

Recent developments in Robotic FSW at TWI

AG 52 meeting Oskarshamn - May 2015

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Materials Joining and Engineering Technologies

A faint, stylized graphic of a globe is visible in the bottom right corner of the slide, showing the continents of Europe and Africa.



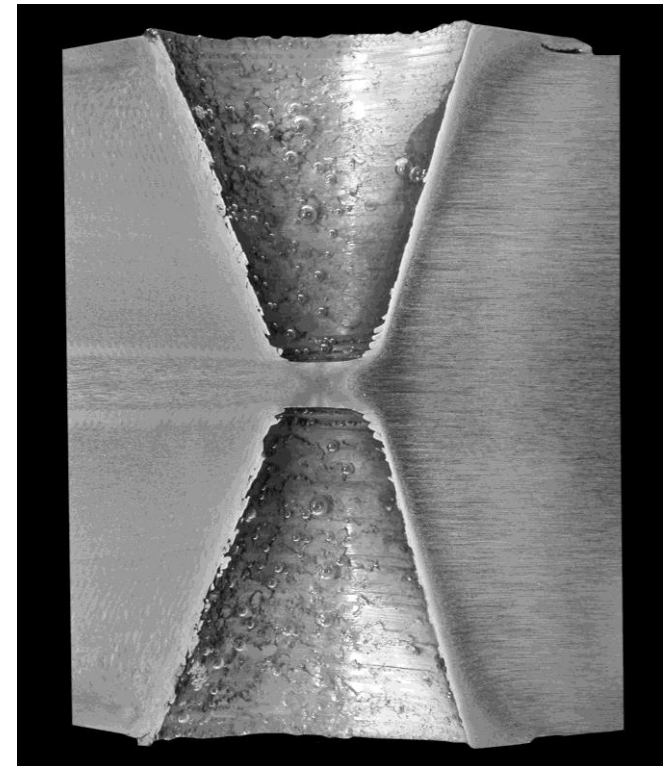
- Membership based Research and Technology Organisation - est. 1946
- Over 800 staff
- £80M turnover
 - Non profit distributing
- Over 700 Industrial members in 60 countries
- Over 24,000 trainees/ year

To provide our Members with authoritative and impartial expert advice, knowhow and safety assurance through

- Materials selection
- Joining technologies
- Structural Integrity



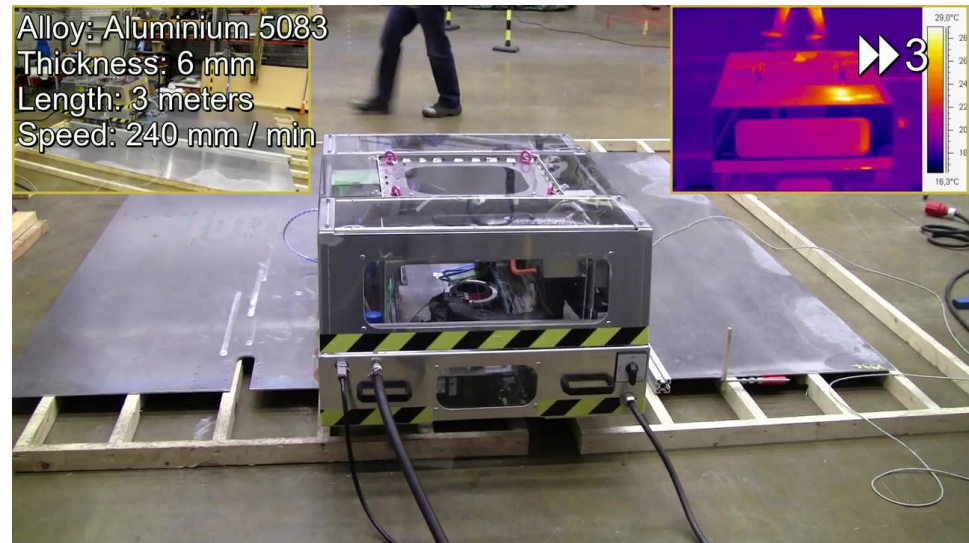
- Continued development of the technology
- Participate on Standards Committees
- Multidisciplinary team of 20 engineers with over 120 years of combined FSW experience
- Over 300 industrial FSW research projects to date



A Mobile Friction Stir Welding (FSW) System

Objectives:

Develop a prototype, mobile Friction Stir Welding (FSW) system, designed and constructed for use in final fabrication/assembly of aluminium structures in a shipyard.



The research leading to these results has received funding from the European Union Seventh Framework Programme [FP7/2007-2013] under grant agreement no 315238. Copyright Mobi-Weld © 2013. All Rights Reserved.

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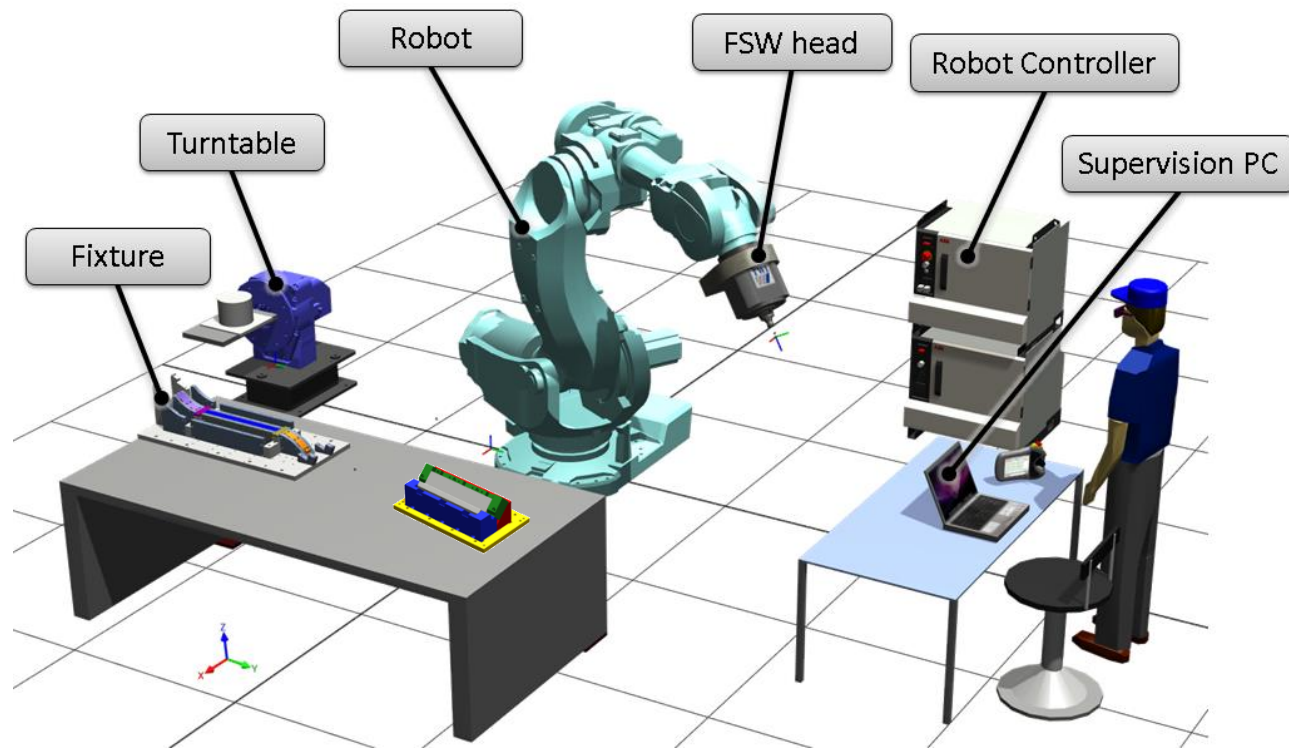


