NASA Facts

National Aeronautics and
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Marshall Space Flight Center
Huntsville, Alabama 35812

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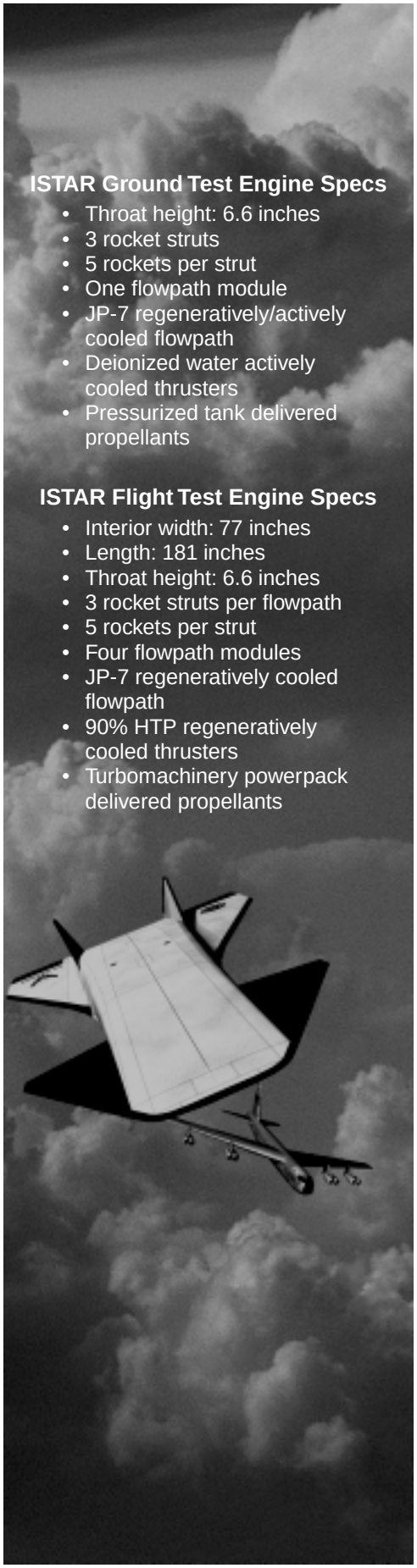
Integrated System Test of an Air-breathing Rocket (ISTAR)

An artist's rendering of a futuristic Hyper-X series flight demonstrator, which might be powered by NASA's air-breathing ISTAR engine technology by decade's end.

The Integrated System Test of an Air-breathing Rocket or "ISTAR" project is NASA's first flight-type system development and ground test of a rocket-based, combined cycle (RBCC) propulsion system.

The project, managed for NASA's Next Generation Launch Technology Program by the Marshall Space Flight Center in Huntsville, Ala., is developing a rocket-based combined cycle engine system, intended to be ground-demonstrated by 2008. NASA may flight-test the engine on a self-powered demonstrator vehicle by the end of the decade.

NASA and its government, academic and industry partners are developing air-breathing propulsion systems such as ISTAR to power future reusable launch vehicles. These proposed hypersonic demonstrators, which draw oxygen from the atmosphere during flight, are more efficient than conventional rocket propulsion systems, which must carry their oxidizer with them. Such vehicles could revolutionize air travel, commerce and access to space.



In June 2002, the primary ISTAR industry development team, the Rocket-Based Combined Cycle Consortium, or RBC3, completed the first major milestone for its engine prototype — a comprehensive system requirements review, which includes exhaustive examination of the engine's design and performance requirements. The consortium, funded by NASA, includes the Rocketdyne Propulsion & Power business unit of The Boeing Co., of Canoga Park, Calif.; the Pratt & Whitney Space Propulsion business unit of United Technologies Corp., of West Palm Beach, Fla.; and the Aerojet Missile and Space Propulsion business unit of GenCorp, Inc., of Sacramento, Calif.

Dubbed "ARGO" by its design team, the prototype engine is named for the mythical Greek ship that bore Jason and the Argonauts on their epic voyage of discovery. The ISTAR contract calls for completion of the conceptual system design by November 2002. Testing of the flight-weight, fuel-cooled engine flowpath is scheduled to begin in 2008.

In a rocket-based combined-cycle engine system, a conventional rocket is integrated with a unique, dual-mode ramjet engine, which scoops air from the atmosphere during flight by way of an inlet. The rockets power flight until the ramjet achieves enough compression of ingested air to produce positive thrust, typically at about Mach 3. At some point between Mach 5 and Mach 7 (approximately 3,750 mph to 5,300 mph), the ramjet switches to supersonic combustion ramjet, or "scramjet" mode as it climbs into the upper reaches of the atmosphere. The on-board rocket is reignited around Mach 12 for the final boost to low Earth orbit.

Air-breathing, hypersonic flight vehicles are a key NASA technology in its mission to deliver next-generation reusable flight vehicles that are safer, more reliable and more affordable than today's spacecraft. Hypersonic vehicles powered by air-breathing propulsion systems are expected to be completely reusable, capable of taking off and landing at ordinary airport runways, and ready to fly again within days. They could begin operation for commercial use mere decades from now.

While rockets and ramjets have been in use since the 1950s, work on scramjets and combined-cycle systems has largely been confined to the laboratory. The ISTAR project — building on NASA studies dating back to 1985 and relying on technology resources and manufacturing capabilities previously unavailable — seeks to validate predictive tools and system models, develop innovative fabrication techniques and pursue flight-weight and flight-like structures, while serving as a test bed for other promising component technologies.

For more information about NASA space transportation systems, the Space Launch Initiative, the Next Generation Launch Technology Program or NASA's hypersonics research, visit:

http://www.spacetransportation.com
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