STORM POWER COMPONENTS

Design Guide

Understanding Best Practices for Busbar Plating

Practical selection criteria for power distribution systems, with Storm Power capabilities

Role of Plating in Busbar Design

In high current busbar systems, plating is a key design variable, not an afterthought. It directly affects contact resistance, thermal performance, corrosion resistance, and joint reliability over the life of the equipment.

Storm Power's plating portfolio is built around these design drivers, with finishes tuned to specific environments, assembly methods, and cost targets.

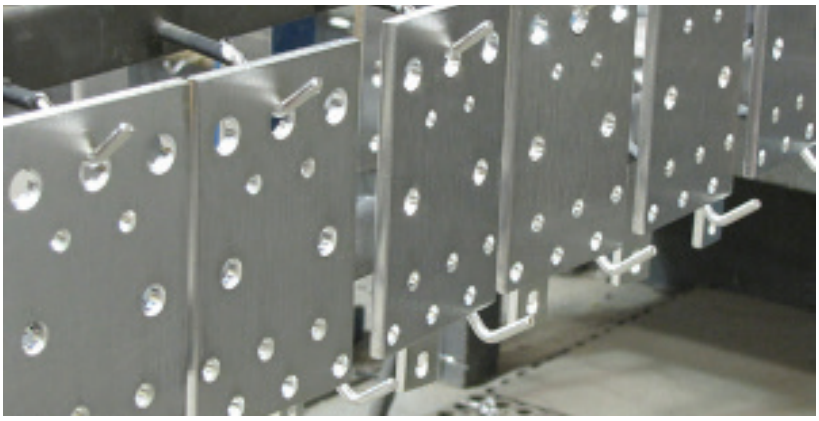
Storm Power Plating Portfolio for Copper and Aluminum

Storm Power plates copper and aluminum busbars with the following in house finishes:

- Bright tin
- Matte tin
- Nickel (electrolytic)
- Electroless nickel (mid phosphorus, 5–9%)
- Silver (including ASTM B700 options)
- Tin lead
- Lead

Gold is available through qualified partners for applications that require it. For aluminum busbars, Storm applies an electroless nickel strike layer first, then can deposit any of the above finishes on top; this addresses aluminum's native oxide and supports reliable electrical interfaces.

For design engineers, this means a common plating strategy can be carried across both copper and aluminum conductors within the same system where needed.



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How to Select a Finish: Key Design Considerations

A practical way to choose a busbar finish is to rank these considerations in order of importance for the application:

- Cost
- Contact resistance
- Environmental severity (mild, moderate, harsh)
- Cosmetic requirements (customer visible vs enclosed)
- Solderability
- Temperature capability
- Whisker risk and contamination potential

Bright/matte tin, nickel, electroless nickel, silver, and tin lead fall at different points on each of these axes. Storm Power routinely helps engineers map system requirements onto these trade offs, so final prints specify finishes that are both technically appropriate and manufacturable at scale.

Tin (Bright and Matte): Default for General Purpose Power

Key behaviors

- Excellent contact resistance and solderability.
- Suitable for use in mild to moderate environments.
- Soft enough to deform under bolt pressure, increasing real contact area and reducing interface contact resistance.
- Soft enough to bend without cracking but easily scratched; not ideal for sliding or abrasive contacts.
- Can be incompatible with welding processes and generally not recommended in contact with gold.

Bright vs matte

- Matte tin usually offers slightly better technical performance (including lower whisker tendency) but has a duller appearance and shows fingerprints and handling marks.
- Bright tin has a more cosmetic, shiny look, but a higher risk of whisker formation.

Storm Power offers both bright and matte tin; Storm engineers can help align the choice with the customer's whisker policy, cosmetic expectations, and assembly method.

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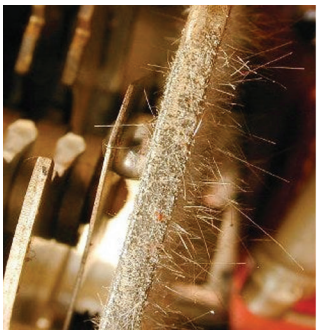
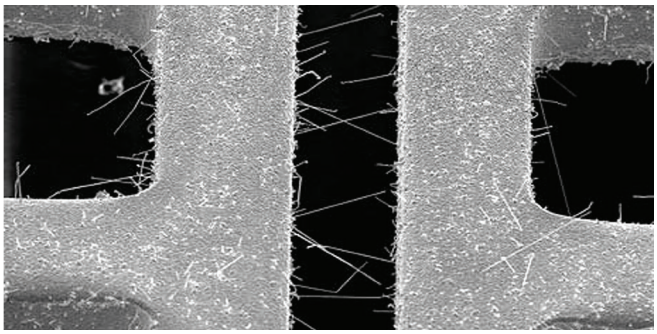
Tin Whiskers: When Risk Management Matters

Tin whiskers are spontaneous, conductive filament growths that can occur on tin surfaces, especially bright tin, over time. In high power assemblies they can cause shorts directly or contribute to conductive dust after burning off, which some OEMs have seen as a reliability issue and now actively avoid.

Design implications:

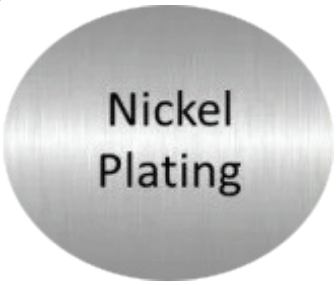
- Avoid bright tin in applications with strict contamination controls or sensitive creepage/clearance requirements.
- Prefer nickel, matte tin, or tin lead when whisker risk is a concern; lead in tin lead inhibits whisker growth, and matte tin is less prone to whiskers than bright tin.





