

# NASA Facts

National Aeronautics and  
Space Administration



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## Proteus

The Proteus is a unique aircraft designed as a high-altitude, long-duration telecommunications relay platform, with potential for use on atmospheric sampling and Earth monitoring science missions as well. It was designed by Burt Rutan, president of Scaled Composites, and built during 1997-98 at the firm's development facility in Mojave, Calif. Normally flown by two pilots in a pressurized cabin, the Proteus also has potential to perform its missions semi-autonomously.

### Aircraft Description

The Proteus was designed to carry an 18-foot diameter telecommunications antenna system for relay of broadband data over major cities. Rutan's design allows for Proteus, so named for the mythological Greek sea-god who could change his appearance at will, to be reconfigured for a variety of other missions as well, such as atmospheric research, reconnaissance/surveillance, commercial imaging, and launch of small space satellites. The aircraft is designed for extreme reliability and low operating costs, and to operate out of general aviation airports with minimal support.

The Proteus features an unconventional tandem-wing, twin-boom configuration with two rear-mounted turbofan engines providing power. The aircraft features modular construction that allows payloads to be carried in a variety of locations. Removable tip sections can be added to or removed from the rear wing or the forward canards to tailor the



Proteus' aerodynamics for various external payloads or for maximum altitude. The main landing gear is set wide apart, allowing for large externally-mounted payloads to be carried under the fuselage.

The aircraft is designed to cruise at altitudes from 50,000 to more than 63,000 feet for up to 18 hours. Proteus' small cabin is pressurized to allow the flight crew a shirt-sleeve environment equivalent to an altitude of 14,500 feet when the aircraft is at 55,000 feet, or 15,500 feet at a 60,000-foot altitude.

## NASA Dryden's ERAST Involvement

The Proteus was conceived as an "optionally piloted" aircraft flown by a two-person crew for takeoff, climb to mission altitude, descent and landing, and then operated either by a single pilot, remotely from the ground, or autonomously when on station at mission altitude.

To that end, NASA's Dryden Flight Research Center, under the Environmental Research Aircraft and Sensor Technology (ERAST) project, assisted Scaled Composites in development of a sophisticated station-keeping autopilot system that gave the Proteus a fully functional autonomous capability when on station. In addition, the ERAST project helped fund a satellite communications (SATCOM)-based uplink/downlink data system for aircraft and payload data. The SATCOM system has full over-the-horizon capability, allowing the aircraft to be controlled remotely from a distant ground-based control station via the SATCOM uplink/downlink.

## Developmental Flight Tests

The Proteus began its flight test and development program in the summer of 1998 from Scaled Composites facility at the Mojave Airport.

The aircraft set two milestones on its 16th flight in February, 1999 when it reached an altitude of 50,000 ft while carrying an operating science imaging payload, the Airborne Real-Time Imaging System (ARTIS) developed by HyperSpectral Sciences, Inc.(HSI). The small ARTIS camera, developed by HSI under NASA's ERAST project, was operated remotely by the flight crew, taking visual and near-infrared photos of the California desert near the Mojave Airport. The system provided near-real time images to a ground station.



The SATCOM equipment, including avionics and antenna systems, performed flawlessly during Proteus' deployment to the Paris Air Show in the summer of 1999.

## Record Altitude Flights

In October 2000, the Proteus set three world altitude records during envelope-expansion flights over California's high desert. The records were certified by the Swiss-based international aviation record certification agency Federation Aeronautique Internationale.

The first records were for a peak altitude of 63,245 feet and sustained horizontal flight at 62,385 feet. On a second flight, the Proteus reached a peak altitude of 55,994 feet while carrying a 1,000 kg (2,200 lb.) payload. All three records were certified for aircraft in the Class C-1E, Group III with gross weights of 12,500 lbs. or less.

NASA Dryden supported Proteus envelope-expansion flights by providing full pressure suits for the pilots through the ERAST project. NASA's Office of Earth Science joined the National Oceanic and Atmospheric Administration and the Department of Defense in funding the record-setting flights as part of their evaluation of the Proteus as an airborne platform for atmospheric science and remote sensing missions at altitudes up to 60,000 feet.

## Recent Milestones

Since the record flights in 2000, the Proteus has continued its support of the international atmospheric science community. This sensor development work has included six different science campaigns spanning the United States and the Pacific Rim, from Japan to Virginia and the Caribbean to the North Pole. In addition, the Proteus has continued to work with other customers, including NASA and the United States Air Force, in the flight test of next-generation flight systems. Significant recent missions included:

- March 2001 -- As part of the TRACE-P mission, Proteus gathers data over the North Pole.
- March 11-16, 2002 -- Proteus serves as a surrogate UAV in a successful "Detect, See, and Avoid" flight test campaign involving "cooperative" transponder-equipped aircraft under NASA's ERAST program.
- July 2002 -- Proteus team was part of NASA's Crystal FACE science campaign involving six aircraft and hundreds of scientists.
- April 2003 -- Proteus again serves as a surrogate UAV in a follow-on "Detect, See and Avoid" flight demonstration for NASA involving both cooperative and non-cooperative (non-transponder-equipped) target aircraft.

Proteus is maintained and flown by Scaled Composites and is available for research and evaluation purposes by NASA and other customers.

