



THEMES



**Aeronautics  
Technology**

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# AERONAUTICS

**PURPOSE**

Aviation is an indispensable part of our Nation's transportation system, providing unequaled speed and mobility for people and goods. The Aeronautics Enterprise holds a unique role within NASA as the sole steward of the Agency's aeronautics investments. By developing and transferring technologies, NASA's investments in aeronautics technology play a key role in creating a safer, more secure, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new platforms for science or commercial uses. This Theme also enhances the Nation's security through its partnerships with Department of Defense, Department of Homeland Security, and the Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, revolutionary display and control systems, adverse weather countermeasures, adaptive controls, advanced vehicle designs, and new collaborative design and development tools. In collaboration with the FAA, research is conducted in air traffic management technologies for new automation tools and concepts of operations.

### FY 2003 ACCOMPLISHMENTS

During FY 2003, the Aeronautics Enterprise made substantial progress in developing aeronautics technologies that, when implemented, will support a 21st century air transportation system that is safer, more efficient, environmentally friendly, flexible, and able to meet the increasing demands of the Nation.

**Icing safety.** In cooperation with the FAA and industry, aviation safety research addresses accidents and incidents involving hazardous weather, controlled flight into terrain, human performance, and mechanical or software malfunctions. To enable safer aircraft operations in icing conditions, NASA is developing a Smart Icing System (SIS) concept that, upon sensing the presence of ice on an aircraft, would automatically activate and manage the ice protection systems. A SIS provides the pilot with feedback on the icing event, including the effects on aircraft performance, stability, and control. In FY 2003, the SIS concept was integrated into a desktop simulator and tested by pilots in training scenarios to identify appropriate awareness and action cues for pilots. Also in FY 2003, NASA successfully conducted an evaluation of an revolutionary synthetic vision system that provides the flight crew with a "clear weather, day time equivalent" view of terrain, ground obstacles, air traffic and other important data under all metrological conditions regardless of the time of day and demonstrated an air turbulence warning system that provided the aircrew with an 81 percent probability of detecting severe turbulence with at least 30 seconds lead time at 81 percent.

**Emissions reductions.** Among the chemicals produced during the combustion of aircraft fuel, two have the most significant impacts on the environment. Nitrogen oxides degrade the local air quality by creating smog and impact global air quality by contributing to the loss of ozone. Carbon dioxide is a factor in global climate change. NASA is developing critical engine and airframe technologies that provide a significant reduction in emissions. Engine testing demonstrated a 67 percent reduction in nitrogen oxide emissions below 1996 standards. In addition, a ceramic coating process was developed to create a low conductivity thermal barrier coating to increase the temperature capability and efficiency of aircraft engine turbine blades and reduce carbon dioxide emissions.

**More efficient aircraft engines.** Aircraft inlets regulate airflow into aircraft engines. Efficient inlets improve aircraft speed and lift capabilities. Inlets are traditionally located under the wings of large aircraft, but as engine diameter increases, the weight of the engine, wing and landing gear also increases. NASA is investigating the use of non-circular inlets mounted over the top of wings to increase speed and lift capabilities for next generation subsonic aircraft without increasing engine diameter. In FY 2003, a model of an advanced top mounted inlet was studied in NASA's Basic Aerodynamics Research Tunnel. The goal was to minimize the effects of flow distortion at the engine face using active airflow control. In normal inlets, a large boundary layer (an area where air meets the surface of the engine) is ingested into the inlet. This distorts the flow before it reaches the engine and reduces inlet efficiency. The baseline inlet produced a total flow distortion of 29 percent. With active flow control enabled on the experimental inlet, the distortion was reduced to 13 percent.

**Reducing sonic booms.** An aircraft traveling through the atmosphere continuously produces air pressure waves similar to waves created by the bow of a ship. When the aircraft exceeds the speed of sound, the pressure waves merge to form shock waves, which are heard as a sonic boom when they reach the ground. The annoyance and damage generated by these sonic booms has been one of the limiting factors for routine supersonic flight over land. In a joint program conducted by NASA, DARPA, and the Northrop Grumman Corporation, the forebody of an F-5 fighter was modified to test the theory that by changing an aircraft's shape, the shape of the sonic boom can be adjusted to reduce its impact on the public. Subsequent flight tests verified that the modifications resulted in a substantial reduction in the strength of the resulting sonic boom. This technology will enable a generation of supersonic aircraft that are far less disturbing to the public.

**Reducing air traffic congestion.** Dynamic, reliable air traffic control is the hallmark of safe and efficient air travel. In congested airspace with interdependent traffic flows, a delay at one center often creates a domino effect that spreads quickly to multiple centers. During FY 2003, the Advanced Air Transportation Technologies Project developed and demonstrated an initial version of an active decision support tool for complex airspace. With this tool, the Multi-Center Traffic Management Advisor, controllers will be able to manage arrival flows across multiple routes and arrival points more efficiently (See Figure X). This technology, which can be extended across the National Airspace System, will increase efficiency and capacity in some of the most [something missing here: congested areas?] through regional collaboration. Some of the key features of the Multi-Center Traffic Management Advisor include: arrival rush planning and control across multiple facilities; transition to time-based metering; scheduling information for airports and boundaries; and departure information for nearby airports.

## Enterprise: Aeronautics

### THEME DISTRIBUTION

Budget Authority (\$ in millions)	FY 2003	FY 2004	FY 2005
Aeronautics Technology	599.1	1034.3	919.2
Institutional Support	445.0	-	-
Total	1,044.1	1,034.3	919.2

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

Indicates budget numbers in full cost

### Aeronautics Technology

This theme plays a key role in creating a safer, more secure, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new uses for science or commercial missions. This theme also enhances the Nation's security through its partnerships with the Department of Defense, the Department of Homeland Security and the Federal Aviation Administration. Aeronautics Technology consists of three integrated programs. The Aviation Safety and Security Program directly addresses the safety and security research & technology development needs of the nation's aviation system to either prevent both unintentional and intentional actions that would cause damage, harm, and loss of life or mitigate the consequences when these types of situations occur. The Airspace Systems Program conducts research and technology development that will enable revolutionary improvements to, and modernization of, the National Airspace System, as well as the introduction of new systems for vehicles whose operation can take advantage of the improved, modern air traffic management system. The Vehicle Systems Program develops enabling technologies that will produce future vehicles that are environmentally friendly, quieter, faster, more efficient, and technologically superior and / or support science missions and commercial applications requiring high altitude, long endurance, and remote operations. Highlights for FY 2005 include:

- Conduct experimental flight evaluation of key Small Airplane Transportation System enabling technologies.
- Demonstrate 70% reduction in nitrous oxides emissions in full-scale tests of combustor configurations suitable for a large subsonic vehicle.
- Complete Human in the Loop concept and technology evaluation of shared separation.
- Demonstrate integrated technologies and polices that would allow routine UAV flight operations in the National Airspace System above an altitude of 40,000.
- Accomplish objective of developing technologies that will enable a 50% reduction in the fatal accident rate from the 1991-1996 levels.

### OVERALL BUDGET

FY 2005 request is \$919 million, a 4.5% decrease from the FY 2004 President's Request.

- \$188 million for Aviation Safety and Security projects aimed at reducing accident and fatality rates.
- \$154 million for Airspace Systems projects to provide technologies that can dramatically increase the capacity and mobility of the nation's air transportation system.
- \$577 million for Vehicle Systems projects focused on development of breakthrough technologies that enable people and goods to travel faster and farther with fewer delays and reduce aircraft noise and emissions.