NASA Facts

National Aeronautics and
Space Administration

Dryden Flight Research Center
P.O. Box 273
Edwards, California 93523
AC 661-276-3449
FAX 661-276-3566
pao@dfrc.nasa.gov

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ALTUS™ II — How High is High?

ALTUS™ II flies over the Southern California high desert during a recent test flight.

Project Summary

The ALTUS™ II is one of several slow-flying, remotely piloted aircraft that were developed and evaluated by a NASA-industry team under NASA's Environmental Research Aircraft and Sensor Technology (ERAST) program at the NASA Dryden Flight Research Center, Edwards, Calif. There were two primary goals for the ALTUS II development: to be a testbed for performance and propulsion concepts leading to development of future remotely piloted or autonomous aircraft designed for high-altitude science missions, and to evaluate its practicality for use as an airborne platform for such missions.

Aircraft Description

The ALTUS aircraft—the name is Latin for "high"—was developed by General Atomics Aeronautical Systems, Inc. (GA-ASI), San Diego, CA, as a civil variant of the Predator, the remotely operated surveillance aircraft built for the U.S. Air Force. Although similar in appearance, the ALTUS has a slighly longer wingspan and is designed to carry atmospheric sampling and other instruments for civilian scientific research missions in place of the military reconnaissance equipment carried by the Predators.

It is distinguished by its long, narrow, high aspect-ratio wing, its slender fuselage, rear-mounted engine and propeller, and inverted-V horizontal tail. It can carry up to 330 lb of sensors and other scientific instruments in a nose-mounted payload compartment, a location designed to allow air being sampled by the sensors to be undisturbed by heat or pollutants from engine exhaust. It has a tricycle-type retractable landing gear. Power is provided by a four-cylinder Rotax 912 gasoline engine with additional airflow provided by a turbocharger built by Thermo-Mechanical Systems., Inc., of Canoga Park, CA.

GA-ASI has built two ALTUS aircraft to date: the ALTUS I, equipped with a single-stage turbocharger, for the Naval Postgraduate School, and the ALTUS II, with a two-stage turbocharger, for NASA under the ERAST program.

ALTUS Flight History

The ALTUS II, the first of the two craft to be completed, made its first flight on May 1, 1996. With its engine at first augmented by a single-stage turbocharger, the ALTUS II reached an altitude of 37,000 ft during its first series of development flights at Dryden in August, 1996. In October of that year, the ALTUS II was flown in an Atmospheric Radiation Measurement (ARM-UAV) study in Oklahoma conducted by Sandia National Laboratories for the Department of Energy (DOE). During the course of those flights, the ALTUS II set a single-flight endurance record for remotely operated aircraft of more than 26 hours.

The ALTUS I, completed in 1997, flew a series of development flights at Dryden that summer. Those test flights saw the craft reach an altitude of 43,500 ft while carrying a simulated 300-lb payload, a record for a remotely operated aircraft powered by a piston engine augmented with a single-stage turbocharger.

After major modifications and upgrades, including installation of a two-stage turbocharger in place of its original single-stage unit, a larger fuel tank and additional intercooling capacity, the ALTUS II returned to flight status in the summer of 1998. The goal of its development test flights was to reach one of the major Level 2 performance milestones within NASA's ERAST program: to fly a gasoline-fueled, piston-engine remotely piloted aircraft for several hours at an altitude at or near 60,000 feet. On March 5, 1999, The ALTUS II maintained flight at or above 55,000 feet for three hours, reaching a maximum density altitude of 57,300 feet during the mission.

Later that spring, the ALTUS II flew another series of Atmospheric Radiation Measurement missions conducted by Sandia National Laboratories for the DOE. Hard-to-measure properties of high-level cirrus clouds that may affect global warming were recorded using specially designed instruments while the Altus flew at 50,000 feet altitude off the Hawaiian island of Kaua'i. Clouds both reflect incoming solar energy back to space, and absorb warm longwave radiation from the Earth's surface, keeping that heat in the atmosphere. Data from the study will help scientists better understand how these dual roles of clouds in reflecting and absorbing solar energy work, and build more accurate global climate models.

