Industrial Processes

Non-Destructive Evaluation Methods for Friction Stir Welding

Partner with NASA to help understand defect formation

Friction stir welding used in Ares I upper stage fabrication.

The Non-Destructive Evaluation (NDE) team at NASA's Marshall Space Flight Center seeks a partner that can provide information and expertise to support a study of how defects are created during various friction stir welding (FSW) techniques. In addition, the NDE team hopes to determine how the defects affect welded materials and which defects are mission-critical (that is, what types of defects could cause breach of pressure vessels leading to catastrophic loss of spaceflight hardware or entire spaceflight vehicles).

Requirements

The NDE team seeks organizations that can provide access to "effects of FSW defects" data on materials and weld types used by NASA or that can produce this data via a joint partnership. NASA is interested in the following specific information:

- Types of defects created during FSW, self-reacting FSW, and plug welding
- Methods of detecting and evaluating the size, depth, and other measurements of the defects
- Methods of creating specific defects with consistent volume, cluster, depth, and other qualities
- Tests and methods to determine critical effects on test materials
- Commercial-off-the-shelf (COTS) applications and software that enable the detection and characterization of FSW defects and provide easy-to-interpret data

technology need

For More Information

If you are interested in more information, or want to pursue partnership or collaboration with Marshall Space Flight Center in the development of NDE Methods for Friction Stir Welding, please contact:

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Details

To support Marshall Space Flight Center's spaceflight hardware, the NDE team uses the best available NDE tools to evaluate and test hardware for defects. FSW, a solid-state phase approach to joining two metal surfaces without melting, is an increasingly used hardware joining method that is susceptible to unique defects when not under control. NASA uses self-reacting FSW (SR-FSW), conventional FSW, and friction plugs.

FSW uses frictional heating combined with high forging pressure to produce high-strength bonds. SR-FSW utilizes a reacting threaded nut on the opposite side of the pin, enabling mixing from both sides. Conventional FSW utilizes a single pin tool, mixing from one side only. Finally, friction plugs are usually extruded and used in a high-rotational frictional press, which plugs a pre-drilled hole for the purpose of closing out circumferential welds (usually SR-FSW).

FSW techniques do not create toxic fumes, require no consumables, and allow welds to be made on aluminum alloys that cannot be readily welded using fusion-arc methods. These qualities have increased NASA's use of FSW for hardware construction efforts, and the NDE team is seeking to improve its FSW defect detection capabilities. While improved detection for all types of defects is desirable, particularly important is detection of:

- Kissing bonds (e.g., tight LOP in conventional FSW)
- Sub-surface tears (associated with the precursor condition to galling in SR-FSW)
- Laminar-type defects (e.g., lack of adequate forging)
- Small, low-volume defects (e.g., wormholes, inclusions, residual oxides, joint line remnant)

Because NDE is most often conducted in the field, the team is also seeking partners with techniques and instruments that will enable improved field-testing.

Partnering Opportunities

Fulfilling NASA's need for improved NDE methods for FSW may also lead to commercial products or innovations. Companies are invited to inquire about partnering opportunities that may help NASA efficiently and effectively meet this need.

Dual-Use Applications

Other industries may also benefit from this information and provide the basis for future partnerships. Those industries include:

- Aerospace manufacturing
- Shipbuilding and marine industries
- Automotive manufacturing

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