- EU FP7 project FlexiFab
 - Flexible fabrication of complex aluminium structures
 - Partners:
 - EUROPEAN WELDING FEDERATION
 - ASOCIATIA DE SUDURA DIN ROMANIA
 - BOLUDA DIVISION INDUSTRIAL SL
 - RRS SCHILLING GMBH
 - TRA-C INDUSTRIE SAS
 - META VISION SYSTEMS LIMITED
 - INNORA PROIGMENA TECHNOLOGIKA
 - IGM ROBOTERSYSTEME AG
 - TWI LTD.
 - LUNDS UNIVERSITET

- Terminology

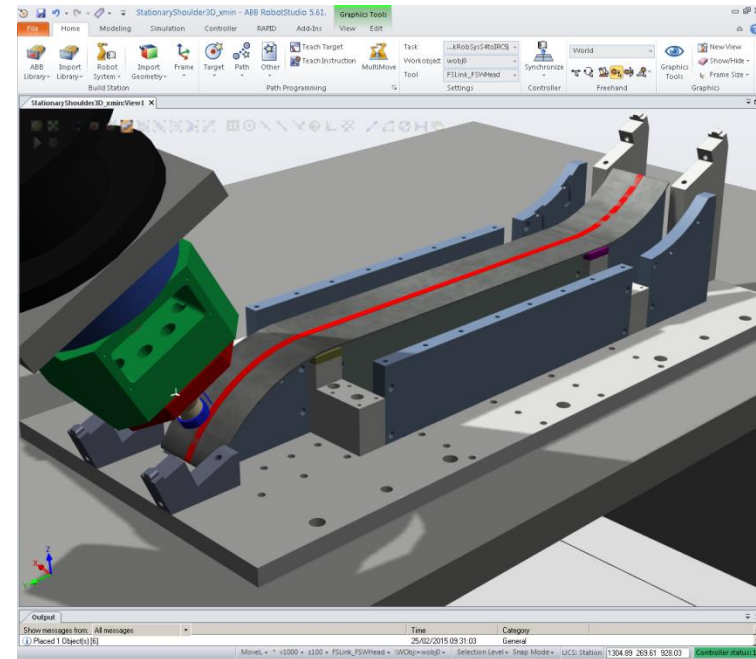
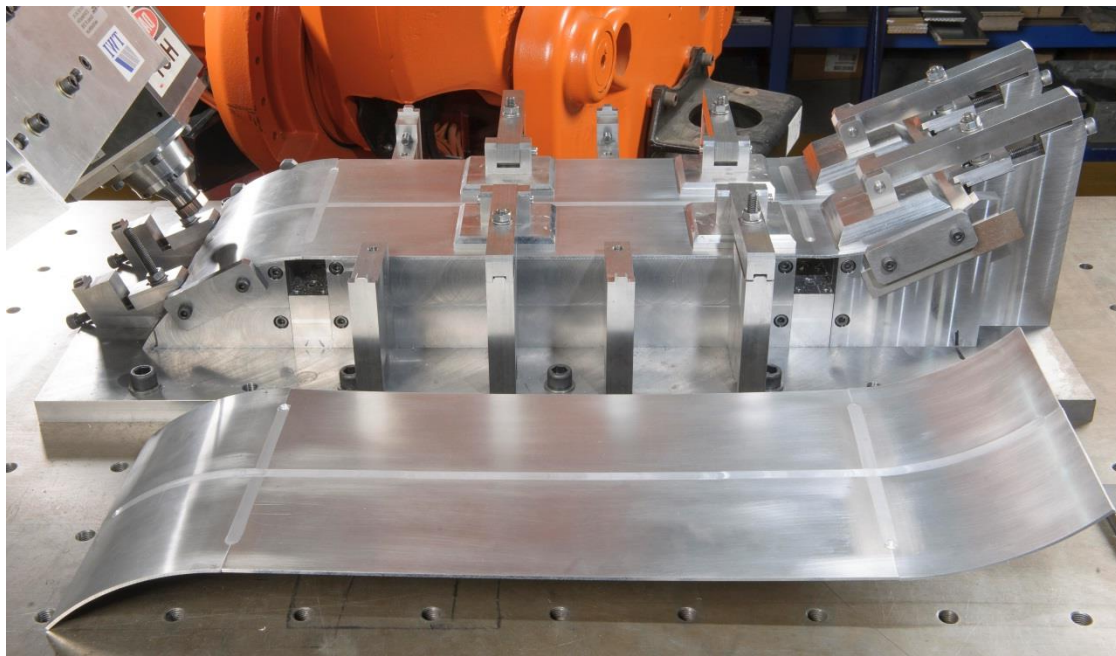


