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Industrial Member Report Summary – Key Findings for Industry

In-bore Multi-positional Laser Welding Stainless Steel, Nickel Alloy 718 and Ti-6Al-4V

TWI Core Research Programme

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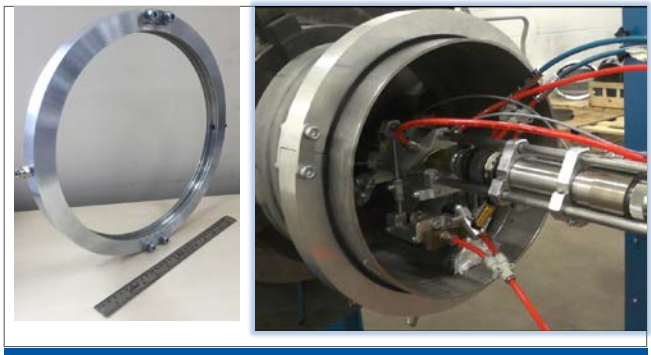
Industrial need

Laser welding is already an industrially accepted joining process for a wide number of applications ranging from shipbuilding and aircraft fuselage manufacture, through to production of high precision medical devices.

Multi-positional laser keyhole welding is established in the automotive industry, where it is used for assembly of body-in-white structures. Also, several potential industrial applications exist for an in-bore multi-positional laser welding solution, such as manufacture and repair of pipework for aging nuclear reactors and in the construction of pipelines in new build nuclear power plants. A laser welding solution to this problem offers certain advantages, such as its flexibility for remote deployment and operation, as well as its speed of joint completion. Modern high power solid state industrial lasers all transmit their optical power using flexible optical fibres, which can be over 100m long. This laser technology is thus well suited to this particular welding application.

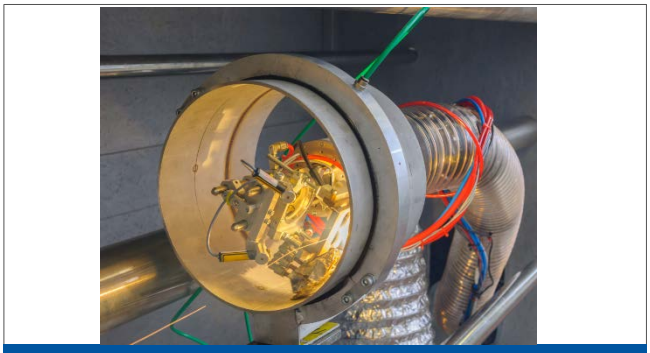


Images of the gas shielding collar used for shielding the weld root region (left, before use, right, during use)

Key Findings

The work in this project on multi-positional in-bore welding of 304L stainless steel, Ti64AlV and nickel alloy 718, using a 5kW fibre laser, has produced the following key findings:

- The most difficult parameter to control for practical multi-positional in-bore pipe welding would be the focus position in relation to the pipe surface.
- It is possible to laser weld 3-5mm 304L Stainless steel in all positions in accordance to ‘stringent’ criteria in ISO 13919-1
- It is possible to laser weld 1-4mm 304L Titanium and Nickel alloys in all positions, in accordance to ‘Class A’ criteria in AWS D17.1
- The in-bore laser welding head can be successfully integrated with a snake arm robot



The snake arm integrated, multi-positional in-bore laser system, in operation in TWI’s laboratory.

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