STORM POWER COMPONENTS

Best Practices for Soldering, Brazing and Solderfree Methodologies for Use in Busbar Designs

Joining together multiple busbar segments is often a requirement for creating complex, unified busbar designs. In some cases, it may be necessary to create a longer busbar out of short segments or to incorporate T-segments into the design. Also adding bushings for mounting, insulation and/or mechanical strength are key factors for many busbar designs.

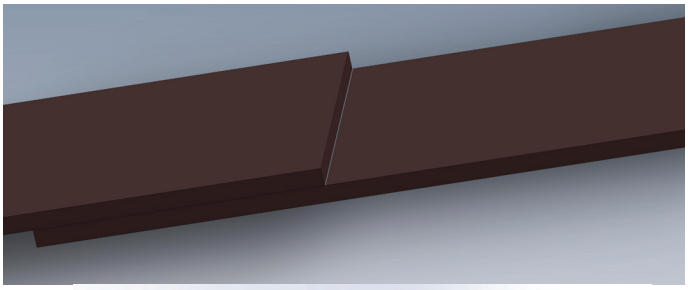
In this App Note, we provide an overview of three methods, soldering, brazing and solderfree press-fit, along with comparison of the key considerations, use cases and trade offs for each approach.

Key Considerations:
Choosing the best approach starts with an assessment of the application requirements and specifications for the overall busbar design. Key considerations include:

1. **Mechanical Strength** - a primary concern with choosing any joining process is to make sure the mechanical strength of joints is sufficient to withstand the stress levels required by the application.
2. **Electrical Integrity** - providing robust electrical connections with low resistance levels is a critical factor for achieving required busbar performance.
3. **Material Compatibility** - depending on the material selected for each busbar segment, there can be factors that impact joining method choices, such as issues with soldering or brazing different materials.
4. **Heat Management** - if the busbar design includes components or other elements that may be heat sensitive, the selection of a joining method needs to take that into consideration.
5. **Lifecycle Performance** - understanding the application's power cycling and thermal environment are important factors to assure the joints can deliver required performance over the anticipated lifecycle.
6. **Environmental Issues** - for some deployment environments, issues such as corrosion can be a critical factor when choosing a joining method.
7. **Production Efficiency** - the selected joining method should provide ease of assembly, while minimizing any unnecessary steps and providing sufficient throughput to achieve required production volumes.
8. **Cost Effectiveness** - finally the overall design, joining methods, and production plan needs to achieve the cost targets required by the customer's end application.

Applications Note: Joining Busbars with Soldering, Brazing or Solderfree Methods

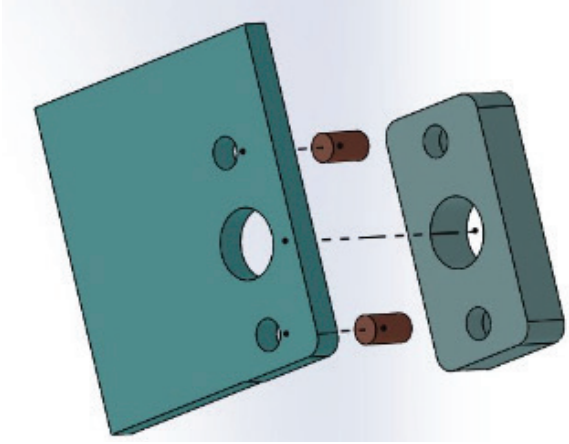
Soldering



Both soldering and brazing begin with overlapping the segments being joined in order to provide sufficient surface area for a robust joint and to minimize contact resistance.

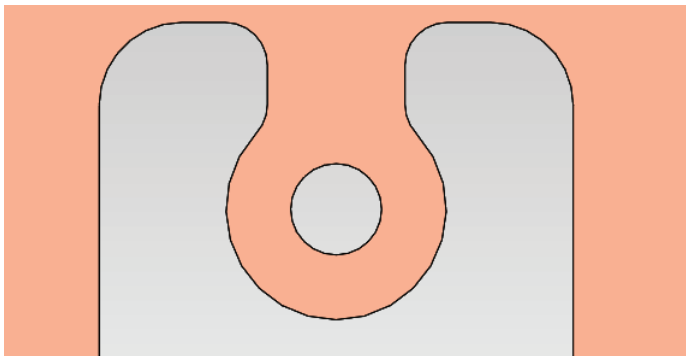
Also, matching solder alloys with the materials being joined is key to ensuring good adhesion and electrical conductivity.

