

Disassemblable busbar-to-prismatic cell interconnections for electric vehicles

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INTRODUCTION

With the rapid growth of electric vehicles, improving the disassembly of battery packs is essential to enable reuse, second-life applications, and efficient recycling of critical materials from end-of-life batteries. Current battery designs—such as those in the Nissan Leaf and Peugeot 208—use numerous screws and welded joints, significantly increasing disassembly costs. The EU targets recycling 70% of battery weight and recovering key metals by 2030. To address these challenges, this work introduces tube fit joining, a novel forming-based process for connecting prismatic cell terminals to busbars without metallurgical bonding, enabling lightweight, reliable, and easily disassemblable joints for sustainable EV battery systems.

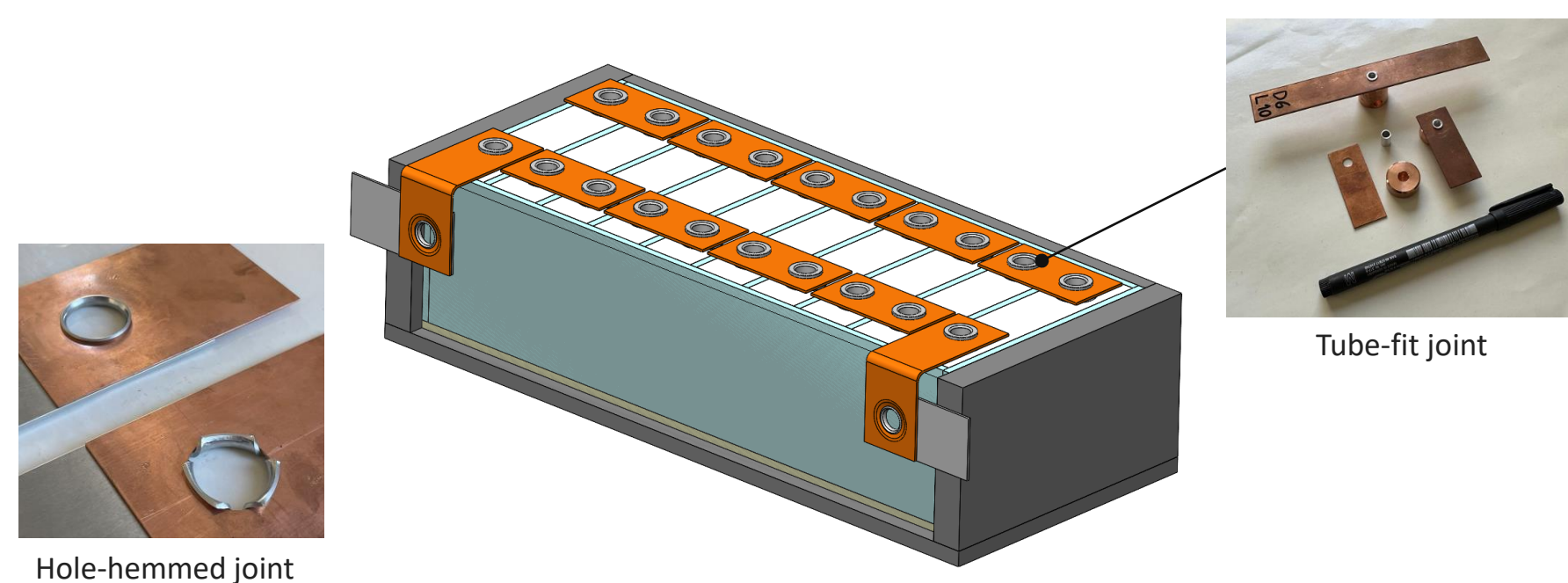


Figure 1— Novel joints developed for EV battery interconnections: (left) hole-hemmed joints between aluminum and copper busbars; (right) tube-fit joints for terminal-to-busbar interconnections.

