STORM POWER COMPONENTS

Industry Spotlight

How to Select Between Copper and Aluminum Busbars for High-Current Applications

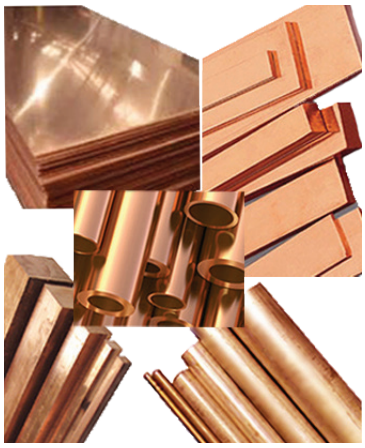
Selecting between copper and aluminum busbars in high current systems comes down to balancing electrical performance, weight, cost, and environment—then matching those needs with Storm Power's material, engineering, and manufacturing capabilities.

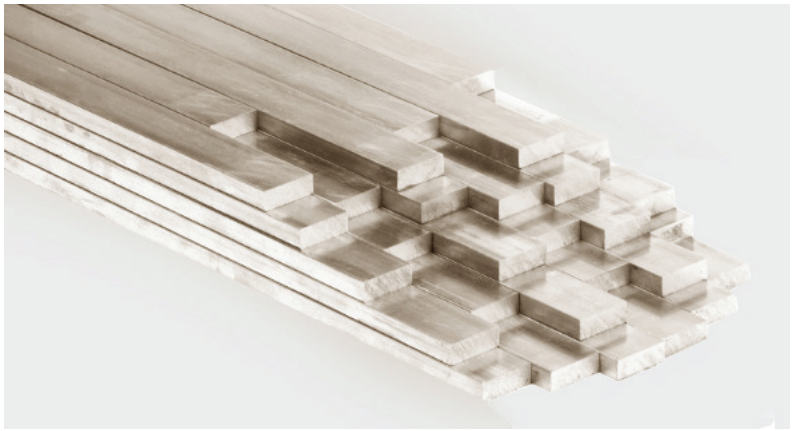
Core Electrical and Thermal Considerations

- Copper has significantly higher conductivity than aluminum (about 100% IACS vs roughly 40–60% for aluminum), so a copper busbar can carry the same current with a smaller cross sectional area.
- For the same physical size, copper busbars provide higher ampacity and lower resistive losses, which reduces self heating and voltage drop in high current applications.
- Aluminum can match copper's ampacity if the cross section is increased (on the order of 50–60% larger area), which often requires more physical space in the equipment envelope.
- In tightly packed switchgear, inverters, and power distribution cabinets where thermal margins and clearances are critical, copper's compact, high current performance is usually the preferred option.

Mechanical, Weight, and Installation Factors

- Copper is denser and mechanically stronger than aluminum, making it more resistant to deformation and fatigue under short circuit forces and mechanical stress.
- Aluminum busbars are much lighter—less than one third the weight of copper—so per pound they are roughly twice as conductive, which can simplify handling and installation in large or elevated structures.
- In applications where buses span long distances (for example, data center distribution, transport, or large process plants), weight reduction can ease mounting requirements and reduce structural cost.
- For harsh mechanical or high fault environments (heavy industrial switchgear, traction power, and dense power modules), copper's strength and short circuit withstand are typically preferred.





Applications Note:

Selecting Between Copper and Aluminum for Busbars

Cost, Lifecycle, and Environmental Conditions

- Aluminum bar stock is generally less expensive per unit mass than copper, making aluminum busbars attractive when initial material cost is a major driver and adequate space is available for the larger profile.
- Over a system's life, copper's lower losses and higher durability can offset its higher upfront price, particularly in 24/7 high current systems where energy efficiency and long service life matter.
- Copper maintains stable, low resistance joints over long periods, especially when tin, nickel, or silver plated, which helps in high cycle or vibration prone connections.
- Aluminum requires careful joint design, surface preparation, and suitable plating or hardware to manage oxide layers and thermal expansion, but when properly engineered it can deliver reliable performance in many enclosed or controlled environments.

Storm Power–Specific Strengths and How They Guide Selection

Storm Power fabricates both copper and aluminum busbars and provides engineering support to help match the material to the application instead of forcing a one size fits all.

- Storm's copper and aluminum bus bar capabilities include full in house CNC machining, punching, bending, laser processing, and plating for custom high conductivity busbars used in switchgear, inverters, IGBTs, power distribution, backplanes, breaker connections, and more.
- Storm sources copper and aluminum sheet and bar specifically for power applications and notes that select aluminum alloys offer above average corrosion resistance, good machinability, and high strength to weight ratio, for enclosed electrical grounding and conductor installations.
- By using busbars instead of cable and lugs, Storm designs help decrease system cost, improve thermal behavior, reduce wiring errors, and lower resistance—benefits that apply whether the bus material is copper or aluminum.
- Storm's technical library and ampacity charts for both copper and aluminum busbars give designers data to size conductors correctly and evaluate temperature rise, clearances, and safety margins for each material.

Applications Note:

Selecting Between Copper and Aluminum for Busbars

Where Storm Typically Recommends Copper

- High current, space constrained cabinets and modules where compact geometry and tight thermal control are critical (e.g., power electronics, UPS, drives, dense switchgear).
- Applications requiring high short circuit strength, long term joint stability, or compliance with standards and customer specifications that call out copper.
- Laminated bus bars where low inductance and low IR loss must be combined with complex shapes, multiple layers, and long lengths.

