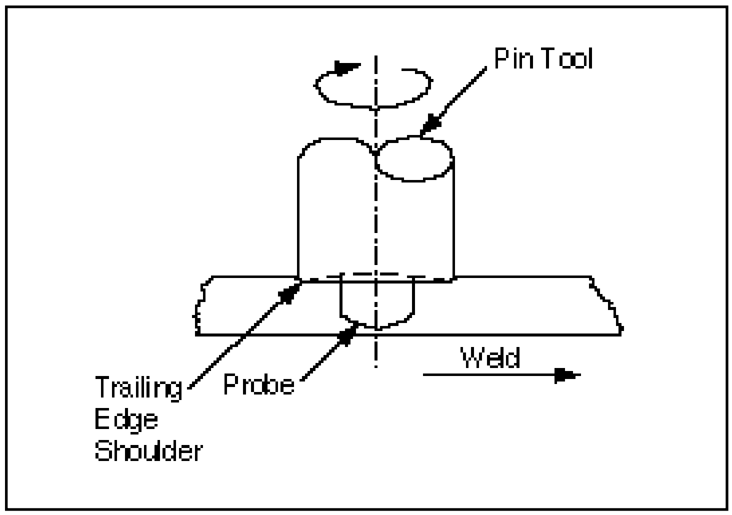
Technology Opportunity

Friction Stir Welding at Marshall Space Flight Center (MSFC)

Marshall Space Flight Center (MSFC) engineers, working in the Metallurgical Research and Development Branch of the Materials and Processes Laboratory, have developed a welding process with the capability to make straight line welds without bringing the parent materials to the liquid stage. This revolutionary, solid state welding process has the potential to change the way aluminum alloys, aerospace materials, and commercial materials are joined in the future.



Potential Commercial Uses

Within both the aerospace industry and the commercial sector there is considerable interest in the development of the friction stir welding process for use in manufacturing. The weld process is optimized for use in straight line, constant thickness welds. And, the process is safe–no high voltage, liquid metals, or arcing. Aerospace companies such as McDonnell Douglas, Lockheed-Martin, and Boeing are pursuing the process.

Benefits

The key benefits of this newly developed welding process include an increase in joint efficiency and process robustness, as well as a greater range of applicable alloys that can be welded. Friction stir welding will permit production welding opportunities relative to dissimilar alloys and materials previously thought to be “unweldable” such as aluminum alloy 7505. Composite materials are also candidate materials for this welding process. Friction stir welding’s solid-phase, low distortion welds are achieved with relatively low costs, use simple energy efficient mechanical equipment, and require minimal operator expertise and training.

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The Technology

Friction stir welding can be done with a modified end mill type machine and a specially designed pin tool with a probe length less than the weld depth required. The welding process is started by plunging the rotating shouldered pin tool into the aligned faying work-piece faces until the tool's shoulder is in intimate contact with the work surface. The rotating probe within the work-piece produces friction, which heats the metal and produces a plasticized tubular column of metal around the probe. As the pin tool is moved in the direction of the welding, the leading face of the probe crushes and forces plasticized material to the back of the pin, while the system applies a substantial downward mechanical forging force. This force consolidates the weld metal into the weld joint at the trailing edge of the tool. A simple butt joining weld configuration can be used with no requirements for filler materials or shielding gases.

The development of friction stir welding is expected to lead to a considerably wider use of aerospace materials in many sectors of the commercial market.

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Key Words

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