Experimental Detatils

The process involves inserting a tubular connector into aligned holes in the terminal and busbar, followed by plastic deformation to create a combined force- and form-fit connection (Figures 1 and 2). It requires only a punch, a blank holder, and access to one side of the components, as the terminal is connected from the bottom to the anode or cathode current collector, which links to the jelly roll. In this study, both the terminal and busbar were made of Cu-ETP copper, while the connector was manufactured from AA2024-T351 aluminum alloy. Connectors with different diameters and lengths were tested to evaluate their influence on joint strength and disassembly through pull-out tests.

Results and Discussion

Mechanical tests under normal loading revealed two distinct failure mechanisms: Failure Mode 1, where both the connector and busbar were removed from the terminal, and Failure Mode 2, where only the busbar was removed, leaving the connector inside the terminal (Figures 3). Although Failure Mode 2 produces a stronger joint due to increased force-fit between the terminal and connector, joints exhibiting Failure Mode 1 are advantageous for disassembly, as the connector can be fully removed from the terminal without causing damage to the terminal or the battery cell. Increasing the connector's diameter and length resulted in higher maximum loads and shifted the failure mode from 1 to 2 (Figures 4).

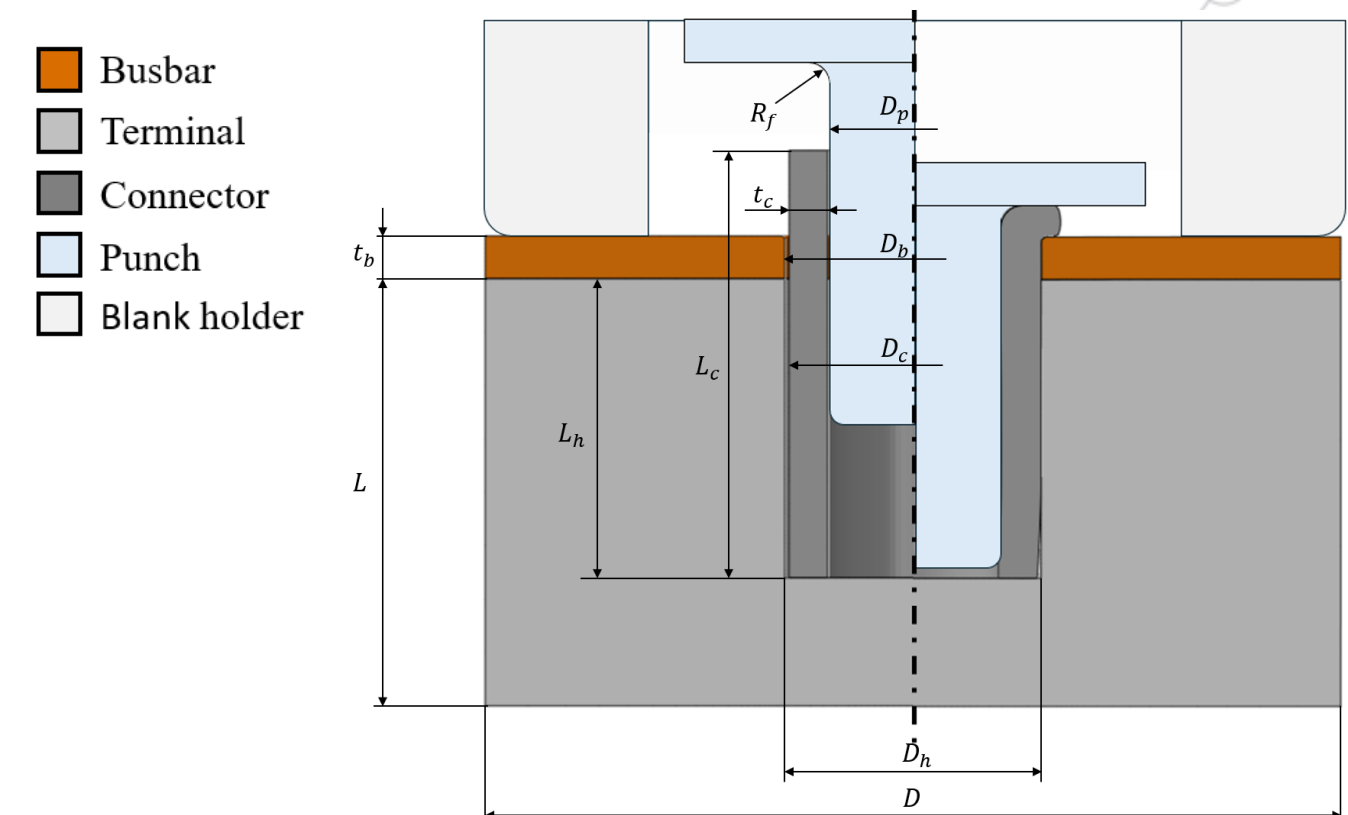


Figure 2— Schematic representation tube fit joining process.

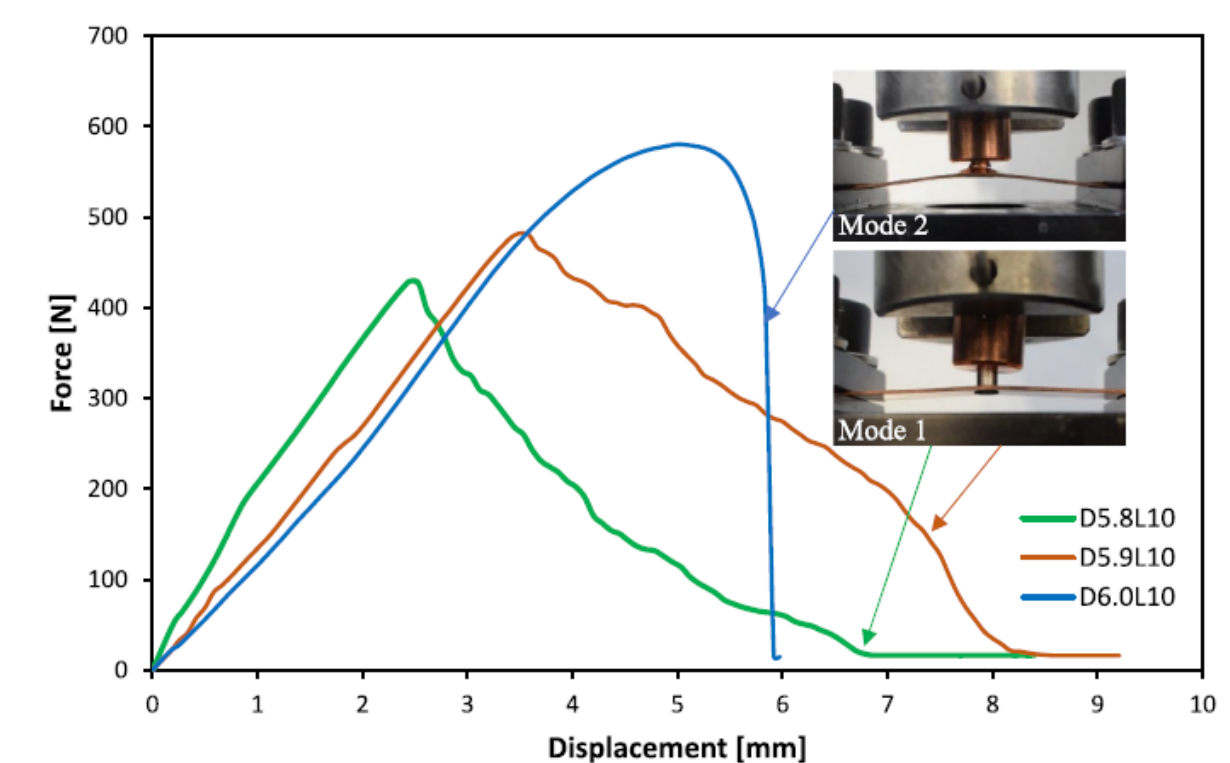


Figure 3— Force–displacement curves from pull-out tests highlighting the effect of different connector diameters on joint performance and disassembly.

