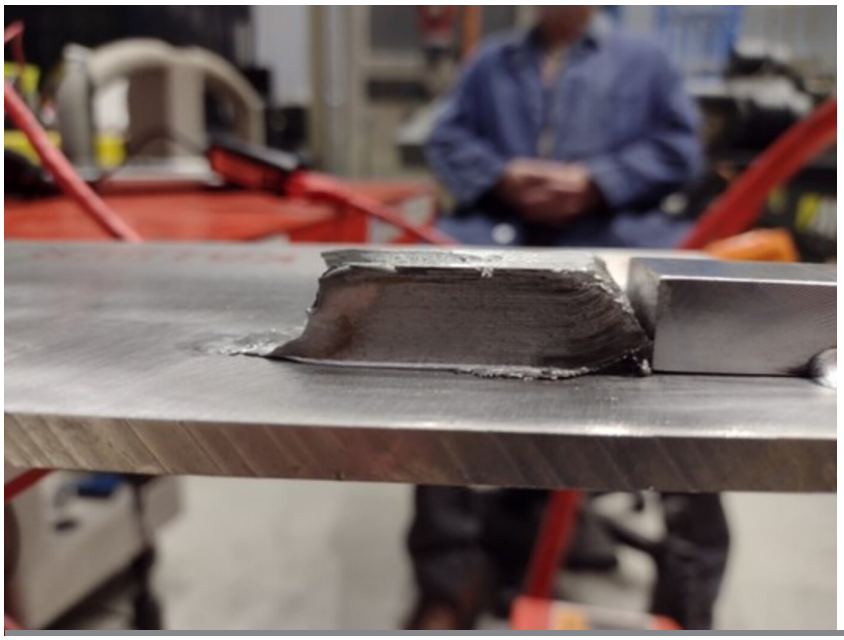


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Manufacturing

Conventional friction stir extrusion machine

Retrofit friction stir welding tools for advanced metal extrusion

NASA Marshall Space Flight Center has developed a new small-scale metal extrusion tool, called a conventional friction stir extrusion (C-FSE) machine that may be attached or added-on to a conventional friction stir welding (C-FSW) system. The C-FSE machine uses the heat generation and plastic deformation processes underpinning C-FSW to perform metal extrusion instead of metal joining. The new tool can perform small-batch extrusion runs with custom geometries that can be easily changed by replacing the modular extrusion block face plate. Compared to traditional metal extrusion processes, large billets of metal do not have to be preheated prior to the extrusion for the C-FSE machine as raw metal rods can be fed directly into the extrusion block, saving significant tooling and energy costs. The C-FSE machine can work with any metal alloy that is amenable to FSW processes, including aluminum alloys and other lightweight or exotic alloys.

BENEFITS

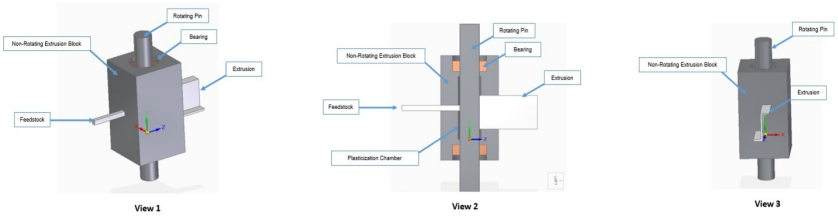
- Reduced capital cost: the extrusion tool can be retrofit onto an existing FSW system.
- Easily customizable extrusion shapes: the extruded metal geometry is defined by a modular face plate that can be easily swapped for different profiles.
- Cost-effective, low-volume runs: compared to typical metal extrusion, the C-FSE tool can cost-effectively perform small metal extrusion runs.
- Raw metal input: no pre-heating is required of the standard raw metal feedstock used as an input in the C-FSE machine.
- Flexible: C-FSE machine is amenable to using any FSW-ready metal.

THE TECHNOLOGY

Typical metal extrusion relies on heating large metal billets and then forcing the heated billet through a dye to extrude the geometry and length of interest. These processes require high energy inputs, expensive machinery to heat and manipulate the billets, and the length of the final part is limited by billet size. Thus, new ways to cost effectively and efficiently produce extruded parts are needed.

The C-FSE machine developed by NASA encompasses a non-rotating extrusion block and a rotating pin that extends through the chamber. The extrusion block has a close tolerance fit to the rotating pin to prevent material from escaping from the ends of the block. Raw metal feedstock is fed into one side of the chamber, the rotating pin interacts with the metal to generate plastic deformation and heat, and the metal is driven out the other side of the extrusion block through a customizable die. As the C-FSE machine does not require pre-heated billets, the extruded parts may be of any desired length. Further, the extrusion machine is modular in nature and may be retrofitted onto an existing FSW system, and the die may be easily replaced for varying extrusion geometries. The C-FSE machine has been prototyped and used to produce freestanding metal parts.

The C-FSE machine is at technology readiness level (TRL) 4 (component and/or breadboard validation in laboratory environment) and is available for patent licensing.



Three views of the designed and prototyped conventional stir friction extrusion (C-FSE) machine showing the extrusion block, rotating pin, and metal feedstock being forced through the assembly.

APPLICATIONS

The technology has several potential applications:

- Aerospace: metal component (e.g., rib stiffeners) manufacturing
- Automotive: metal part extrusion
- Railway cars: metal part extrusion
- Ship building: metal part extrusion

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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