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Heat Transfer Analysis and Heat Sink Design for MELD Additive Manufacturing[1] JACOB STAFFORD, University of Evansville, DAVID MACPHEE, PAUL ALLISON, University of Alabama — MELD manufacturing is a solid-state additive manufacturing process that provides an alternate path to fusion-based additive manufacturing. Understanding the thermal cycle and hardness of the weld zone for components made using the MELD manufacturing process are essential in predicting the quality of the manufactured components. To facilitate better understanding of the process, a simulation of the conjugate heat transfer problem was modeled in ANSYS Fluent. The model was then used to design a heat sink to better disperse thermal energy during material deposition. As a baseline for the heat sink design, a cold plate used in HVAC applications was modeled and tested experimentally. The computational solver was refined using grid size and time-step independence tests, and validated with experimental data. This computational solver was used to design a new heat sink plate to help better control deposited material temperatures. By controlling the temperature of the deposited material, better predictions for the thermal cycle and hardness are possible. This allows for improved prediction of the quality of solid-state additive manufacturing components.

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