

# Marshall Space Flight Center Propulsion Systems Design

Engineering Solutions for Space Science and Exploration



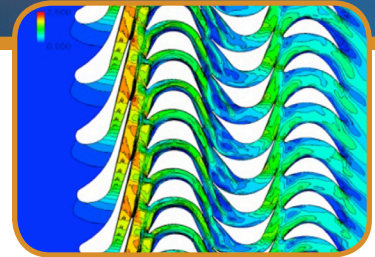
Liquid Propulsion Systems  
Design & Integration



Solid Propulsion Systems



Propulsion Component  
Design & Development



Propulsion Structural, Thermal,  
& Fluid Analysis

Marshall established and has maintained NASA's leadership position in space propulsion for more than five decades. These contributions enable the exploration and development of space while dramatically increasing program and mission safety and reliability and reducing overall cost.

Marshall's managers and engineers have designed, developed, integrated, and sustained propulsion systems for a range of applications since the beginning of America's space program.

- **Apollo Program:** F-1 engines from testing to flight and J-2 engines from concept development to flight
- **Inertial Upper Stage (IUS):** placed in orbit a number of science missions including Magellan, Galileo, Ulysses, and Chandra, as well as several Department of Defense (DOD) missions
- **Space Transportation Program (Shuttle):** external tank, space shuttle main engine, and reusable solid rocket boosters
- **Constellation Program:** design, development, and testing of the Ares I-X; Orion Launch Abort System; J-2X upper stage engine; 5-segment solid rocket boosters; and upper stage main propulsion system, reaction control system, and small solids
- **Space Launch System:** propulsion system design, development, and testing as well as system integration and operation

Marshall also developed new propulsion technologies such as the Fastrac engine system, which was developed in only three years, and provided early development for the hydrogen-fueled RS-83 and the hydrocarbon-fueled RS-84 engines. This Fastrac engine is the foundation for the Space Exploration Technologies (SpaceX) Merlin engine.

## NASA Mission Benefit

Marshall maintains a wealth of experience—from concept to operation—for propulsion systems ranging from traditional chemical boost to advanced in-space systems including chemical, nuclear, high-power electric, solar and propellant-free systems, and other support technologies such as alternate fuels and advanced manufacturing and materials.

For both Earth-to-orbit and in-space applications, Marshall's propulsion research, systems engineering, and testing capabilities support current and future missions unique to the nation's civil space program. Marshall's propulsion systems development and test capabilities ensure responsible government oversight and insight into technology and life-cycle challenges related to NASA's cutting-edge missions.

## The Propulsion Systems Department (ER)

- Propulsion Systems Department
- Resource Management Office
- Propulsion Systems Design & Integration Division
- Engine Systems Branch
- Main Propulsion Systems Branch
- Spacecraft & Auxiliary Propulsion Systems Branch
- Propulsion Research & Technology Branch
- Propulsion Component Design & Development Division
- Turbomachinery Design & Development Branch
- Combustion Devices Design & Development Branch
- Valves, Actuators, & Ducts Design & Development Branch
- Propulsion Detailed Design Branch
- Thrust Vector Control Systems Integration & Components Branch
- Propulsion Structural, Thermal & Fluid Analysis Division
- Structural & Dynamics Analysis Branch
- Fluid Dynamic Branch
- Thermal & Combustion Analysis Branch
- Solid Propulsion Systems Division
- Solid Launch Systems & Analysis Branch
- Solid Separation & Maneuvering Systems Branch

# Capabilities



## Liquid Propulsion Systems Design & Integration

The Propulsion Systems Design & Integration Division (ER20) performs engineering development, oversight, and integration of propulsion systems for space transportation applications, ensuring the sustained, safe operations of existing systems as well as the successful development of new systems.



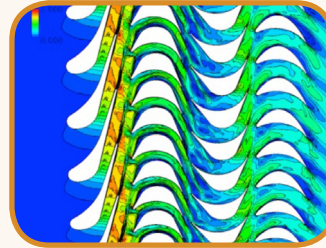
## Solid Propulsion Systems

The Solid Propulsion Systems Division (ER50) performs engineering development, oversight, and integration of solid propulsion systems for space transportation applications, ensuring the sustained, safe operation of existing systems as well as the successful development of new systems.



## Propulsion Component Design & Development

The Component Design and Development Division performs engineering development and oversight of space transportation subsystems and components. Engineering efforts conducted assure the safe operation and development of existing and future space transportation.



## Propulsion Structural, Thermal, & Fluid Analysis

The Propulsion Structural, Thermal & Fluid Analysis Division provides engineering analysis and assessment of all propulsion systems and components, and predicts performance and life of solid rocket motors and liquid engine systems with detailed analyses.

## Propulsion Research and Development Laboratory



## Component Development Area (CDA)



Component Development Area Blast Cells

## Thrust Vector Control Lab



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

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