Alignment and orientation can be controlled through the use of pins and holes in the segments or keyed parts.



This is important to avoid any shifting of the parts when soldering heat and pressure are applied. Alignment pins also reduce the hassles and costs of using external fixtures to hold the parts in place.

Designing in thermal relief, as shown at right, is also important to assure controlled uniform heating, promote proper solder flow and improve reliability of the solder joints.



In the production process, some soldering methods can involve lead-based solders, potentially posing some environmental and health considerations that need proper handling and disposal.

Brazing

The key difference with brazing is that it uses higher temperature levels and filler materials with higher melting points. Brazing is often above 450°C (840°F) while soldering can typically be done below 450°C (840°F).

Brazing creates a metallurgical bond between the filler metal and the base metals. This bond results in a joint that is often stronger and more durable than a soldered joint.

In contrast, Soldering uses filler metals (solders) with lower melting points than the base metals being joined. This minimizes the risk of damaging or altering the properties of the base metals, but doesn't produce as strong a joint.

Brazed joints can withstand higher mechanical stresses and temperatures compared to soldered joints, making them suitable for applications where joint strength and reliability are critical.

On a cautionary note, as heat from the brazing process can potentially soften material around the brazed area, the process may have a negative affect on bolted joints or clinch hardware. The designer should take that into account.

Solderfree Press-Fit

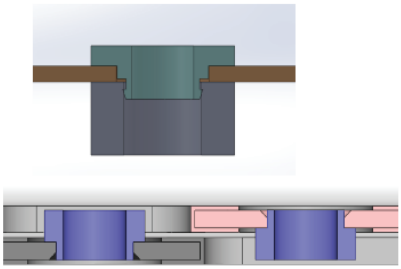
Solder-free press-fit methods offer several advantages and challenges compared to traditional soldering or brazing techniques, especially when adding bushings to busbars.

Advantages:

- **Speed and Efficiency:** Press-fit methods can be faster than soldering or brazing, as they often involve simple mechanical assembly rather than heating and cooling processes.
- **No Heat Damage:** Unlike soldering or brazing, press-fit methods eliminate the risk of heat damage to sensitive components or materials.
- **Ease of Assembly:** Press-fit connections can be straightforward to assemble and disassemble, facilitating easier maintenance and repair.
- **Cost-Effectiveness:** Eliminating the need for soldering materials or brazing alloys can reduce material costs and simplify supply chain logistics.

Challenges:

- **Mechanical Strength:** While press-fit connections can be strong, ensuring sufficient mechanical strength and reliability over time requires precise engineering of the connection points and materials.
- **Contact Resistance:** Ensuring low contact resistance between mating surfaces is critical for maintaining electrical conductivity.
- **Tolerances and Fit:** Press-fit connections rely on tight tolerances between components; variations in manufacturing tolerances can affect the reliability and effectiveness of the connection.
- **Environmental Factors:** Press-fit methods may not be suitable for environments with extreme temperatures, vibrations, or corrosive conditions without appropriate design considerations.



Press-Fit Bushing

- Delivered Installed
- Cheaper than Soldering
- Low Resistance

Storm Power has deep experience with designing application specific press-fit interconnects such as the bushings shown at right. These are specially configured for custom busbars and designed to handle a wide range of busbar specifications.

Summary

In summary, all three of the above described methodologies have applicability for joining together busbar segments for a variety of applications.

As a rule of thumb the comparison is as follows:

Methodology	Cost	Joint Strength	Conductivity
Soldering	$$	Excellent	Better
Brazing	$$	Stronger than Base Metal	Best
Press-Fit	$	Good	Good

At Storm Power Components, our engineering teams have decades of experience with designing complex busbars that have proven reliable in the most demanding of deployments. This is because we always start with the end goal of the system in mind and then bring our knowledge, experience, and creativity together in a holistic manner to achieve those goals, including when it comes to selecting and implementing the best methods and practices for joining busbar segments together or adding bushings for any application.