RoboStir system at TWI

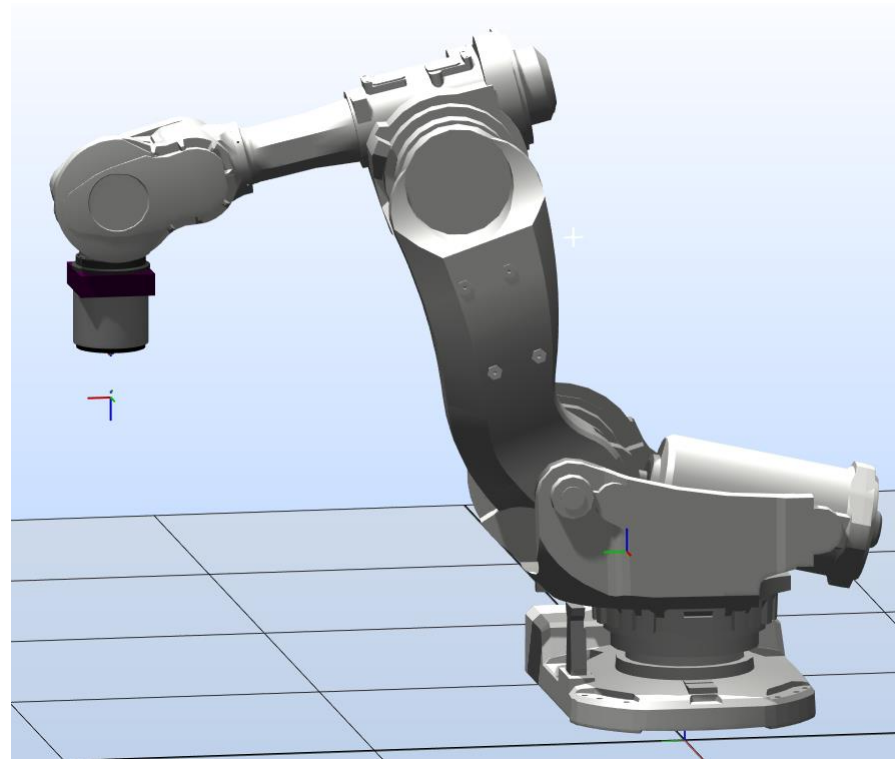


FlexiFab system (virtual model)

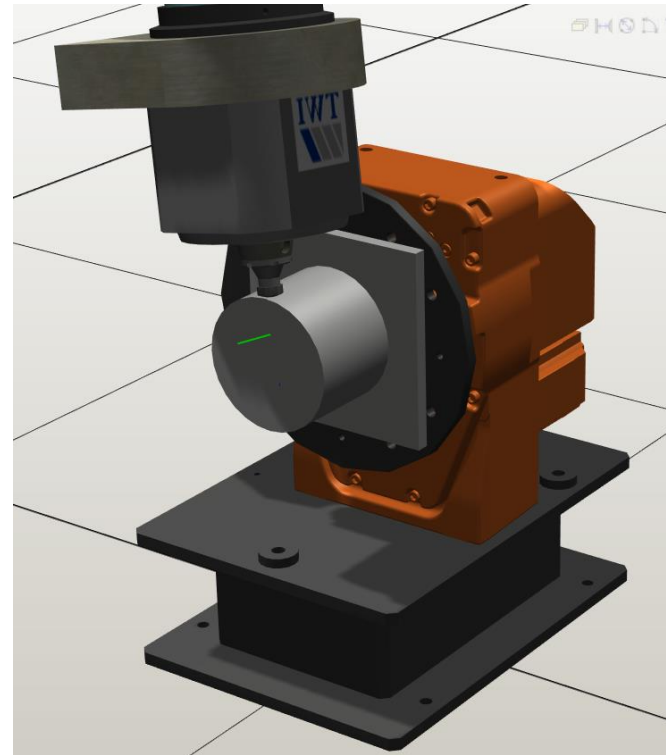
- Reconfigurable fixture
 - ▢ Suitable for bobbin and stationary shoulder
 - ▢ 1D, 2D and 3D joints

