WE ARE GO FOR LAUNCH!

AEROJET ROCKETDYNE

NEXT GEN ERATION LAUNCH SOLUTIONS

The demand for the high ground has never been more urgent. Aerojet Rocketdyne is responding with innovative, low-cost, responsive launch solutions.

ENABLING

Aerojet Rocketdyne is the only U.S. company to have developed and launched large booster engines. We have provided propulsion for more than 2,100 successful launches that have sent spacecraft to explore every planet in the solar system, and safely carried more than 350 astronauts to space.

Vanguard
11 launches

Redstone
64 launches

Navaho
11 launches

Jupiter
75 launches

Thor
380 launches

Atlas I/II/III
579 launches

Saturn I/IB
19 launches

Saturn V
13 launches

Titan I - IV
369 launches

Peacekeeper
51 launches

Athena
7 launches

Space Shuttle
135 launches

Antares
4 launches

Delta I/II/III
344 launches

Atlas V
More than 79 launches

Delta IV
More than 35 launches

Vulcan
Centaur

SLS

EFFICIENT, RESILIENT, FLEXIBLE

Premier Space Transportation

Aerojet Rocketdyne is rethinking how we access space and move more mass over greater distances, which is why we power a mixed fleet of launch vehicles and are focused on space transportation. Space maneuverability is the key to future space operations. To empower future defense, exploration and commercial architectures, our unmatched capabilities encompass all forms of space transportation from Earth to space, point-to-point in-space, and to and from planetary surfaces.

Key Features

Affordable Access: Our affordable space transportation services align with nearly any mission.

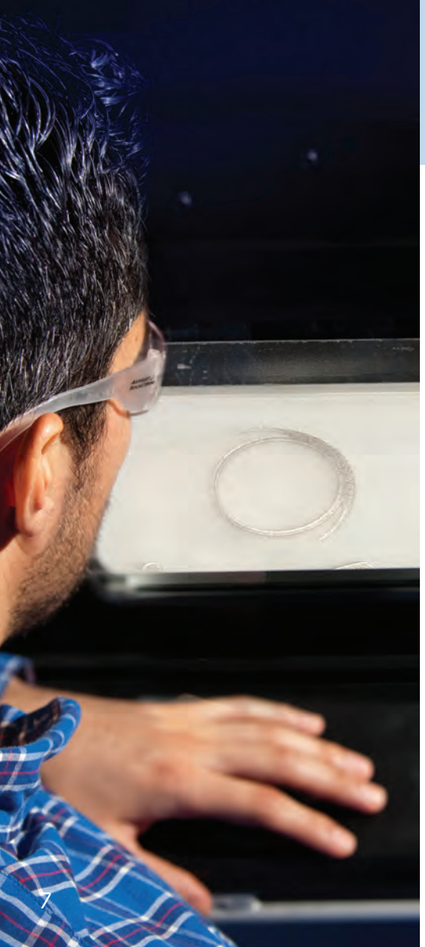
Maximum Flexibility: Our customers can move freely in space, where they want and how they want.

Rapid Mobility: Our portfolio of products allows for an agile and responsive strategy.

Fast, Efficient, or Both: Our chemical, nuclear, and electric propulsion systems allow for fast or efficient in-space transportation and our hybrid systems enable both.

Unmatched Experience: For decades, our experts have provided reliable solutions for the Nation's highest priority missions.

Aerojet Rocketdyne powers a mixed fleet of launch vehicles to support defense, commercial and exploration architectures



INNOVATION

Aerojet Rocketdyne is investing in and advancing cutting-edge technologies

Additive Manufacturing

Aerojet Rocketdyne is leading the industry with breakthroughs in additive manufacturing, also referred to as 3-D printing. This technology is being applied across our propulsion product line, including: RS-25, RL10, AR1, Bantam Family, NASA's Orion Crew Module engines, and various missile defense and tactical products.

Key Features

Cost Savings: Significantly reduces the amount of touch labor

Design Flexibility: Eliminates traditional design constraints

Shortened Manufacturing Timelines: Reduces lead times

Rigorous Design Approach: Understanding the powders, processes and material properties to build components that can withstand the rigors of launch.

