

F. Plunge Testing to Evaluate Tool Materials for Friction Stir Welding of 6061 Aluminum and 6061+20wt%Al₂O₃ Composite

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A simple plunge test was used to evaluate some of the interactions between 6061 T6 aluminum and 6061 + 20 wt%Al₂O₃ plates and flat-faced, cylindrical pin tools of H13 steel, WC bonded with 10 wt% Co, and gas pressure sintered Si₃N₄. The 12.5 mm-diameter pin tools were rotated and driven into the plates to a depth of approximately 10 mm. Each test consisted of two segments, a constant-displacement-control plunge to a depth of 1.5 mm followed by a constant-displacement-control plunge from 1.5 mm to about 10 mm. The forces supported by the pin tools in the constant displacement segments varied with pin tool material. Normal force and spindle torque measurements were used to calculate effective friction coefficients. Metallographic analysis confirmed that chemical reactions occurred between the pin tools and the base materials.