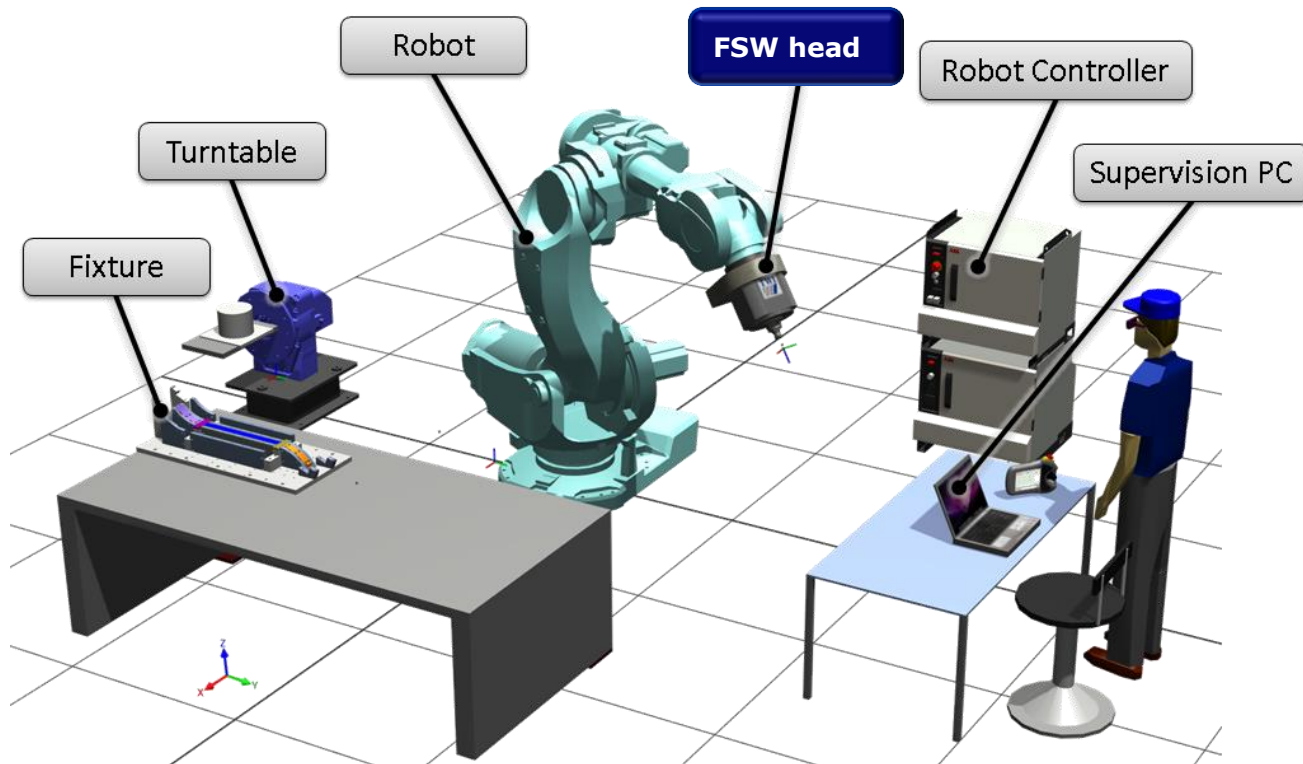


- Robot - ABB IRB7600
 - ▣ 400kg payload heavy duty robot
 - ▣ Integrated force control



- Turntable
 - Enables full circumferential welds
 - Integrated with ABB IRC5 controller

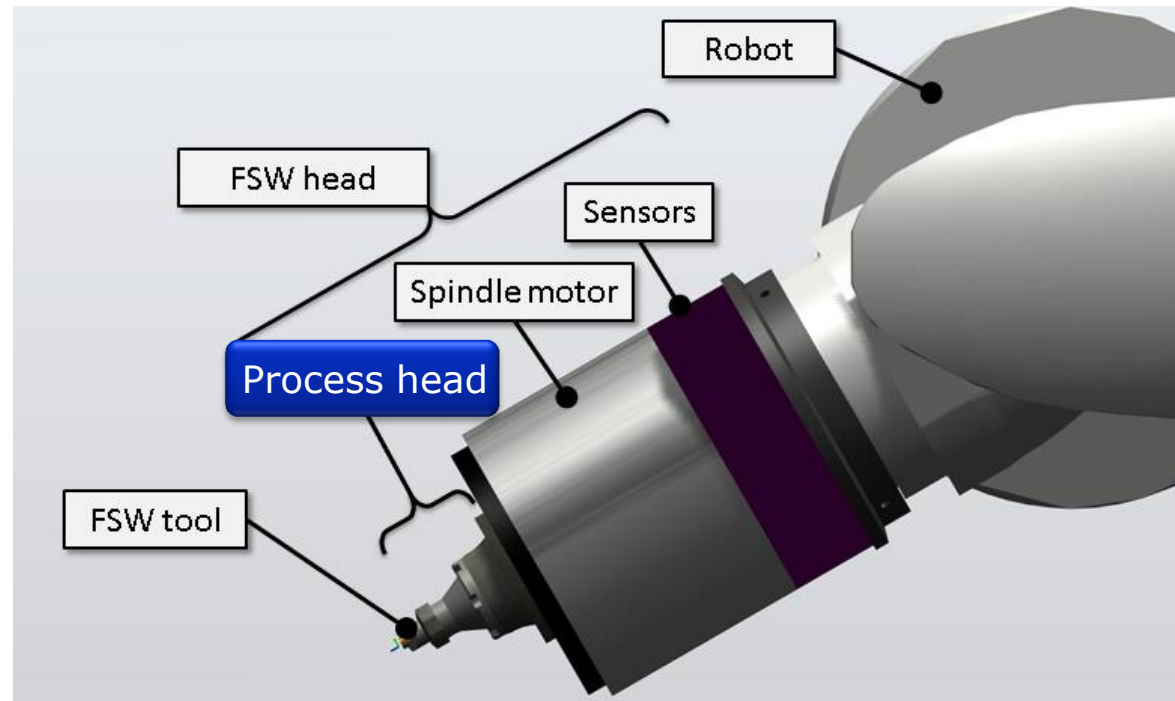




FlexiFab system (virtual model)

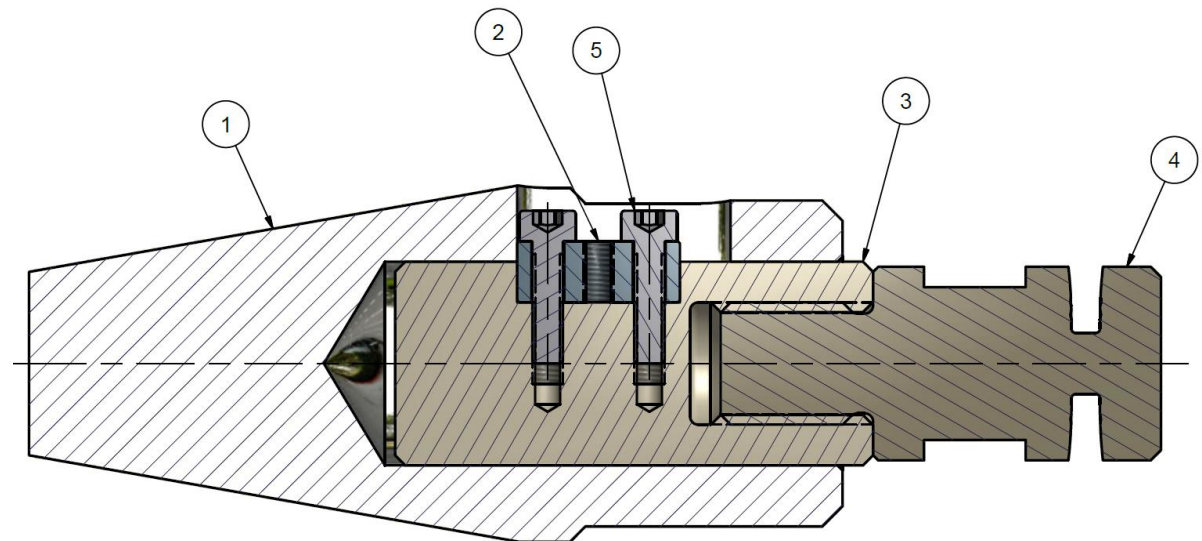
WP1 - New welding head

- FSW head
 - Includes spindle motor for tool rotation
 - Three different process heads to be developed
 - FBFSW
 - SSFSW
 - Corner