Materials Science

Aerojet Rocketdyne is continuing to research and develop new alloys that will benefit our designs. One of our most prominent accomplishments to date is the development of Mondaloy 200™.

Mondaloy 200™ A high-strength, burn-resistant super alloy designed for use in high-pressure, oxygen-rich environments that can withstand the extreme temperatures and dynamic stresses of rocket engine combustion and operation. Mondaloy 200™ eliminates the need for protective coatings that are challenging to manufacture and prone to cracking.

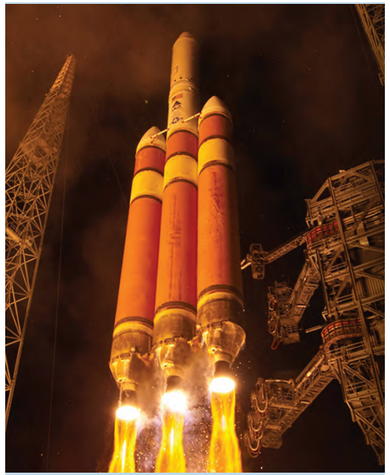
Reusability

The Space Shuttle Main Engine (SSME) built by Aerojet Rocketdyne is a classic example of reusability in rocket propulsion. Each of these high-performance engines were designed for 55 missions, which was fully demonstrated during ground testing. Remaining SSME engines from the Shuttle program are being adapted for the Phantom Express and Space Launch System programs.

Upper-Stage Engine of Choice

For more than 50 years, Aerojet Rocketdyne's liquid hydrogen/liquid oxygen-fueled RL10 has been the Nation's premier upper-stage rocket engine, placing numerous military, civil and commercial satellites into Earth orbit and sending spacecraft to explore every planet in our solar system. Today, several RL10 variants carry on the engine's legacy as the U.S. launch industry's workhorse engine, each producing more than 22,000 pounds of thrust at altitude.

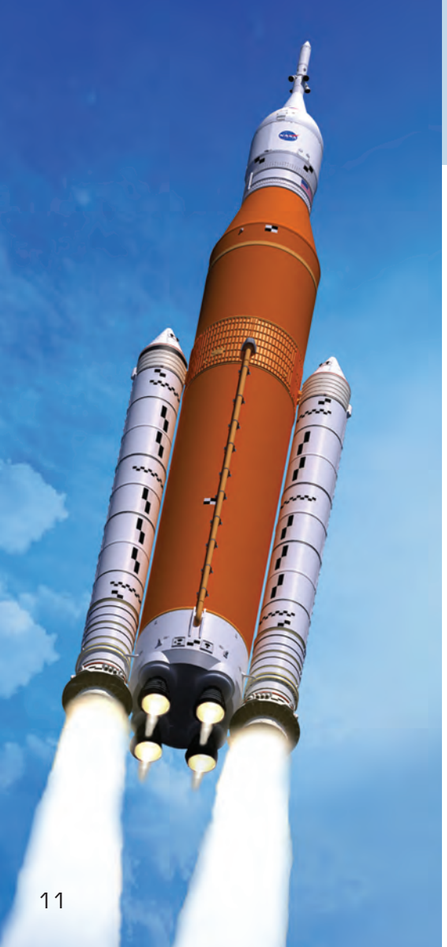
Atlas V
Depending on mission requirements, the United Launch Alliance Atlas V's Centaur upper stage is powered by a single RL10C-1 engine or two RL10A-4-2 engines.



Delta IV
The RL10B-2 powers the United Launch Alliance Delta IV's second stage with 24,750 lbs of thrust. This engine boasts a precision control system and restart capability to accurately place payloads into orbit.

SLS Exploration Upper Stage
One RL10B-2 engine will help power the inaugural flight of NASA's Space Launch System, Exploration Mission-1. Future flights will incorporate four RL10C-3 engines on the SLS launch vehicle's Exploration Upper Stage.

Vulcan Centaur
RL10 rocket engines that incorporate 3-D printing and other advanced technologies will power the upper stage of the Vulcan Centaur launch vehicle that is currently being developed by United Launch Alliance.



