Effective Friction Stir Welding (FSW) of Thick Section Aluminium Alloys

PUBLISHABLE SUMMARY

25700

Background

There are many applications for which joining of thick section aluminium components is required; these include aircraft wing spars, liquid natural gas tanks, armour plate, bulkheads and railway headstocks. Using conventional fusion welding techniques can be challenging as typically:

- Component edge preparation and a shielding gas are necessary.
- Preheat is required.
- The process is difficult to control.
- A multi-pass technique is required leading to low productivity.
- Welds are prone to porosity and cracking.
- Welding can lead to component distortion.
- Some aerospace alloys are difficult or impossible to fusion weld.

Friction stir welding (FSW) is now a well-established technique for joining similar and dissimilar aluminium alloys, by which properties of a structure can be tailored for enhanced performance. The majority of current industrial applications involve joining components in the thickness range of 2-8mm. Companies report many benefits from using FSW; however the technical and commercial benefits of joining thicker section aluminium alloys are less well established.

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Objectives

This JIP aims to develop three different FSW techniques to achieve repeatable, high quality joints in thick section aluminium alloys and to assess the benefits offered by the new approaches. The techniques include double sided simultaneous, supported bobbin and supported FSW. The specific objectives are to:

- Demonstrate the feasibility of applying the three different techniques to weld thick section aluminium alloys.
- Assess tool materials, designs and performance.
- Assess weld stability and process reproducibility.
- Evaluate welds mechanical properties.
- Assess component distortion.
- Determine requirements in terms of fixturing and FSW machine design for thick section welding.
- Assist, where appropriate, in the development of business cases for the adoption of these techniques.

Benefits

Sponsors will benefit from an early assessment of new and novel FSW techniques for joining thick section aluminium alloys. These techniques have the potential to:

- Increase production rates.
- Reduce tooling costs.
- Improve weld properties.
- Reduce distortion.

The results of this project will provide data to assist sponsors in commercial evaluation of the new techniques and the calculation of return on investment on bespoke FSW equipment to weld thick section aluminium alloys.

Participants

- Arconic Inc
- Aleris Rolled Products Germany
- Beijing Aeronautical Manufacturing Technology Research Institute (BAMTRI)
- Kaiser Aluminium Fabricated Products

Scope of Work

Using the unique capabilities of the Powerstir™ FSW machine, the three FSW techniques will be developed and assessed. Based on previous work, FSW tools will be designed and developed to initially make sound welds. The weld strength and hardness will be assessed and improved through process development. The effect of component cooling and post weld heat treatment on weld properties and an assessment of component distortion will be made. It is expected that each of the techniques will have its own inherent characteristics and benefits which will be established in order to inform the sponsors of their applicability to specific applications. Information will also be generated for calculation of return on investment for purchase of bespoke FSW equipment.

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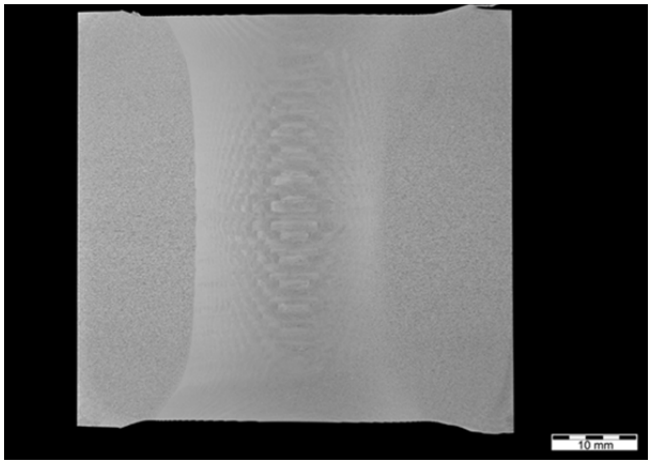
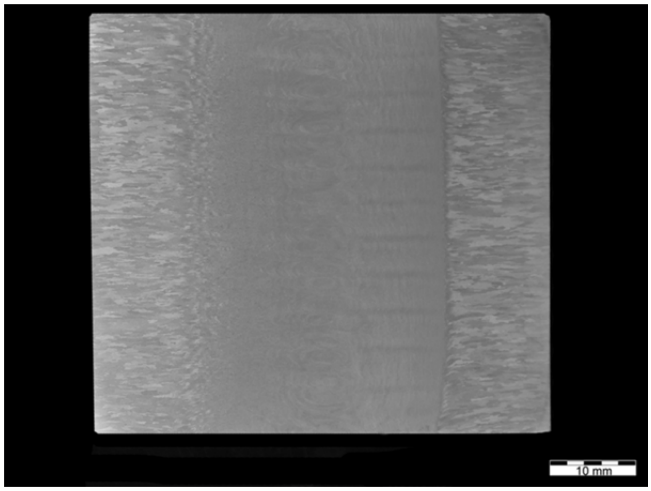


Example of a supported bobbin FSW weld in 50mm thickness AA5083-O



Example of a supported FSW weld in 50mm thickness AA6082-T6

Reporting

During the project, progress updates will be issued bi-monthly by e-mail and, at six monthly intervals, the Sponsors will meet to review the work and guide its progress. A detailed progress report will be issued in advance of each six monthly progress meeting. A final meeting will be held to present the overall project findings. All progress reports and the final report will be available through a secure area on the TWI website.

Price and Duration

The estimated total cost of the Project is £250,000 (excluding VAT) and will be undertaken over a period of two years. Five sponsor companies are sought, each contributing £25,000 per annum.

Further Information

For further information on how a Joint Industry Project (JIP) runs please visit:

http://www.twi-global.com/services/research-and-consultancy/joint-industry-projects/

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