Floating Bobbin Process head

- Machine taper (1)
- Floating tool holder (3)
 - ▣ 5 mm “floating range”
 - ▣ Restricted by key/slot (2)
- One-piece fixed bobbin tool (4)

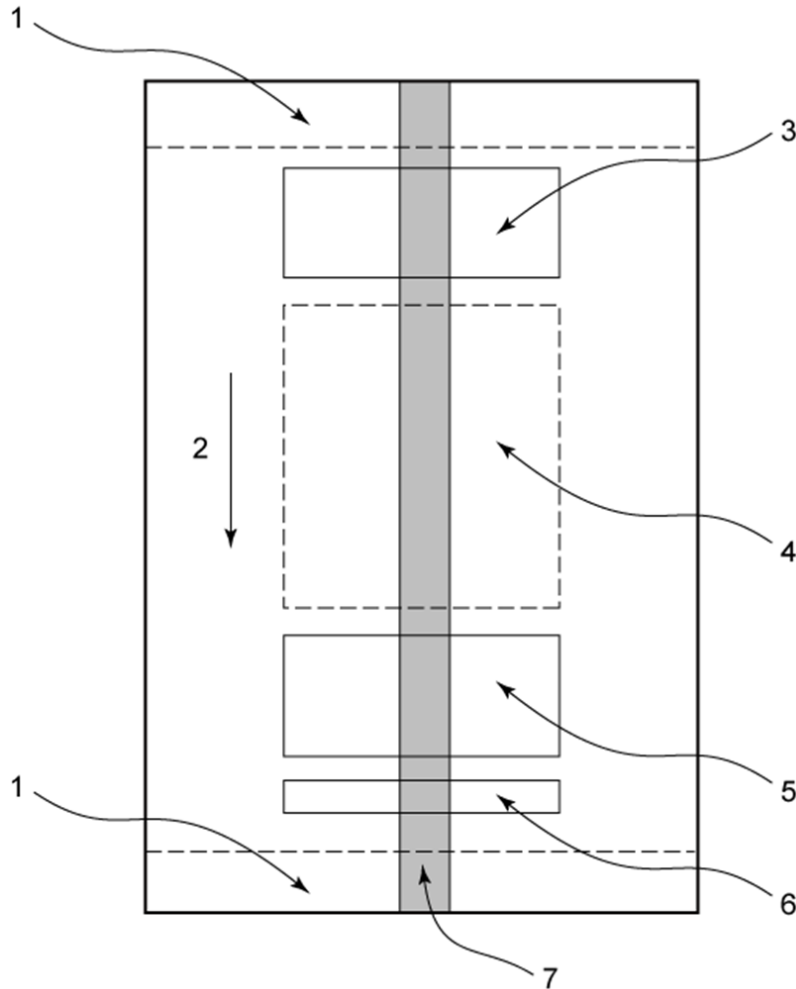


3mm Butt weld AA6082

- Tool design for 3mm AA 6082-T6



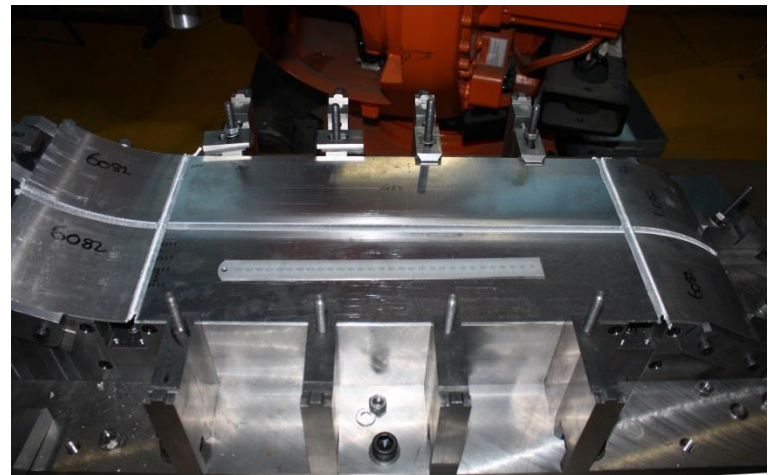
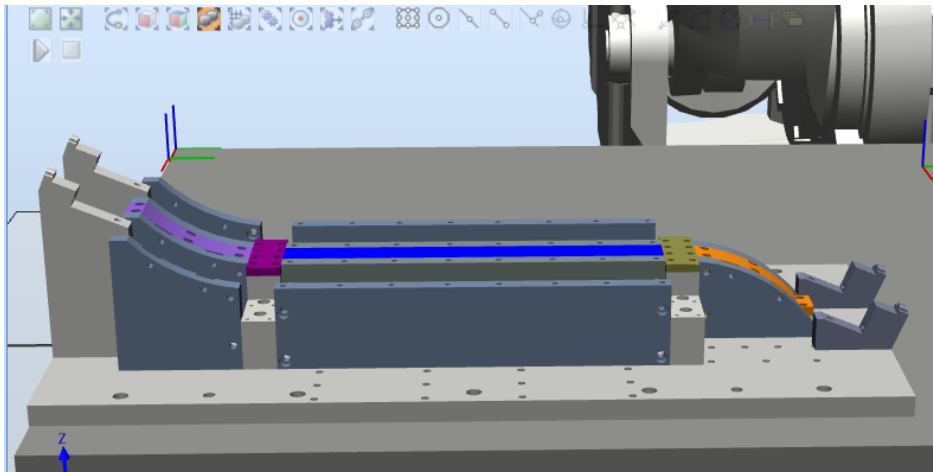
ISO 25239 (500mm long)



1. Discard 50 mm from each end
2. Direction of welding
3. Tensile, bend or fracture test specimens
4. Area for additional test specimens
5. Tensile, bend or fracture test specimens
6. Test specimen for macroscopic examination
7. Weld

3D Bobbin (3mm AA6082)

