Electrode Storage

Aqueous reference electrodes must be stored properly to prevent damage when not in use. The ceramic frit should never be allowed to dry out. Follow these steps to properly store this reference electrode:

1. Rinse the reference electrode with distilled water (aqueous) or clean solvent (non-aqueous).
2. Suspend the reference electrode in $4M\ KCl$. A $20\ mL$ scintillation vial with a $4\ mm$ OD hole drilled in the cap serves as an ideal storage vessel. Ensure the frit is fully submerged in solution.
3. Always store the reference electrode upright and never in direct sunlight.

Performance Verification

Reference Electrode Impedance

Reference electrode input impedance should be less than $10\ k\Omega$. The most likely cause of high reference electrode input impedance is a blocked or partially blocked ceramic frit (**H**). Ceramic frits can become blocked by precipitation of salts in the microporous structure. *In some cases*, the frit clog can be cleared *but often*, the frit cannot be cleared and the electrode must be replaced.

Checking the Reference Potential

The standard potential of a reference electrode can be checked relative to another of the same reference electrode. Pine Research recommends that all users keep a "master" reference electrode that is never used in experiments and is always properly stored.

To check the reference potential of a reference electrode, submerge the experimental and master electrodes in filling solution. Measure the potential difference between the electrodes using either a simple voltmeter or a potentiostat in two electrode, open circuit potential mode. The difference should be less than $5\ mV$ if the reference electrode standard potential is correct. If the difference is $> 5\ mV$, the reference electrode should be disposed.

This reference electrode will last a long time if proper care and storage conditions are met. Should the electrode become unusable, it cannot be refreshed or regenerated. It should be discarded and replaced.

Reference Electrode Conversions

From ▶ / To ▼	NHE	MOE 20% KOH	Ag/AgCl sat'd KCl	SCE sat'd KCl	MSE sat'd K_2SO_4
NHE	0	98	199	241	650
MOE 20% KOH	-98	0	101	143	552
Ag/AgCl sat'd KCl	-199	-101	0	42	451
SCE sat'd KCl	-241	-143	-42	0	409
MSE sat'd K_2SO_4	-650	-442	-451	-409	0

Add listed value (in mV) to convert.
NHE = Normal Hydrogen; MOE = Mercury Oxide;
SCE = Calomel; MSE = Mercury Sulfate

Optional Accessories

Additional reference electrodes are available from Pine Research, including aqueous, non-aqueous, and standard size applications. Ensure proper operation and lifetime of the reference electrode with a storage system. Use of an isolation tube or salt bridge when temperature or ion contamination are of concern.

Parts List

The following are included in the box:

- Single junction Ag/AgCl reference electrode
- $3.5mm$ OD fluorocarbon (FKM) O-Ring
- Polymer shipping cap

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Reference Electrode

Product Guide

This brief reference guide describes how to unpack, use, clean, store, and test the product. Please contact us with any additional questions.

Part #: RRPEAGCL and RRPEAGCL2

LowProfile (3.5 mm) Single Junction Ag/AgCl Reference Electrode (Saturated KCl)

Quick Facts

Reaction	$AgCl_{(s)} + e \rightleftharpoons Ag_{(s)} + Cl^-$
Standard Potential (E°)	$+199\ mV\ vs.\ NHE$
Filling Solution	$4M\ KCl\ gel$
Temperature Tolerance	$10°C\ to\ 80°C$
Avoid Use With	NH_3 buffers, sulfides, $[base] > 0.1M\ OH^-$
Typical Variance	$\pm 3 - 5\ mV$
Typical Input Impedance	$< 10\ k\Omega$

Cannot be refilled/refreshed!

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Unpack the Electrode

Newly purchased reference electrodes are packed to ensure safe shipment. To unpack the electrode (refer to diagram on adjacent page): Remove the Parafilm around polymer shipping cap (**G**) and glass body (**B**). Rinse the reference electrode with distilled water to remove any solution that may have leaked during shipment. You can dispose of the polymer shipping cap (**G**), it should not be used for storage.

Electrode Usage Tips

For optimal use, review the following tips for proper reference electrode use:

1. During an experiment, ensure the ceramic frit (**H**) is fully submerged in solution.
2. Ensure the clip connected to the brass contact pin (**A**) is not corroded and is firmly attached.
3. Ensure reference electrodes are always connected properly to the potentiostat. Current should never pass through a reference electrode.
4. The fluorocarbon (FKM) O-Ring (**D**) can carefully be moved along the length of the glass body (**B**) for optimal solution immersion depth.

