



National Aeronautics and  
Space Administration

## Boeing 777





When the Boeing 777 first rolled off the assembly line, it carried with it advance technology and aerodynamic knowledge honed from NASA research.

The 777 is the largest twin-engine (medium- to long-range) jet to be manufactured today. Passenger service began in June 1995. The Boeing Company estimates that the 777 fleet will capture two-thirds of the market for airplanes in its class, further strengthening this country's positive balance of trade in aeronautics.

The 777 has inlet, hinge and strut blankets, which protect certain areas of the plane from high temperatures and fire. These blankets were derived from the Space Shuttle program by the Ames Research Center. These blankets are quilted with stainless steel or ceramic threads.

Dryden Flight Research Center contributed research on reducing pilot induced oscillation (PIO), which can occur when a pilot overcontrols an aircraft resulting in undesirable oscillations.

Together, the Dryden and Langley Research Centers developed a digital flight control system for fly-by-wire application. This system for control of wing and tail surfaces replaces the conventional, bulkier, and heavier pulley and cable systems. As a result, the 777 is safer, more maneuverable, and more efficient.

Langley conducted tests in the Transonic Aerodynamics Wind Tunnel. These tests confirmed the structural integrity of the 777 wing-airframe integration. Boeing directly reimbursed NASA for use of the facility.

Other NASA technology contributions include use of lightweight aerospace composite structures for increased fuel efficiency and range. For example, the 777's floor beams, flaps and tail use lightweight composites materials. The radial tires used on the aircraft underwent strength and durability testing at Langley's Aircraft Landing Dynamics Facility.

Langley's research in cockpit technology has been incorporated into the 777's modern glass cockpit. This advanced cockpit uses computer technology to integrate information and displays it on monitors in easy-to-use format. Research was undertaken on the challenge of maintaining a pilot's situational awareness during flight operations.

Langley also developed fundamental mathematical procedures for computer-generated airflow images. These procedures allowed advanced computer-

based aerodynamic analysis on the 777, the first U.S. plane designed on the computer.

The 777 benefited from key technologies developed by Lewis Research Center through the Energy Efficient Engine (E<sup>3</sup>) Project. These technologies significantly reduced exhaust emissions, noise and fuel consumption. They also enabled increased performance through elevated operating pressures and temperatures.

In the High Performance Computing and Communications (HPCC) Program, Lewis research focuses on rapid, accurate predictions of air flow in order to produce superior aircraft engine designs, reduce cost and improve reliability. These techniques have resulted in engineering productivity improvements on the 777 providing savings in development and operations costs.

Marshall Space Flight Center's test results aimed at improving the performance of space shuttle engines led to improvements in the 777's new, more efficient jet engines. Specifically, engineers conducted evaluations of wake patterns flowing through the plane's turbine engine airfoils. Data taken proved useful in obtaining better turbine efficiency, as well as realizing substantial fuel savings.

In 1995, The Boeing Company received the Collier Trophy for designing, manufacturing and introducing into service the world's most advanced commercial airplane transport, the Boeing 777. NASA's contributions in advance research and technology development played a major role in this aircraft's success.