In September, 2001, ALTUS II served as the UAV platform for a flight demonstration of remote sensoring and imaging capabilities that could detect hot spots in wildfires and relay that data in near- real time via the Internet to firefighting commanders below. The demonstration, led by NASA Ames Research Center, was flown over GA-ASI's El Mirage development facility in Southern California.

In the summer of 2002, The Altus II served as the airborne platform for the Altus Cumulus Electrification Study (ACES), led by Dr. Richard Blakeslee of NASA Marshall Space Flight Center. The ACES experiment focused on the collection of electrical, magnetic and optical measurements of thunderstorms. Data collected will help scientists understand the development and life cycles of thunderstorms, which in turn may allow meteorologists to more accurately predict when destructive storms may hit. For more information on the ACES study, visit the National Space Science and Technology Center web site at the NASA Marshall Space Flight Center: http://aces.msfc.nasa.gov.

The ERAST Program

The Environmental Research Aircraft and Sensor Technology (ERAST) program is one of NASA's initiatives designed to develop the new technologies needed to continue America's leadership in the highly competitive aerospace industry.

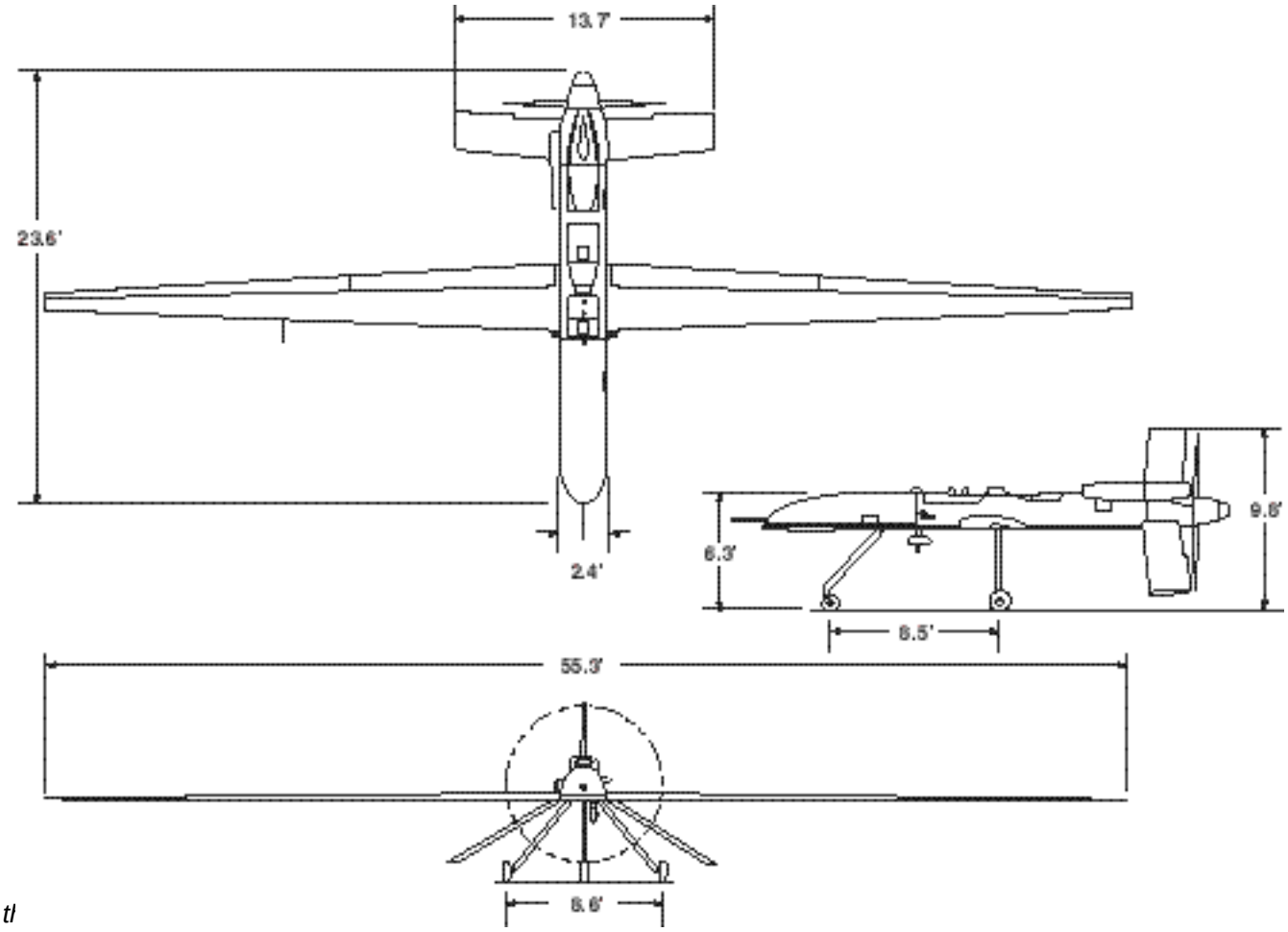
ERAST is a multiyear effort to develop the aeronautical and sensor technologies for a new family of remotely piloted aircraft intended for upper atmospheric science missions. Designed to cruise at slow speeds for long durations at altitudes of 60,000 to 100,000 ft, such aircraft could be used to collect, identify, and monitor environmental data to assess global climate change and assist in weather monitoring and forecasting. They also could serve as airborne telecommunications platforms, performing functions similar to communications satellites at a fraction of the cost of lofting a satellite into space.