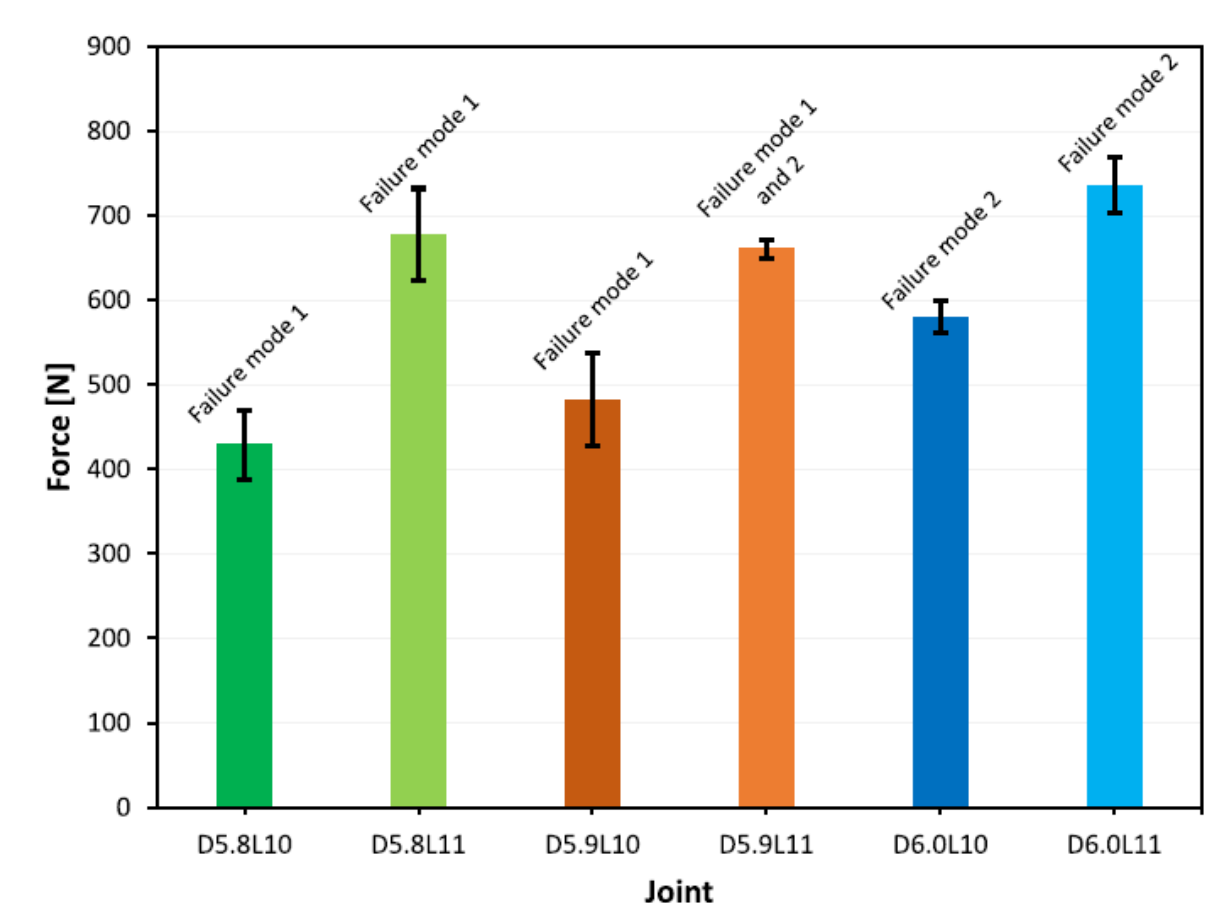


Figure 4— Maximum force and failure mode comparison from pull-out tests.

CONCLUSION

Increasing the connector's diameter and length enhances both the force-fit and form-fit characteristics, thereby improving the joint's mechanical performance and achieving a maximum strength of 750 N. However, to ensure easy and safe disassembly, the severity of the force-fit must be carefully controlled. Joints exhibiting Failure Mode 1 are preferred, as they offer advantages for disassembly.

REFERENCES

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