



MANTECH-INC.COM

# Silver Billet

Silver Billet Electrode Manual

PCE-80-AG1001

Ag



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## SILVER BILLET ELECTRODE INSTRUCTIONS

### GENERAL INSTRUCTIONS

#### **INTRODUCTION**

This combination Silver Billet electrode is designed for maximum reliability, accuracy, and ease of use. The electrode is shipped with a protective boot filled with a Silver Billet membrane/junction wetting agent (1:1 pH4 buffer/KCl). Crystals which may form around the protective boot in no way affect electrode performance.

Silver Billet potential measurements can be used to determine the oxidizing or reducing capability of a solution and are commonly made in polluted streams, chlorinated waters, industrial waste waters, and other water samples.

#### **PREPARATION**

1. Remove the Silver Billet bulb protector boot covering the Silver Billet band and rinse the bottom of the electrode with deionized water. Save the boot if the electrode will be stored.
2. Prior to first usage, or after long-term storage, immerse the Silver Billet electrode in deionized water for thirty minutes. The electrode is now ready for use.

#### **REQUIRED MATERIALS**

Meter: Consult the meter instruction manual for specific details on connecting the Silver Billet electrode to the meter or operating the meter in the mV mode. Some electrodes may require adaptor cables or detachable lead cables for connection to the pH and/or mV meter.

Silver Billet standards: For precise electrode standardization, one or two buffers are required to check that the electrode is operating properly.

#### ELECTRODE STANDARDIZATION (OPTIONAL)

1. Set instrument to read in mV. Add sufficient crystals of quinhydrone to saturate a solution of 7.00 pH buffer. This will be apparent by un-dissolved crystals suspended in solution. While stirring, immerse electrode into the solution. Measure potential after 30 seconds to one minute. Potential should be within  $\pm 20$  mV of the following values:

Temperature (°C):	20	25	30
Potential (mV):	+92	+86	+79 (Ag/AgCl reference)
	+47	+41	+34 (calomel reference)

2. Remove electrode and rinse thoroughly with distilled water. Add sufficient crystals of quinhydrone to saturate a solution of 4.01 pH buffer. This will be apparent by un-dissolved crystals suspended in solution. While stirring, immerse electrode into the solution. There should be a rapid response. Measure potential after 30 seconds to one minute. Potential should be within  $\pm 10$  mV of the following values:

Temperature (°C):	20	25	30	
Potential (mV):	+268	+263	+258 (Ag/AgCl reference)	
	+223	+218	+213 (calomel reference)	

The mV difference between the two solutions is theoretically 177 mV. The absolute values may shift a few mV due to slight liquid junction variations in a given reference electrode.

**NOTE:** quinhydrone buffers are not stable and should be discarded after completion of this test.

If the mV difference is less than 150 mV or the buffer potentials are offset by more than 20 mV, clean the Silver Billet electrodes by one of the procedures outlined in the electrode cleaning section below.

3. Rinse the electrode with distilled water. Place in sample and stir. Allow meter reading to stabilize for 30 seconds to one minute. Record reading. For best accuracy, the temperature of the Silver Billet standards and samples should be identical and at room temperature.

### TITRATION

A Silver Billet titration consists of adding small increments of a titrant to an unknown sample. After each addition of titrant, the Silver Billet electrode develops a millivolt potential proportional to the change in the Silver Billet value. At the inflection point, the titrant has completely reacted with the unknown, causing a sharp change in the Silver Billet value and producing a dramatic change in the mV potential developed by the Silver Billet electrode.

Place Silver Billet electrode(s) in 50 ml sample and stir. Fill a 10 ml buret with a standard titrant solution whose concentration is 5 to 10 times that of the sample. At first, add titrant in 0.5 to 1 ml increments, recording the potential 30 seconds to one minute after each addition. Near the end point, potential changes will become larger, so add smaller increments of titrant. Continue the titration a few ml past the end point. The end point occurs at the point of greatest inflection as plotted on graph paper or plotted on a computer or determined by the meter (if featured).