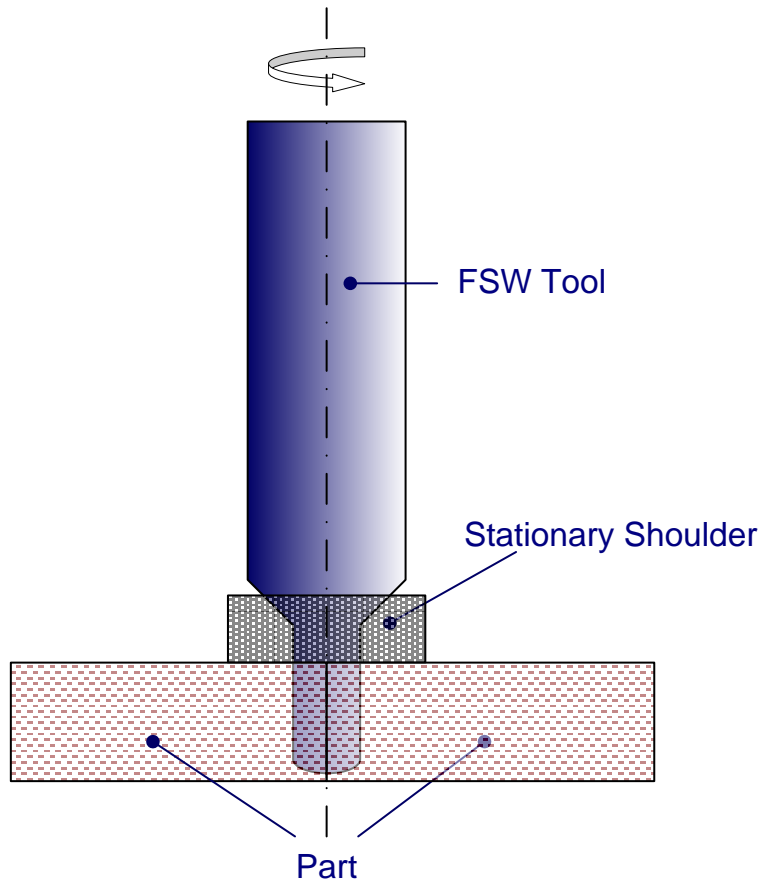
- FSW Robot on the new 3D-fixture



3mm Butt AA6082 3D

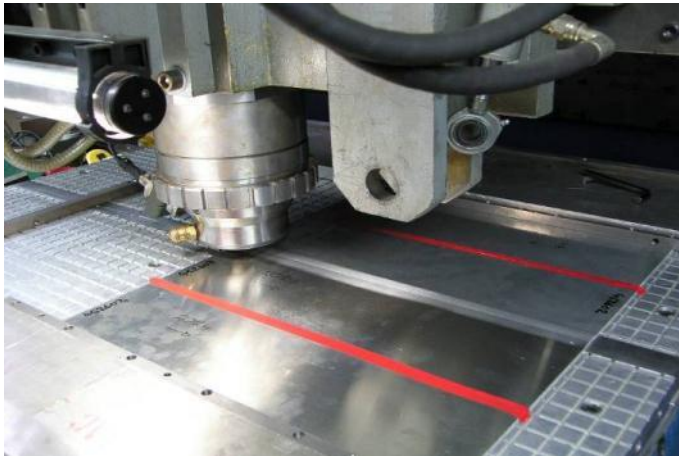
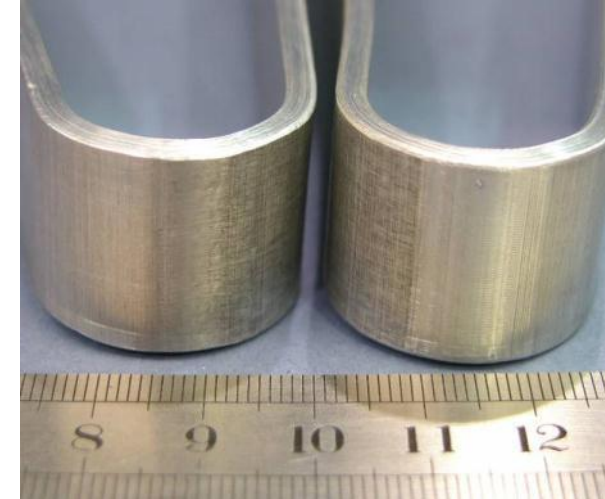
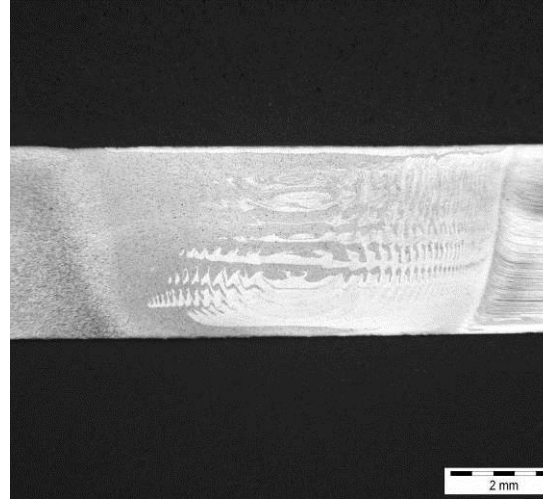


Stationary Shoulder FSW



- Originally developed for FSW of low conductivity materials i.e. titanium
- The FSW probe rotates through a stationary shoulder / sliding component.
- The non-rotating shoulder component adds no heat to the weld surface.
- The resulting heat input profile is basically linear.

