

Marshall Space Flight Center

Advanced Metal Joining Facility

A One-stop-shop for Aerospace Welding and Manufacturing Solutions

Advanced Weld Process Development and Manufacturing

The Welding and Manufacturing Team at NASA's Marshall Space Flight Center (MSFC) has pioneered the development of metal joining and manufacturing processes for a wide variety of applications including manufacture of large propellant tanks and primary vehicle structures. During the 1980's and early 1990's, MSFC led the development of the first variable polarity plasma arc welding systems. MSFC also has developed and patented a plasma welding torch that was used for External Tank production and is still widely used in the launch vehicle industry today. Engineers at MSFC matured the friction-stir welding process to full implementation on NASA flight programs. Most recently, a Self-Reacting Friction Stir Welding (SRFSW) process was developed to manufacture the Space Launch System (SLS) Launch Vehicle Stage Adapter (LVSA), and a Friction Pull Plug Welding (FPPW) process was developed to perform close-outs of SRFSW welds on the SLS Core Stage fuel tanks.

From welding process development, process qualification, tooling design, full scale implementation, and flight hardware manufacturing – the MSFC welding and manufacturing team is truly one's one-stop-shop for aerospace welding and manufacturing solutions.

Capabilities

Welding and Manufacturing

- On-site manufacturing facilities including major high bays capable of accommodating the assembly of full-scale launch vehicle structures.
- Two available and highly portable handheld laser-brazing systems that were developed for in situ repair of nozzle cooling tubes on the space shuttle main engine.
- Laser and electron-beam welding techniques have been developed for manufacturing flight hardware components for Enviromental Control and Life Support System (ECLSS) and the International Space Station (ISS). Laboratory engineers supported procedure



Completed Launch Vehicle Stage Adapter manufactured in the Advanced Metal Joining Facility.



Gas Tungsten Arc welding of the Cryogenic Propellent Storage and Transfer Tank.



Computer Aided Design (CAD) can be used for fixtures needed for complex welding of structures. Shows fixture for the manufacture of LVSA.



Stress analysis for large scale tooling can be accomplished using Finite Element Analysis.

development and qualification for the hardware, which was manufactured and welded in-house at MSFC.

- Weld analytical modeling tools have been developed and used extensively to solve process anomalies and push the state of the art for advanced joining techniques.
- Extensive experience developing tooling and fixtures for large-scale, high-value, manufacturing projects.
- All welding and manufacturing processes are critically evaluated through Non-destructive Evaluation (NDE), metallurgical evaluations and mechanical property testing.
- Cross-disciplinary, vehicle-level manufacturing planning for optimizing process flows, facility utilization plans and requirements, tooling concepts, and cost estimates.

Experience

- In-house manufacture of the Launch Vehicle Stage Adapter and Multi-purpose Crew Vehicle Stage Adapter (MSA) for the Space Launch System. Developed welding processes, designed novel modular tooling, fabricated structures, and performed final dimensional verifications with advanced metrology techniques.
- Manufactured aluminum test tanks for the Cryogenic Propellant Storage and Transfer (CPST) project using gas tungsten arc welding and simplified tooling.
- Fabricated several 27.5 foot-diameter and 8-foot-diameter Shell Buckling Barrel Assemblies for testing to validate and update models for launch vehicle core structures.
- Development of Thermal and Ultrasonic stir Welding processes continues. Thermal stir welding of 0.5" thick titanium gun turrets have been successfully completed for the Navy.
- Friction-stir weld development for high temperature alloys such as GRCop-84, Haynes 230, IN 903, A286, and JBK75 for large rocket engine nozzles and components.
- Glovebox fusion welding of niobium and tantalum refractory metal assemblies for Nuclear Thermal Propulsion components.

Key Benefits

- · Advanced in-house facilities and tools
- · Widely recognized welding engineering expertise
- Cross-discipline integrated approach to joining solutions.



Vertical Weld Tool (VWT) can weld barrels up to 25 feet tall and 40 feet diameter.



Robotic Weld Tool (RWT) seen Friction-stir Welding a ring frame to dome body. Used for complex curvature welding up to 36 feet diameter and 22.5 feet tall.



Hi-bay area showing several domes in finished and un-finished state. The Robotic Weld Tool is seen at the top right-hand corner and the Vertical Weld Tool is seen as the large structure on right.

Doing Business With MSFC



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MSFC-02-2025-G-657270 (10)