TINKER & RASOR

CORROSION MITIGATION INSTRUMENTATION

PORTABLE COPPER-COPPER SULFATE REFERENCE ELECTRODES MAINTENANCE GUIDE

Tinker & Rasor Portable Copper–Copper Sulfate (Cu-$CuSO_4$) Reference Electrodes are used for structure-to-soil potential measurements in cathodic protection applications. Proper maintenance ensures consistent accuracy and long service life.

This guide provides step-by-step instructions for maintaining, cleaning, and refilling Tinker & Rasor Portable Copper–Copper Sulfate (Cu-$CuSO_4$) Reference Electrodes. Proper maintenance ensures accurate structure-to-soil potential measurements and extends the service life of the electrode.

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1. Safety Notes — WARNING!

Copper sulfate must be handled with care. Avoid contact with eyes, skin, and clothing, and always work in a well-ventilated area. When preparing, refilling, or cleaning the electrode, wear rubber gloves, safety glasses, and appropriate inhalation protection. Refer to the **Tinker & Rasor Copper Sulfate SDS** for complete safety information.

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2. Cleaning & Rejuvenation Procedure

Step 1 — Disassemble the Electrode

Unscrew the tube from the upper rod assembly/cap to expose the internal copper rod.

Step 2 — Clean the Copper Rod

- Clean the rod using a clean **non-metallic scouring pad** (such as a green 3M pad) until a bright metallic finish is achieved.
- Avoid oxide sandpaper or metallic abrasives, which introduce contaminants to the rod surface.

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3. Cleaning, Inspection, and Refilling Steps

Step 3 — Inspect and Replace the O-Ring

Inspect the O-ring for cracks, flattening, chemical wear, or swelling. Replace if damaged. When reassembling, tighten the end cap **finger-tight plus an additional ¼ turn** to fully compress the O-ring and prevent leakage. Do not overtighten, as this may damage threads or deform the seal.

Step 4 — Add Copper Sulfate Crystals

Use **only high-purity copper sulfate crystals**, as impurities can affect the electrode's reference potential.

Tinker & Rasor Copper Sulfate Options:

- **049-011:** High-Purity Copper Sulfate Crystals, 1 lb 3 oz — **Models 3A, 6A/B**
- **049-021:** Fine Copper Sulfate Crystals, 4 oz — **Model 2A**

Crystal Quantities:

- **Model 6A / 6B:** 20 g (fills approx. 1/3 of the tube)
- **Model 3A:** 60 g (fills approx. 1/3 of the tube)
- **Model 2A:** 1.5 g (fills approx. 1/3 of the tube)

Step 5 — Add Distilled Water

After adding crystals, fill the tube with **distilled or deionized water** to the appropriate level for each model. Avoid splashing solutions or crystals onto the threads.

Water Amounts:

- **Model 6A / 6B:** 0.7–1.0 oz — fill to approx. **½ inch (13 mm)** below the top
- **Model 3A:** 6 oz — fill to approx. **½ inch (13 mm)** below the top
- **Model 2A:** 0.05 oz — fill to approx. **½ inch (13 mm)** below the top

Step 6 — Reassemble and Saturate

Reinstall the electrode body and tighten **finger-tight + ¼ turn** to properly seat the O-ring. Shake gently until the solution becomes deep blue. A correctly prepared half-cell must contain **some undissolved crystals**, indicating full saturation. Add additional crystals if all crystals dissolve.

Allow the electrode to stand upright (ceramic tip down) for **1–2 hours** to fully moisten the ceramic plug and stabilize the internal solution.

Note: All Tinker & Rasor Half Cell ceramic tips are pretreated with copper sulfate for rapid wetting during first-time preparation.

When using the electrode fully submerged in water (such as tanks, manholes, or vaults), ensure the electrode body is completely filled to prevent external water from entering through the ceramic plug.

Tinker & Rasor Waterproof Adapter:

- **085-135:** T&R MODEL W-7 - WATERPROOF ADAPTER

The Model W-7 can be used with most reference electrodes utilizing 1/4-20 threads.

4. Short-Term Maintenance (After Each Use)

- Rinse the ceramic tip under clean water to remove soil and contaminants.
- Wipe the ceramic tip gently with a clean cloth—do not scrub aggressively.
- Install the protective cap to limit evaporation and prevent the tip from drying.

5. Long-Term Maintenance

If the electrode will not be used for **one month or longer**:

1. Empty the copper sulfate solution.
2. Rinse the tube with distilled water to remove residual crystals.
3. Dispose of spent solution according to local regulations.
4. Before reuse, perform a full rejuvenation beginning with copper rod cleaning.

6. Temperature Precautions

Cu-$CuSO_4$ electrodes contain a water-based solution that can freeze below **32°F (0°C)**. Freezing increases internal resistance and may crack the ceramic plug, rendering the electrode inaccurate. When storing or operating the electrode in freezing conditions, use **Tinker & Rasor Antifreeze Solution (Part No. 049-012)** instead of standard solution.

Antifreeze solution causes a **+12 mV shift** in electrode potential; this must be accounted for when verifying or comparing readings.

Cu-$CuSO_4$ electrodes also naturally shift approximately **+0.5 mV per °F** above or below **77°F (25°C)**. For accurate measurements, allow the electrode and any electrode being compared to reach the same temperature before testing.

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7. Accuracy Check

To verify performance:

1. Compare the in-service electrode to a lab-use Cu–$CuSO_4$ electrode.
2. Submerge both ceramic tips in clean **tap water** (not distilled).
3. Connect the lab electrode to the meter's negative terminal and the test electrode to the positive terminal.
4. A reading of **0 ± 10 mV** indicates acceptable performance.
5. If outside tolerance, rejuvenation is recommended.

Note: Cu–$CuSO_4$ reference electrodes are manufactured to **±5 mV when compared to a Standard Calomel Reference Electrode**. The ±10 mV tolerance in this accuracy check applies only when **two Cu–$CuSO_4$ electrodes** are compared to each other, since **each electrode contributes its own ±5 mV tolerance, resulting in a combined ±10 mV difference**. The electrode itself remains **±5 mV** relative to standard.

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8. Common Causes of Bad Readings

- Low meter input impedance (<10 MΩ)
- Dirty or contaminated ceramic plugs
- Poor soil contact during field use
- Worn or cracked ceramic tips
- Discolored, cloudy, or contaminated copper sulfate solution