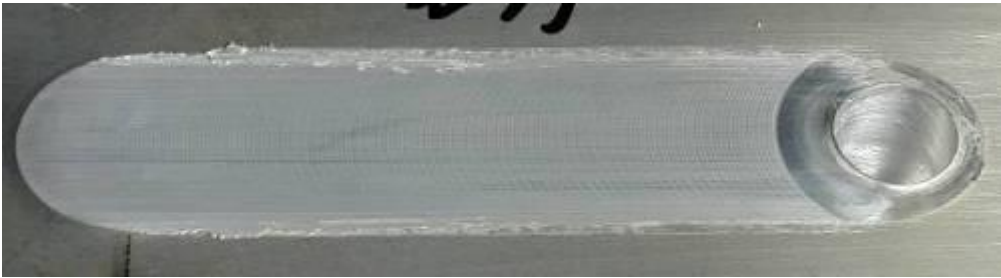
SSFSW for Al Alloys



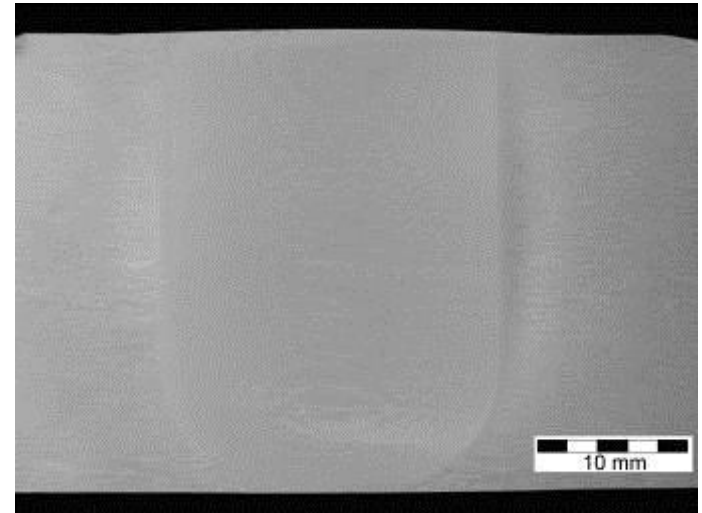
- Results in improved surface finish, no surface undercut, reduced surface heat input and significantly lower process forces

Stationary Shoulder FSW

Thick Section Welding

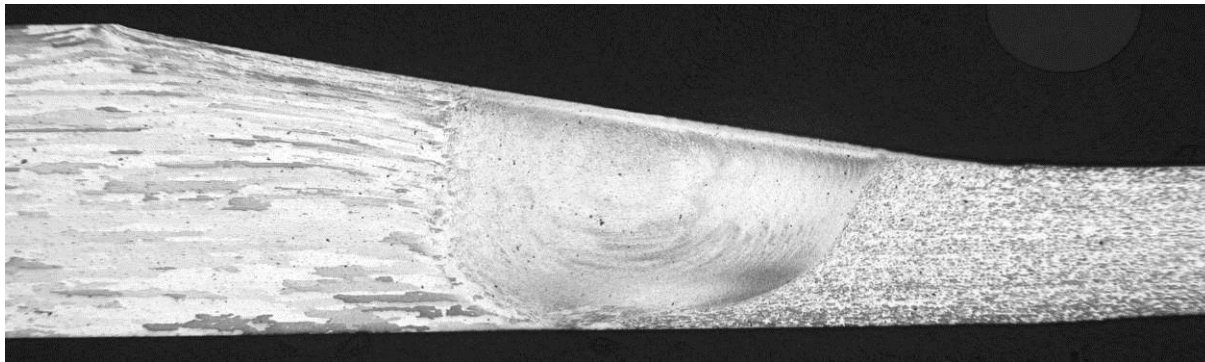
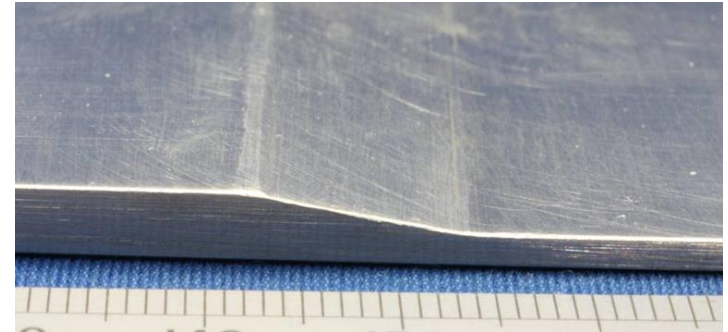
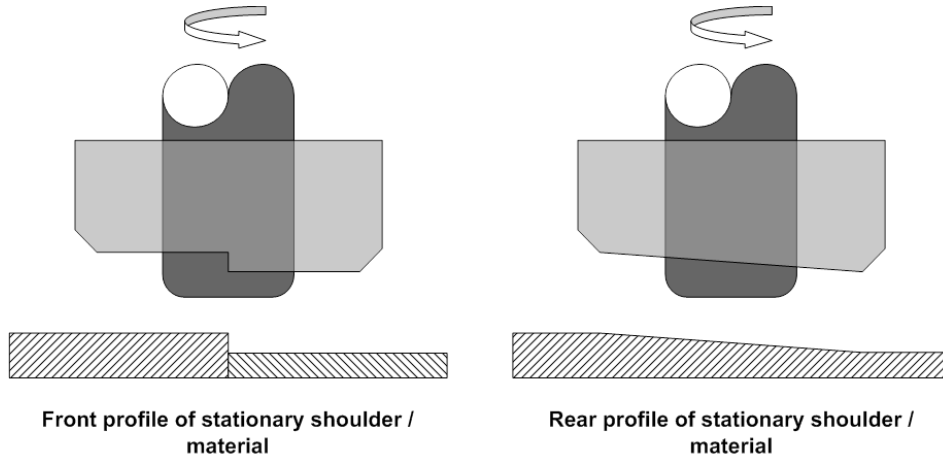