Space Launch System

Aerojet Rocketdyne is the prime contractor for the high-performance RS-25 engines used to propel America's next-generation heavy-lift launch vehicle, NASA's Space Launch System (SLS).

RS-25 Key Features

High Performance: Liquid hydrogen and liquid oxygen-fueled engine that produces 512,000 pounds of thrust.

Demonstrated Reliability: Between NASA's Space Shuttle and SLS programs, the engines have collectively undergone more than 1.1 million seconds of testing.

Adaptable: Engines have undergone six major upgrades to incorporate the most modern technologies and innovations while demonstrating major improvements in safety and reliability.

Enhancing Affordability

Building on the RL10 engine's more than five decades of proven performance, the RL10C-X represents the next generation of this historic family of engines.

The RL10C-X leverages Aerojet Rocketdyne's industry-leading 3-D printing technology to build an engine that provides the reliability and performance our customers have come to expect, while making the engine more affordable to meet the demands of today's marketplace.

Aerojet Rocketdyne has successfully hot-fire tested a full-scale RL10C-X copper thrust chamber assembly and is currently in the process of qualifying additional 3-D printed components for this new generation of RL10 engines that will deliver the same performance and reliability at a much lower cost.

Aerojet Rocketdyne recently completed successful hot-fire testing of a full-scale, additively manufactured copper thrust chamber assembly for the RL10C-X rocket engine at its facility in West Palm Beach, Florida.

Delta IV, Delta IV Heavy

The RS-68A is the world's most powerful liquid-hydrogen/liquid-oxygen booster engine designed to provide increased thrust and improved fuel efficiency for ULA's Delta IV family of launch vehicles. It is evolved from the RS-68 engine, which was developed and certified for commercial use with private company funds.

RS-68A Key Features

High Performance: The RS-68A is the world's most powerful hydrogen-fueled engine built to date. Each RS-68A provides 705,000 pounds of lift-off thrust.

Reliable: The engine is the centerpiece of the Delta IV Heavy, which has delivered 15+ years of 100% mission success delivering high-priority payloads to orbit for the U.S. Department of Defense.

3-D Printed Rocket Engine

Aerojet Rocketdyne is developing a family of low-cost, highly-reliable rocket engines for main-stage, upper-stage and in-space propulsion using additive manufacturing, or 3-D printing.

The design of the Bantam engine is adapted from the proven Atlas Sustainer engine and is capable of burning a variety of fuels, including kerosene, hydrogen, ethanol, methane and storable propellants.

Bantam Key Features

Simple Design: Consists of three additive-manufactured components: the entire injector assembly; the combustion chamber; and a throat/nozzle section.

Streamlined Production: Additive manufacturing technology reduces total design and manufacturing time from more than a year to just a couple of months.

Reduced Cost: Reduced manufacturing time lowers the cost of producing the engine by roughly 65 percent, as well as reducing the overall development cycle cost.

