

**Feasibility Study for Development of an Automated Multi-Plane Wax Tree  
Assembly System for Investment Casting**

By

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## **ABSTRACT**

There is a demand within the investment casting industry for an automated process for assembling wax tree/runner assemblies. The traditional method of using humans is very labor intensive and is not accurate and repeatable. An automated system was created to join wax parts to the runner system; however this system can only be used for parts with gates on one plane. These types of parts only consist of a small portion of the total investment casting industry. Since the majority of the industry involves more complex parts with gates on multiple planes, an automated system needs to be created that can handle these parts.

Previous work on this project has proven that an acceptable weld can be made between two wax parts, but the processes did not readily lend themselves to automation. The processes are complex and require part specific tooling in order to achieve a uniform and strong weld.

Further research was done on three different methods to see if an acceptable weld could be created while having a process that can be easily automated. The three methods are ultra-violet curable adhesives, laser heating, and microwave reactive filler material. Each method was tested to find the strength of the weld, as well as the shape of the weld it produces.

The ultra-violet curable adhesive was found to produce weak bonds and a gap could not be filled. The laser heating approach produced strong welds; however there was some undercutting of the part and the cycle time was too long. The laser also required a tool to follow the path of the weld joint, which would be hard to automate with the varying size and shape of the wax parts. The microwave reactive material approach produced strong, uniform fillet welds if all the conditions were correct. However, it was almost impossible to get repeatable acceptable welds using a simple microwave delivery system. More work would have to be done with a more complex microwave system to produce an acceptable weld every time.