

# **ANALISIS SIFAT MEKANIS HASIL *PINLESS FRICTION STIR SPOT WELDING* PADA ALUMINIUM ALLOY 1100 BERDASARKAN VARIASI TIPE *TOOL* DAN PARAMETER PROSES**

**Ridwan Bambang Rianto**

## **Abstrak**

*Pinless friction stir spot welding* (PFSSW) merupakan metode sambungan padat yang efisien untuk material non-ferro seperti Aluminium Alloy 1100, terutama dalam aplikasi industri yang membutuhkan kekuatan tinggi dan distorsi termal rendah. Penelitian ini bertujuan untuk menganalisis pengaruh variasi tipe tool dan parameter proses terhadap sifat mekanis hasil sambungan PFSSW. Tiga jenis *tool profile* berbahan stainless steel 304 yang digunakan adalah round, cube, dan cone, dengan kombinasi parameter berupa *rotational speed* (1000 rpm, 1100 rpm, 1200 rpm), *plunge depth* (0,5 mm, 0,8 mm, 1,2 mm), dan *dwell time* (5 s, 7 s, 9 s). Proses PFSSW menghasilkan 27 spesimen, yang seluruhnya diuji secara mekanis menggunakan tensile test untuk memperoleh nilai ultimate tensile strength (UTS), yield strength, shear strength, dan modulus elastisitas. Selain itu, sebanyak 9 spesimen dipilih secara acak untuk menjalani *penetrant test* guna mendeteksi adanya cacat permukaan. Hasil penelitian menunjukkan bahwa variasi *tool profile* dan parameter proses memberikan pengaruh signifikan khususnya pada parameter tinggi (1200 rpm, 1,2 mm, 9 s) terhadap kualitas sambungan. Kemudian *tool profile* cube menghasilkan nilai UTS dan shear strength tertinggi dibandingkan tipe lainnya. Sedangkan cacat permukaan cenderung muncul pada parameter dengan *rotational speed* rendah dan *dwell time* yang singkat. Dengan demikian, pemilihan *tool profile* cube dan kombinasi parameter proses *high level* terbukti mampu meningkatkan performa sambungan PFSSW pada Aluminium Alloy 1100 secara efektif.

**Kata kunci:** PFSSW, Aluminium Alloy 1100, tipe tool, parameter proses, sifat mekanis.

# MECHANICAL PROPERTIES ANALYSIS OF PINLESS FRICTION STIR SPOT WELDING ON ALUMINUM ALLOY 1100 BASED ON VARIATION OF TOOL TYPE AND PROCESS PARAMETERS

Ridwan Bambang Rianto

## *Abstract*

*Pinless Friction Stir Spot Welding (PFSSW) is an efficient solid-state joining method for non-ferrous materials such as Aluminium Alloy 1100, especially in industrial applications that require high strength and low thermal distortion. This study aims to analyze the influence of tool type variations and process parameters on the mechanical properties of PFSSW joints. Three types of tool profiles made from stainless steel 304 were used: round, cube, and cone, with parameter combinations consisting of rotational speed (1000 rpm, 1100 rpm, 1200 rpm), plunge depth (0.5 mm, 0.8 mm, 1.2 mm), and dwell time (5 s, 7 s, 9 s). The PFSSW process produced 27 specimens, all of which were mechanically tested using tensile testing to obtain values of ultimate tensile strength (UTS), yield strength, shear strength, and elastic modulus. In addition, 9 specimens were randomly selected to undergo a penetrant test to detect the presence of surface defects. The results of the study show that variations in tool profile and process parameters have a significant effect, particularly at high parameter settings (1200 rpm, 1.2 mm, 9 s), on joint quality. The cube tool profile produced the highest UTS and shear strength values compared to the other types. Meanwhile, surface defects tended to appear at low rotational speeds and short dwell times. Therefore, selecting the cube tool profile and a high-level combination of process parameters has been proven to effectively enhance the PFSSW joint performance on Aluminium Alloy 1100.*

**Keywords:** PFSSW, Aluminium Alloy 1100, tool profile, parameter process, mechanical properties.