AA6082-T6
30mm Bead on Plate



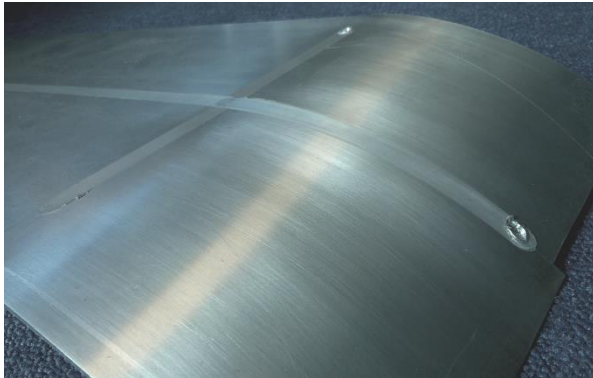
AA6082-T6
30mm butt weld

Stationary Shoulder FSW Tailored Blank

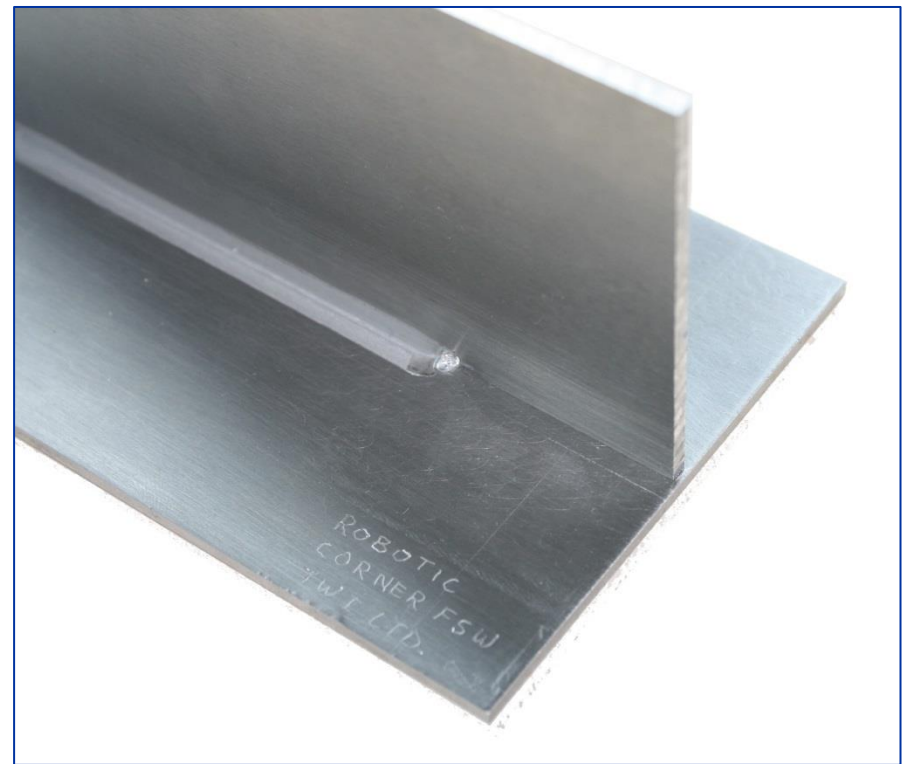


SSFSW of 2mm to 4mm AA6082

- 3D SSFSW in AA 6082-T6
 - ▣ Void-free welds
 - ▣ excellent surface finish

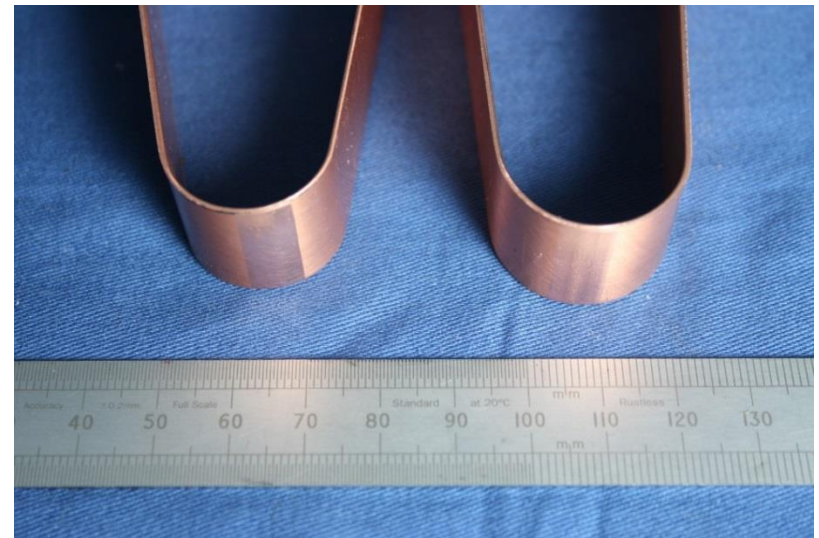


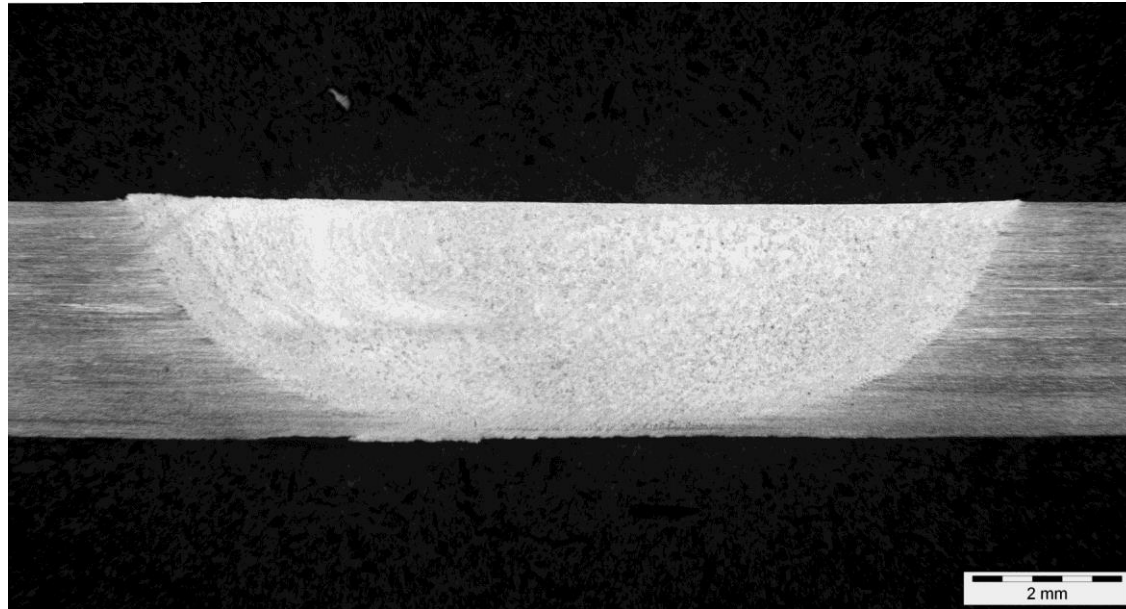
- Corner & AdStir Welding Technique Development
 - ▣ Sample



- FlexiFab film – Stationary Shoulder FSW







11th FSW Symposium

- 17 – 19 May 2016 – TWI Cambridge
- 25th anniversary of FSW