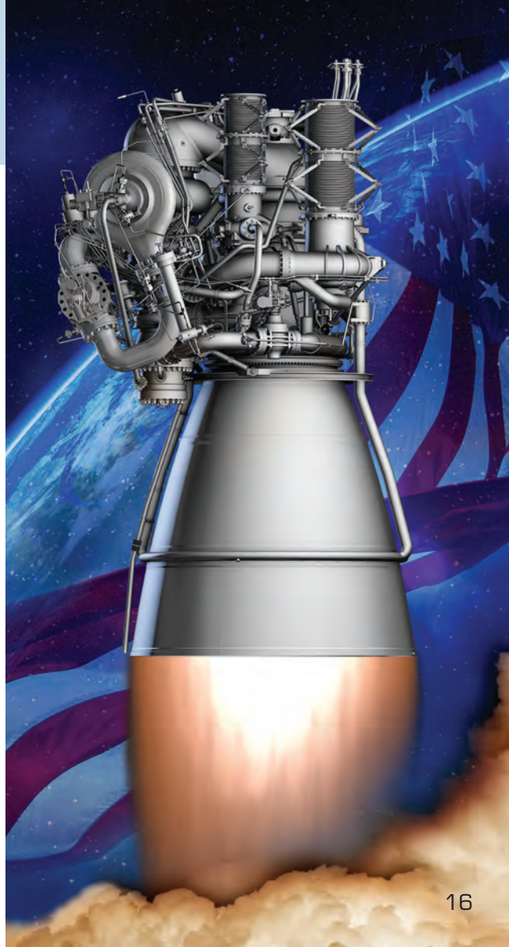
America's Rocket Engine

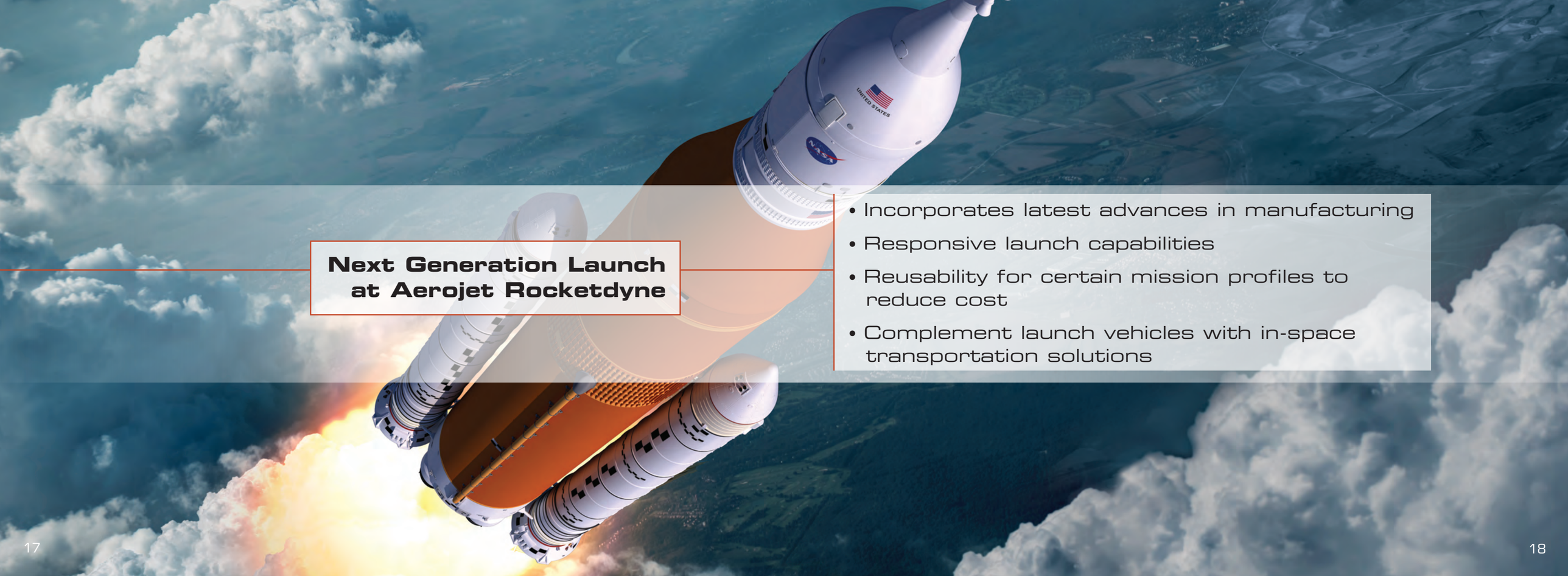
AR1: The versatile choice

A single AR1 engine generating 500,000 pounds of thrust is ideally suited to power the core stage of current and future medium-lift launch vehicles.

Citing threats to U.S. space capabilities, senior U.S. defense officials have emphasized a need to shift away from the large satellites that comprise the current military space architecture toward smaller spacecraft that can be developed and launched relatively quickly.

A medium-class launch vehicle powered by a single AR1 is ideally suited to become a new workhorse rocket for the Nation.





Next Generation Launch at Aerojet Rocketdyne

- Incorporates latest advances in manufacturing
- Responsive launch capabilities
- Reusability for certain mission profiles to reduce cost
- Complement launch vehicles with in-space transportation solutions

At the Center of Defense and Discovery

www.rocket.com

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