Storm Power can support customers with documented whisker mitigation strategies by recommending finishes and process conditions that align with those internal standards.

Nickel and Electroless Nickel: Harsh Environment and Base Layers



Nickel finishes are suited to busbars exposed to moderate to harsh environments, where corrosion resistance, durability, and appearance are important.

Nickel

- Produces a hard, shiny, scratch resistant surface with good environmental resistance.
- Contact resistance is acceptable but not as low as tin or silver.

Electroless nickel (mid phos)

- Storm uses a mid phosphorus electroless nickel (5–9% P) to increase hardness and environmental protection at the cost of somewhat higher contact resistance.
- Deposits evenly over complex geometries and is preferred where uniform thickness is critical, particularly for thicker nickel layers.

Nickel finishes can be compatible with both soldering and welding and Electroless Nickel can be used under gold or silver as a base layers. For example, electroless nickel under silver combines robust environmental performance with excellent surface conductivity.

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Silver: High Performance Contact Finish

Silver is typically specified where very low contact resistance and high temperature capability are required.

Characteristics

- Excellent contact resistance and strong thermal performance for high current joints.
- Good environmental robustness; silver tarnishes, but silver oxide remains conductive, so tarnish is usually a cosmetic issue rather than an electrical one in power applications.
- Moderate scratch and abrasion resistance, and suitable for flexing without cracking.
- Good for soldering; but generally not preferred for welding.

Storm Power offers pure silver and B700 silver over a nickel flash and can apply an anti tarnish coating per ASTM B700 Class N when needed. This enables design engineers to specify silver within a standards based framework while tailoring protection to actual field conditions.

Tin Lead and Lead: For Legacy or Specialized Requirements

Tin lead is still used in applications where it is allowed by regulation and where its combination of solderability, contact performance, and whisker suppression is valuable.

- Excellent contact resistance and solderability in mild to moderate environments.
- Lower temperature capability compared to pure tin, nickel, or silver, which must be considered in thermal analysis.
- Lead content acts as an effective whisker suppressant.

Lead and tin lead finishes are often specified on legacy platforms or where qualification data is built around these finishes. Storm Power maintains these capabilities for customers with such constraints and can support transitions to lead free alternatives when needed.

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Aluminum Busbars: Surface Strategy

Aluminum is attractive for weight and cost, but its native oxide layer complicates reliable electrical interfacing and adhesion. Storm addresses this with an electroless nickel strike on aluminum, which provides a robust interface layer that can then receive any standard Storm finish (tin, nickel, silver, etc.). This allows design engineers to standardize on a common finish across copper and aluminum conductors while maintaining performance.

Aligning Plating with Assembly and Maintenance

Plating selection should be made concurrently with decisions about joint type, assembly method, and maintenance strategy:

- Bolted/clamped joints: Tin, tin lead, silver, or nickel, depending on environment and cost targets; tin and silver are particularly effective where low contact resistance is critical.
- Soldered connections: Tin and tin lead provide excellent solderability; silver and nickel are also suitable with correct process controls.
- Welded connections: Nickel finishes are generally acceptable; tin and silver are typically not ideal for welding and should be avoided where welded joints are required.

Storm Power's engineering team routinely reviews drawings and specifications to catch plating/assembly conflicts early (for example, a welded joint specified on a tin plated surface), helping avoid costly changes late in the design cycle.

Comparison of Plating Approaches

Below is a summary comparing key factors between the various plating approaches.

	Cost	Contact Resistance	Environment	Cosmetic	Solderability	Temperature Resistance
Bright Tin	$	Excellent	Mild-Moderate	Good	Excellent	Moderate
Matte Tin	$	Excellent	Mild-Moderate	Fair	Excellent	Moderate
Nickel	$$	Fair	Moderate-Harsh	Excellent	Fair	High
Electroless Nickel	$$$	Fair	Harsh	Excellent	Fair	High
Silver	$$$$	Excellent	Moderate	Good	Good	High
Tin Lead	$$	Excellent	Mild-Moderate	Fair	Excellent	Low

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Where Storm Power Adds Value

Storm Power is more than a plating provider; we are a partner in power distribution design that combines in house plating capability with application experience in high current busbar systems.

From material choice (copper vs aluminum) to finish selection and joint design, Storm supports OEMs, system integrators, and panel builders in creating reliable, manufacturable solutions. With options ranging from economical tin to high performance silver over nickel and robust electroless nickel systems for harsh environments, Storm can tailor plating strategies to each project's technical and commercial constraints.

How Storm Power Supports Design Engineers

Storm Power views plating as an integral part of the system design process, not just a finishing step. Typical support for design engineers includes:

- Recommending finishes based on environment, current, and assembly method
- Suggesting stack ups (for example, electroless nickel under silver) to meet both performance and standards requirements
- Advising on plating choices for aluminum vs copper busbars within the same system
- Helping reconcile internal standards (such as tin whisker policies) with cost and manufacturability

Because Storm offers a full range of plating services in house, the Storm design team can provide detailed feedback on feasibility, lead time, and process limits that can be incorporated early in the conceptual design process, thereby reducing risk during validation, prototyping and ramp up in production.