## The ERAST Project

The Environmental Research Aircraft and Sensor Technology (ERAST) project is a NASA initiative to develop new technologies for civil use of remotely operated unmanned aerial vehicles (UAVs).

The primary focus of ERAST is to develop slow-flying UAVs that can perform long-duration science missions at altitudes above 60,000 feet. These missions could include remote sensing for Earth sciences studies, hyperspectral imaging for agriculture monitoring, tracking of severe storms, and serving as telecommunications relay platforms.

A parallel effort headed by NASA Ames Research Center, Moffett Field, Calif., developed lightweight, microminiaturized sensors that can be carried by these aircraft for environmental research and Earth monitoring.

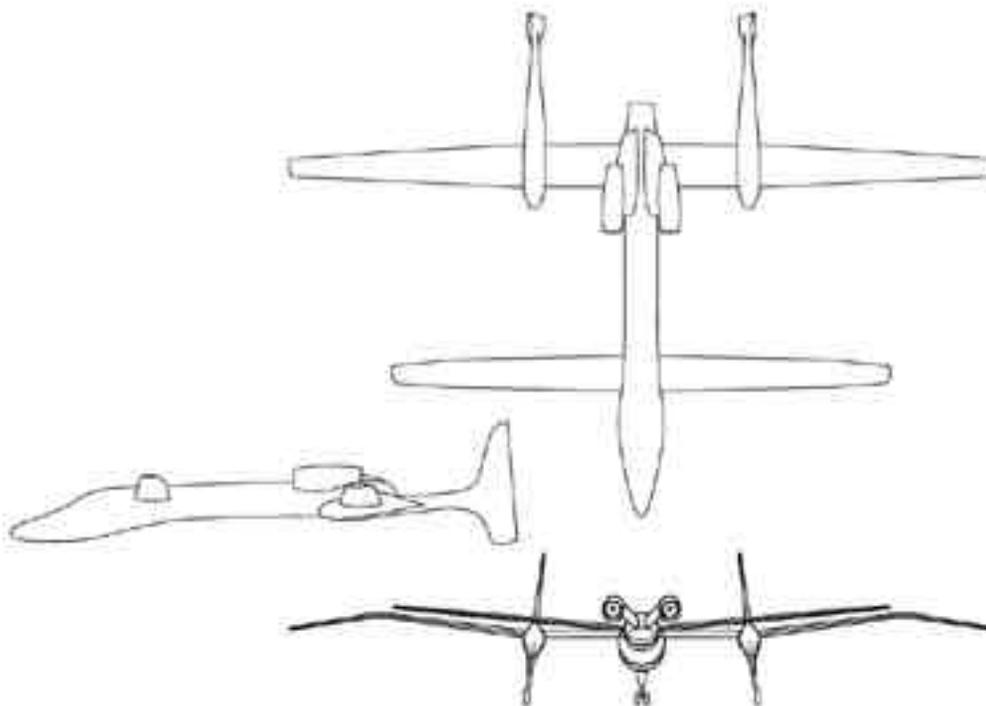
Additional technologies considered by the joint NASA-industry ERAST Alliance include lightweight materials, avionics, aerodynamics, and other forms of propulsion suitable for extreme altitudes and duration.

Although ERAST Alliance members are responsible for aircraft development and operation, NASA has primary responsibility for overall program leadership, major funding, individual project management, development and coordination of payloads. NASA also is working long-term issues with the Federal Aviation Administration and developing technology to make operation of these remotely operated aircraft in national airspace practical.

Sponsored by the Office of Aerospace Technology at NASA Headquarters, ERAST is managed by the NASA Dryden Flight Research Center, Edwards, Calif.

## Aircraft Specifications

- **Wingspan:** 77 ft, 7 in; 92 ft with removable tips installed.
- **Wing area:** 300 ft<sup>2</sup>
- **Canard span:** 54.7 ft; 64.7 ft with removable tips installed.
- **Canard area:** 178.7 ft<sup>2</sup>
- **Length:** 56.3 ft
- **Height:** 17.6 ft (on landing gear)
- **Cabin dimensions:** 9 ft long, 5 ft dia.
- **Crew:** 2, single-pilot operation.
- **Empty weight:** 5,900 lb
- **Gross weight:** 12,500 lb; 15,800 lb in military usage.
- **Fuel capacity:** 6,000 lb in fuselage, canard, and wing tanks.
- **Flight control system:** Conventional manual pushrod/cable system with sidestick controllers; autopilot for hands-off flight when on station.
- **Payload:** 1,800 to 7,260 lb, depending on mission.
- **Electrical power:** 19kw up to 30kw, depending on payload requirements.
- **Propulsion:** Two Williams Research/Rolls FJ44-2 turbofan engines, 2,300 lb thrust each.
- **Airspeed:** 190 kt at 20,000 ft, 280 kt at 40,000 ft, true air speed. Mach 0.42 at cruise.
- **Takeoff distance:** 2,500 ft at maximum gross weight.
- **Rate of climb:** 6,000 ft/min at 8,000 lb, 3,400 ft/min at 12,500 lb.
- **Altitude:** Up to 65,000 ft at 7,000 lb; 58,000 ft at 12,500 lb.
- **Endurance:** Up to 18 hr, depending on payload and altitude.
- **Primary materials:** All composite airframe, graphite-epoxy sandwich construction. Crew compartment is grid-stiffened solid laminate construction.



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