### ELECTRODE STORAGE

When not in use, the Silver Billet element may be stored in air or distilled water, but water is more preferable to keep the reference junction wet. The protective boot filled with buffer will provide an ideal storage chamber for long periods. If left in air for an extended period of time, remove salt crystals on the outside of the reference junction by rinsing with distilled water and store wet.

TROUBLESHOOTING HINTS

Symptom	Possible Causes	Next Step
Out of Range Reading	defective meter	check meter with shorting plug
	defective electrode	check electrode operation
	electrode wired incorrectly	check wiring connections
	air bubble	remove electrode and re-attach
Noisy or Unstable Display	defective meter	check meter with shorting plug
	solution not grounded	ground meter and electrode
	air bubble	remove electrode and re-attach
Drift (reading slowly changing in one direction)	reference clogged	see CLEANING hints
	Silver Billet band coated	see CLEANING hints
Low Slope	buffers contaminated	use fresh buffers
	Silver Billet band coated	see CLEANING hints
	reference clogged	see CLEANING hints
	defective electrode	check electrode operation

Should a refillable electrode repeatedly fail calibration, try the following to remedy the calibration:

1. Ensure the stopper at the top of the electrode is removed from the fill hole during readings.
2. Ensure standards are poured fresh for each use, and they are not expired.
3. Replace the fill solution: remove the fill solution, refill with deionized water, invert the probe several times to ensure any salt crystals that may be present are fully dissolved, remove the deionized water from the probe, and add electrode fill solution to the probe. Ensure the fill solution comes to a level just below the fill hole.
4. Shake the electrode like a thermometer to remove any trapped air bubbles.
5. Soak the probe in DI water for at least 30 minutes prior to recalibrating.

Order a new probe if repeated cleaning and troubleshooting does not remedy calibration failures

ELECTRODE CLEANING

Electrodes which are mechanically intact with no broken parts can often be restored to normal performance by one of the following procedures:

General Cleaning: Soak the electrode in 1:10 dilution of household laundry bleach in a 0.1-0.5% liquid detergent solution in hot water with vigorous stirring for 15 minutes. Drain/refill the reference chamber. Soak the electrode in distilled water for at least 10 minutes.

Salt Deposits: Dissolve the deposit by immersing the electrode in 0.1 M HCl for five minutes,

followed by immersion in 0.1M NaOH for five minutes, and thorough rinsing with distilled water.

Oil/Grease Films: Wash electrode in a little detergent and hot water. Rinse electrode tip with distilled water.

Clogged Reference Junction: Heat a diluted KCl solution to 60-80 °C. Place the reference portion of the Silver Billet electrode into the heated KCl solution for approximately 10 minutes. Allow the electrode to cool while immersed in some unheated KCl solution.

Protein Deposits: Dissolve the deposit by immersing the electrode in a 1% pepsin solution with a background of 0.1M HCl for five minutes, followed by thorough rinsing with distilled water.

After any of these special cleaning procedures, remember to drain/refill the reference chamber, if refillable. Soak the electrode in storage solution for at least 10 minutes.

If these steps fail to restore normal electrode response, replace the electrode.

## SPECIFICATIONS

Silver Billet Range:	0 +/- 2000mV
Slope:	59 +/- 3 mV/pH unit at 25°C
Accuracy:	+/- 10 mV
Response Time:	< 20 seconds (95% response)
Stability:	< 3 mV drift/24 hours
Operating Temperature Range:	Variable, consult product literature
Operating Pressure Range:	Variable, consult product literature
Electrode Length:	Variable, consult product literature
Electrode Width:	Variable, consult product literature
Cable Length:	variable or detachable, consult literature

## ORDERING INFORMATION

P/N	DESCRIPTION
PCE-80-AG1001	Silver Billet Ion Electrode
PC-R001013	KCl Fill Solution

## Document Change Log

Version	Date	Author	Changes
2	25-July-2019	Heather Jasumani	<ul style="list-style-type: none"> <li>• Document ID assigned</li> <li>• Troubleshooting section updated; and formatting.</li> </ul>



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