the 551 sensor must pass though additional process piping (nipple, weld-o-let, flange) then the sensor must have enough insertion length to reach into the process flow by at least 1/4 inch.

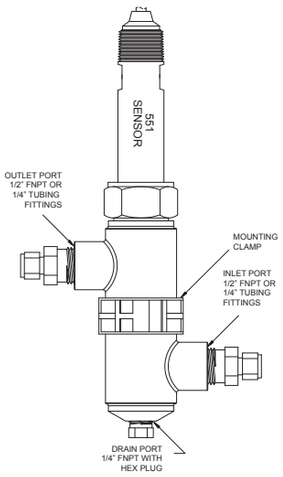


SUBMERSIBLE INSTALLATION



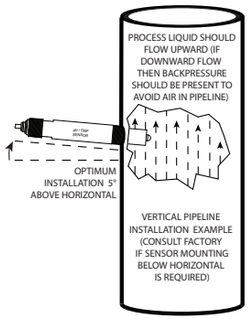


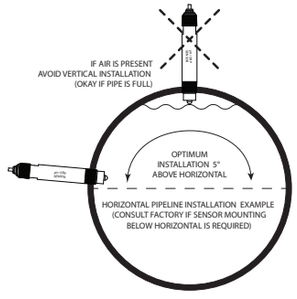
IN-LINE INSTALLATIONS

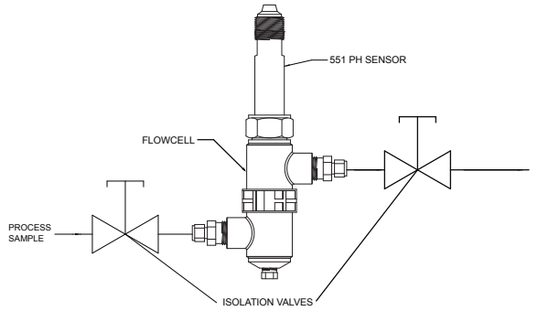


FLOWCELL INSTALLATION

IN-LINE MOUNTING GUIDELINES







Isolation valves should be mounted upstream and downstream to aide in sensor removal for cleaning, calibration, or replacement.

CALIBRATION, CLEANING & STORAGE

Two Point Calibration for Barben Sensors
A new pH sensor should go through a two point calibration. One buffer solution should be 7pH. Using an neutral buffer ensures a good zero point to reference. The second buffer solution is typically either 4ph or 10pH. A 3pH Δ is enough difference for the analyzer to perform an accurate slope calculation. Slope corresponds to the efficiency of the glass electrode and is expressed as a percentage. A theoretically perfect sensor will have a slope of 100%. In reality, a new sensor will have a slope of 97% to 99%. A new sensor will respond very quickly when moved from 4pH to 7pH buffer. Once the slope gets below 80% the response of the pH sensor will be noticeably slower. Replacement of the sensor should be considered. Here are the important considerations with a two point calibration.

- The slope indicates the sensitivity of the glass electrode. Recording slope values over time will provide an on-going indication of the health of the sensor.
- Two point calibrations should always be performed for new sensors. Ongoing, two point calibration may be suitable in less aggressive processes close to neutral 7pH.
- Rinse the sensor in tap water when changing between buffer solutions to avoid cross-contamination.
- The speed of response (T_{90}) between buffers should be < 30 seconds. If response is slower then additional cleaning or replacement may be required.
- 4ph buffer is highly recommended. It has less temperature error and tends to have longer shelf life than 9.18pH or 10pH buffers.
- If the pH analyzer has a manual calibration option then select this option over automatic calibration.

Grab Sample, One Point Calibration for Barben pH Sensors
To achieve the best accuracy in harsh chemical processes, initial two point calibrations should be followed up by one point grab sample calibrations. As mentioned earlier in this paper, changes in the reference half cell can also impact the accuracy of the pH reading. A one point grab sample corrects for these changes in the reference. The procedure is listed below.

- Remove Barben pH sensor from the process. Clean as necessary. (see separate cleaning Tech Note for additional information).
- Reinstall the pH sensor into the process and give it time to reach process temperature.
- Take a sample of the process near the sensor installation and measure the pH using a laboratory style pH electrode. This measurement should be done in the field to avoid any temperature changes. Swirl the sensor back and forth in the sample for best results.
- Use the reading from the laboratory electrode to offset the pH value in the analyzer.

Sensor Storage & Shelf Life
pH sensors need to be kept hydrated in order to function. Sensors are shipped from the factory with a small, liquid filled cap. Save this cap! If the sensor is taken out of service for any length of time the cap can be reused to keep the sensor tip wet. Potable water or buffer solution work equally well for this purpose. If the sensor will be stored for long periods of time then mold can form in the cap. The mold is not harmful and can be easily cleaned off prior to usage. If mold is a concern use diluted 4pH buffer solution. The acidity of the solution will prevent mold from forming inside the cap.

pH sensors have a shelf life just like a battery does. It is typical for the sensor to lose 5% of its life for each year of storage. If a sensor has not been used for some time check its response in buffer solutions. A 5 minute soak in dilute (3-5%) hydrochloric acid is also effective in restoring the sensitivity of the electrode.

Mechanical Cleaning
Bio-films, sludge, and other soft coatings can usually be removed through mechanical cleaning of the sensor. A water jet may be enough to remove the coating. If the coating persists a cotton cloth or a toothbrush can be used to remove it. Avoid the temptation to scrape off the coating with hard objects such as a knive. Scraping may damage the pH sensitive glass. Once the coating is removed, rinse the sensor with tap water and test in buffer solution. A typical T_{90} response from 4pH buffer to 7pH buffer should be < 30 seconds for a functional electrode.

Chemical Cleaning
If the sensor is not responsive after mechanical cleaning then chemical cleaning may be required. *Proceed with caution!* Strong chemicals can actually damage the glass electrode. Immerse the sensor in the cleaning solution for ≤ 5 minutes to dissolve the coating. Immerse the sensor in water to rinse off any residual cleaning chemical and test in buffer solution. As with mechanical cleaning, a typical response from 4pH buffer to immersion in 7pH buffer should be < 30 seconds for a functional electrode. Repeated cleanings may be required to fully remove the coating. If the sensor does not exhibit response after multiple cleanings than it may be due for replacement.

Cleaning for ORP & Antimony Electrodes
ORP and Antimony electrodes use metal electrodes instead of glass. Mechanical cleaning is typically the best approach to remove scale and build-up. 600 grit or finer paper can be used to polish the metal electrode. The metal should look clean and shiny when dry. *Note - Antimony is a known carcinogen thus wet polishing should be done to avoid airborne dust.*

Care for the Reference Junction
Just like the measurement electrode, the annular Teflon reference junction should be clean and clear of any coatings. A light scrub with a toothbrush is usually enough to remove any external coatings. Soak the sensor in a bucket of deionized water for 5-10 minutes to leach out any chemicals that may have soaked into the reference.

Process Conditions	Cleaning Fluid*
Coating from high pH process	5 to 10% Hydrochloric Acid
Coating from low pH process	5 to 10% Caustic (NaOH) (>130F)
Oil and grease	Isopropyl Alcohol or Detergent
Sulfate & Carbonate Coatings	5 to 10% Hydrochloric Acid
Silica Coatings	3 to 5% Hydrofluoric Acid**

* Follow all MSDS procedures when handling strong acids and bases
** HF acid is extremely aggressive in low concentrations. Special care should be observed when using this cleaning solution. Please follow recommended handling procedures from supplier.