



SuperStir™

Friction Stir Welding - **quality in depth**

ESAB

■ Your full-service global partner

With one of the industry's largest and most advanced R&D departments and a global network of support and maintenance services, ESAB's cutting edge technology is never further than a call away. This close relationship translates into speedy technical support, effective preventive maintenance and relevant upgrades. Active dialogue with customers assures the ongoing upgrade of products and services, to exploit the full potential of the latest materials and technologies. Designed for exceptional productivity in the toughest industrial environments, ESAB products also comply fully with international standards and the latest EU legislation. ESAB – another name for future-ready.

FSW – 'revolutionary' welding technology

Friction Stir Welding (FSW) is a truly 'revolutionary' process, developed and

patented by TWI in the UK in 1991.

As a joint sponsor of its ongoing development and commercialisation, ESAB has been instrumental in promoting the multiple industrial applications of this innovative technology.

Stirred – not melted

ESAB innovations have stirred the welding industry since 1904. One of our latest innovations stirs more than market emotions – it stirs the material – but without melting it. Like all the best ideas, the principle – based on friction – is disarmingly simple. A rotating pin-shaped tool is plunged, under considerable pressure, into the joint between two firmly clamped workpieces. Friction between wear-resistant tool and workpiece 'plasticizes' the metal, but without melting it. As the tool moves along the joint, the plasticized material is transferred to its trailing edge.

On cooling, the material forges a solid-phase bond between the two pieces.

This innovative solid-state method opens up a whole new range of welding possibilities: the low melting points of soft non-ferrous metals no longer pose a problem. Bending and tensile tests have confirmed superb rigidity and excellent fatigue resistance. Post-treatment is minimal, thanks to a perfect root surface and virtually stress-free weld. And the finished joint comprises original material only – no inclusions or impurities.

ESAB's ongoing development programme is producing an ever-expanding range of applications. Friction Stir Welding is ideal for joining straight profiles and flat plates. With larger and more powerful welding heads and improved rotating tools, our latest FSW machines can weld flat plate in thicknesses from 1.2 to 130 mm, with full penetration.



■ **Cleaner, quieter, safer**

SuperStir™



Win-win welding!

In contrast to conventional welding techniques, the FSW process requires no filler material, gas or other consumables – and consumes much less energy. Generating no harmful gases, no slag, no spatter and little sound, the process actively contributes to a better working environment, while simultaneously boosting productivity. Best of all, weld quality is unrivalled. The complete lack of voids and impurities and the fact that the material has been plasticized – not melted – ensures exceptional weld strength. This makes the technique especially suitable for the volume production of flat or curved panels, where safety-critical welds must be flawless – as in the shipping, offshore, rail and aerospace industries.

Full-scale automation for high-volume applications

The ESAB SuperStir™ range is purpose-built for high-volume production of large aluminium panels, girders and trusses. These large custom-designed units offer a safe, clean and simple welding process that can be fully automated, dramatically reducing production costs.

Whatever your requirement – operator-controlled units for the workshop, fully-automated industrial scale units for the heavy engineering industry or robotic units for the components industry – ESAB Friction Stir Welding is the answer.



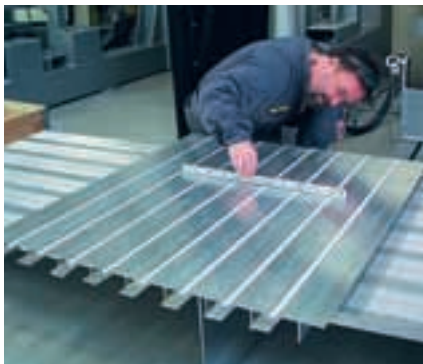
Multiple choice

■ Much more than aluminium

Friction stir welding produces excellent results with all non-ferrous metals (aluminium and copper alloys, magnesium, zinc and lead). But more is possible. Ongoing research indicates that the technique also offers considerable promise in welding mild steels, stainless steels and titanium. This presents exciting possibilities in every industrial sector.

Make your weld joint the strongest point

Whatever your sector – shipbuilding, offshore, aerospace, transport, contracting, defence or the processing industry - friction stir welding offers multiple benefits. Quite apart from improved operational safety, simplified automation, no consumables and



low energy costs, FSW produces welds of unrivalled quality. So good, in fact, that the technique can also be used for material enhancement – Friction Stir Processing.

Other key benefits include

- Minimal distortion and shrinkage
- No joint preparation – degreasing only
- No grinding, polishing or straightening
- No repair welding
- Reduced weight (40% less than GMAW)
- High joint-gap tolerance
- Consistent weld quality
- Increased tensile strength
- Outstanding fatigue properties
- No fumes, sparks or spatter
- Low noise level
- Simple operation (HMI)
- Improved repeatability

From deep-sea drilling rigs to outer space...

Friction Stir Welding is ideally suited to the production of flat or curved panels, in industrial applications where the demand for high productivity is matched by the demand for outstanding weld quality. Current applications include the on-site production of structural panels for high-speed ferries

and ships, offshore platforms, rolling stock and fuel tanks for space rockets.