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

The ERAST program is sponsored by the Office of Aeronautics and Space Transportation Technology at NASA Headquarters, and is managed by NASA Dryden Flight Research Center. The NASA Ames Research Center, Moffett Field, CA, heads the sensor technology development. The NASA Lewis Research Center, Cleveland, OH, and NASA Langley Research Center, Hampton, VA, are contributing expertise in the areas of propulsion, structures, and systems analysis. Several small high-technology aeronautical development firms, including ALTUS developer General Atomics Aeronautical Systems, Inc., are teamed with NASA in the ERAST Alliance to work towards common goals of the program.

ALTUS II Specifications

- **Wingspan:** 55.3 ft. (16.5 m)
- **Wing area:** 131 ft.^{2}
- **Wing aspect ratio:** 24
- **Length:** 23.6 ft. (7 ms)
- **Maximum gross takeoff weight:** 2,130 lb (967 kg).
- **Wing loading at gross weight:** 16.3 lb/ ft.^{2}
- **Payload:** Up to 330 lb in nose compartment
- **Propulsion:** Rear-mounted Rotax 912 four-cylinder piston engine rated at 100 hp, integrated with a two-stage Thermo-Mechanical systems turbocharger. An 84-in. diameter two-blade pusher propeller is used for flights up to about 53,000 ft. altitude; a larger 100-in. diameter lightweight carbon-fiber propeller is installed for flights above that altitude.
- **Fuel capacity:** 92 gal.
- **Airspeed:** 100 knots (115 mph) maximum; 70 kn (80 mi/h) cruise, speed varies with altitude.
- **Maximum altitude:** Approx. 65,000 ft. (19,500 m) with two-stage turbocharger; approx. 43,500 ft. with single-stage turbocharger.
- **Endurance:** Approximately 24 h, depending on altitude.
- **Radius:** Approx. 460 mil (400 nmi; 735 km)
- **Construction:** Primarily composites
- **Manufacturer**: General Atomics Aeronautical Systems, Inc. (GA-ASI), San Diego, Calif.



Altus II