Refresh Reference Electrodes

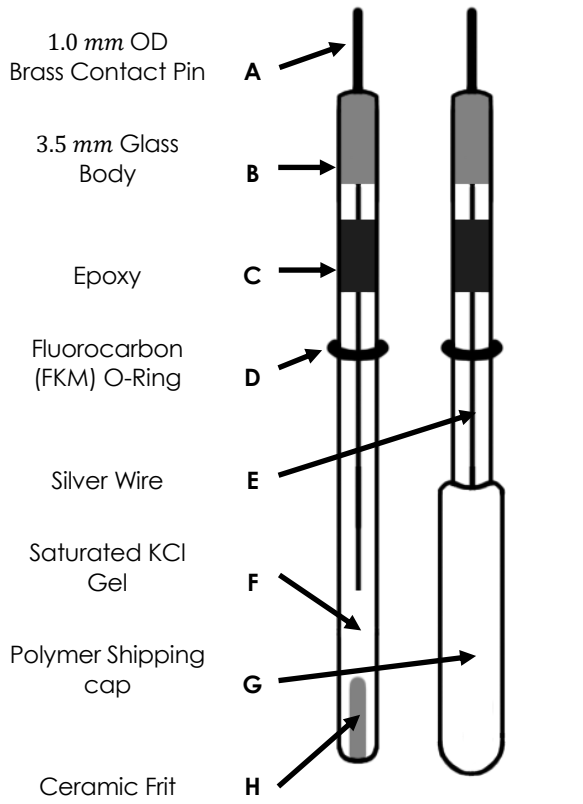
When the ceramic frit has been plugged (by precipitates or crystals), a higher than normal input impedance may cause problems such as potentiostat instability. The RRPEAGCL and RRPEAGCL2 reference electrodes cannot be refreshed. Dispose properly and replace with a new electrode.

Electrode Sizes

This reference electrode is available in two lengths: $60\ mm$ and $74\ mm$.

- $60\ mm$ Ag/AgCl reference electrode was developed specifically for use in the Honeycomb Spectroelectrochemical Cell Kit.
- $74\ mm$ Ag/AgCl reference electrode is ideal for use in the compact voltammetry cell kit (with Pt and Au ceramic screen printed electrodes) and the LowVolume series cells.

Reference Electrode Diagram



The filling solution in the RRPEAGCL and RRPEAGCL2 reference electrodes is a solid, KCl saturated gel, making the flow of chloride ion from these electrodes slow compared to liquid junction reference electrodes.

Additional Resources

Search YouTube for "Pine Research Instrumentation" for instructional videos on this product.

LowProfile Reference Electrodes are also available in a Non-Aqueous version. This electrode, also called a pseudo reference electrode, can be customer-modified to be used as a standard reference in non-aqueous media.

Other Reference Electrodes

Ag/AgCl Double Junction (saturated KCl)
- Part #: RREF0024
- $E^{\circ} = 199$ m$V\ vs.\ NHE$*
- Internal Filling Solution: $4M\ KCl\ with\ AgCl$
- External Filling Solution: 10% KNO_3
- Temperature Range: 10°C to 80°C

Calomel/SCE Single Junction (saturated KCl)
- Part #: RREF0022
- $E^{\circ} = 241$ m$V\ vs.\ NHE$
- Filling Solution: $4M\ KCl$
- Temperature Range: 10°C to 50°C

Mercury Sulfate Single Junction (saturated K_2SO_4)
- Part #: RREF0025
- $E^{\circ} = 650$ m$V\ vs.\ NHE$
- Filling Solution: saturated K_2SO_4
- Temperature Range: 10°C to 60°C
- Contains no chloride ion

Mercury Sulfate Double Junction (saturated K_2SO_4)
- Part #: RREF0026
- $E^{\circ} = 650$ m$V\ vs.\ NHE$*
- Internal Filling Solution: saturated K_2SO_4
- External Filling Solution: saturated K_2SO_4
- Temperature Range: 10°C to 60°C
- Contains no chloride ion

Mercury Oxide (20% KOH)
- Part #: RREF0038
- $E^{\circ} = 98$ m$V\ vs.\ NHE$*
- Filling Solution: $4.24M\ KOH$
- Temperature Range: 10°C to 80°C
- Contains no chloride ion
- Ideal for use in alkaline solutions

Ag/Ag+ Pseudo Electrode Kit
- Part #: AKREF0033
- Ideal for use in non-aqueous solvents
- Unstable reference potential unless made into a $Ag/AgNO_3$ reference

LowProfile (3.5 mm) Reference Electrodes
- $Ag/AgCl$ in $60\ mm$ and $74\ mm$ lengths
- Ag/Ag^{+} in $60\ mm$ and $74\ mm$ lengths

*Double junction electrodes are subject to additional potential drop across the second frit.

Be prepared! Always have a spare reference electrode to use!