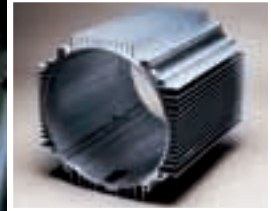
The automotive industry is also exploring ways in which automated Friction Stir Welding can help it generate large quantities of faultless parts from cut extrusions.

The aerospace industry has been quick to see the potential too. It already exploits the technology to construct fuel tanks for rockets and is assessing its viability in airframe construction.

...and the applications just keep multiplying!

The possibilities for friction stir welding seem endless. Current applications include the fabrication of complex cooling blocks and coolers, electrical motor housings, complex beams, for seal welds, joining tailor blanks, constructing panels with stiffeners or joining different material combinations (copper/aluminium, magnesium/copper etc).

The process may even be used for material improvement, or Friction Stir Processing. This technique is ideal for enhancing the material properties of components subjected to extreme stress, like piston surfaces in diesel engines.



Flexible

Flexibility for more varied production



Modular flexibility for 'standard' applications

A modular concept, the ESAB LEGIO™ system offers optimum flexibility and economy. Comprising five basic designs, available in seven sizes, this FSW system enables welding depths from 1.2 mm to 65 mm (100 mm). Designed for 'standard' applications, a broad range of supplementary equipment is available to further enhance flexibility. Combining the latest technology with proven quality, the modularity of the ESAB LEGIO™ concept makes the most varied friction stir welding applications possible – including small batches in varied sizes.

The S and U models are designed for ease of integration with larger fixtures, rotary units and exchangeable clamping systems. For the production of smaller workpieces, UT or ST models are recommended. These models have tables with pre-cut hole patterns, for attaching fixtures.

Robotised for more complex applications

Designed for complex joints, particularly in the aluminium 6000 series, the ESAB FSW robot system, Rosio™, features full integration of the friction stir welding equipment, for unrestricted reach (> 2.5 metres) and flexibility.

The latest IRC5 control system, featuring embedded force control, ensures high accuracy in-contact motion. The upgraded motion software permits linear welding in arbitrary patterns, as well as circular and square paths. Additional functionalities, to support customized path programming and spindle operation, permit advanced welding, even with limited programming skills. A user-friendly HMI extends the IRC5 interface, providing full operator feedback via a Flex Pendant.

ESAB SuperStir™ FSW technology is applied across the entire industrial spectrum, from shipping, offshore, construction and transportation to defence and aerospace. Already used in welding a broad range of light metals, current research also points the way to applications for mild and stainless steels – even titanium. Benefits include improved operational safety, simplified automation, reduced energy costs and the elimination of consumables. Combining high productivity with outstanding weld quality, this fume, spark and spatter-free technology is revolutionizing the fabrication of flat and curved panels – as discovered by Boeing, SKB, Marine Aluminium and others.



The Boeing Company, USA

- A longitudinal welding machine, plus handling equipment for welding of fuel tanks for the Delta II programme of space rockets.
- Two vertical welding machines for longitudinal welds on fuel tanks for the Delta IV programme of space rockets.
- A special lab unit for Adaptive Pin Tool and Bobbin Tool test production.
- A small production machine used as a lab unit, complete for both longitudinal and circumferential welding of 2000- and 7000-series.
- A complete plant designed for circumferential welding of fuel tanks, also including a friction plug welding unit.



Photo courtesy of Swedish Nuclear Fuel and Waste Management Co. (SKB)

SKB, Sweden

ESAB supplied a SuperStir™ FSW system to the Swedish Nuclear Fuel and Waste Management Company (SKB) in early 2003. The system was manufactured in Sweden at ESAB's Laxå facility.

SKB initiated tests with EBW (Electron Beam Welding) at its Canister Laboratory in 1986 and, following the introduction of FSW technology, embarked on joint tests with UK-based TWI (The Welding Institute) in 1997.

Since installation of the FSW system in 2003, SKB has welded a large number of canisters, employing both the EBW and FSW systems, for purposes of comparison. In 2005, FSW was the welding method selected for the future production facility (Encapsulation Plant).



Marine Aluminium, Norway

This Norwegian company has installed an ESAB SuperStir™ system for the production of 16x6-meter flat panels, freezing blocks, coolers, rail wagon parts, H-beams, road signs and barriers, as well as complex extrusions.

World leader in welding and cutting technology and systems



ESAB operates at the forefront of welding and cutting technology. Over one hundred years of continuous improvement in products and processes enables us to meet the challenges of technological advance in every sector in which ESAB operates.

Quality and environment standards

Quality, the environment and safety are three key areas of focus. ESAB is one of few international companies to have obtained the ISO 14001 and OHSAS 18001

standards in Environmental, Health & Safety Management Systems across all our global manufacturing facilities.

At ESAB, quality is an ongoing process that is at the heart of all our production processes and facilities worldwide. Multinational manufacturing, local representation and an international network of independent distributors brings the benefits of ESAB quality and unrivalled expertise in materials and processes within reach of all our customers, wherever they are located.

ESAB Sales and Support offices worldwide



* Includes manufacturing facilities of ESAB North America. A wholly owned subsidiary of Anderson Group Inc.



ESAB AB
Welding Equipment
SE-695 81 LAXÅ, Sweden
Phone: +46 584 810 00
Fax: +46 584 41 17 21
www.esab.com

