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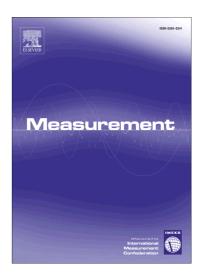
PII: S0263-2241(18)30608-0

DOI: https://doi.org/10.1016/j.measurement.2018.07.015

Reference: MEASUR 5699

To appear in: *Measurement* 

Received Date: 16 June 2017 Revised Date: 9 May 2018 Accepted Date: 6 July 2018



Please cite this article as: N.Z. Khan, A.N. Siddiquee, Z.A. Khan, Proposing a new relation for selecting tool pin length in friction stir welding process, *Measurement* (2018), doi: https://doi.org/10.1016/j.measurement. 2018.07.015

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ACCEPTED MANUSCRIPT

Proposing a new relation for selecting tool pin length in friction stir welding

process

Noor Zaman Khan\*, Arshad Noor Siddiquee, Zahid A. Khan

Department of Mechanical Engineering, Jamia Millia Islamia (A Central University), New Delhi,

India

**Abstract** 

In this paper, an empirical relation to determine tool pin length for a specific set of Friction Stir

Welding (FSW) parameters such as base material thickness, tool shoulder diameter, tool pin

diameter and tool tilt angle is derived and proposed. The effectiveness and suitability of the

proposed relation was verified through FSW experiments. Tool pin length was obtained from the

relation and FSW of dissimilar aerospace grade aluminium alloys (AA7475 and AA2219) was

performed. Three welds were made: one using the FSW tool with the pin length obtained from the

proposed relation; second with the pin length smaller and third with the pin length greater than

that obtained from the proposed relation. Subsequently, the three welds were compared and it was

found that the tool having pin length obtained from the proposed relation resulted in smooth

surface morphology and proper material mixing with good consolidation of flowing material at

the bottom of the joint. Value of pin length smaller than that obtained from the proposed relation

resulted in heavy flash due to larger plunge depth. Value of pin length larger than that obtained

from the proposed relation resulted in surface cracks along with insufficient mixing and lack of

bonding at the bottom of the joint due to insufficient plunge depth. Joint fabricated with

optimized pin was characterized by mechanical testing, microstructure and fractography.

**Keywords:** Friction stir welding; Aluminium; Plunge depth; Pin length; Microstructure.

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