Where Storm Typically Recommends Aluminum

- Large frame distribution and grounding conductors where weight and cost are more important than minimum footprint and where additional cross sectional area is acceptable.
- Enclosed bus runs and grounding systems using aluminum bar, which provides a lightweight, more affordable alternative to copper with good corrosion resistance when plated.
- Systems where long spans or elevated runs make weight reduction valuable, such as some data center trunking, transport platforms, and large industrial plants.

Practical Selection Framework for High Current Designs

Use the following questions to decide whether to specify copper or aluminum busbars with Storm Power:

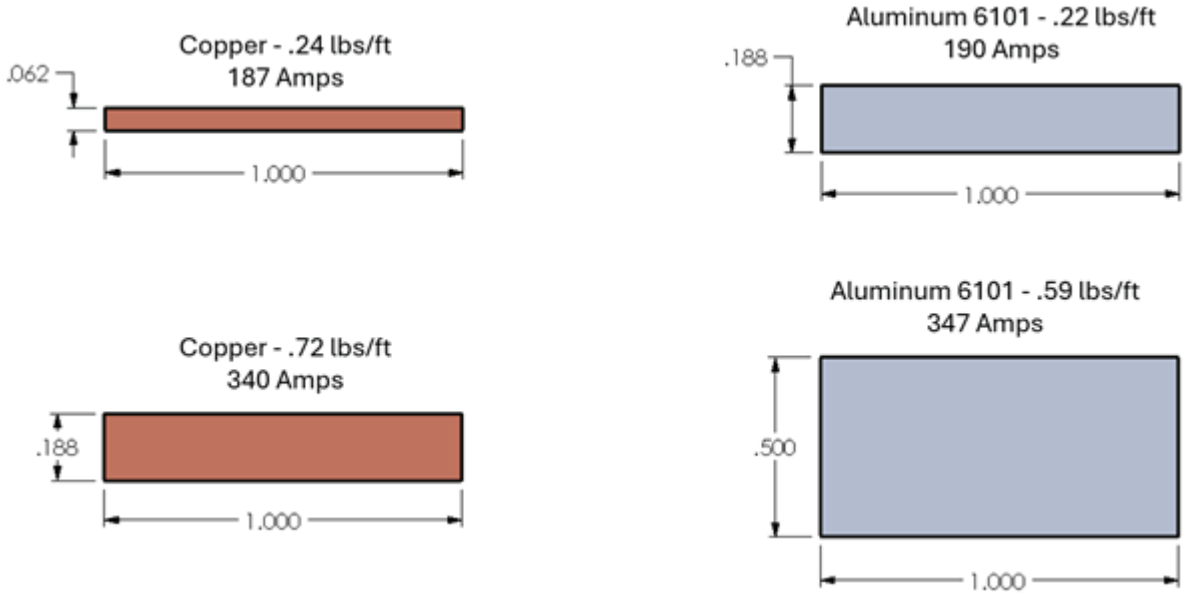
- What continuous and peak currents must the busbar carry, and what maximum temperature rise is acceptable? Higher currents in limited space usually favor copper; moderate currents with available space can often use aluminum sized up appropriately.
- How constrained is the physical envelope—height, width, phase spacing, and clearance to insulation and other components? Compact or highly integrated layouts typically benefit from copper's smaller cross section and better thermal behavior.
- What are the mechanical and fault conditions—expected short circuit levels, vibration, and mechanical support? Severe fault or mechanical environments tend to favor copper; lighter, well supported runs can often use aluminum successfully.
- What is the project's cost strategy—lowest installed cost versus lowest lifetime loss and maintenance? Aluminum often wins on raw material and handling, while copper can win on lifecycle efficiency and robustness.
- Are there environmental factors like humidity, corrosive atmospheres, or outdoor exposure? Proper plating, insulation, and alloy selection—which Storm engineers can help define—are essential for both materials but are especially critical for aluminum joints.

Applications Note:

Selecting Between Copper and Aluminum for Busbars

Comparing Copper and Aluminum Busbars at a Glance

Design factor	Copper busbars	Aluminum busbars
Electrical conductivity	~100% IACS, highest conductivity for compact, low loss designs.	~40–60% of copper; needs larger area to match ampacity.
Cross section for same current	Smaller required, supports tight footprints and dense layouts.	Approximately 50–60% larger area needed for equivalent current.
Weight	Heavy; higher structural and handling load.	Less than one third the weight of copper, about twice as conductive per pound.
Mechanical strength & faults	Higher strength and short circuit withstand, maintains shape under stress.	Softer than copper; can deform more under bolt; requires careful mechanical design.
Thermal behavior	Lower resistance and often better thermal margin at given size.	Slightly higher losses; temperature rise managed by increased volume and surface area.
Cost emphasis	Higher material cost, often justified by performance and lifecycle savings.	Lower material cost and lighter handling; attractive for large runs.
Typical Storm use cases	High current, space limited modules, laminated bus bars, switchgear, inverters, IGBT and power distribution busbars.	Cost and weight sensitive distribution and grounding conductors.



Cross Section Examples using this chart for 60Hz, 30°C rise, room temperature

To turn this framework into a specific design, Storm Power's engineering team can take your current profile, environment, and mechanical constraints, then size and compare both copper and aluminum busbar options—often revealing where copper is the performance driven choice and where aluminum can safely reduce weight and cost.