



Assessment of Bobbin Friction Stir Welding for the Joining of Aluminium Alloys



**PUBLISHABLE
SUMMARY**

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Background

The friction stir welding (FSW) process was invented by TWI and was originally developed for industrial exploitation via a TWI Joint Industry Project (JIP). The Sponsors of that project were amongst the first to adopt the new technology and benefited considerably from its early exploitation.

TWI has recently developed a novel enhancement to the FSW process which offers the potential to produce improved full penetration welding performance using significantly simplified, and therefore cheaper, equipment. The enhanced process can be implemented in two varieties named fixed and floating bobbin FSW. Bobbin FSW has the potential to be a valuable high productivity manufacturing technique for structures of interest to the transport industries, offering high quality, highly repeatable welds at a competitive cost. This project developed, evaluated, and demonstrated the capabilities and benefits of bobbin FSW. Participants in the JIP became early adopters of the new technique able to benefit from the enhanced capabilities that it offers.

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Objectives

This JIP aims to optimise the fixed and floating bobbin techniques to achieve repeatable, high quality joints in aluminium alloys and to assess the benefits offered by the new approaches. Specific objectives were to:

- Demonstrate the feasibility of applying bobbin FSW to a range of commercially available aluminium alloys and section thicknesses chosen by the Sponsors.
- Optimise bobbin tool designs and assess performance.
- Determine the requirements for bobbin welding in terms of fixturing, FSW machine tool requirements, component dimensional tolerances and set-up alignment.
- Evaluate joint properties compared with conventional FSW techniques.
- Assess weld stability and process reproducibility.
- Apply the developed technology to prototype components.
- Demonstrate the use of the approach on a range of industrially relevant FSW machines.

Benefits

The development of the fixed and floating bobbin techniques provided the following benefits and information:

- Elimination of the risk of root defects in butt welds.
- Removal of the requirement for a backing bar.
- Significantly reduced component distortion due to balanced heat input.
- Information to allow evaluation of the bobbin welding techniques to aid in the justification of early adoption of the technology.
- Quantitative data on the reduced process forces allowing the development and use of lighter, simpler and cheaper fixturing and/or FSW machines.
- Results from weld feasibility trials performed on prototype components that were specific to the Sponsors' applications allowing clear demonstration of the process benefits.

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Participants

The Sponsor Group Comprised:

- Bamtri
- ESAB AB
- Hyundai Rotem Company
- Nippon Light Metal Co Ltd
- Embraer SA
- Hitachi Ltd
- Kawasaki Heavy Industries Ltd
- SAPA Technology

Price and Duration

The project had a duration of 2 years and a budget of £320,000. It was funded by 8 Sponsors each making a contribution of £40,000. The fee for additional companies buying back into the project results is £40,000.

Further Information

For further information on Joint Industry Projects (JIP) and their operation, please visit:

<http://www.twi.co.uk/services/research-and-consultancy/joint-industry-projects/>

JIP Co-ordinator: Tracey Stocks

Ref: 18887/14-1/14

Email: jip@twi.co.uk

Project Leader: Jonathan Martin

Email: jonathan.martin@twi.co.uk