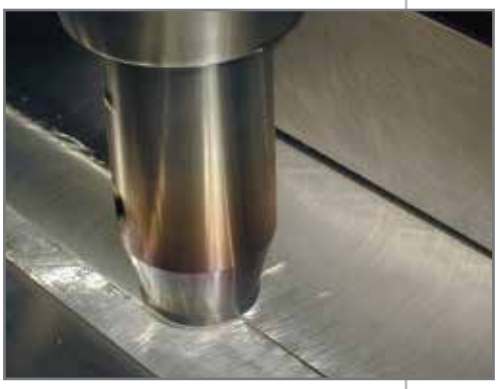
Concurrent Technologies Corporation
Friction Stir Welding

Friction Stir Welding (FSW) is a joining process that offers significant advantages over conventional arc welding methods, especially for thick aluminum structures. FSW utilizes friction between the tool and material to heat (but not melt), soften, and "stir" material across the joint to produce a solid-state weld. Concurrent Technologies Corporation (CTC) has repeatedly proven the superior performance and cost effectiveness of FSW relative to other conventional welding solutions.



FSW circumvents or minimizes many arc welding difficulties. Applications include ground vehicle structures, trailer beds, ship deck structures, ballistic and blast test panels, armor panels, and more.

FSW Advantages Compared to Arc Welding

- Improved mechanical properties
  - For 2xxx, 5xxx & 7xxx, FSW joints have superior performance in Ultimate Tensile Strength and Elongation minimum requirements compared to traditional fusion welding
- Reduced post-weld rework and fit-up issues
  - Solid-state friction stir welds have less weld distortion and build-up of residual stresses
- Enables joining of dissimilar alloys with equal/better joint properties than joints made of lesser alloy
  - 5xxx to 2xxx, 5xxx to 7xxx
- Enables joining of different product forms
  - Castings to forgings, forgings to plate, extrusions to plate
- Much simpler process (Computer Numerical Control [CNC]) with fewer variables to control in manufacturing
  - Reduces variability or "art" inherent in traditional joining processes
  - CNC speeds and feed rates
  - Much higher joint quality, repeatable
- Lower training requirement for operators
  - CNC operators as compared to aluminum arc welders
- Significantly higher production rates for thick materials
  - 2-inch thick aluminum plate can be joined at over 2 inch/minute in a single pass
- Minimizes environment, health and safety concerns – "Green"
  - Near zero dangerous fumes and emissions
  - No arc or high electrical current at the weld
  - No weld consumables (electrodes or gases)

What We Can Do For You

- Design for FSW Manufacturability
- Tool/Fixture Design & Fabrication
- Process Development & Optimization
- Mechanical Testing & Analysis
- Demonstration Article Fabrication
- Low Rate Initial Production
- FSW Equipment Design & Fabrication
- Implementation
- Research and technology transition to client's product
- Qualification to AWS D1.2, D17.3 and ABS

FSW has made the structures of these vehicles stronger and more battlefield survivable.

Paladin Howitzer. Photo courtesy of the U.S. Army.

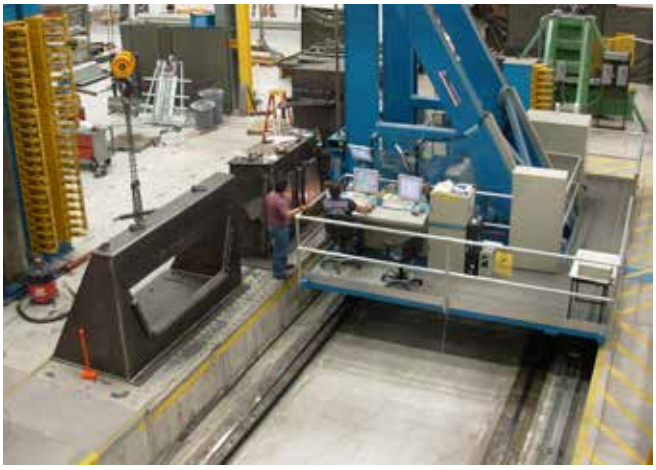
Assault Amphibious Vehicle. Photo courtesy of the U.S. Marines.

The Concept for Advanced Military Explosion-mitigating Land Demonstrator (CAMEL). Photo courtesy of the U.S. Army.

(continued)

FSW Equipment at CTC

- Flexible fixtures for routine and special requirements
- Full load and torque cell instrumentation on 8-axes of motion
- Real time monitoring for R&D and process optimization
- Physical Specifications:
  - 26’ x 12’-9” x 20” work envelope
  - X-axis: 12 kips; 60 in/min (primary horizontal)
  - Y-axis: 12 kips; 26 in/min (vertical)
  - Z-axis: 30 kips; 10 in/min (plunge)
  - Spindle: 1,500 lbf-ft; 700 rpm



This large FSW machine is ideal for process development, prototyping, and fabrication of large structures.

FSW Project Examples

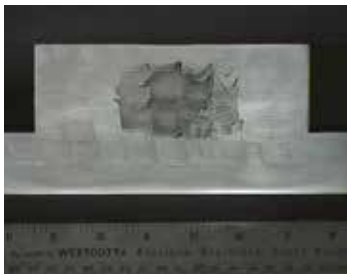
Seaming Together Large Plates

CTC’s FSW machinery is able to seam together large plates, such as the pictured three four-foot by twelve-foot plates. CTC can create the necessary plate size for clients from standard mill run stock plates. FSW improves strength and resistance compared to traditional welding techniques.

Manufacturing Ground Combat Vehicle Prototype Hulls

CTC is collaborating with Tank Automotive Research Development and Engineering Center (TARDEC) to improve the manufacturing of the U.S. Army’s friction stir-welded Hull Frame Body Cab (HFBC) prototype hulls for the Next Generation Combat Vehicle. OPSEC SOP #29698

Employing FSW Techniques to Additive Manufacture Dissimilar Alloys



CTC developed FSW techniques to additive manufacture (AM) complex multi-alloy structural components. The evaluation of FSW-AM blended dissimilar alloys discovered the ability to embed high strength alloys into structural components, as well as the ability to engineer the load paths with the desired alloy characteristics. Due to this new technique, CTC can leverage innovative but practical designs to make lightweight but stronger structures compared to traditional designs.

Developing a Low-Cost FSW Machine for the Littoral Combat Ship (LCS) Program

CTC developed a transportable FSW machine to be used on the Littoral Combat Ship (LCS) program. Leveraging fixed geometry welding tool technology, CTC was able to design and produce a low-cost FSW machine. The machine’s functionality and quality was proven through producing numerous representative panels and conducting tests of panels and joints.

Quality Commitment | Concurrent Technologies Corporation (ctc.com)

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