

0.625" FPPW Abstract

Friction Pull Plug Welding (FPPW) is a solid-state process that is the primary close out method for Self-Reacting Friction Stir Welding (SR-FSW). This process uses a servo hydraulic machine to spin an aluminum plug to several thousand revolutions per minute and pull the plug with several thousand-pound force into an aluminum piece of material. This process, which has been around for approximately a decade, has proven to be a very difficult process to develop. There are large number of variables with interactions and correlations that are difficult to detect. Historically this method only provided good results on aluminum material up to 0.327" thick. The SLS rocket required weld land configurations of up to 0.625" thick. This not only pushed the limits of the process but also of the tools procured for materials ½ as thick.

Ultimate Tensile Results was typically the response used for FPPW input variables. The problem was there were multiple processes including, welding, post weld machining, Non Destructive Evaluation, specimen fabrication and mechanical testing between the FPPW inputs and the mechanical test results. This only compiled the list of variables and made the process of FPPW even more difficult to develop. This presentation and paper describes the new process development methodology, which uses the FPPW tool's feedback to observe the process and develop it systematically. It captures 6 months and 600 plugs worth of work using only the tool's feedback as a response to the process. This presentation describes the solution to the issue, a solution whose methodology could apply to a variety of other processes.