



# Marshall Space Flight Center Materials and Processes Laboratory



Materials and Manufacturing Solutions for Space Science,  
Exploration, and Life on Earth

## Marshall's Materials and Processes Laboratory

has provided core capabilities for NASA for over fifty years. Marshall has a proven heritage and recognized expertise in materials and manufacturing that are essential in enabling and sustaining space exploration. We provide a “systems-wide” capability for applied research, flight hardware development, and sustaining engineering. The Materials and Processes Laboratory has provided leadership for the materials and manufacturing discipline through many of NASA’s most notable projects including Apollo, Skylab, Mir, Spacelab, Space Shuttle (Main Engine, External Tank, Reusable Solid Rocket Motor and Booster), Hubble, Chandra, and the International Space Station.

The Materials and Processes Laboratory has extensive experience in metals, composites, ceramics, additive manufacturing, materials and process modeling and simulation, space environmental effects testing, non-destructive evaluation, and fracture and failure analysis. The laboratory provides products ranging from materials research in space to fully integrated solutions to the challenges of large complex space systems. The advanced materials research, development and manufacturing capabilities at Marshall assure that NASA has access to cutting-edge, cost-effective engineering design and production options capable of using frugal design margins that are verifiably safe and reliable. These capabilities are critical for both future mission success and affordability.

Marshall has a unique capability to develop technology for materials and manufacturing.

Marshall has a unique capability to develop technology for materials and manufacturing.

The Laboratory develops, builds, and demonstrates capabilities that solve production challenges in exploration systems. The materials diagnostic and evaluation capabilities provide rapid-response problem assessment and mitigation throughout all phases of programs. Our unique technology development capability for the Virtual Enterprise, for example, will develop, demonstrate, and transition new or improved methods and models for integrating design, manufacturing and supply chain management.

Marshall’s Materials and Processes Laboratory manages the National Center for Advanced Manufacturing (NCAM), NASA’s chief resource for aerospace manufacturing research and development. Research and development in materials and manufacturing is critically important in enhancing the nation’s global aerospace and manufacturing competitiveness. Through NCAM facilitated partnerships and innovative developments such as the maturation of friction stir welding, the Laboratory’s capabilities contribute to the viability of the domestic aerospace structures manufacturing industrial base. Subject matter experts provide Marshall a direct link to critical sub-tier suppliers and the pressing issues in the aerospace industrial base. Fundamental materials research contributes to the domestic knowledge base and fosters innovation in the commercial sector. Marshall’s materials and manufacturing capabilities also frequently “cross-fertilize” with national priorities such as defense, science, homeland security, energy, and civil industry and infrastructure. The uniqueness of Marshall’s research and development capabilities are a tremendous asset to private industry and other government agencies.



# Capabilities



## Materials Testing

- > Mechanical Testing at elevated and cryogenic temperatures, along with chemical, crystallographic, thermal and thermophysical material properties.
- > Evaluations of oils, greases, dry film lubes and coatings on materials, along with highly accurate dimensional and surface measurement expertise.
- > Bearing applications and computer modeling of bearing systems.



## Nonmetallic Materials and Manufacturing

- > Provide research, technology, and engineering solutions for nonmetallic materials, processes, and products used in space exploration applications and manufacturing.
- > Provide engineering solutions, manufacturing development, and full-scale hardware production of test and flight articles of the most complex sizes and shapes using digital manufacturing, structure light scanning, composites and additive manufacturing.



## Materials Selection and Control & Informatics

- > Materials and Processes Technical Information System (MAPTIS) is the one location for acquiring, assessing, archiving, and disseminating materials information to save resources throughout a product life cycle.
- > Monitoring of environmental regulatory requirements to assist customers in planning for material supply changes, toxic substance management, and end of life cycle disposal.



## Damage Tolerance Assessment

- > Evaluations of the ability of structures to perform reliably throughout their service life in the presence of a defect, crack, or other form of damage.
- > Non-destructive evaluations of hardware to assess the integrity of parts and to reliably detect characteristic flaws.



## Environmental Effects

- > Provide valuable information on materials and processes related to contamination control and the space environment.
- > Provide unique test facilities to simulate spacecraft charging of materials and components at cryogenic temperatures are available to verify spacecraft system designs.



## Metallic Engineering

- > Provide world-class support for materials design, development, characterization, and constituent hardware failure analysis.
- > Perform world-class research in Materials Science on International Space Station in a microgravity environment.
- > Friction stir, thermal stir, ultrasonic stir, and fusion weld development for aluminum and other advanced alloys for aerospace applications.
- > Develop manufacturing techniques for small- to large-scale metallic components using traditional and advanced processes such as spin forming, forging, rolling, casting, powder metallurgy, friction stir welding and vacuum plasma spray.
- > High temperature fuel element materials and processes for Nuclear Thermal Propulsion applications.

# Key Benefits

- > Full life-cycle design, development, testing, and integration of metallic and non-metallic structures into complex systems.
- > World-class facilities for materials science, materials testing, manufacturing processes development, and life cycle management.
- > A 50 year history of materials, manufacturing and hardware integration expertise in complex aerospace systems.
- > We embody the state of the art in engineering practices and discipline, teaming with other government agencies, industry and academia, partners to deliver the most value for the investment.

For more information, please visit [www.nasa.gov/centers/marshall/about/business.html](http://www.nasa.gov/centers/marshall/about/business.html)

National Aeronautics and Space Administration  
George C. Marshall Space Flight Center  
Huntsville, AL 35812  
[www.nasa.gov/marshall](http://www.nasa.gov/marshall)

[www.nasa.gov](http://www.nasa.gov)

FL-2013-06-054-MSFC  
5-565173b

