

Reasonable Control Measures
For Circuit Board & Metal Finishing Facilities

1. **Minimize Drag-Out** - Install an appropriate combination of the following measures at all cleaning, etching, or plating baths that contain copper. The specific measures for each bath will depend upon parts geometry, bath characteristics, process automation, and similar issues.
 - 1a: Static drag-out tank, and
 - 1b: Spray rinse over the bath or drag-out tank, or
 - 1c: Squeegees over the bath or drag-out tank, or
 - 1d: Air knives over the bath or drag-out tank, and
 - 1e: Drain boards between tanks, and
 - 1f: Splash guards for spray rinses, and
 - 1g: Drip bars to hang parts for 10+ seconds over the bath or drag-out tank, or
 - 1h: Hoist dwell time of 10+ seconds over the bath or drag-out tank, and
 - 1i: Return drag-out back to bath or drag-out tank.
2. **Use Countercurrent Rinsing** - After all etching or plating baths that contain copper, provide two-stage rinses consisting of any one of the following combinations:
 - 2a: Two-stage rinsing (provide separate tanks), or
 - 2b: Two-stage rinsing (divide existing tank), or
 - 2c: Two-stage rinsing (provide spray over existing rinse tank).
3. **Provide Positive Flow Control Devices** - Limit the flow of rinse water to just that amount needed to effectively rinse parts. Use any one of the following measures:
 - 3a: Conductivity flow control, or
 - 3b: Timer flow control, or
 - 3c: Contact switch flow control.

4. **Extend Bath Life** - Install an appropriate combination of the following measures at all cleaning, etching, or plating baths that contain copper. The specific measures for each bath will depend upon bath characteristics.
 - 4a: Periodic or continuous bath purification, and
 - 4b: High purity anodes, and
 - 4d: Bath changes only when needed (i.e., as determined by analysis, not by a time schedule or parts count), and
 - 4e: Shift to bath chemistry that can be purified (if one is available).
5. **Pre-Treat Spent Baths** - Install an appropriate combination of the following measures at all cleaning, etching, or plating baths that contain copper. The specific measures for each bath will depend upon bath characteristics.
 - 5a: Electrowin spent copper and nickel baths & etches, or
 - 5b: Batch treat high metal concentration baths & etches.
6. **Control Bath Make-up** - Use all of the following measures at all cleaning, etching, or plating baths that contain copper.
 - 6a: Select best bath chemistry, and
 - 6b: Control bath make-up (use standard recipes and trained staff), and
 - 6c: Use de-ionized water.
7. **Minimize Drag-in** - Install all of the following measures at all cleaning, etching, or plating baths that contain copper.
 - 7a: Efficient pre-cleaning, and
 - 7b: Coated racks, and
 - 7c: Optimize prior process steps, and
 - 7d: If appropriate and practical, use drag-in/drag-out rinsing sequence
8. **Optimize Wastewater Treatment** - Install an appropriate combination of the following measures at the on-site treatment plant handling all cleaning, etching, or plating baths and rinses that contain copper. The specific measures for each situation will depend upon treatment plant type and waste stream characteristics.
 - 8a: Automate control of the continuous treatment process. And
 - 8b: Equalize flow rates through the treatment process, and
 - 8c: Use additives to improve coagulation, and
 - 8d: Use effluent polishing where required, and
 - 8e: Evaluate low-flow & low-load operations, and adapt plant operations as needed to maintain required effluent levels.